NILE EQUATORIAL LAKES SUBSIDIARY ACTION PROGRAM

(NELSAP)

KAGERA RIVER BASIN MANAGEMENT PROJECT

Detailed Identification Studies for Mgozi Dam site, Tanzania

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EXECUTIVE SUMMARY

Background

The Kagera basin is characterized by low-productive peasant agriculture, endemic poverty, and extensive land degradation caused by population pressure and deforestation, and increasing water scarcity. Water scarcity and growing food insufficiency are some of the major issues facing the Kagera river basin and 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 and is exacerbated by the imminent effects of climate change. A multipurpose water resources development project with a focus on storage for energy, irrigation and other uses is thus conceived to address issues related to water, food and energy security within the basin. Some potential dam sites have been identified in earlier rapid identification studies and their suitability shall be further investigated by the individual consultant. The Consultant was be required to make detailed appraisal of Mgozi dam site, in Tanzania, to augment the earlier study on the 9 large[1] dam site, and subsequently prepare its preliminary designs and cost estimates.

Objective of the Assignment

The overall objective of this study was to undertake detailed identification studies for a potential multipurpose water resources development project at Mgozi, Ngara District, Tanzania.this would include preparing Initial Environmental and Social Evaluation (IESE) report as well as a technical report about the project.

The Initial Environmental and Social Examination

The Initial Environmental and Social Examination (IESE) or Scoping was undertaken for Mgozi potential large multi-purpose dam as part of the detailed identification study. The overall objective of the IESE was to analyse potential adverse environmental impacts arising from site selection, design, construction, and operation of the Project. The IESE has been prepared to meet the requirements of NELSAP. In addition, the study also made reference to Sida's Guidelines for the Review of Environmental Impact Assessments of 2002 as well as the World Bank Safeguard policies which have all informed the preparation of this IESE.

Focus of IESE Study

Preliminarily, the IESE study covered the following:

- provision of information about the general environmental and social settings of the project areas as baseline data;
- provision of information on the potential impacts of the project and the characteristic of the impacts, magnitude, distribution, who will be the affected group(s), and their duration;
- provision of information on the potential mitigation measures to minimize the impacts;
- establishing the existing social and economic profiles for the probable areas of project influence, which profiles included but was not be limited to: existing demographics and trends, social setting and structures, economic activities and livelihoods, level of access to safe water and sanitation and electricity, current water uses and demands; and Identification and justification of the potential water uses/demands for the site.

[1] Large dams, as defined by the World Bank Environmental and Social Safeguards OP 4.37

These have helped to produce a socio-economic and environmental profile of the project areas with amongst others.

Technical assessment of the site

The study reviewed and analyse existing hydro-meteorological data and used it to delineate the contributing catchments for the Mgozi. The catchment characteristics such as area, slope, soil type, and land cover for the site were established. Water availability (annual catchment runoff) at the site based on rainfall-runoff modelling was computed. The reservoir storage capacity (with a volume-depth-surface area relationship); the dead and active dam storage volumes, the reservoir area for inundation at maximum flood level were all established at the site. The study established the sediment yield rates using the suitable empirical relationships.

The reservoirs volume and area as well as people to be affected for the Mgozi site are shown in Table 1 below.

Table 1: Reservoir characteristics for Mgozi site

Property	Reservoir Capacity m^3	Reservoir Area (km^2)	Catchment Area (km^2)	Potential number of people to be relocated
Mgozi	77.3	11.4	720	470

Water requirements and demands for the different multipurpose uses were computed; irrigation command area the site was established and their maps developed. The hydropower potential at the site was quantified [where applicable]; drawings of the conceptual designs and dam profiles were produced for the site. Table 2 below shows these potential various dam uses.

Table 2: Potential Irrigation areas, Hydropower Potential and No of people to benefit from water supply from Mgozi damsite

Population affected										
Location	Irrigation			Water Supply				Electricity		
	Command area (ha)	No of farmers	No of people fed	Year 2012	Year 2016	Year 2041	Year 2062	Annual Energy (GWh)	Population served	Households served
Mgozi	3,093	6,186	30,929	25,214	28,600	54,599	121,794	16	106,667	17,778

Preliminary costs

For the preparation of the preliminary costs, quantities of the dam structure and appurtenances were estimated from the site maps and proven formulae. The unit rates were derived basing on current rates in dam construction within the East African region. A 15% contingency was included as part of the project costs, along with another 10% as consultancy fees for both the design and supervision of the construction. Table 3 below gives a summary of the costs for the proposed Mgozi da,.

Table 3 Summary Costs of the proposed Mgozi dam

Dam site	Type of Dam	Dam height, (m)	Reservoir Capacity Million m^3	Cost of Dam Million US$
Mgozi	Rock fill	36.8	77.3	44.4

1.1 Evaluation of the Mgozi project

The following multi-criteria matrix was developed to guide evaluation and ranking of the different dam sub-projects:

(i) Reservoir Capacity

(ii) Water Storage/earth ratio,

(iii) Irrigation command area

(iv) Hydropower potential

(v) Water Supply

(vi) Cost of sub-projects

(vii) Environmental considerations

The Mgozi project has good environmental scores, and provides net economic benefits. In relation to the 9 sites presented in the Main report, Mgozi site is the only site located in Tanzania and should therefore be given high priority to ensure regional representation.

1.2 Conclusions

The following conclusions apply to the study of Mgozi dam site and are additional to those presented in the Main report:

1. The proposal to develop multi-purpose dams seeks to ensure efficient and optimal use of water resources in light of changing environmental and social parameters;
2. The proposed dam site presents no major negative impacts.
3. It is evident that, the proposed Mgozi multi-purpose dam will have many positive economic impacts to the immediate communities, partner states and their sectors;
4. Developing the dam site will initiate economic growth within the Ngara district and the wider Kagera Region of Tanzania;

1.3 Recommendations

The following recommendations are extracted from the main report and apply to Mgozi dam site

1. The dam project has potential multipurpose purposes of water supply, hydropower generation and irrigation, and each of these has set of activities with their own impacts which will be in the same ecosystem. It is therefore noted that, there will be need to put in place multi-stakeholder committees to over-see implementation and general compliance of project works with environmental and social requirements as enshrined in the line polices and laws in partner states;
2. Staff gauges should be placed at the river to start monitoring the discharge as soon as possible. Since Mgozi is ungauged, early placement of the discharge station will prove very valuable in a few months' time when further downstream, studies commence.
3. Recognizing the importance of an accurate assessment of current sediment loads to the planning of reservoirs, it would be prudent to carry out observations of sediment concentration in the rivers at the proposed dam sites during at least one flood season.

4. The implementation of the project should take cognizance of lessons learned from other trans-boundary water resources management frameworks. These should include the need to have focused missions; the need for autonomy and impartiality; the need to have high level of political support; the need to focus on common crosscutting issues of immediate challenges; the need to avoid areas of conflict with governments; the need to have full stakeholder participation at all stages of project implementation; the need to build reliable funding mechanisms; the need to build on existing institutions and the need to build transparent systems of sharing information, costs and benefits

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List of Acronyms

AfDB	African Development Bank
ASDS	Agricultural Sector Development Strategy
CDM	Clean Development Mechanism
CFR	Central Forest Reserve
CRS	Catholic Relief Services
DSOER	District State of Environment Report
EMP	Environmental Management Plan
ESMP	Environmental and Social Management Plan
ESIA	Environmental and Social Impact Assessment
ESRF	Economic and Social Research Fund
EWSA	Energy, Water and Sanitation Authority, Rwanda
DPAE	Direction Provinciale de l'Agriculture er de l'elevage
FAO	Food And Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographical Information System
GoB	Government of Burundi
GoR	Government of Rwanda
GoT	Government of Tanzania
GoU	Government of Uganda
HIV/AIDS	Human Immuno Virus/Acquired Immuno Deficiency Syndrome
IESE	Initial Environmental and Social Examination
KBO	Kagera Basin Organization
KIRBMD	Kagera Integrated River Basin Management and Development
KIWRM	Kagera Integrated Water Resources Management
KRBMP	Kagera River Basin Management Project
MINAGRI	Ministry of Agriculture, Republic of Rwanda
MININFRA	Ministry of Infrastructure, Republic of Rwanda
MINIRENA	Ministry of Natural Resources, Republic of Rwanda
NAPA	National Adaptation Plan of Action

NBI	Nile Basin Initiative
NEA	National Environment Act
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEMA	National Environment Management Authority
NWSDS	National Water Sector Development Strategy
PMU	Project Management Unit
PUP	Planning Unit of Population
RBM	River Basin Management
RDB	Rwanda Development Board
REMA	Rwanda Environment Management Authority
RNRA	Rwanda Natural Resources Authority
SAPs	Subsidiary Action Program
Sida	Swedish International Development Agency
SVP	Shared Vision Program
SWAP	Sectorwide Approach Planning
SWAT	Soil and Water Assessment Tool
WCD	World Commission on Dams
WRD	Water Resources Development

2 General Overview of the Assignment

2.1 Introduction

This report presents findings for detailed identification studies undertaken for the proposed multipurpose water resources development project at Mgozi, in Ngara District, Tanzania.

2.2 Project Rationale and Origin

The Nile Basin Initiative (NBI) is a partnership of riparian states of the Nile, which seeks to develop the River Nile in a cooperative manner, share socioeconomic benefits, and promote regional peace and security. The NBI's Strategic Action Program is made up of two complementary programs: the basin wide Shared Vision Program (SVP) to build confidence and capacity across the basin, and Subsidiary Action Programs (SAPs) to initiate concrete investments and action on the ground in the Eastern Nile (ENSAP) and Nile Equatorial Lakes sub-basins (NELSAP). The programs are reinforcing in nature. The SVP focused on building regional institutions, capacity and trust, to lay the foundation for unlocking the development potential of the Nile, which will be realised through concrete investments carried out through the Subsidiary Action Programs.

The Countries of the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) have identified a number of projects to promote poverty alleviation, economic growth, and reversal of environmental degradation in the sub-basin. The investments are grouped into two major groups: Natural Resources Management and development of projects, and the Power Trade and Development program. The two programs target investments in agricultural development, fisheries development, water resources management, water hyacinth control, hydropower development and transmission interconnection. The Natural Resources Management sub program consists of three transboundary river basin management projects, namely Kagera, Mara and Sio-Malaba-Malasiki River Basin Management Projects. The Projects are aimed at poverty reduction and achieving socio-economic development through the rational and equitable use of the shared water resources of their respective River Basins.

The project objective of the Kagera RBM Project is to establish a sustainable framework for management of water resources of Kagera River Basin, in order to prepare for sustainable development oriented investments that will improve the living conditions of people while protecting the environment. The Kagera River is the largest of 23 rivers that drain into Lake Victoria and it carries 34% of the annual inflow to the lake. The river basin covers some 59,800 km^2 and has a population of nearly 15 million people. The basin covers portions of the four countries of Burundi (22%), Rwanda (33%), Tanzania (35%) and Uganda (10%).

The Kagera basin is characterised by low-productive peasant agriculture, endemic poverty, extensive land degradation caused by population pressure and deforestation, increasing water scarcity. Water scarcity and growing food insufficiency are some of the major issues facing the Kagera River Basin and the situation is expected to get worse as the population increases and demand by the different water use sectors out-matches the existing supply and exacerbated by the imminent effects of climate change.

A multipurpose water resources development project with a focus on storage for energy, irrigation and other uses is thus conceived to address issues related to water, food and energy security within the basin. A potential project has been proposed at Mgozi in Ngara District, for which detailed identification studies were undertaken (as presented in this report).

2.3 Study Objective

The primary objective of this study was to undertake detailed identification studies for one potential multipurpose WRD project at Mgozi-Tanzania, and prepare preliminary designs and cost estimates.

2.4 Scope of Services

As outlined in the ToRs, the scope of services included:

(i) Desk review of relevant documentation to the assignment:

(ii) Preliminary socio-economic analysis of the project sites

(iii) Environmental and social scoping of the project sites

(iv) Preliminary hydrological studies of the project sites

(v) Preliminary technical design of the project sites

(vi) Preliminary economic/financial analysis

(vii) Ranking of the sites

(viii) Development of Terms of reference for downstream feasibility studies

The above scope of services could be broadly summarised into two categories, the Initial Environment and Social Examination (IESE) for the sites on one hand and on the other; preliminary hydrological and technical assessment of the sites crowned with their respective preliminary economic and financial assessment.

2.5 Expected Outputs of the study

As per ToR requirement, this report contains the following outputs from the study;

(i) Detailed synthesis of the collected and reviewed data, with clear deductions and issues pertinent to this assignment. (This informs all the analysis and deductions of all the report chapters)

(ii) Environmental and Socio-economic profiles of the project areas, with clear justification for the potential water uses/demands. (Chapter 3 and 4)

(iii) Initial Environmental and Social Examination (IESE) reports for the site (Summarised in Chapter 3 and 4)

(iv) Description of the catchment physiographic characteristics, with maps and areas of delineated site catchment, reservoir storage capacity with volume-depth-surface area relationships, dead and active dam storages, catchment runoff and sediment yield, reservoir inundation areas, future water demands, IDFs. It should also include maps of the catchment and reservoir extents for the site, etc. (Chapter 4)

(v) Water requirements and demands for the different multipurpose uses; delineated irrigation command areas, maps, etc.; hydropower potentials; conceptual designs; dam profiles; drawings; proposed approaches for construction and operation of the multipurpose infrastructure (distributed within Chapter 3 and 4).

(vi) Preliminary CBA results; preliminary cost estimates. (Chapter 5)

(vii) Evaluation of the site (Chapter 5)

(viii) TOR for feasibility studies for the site (Attached in the Report Annex).

2.6 Arrangement of this report

This report has been arranged into two volumes, Volume I and II.

Volume I (this report) is the main text and consists of six chapters, each addressing issues pertinent to the study as spelt out in the ToR. Chapter One gives a background, objectives and expected output of the assignment. Chapter two presents the policy and institutional setting within which the study was made. Chapter Three presents an overview of the methodology adopted for the Initial Environmental and Social Examination (IESE) assessment for the site. Chapter Four details the IESE outcomes combined with the the technical assessment for the site. Chapter five discussed the economic and financial considerations of the subprojects as well as the ranking criteria. Finally, Chapter Six presents the conclusions and recommendations from the study.

Volume II contains all the maps and AUTOCAD design drawings for the conceptual dam designs for the site.

3 Policy, Legal and Institutional Framework

The purpose of this section is to set out the legislative, regulatory, and policy context in the three countries under which the proposed projects will be undertaken and the need for compliance. These policies, legal and institutional instruments have been summarised on countrywide basis as follows:

3.1 Policy Frame work

Environment 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 EIA, most sectoral policies and legislations in Tanzania have incorporated the requirement of undertaking EIA in the designing and implementing development activities. The following are relevant sectoral and cross-sectoral policies applicable in the Tanzanian legal and regulatory framework which stipulate the need for EIA 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 EIA. Paragraph 64 states that: *"It is in the context of an EIA regime that policy guidance on choices to maximize 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 The National Water Policy (URT, 2002)

The National water policy recognizes the following:

a. 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;
b. Existence of uncontrolled abstraction of water resources from different water basins;
c. Existence of ecological minimum flow levels of surface water flow to sustain ecosystem's flora and fauna.

d. 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.
e. 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 prioritization 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; and
f. There is inadequate linkage between water and land development, which results in pressures on water resources. With the ongoing liberalization there is need to have coordination 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

3.1.4 Community Development Policy, 1996

The policy is currently under review. The aim of the policy is to enable Tanzanians to bring about their own development; to use their wealth to bring about social and economic development; and to join together in groups and increase their commitment to self-development. The major objective of the policy is to enable Tanzanians as individuals and collectively to contribute more to the government objectives of self reliance and thereby bring about development at all levels.

3.1.5 The Second National Multi-Sectoral Strategic Framework on HIV and AIDS (2008-2012)

The framework builds on the success on past strategies and seeks to redress challenges faced. It is guided by four main thematic areas one of which is an enabling environment that includes the sub-themes of advocacy, non-discrimination, mainstreaming HIV/AIDS, and poverty reduction strategies. The second thematic area is prevention; the third care, treatment and support; and the fourth, impact mitigation. All agencies are supposed to mainstream these areas in their activities.

3.1.6 The Water Resources Management Act and the National Water Policy

The main objective of the *National Water Policy, 2002* is to develop a comprehensive framework for sustainable development and management of Tanzania's water resources. The policy objective for water resources management is to develop a comprehensive framework for promoting the optimal, sustainable and equitable development and use of water resources for the benefit of all Tanzanians, based on a clear set of guiding principles. As regards water and environment, the policy objective is to have in place a water management system that protects the environment, ecological system and biodiversity.

It is observed that Tanzania shares water bodies with a number of neighbouring countries. Each of the trans-boundary water bodies exhibits unique characteristics and a complex range of water management challenges that are grouped as environmental management challenges, river basin development and alternative use challenges, river control and regulation including international border stability, and inter-basin water transfer. A number

of measures aimed at an effective framework for the management, development and utilisation of transboundary water resources are proposed in the policy.

3.1.7 National Strategy for Gender Development, 2005

The aim of the strategy is to implement the Women and Gender development policy which strives to redress gender gaps and inequalities between men and women. It also aims to guide implementers to incorporate gender concerns into their plans policies and programmes. The goal is to achieve gender equality and equity as stipulated in the national Constitution. The objective is to guide and involve all stakeholders to realize gender equality in a more harmonised manner in order to enhance development. The areas of concern include economic empowerment, HIV/AIDS, food security and nutrition, environmental protection and conservation, community participation and customs and traditions.

3.1.8 Tanzania Vision 2025

By the mid-1980s, the Government of Tanzania had realized that the past development policies and strategies were not adequately responding to changing market and technological conditions in the regional and world economy and were also not adapting to changes in the domestic socio-economic conditions. In response, beginning mid-1986, the Government adopted socio-economic reforms which continue to be implemented to date. However, it has increasingly become apparent to the Government and its people that these socio-economic reforms are not adequately informed by a national long-term development philosophy and direction.

In view of these, the Tanzania Vision 2025 aims at amongst others, achieving a high quality livelihood for its people and attain good governance through the rule of law and develop a strong and competitive economy. It is envisioned that some of Vision's specific achievements which relate to Mgozi Project that could be attainable by the year 2025 would include High quality Livelihood which is expected to be attained through strategies which ensure the realization of the following goals:

- Food self-sufficiency and food security;
- Gender equality and the empowerment of women in all socio-economic and political relations and cultures;
- Universal access to safe water;
- Life expectancy comparable to the level attained by typical middle-income countries; and
- Absence of abject poverty.

It is also envisaged that fast growth will be pursued while effectively reversing current adverse trends in the loss and degradation of environmental resources (such as forests, fisheries, fresh water, climate, soils, biodiversity) and in the accumulation of hazardous substances. This implies that, project interventions such as Mgozi dam has integrated an Environmental and Social Impact Assessment (ESIA) to evaluate its anticipated negative impacts and propose mitigation measures to address such impacts so as to ensure project sustainability and reduce environment degradation.

3.1.9 Tanzania Agricultural Sector Development Strategy, 2001

Agricultural Sector is the leading sector of the economy of Tanzania and accounts for over half of the GDP and export earnings. Over 80% of the poor are in rural areas and their livelihood depends on agriculture. Moreover, about 80% of the population live and earn their living in rural areas with agriculture as the mainstay of their living. The agricultural sector has maintained a steady growth rate of over 3 percent per annum over the last decade. Although this is greater than the growth rate of the population, this rate is considered to be unsatisfactory because it has failed to improve the livelihood of the rural people whose major occupation is agriculture. This includes localized food insecurity and hunger that continues to be influenced by lack of access to and inadequate resources endowments at the households level. The Strategy is a step forward towards laying the foundation for the ways to develop the agricultural sector, hence the national economy at large as well as poverty reduction especially in the rural areas.

The primary objective of the Agricultural Sector Development Strategy (ASDS) is to create an enabling and conducive environment for improving profitability

of the sector as the basis for improved farm incomes and rural poverty reduction in the medium and long-term. The Agricultural Sector Development Strategy, which is the conclusion of a participatory consultative process among a wide range of sector stakeholders, provides a basis for action by both the public and private sectors to support Tanzania's efforts to stimulate agricultural growth and to reduce rural poverty.

3.1.10 National Water Sector Development Strategy, 2005-2015

In keeping up with the changing global trends in the Water Sector, and taking into account other national policy reforms, the Government of Tanzania (GoT) launched a revised National Water Policy in July 2002. The Strategy sets out the future direction for the Water Sector in achieving sustainable development and

management of the Nation's water resources for economy-wide benefits and an increase in the availability of water supply and sanitation services. The water resources aspects of the National Water Policy have implications for all water using key sectors of the economy, such as agriculture, energy, industry, livestock, mining, environment, tourism and fisheries, as well as for domestic supply. Amongst others, the Policy embodies the provisions of the Water Utilization and Control Act, 1981 that river basins should be the planning and management units rather than regions. The National Water Sector Development Strategy is, therefore, a blueprint for prioritized timely and appropriate interventions to address the Water Sector challenges and constraints to implementing the directives of the National Water Policy of 2002. The main objective of the NWSDS is to develop a coherent, holistic and integrated strategy for the Water Sector in order to implement the National Water Policy. This will then allow the on-going sub-sectoral initiatives and projects to be set within the overall strategic and planning framework for the sector, supported through a Sector Wide Approach to Planning (SWAP). No doubt, the proposed Mgozi multi-purpose dam project is to be planned multi-sectoral manner with involvement of key stakeholders such as water, irrigation, agriculture, regional and local administration as well as farmers which will ensure its sustainability and ownership.

3.1.8 The National Irrigation Plan (URT, 1994)

The objectives of the plan are to:

a. Satisfy subsistence requirements in many parts of the country;
b. Generate local surpluses of main staple foods, particularly rice, in order to facilitate food security at regional and national levels;

c. Ensure adequate production of much needed dietary supplements
d. Produce food grains and inductrial crops for export;
e. Improve capacity utilization in the inductrial sector through improved supply of raw materials

3.2 Legal frame work

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

3.2.1 The Environment Management Act, 2004

The objective of the Act is to provide for and promote the enhancement, protection, conservation and management of the environment. Every person exercising powers under the act shall abide by the guiding principles of environment management which include environmental planning, polluter pays principle, precautionary principle, the principles of inter and intra generational equity, public participation, access to information and access to justice. The Act provides the legal and institutional framework for the sustainable management of the environment, outlines the principles for sound environment management including impact and risk assessments. It provides the basis for implementation of international agreements on the environment. The application of the Act is limited to mainland Tanzania.

3.2.2 The Water Resources Management Act, 2009

Outlines the principles of water resources management and provides for the institutional and legal framework for the sustainable management and development of water resources. Sustainable management means managing the use, protection and development of water resources in a manner which provides for the social, economic, sanitation and cultural well being of the people, while safeguarding the life supporting capacity of water for the ecosystem both in the present and the future.

The objective of the Act is to ensure that water resources are protected, used, developed, conserved, managed and controlled in accordance with a number of fundamental principles that include meeting the basic human needs of the present and future generations; promoting the efficient, beneficial and sustainable use of water in the public interest; facilitating socio-economic development; protecting biodiversity especially in the aquatic ecosystems; and preventing and controlling pollution and degradation of water resources. Specific provision is made for transboundary water resources.

3.2.3 The Land Act, 1999

The Act provides for land holdings in accordance with the tenure systems in place. Compensation is made for acquisition of land. In addition, accommodation allowance for a period of 36 months is awarded; loss of profit, disturbance allowance, transport allowance are paid to enable the resettlement of a person whose land has been acquired. An affected person must be paid compensation within a period of six months from the date of the approval of the award. Failure to do so will attract compounded interest on the award sum at the market rate. If a person is dissatisfied with an award, they can appeal to the CGV;

and if still not satisfied with the subsequent award can appeal to the Valuation Tribunal under the Ministry of Lands. A person reserves the right to appeal to the High court.

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

This act provides for a detailed responsibility for the District Councils on administration of day-today activities within its area of jurisdiction. Since the project area is within the jurisdiction of the Ngara 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.

3.2.5 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 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 ecosystems in the catchment area of the dam.

3.3 No 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.

3.3.1 World Bank Safeguard Policies

The Bank's categorization of its projects is based on screening process in which, the proposed projects are screened to determine their appropriate extent and type of EIAs to be undertaken. The Bank classifies its project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. Based on these considerations, the Mgozi dam project fall under the Bank's Category A group and the safeguards justification is as follows:

Table 3.3-1 Summary of the Safeguard Policies with Reference to the Planned Mgozi Dam Project

OP Nº.	Summary of Safeguard policy	Its implication	Triggered/Not Triggered
OP 4.01	Environmental Assessment: Under the OP 4.01 category A projects are characterized based on amongst others, if such a project 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. The planned works on the multi-purpose dams will likely be major and trans-boundary hence, the EIA will be required to recommend measures that will be needed to prevent, minimize, mitigate, or compensate for such adverse impacts and improve environmental performance which qualifies the projects to be Category A type.	The planned large dam fall under those projects that require an EIA to be prepared and approved before their implementation.	√
OP 4.04	Natural Habitat: The Bank supports the protection, maintenance, and rehabilitation of natural habitats and their functions. The conservation of natural habitats is essential for long term sustainable development.	No natural habitats will be impacted by the planned project.	X
OP 4.09	Pest Management: In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity.	At this stage, it is not known if agro-chemicals shall be applied on the project, hence this IESE study cannot commit to assess whether this safeguard will be triggered or not. This should be explored in the detailed ESIA.	X
OP 4.10	Indigenous peoples: These are defined to be a distinct, vulnerable, social and cultural group possessing a number of characteristics including collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories.	No Indigenous People exist in the project area hence, this safeguard will not be triggered.	X
OP 4.11	OP 4.11 Physical Cultural Properties: This policy addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.	This IESE did not encounter any information on physical cultural resources in the area of the project. It is suggested that, during detailed ESIA for the project assess this further to confirm existence of such resources.	X
OP 4.12	Involuntary Resettlement: This policy includes safeguards to address and mitigate these risks and recommends involuntary resettlement instruments which include a resettlement plan, a resettlement policy framework and a resettlement process framework.	The Project will involve land uptake for project infrastructure and associated facilities.	√
OP 4.36	Forests: The objective of this policy is to assist borrowers to harness the potential of forests	There are no forests in the vicinity of the	X

OP Nº.	Summary of Safeguard policy	Its implication	Triggered/Not Triggered
	to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.	project hence, no forests will be impacted and this policy will not be triggered.	
OP 4.37	Safety of Dams: For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken and sufficient resources provided for the safety of the dam, irrespective of its funding sources or construction status. When the Bank finances a project that includes the construction of a new dam, it requires amongst others, that the borrower adopt and implement certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works. The Bank distinguishes between small and large dams where large dams are 15 m or more in height. Dams that are between 10 and 15 m in height are treated as large dams if they present special design complexities. Dams fewer than 10 m in height are treated as large dams if they are expected to become large dams during the operation of the facility. Such large dams require amongst others, that preparation and implementation of detailed plans ensure safety aspects. The EIA is one of the tools that can therefore formulate some of the safety aspects in large dams.	The planned dams under this study have heights above 15 m and therefore qualify as large dams, as per OP 4.37.	√
OP 7.50	Projects on International Waterways: This policy applies to the following types of international waterways: (a) any river, canal, lake, or similar body of water that forms a boundary between, or any river or body of surface water that flows through, two or more states, whether Bank members or not; and (b) Any tributary or other body of surface water that is a component of any waterway described in (a) above.	Based on this Policy provisions above, the planned dam will be on river systems that follow between Rwanda, Burundi and Uganda, it also flows through more than two states. In addition, the river system forms part of the larger trans-boundary Kagera River. This further justifies the need for an EIA to be conducted on the proposed multipurpose dam project.	√
OP 7.60	Projects in Disputed Areas: Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the country in which the project is carried out and one or more neighbouring countries.	The project areas for planned dam site are not disputed, and therefore, this policy will not be triggered.	X

4 Overview of the methodology adopted for the IESE of the Mgozi site

4.1 Project Approach

The study approaches employed during the IESE study included document review, reconnaissance surveys, stakeholder consultations and field observations. These approaches are further elaborated below.

4.1.1 Review of Available Documents

Documents and records were reviewed to obtain existing secondary data and information relevant to the study. The major source of such information included socio-economic and investment profiles for Kagera River Basin Management Project (Kagera RBM Project), national or partner country's education, health and community development reports. Environmental and social safeguard policies Furthermore, policies of focus in the study included but were not limited to the following:

- Sida's Guidelines for the Review of Environmental Impact Assessments, 2002;
- World Bank safeguard policies;
- Initial Environmental Examination (IEE) procedures for AfDB funded projects of 2002;
- African Development Bank safeguard policies;
- EAC Protocol on Environment and Natural Resources; and
- EAC EIA Guidelines for shared ecosystems.

4.1.2 Reconnaissance survey

Reconnaissance visit to the proposed Mgozi dam site was undertaken which was a vital activity of this assignment which accorded the consultant the opportunity to carefully take stock of what is on the ground, examine the extent to which water services are required, and collect all the preliminary field data from the site. The carefully planned tour, using the checklist and plan developed at the initial analysis of maps and desk review provided the Consultant with an in-depth understanding of the social, economic, environmental and hydrologic situation on the ground, leading to an improved strategy and action plan for detailed investigations.

From the perspective of the environment and socio-economic scoping, the field reconnaissance visit was used to gather information on the ground issues that are likely to be impacted on and impact on the project intervention during its implementation. The site visit was important in helping to formulate focus for subsequent and detailed Environmental and Social Impact Assessment Study (ESIA) investigations and general formulation of ToRs for ESIA. In all, the reconnaissance survey helped to answer the key question which is "what exists where and what is/and of what value is it and to who?". Information gathered from the field reconnaissance visit was utilized in the preparation of the description of existing environmental and social conditions at the site and the characterization of the spot preliminary evaluation of the project's potential environmental and social risks and impacts in their areas of influence thereby leading to formulation of ways to prevent, minimize, mitigate, or compensate for adverse environmental impacts and enhance positive impacts.

4.1.3 Stakeholder Consultations

The Consultant carried out consultations with the relevant stakeholders and these included the District staff, ministries, local authorities and also local people at the project site that might be affected by the project. The local people provided information such as land tenure systems, existing conflicts in regard to natural resources, and socioeconomic information among others.

4.1.4 Field Observations

Observations were made through transect walks; the consultant observed among other things housing, infrastructure, settlement patterns and other economic activities. This method was equally employed to document major vegetation and animal groups in the areas of the project.

5 IESE and Technical assessment of the Mgozi Dam site

A discussion of the technical assessment of the site follows, which includes the site hydrology; an appreciation of the water uses (irrigation, water supply and hydropower where applicable) and a summary of the site specific dam design elements. The discussion of the site ends with an outline of the estimated project costs.

5.1 Physical Environment Profile

Mgozi dam site is situated near Rulenge town in Ngara district/NW-Tanzania just 37km from the Tanzania – Rwanda – Burundi border confluence. The site is located in Karagwe region, Ngara District in Rulenge Division. The site is in Rulenge Ward and covers the villages of Mbuba, Kumwendo and Kaninye (Figure 5-1). The site coordinates are -2° 44' 51.72" (South) and 30° 39' 15.87" (East.) at an altitude level of 1375 m.

As a physiographic unit it consists of a flat valley floor in roughly NE-SW orientation flanked by smooth hills on the western and steep hills on the eastern side. The planned dam site is located on River Bigombo which is known as R. Mgozi downstream. The Bigombo – Mgozi system drains into the Ruvubu River system. The planned reservoir has potential multipurpose use for irrigation, hydropower and water supply.

5.1.1 Geology of the Dam site

Geologically, the precambrian basement complex prevails. The Karagwe-Ankolean formation consists of acid sedimentary and partly metamorphic rocks. Ferralsols are the most frequent upland soil types, whereas in the lowland areas Gleysols prevail. While the mean annual temperature ranges about 20^0 C there is a distinct difference between day- and nighttime temperatures. The highly variable amount of rainfall in the two rainy seasons reaches nearly 1000 mm/annum. Flooding and excessive wetness due to poor drainage conditions characterize the hydrological situation of the valley floor which led to the formation of a papyrus swamp (Van oort 1987). For lowland soils, classified as Mollic Gleysols (FAO-UNESCO-ISRIC 1990) the typical profile consists of a thick (27-40 cm) greyish-black topsoil and a grey, strongly mottled (hydromorphic) subsoil underlain by a weathering zone in transition to bedrock at approx. 2 m depth. Soil textures range from silty clay loam to clay (without any coarse fragments). The granitic rocks intruded the Karagwe-Ankolean at the time of fold formation and were typically emplaced in the cores of major anticlines. This geological system comprises also of rocks not only occurring beneath the site with elements of mica schists. The Karagwe–Ankolean System (southern and north western) age dating varies from 1300-1400 million years.

5.1.2 Soils

The Kagera Region as a whole has a series of hilly ridges running north to south and parallel to the lakeshore. The region has reasonably fertile old soils in most of its parts. Over use in some parts of the region has led to soil exhaustion and a need for the use of fertilizer. The soils are rich in iron and clay content. The nitrogen content of these soils is usually low but to some extent is boosted by intercropping with legumes and to a lesser extent by manuring. The fairly high rainfall intensity in most of the region coupled with poor soil management has led to instances of soil erosion.

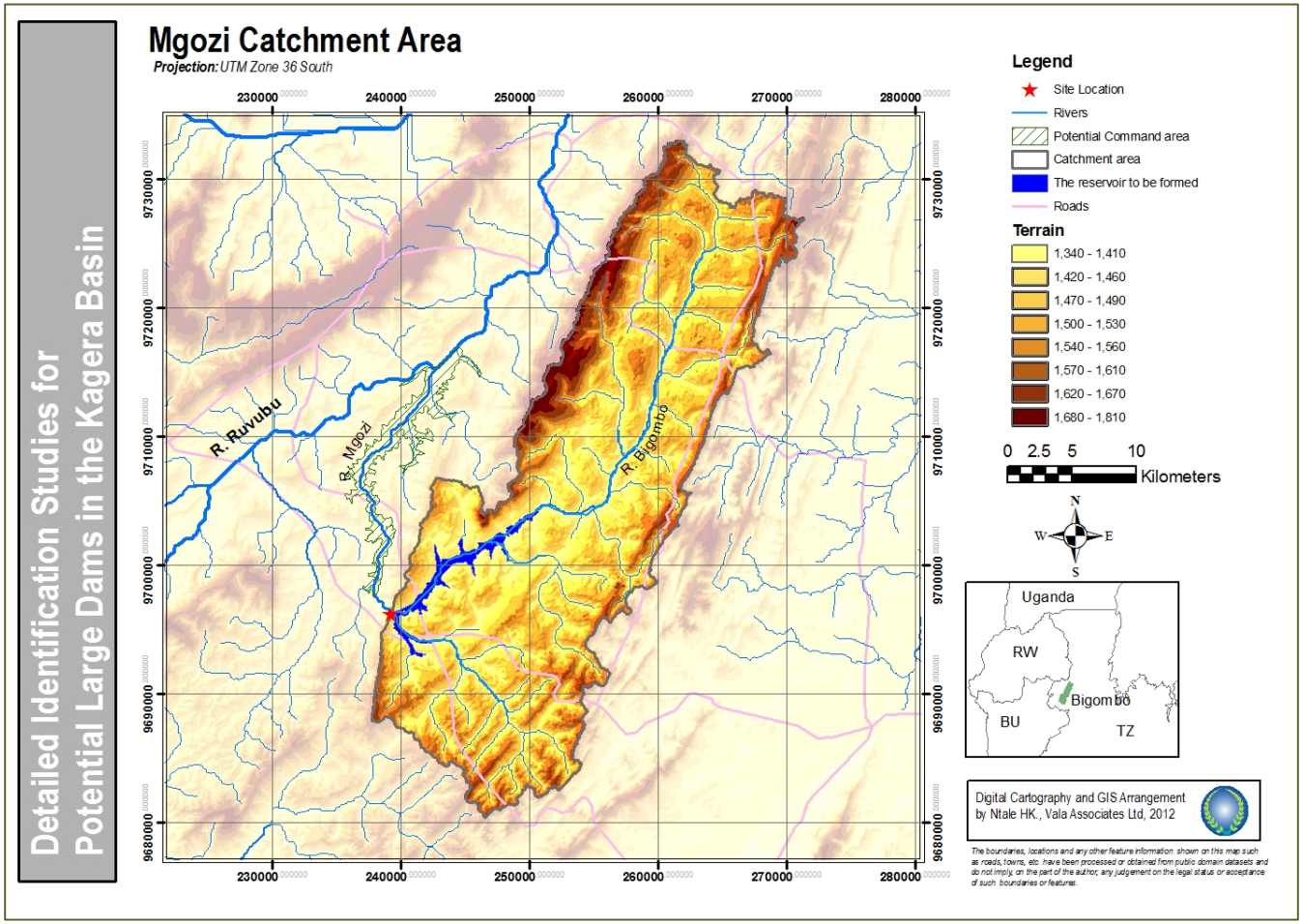

Figure 5-1 Location of the Site and the Contributing catchment

Analysis data of a representative profile was undertaken and interpreted with regard to soil fertility according to Landon (1984): This silty clay loam soil is moderately acidic and slightly limiting for sensitive crops only. The weighted average topsoil organic carbon content is still medium (as a relic of former swamp conditions) and so is the related nitrogen content. Consequently the C/N ratio is favorable. Since the organic fraction largely determines the cation exchange capacity, this topsoil has a medium cation exchange capacity. Base saturation is medium also, while among the exchangeable bases magnesium is somewhat high in relation to calcium whereas the potassium content is very low (exchangeable potassium percentage 0.5 %).

Table 5-1 Soil Analysis data for Mgozi/Bigombo Dam site

Depth (cm)	Horizon symbol	Sand %	Silt %	Clay %	$C_{organic}$	N %	C/N Ratio
0-5	Ap1	6.5	53.6	39.9	4.97	0.41	12.1
5-20	Qp2	6.0	53.7	40.3	4.63	0.44	10.6
20-32	Ah/Cg	6.8	52.9	40.3	1.38	0.14	9.6
32-130	Cg_1	12.4	52.9	34.7	0.38	0.07	5.8
130-150	Cg_2	74.6	19.4	6.0	0.05	0.00	--

Table 5-2 Mineral composition for Mgozi/Bigobi Dam site

Depth	Ph/H_2O	Ca	Mg	K	Na	Sum	CEC	Base saturation
cm	1:2.5	Cmol (+)/kg soil						%
0-5	5.7	8.2	3.6	0.15	0.4	12.4	25.2	49
5-20	5.9	8.9	5.3	0.16	0.3	14.7	28.4	52
20-30	5.8	5.2	2.8	0.05	0.3	8.4	13.5	62
32-130	5.1	2.6	1.3	0.05	0.2	4.2	8.1	52
130-150	5.7	0.7	0.4	0.01	0.0	1.1	1.8	6.1

5.1.3 Climate

The Rulenge region experiences a weak bimodal rainfall pattern, March-May and October-December, with average annual rainfall of 950mm. These two seasons are separated by relatively dry June – September period. There is typically no rainfall during the month of July. On the other hand, it could be stated that the water year for this zone starts in October and goes on right through to the May of the subsequent year (see Figure 5-2 and Figure 5-3).

The region consists of a series of hilly ridges running North East – South West. The area has a pleasant climate, with monthly maximum and minimum temperatures of 26°C and 16°C respectively.

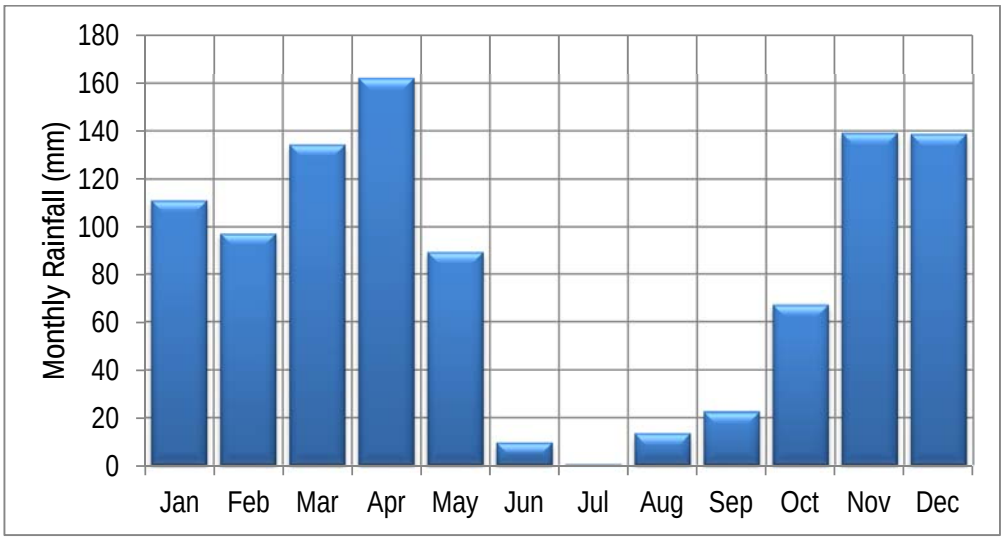

Figure 5-2 Average monthly rainfall for Rulenge Metereological station

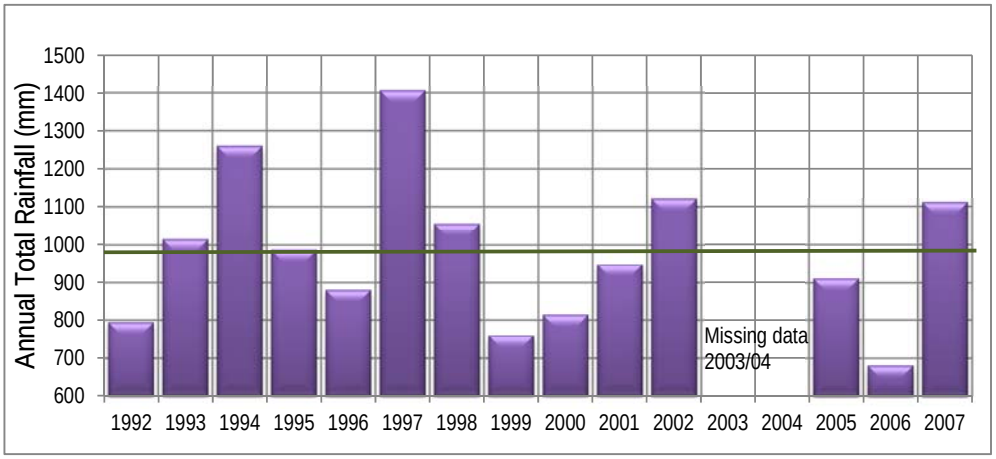

Figure 5-3 Annual Total rainfall, Rulenge Met station

5.1.4 Vegetation

The Vegetation is the project site can be said to be of secondary type as a result of cultivation and repeated seasonal fires. There are no forests in the vicinity of the site except stands of members of Poacea family largely *Hyperrehnia rufa, Impereta cylindrical*, *Panicum maximum* and shrubs such as *Acanthus acutifolia*. There are gardens cultivations of *Manihot utilisima* (cassava), *Eleusine caracana* (millets), *Ipomoea batatus* (sweet potatoes) and some *Zea mayze* (maize). There are isolated stands of agroforestry/ornamentals around homesteads towards the valley and these includes trees such as *Grevelia* spp, some *Eucalyptus* spp, as well as Cassia trees and *Solanaceas* which all appear as patches (Plate 5-1 below). The communities up the valleys engage in cultivation of bananas, sorghum and coffee though the levels are fairly low.

Plate 5-1 Characteristic vegetation up the valley

The immediate valley bottom with estimated 80 hectares has been reclaimed and cultivated under the Bigombo project where farmers had crops such as maize and is now overgrown with weeds such as *Polygonaceas* seen growing close to the main river stream. From discussions with Rulenge Division Irrigation staff, it emerged that, the valley bottom of the stream were of papyrus which were reclaimed during irrigation process. Evidence of some papyrus patches are evident in some spots in the valley.

Plate 5-2 Cultivation close to the riverbanks with weedy vegetation closing onto the stream

Further downstream there is a continuum of Cyperus papyrus (Plate 5-3)

Plate 5-3 A continuum of Cyperus papyrus downstream the site

Close to the actual dam site, the riber banks have been as a result of cattle tracks to the river for watering (Plate 5-4). Furthermore, in isolated places attempts by the community to cultivate have been hampered by rock outcrops. The vegetation is a mix of *Cordifolia* spp and *Combretacea*e members. No species of conservation concerns were encountered in this section as well.

Plate 5-4 Degraded slopes near the site where cattle watering takes place

5.2 Social Environment Profile

This section presents preliminary socio-economic assessment, and the current project socio-economic baseline which is a summary of the situation formed through a combination of secondary data and stakeholder consultations.

5.2.1 Population

According to the 2002 population census, Tanzania had a total population of 34,569,321, 16,910,321 and 17,658,911 being male and female respectively and a population growth rate of 2.9%. According to the Government Population Planning Unit, the country population should be standing at 47,346,855 in 2013.

Mgozi site is within Ngara district, Kagera region. According to the 2002 census, Ngara district had a population of 334,409 of which 162,314 were women and 172,095 were men. This district also had a lot of refugees from neighbouring countries totaling to 101,538. Therefore 30.36% of the district population were refugees. According to the Population Planning Unit, The district has a population growth of 2.7% and such its current (2013) population should be about 312,169 persons.

With specific reference to Mgozi site, the available district statistics show the population of the area to be as follows:

Table 5-3 Population of Rulenge Ward 2010/2012

Village	Households	Total Population	Male	Female	Total
Rulenge	1,764	8,820	4,064	4,756	19,404
Kumwendo	494	1727	851	946	4,018
Mbuba	912	7,201	3,900	4,001	16,014
Kanyinya	674	3,539	1,706	1,833	7,752
Muyenzi	599	2,737	1,224	1,513	6,073
Muyembwe	519	3,127	1,510	1,617	6,773

(Source: Rulenge Ward Records, 2013)

Note: The villages of Kumwendo, Mbuba and Kanyinya are within the project site of Mgozi.

5.2.2 Agriculture

The Department of Agriculture and Livestock foresees uplifting and bring closer advice and services to farmers.

The main aim is to give enough services, so that farmers, stakeholders and donors participate in the uplifting of the Agriculture and Livestock sector. Reducing poverty by using availiable options, which is land, people, seasons and good leadership. Agriculture and livestock rearing are given first priority in development. Almost 90% of Ngara residents depend on agriculture and livestock for uplifting their needs.

The District effort in Agriculture is shown in the table below.

Table 5-4 Land use in Ngara District

No	Area/Land	Acres
1	Land for cultivation	57,550
2	Suitable area for irrigation	5,000
3	Area for livestock grazing	165,933
4	Un-used area upto now	105,000
5	Toatl land suitable for cultivation in the whole district	333,483
6	Unsuitable land for cultivation	40,917
	Total land of Ngara	374,900

5.2.2.1 Irrigation Farming

In the year 2009/2010, the district council approved the cultivation of 3,000 acres of land using traditional way of irrigation, but the area they managed to cultivate was 2,800 acres which is equivalent to 93.3%. In this region, farmers managed to harvest 10,710 tonnes the first year and 2,656 tonnes in the following year. In the budget of the third financial year, the District Board through its Agricultural Plans (DADPs) is determined to rehabilitate the irrigation scheme Bigombo of 3,500 Acres in the location of Rulenge in Rulenge Division, using funds from the DASIP.This project is supposed to benefit 762 families in Rulenge Village. Meanwhile the District Irrigation Development (DIDF) will also develop 300 Acres in the river Mwiruzi valley in the area of Murusagamba in Murasagamba Division.

Banana and beans are the staple food in the area; the two crops are also traditional food and cash crops. Coffee is commonly grown as a cash crop despite problems of inputs and markets. All systems are characterized by declining soil fertility due to soil erosion, leaching, inappropriate agricultural practices like growing the same crops on the same piece of land for many years without rotation, ridge cultivation along slopes etc. There is some tradition of growing trees to mix up with coffee and as woodlots (mostly *Eucalyptus*), though there is a serious problem of tree management and species selection which contributes to poor benefits. Coffee comprises 89% of the total land area under cash crops – this region is the leading coffee producer in the country. Other cash crops include cotton and tea. The main livestock in the region are cattle, goats, sheep and pigs. There is little introduction of dairy farming into the coffee/banana complex. The development and use of existing irrigation capacity could make a difference to the income of many households with access to the irrigation scheme

5.2.2.2 Constraints for wetland crop production in Mgozi/Bigombo site

Yield decline in the site was witnessed since 1991 mainly affecting the main crop beans already led to abandonment of plots. Through participatory rural appraisal (PRA), farmers on the site identified the following major constraints to crop production in the wetland. These largely included ineffective water management which emerged as one of the major constraints and this was attributed to deterioration of the water scheme caused by lack of maintenance of drainage and irrigation structures. The annual reclamation of the entire valley floor with only hand tools was found to be extremely hard work. While farmers could manage to clean secondary and tertiary channels, manual excavation and cleaning of the large outside main drains was seen as rather too difficult. To address this constraint, management of the project thought that, an excavator could be rented every 3 years for the exercise. This was found not to be feasible due to lack of funds. While the project administration assumed that, the farmers should pay the costs for mechanical ditch

cleaning (from funds generated from increased valley crop production), the farmers, sticking to traditionally low crop production remained poor and expect the project/donor to provide this service free. As a result, soil wetness increased due to widespread flooding of valley consequently, the lower half of the downstream returned to its former swamp conditions.

Secondly, the problem of blocked drainages was further enhanced by the large number of farmers involved in the project which made organization of common work difficult, as well poor management of the project which was needed to give it management direction in execution. In addition, the irrigation system was similarly affected by farmers struggle with ineffective water distribution/water shortage towards the end of the dry season.

Due to these, the farmers had requested the project to be re-designed into a shallow channel system which they could handle themselves in view of the local natural wetness conditions which become rampant for during the heavy rains.

5.2.3 Land, Natural resources and Environment

This sector is made up of Lands, Natural reseources and Environment with seven sub-sectors as follows; land and value, survey and mapping. Others are forests, wildlife, and bee farming. For now, the department has insufficient staff, meaning the sectors of bee farming and land and surveying have no experts completely. Even other sectors which have servants, they are inadequate. Efforts of employing more civil servants have been hampered with various difficulties that include limited financial base and the general reluctance by trained workers to get deployed in the remote areas of Ngara District.

Ngara District is estimated to have 105,000 acres of forests and 100,600 Acres of tropical forest, man-made forests are 4,400 acres. Major uses of the forest are firewood, timber and building materials.Below are the reserved forests.

- Goragoya Forest- 1434 acres.
- Forest Reserve of Bungi (on Ngara side)-13,500 acres.
- Forest Reserve (Ngara side) 37,000 acres.

5.2.4 Water Sector

It is reported that, the Kagera region urban safe water coverage stands at 36.8% with an urban coverage of 55.4% and that of rural coverage is at 35.1%. It is important to note that, the region's safe water coverage was at 33.8% in 1988. Therefore, at this pace, the vision of attaining 100% safe water coverage will take much longer than anticipated. No doubt, concerted efforts and financial assistance are needed to accelerate the pace of coverage. Although coverage with safe and clear water is very low in the region as a whole, that of toilets is reportedly very high. With an estimated 70-80% of people with access to toilets which is fairly much better in urban centers. However, sewerage and garbage collection and disposal in urban centers still needs improvement. The construction and maintenance of good running public toilets in urban centers needs attention as well as garbage collection and disposal in towns require investment.

In 2002, the National Water Policy was adopted which provided a comprehensive framework for sustainable development and management of Tanzania's water resources. In Ngara, the safe water coverage grew up from 53% to 65% between year 2002 and 2003 in the urban area and 75% to 90.5% in the rural areas as per the end of financial year

2010/2011. Basing on the research that was done by Geodata Company on the sources of water in all districts, it was discovered that most of water stations were not working due to failure to modernize water sources together with maintaining boreholes and pumping stations.This situation made a reduction in the usage of safe water in urban areas from 89.9% to 69.9%. The reduction on water funding and late release of government funds in the water sector together with the population increase is the causing the water sector to fail to meet the national and global MDG targets.

5.2.5 Energy

The district energy sources are mainly woodfuel, petroleum products, electricity and renewable resources like solar energy and Biogas Woodfuel accounts for 95% of the total energy used in the district. This has resulted into a lot of deforestation and loss of tree cover. The increased demand for wood fuel is due to slow adoption of Biogas and solar energy technologies and high cost of petroleum products and slow rate of rural electrification and increased tariffs on electricity.

5.3 Hydrology

5.3.1 The catchment

The catchment area of the basin upstream of the dam site is 720 km^2 and is entirely within the United Republic of Tanzania. The topography of the catchment is shown in Figure 5-1. The elevation of the riverbed at the dam site is about 1375 m asl. At the site, the right and left banks of the river rise at a slope of about 27%. The catchment has a length of 57 km and an average width of about 13 km (Figure 5-1).

The mean catchment slope is about 11.4% but the steepest slopes may be higher than 150%. The catchment elevation ranges between 1375 m asl at the dam site to over 1800 m asl while the mean is 1517 m a.s.l.

5.3.2 Alternative locations for the Bigombo-Mgozi site

Three alternatives were considered for the Bigombo-Mgozi site. These are shown in Figure 5-4 below.

Figure 5-4 Options for the Mgozi site

The options are described briefly as follows:-

Option A: These are the coordinates that were supplied by the client. The point is located at a place where the river swamp narrows down to a small water passage between two towering rock hills. Indeed it would be an excellent dam site. However the resultant impoundment reservoir would of necessity inundate some of the earlier cropped valley area (From the Bigombo irrigation scheme).

Option B: This point is located at the original Bigombo headworks. In the 1980s, a small earth retaining wall was placed at this point (which has over time been breached). The rehabilitation of the Bigombo irrigation scheme presupposes that this earth dam shall be repaired.

Option C: This point is about 2 km upstream of the original Bigombo irrigation head works. It lies at a site that is suitable for dam constructions, in part due to the existing

rock formation and site geometry. What makes this site particulary attractive is that it can produce some hydropower if the power house is located 2 km downstream at the original bigombo irrigation head-works. The tailwater from the power house should feed into the primary irrigation channels for onward transmission. The technical challenge with option C is that some rocks will have to be blasted at site A in order to allow for the passage of the primary irrigation canals each side of the valley.

5.3.3 Runoff

R. Mgozi is ungauged despite having had an irrigation scheme running for a more than a decade. The probable discharge for the river had to be derived using comparative methods.

There is some similarity between the Kagitumba and Mgozi catchment particulary regarding the areal extent (both are approximately 720km^2). The altitude of the Kagitumba catchment ranges from 1770m to 2475m with an average of 2001m while its average rainfall 1054mm. On the other hand, the altitude of the Mgozi catchment ranges from 1375m to 1850m with an average of 1517m while its average rainfall 915mm. Mgozi catcahment is dryer, its average slope milder, with a lower altitude - hence it is hotter than Kagitumba.

Taking all the above into consideration, the inferred discharge for R. Mgozi at Site C was derived using Kagitumba discharge and our findings show that average Mgozi discharge should be about 3 m^3/s. The mean monthly total flows vary between 6.5 to 12.5 Million m^3 (Mm^3) while total annual flow averages about 92.1 Mm^3.

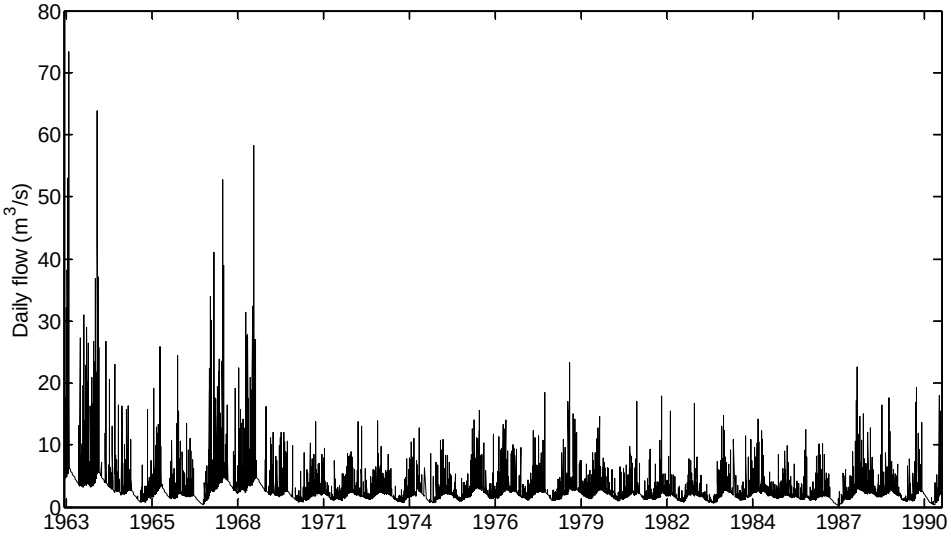

Figure 5-5 Derived Daily flow variation, River Mgozi

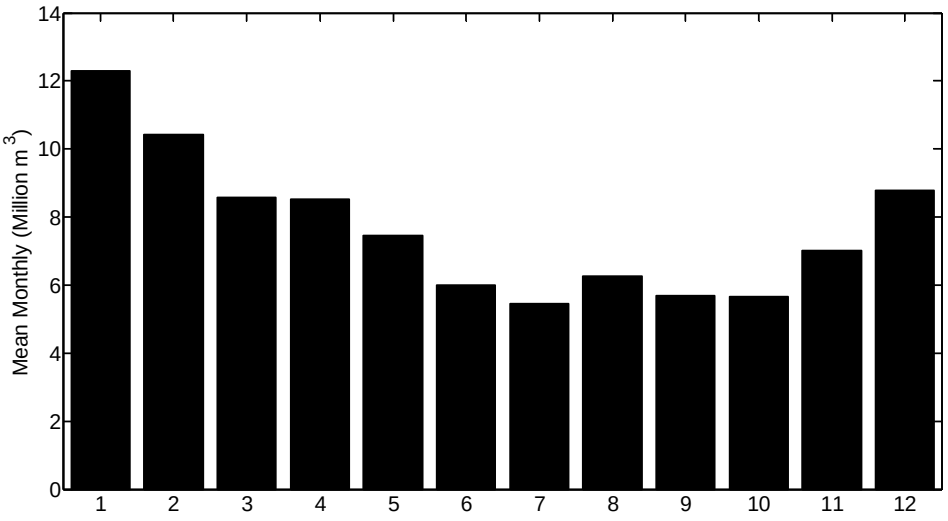

Figure 5-6 Derived Mean monthly flow variation, R.

5.3.4 Reservoir

Using a 30m digital elevation model (DEM) of the area, reservoir elevation-area and elevation-volume curves were prepared and are shown in Figure 5-7 and

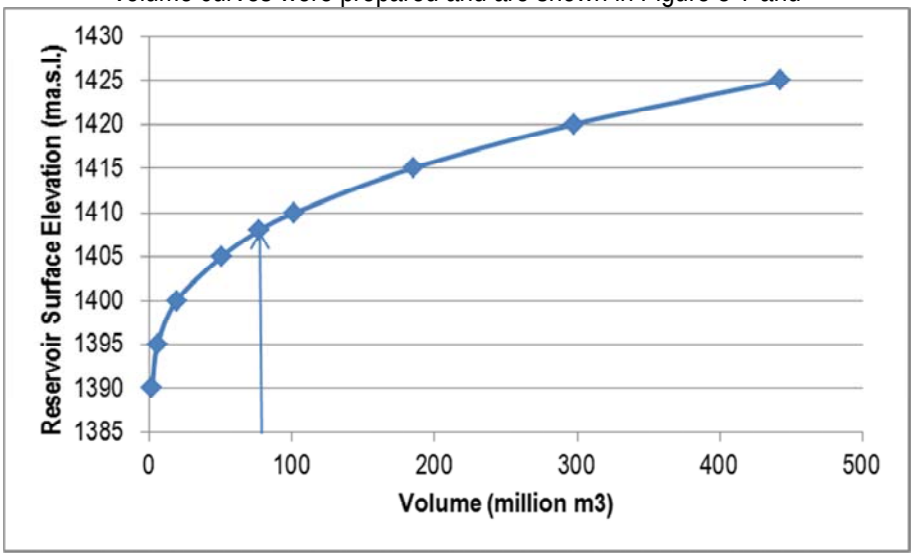

Figure 5-8 respectively. Figure 5-7 shows that the inundation area increases gently with elevation up from elevation 1395 m asl.

Taking dead storage into consideration, a reservoir elevation of 1408 m asl would be sufficient to meet the water requirement at the proposed dam site. Detailed socioeconomic assessments at the feasibility and detailed design stages will be necessary to assess the relative costs of different possible reservoir maximum elevations in terms of cost effectiveness.

A reservoir elevation of 1408 m asl will inundate 1140 ha of land and will have a total volume of 77.28 million cubic meters of water. The reservoir fetch will be 14.29 km along the main river while the fetch along the tributaries will be about 5km upstream of their

confluence with the main river at Site C (Figure 5-9). The average width of the reservoir will be about 550 m. The Mgozi reservoir would result in resettlement of about 470 people (Table 5-5)

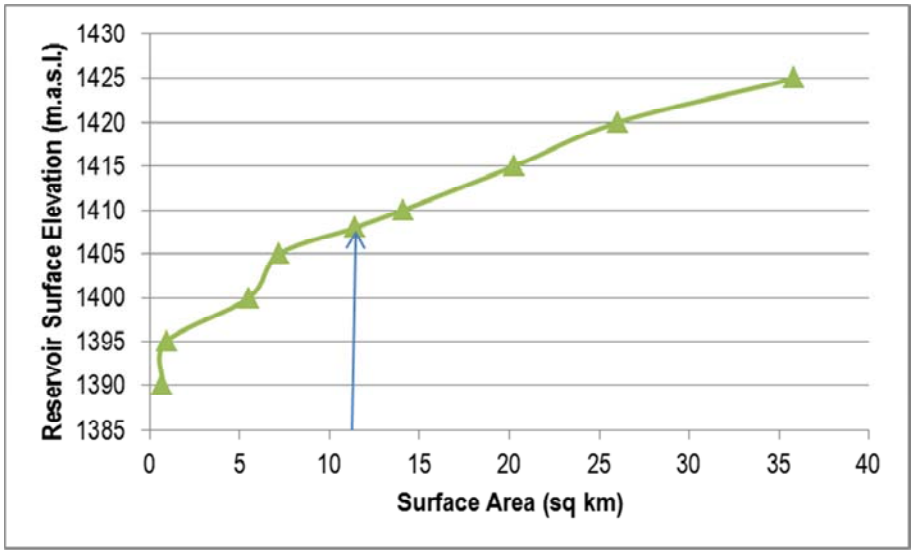

Figure 5-7: Plot of reservoir surface elevation versus reservoir surface area, Mgozi project

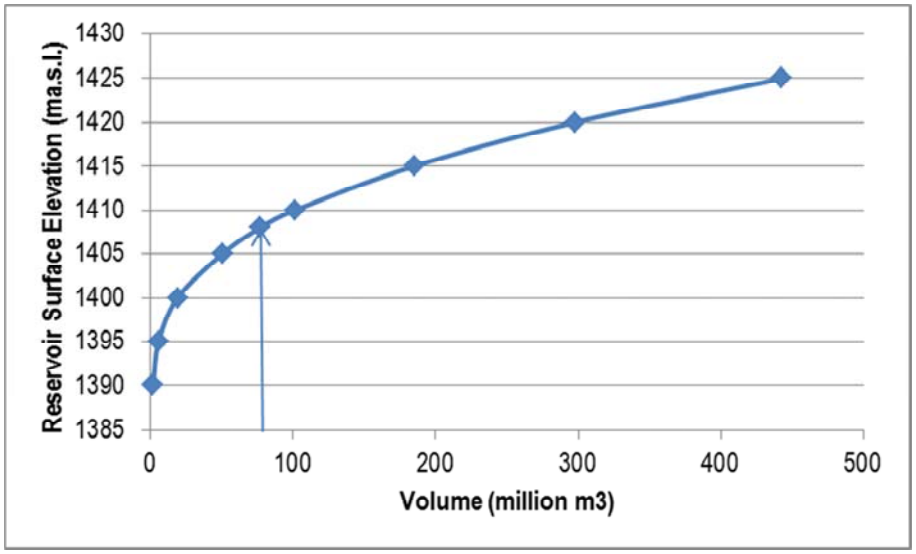

Figure 5-8: Plot of reservoir surface elevation versus reservoir volume, Mgozi project

Table 5-5: Land area to be inundated by the Mgozi reservoir and the affected population

Reservoir inundation				
District	Ward	Population density (per km2	Land area (km2)	Population (2012)
Ngara	Keza	41	9.1	373
	Nyakisasa	40	0.0	0

Reservoir inundation				
	Rulenge	42	2.3	97
Total (reservoir inundation)			11.4	470

5.3.5 Reservoir evaporation

Being an open water body, the reservoir evaporation rates would be expected to be close to the potential evapotranspiration rates. Table 5-6 shows the daily and monthly potential evaporation rates estimated from data at Rulenge meteorological station located close to the Mgozi dam site.

Table 5-6 Daily and monthly potential evaporation rates, Mgozi project

Month	Daily Evaporation	Monthly Evaporation (mm)
Jan	2.3	71.7
Feb	2.4	66.8
Mar	2.7	82.8
Apr	2.3	68.6
May	2.4	73.1
Jun	2.9	86.1
Jul	3.5	109.5
Aug	3.6	112.1
Sep	3.6	108.5
Oct	3.1	95.0
Nov	2.5	75.5
Dec	2.1	65.6
Annual	**2.8**	**1015.3**

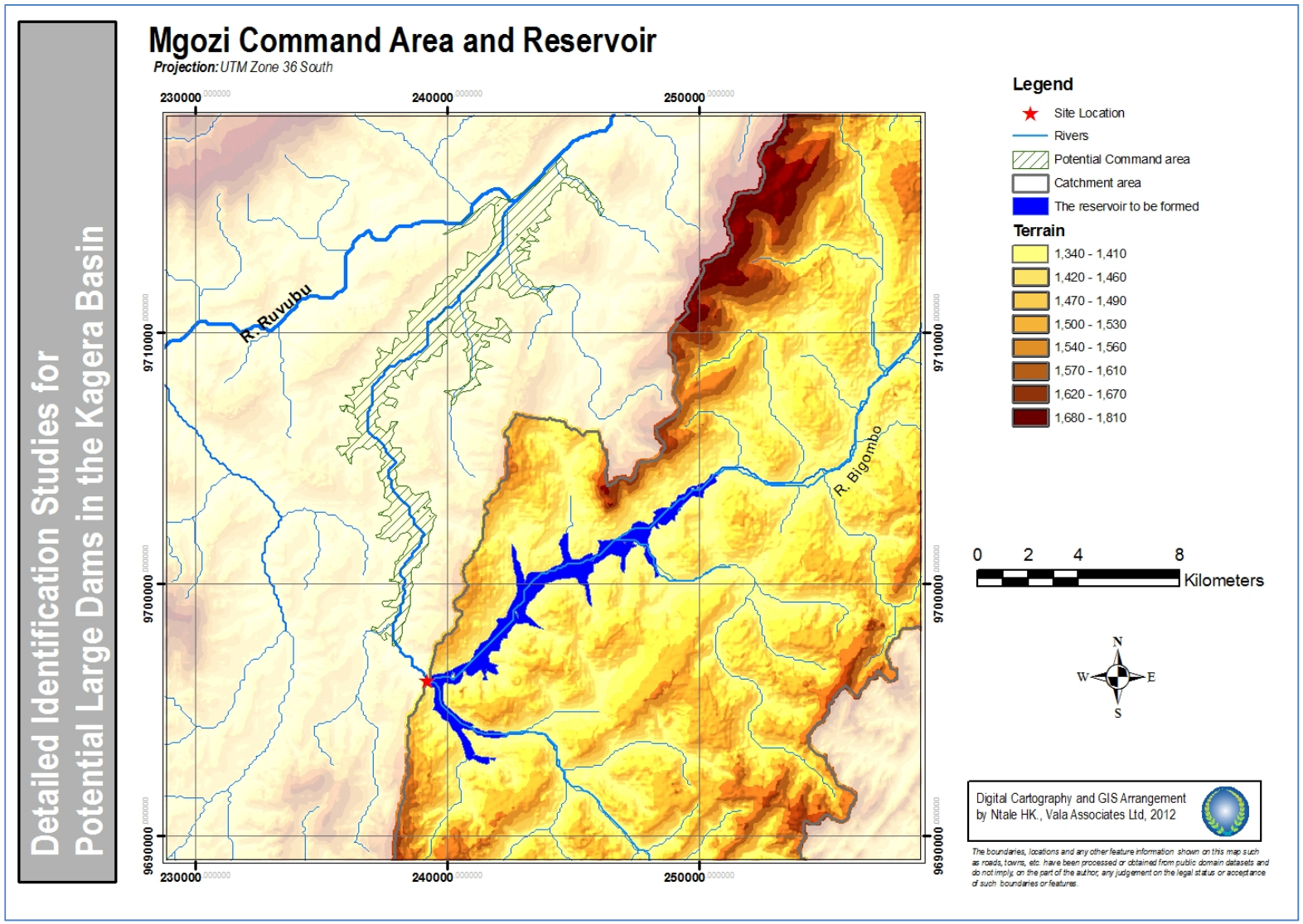

Figure 5-9 Mgozi Reservoir and at 1408m above sea level and the potential command area

5.3.6 Sedimentation

Using the approach suggested by Lawrence et al (2004), sedimentation yields for the Mgozi catchment contributing to the dam site was established to be 492 t/km^2/yr. The dead storage properties of the dam are shown in below:

Table 5-7 Mgozi Sediment Properties

Site Name	Mgozi
Reservoir Volume (Mm^3)	77.28
Catchment area (km^2)	720
S_Y (t/km^2/yr)	492
Assumed Sediment density (t/m^3)	1.1
Dead Volume (Mm^3)/yr	0.14
Dead storage after 50 years (Mm^3)	6.93
Percentage of Reservoir filled with sediment after 50 years	8.96%

5.3.7 Floods

The annual maximum series model was used for flood frequency analysis. The following approach was used

i). Selection of the maximum 24-hour flows from the derived flow for R. Mgozi

ii). Selection of the distribution that best fits the data. Lognormal distribution was shown to provide an acceptable fit to the annual maximum data

iii). Estimation of the flood magnitudes corresponding to various return periods (Table 5-8)

Table 5-8: Mgozi flood estimates and associated return periods

Return period, T (years)	Flood magnitude (m3/s)	Risk of failure for a 50 year design life (%)
50	61.4	63.6
100	71.4	39.5
200	82.0	22.2
500	96.9	9.5
1000	108.9	4.9
2000	121.7	2.5
5000	139.7	1.0
10000	154.2	0.5

5.4 Dam Design elements

5.4.1 General

Owing to the nature of the river cross-section at the proposed dam site as a U-shaped medium width valley, a rockfill dam is proposed. The dam will have a base elevation of 1375 m asl while the crest elevation will be 1411 m asl (Figure 5-10). The dam crest will be 390 m long. An Ogee spillway is included within the design to be located on the right side of the dam. The spillway crest elevation will be 1408 m asl while the spillway crest length

will be 60 m. Options for location of the power station should be explored during the feasibility study stage. This study explores only the option of having the power station located 2 km downstream of the dam because it maximises hydropower production even though it results in incurring the cost of a 2 km long power canal.

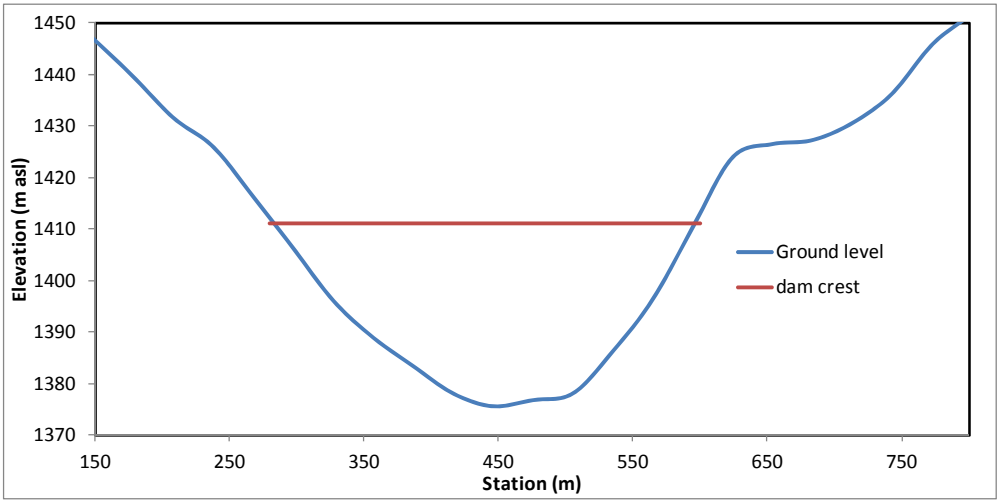

Figure 5-10: Mgozi dam site showing crest elevation

5.4.2 Dam Type

The dam at Mgozi has been designed as a rockfill dam with an impervious core and a roadway on top plus an unregulated Ogee type overflow spillway located in a side channel. This preliminary design proposes a downstream slope of 2 and an upstream slope of 2. The dam foundation will be located firm basement rock assumed to be 10 m below the ground level in the current design.

Table 5-9: Mgozi dam design

Variable		Units	Value	Check	
				Criteria	Value
Dam location			Mgozi		
Dam type			Rockfill		
Reservoir base elevation		m asl	1,375		
Reservoir top elevation		m asl	1,408		
Reservoir depth at above dam base (Hnet)		m	33.0		
Free board (Flood control pool + 3% of dam height)		m			
	Flood control pool (flood height above spillway crest)	m	1.8		
	3% of dam height (for wave action, etc)	m	2.0		
	Freeboard on dam	m	3.8		
Dam height H		m	36.8		
Dam crest elevation		m asl	1,412		
Spillway crest elevation		m asl	1,408		
Crest length		m	390.0		
Base length		m	110.0		

Variable		Units	Value	Check	
Top width (7-12 m depending on dam height)		m	7.0	Allows for road on top	
Upstream slope N:1			2.0		
Downstream slope N:1			2.0		
Bottom width		m	154.4		
Impervious core	Top width	m	4.0	>=3.5 m	
	U/S slope N:1		0.6		
	D/S slope N:1		0.5		
	Core depth (1 m below crest level)	m	35.8	Protection of core	
	Base width	m	43.4	Min width 0.4*H=	14.7
Cutoff (compacted backfill trench)	Bottom width (contact with core)	m	43.4		
	Depth of pervious foundation material	m	10.0	assumed	
	U/S slope N:1		1.0		
	D/S slope N:1		1.0		
	bottom width (contact with impervious layer)	m	23.4		

5.4.3 Diversion works

During the construction of the dam, the river will be diverted by an upstream coffer dam through two tunnels on the left of the bank. The tunnels will be 220 m long and unlined. The tunnels will be circular with a cross-sectional area of 7 m^2 that is needed for safely discharging a 100-year flood of 72 m^3/s without overtopping the cofferdam that shall be raised to an elevation of 1379 m asl. A cofferdam will also be provided upstream from the tunnel outlet to prevent the diverted water from rising into the works area. The cofferdams will be random fill embankments with impervious facings. The crest elevation of the upstream cofferdam will be 1379 m asl while that of the downstream cofferdam will be 1378 m asl. After construction, the two cofferdams will be breached. The inboard tunnel will be fitted with a valve and retained as a bottom reservoir outlet while the outboard tunnel will be plugged at the upstream end and used to access the valve chamber for the bottom outlet.

5.4.4 Spillway

The spillway will be of the unregulated Ogee type. It will be located on the left side of the dam. The inlet to the spillway will be shared with the power station inlet. Table 5-10 shows the main design parameters of the spillway. The spillway will discharge via a flared ski-jump into an existing an existing pond below the dam.

Table 5-10: Spillway design parameters, Mgozi project

Variable	Units	Value
Spillway type	Unregulated Ogee	
Return period	years	10,000
Spillway crest elevation	m asl	1,408
Design flood	cumecs	154

Variable	Units	Value
Discharge coefficient, Cd (assumed)		1.7
Spillway crest length, L	m	60.0
Head on spillway, H=(Q/(Cd*L))^(2/3)	m	1.3
Freeboard (40% of head on spillway)	m	0.5
Total height above spillway crest	m	1.8

5.4.5 Power station

The power station will be located 2 km downstream of the dam site which will help build a further 20 m of head giving a total available head of 53m. The power canal will share an inlet with the spillway. Further studies will be carried out to identify the route that the head race canal should take which results in minimum head loss. The power station will be a surface concrete structure equipped with 2 turbines each with a rated power of 0.9 MW.

Table 5-11: Hydropower estimation, Mgozi project

Variable	Value	Units
Rated reservoir level	1408	m asl
Power station elevation	1355	m asl
Head	53	m
Mean flow	3	m3/s
Rated flow (30% higher than mean)	3.9	m3/s
Plant efficiency	90%	
Power	1.8	MW
Energy	16.0	GWh/year
Turbine type	Francis	
Number of turbines	2	
Flow for each turbine	2.0	m3/s

The proposed hydropower station at the Mgozi site has the potential to produce 16 GWh of energy per year, which is enough to supply about 18,000 houses and over 107,000 people.

5.4.6 Ancillary works

This will involve opening up roads and also some remedial works on existing roads to provide access for the heavy trucks, construction materials and supplies during dam construction. A permanent road will have to be constructed to provide easy access to the power station and dam during operation. The length of temporary accesses to be constructed will be in the order of 2 km while the permanent road may be about 3 km long.

5.4.7 Construction materials

A full investigation of the availability of good quality construction materials will be carried out at the feasibility stage. Good quality concrete aggregates can partly be obtained from alluvial deposits in the river valley. However, the bulk of the aggregates may be obtained from a quarry opened above the left or right flanks of the river valley. Investigations may reveal that there may be other locations with better material quality and economic haul distances. Random fill for the cofferdams will be obtained from foundation stripping operations.

5.5 Irrigation command area

The estimated irrigation command area for Mgozi site is 3093 ha all located within Tanzania. (Table 5-12). The command area can support 6,200 farmers and provide food for about 31,000 people. This command area is shown in the attached drawing in Volume II of this report. The annual water demand for irrigation is about 15.5 Mm^3.

Table 5-12: Irrigation command area for Mgozi

Irrigation Command Areas		
District	Ward	Area (ha)
Ngara	Kibimba	3
	Nyakisasa	598
	Rulenge	2492
Total irrigable area		3093

5.6 Water Supply

The total population that can benefit from water supply from the Mgozi project in 2012 and 2062 was estimated at 25,214 and 121,794 people respectively (Table 5-13). The annual water demands are 0.3 Mm^3 and 1.3 Mm^3 for 2012 and 2062, respectively.

Table 5-13: Potential water supply beneficiaries for the Mgozi Project

Water Supply					
District	Ward	Population density (per km2	Land area (km2)	Population (2012)	Population (2062)
Ngara	Bukiriro	41	28.0	1,148	5,545
	Rulenge	43	220.0	9,460	45,696
	Kanazi	41	36.0	1,476	7,130
	Kibimba	41	16.0	656	3,169
	Nyakisasa	41	148.0	6,068	29,311
	Keza	40	154.0	6,160	29,755
Biharamulo	Nyakahura	41	6.0	246	1,188
Total (water supply)			608	25,214	121,794

5.7 Project costs

The estimated costs for the Mgozi project total to 44.4 million US dollars as broken down in Table 5-14 below.

Table 5-14 Mgozi Dam project costs

No	Item	Units	Quantity	Rate (USD)	Amount (USD)
1.0	PREPARATORY WORKS				
	Mobilisation and demobilisation	Lumpsum	1	1,200,000	1,200,000
	Permanent access	km	3	100,000	300,000
	Temporary access	Lumpsum	2	100,000	200,000
	River diversion during construction	Lumpsum	1	800,000	800,000
	Resettlement and compensation	ha	1,140	2,500	2,850,000
	Subtotal				5,350,000

No	Item	Units	Quantity	Rate (USD)	Amount (USD)
2.0	MAIN DAM				
	Excavation, loose	m3	160,000	15	2,400,000
	Excavation, rock	m3	38,000	22	836,000
	Foundation preparation	Lumpsum	1	500,000	500,000
	Dam - rockfill	m3	540,528	15	8,107,920
	Dam - impermeable core	m3	335,138	20	6,702,760
	Subtotal				18,546,680
3.0	SPILLWAY, INTAKE, AND PENSTOCKS				
	Excavation, loose	m3	3,900	15	58,500
	Excavation, rock	m3	13,000	22	286,000
	Concrete Spillway	m3	6,200	200	1,240,000
	Concrete intake	Lumpsum	1	250,000	250,000
	Penstocks, 2No @ 1.2 m2 steel	m	2,100	1,150	2,415,000
	Other civil structures	Lumpsum	1	500,000	500,000
	Subtotal				4,749,500
4.0	POWER STATION				
	Excavation, loose	m3	4,000	15	60,000
	Excavation, rock	m3	3,200	22	70,400
	Reinforced concrete power station	m3	6,000	350	2,100,000
	Other civil works	Lumpsum	1	300,000	300,000
	Subtotal				2,530,400
5.0	MECHANICAL AND ELECTRICAL WORKS				
	Turbines (2x0.9MW Francis) and miscellaneous mechanical equipment	Lumpsum	1	1,050,000	1,050,000
	Generators, transformers and miscellaneous electrical equipment	Lumpsum	1	2,000,000	2,000,000
	Gates for intake, outlet	Lumpsum	1	1,000,000	1,000,000
	Switchyard	Lumpsum	1	300,000	300,000
	Subtotal				4,350,000
	TOTAL, CONSTRUCTION COST				35,526,580
	ADMINISTRATION AND ENGINEERING		10%		3,552,658
	CONTINGENCIES		15%		5,328,987
	CAPITAL COST (WITHOUT VAT)				44,408,225

5.8 Anticipated Impacts and Mitigation Measures for the Mgozi Project

5.8.1.1 Positive Impacts

The following are some of the anticipated positive impacts of the dam project. They are:

- The dam will likely facilitate cultivation of crops to be done throughout the year and that will guarantee household income for the communities and also food security;
- There will be improved supply of water for both domestic and livestock purpose;
- It will also support cattle production some of which were seen grazing in the vicinity of the planned dam site;

- During construction phase, the communities will get benefits in terms of employment.
- The project will attract development in the area due to increased activities during project implementation;
- Improved use of the valley bottom through having in place water control measures; and
- Communities can benefit from sale of local construction materials to the project.

5.8.1.2 Negative Impacts and mitigation measures

At this stage of the study, the preliminary potential impact examination has identified the following impacts:

- The dam construction process will likely interfere with the community water sources for livestock. ***This will be of short term nature since the water availability in the dam will be improved once the dam is in place***;
- The erosion of river banks could be an issue from loose construction materials. ***The dam sides will be planted with grass to stabilize loose soils***;
- Loss of vegetation through clearances of the sites and access roads. ***This will be short-term and moreso, the clearance will be minimal in scale***;
- Sedimentation transport could be an issue as the annual sedimentation is quite important, leading the site likely exposed to siltation. ***Thus, it should be taken into consideration during the ESIA as the area is highly cultivated;***
- Noise and vibrations from equipment operations as well as air quality concerns. ***The works will be restricted to daytime hours. More so, there are no nearby settlements in the vicinity of the project, hence minimal effect***;
- Due to the change of the hydrology of the River, the aquatic environment as well as the wetlands near the Project area should be taken in consideration during the ESIA;
- Pollution of water sources from loose soils, and agro-chemical residual impacts. ***Appropriate measures to address agro-chemicals will be charted out in the ESIA;***
- HIV/AIDS from the workforce and the communities is likely to be an issue during construction phase of the dam. ***The contractor will have an independent programme to address HIV/AIDS issues in the project;*** and
- Potential equipment related concerns in terms of oil spillages, used batteries and oil filters as well as used tyres all these are anticipated to occur in the campsite. ***The contractor will have his/her plan to handle hazardous waste in the project such as oil spills etc***.

One of the tasks of this assignment is preliminary identification of potential environmental and social impacts of the project and proposing mitigation measures. At this point, the consultant has identified some key impacts as well as proposing mitigation measures to address such concerns and have been summarized in Table 5-15 as follows:

Table 5-15 Key impacts and mitigation measures for the planned Mgozi Dam site

Nº.	Project Impact	Mitigation measures
01.	Land uptake through construction of access roads, camp sites, etc	Compensation for land uptake after Resettlement Action Plan (RAP) studies.

Nº.	Project Impact	Mitigation measures
02.	Concerns relating to management of cut to spoil materials	Disposal sites for cut to spoil have to be approved by the Supervising consultant.
03.	Loss of marsh and cropland areas due to inundation where rice fields are in place.	Compensation for loss of crop and issuing early notice to farmers to harvest crops. The project will likely disrupt cropping on the marshland and there will be need to put in place measures to ensure sources of livelihoods are not disrupted
04.	Loss of vegetation through clearances of the sites and access roads.	Restrict clearances to work/designated portions or areas. Compensatory planting of trees by the projects.
05.	Conflicts in water use due to a multiplicity of users (power generation, water supply and irrigations needs including local domestic uses). Some sections of the river have a number of dams and the planned ones will add to such existing dams along the same river system there by putting stress on water supply process.	Put in place site-based sectoral committees to handle equitable and rational use of water in the project. There is need to plan the development of this dam sites while ensuring that the needs of other users are taken care of.
07.	Impacts on water quality through upgrading of existing facilities and where communities draw water for their needs	Provide alternate site rather than disrupt this existing and functioning facility already in place.
08.	Soil erosion concerns which will likely arise through loose soil materials causing sedimentation	Soil control measures have to be instituted during works implementation.
09.	Pollution of water sources from loose soils, and agro-chemical residual impacts.	Impacts of water quality from agro-chemicals have to be mitigated through monitoring water quality parameters during the project phases.
10.	Equipment related concerns in terms of oil spillages, used batteries and oil filters as well as used tyres.	Preparing decommissioning plan and site restoration and re-grassing.
11.	Human waste management especially in irrigation fields and workers camp sites.	Measures for human waste management to be instituted on the sites.
12.	Noise and vibrations	Noise from equipment and the workforce
13.	HIV/AIDS from the workforce and the communities	Contractors to work with HIV/AIDS service providers to sensitize communities on HIV/AIDS.
14.	Air Quality concerns	Furthermore, the project should work out HIV/AIDS mitigation measures with the district leadership and the health department so that there should be an HIV/AIDS programme dedicated to the project. This is important in that, the project will affect social dynamic of the areas, hence there will be induced developments and population influx which all will have impacts on the communities with reference to HIV/AIDS prevalence.
15.	Crime rate possible increase	In all, the detailed ESIA should investigate this issue

Nº.	Project Impact	Mitigation measures
		and propose appropriate mitigation measures.
16.	Impacts on socio-cultural sites	Dust suppression measures will be instituted to ensure air quality levels are kept appropriate.
17.	Impacts on biodiversity areas of high conservation concerns (Important Bird Areas-IBAs, national and central forest reserves etc).	Working together with the police and law enforcement agencies to control crime in the areas.

6 Preliminary economic analysis and evaluation of Mgozi dam site

6.1 Background

The economic analysis of a proposed project focuses on the benefits the project would bring to the target population if developed. Once the project is evaluated to cause substantial benefits; and therefore contribute to optimum utilization of the country's resources, it is concluded to be robust and worth harnessing. To elaborate on this; a project that provides safe water reducing on the incidences of water borne diseases in a community is attractive albeit having no direct financial returns to the national economy. The socio-economic considerations for an attractive project are largely intangible (non-financial).

On the other hand, the purpose of financial analysis is to determine whether the proposed project is profitable for the owner/financier/investor. The reason for this is obvious; the financiers are interested to invest where they can make financial profits from the investments. The prime consideration is therefore anticipated revenue from the project. The main consideration is receipts from the products in relation to all financial variables such as initial investment, operating costs, taxes, inflation, and interest rates among others. Focus is on ensuring that after all these considerations; there should be surplus revenue (profit). The attractiveness of a project depends on the level of profitability. The specific objective relating to this chapter required "*undertaking an initial financial analysis for the proposed interventions for multipurpose use".* However, at this stage it is far-fetched to conduct comprehensive economic and financial analyses. It is appropriate to do the analyses after conclusive decisions have been made regarding what development alternatives (together with those presented in the Main report) will be selected for each site and for what purpose. This study recommends that more elaborate economic and financial analyses to be done at feasibility study stage after conclusive consultations.

6.1.1 Assumptions

The following assumptions have been made in deriving the estimates of project beneficiaries

- *Population*: Use was made of spatially disaggregated population density data produced by Columbia University Centre for International Earth Science Information Network (CIESIN) in collaboration with the International Food Policy Research Institute (IFPRI), The World Bank, and Centro Internacional de Agricultura Tropical (CIAT). Raw data for deriving the spatial population data were derived from the UN population census database

- *Irrigation*
  - Farmland (Hectares per farmer): According to the World Development Indicators of the World Bank, the average size of a plot of land in the Burundi, Rwanda and Uganda in 2011 was 0.11 ha, 0.12 ha and 0.2 ha respectively.
  - Hectares needed to feed 1 person: To feed 1 person, 0.18 Ha of land was needed in Eastern Africa (based on calculations by Kastner et al (2011), "Global changes

in diets and the consequences for land requirements for food" using data from FAOSTAT food balance sheet data (http://faostat.fao.org/)). Irrigation should result in increased efficiency. This study has assumed a figure of 0.1 ha per person

- *Per capita energy consumption*: The per capita electricity consumption in 2011 for Burundi, Rwanda and Uganda was estimated at 12, 20 and 63 kWh/year (Source: CIA World Fact Book). These rates are very low by any standards and are responsible for the high rates of environmental degradation due to usage of biomass as energy sources. For an improved impact by the proposed projects, it is assumed that the energy balance for an average house in the 3 countries should be made up of; (a) four energy saving bulbs (20W@) operated for 6 hours per day = 0.48kWh/day; (b) one TV (70W) operated for 6 h per day = 0.42 kWh/day; and (3) one radio (20W) operated for 6 h per day = 0.12 kWh//day. Other household uses=20%. Total for household energy consumption = 450 kWh/year. Other types of uses (commercial, industrial) assumed at 100% of household consumption. Total consumption per house = 900 kWh/year. Average household occupancy assumed at 6 members. Per capita energy consumption = 150 kW/year

- The useful life of each project is 50 years

- Population growth rates (source: FAO)
  - Burundi 2.7%
  - Rwanda 2.8%
  - Uganda 3.2%
  - Tanzania 2.8%

- The areas that can be supplied with potable water are assumed to be within a distance of 5 km from the reservoir and also within the irrigation command areas. Water demand for each category
  - Irrigation demand = 5,000 m^3/ha
  - Domestic demand = 30 l/cap/day

6.2 Preliminary costs

For the preparation of the preliminary costs, quantities of the dam structure and appurtenances were estimated from the site maps and proven formulae. The unit rates were derived basing on current rates in dam construction within the East African region. Estimates were also made for components such as the preparatory works (5 km access roads, resettlement and land compensation, river diversion works during construction, and construction of contractor's camp facilities such as offices & accommodation), irrigation infrastructure, hydropower infrastructure and water supply systems. A 15% contingency was included as part of the project costs, along with another 10% as consultancy fees for both the design and supervision of the construction.

Table 6-1 gives a summary of the costs for the proposed dam at Bigombo-Mgozi.

Table 6-1 Summary Costs of the proposed Mgozi dam project

Dam site	Type of Dam	Dam height, (m)	Reservoir Capacity Million m^3	Cost of Dam Million US$
Mgozi	Rockfill	36.8	77	44.4

6.3 Evaluation of Mgozi Project

A multi-criteria matrix was developed in the Main Report to guide evaluation of Mgozi dam site. The criteria included:

(i) Reservoir capacity,
(ii) Storage/earth ratio,
(iii) Water use benefits of created and/or boosted irrigated agriculture and hydropower generation,
(iv) Cost of sub-projects,
(v) Environmental attributes: these included the following attributes;
- Land take area, expressed as reservoir area in hectares,
- Number of displaced people,
- Number of relocated settlements,
- Acreage of affected crops in hectares,
- Extent of affected infrastructure such as roads, bridges, schools, etc,
- Number of archaeological, cultural, historical and protected areas affected,
- Number of endangered/threatened species.

Table 6-2 below summarizes the ranking criteria used.

Table 6-2: Summary of the criteria and scoring system used for ranking

Ranking criterion	Scores					Weight
	1	2	3	4	5	
Reservoir capacity range (MCM)	0 - 25	25 - 50	50 - 100	100 - 200	> 200	3
Water storage/earth ratio	0 - 40	40 - 80	80 - 160	160 - 320	> 320	1
Irrigation command area (1000 ha)	0 – 0.5	0.5 - 1	1 - 5	5 - 10	> 10	4
Hydropower potential (MW)	0 - 1	1 - 5	5 - 10	10 - 25	> 25	3
Water Supply; Number of people site can serve in 2062 (million)	0-0.2	0.2- 0.5	0.5 – 1.0	1.0 – 5.0	> 5.0	1
Cost of sub-project (MUSD)	>120	60 – 120	30 – 60	15 - 30	0 –15	4
Environmental criteria*	> 18	14 - 18	12 - 14	9 - 12	0 - 9	4

*The *environmental criteria* are elaborated in the Main Report. The raw environmental score for Mgozi project is shown in Table 6-7 below

The scores are multiplied by the weights to give the final points. The distribution of the weights is subjective and has been selected by the consultant to reflect the importance of the various ranking factors.

6.3.1 Reservoir capacity

The storage capacity was one key criterion used for the ranking (see Table 6-3).

Table 6-3: Evaluation criterion of reservoir capacity

Property	Reservoir Capacity Million m^3	Score
Mgozi	77	3

6.3.2 Water storage/earth ratio

This ratio gives an indication of the storage capability of a particular reservoir geometry assuming the dam is an earth fill embankment. The ratio can help show the embankment volume and cost efficiency; the higher the ratio the higher the efficiency (see Table 6-4 below).

Table 6-4: Evaluation criterion of water/earth ratio

Dam site	Reservoir Capacity (million m^3)	Volume of Earth fill (million m^3)	Water/ Earth Ratio	Score

Mgozi	77	0.875	88	3

6.3.3 Water use

Concerning water use, the purposes of irrigation watering, domestic water supply and hydropower generation were evaluated. The other purposes such as livestock watering and fishing, etc were left out because of lack of ready access to their data and with the assumption that their water requirements would be quite small.

The scoring for irrigation watering was based on the size of command areas that could utilize the impounded water through gravitational abstraction and low-head pumping.

The Table 6-5 shows the scoring of the 3 purposes of irrigation and potential hydropower and water supply highlighted above.

Table 6-5: Evaluation criterion of selected water uses

Dam site	Irrigation command area		Hydropower potential		Water Supply	
	(ha)	Score	MW	Score	No of People who can be served with Water, 2062	Score
Mgozi	3093	3	1.9	2	121,794	1

6.3.4 Environmental ranking

During the IESE study, the assessment of the impacts was predicted in relation to the prevailing environmental and social settings of the sites. This was be done by comparing baseline conditions (i.e. the current situation without the project) with the conditions that would prevail when the project is implemented. The environmental and social impacts of the projects were predicted in relation to the baseline environmental and social receptors.

Based on these, the following parameters were used in ranking of the Mgozi dam site:

- impacts on protected areas,
- impacts on settlements;
- impacts on cropped marshlands;
- impacts on settlements and community infrastructures;
- loss of vegetation and flora; and
- impacts on water sources for the communities.

The levels of negative impacts were drawn based on a continuous scale ranging from *4 being Very Large Negative* through to *0 denoting minimal/no impact.*

For instance, an area/aspect or habitat of “high value” which is to be impacted by “highly negative impacts” results in an overall impact assessment for that particular aspect to be of

"very large negative impact". An area/aspect of "high value" affected by "little/no impacts" will give an overall impact assessment of "minimal/no impact" or "small negative impact", depending on the specific characteristics.

Table 6-6 Impact Categorization

0	Minimal/No Impact
X	Small Negative Impact
XX	Medium Negative Impact
XXX	Large Negative Impact
XXXX	Very Large Negative Impact

From the environmental ranking of the site in Table 6-7, it will be appreciated that the Mgozi preliminary environmental ranking are medium suggesting average impacts. It will however require serious consultations and good planning to implement the planned dam site.

Table 6-7 Summary of the Environmental Ranking of Dam Sites

Nº.	Impacts and their levels	Mgozi	Net impacts
01.	impacts on protected areas	0	4
02.	impacts on cropped marshlands	xx	18
03.	Impact on crops in the vicinity	xx	18
04.	impacts on settlements	xx	13
05.	Impacts infrastructures (roads, energy facilities)	0	14
06.	Impact on communities economic activities (sand mining, community conservation and brick/tile making)	x	5
07.	loss of vegetation and flora	0	11
08.	Impacts on water sources for the communities	xx	16
09.	Impacts on physical cultural resources	0	0
Overall site scale of negative impacts		9	98
	Final environmental score	5	

6.3.5 Cost

The costs of the different dam sub-projects were also used to guide the selection and ranking of the sub-projects.

Table 6-8: Evaluation criterion for cost

Dam site	Cost of Dam Million US$	Score (Multiplicative)
Mgozi	44.4	3

6.3.6 Overall ranking

The scores that were estimated for Mgozi were multiplied by weights (as shown in Table 6-9) to get a total site score.

Table 6-9: Combination of all evaluation criteria

Site	Scores							Total weighted Score	Global ranking
	Reservoir Capacity	Water/earth ratio	Irrigation command area	Hydropower potential	Water Supply	Cost	Environmental Criteria		
Weights	*3*	*1*	*4*	*3*	*1*	*4*	*4*		
Max. Pts	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*100*	
Mgozi	3	3	3	2	1	3	5	57	5

6.4 Cost Benefit Analysis

Preliminary cost benefit analysis (CBA) was carried out to assess whether multipurpose reservoirs constructed at Mgozi site is viable in terms of benefits accrued over the project period. For the analysis, it was assumed that the project construction would start in 2012 and the project would take 4 years to complete. The project economic life was taken as 25 years starting in 2012. Cost benefit analysis was carried out to check whether implementation of the project would result in net benefit over the assumed time horizon. The criterion used to evaluate this was that the ratio of the present value of benefits to present value of costs (B/C) is greater than one.

6.4.1 Assumptions

The following key assumptions were adopted for the cost benefit analysis (Adopted from Main Report):

- Annual O&M cost = 1% of investment cost. Replacement costs for infrastructure not considered
- Discount rate = 10% as base case. This is approximately the average discount rate in the 3 countries between 2008 and 2011 (Source: CIA world fact book).
- The power price was adopted from figures used by Uganda's Electricity Regulatory Authority (ERA) at US$12 cents/kWh for the year 2009
- Construction period = 4 years.
- Commissioning carried out 3 years after start of construction.
- Project economic life = 25 years starting from commissioning date

- The distribution of investment costs with time during the construction period is 30%, 40%, 20% and 10% in year 1, year 2, year 3 and year, respectively
- Replacement of major electromechanical equipment carried out every 30 years
- Irrigated crops: Maize.
- Irrigation yields: According to the FAO Country Statistics database (www.faostat3.fao.org) , the current yields for the three countries (Burundi, Rwand and Uganda) average 1.6 ton/ha and 3.5 ton/ha for maize and rice, respectively. Maize yields in Australia and USA are about 6.0 and 9.5 Ton/ha while rice yields are in the order of 10 and 7.5 Ton/ha. It seems possible to achieve yields of about 5 Ton/ha for maize and 7 Ton/ha for rice with irrigation in the proposed schemes. This would mean an incremental yield of 3.4 and 3.5 Ton/ha for maize and rice, respectively, due to implementation of the projects.
- Maize and rice prices from The World Bank database (econ.worldbank.org) for commodity price averages for Jan-Sep 2012. Maize = 292 US$/ metric ton growing at 3% p.a. between 1990 and 2011 and for rice the price is 440 US$/ metric ton growing at 5% p.a between 1990 and 2011.
- Benefit from flood control: where flood control was considered as a benefit, it was assumed that all the benefits would be towards protecting agriculture land which is the dominant feature in most of the valleys. Annual flood control benefits were estimated as 50% of the annual agriculture benefits.

6.4.2 Key site data

Table Table 6-10 shows the input data which was used in the CBA computations for Mgozi multipurpose reservoir site

The CBA runs for the Mgozi site are given in Table 6-11

Table 6-10 Key input data for Mgozi multipurpose reservoir site

Input data		
Variable		**Mgozi**
Discount rate		10%
Proportion of Civil and Irrigation Investment Cost in Year	1	30%
	2	40%
	3	20%
	4	10%
Investment cost (US$) - Civil and hydropower infrastructure		32,176,580
Electromechanical equipment cost (US$)		3,350,000
O&M costs		1%
Investment cost for irrigation infrastructure (US$/ha)		5,000
O&M costs for irrigation infrastructure		2%
Investment cost for water supply infrastructure (US$/cap)		25
O&M costs for water supply infrastructure		1%
Unit power price (US$ cents/KWh)		12
Power sales (GWh/year)		16
Percent of firm power compared to maximum power		70%
Population - Year 1 (2016)		28,600
Population - Year 25 (2041)		54,599
Domestic water sales (m3) - Year 1 (2016)		276,093
Domestic water sales (m3) - Year 25 (2041)		1,333,647
Unit price of domestic water (US$/m3)		0.5
Irrigation demand (m3/year)		15,464,500
Irrigated area (ha)		3,093
Yield - Maize (Ton/ha)		3.4
Yield - Rice (Ton/ha)		3.5
Commodity price - maize (US$/metric ton)		292
Commodity price - rice (US$/metric ton)		440
Percent price increase (Maize) - % per annum		3%
Percent price increase (Rice) - % per annum		5%
Flood control benefit (50% of crop benefit)		0%

Table 6-11: CBA for Mgozi

No. of years from...		Costs							Benefits				
		Civil Structures and Hydropower		Irrigation infrastructure		Water supply infrastructure		Total Cost	Hydropower	Water supply	Irrigation	Total benefits	Net benefit
Construction start	Commissioning date	Investment	O&M	Investment	O&M	Investment	O&M						
1		9,652,974		4,639,350				14,292,324					-14,292,324
2		12,870,632		6,185,800				19,056,432					-19,056,432
3		6,435,316		3,092,900				9,528,216					-9,528,216
4	1	6,567,658	355,266	1,546,450	309,290	844,988	8,450	9,632,101	1,344,000	138,047	5,789,536	7,271,583	-2,360,518
5	2		355,266		309,290		8,450	673,006	1,344,000	148,838	6,079,013	7,571,851	6,898,846
6	3		355,266		309,290		8,450	673,006	1,344,000	159,629	6,382,964	7,886,593	7,213,588
7	4		355,266		309,290		8,450	673,006	1,344,000	170,421	6,702,112	8,216,533	7,543,527
8	5		355,266		309,290	129,997	9,750	804,302	1,344,000	181,212	7,037,218	8,562,430	7,758,127
9	6		355,266		309,290		9,750	674,306	1,344,000	192,003	7,389,079	8,925,082	8,250,776
10	7		355,266		309,290		9,750	674,306	1,344,000	202,795	7,758,533	9,305,327	8,631,022
11	8		355,266		309,290		9,750	674,306	1,344,000	213,586	8,146,459	9,704,045	9,029,740
12	9		355,266		309,290		9,750	674,306	1,344,000	224,378	8,553,782	10,122,160	9,447,854
13	10		355,266		309,290	129,997	11,050	805,602	1,344,000	235,169	8,981,471	10,560,640	9,755,038
14	11		355,266		309,290		11,050	675,606	1,344,000	245,960	9,430,545	11,020,505	10,344,900
15	12		355,266		309,290		11,050	675,606	1,344,000	256,752	9,902,072	11,502,824	10,827,218
16	13		355,266		309,290		11,050	675,606	1,344,000	267,543	10,397,176	12,008,719	11,333,113
17	14		355,266		309,290		11,050	675,606	1,344,000	278,334	10,917,035	12,539,369	11,863,763
18	15		355,266		309,290	129,997	12,350	806,902	1,344,000	289,126	11,462,886	13,096,012	12,289,110
19	16		355,266		309,290		12,350	676,906	1,344,000	299,917	12,036,031	13,679,948	13,003,042
20	17		355,266		309,290		12,350	676,906	1,344,000	310,708	12,637,832	14,292,540	13,615,635
21	18		355,266		309,290		12,350	676,906	1,344,000	321,500	13,269,724	14,935,223	14,258,318
22	19		355,266		309,290		12,350	676,906	1,344,000	332,291	13,933,210	15,609,501	14,932,595
23	20		355,266		309,290	129,997	13,650	808,202	1,344,000	343,082	14,629,870	16,316,953	15,508,751
24	21		355,266		309,290		13,650	678,206	1,344,000	353,874	15,361,364	17,059,238	16,381,032
25	22		355,266		309,290		13,650	678,206	1,344,000	364,665	16,129,432	17,838,097	17,159,892
26	23		355,266		309,290		13,650	678,206	1,344,000	375,457	16,935,904	18,655,360	17,977,155
27	24		355,266		309,290		13,650	678,206	1,344,000	386,248	17,782,699	19,512,947	18,834,741
28	25		355,266		309,290		13,650	678,206	1,344,000	397,039	18,671,834	20,412,873	19,734,668
TOTAL		35,526,580	8,881,645	15,464,500	7,732,250	1,364,975	281,445	69,251,395	33,600,000	6,688,574	276,317,780	316,606,354	
Present value		28,733,064	3,224,762	12,709,810	2,807,438	1,142,782	91,841	**46,757,293**	12,199,542	1,983,591	79,600,684	**93,783,816**	
											B/C	**2.01**	
											NPV	**23,703,876**	

6.4.3 Summary of the CBA results

The results of the Preliminary Cost Benefit analysis are summarized in Table 6-12 below.The net present value of benefits accrued over the project life of Mgozi dam site is higher than the net present value of costs meaning that the project would have a net economic benefit for the riparians

Table 6-12: Summary of CBA results

Site	Benefits (B)	Costs (C)	B/C
Mgozi	93,783,816	46,757,293	2.01

The cost benefit analyses carried out at this stage are preliminary and based on the limited available data. More rigorous analysis should be carried out during feasibility studies for the site, including sensitivity analysis to assess the impact of limited knowledge about some of the input variables.

7 Conclusions and recommendations

The studies included Initial Environmental and Social Examinations, hydrology and engineering assessments for Mgozi site, and consequently developed preliminary conceptual designs for the site. Preliminary costs were also estimated together with detailed multi-criteria evaluation of the proposed dam project to evaluate its viability and provide a background on which to base any decisions to carry out feasibility studies.

7.1 Evaluation of the project

The following multi-criteria matrix was developed to guide evaluation and ranking of the different dam sub-projects:

(viii) Reservoir Capacity
(ix) Water Storage/earth ratio,
(x) Irrigation command area
(xi) Hydropower potential
(xii) Water Supply
(xiii) Cost of sub-projects
(xiv) Environmental considerations

The Mgozi project has good environmental scores, and provides net economic benefits. In relation to the 9 sites presented in the Main report, Mgozi site is the only site located in Tanzania and should therefore be given high priority to ensure regional representation.

7.2 Conclusions

The following conclusions apply to the study of Mgozi dam site and are additional to those presented in the Main report:

1. The proposal to develop multi-purpose dams seeks to ensure efficient and optimal use of water resources in light of changing environmental and social parameters;
2. The proposed dam site presents no major negative impacts.
3. It is evident that, the proposed Mgozi multi-purpose dam will have many positive economic impacts to the immediate communities, partner states and their sectors;
4. Developing the dam site will will initiate economic growth within the Ngara district and the Wider Kagera Region of Tanzania;

7.3 Recommendations

The following recommendations are extracted from the main report and apply to Mgozi dam site

1. The proposed project will serve multipurpose purposes of water supply, electricity generation and irrigation, and each of these has set of activities with their own impacts which will be in the same ecosystem. It is therefore noted that, there will be need to put in place multi-stakeholder committees to over-see implementation and general compliance of project works with environmental and social requirements as enshrined in the line polices and laws in partner states;
2. Staff gauges should be placed at the river to start monitoring the discharge as soon as possible. Since Mgozi is ungauged, early placement of the discharge station will prove very valuable in a few months' time when further downstream, studies commence.

3. Recognizing the importance of an accurate assessment of current sediment loads to the planning of reservoirs, it would be prudent to carry out observations of sediment concentration in the rivers at the proposed dam site during at least one flood season.
4. The implementation of the project should take cognizance of lessons learned from other trans-boundary water resources management frameworks. These should include the need to have focused missions; the need for autonomy and impartiality; the need to have high level of political support; the need to focus on common crosscutting issues of immediate challenges; the need to avoid areas of conflict with governments; the need to have full stakeholder participation at all stages of project implementation; the need to build reliable funding mechanisms; the need to build on existing institutions and the need to build transparent systems of sharing information, costs and benefits

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Annex 1: Summary of the consultative meetings held for the Mgozi site

Persons Consulted

Name	Designation	Organization
Richard Sentoce	Ward Executive Officer	Rulenge Division
Anselm Rugumisa	Irrigation Technician/Agronomist	Rulenge Division
Peter Kapalata	Village Executive Officer	Rulenge Division
Hamadi Baliyanga	Ward Councillor	Rulenge Division