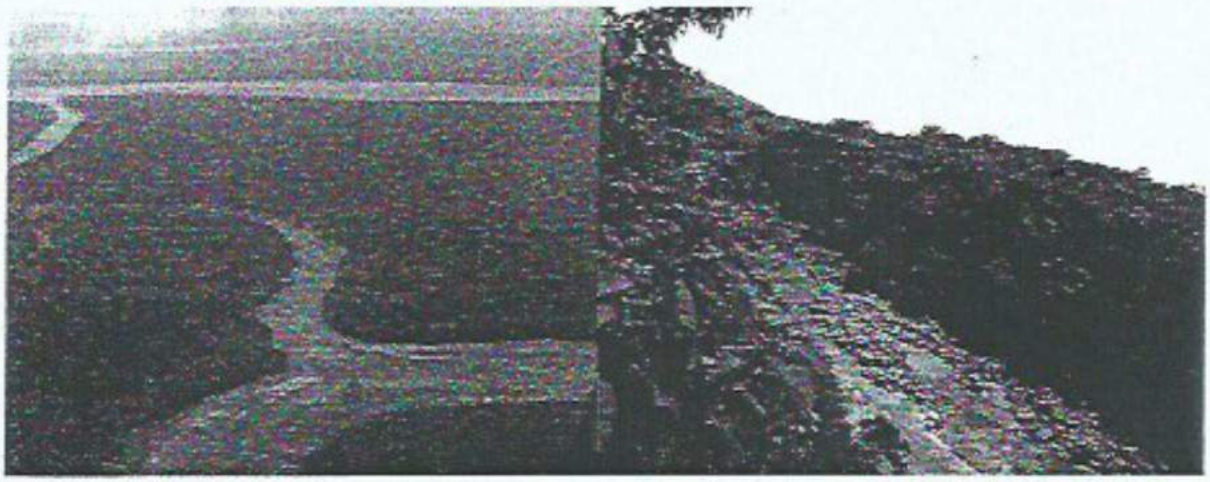
Environmental Impact Assessment for the Stiegler's Gorge Hydropower Project, Tanzania



DRAFT REPORT

Developer	**Tanzania Electricity Supply Company Limited (TANESCO)** **Umeme Park, Ubungo, P.O. Box 9024** **Dar es Salaam** **Phone: +255 22 2451130/9** **Fax: +255 22 2451206** **Email: info@tanesco.co.tz**
Consultant	**University Consultancy Bureau (UCB),** **University of Dar es Salaam** **P.O.BOX 35097 DAR ES SALAAM** **Tel+225 784471686** **Fax+ 225 222419393** **E-mail: .....**
Submitted to:	**National Environmental Management Council (NEMC)** **P.O. Box 63154, Dar es Salaam** **Tel: +255 22 277 4889** **Email: nemc@nemctan.org**

Submission Date: 4th MAY 2018

ACRONYMS AND ABBREVIATIONS

AIDS	Acquired Immunity Deficiency Syndrome
AWF	African Wildlife Foundation
BAU	Business As Usual
BRN	Big Results Now
CDM	Clean Development Mechanism
CSG	CLIENT Stakeholder Group
DANIDA	Danish Agency
DOE	Division of Environment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMA	Environmental Management Act
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EWURA	Energy and Water Utilities Regulatory Authority
FAO	Food and Agriculture Organization
FDC	Flow Duration Curve
GHG	Green House Gases
GMP	General Management Plan
HIV	Human Immunity
IUCN	International Union for Conservation of Natural Resources
KSG	Key Stakeholder Group
KII	Key Informant Interviews
LGA	Local Government Authority
MDGs	Millenium Development Goals
MLFD	Ministry of Livestock and Fisheries Development
MoWI	Ministry of Water and Irrigation
MNRT	Ministry of Natural Resources and Tourism
MW	Megawat
NEMC	National Environment Management Council
NEP	National Environmental Plan
NESC	National Environmental Standards Compendium

NGO	Non-Governmental Organization
NSGRP	National Strategy for Growth and Reduction of Poverty
NLUPC	National Land Use Planning Committee
OUV	Outstanding Universal Value
PAYE	Pay as you Earn
PSMP	Power Systems Master Plan
RBWO	River Basin Water
RISDP	Regional Indicative Strategic Development Plan
RSAP-IWRM	Regional Strategic Action Plan for Integrated Water Resources Development and Management
RUBADA	Rufiji Basin Development Authority
SADC	Southern Africa Development Cooperation
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SGHPP	Stiegler's Gorge Hydropower Project
SGR	Selous Game Reserve
SIA	Social Impact Assessment
SIDP	Sustainable Industrial Development Policy
SMEDP	Small and Medium Enterprises Development Policy
SME	Small and Mediaum Enterprises
STDS	Sexual Transmitted Diseases
TFS	Tanzania Forest Services
TANESC	Tanzania Electricity Supply Company
TANROADS	Tanzania RoadsD
TAWA	Tanzania Wildlife Authority
TAWIRI	Tanzania Wildlife Research Institute
TAZARA	Tanzania-Zambia Railway Authority
TEEB	Tanzania Economics of Ecosystems and Biodiversity
TIC	Tanzania Investment Centre
TMA	Tanzania Meteorological Agency
TZS	Tanzania Shilling
UNESCO	United Nations Education, Scientific and Cultural Organization
UNEP	United Nations Environment Programme
URT	United Republic of Tanzania
VAT	Value Added Tax

VPO	Vice President's Office
WCA	Wildlife Conservation Act
WHC	World Heritage Centre
WWF	World Wildlife Foundation

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

1.0 Project background and rationale

Tanzania's economic growth and changes in economic policies has raised great demand for electrical power in the country. Whereas the current power supply in Tanzania is only about 1,400MW, the demand by 2025 is expected to be 5,000MW. To meet the growing demand for electricity, the Government has embarked on reforming the Electricity Supply Industry (ESI) mainly by attracting private capital in the industry. Lack of reliable electricity is currently a major production cost component as any slight increase of tariff has been a subject to soaring of prices of goods and services. This electricity unreliability needs to be addressed promptly, particularly following the increase of population and continual deterioration of other generation plants and transmission lines.

The current National Energy Policy (2015) objective is to ensure availability of reliable and affordable energy supply and use in a rational and sustainable manner in order to support national development goals. The national energy policy therefore, aims to establish an efficient energy production, procurement, transportation, distribution and end-use systems in an environmentally sound and sustainable manner. Currently, Tanzania's energy balance is dominated by biomass-based fuels particularly fuel-wood (charcoal and firewood), which are the main source of energy to both urban and rural areas.

While the short-term plan requires an immediate decision and actions, the mid – long term plan requires coordinated planning and project development studies to ensure that future electricity supply utilizes the least cost projects consistent with sound planning criteria in order to address national interests including the industrialization policy to achieve middle income economy in the country. As an intervention to the power shortage in the grid system, the Government of Tanzania has decided to embark on the development of this project immediately.

The Rufiji (Stiegler's Gorge) Hydropower project is the only large scale project that can provide over 2000MW within a relatively short time scale (< 5 years). The Stiegler's Gorge is among the favourable dam sites along the Rufiji river in the Rufiji Basin, which provides high head and large storage volume with a very low investment per unit storage. The project can aid Tanzania's electrification through its provision of abundant power that is crucially cheap and

therefore more affordable to the low - income, unconnected majority of citizens. The volume of megawatts and low cost of the power make Stiegler's Gorge
capable of supporting industrialization.

2.0 Brief description of the project

Stiegler's Gorge Hydropower project is located about 314 km from Dar es Salaam and 152 km south of Morogoro town in Morogoro district, between Longitudes of $33.1/2^0$ and $39.1/2^0$, east and Latitudes $5.1/2^0$ and $10.1/2^0$ south (Figure 2.1). The site for the proposed project in located along the Rufiji River receiving inputs from three major rivers Kilombero River, Luwegu River and Great Ruaha River all of which drain the Southern highlands and empting its water into the Indian ocean via the Rufiji Delta. The area can be easily accessed by road from Dar es Salaam via Morogoro and Kisaki or from Dar es Salaam to Matambwe via TAZARA railway and take rough road about 48 Kilometer to the Stiegler's gorge. Also the site can be accessed from Dar es Salaam via the –Lindi/Mtwara road and branching at Ikwiriri to Mloka through Mtemele gate to the Stiegler's Gorge (about 170 km).

The proposed project will be right in Selous Game Reserve, a famous photographic tourism area and a World Heritage Site f. The Game Reserve is a world heritage site following its inscription in 1982 by UNESCO. Its universal outstanding values are centered on two major criteria i.e. being one of the largest remaining wilderness areas in Africa, and having a higher density and diversity of species than any other Miombo woodland area in the world. The *core project* area includes the Stiegler's gorge site where aa 131m high concrete dam wall will be constructed, as well as nine semi-underground power generation units and associated power station, the spillway, saddle dams and auxiliary infrastructure, which would bear the most impacts than the rest. West of the Stiegler's Gorge, will be the reservoir of maximum surface area 1,250 km^2 (approximately12.5 km wide and 100 km long) between the dam site and Luwegu and Kilombero rivers confluence (equivalent to about 3% of the gross area of the Selous Game Reserve). Here there will be vegetation removal to avoid reservoir anoxic condition in the reservoir. There will also be two staff quarters - one north-west about 3 km from the gorge and another one about 7 km from the gorge. Associated with these locations is the roads infrastructure connecting these various components of the project.

3.0 Project Stakeholders and their involvement in the ESIA process

Section 89 of the EMA No. 20 of 2004 emphasizes the importance of stakeholder participation by providing guidance on public participation. Regulation 17 of the EIA and Audit Regulations (URT, 2005) provides further directives and procedures for public participation in the EIA process.

Stakeholder participation involves processes whereby all those with interest in the outcome of a project participate in decisions on planning and management of the proposed development. Stakeholders share information and knowledge, and may contribute to the project activities. Apart from the fact that they help the consultant to harness traditional knowledge, which conventional approaches may overlook, they help the EIA address relevant issues including those perceived as being important by local communities. Also, stakeholders help to influence project design, so that it responds to their needs. In this ESIA process stakeholder was given a very broad definition to include all different government agencies, beneficiaries, private sector, individuals, politicians and all other formal or informal groups associated with the project.

The range of potential stakeholders to ESIA greatly depends on the definition of boundaries for that project but it is important to be 'inclusive' rather than 'exclusive'. Stakeholders in the EIA process can be categorized in various ways including; primary, secondary or key. Primary stakeholders for example, are those who gain materially from the project or who make direct contribution of resources or services to the project. Key stakeholders on the other hand are those who have significant power or influence to determine the direction and outcome of the project.

A number of stakeholders were identified through the use of techniques such as simple network diagrams, literature review and interviews. Thus, having identified the relevant stakeholders, the ESIA team had to establish clear lines of communication and interaction with the stakeholders. The techniques used varied from one stakeholder group to another. However, simple methods such as individual discussions, focused group discussion and interviews were used.

The consulting team started with various stakeholders as well as securing and reading through several documents related to hydropower generation and environmental characteristics of the project area. The consultation started with kick off meeting with the

client representatives (TANESCO) held at the TANESCO Officein Dar es Salaam. This was followed by field visits in Coast and Morogoro regions where various consultations were undertaken with different stakeholders from 19th – 22nd December, 2017 and 03rd to 5th January, 2018. The consultation process was preceded by sending prior information through letters to the Regional Administrative Secretaries of Morogoro and Coast regions. The Regional administrative Secretaries allowed the consultants to proceed with consultation in Kilombero, Ulanga and Rufiji districts. The second phase of consultation during the scoping focused on tourist hotels and SGR management at Matambwe within Selous Game Reserve.

In general, the consultation was undertaken with regional, districts, tourist's hotel managers and government agencies such as TAWA, TFS, and RAMSAR based in Ifakara as well Wami/Ruvu Water Basin – Sub office also based in Ifakara. Further consultation at ministerial level and ward and villages surrounding the proposed development will be undertaken during Full ESIA study.

4.0 Issues and Concerns Raised During Public and Stakeholder consultation

- ***Population increase***

Stakeholders in the study area believed that there would be an increase in population due to in-migration or resettlement in some villages such as Kisaki and Mloka in the Lower Rufiji. Most the stakeholders seemed to feel this would be positive since it would bring increased economic opportunities with it such as a larger market for farm produce. However, stakeholders were concerned about the possible increase in crime in the local area.

- ***Opportunities for improved roads and electricity infrastructure.***

Stakeholders felt that the proposed development would bring improvements to roads and transportation network of goods and people. Another main benefit mentioned by stakeholder was the connection of villages and hotels to the national electricity grid.

- ***Impact on fisheries in the Lower Rufiji Floodplain***

Stakeholders in Rufiji district were concerned that the change in the river flow regime and possible silting of the river downstream could result in a decline in fish resources and fisheries.

- ***Human health and safety issues***

Although there are no settlements close to the proposed project development site, stakeholders were concerned that during the construction stage dust, noise and vibration will be generated, with impact on health and safety of workers. In addition, the in-migration of labour from different parts of the country, there is potential to increased diseases such as HIV/AIDS, STDs and potential conflicts of migrant workers and the local communities in nearby villages such as Kisaki and Mloka.

- ***Potential employment opportunities***

Stakeholders expressed their concerned about lack of employment among the youth in villages. Since the proposed project will require a number of skilled, semi-skilled and unskilled workers, the stakeholders requested that the majority of labour force, especially for works which do not require specific skills should come from communities surrounding the Project Area such as Kisaki, Mloka and other villages downstream of Rufiji River.

- ***Impact on tourism industry***

Tourism is an important undertaking in Selous Game Reserve. According to the tourist facility operators and SGR officials at Matambwe, some of the natural attractions in the SGR include hot springs; large concentration of elephants, bird watching around Lake Tagalala; and large pods of hippos and crocodiles. Stakeholders were concerned that the implementation of the project is likely to reduce the amount water in the Lower Rufiji River which could ultimately control the floods which are largely the source of water for several Lakes in the downstream of the river.

- ***Economic benefits***

The project is likely to generate substantial electricity which is badly needed for industrial development being currently emphasized all over the country. People are confident that the electricity so generated will stabilize the supply country-wide as opposed to frequent power cuts being widely experienced in the country. The country also needs adequate and reliable power for irrigation agricultural development.

- ***Salt water intrusion and associated impacts***

It is feared by communities in the Lower Rufiji valley that implementation of hydropower project could lead to decreased fresh water supply to the delta and lead to increased salt water intrusion further inland into the floodplain agricultural/settlement areas.

- ***Decline in the Rufiji River discharge***

Stakeholders observed that due to increased uncontrolled land use changes in the river catchment including in Kilombero Valley, water discharge by the river may have declined

compared to the 1980s due to destruction of water sources negating the possibility of generating the desired electric power.

- ***Reduced dependence on irrigated paddy cultivation***

In the recent years there has been decreased dependence on flood irrigated paddy cultivation in the Lower Rufiji Valley due to shift in practice towards rainfed cultivation by smallholder farmers. However, floods are still necessary for maize cultivation.

- ***Health implications***

HIV/AIDS prevalence in Rufiji and Kibiti Districts has now reached 5.4, which is above the national average. It is feared that, with the project and associated increase in population, the problem may get worse than it is now.

5.0 Description of Major/Significant Impacts

5.1Positive impacts

Several positive and negative impacts associated with the proposed development were predicted. The significant positive impacts include the following:

- Significant direct benefits to Government would accrue from a large number of employees who will be paying their taxes to the government as "Pay-as-You Earn (PAYE) during project implementation, while secondary benefits would be realized during the **operation phase** under power generation and management.
- The Project would attract significant numbers of people seeking for direct employment in the project and other indirectly related activities and service provisions like transportation, accommodation and food supplies, particularly during the mobilization and construction phases when a large workforce will be required
- The influx of people into Morogoro Rural and Rufiji Districts attracted by potential employment opportunities would stimulate significant innovations in agro-processing and value addition around the project area (Kisaki and Lower Rufiji Floodplain).
- Following the current basic dam and turbine designs capable of discharging a total maximum of 3,455m^3/s into the lower Rufiji river, and given the high demand for water for modern and traditional irrigation, maintenance of floodplain lakes fisheries and Rufiji delta ecology, reservoir operation for controlling floods in excess of 2,500m^3/s should be possible.

- With the current basic dam and turbine designs suggesting maximum discharges of 3,455m3/s into the Lower Rufiji river, it is expected that the Lower Rufiji SAGCOT Cluster development and traditional floodplain irrigation farming could benefit significantly from such discharges and thus contribute to the socio-economic transformation of the plain and Tanzania in general.
- Within the approximately 1000km^2 planned reservoir, and should some flood zone vegetation develop in the relatively large areas which fall dry during low-water level, the drawdown may be significantly beneficial to fish resources development and create an additional environment for recreation, including boat rides and sport fishing (especially tiger fishing) safaris.
- With the proposed basic dam and turbine designs, with up to 3,455m^3/s of water being discharged into the Lower Rufiji river during operation phase, the amount of released water would far exceed the 2000m^3/s amount, enough to keep the floodplain lakes connected to the Rufiji river for most of the months of the year and thus sustain floodplain fish production and fisheries to a significant level.
- Since the current design modifications suggest that the total maximum discharge into the Lower Rufiji river is likely to significantly alter the geochemistry of the delta in favour of maintaining the optimum balance of salinity regime to ensure ecological integrity of the delta and the pattern of its ecosystem services.

5.2. Negative impacts

Also, the significant negative impacts associated with the proposed development include the following:

- There are many competing water use options associated with the hydropower project including: forestation of mountain grasslands with pines and eucalyptus species leading to increased surface runoff and less groundwater recharge in the hupland areas, development of dams for irrigation and power generation, and water-intensive farming practices in the river floodplains, which make sustainable water use of the Rufiji river a challenge.
- Liquid wastes would be generated mainly during project mobilization and construction and to some degree during project decommissioning including: sewage (from offices, accommodation, kitchen and sanitary facilities), mechanical maintenance (which include oils, fuels, grease), storm water runoff and water

treatment sludge. All these would need appropriate disposal, which will be relatively complex in a game reserve.

- Substantial solid wastes would be generated from: vegetation biomass due to clearance for construction of the dam and related infrastructure, workers camp and the reservoir area; top soil overburden and excavated material; garbage, rubbish and other health facilities including medicines sharp objects (e.g. needles). If not appropriately disposed these wastes may become an eye sore and environmental and health hazards, water and environmental contamination/pollution and outbreak of diseases, including those shared between animals and people.
- Significant amount of deforestation is anticipated due to vegetation clearing for implementation of various project activities. The magnitude of loss and extent of de-vegetation is expected to be highly significant and long term as most of those cleared areas would remain devoid of vegetation (especially trees) permanently. Deforestation will also significantly contribute to loss of plant biodiversity as many plant species will be lost. A quick field survey revealed that about 53 plant species will be affected by clearing.
- Soil erosion is expected during: project mobilization, construction, and decommissioning phases; site clearance, removal of soil overburden, actual road construction and management of workers camp; and during periodic road maintenance when the access road becomes operational, and during demolition of infrastructure in the event the road or power plant is decommissioned. Soil erosion and land sliding is particularly predicted when construction is done on the slopes of the gorge because in some cases the latter is of steep gradient, and deep and unconsolidated soils, especially if construction is done during the rainy season when precipitation can rise above 1000 mm/annum.
- Particularly during the **construction phase**, substantial amount of noise is likely to be generated due to operation and movement of heavy construction and excavation machines and equipment including: concrete mixing, stone quarrying trucks and vehicles, as well as noise from construction staff including casual labourers. Noise from the various sources will particularly disturb and drive resident wildlife from the project impact zone, the extent of displacement varying from species to species.
- Water quality particularly in the reservoir would be influenced by the residence time, the chemical-biological processes, and the mixing behaviour in the reservoir, with

major implications on the oxygen budget especially during the filling period, when the water quality would be strongly influenced by the rate of filling, which in turn would determine the rate at which degradable material would be brought into the water.

- Since large numbers of people are likely to be attracted to the project areas, the proposed project could increase the risk of spreading the pandemic in the surrounding districts thereby increasing the burden on health care. The disease's risks will be equally high throughout the project phases due to unavoidable interaction between the local people in Morogoro Rural and Rufiji Districts and incoming people from different parts of the country.
- The potential for the increase in the level of crime and insecurity is likely to be significant during the **construction phase** because more people from different parts of the country and outside will be recruited by the project. As more people migrate into the area social vices such as crime, theft of construction materials and other properties, alcoholism and sexual laxity/ prostitution are likely to occur as they are associated with migrant workers living alone, away from their families.
- Impact on the local culture is likely to be significant following the increase in number of people (project workers and their families, job seekers and other people visiting the project from different parts of the world), bringing different cultures to the local community to which some of them might be contravening local culture and norms.
- Establishment of a modern 2,100MW hydropower plant and its associated infrastructure including a 130m high dam, saddle dams, dam water outlets, power station, staff accommodation and worker's camp at Stiegler's Gorge would be relatively imposing and obtrusive to the environment. Other establishments are the creation of the approx. 1,000km^2 reservoir in a currently terrestrial woodland and the operation of the power plant (for more than 50 years) in a relatively remote and pristine miombo woodland of the SGR. All these will dramatically change the landscape of the area following massive deforestation, drilling, excavation, construction and relatively major human settlement in the reserve. Similarly a number of scenic sites like the Rufiji-Ruaha River confluence at Shughuri Falls and other rock outcrops (Plates 5.1 and 5.2) are likely to be submerged in the reservoir water. The associated loss of established tourist facilities will be permanent and largely residual. In addition, the projects would attract job seekers and various service providers as well

as visitors and tourists. In the absence of land use planning around the project outside the SGR, the areas could easily turn into a squatter development with significant and costly long-term implications on human and environmental health. During project decommissioning, demolition of structures would generate substantial rubble and spoil material which could become an eye sore and impair the local aesthetics.

5.3 Impacts on Outstanding Universal Values

- Trends in wildlife populations in the SGR suggests that implementation of the project would impact variously among the remaining species and populations. Widespread or catholic animal species in both the reservoir and the Lake Tagalala area would not be in any way at risk, because they would be easily absorbed elsewhere in the SGR if they were displaced. However, species of commercial value (e.g. Elephant) would be highly at risk, from socio-ecological changes due to human intrusion in the area. But there is likely to be no impact on Rhinoceros and Cheetah as these have almost become extinct in the SGR, while elephant population appears to be stabilizing. Species selecting riparian habitats such as Water buck, would be affected by inundation of the reservoir area. "Specialist" species such as Giraffe, Wildebeest, and Zebra, would remain stable because no significant changes are expected in the hydrology and ecology of the Lake Tagalala area. Animal species that inhabit very small and limited patches (e.g. Crocodile and Hippopotamus) would most likely increase in the reservoir area and Lake Tagalala area due to increased water availability. In the downstream floodplain area, Hippopotamus would also increase, but Crocodiles would probably not.
- The diversity of vegetation in the project impact area would not significantly change as a result of the since the miombo are so extensive inside the reserve in particular and in Tanzania in general, and the removal of about 1000km^2 of such forest would not constitute a significant loss. In relation potential for habitat and species diversity change in the Miombo woodlands, the power project will result in relatively more positive change than has been the case currently due to the creation of a large water body in a formally terrestrial area in the SGR thus providing new aquatic habitat that is likely to attract aquatic species of wildlife and fish variety and tourism activities including sport fishing and boating safaris.

- With regard to the fascinating sand rivers in the Lower Rufiji, the development of the hydropower project at Stiegler's Gorge site would have significant impact on the sand rivers downstream the gorge where relatively high river flow are likely to be continuous throughout the year given the relatively higher river discharge at the dam and wash down any developing sand banks in the river.

5.4 Cumulative Impacts

- The most critical cumulative impacts of the project relate to the existing upstream hydropower dams, irrigation schemes, mining, oil and gas exploitation schemes on the Rufiji river flow and water quality.
- Another critical set of impacts relates to the proximity and ecological implications of the project on the relationships between the Selous Game Reserve (and associated impacts of the Rufiji Hydropower development) and the Kilombero Valley Floodplain Ramsar site upstream Stiegler's Gorge on the one hand, and the Rufiji-Mafia-Kilwa Marine Ramsar site downstream the Gorge, on the other.

5.5 Residual Impacts

Residual impacts are those that cannot be mitigated. In this particular project they would include:

- Landscape change of the Rufiji Project Impact Are including: establishment of an imposing 131m high dam on a ridge at Stiegler's Gorge; creation of a relatively large water body (reservoir) in the middle of the SGR; change in the Rufiji river natural discharge regime downstream the Dam; and the consequent change in the ecology and biology of the Rufiji delta.
- Changes related to the whole SGR due to the implementation of some other planned developments such as the uranium mining operations, Kidunda dam construction and the SAGCOT irrigation programme.

5.6 Consideration of Alternatives

- *The "No Project" Alternative*

The *"no project"* project alternative literally means that the SGHPP should not be implemented. Taking this option would mean that the identified potential negative impacts

associated with the project would not happen or occur, which is good. But, does not mean that the baseline conditions in the project impact area will be halted because it has been shown that there are other factors that significantly contribute to changes in the biological/ecological and physical environment probably even more than would be caused by the SGHPP.

- *Development of other power generation options*

The rapidly increasing human population, desire for industrialization and other development related activities in the country could force development of other power generation options including gas, geothermal and coal that tend to generate more GHG emissions and therefore resulting into serious environmental and social impacts, probably more than the SGHPP. It must be pointed out that natural gas although relatively abundant in Southern Tanzania, it has various other uses primarily as energy source and feedstock for producing other commodities. It is used for cooking and heating in households, in vehicles and many other applications.

- **Planned investment in tourism and tourist infrastructure alternative**

The support programmes offered by the World Bank and the German Government are also coming in following the desire of the country (Tanzania) to ensure that future tourism is sustainable and contributes to the national economy and livelihood of its people. However, this support largely targets Southern Tourism Circuit. Moreover, the success of this programme will very much depend on the provision of even more resources and adequate and reliable supply of power, and hence the importance and urgency of the SGHPP.

6.0 Mitigation Measures and Mitigation Plan

The Environmental and Social Management Plan (ESMP) outlines mitigation and enhancement measures addressing all predicted significant negative and positive impacts as per the ESIA report. The ESMP requires the developer to implement mitigation and enhancement measures for predicted impacts and demonstrate compliance to environmental standards relevant to Tanzania and/or as adopted from international organizations. The cost of mitigation/enhancement to the developer is about **Tsh 3.305Billion,** which is relatively modest and manageable. A larger proportion of the mitigation/enhancement costs are due to the government but in this ESIA some of these costs have not been determined or included in

the report. The developer will have to set aside budget to cover the cost of mitigating all impacts as addressed in the ESIA document.

7.0 Environmental and Social Monitoring Plan

A Monitoring Plan presented as part of this ESIA details the parameters and frequencies for measurement or monitoring as well as institutional arrangement for monitoring. Monitoring would entail examination of whether impacts have actually occurred as predicted, the effectiveness of mitigation measures and compliance to national and international standards. Reports from the monitoring process would provide information that might be used for intervention purposes. Various parameters including social, economic and biological/environmental ones would be considered in the monitoring process. The main responsibility for monitoring is with the developer and it would cost about TZS 585,000,000. Other players in monitoring include the government i.e. MNRT, NEMC, LGAs and other ministries as identified in the Plan. The cost for the participation of government institutions in monitoring is not included in this ESIA.

8.0 Summary and Conclusion

The need to implement the Stiegler's Gorge Hydropower Project in SGR is paramount because of one major/critical reason i.e. the current trend of Tanzania's economic growth and changes in economic policies that has raised great demand for electrical power in the country. Lack of reliable electricity is currently a major production cost component as any slight increase of tariff has been a subject to soaring of prices of goods and services. This electricity unreliability needs to be addressed promptly, particularly following the increase of population and continual deterioration of other generation plants and transmission lines.

The most significant observation in this ESIA is that the proposed development touches on the two criteria for qualifying the Selous Game Reserve as having Outstanding Universal Values (OUV). Some of the direct impacts addressed in chapter six potentially degrade to some extent both criteria IX and X that qualifies SGR as OUV. However, the analysis of the impacts and the mitigation measures developed are adequate enough to address the impacts both direct and cumulative that poses potential damage to the OUV of the Selous Game Reserve.

CHAPTER ONE: GENERAL INTRODUCTION

1.1 Project background

Tanzania's economic growth and changes in economic policies has raised great demand for electrical power in the country. The current power supply in Tanzania is about 1,400MW and the demand by 2025 is expected to be 5,000MW. At the expected current trend in average annual GDP growth of between 6 and 8 percent for the coming 10 years, the expected national demand of 5000MW by 2025 cannot be achieved. Such imbalance needs to be resolved as soon as possible. During the period when the shortage is gradually being relieved, power demand will grow at higher rate than normal because of the ongoing parallel industrialization efforts. In the Power System Master Plan (PSMP) of 2016, it is assumed that the power shortage will be relieved toward the year 2020.

Tanzania's power sources include hydro, natural gas, coal, uranium, wind, geothermal, biomass, solar, tidal and waves. Currently (2018), the country's total grid installed capacity of around 1,358 MW is mainly composed of hydro 567 MW (42%), natural gas 607 MW (45%) and liquid fuel 173 MW (13%). To meet the growing demand for electricity, the Government is planning to increase Tanzania's generation capacity to 10,000 MW in 2025. To achieve this goal, the Government of Tanzania has embarked on reforming the Electricity Supply Industry (ESI) mainly by attracting private capital in the industry. Lack of reliable electricity is currently a major production cost component as any slight increase of tariff has been a subject to soaring of prices of goods and services. This electricity unreliability needs to be addressed promptly. With the increase of population and continual deterioration of other generation plants and transmission lines, the outages are there to increase unless the generation is increased.

The current National Energy Policy (2015) objective is to ensure availability of reliable and affordable energy supply and use in a rational and sustainable manner in order to support national development goals. The national energy policy therefore, aims to establish an efficient energy production, procurement, transportation, distribution and end-use systems in an environmentally sound and sustainable manner. Currently, Tanzania's energy balance is dominated by biomass-based fuels particularly fuel-wood (charcoal and firewood), which are the main source of energy to both urban and rural areas.

The Power System Master Plan 2016 Updates, issued by the Ministry of Energy and Minerals in December 2016, to re-assess short-term (2016 – 2020), mid-term (2021 – 2025) and long term (2026 – 2040), generation and transmission plan requirements and the need for connecting presently off-grid regions; options for power exchanges with neighbouring countries; and increased supply of reliable power. While the short-term plan requires an immediate decision and actions, the mid – long term plan requires coordinated planning and project development studies to ensure that future electricity supply utilizes the least cost projects consistent with sound planning criteria in order to address national interests including the industrialization policy to achieve middle income economy in the country. The immediate requirement is to achieve about 5000MW by 2020. As an intervention to the power shortage in the grid system, the Government of Tanzania has decided to embark on the development of this project immediately.

1.2 Project rationale and need for this ESIA

The Rufiji (Stiegler's Gorge) Hydropower project is the only large scale project that can provide over 2000MW within a relatively short time scale (< 5 years) (Figure 1). The Stiegler's Gorge is among the favourable dam sites along the Rufiji river in the Rufiji Basin, which provides high head and large storage volume with a very low investment per unit storage. It will be among the least cost power generation sources in the country and undoubtedly in the East Africa region. The Stigler's Gorge can aid Tanzania's electrification through its provision of abundant power that is crucially cheap (predicted level led cost to be 4.5 cents/kWh and therefore more affordable to the low - income, unconnected majority of citizens. Moreover, the volume of megawatts and low cost of the power make Stiegler's Gorge capable of supporting industrialization.

The first ecological impact assessment of the project was conducted in 1980 i.e. over 30 years ago, and may no longer be reliable for current area characterization, prediction and/or monitoring future changes during this material time. For example, the opening of the Mkapa Bridge about 15 years ago has had a lot of socio-economic impacts in terms of natural resource utilization in the southern regions, thus affecting the environmental integrity of the regions. Also, climate change, and economic development within the Rufiji Basin both upstream and downstream of the Stiegler's Gorge may have changed river and sediment

dynamics and affected potential opportunities associated with the project. Such new/additional baseline data is thus essential.

Above all, and according to Section 81 of the Environmental Management Act Cap 191 of 2004, and item 6 of the First Schedule of the Regulations for EIA and EIA Audit (2005), calls for a mandatory EIA. Particularly item 7(V) of the First Schedule of the Regulations for the Regulations for EIA and Audit concerning energy, demands mandatory EIA on such a large scale power generation project. Similarly, the SGR is a designated World Heritage Site. Through the World Heritage Convention, to which Tanzania is a Party, UNESCO is encouraging State Parties to identify, protect and preserve cultural and natural heritage around the world that are considered to be of ***outstanding value to humanity***. SGR was listed as a World Heritage Site in 1982. By accepting to be part of this Convection, Tanzania reaffirms its commitment to protect and preserve those outstanding values to humanity that has caused the listing of the site with the World Heritage Committee. As such and for being under the World Heritage Sites, the proposed development must also adhere to the World Heritage Advice Note on Environmental Assessment (IUCN, 2013). The note provides details of the requirements to State Parties when undertaking Environmental Impact Assessment for projects earmarked in the World Heritage Sites. According to the IUCN (2013),

> *" An Environmental Assessment for a proposal affecting, or with the potential to affect, a natural World Heritage Site is intended to ensure that the proposal's likely impacts on the Outstanding Universal Values of the site are fully considered in land use planning decisions with the objective of preserving these exceptional places for future generations. The assessment should also consider the site's links with the surrounding landscapes as a natural World Heritage cannot be considered separately from the wider ecosystem"* (IUCN, 2013: 13).

Therefore, the fundamental challenge is how to preserve these resources that are considered to have Outstanding Universal Value (OUVs) whilst also promoting human development. The WHC is promoting use of EIA as a tool to ensure that such resources are not degraded. This ESIA report is thus also a response to both national environmental laws and the requirements of the World Heritage Convention.

1.3 ESIA Boundaries

Bounding the ESIA entailed designation of boundaries within which the ESIA focused and bound the impacts to where they are likely to be felt on the bio-physical environment and the local economy. Three types of boundaries were considered i.e. institutional, temporal and spatial boundaries as elaborated in the following paragraphs.

1.3.1 Institutional boundaries

These refer to institutions and sectors in which the project lies or interacts. They were determined in terms of political, legal, regulatory and/or institutional mandates and administrative structures. The proposed development is about dam construction and hydropower generation at Stiegler's Gorge, reservoir creation behind the dam and flood control in Morogoro Rural District, Morogoro Region; and agricultural development in the Lower Rufiji Floodplain in the Rufiji District, Coast Region. This development touches the interests of national institutions (i.e. TAWA, TFS, TAZARA,RAMSAR,TANROAD & TANESCO); administrative units (Morogoro and Coast Regional Secretariats, Morogoro Rural District Council and Rufiji and Kibiti District Councils, several Village Governments in the Lower Rufiji and delta; and sector ministries (i.e. Ministry of Agriculture, Food Security and Cooperatives; Ministry of Industries, Trade and Marketing; Ministry of Water and Irrigation; Ministry of Labor, Employment and Youth Development; Ministry of Energy; Ministry of Natural resources and Tourism; Ministry of Livestock and Fisheries; and Ministry of Lands, Housing and Human Settlement Development).

1.3.2 Temporal boundaries

These refer to the lifespan and reversibility of impacts associated with the proposed project development and operation. For example, the impacts may be either short-lived or long term, reversible or irreversible, with implications stretching far into the future. Consideration is also given to what happens when the project ends i.e. decommissioning.

1.3.3 Spatial boundaries

The hydro-electricity power generation at Stiegler's Gorge will have wide-ranging implications that could be felt locally, regionally, nationally and internationally. For example, the water used to ensure sustainable generation of electricity at Stiegler's Gorge will largely

depend on catchment management in the Southern Highlands including Mbeya, Njombe, Ruvuma and Iringa regions. The power generated will be fed in the national grid to serve for industrial development throughout Tanzania. The power generated could also be sold to neighbouring countries with need for electricity. However, in determining the spatial dimension of the ESIA, it is important to consider impacts in a form similar to a contour layout, starting with the *core impact area*. This is the area where the actual plant will be located and where the electricity will be generated, and where auxiliary infrastructure are actually located and, which would bear the most impacts than the rest. In this case, the core impact area will include the Stiegler's Gorge area, the created reservoir behind the dam, and the Lower Rufiji Floodplain and delta.

This core impact area is surrounded by an *immediate impact area*, an area that is outside the core area but plays an important role or bears relatively some of the impacts (positive or negative) felt in the core area. The immediate impact area in the case of the proposed hydropower project would include the villages of Kisaki and Mloka where most of the labour force, food and goods are likely to come from. Other such villages and towns include those in the Lower Rufiji Floodplain and delta, Utete and Kibiti towns, Morogoro and Dar es Salaam. The latter areas will be linked with the proposed development project through power transmission, road and railway transport, supply of goods and services as well as labour force.

The more outer spatial dimension for this proposed project is *the area of influence* that consists of centers of decision-making that can influence the development of the project. These centers of decision – making include Dar es Salaam, the commercial city in Tanzania and Dodoma, the capital City of Tanzania, headquarters for the relevant stakeholder ministries and other sector institutions.

CHAPTER TWO: PROJECT DESCRIPTION

2.1 The Project Location

Stiegler's Gorge Hydropower project is located about 314 km from Dar es Salaam and 152 km south of Morogoro town in Morogoro district, between Longitudes of $33.1/2^0$ and $39.1/2^{0r}$ east and Latitudes $5.1/2^0$ and $10.1/2^0$ south (Figure 2.1). The site for the proposed project in located along the Rufiji River receiving inputs from three major rivers Kilombero River, Luwegu River and Great Ruaha River all of which drain the Southern highlands and empting its water into the Indian ocean via the Rufiji Delta (Figure 1.2). The area can be easily accessed by road from Dar es Salaam via Morogoro and Kisaki or from Dar es Salaam to Matambwe via TAZARA railway and take rough road about 48 Kilometer to the Stiegler's gorge. Also the site can be accessed from Dar es Salaam via the Lindi/Mtwara road and branching at Ikwiriri to Mloka through Mtemele gate to the Stiegler's Gorge (about 170 km).

The proposed project will be right in Selous Game Reserve particularly the Northern Sector which is famous for photographic tourism. The Game Reserve is a world heritage site inscribed to UNESCO due to high biodiversity of both plant and wildlife and had significant populations of elephants and black rhino and other endangered species at the time of

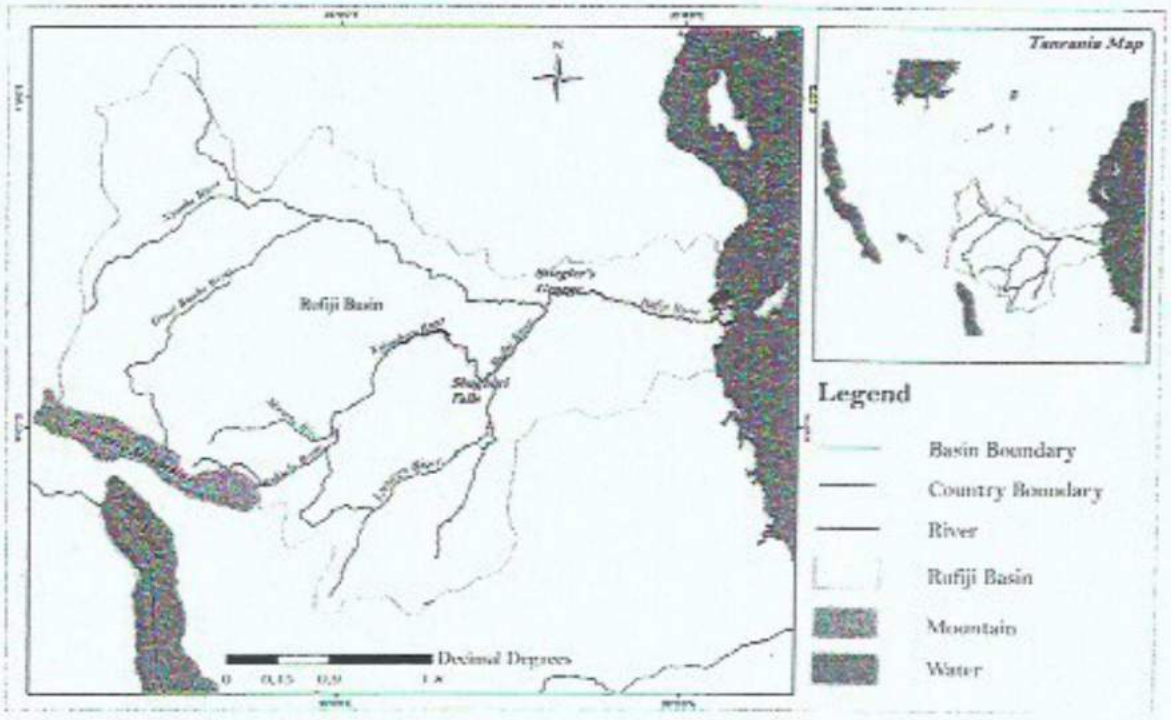


Figure 1: Location of the Rufiji River Basin in Tanzania

Inscription in 1982. Its universal outstanding values are centered on two major criteria i.e. a) Criterion (ix) - The Selous Game Reserve is one of the largest remaining wilderness areas in Africa, and Criterion (x) - The reserve has a higher density and diversity of species than any other Miombo woodland area in the world.

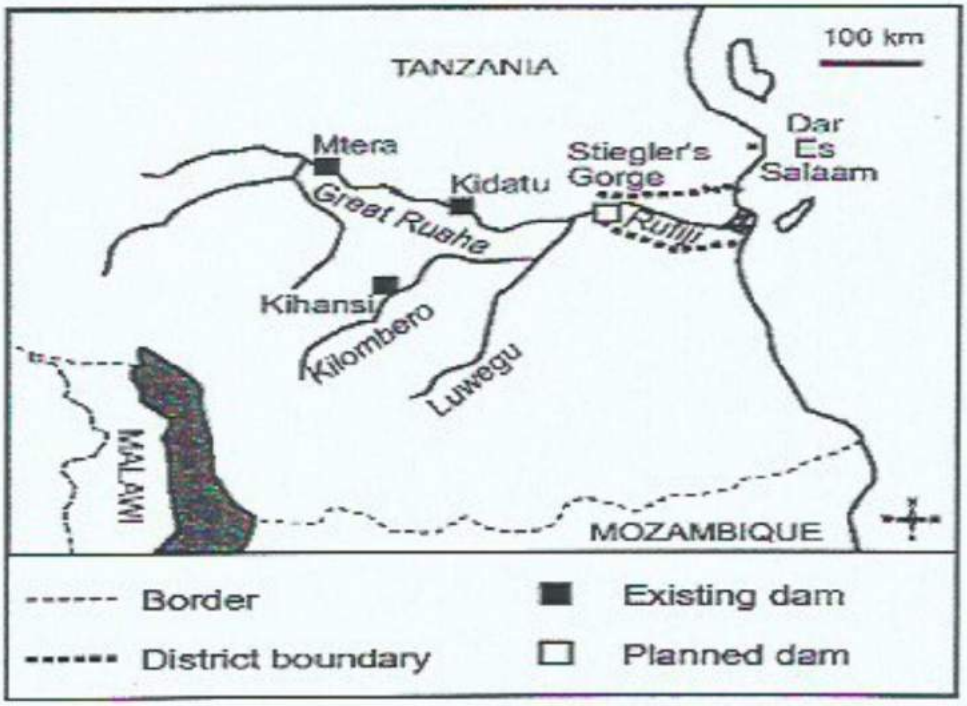


Figure 2: The Rufiji River Basin Sowing th Location of Stiegler's Gorge

The *core project* area includes the Stiegler's gorge site where concrete dam wall will be constructed, as well as semi-underground power generation units and associated power station, the spillway, saddle dams and auxiliary infrastructure, which would bear the most impacts than the rest. West of the Stiegler's Gorge, there will be the reservoir of maximum surface area 1,250 km^2 approximately12.5 km wide and 100 km long between the dam site and Luwegu and Kilombero rivers confluence (equivalent to about 3% of the gross area of the Selous Game Reserve). Here there will be vegetation removal to avoid reservoir anoxic condition in the reservoir. There will also be two staff quarters - one north-west about 3 km from the gorge and another one about 7 km from the gorge (Table 2.1). Associated with these locations is the roads infrastructure connecting these various components of the project.

Table 1: GPS Coordinates of Various Key Components of The Project

SN	PROJECT COMPONENT	COORDINATES	
		EASTINGS	NORTHINGS
1	Dam site /Stigo site	0372890	9137894
2	Reservoir areas	0372128	9132007
3		0371541	9131825
4	Rufiji –Ruaha river confluence		
5	Lakes downstream Nzelekela	0403136	9151825
	Siwandu	0404994	9150787

2.2 Project Components/Activities

For a power project which is required to meet a steadily increasing demand over a long period, a single development program is proposed for both technical and economic reasons. The single phase is thus proposed as follows:

- Construction of the main dam (– 131m high) with cofferdams and diversion tunnels. The dam is a classical gravity structure to be constructed using the technology of RCC (rolled compacted concrete).
- Construction of three waterways (with three tunnels, three control shafts, three surge tanks, three vertical penstocks) and aboveground power station with nine units each producing 235MW located in the right flank. The tunnels will be located at elevation 141.05 masl, low enough and below the minimum operating level (163.00masl).
- Construction of two 4 m diameter low level outlets (for environmental and downstream releases (~200m^3/s) at 80masl and to flush sediments in the reservoir where necessary.
- Construction of another two middle level outlets in the non-overflow section at 110masl on either side of the spillway for discharging stratified (anoxic) water from the reservoir as well as controlling impoundment at elevation 126masl.
- Construction of the main spillway at the central block at 165masl and emergency spillway in the saddle at 188m.
- Construction of administration and control building, switchyard and necessary power lines.

- Construction of workers camps, dwellings, water supply, internal electricity supply, and sewers.
- Quarries and associated plant, internal roads and bridge, and airstrip.
- Forest clearing of construction sites including the reservoir area and disposal of biomass material.
- Animal rescue operations in the reservoir area, just in case.
- Installation of a flood warning system.

2.3 Project Phases and activities

2.3.1 Project mobilization

The project activities during mobilization phase include mobilization of human resources, designing of the structures, obtaining various permits that include environmental permits, mobilization of resources, and importation of machinery and purchase of various construction materials. Acquisition permits, access route selection, clearance of vegetation, topographic survey and geotechnical investigation works, establishment of camps, internal isolation fence, identification of construction materials, and mobilization of equipment during the preconstruction phase.

2.3.2 Project construction

The construction phase will include construction of access/approach road, construction of coffer dams to separate the working site (dam wall site) from in-coming water from the river and backrush water from the diversion tunnels. Also there will be construction of two tunnels to divert water from the coffer dam to bypass the dam wall site and return water into the river channel further downstream. Other activities during construction phase will include: construction of dam wall and transportation of construction materials; construction of power plant and associated structures; installation of mechanical equipment, electrical equipment, plant control system, civil and structural elements, administration and control building, guard house, water treatment, workshop and storage rooms, fuel supply system, switchyard, transmission lines and substations, test operations, performance test and staff training.

The construction phase is estimated to take between 36 months; the construction workforce is estimated at 12, 000 at the peak of construction work. During the construction phase, the frequency of vehicle movement and workers movement will be highly controlled. Efforts will be taken to minimize environmental hazards by strictly following all mitigation measures provided in the EIA report. After construction phase all areas disturbed during the construction period will be rehabilitated. The demobilization phase will include removal/demolition of temporary infrastructures, dismantling and transporting of equipment, rehabilitation of areas and general cleanliness.

2.3.3 Project operation

The operation phase will encompass site maintenance works, repair and maintenance of the power plant. During the operation phase the workforce is estimated to be 12,500 fulltime employees. This would be supplemented by the engagement of contractors on an ad hoc status. The running of the completed project will basically entail fulfilling the following core objectives:

a) Commissioning and generation of electricity by means of hydro- electric works in the development area and to supply;
b) Operation and management including undertaking measures for flood control;
c) Promotion and regulation of agricultural activities in the Lower Rufiji Floodplain;

The life span of the project is expected to be 50 years extended to 100 years through maintenance and refurbishing. However, it will be based on correct operation and maintenance.

2.3.4 Decommissioning

During this phase the main issues will involve demolition of the facilities such as power plant facilities, staff quarters and water storage facilities. When the power plant becomes unusable for whatever reasons, decommissioning of the power plant may be carried out via the Environmental and social Management Plan to be made as a part of this Environmental Impact Assessment report. Therefore, dismantling of the unusable equipment will be carried out ready for removal from site and any other buildings and structures which can be used by others for other activities such as offices will be left behind and handed over to new users

during the final years of the project. The main issues of concern will be removal and handling of cleared materials (rubbles). Others issues include noise and dust level due to demolition of structures and restoration of the area.

2.4 Approach and Methodology

2.4.1 Approach

This ESIA involved a combination of several approaches, techniques and methodologies in data collection, analysis and reporting. The ESIA follows the standard *Environmental Impact Assessment and Audit Regulations (200),* procedures and steps. Of particular interest was the focus on World Heritage Values, ecological properties and livelihoods that will be affected by the project, as well as management of Rufiji river catchment as well as the Rufiji Delta and associated mangrove and estuarine environment. This called for vegetation surveys, wildlife census, and social economic surveys to generate information for the ESIA.

Characterization of flora and fauna were undertaken using both systematic and opportunistic surveys. Survey of terrestrial fauna was carried out by TAWIRI in two phases. Phase one of the study involved review of literature on wildlife population surveys in the Selous Game Reserve between1980-2017 (dry season), which mainly comprised of aerial wildlife censuses. Further reviews were done on reports of long-term wildlife research projects in the area and hunting records of harvested species in blocks falling within the project area. Phase two of the study involved on- the- ground inventory of existing terrestrial fauna community in order to highlight species compositions, relative abundance and distribution in the project area, employing; Key Informant Interviews (KII), Ground transect surveys and /or Boat driving, Bucket pitfall trapping, Sherman traps, and Camera trap surveys.

Estimates of vegetation biomass to be cleared within the project impact area including the reservoir area in relation to reservoir water quality and associated aquatic life (e.g. fish resources and fisheries) was adapted from the work of TFS (2018). This data provided estimates of potential charcoal and timber valued biomass likely to be harvested. Assessment of potential availability of threatened, endangered/rare plant species and sensitive habitats both upstream (reservoir area) and downstream (Lower Rufiji floodplain) Stiegler's Gorge was also surveyed.

Further consideration was given to comprehensive and full stakeholder participation and involvement in all stages of the assignment. While there was strong inter-project component collaboration and iterative processes to inform the designing process (e.g., designing team

working closely with EIA/SIA team), there was also strong interaction with various stakeholders in the project. Techniques for stakeholder involvement such as meetings, focus group discussions and use of tools such as questionnaires and checklists and map overlays were adopted whenever possible and applicable.

Hydropower generation will require a lot of water whose availability is certain Data on hydrology, water availability and reliability were obtained from literature. Point data was also obtained to understand the current status including water quality and discharge were taken at a number of sites along the river downstream the dam site. Otherwise most of the data was made available from national water authorities. In accomplishing this ESIA, the key steps/approaches below have been used in this assignment.

- *Scoping*

Scoping for this project was undertaken as one of the initial stages whereby stakeholders were identified, project boundaries established and major issues associated with the project scoped and classified for detailed ESIA. Also, at scoping stage preliminary project alternatives were developed and preliminarily analysed.

- *Literature review*

A preliminary review of the available information on the proposed development and related literature was undertaken as an initial step towards understanding the issues around the proposed Stiegler's Gorge Hydropower Project. This included: the Stiegler's Gorge power and flood control planning reports (Hafslund, 1980); the Identification study on the ecological impacts of the Stiegler's Gorge power and flood control project (Euroconsult, 1980); as well as an understanding of national policy, legal and institutional frameworks, and international conventions. The latter included the IUCN advisory note on Environmental assessment on World Heritage sites.

The review focused on the previous dam designs, and associated social, economic and ecological/biological implications on the core and immediate impact area during project implication as well as guidelines governing implementation of the project on world heritage sites including procedures for conducting assessment in these areas. Literature was useful in describing the current baseline conditions on current environmental characteristics, such as

wildlife distribution and abundance and their habitat (plant species types and distribution) compared to the situation in 1980. In addition, information on the current socio-economic activities within the core and immediate impact areas and area of influence were reviewed and used to establish requirements and needs for additional baseline information. Literature review continues throughout the ESIA process.

- *Site visit*

Apart from literature review, aerial reconnaissance and ground truthing field visits to the project impact area and others close to the project site were made. Site visits were undertaken to assess project area in relation to the main proposed development objectives i.e. power generation at Stiegler's Gorge and flood control in the Lower Rufiji floodplain; assessment of physical characteristics of the project area including the geography, water, vegetation and wildlife resources, world heritage and cultural heritage resources, economic activities, as well as human settlement and distribution in order to gauge the kind of issues and impacts that are likely to be of interest in the ESIA process.

- ***Stakeholder's consultation***

Stakeholder's consultations were conducted as part of stakeholder's involvement and participation as stipulated in EMA 2004 and EIA and EA regulation 2005 for the purpose of gathering views and concerns regarding the proposed project. Stakeholder consulted includes Morogoro and Coast Regional Secretariats with regard to official start-up of the Stiegler's Gorge Project within their regions and meeting with several stakeholders including TAWA, TAWIRI, NGOs such as African Wildlife Foundation (AWF). From Morogoro the team visited Morogoro Rural, Kilombero and Mahenge Districts and held meetings with local authorities including the District Commissioner, while from Kibaha (Coast Region) the team consulted Local Authorities in Utete and Kibiti Districts. Further consultations were made with TFS, TMA, and TAZARA. The purpose of the meeting with TAZARA authorities was to understand management perspectives on the proposed use of TAZARA railway to transport heavy project equipment and machinery to site and upgrading of Fuga Railway Station for delivery.

- ***Baseline data collection***

The baseline data provides information about the current situation covering physical, biological, and socio-economic and cultural heritage conditions before the start of the project. Baseline information provides the basis for predicting and monitoring impacts and helps to identify sustainability issues and alternative ways of dealing with them. Baseline information for this ESIA were collected from stakeholder's consultation, checklist, and field surveys and observations, published and unpublished reports including remote sensed data for comparison of change.

CHAPTER THREE: RELEVANT POLICIES, LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 Introduction

The proposed hydropower project will have implications to several national policies, laws and international policies that relates to the planned activities in the area. The proposed development falls under several administrative regimes that include TANESCO and the Ministry of Energy as the focal point for energy development in Tanzania. However, several other ministries and institutions have direct and indirect links with the proposed development. These include: the Ministry of Water and Irrigation; Ministry of Agriculture, Food Security and Cooperatives; Ministry of Livestock and Fisheries; Ministry of Industries, Trade and Marketing; and Ministry of Natural Resources and Tourism. Some of the policies, laws and administrative regimes that are relevant to this project are discussed below.

3.2 The Policy Framework

(i) National Energy Policy, 2015

To ensure effective management of the sector, the Government of **Tanzania** launched the first **National Energy Policy** in 1992. To cope with increasing activities in the Energy Sector and accommodate public sector reform objectives, a new. **National Energy Policy** was launched in 2003. The main goal of the Energy Policy (URT, 2003) is to improve the welfare and living standards of Tanzanians. Despite several interventions in the past decade, the Energy Sector has been facing some challenges embedded in policy, legal, regulatory and institutional frameworks. To address the challenges and achieve the desired policy objectives, the Government has decided to formulate the National Energy Policy, 2015 (NEP, 2015) that will further enhance provision of adequate, reliable and affordable modern energy services to Tanzanians in a sustainable manner. The new policy also provides comprehensive legal, regulatory and institutional frameworks for petroleum, electricity, renewable energies, energy efficiency as well as local content issues. The new policy aims at improving business environment to attract more private investments and local participation in the Energy Sector. Taking into consideration global initiative of providing sustainable energy for all, the Policy, apart from promoting energy conservation and efficiency, it also focuses on increasing access to modern energy services and increasing the share of renewable energies in electricity generation mix to enhance availability, reliability and security of supply. The Policy objective therefore is to provide input in the development process of the country by establishing a

reliable and efficient energy production, procurement, transportation, distribution and end-use system in an *environmentally sound manner* and with due regard to gender issues. The proposed hydropower development at Stiegler's Gorge meets the above requirements.

(ii) Sustainable Industrial Development Policy – SIDP), 1996

Sustainable Industrial Development Policy-SIDP (1996- 2020) (URT, 1996) is a framework for Tanzania's industrialization process within the short, medium and long term perspective. The main objectives of the SIDP include human development and creation of employment opportunities; economic transformation for achieving sustainable economic growth; external balance of payments and; environmental sustainability and equitable development (URT, 1996: 3).

The Policy outlines several strategies for achieving the mission and objectives of industrialization and a range of activities that are to be implemented within short, medium and long-term priority activities. Within the short-term period (1996-2000), the Policy will promote rehabilitation and consolidation of existing industrial capacities through a series of restructuring. The focus is privatization of the public industries. During the medium term period (2000-2010), the Policy promotes creation of new "capacities in areas with potential for gaining competitive advantage including agro-processing industries. The long-term period (2010-2022) will focus on basic goods industries. The proposed power developments at Stiegler's Gorge will support the objectives of this policy, which also recognizes the need for EIA prior to implementation of the projects. (Ibid: 39).

(iii) Small and Medium Enterprises Development Policy, 2003

The Small and Medium Enterprises Development Policy (SMEDP) (URT, 2003) harmonizes the role of informal sector that constitute the bulk of the SMEs in Tanzania. The main objective of the SMEDP is to foster job creation and income generation through promoting the creation of new SMEs and improving the performance and competitiveness of existing ones to increase their participation and contribution to the Tanzania economy" (URT, 2003: 16). The Policy defines SME as entities mainly based on non-farm economic activities in manufacturing, mining, commerce and services, employing between 5 - 99 people with capital investment of Tshs. 5 million to 800 million (Ibid: 4). The proposed thermal power development at Stiegler's Gorge is likely to stimulate growth and spread of SMEs, that may be engaged in a variety of activities, including service provision. This Policy therefore is

relevant since certain businesses that will need power are likely to emerge or be intensified as result of the proposed development.

(iv) Community Development Policy, 1996

The Community Development Policy (URT, 1996) underscores the problems that communities in Tanzania are facing, including underdevelopment and notes that people must be enabled to develop their capacity to identify problems and develop ways of tackling them. The proposed development will have major implications on community development in terms of providing power that can stimulating growth in various sectors of the economy and improve livelihoods.

(v) National Land Policy, 1997

The overall aim of the National Land Policy (URT, 1997) is to address the various ever-changing land use needs and to promote or ensure a secure land tenure system; to encourage the optimal use of land resources and; to facilitate broad-based social and economic development without endangering the ecological balance of the environment (Ibid: 5). The hydropower plant will require land, and therefore this policy will be relevant to the proposed development.

(vi) National Environmental Policy, 1997

The National Environmental Policy of 1997 outlines six major environmental problems that include loss of wildlife habitats and biodiversity, environmental pollution, land degradation and deforestation (URT, 1997). The Policy stipulates that an EIA shall be mandatory for all major projects to ensure that environmental concerns receive due and balanced consideration in reconciling urgent development needs with long-term environmental sustainability goals. The proposed hydropower generation project will have to be developed taking into account the requirements of this policy.

(vii) Water Policy, 2002

The main objective of the National Water Policy of 2002 is to develop a comprehensive framework for sustainable development and management of the Nation's water resources and putting in place an effective legal and institutional framework for its implementation (URT, 2002). The Policy recognizes the fundamental but intricate linkages between water and socio-economic development, including environmental requirements. The proposed development

will need and use large quantities of water and put additional demand in upstream and downstream areas. This ESIA will examine water demand and supply issues for the proposed development in relation to available resources, other users and address the implications of water demand arising from the establishment of power project.

(viii) The Wildlife Policy of Tanzania, 2007

The Wildlife Policy of Tanzania promotes the sustainable conservation of wildlife and wetland resources (URT, 2007; iii). The overall objectives of the Policy include (a) Protection and conservation of wildlife and wetlands (b) Sustainable utilization of wildlife and wetlands (c) Management and development of wildlife and wetland resources (d) Strengthen resource monitoring and research (e) Enhance communication, education and public awareness (f) Coordinate implementation of the policy and, (g) Foster regional and international cooperation (URT, 2007: 19 - 41). The policy recognizes the importance of ESIA as a tool that can support wise use of the resource. The proposed development may have direct or indirect implications on various species of wildlife found in the area, and therefore, the requirements of this policy will be taken into account.

(ix) The National Forest Policy, 1998

The main objectives of the Policy includes sustainable supply of forest products and services by maintaining sufficient forest area under effective management; increased employment and foreign exchange earnings, ecosystem sustainability through forest conservation and; enhanced national capacity to manage forest sector (URT, 1998:14).

The Forest Policy recognizes that investment projects in forest areas may cause adverse environmental impacts. Environmental Impact Assessment (EIA) must be conducted in order to ensure damage to the environment is avoided and possible mitigation measures are provided. The proposed development will have implications on the forest resources within the proposed development area in relation to reservoir area and site clearance, emissions and carbon related issues and therefore, the provisions of this policy will be taken on board.

(x) The National Strategy for Growth and Reduction of Poverty (NSGRP II), 2010

The Cabinet and Parliament adopted the first National Strategy for Growth and Reduction of Poverty (NSGRP), in early February 2005. In 2010 it was reviewed and the current second version, is to be implemented between 2010/11 and 2014/15. The NSGRP II makes linkages with Vision 2025 and is committed to the Millennium Development Goals (MDGs) as

internationally agreed targets for reducing poverty. The NSGRP II aims to reduce poverty through three broad outcomes: growth and reduction of income poverty; improved quality of life and social well-being; and good governance and accountability. The proposed development is responding to the NSGRP II by investing in an energy supply project, which will contribute to fueling the local and national economy. Issues such as availability of reliable and affordable power not just to the industrial areas but also to local people as well as other sector will be explored in this ESIA as part of the compliance to the NSGRP II.

(xi) Regional Water Policy and Regional Water Strategy

The SADC Regional Water Policy (SADC, 2005) recognizes that water resources of the SADC region are vital for sustainable economic and social development of the region. The SADC member states have initiated several measures since the 1990s to address water use issues in the region. These initiatives include the Regional Strategic Action Plan for Integrated Water Resources Development and Management (RSAP-IWRM), which has became a component of the Regional Indicative Strategic Development Plan (RISDP). The Regional Water Policy also notes that despite several attempts to address water use issues in the region, water development is still facing many challenges.

3.3 The Legal/Regulatory Framework

(i) Water Resources Management Act, 2009

The Water Resources Management Act, 2009 (URT, 2009) provides a framework for the management and utilization of water, taking into account domestic, social, industrial and environmental needs. The Act provides principles and objectives of Water Resources Management, which includes among others: (a) meeting the basic human needs of present and future generation; (b) promoting equitable access to water; (c) promoting the efficient, sustainable and beneficial use of water in the public interest; (e) protecting biodiversity, especially the aquatic ecosystem; and (f) providing a system for the management of the resources and implementation of international obligations.

The Act directs the need to apply and pay all required fees for water utilization permits. It also directs the adoption of integrated water resource management approaches and the application of principles such as; (a) precautionary principle, (b) polluter pays principle, (c) the principle of ecosystem integrity, to mention some. The proposed development will require

water for its operations and therefore, the provisions of this Act will be taken into account in order to safeguard this scarce resource.

(ii) The Water Resources Management (dam safety) Regulations (2013).

Unless the context otherwise requires, these Regulations (i.e. The Water Resources Management (Dam Safety) Regulations, 2013) applies to all dams in Mainland Tanzania. Accordingly, a person shall not design, construct, modify or rehabilitate any dam without engaging approved professional person registered in accordance with the Act and these Regulations. An owner of a dam shall engage approved professional person in dam operation, inspection, monitoring, maintenance and decommissioning. An owner of a dam may request a list of approved professional person from the Director of Water Resources or nominate a person intended to be used as approved professional person and submit to the Director for approval. The Director shall supply the list requested by the owner of a dam under sub-regulation (3) within seven (7) days or approve the nominated person as approved profession person within thirty days provided that the nominated person meets the requirements as provided in the Act and these Regulations. There shall be established and kept by the Director a Register of such approved professional person.

Among the duties of the professional person is to consider whether the safety norms pertaining to the design, construction, monitoring, operation, performance and maintenance of the dam satisfy acceptable dam engineering practices as prescribed in the guidelines

(iii)The Environmental Management Act, 2004

The Environmental Management Act No 20.of 2004 (Cap 191) (URT, 2004) provides comprehensive environmental framework that is intended to streamline management of the environment in Tanzania. The Act makes EIAs mandatory prior to development for specific types of projects. The Act is directly relevant to the proposed development as it calls for full and detailed environmental assessments for such projects.

(iv) Environmental Impact Assessment and Audit Regulations, 2005

The Environmental Impact Assessment and Audit Regulations (URT, 2005) provides details on how an environmental impact assessment and audit can be conducted that list potential projects that shall require mandatory EIA and define how EIA should be conducted. This EIA is responding to EIA Regulations and highlight critical areas that require attention of the developer and other stakeholders.

(v) National Environmental Standards Compendium (NESC), 2009

The National Environmental Standards Compendium (NESC) (URT, 2009) is a collection of various standards prepared at different times. The NESC consist of three parts. Part One comprises of standards that require compulsory compliance, which includes standards for industries with peculiar effect to the environment. Part Two consist of standards that may be implemented on voluntary basis. These include guidelines, codes of practice that can be enforced voluntarily by way of self – regulation. Part Three has the requisite test methods that should be followed when testing for compliance.

Although these are national standards, the NESC states that the standards "are to be reviewed independently to reflect sector specific needs as regulated by the National Environment Management Council". Most of the compulsory standards in the NESC are relevant to the proposed hydropower development project. These national standards include:

(a) TZS 860 – 2005. Municipal and Industrial Wastewater – General Tolerance Limits for Municipal and Industrial Wastewater

(b) TZS 845 – 2005. Air Quality Specification

(c) EMDC 2 (1778). Air Quality – Vehicular Exhaust Emissions Limits

(d) EMDC (1777). Protection against ionizing radiation –Limits for Occupational Exposure

(e) EMDC 6 (1733) P2. Acoustics- General Tolerance Limits for Environmental Noise

This ESIA will explore and recommend all relevant standards that are relevant to the proposed development to safeguard the environment and the people.

(vi) The Electricity Act, 2008

The Electricity Act (URT, 2008) provides for the facilitation and regulation of generation, transmission, transformation, distribution, supply and use of electric energy to provide for cross-boader trade in electricity and the planning and regulation of rural electrification and related matters (URT, 2008:5). The Act provides for requirements to obtain licences for (a) generation (b) transmission (c) distribution (d) supply, (e) physical and financial trade in electricity and electrical installations (URT, 2008:11). Any person intending to conduct any of the activities stipulated in subsection 1 of Section 8 of this Act must apply for a licence to Energy and Water Utilization Regulatory Authority.

(vii) The Land Act and Village Land Act, 1999

The Land Act 1999 (Act No 4 of 1999) and the Village Land Act 1999 (Act No 5 of 1999) (URT, 1999) provides the legal framework for the implementation of the Land Policy. The Acts addresses various issues including defining the legal framework for land tenure system, and how land could be used for social and economic development. The Act also defines issues of land acquisition and compensation to affected people. The Village Land Act addresses land tenure issues with specific reference to land within the village jurisdictions, defining tenure, access and use of such land as well as responsibility for management of the land. The proposed development will require land and therefore the provisions of this Act will be taken into account.

(viii) The Land Regulations, 2001

The Land Regulations (URT, 2001) provide various forms for purposes of the Land Act and Regulations made there under. Forms are divided into seven groups: Management and Administration (a); Granted right of occupation (b); Mortgage (c); Leases (d); Easements (e); Co-occupancy (f); Miscellaneous (g). Forms include standard contracts occupancy (form 38), of mortgage (form 54), of lease (form 55) and derivative right granted by the Tanzania Investment Centre (form 56). The provisions of these regulations will be explored to ascertain compliance with the proposed development.

(ix) Land Acquisition Act, 1967

The Land Acquisition Act, (Act No. 47 of 1967) provide for compulsory acquisition of land for public purposes and in connection with development aspects. Part II b of the Act refers to issues related to compensation and procedures that have to be followed when land is acquired. These procedures are also outlined in the Regulation for the Land Act and include issues of fair and prompt compensation to affected persons. The proposed development will need land for its development therefore the provision of this Act will have to be taken into account in this ESIA.

(x) Energy and Water Utilities Regulatory Authority Act, 2003

The Energy and Water Utilities Regulatory Authority (EWURA) (Act No 11 of 2001 and 8 of 2003 (URT, 2006) establishes a Regulatory Authority in relation to energy and water utilities and outlines its *modus operandi*. The Authority is responsible for regulating energy development and water utilities in Tanzania and requires relevant developers to obtain permits and authorization from EWURA for any proposed development. The proposed

development includes issue of use of water for industrial development but also, it will require having obtained relevant licences from EWURA; thus the provisions of this Act will be taken on board.

(xi) Forest Act, 2002

The Forest Act, (No.14), 2002, (URT, 2002) provides for the management of forests in order to enhance the contribution of the forest sector to the development of Tanzania and the conservation and management of natural resources. Also, the legislation fosters ecosystem stability through conservation of the forest biodiversity, water catchments and soil fertility. The provisions of this Act in relation to environmental compliance issues will have to be addressed in this ESIA.

(xii) The Wildlife Conservation Act, 2009

The Wildlife Conservation Act (URT, 2009) provides for the management and utilization of wildlife resources in Tanzania and defines an institutional. Part 11, Section 5 (1) (a-m) of the WCA specifies the objectives of the Act, which include among others; (a) to protect and conserve and administer areas with great biodiversity, including wetlands, (b) protect and conserve wildlife resources and its habitats in game reserves, wetland reserves, game controlled areas, Wildlife Management Areas, dispersal areas, migratory routes corridors, buffer zones and all animals found in areas adjacent to these areas. The Act stipulates various provisions including making it illegal any off take of wildlife resources that is not regulated or authorized. It calls for the adoption of management tools such as management plans, environmental impact assessment, wildlife impact assessment and environmental auditing and monitoring in areas where development is taking place in wildlife resource areas. The provisions of this Act will be addressed in this ESIA.

(xiii) The National Land Use Planning Commission Act, 1984

The National Land Use Planning Commission Act, (No.3), 1984, established the National Land Use Planning Commission (NLUPC), as the principal advisory organ of the Government on all matters related to land use. The NLUPC is responsible for ensuring that land resources are used in sustainable manner taking into account the need for land use plans. The proposed development is likely to trigger land use conflicts resulting from increased pressure on land as a result of lack of land use planning. Therefore, it is imperative to

understand the significance of land use planning in the district in order to curtail land use conflicts now or in future.

(xiv) The Tanzania Investment Act, 1997

The Tanzania Investment Act, (No.26), (1997) established the Tanzania Investment Centre (TIC) as one stop house for investment purposes in Tanzania. The Act provides procedures that investors need to follow when planning to invest in Tanzania. The requirements of this will be assessed to ascertain compliance with proposed development.

(xv) Occupation Health and Safety Act (OSHA Act)

The Occupation Health and Safety Act, (No. 5) (2003), deals with issues related to health and safety of workers in industrial areas. Under the Act, the Minister responsible for Labour shall appoint the Chief Inspector (CI) to perform the functions stipulated in the Act. Specific provisions of the OSHA Act – namely Section 21, 60, 61, 73-75 and 96 must be fully addressed in order to comply with this legal requirement. The Act addresses such issues of safe equipment, provision of personal protective equipment and a clean and safe work environment (e.g. provision of regular medical examination, air, drinking water, sanitary convenience, washing facilities, accommodation for clothing, first aid facilities: including safety training, etc.). The proposed development should operate within the requirements of this Act in addition to those of the Electricity Act and others as outlined in this section.

(xvi) International Convention on Biological Diversity

The Kyoto Protocol allows for the use of the Clean Development Mechanism (CDM) in which starting in 2000, greenhouse gas emissions from projects in none-Annex 1 countries can be acquired by Annex 1 countries and credited against their emission binding commitment. In this way, those countries can also benefit financially. This project present an opportunity to explore how the requirements of this international convention can be fulfilled. Other regulatory frameworks that are relevant to the proposed development include; the Town and Country Planning Ordinance (Cap 378 of 1958) and Amendment of 1961, for planning purposes. Others are the Grave Removal Act, 1969; the Antiquities Act 1974 and the Local Government Act. No. 9 of 1982. These Acts will be examined in relation to the proposed development.

3.4 The Institutional/Administrative Framework

3.4.1 Overall management responsibility

The institutional arrangement for environmental management in Tanzania is well spelt out in the EMA (2004). There are seven (7) institutions mentioned by the act, and the minister responsible for environment is the overall in-charge for administration of all matters relating to the environment.

> Part III, Section 13(1) of EMA (2004) states that the Minister responsible for environment shall be the overall in-charge of all matters relating to the environment and shall in that respect be responsible for articulation of policy guidelines necessary for the promotion, protection and sustainable management of environment in Tanzania.

The legal institutions for environmental management in the country include;

- National Environmental Advisory Committee;
- Minister responsible for Environment;
- Director of Environment;
- National Environment Management Council (NEMC);
- Sector Ministries (e.g Ministry of Energy and Minerals, Ministry of Trade, Industries and Marketing, Ministry of Transport, Ministry of lands and Human Settlements, Ministry of Livestock and Fisheries, Ministry of Water and Ministry of Economic Planning and Empowerment);
- Regional Secretariat;
- Local Government Authorities (City, Municipal, District, Township, Ward, Village, sub-village "Mtaa and Kitongoji")

(i) National Environmental Advisory Committee

The National Advisory Environmental Committee is comprised of members with experience from various fields of environmental management in the public, private sector and the civil society. The advisory committee advises the Minister on any matter related to environmental management. Other functions include:

- Review and advise the Minister on any environmental plans, environmental impact assessment of major projects and activities to which environmental impact review is necessary;

- Review and advise the Minister on any environmental standards, guidelines and regulations;
- Perform other environmental advisory services to the Minister as it may be necessary.

(ii) Minister responsible for Environment

The Minister is responsible for matters relating to environment, including giving policy guidelines necessary for promotion, protection and sustainable management of environment in Tanzania. The Minister approves EIS. The Minister may also delegate the power of approval for EIA to the DOE, Local Government Authorities or Sector Ministries. The Minister also:

- Prescribes (in the regulations) the qualifications of persons who may conduct EIA;
- Reviews NEMC reports on the approval of EIS;
- Issues EIA certificate for project subject to EIA;
- Suspends EIA certificate in case of non-compliance.

(iii)Director of Environment

The Director of Environment heads the Office of the Director of Environment and is appointed by the President of the United Republic of Tanzania. The functions of the Director of Environment include:

- Coordination of various environmental management activities undertaken by other agencies;
- Promotion of integration of environmental considerations into development policies, plans, programmes, strategies, projects;
- Monitoring and assessing activities undertaken by relevant Sector Ministries and agencies;
- Coordination of issues relating to articulation and implementation of environmental management aspects of other sector policies and the National Environment Policy

(iv) National Environment Management Council (NEMC)

The NEMC's purpose and objective is to undertake enforcement, compliance, review and monitoring of EIA and to facilitate public participation in environmental decision-making. In reference to EMA (2004), NEMC among other things:

- Registers experts and firms authorized to conduct EIA;

- Registers projects subject to EIA;
- Determines the scope of the EIA;
- Set-ups cross-sectoral TAC to advise on EIA reviews;
- Requests additional information to complete the EIA review;
- Assesses and comments on EIA, in collaboration with other stakeholders,
- Convenes public hearings to obtain comments on sensitive and controversial proposed project;
- Recommends to the Minister to approve, reject, or approve with conditions specific EIS;
- Makes recommendations on whether to revoke EIA Certificates, in case of non-compliance;
- Conducts Environmental Audits

(v)Sector ministries

Under the existing institutional and legal framework the Sector Ministries are required to establish Sector Environmental Sections headed by the Sector Environmental Coordinator. In this development project, the key environment sector ministries include: Ministry of Agriculture Food Security and Cooperatives; Ministry of Natural Resources and Tourism; Ministry of Water; Ministry of Energy and Minerals; Ministry of Lands, Housing and Human Settlements Development; and Ministry of Industry, Trade and Marketing.

The responsibilities of these Sector Ministries on environmental issues include to:

- Ensure environmental compliance by the Sector Ministry;
- Liaise with the DOE and the Council (NEMC) on matters involving environment and all matters with respect to which cooperation or shared responsibility is desirable or required;
- Ensure that environmental concerns are integrated into the ministry or departmental development planning and project implementation in a way which protects the environment;
- Promote public awareness of environmental issues through educational programmes and dissemination of information;
- Refer to the Council (NEMC) any matter related to the environment;

- Undertake analysis of environmental impact of sectoral legislation, regulation, policies, plans, strategies and programmes through strategic environmental assessment (SEA);
- Ensure that sectoral standards are environmentally sound;
- Oversee the preparation of and implementation of EIA required for investments in the sector;

(vi)Regional Secretariat

The Morogoro Regional Secretariat, which is headed by the Regional Environmental Management Expert, is responsible for coordination of all environmental management in the region. The Regional Environmental Expert:

- Advises the local authorities on matters relating to the implementation of and enforcement of environmental By-laws/ Act;
- Creates a link between the region and the DOE and the Director General of the Council (NEMC).

(vii) Local Government Authorities

Under the Local Government Act of 1982 (Urban and District Authorities), Local Government Authorities include the Morogoro District Council, Mahenge District Council, Kilombero District Council, Rufiji District Council and Kibiti District Council each with Divisions, Wards, Village governments, Vitongoji and Mitaa at the lower level.

The Environmental Management Committee of each of the above jurisdiction:

- Initiates inquiries and investigation about any allegation related to the environment and implementation of or violation of the provisions of the Environmental Management Act;
- Requests any person to provide information or explanation about any matter related to the environment;
- Resolves conflicts among individual persons, companies, agencies non-governmental organizations, Government departments or institutions about their respective functions, duties, mandates, obligations or activities;

- Inspects and examines any premises, streets, vehicles, aircraft or any other place or article which it believes or have reasonable cause to believe that pollutant or other articles or substances believed to be pollutant are kept or transported;
- Requires any person to remove at own cost without causing harm to health and;
- Initiates proceedings of civil or criminal nature against any person, company, agency, department or institution that fails or refuses to comply with any directive issued by any such Committee.

This EIA has consulted most of these institutions at various stages as part of the EIA undertaking and their views and concerns have been incorporated in the report.

(viii) The Rufiji Water Basin Office

The Rufiji Water Office is the legal authority mandated to oversee utilization and management of water resources in the basin as per the Water Policy (2002) and Water Act 2009. The institution arrangement under the basin water office comprise of catchment committees, water user associations (WUA) which are the grass root organizations mandated to integrate the various water user groups in their respective area e.g irrigators, livestock keepers, wildlife etc.

Within the river basin, local governments prevail such as District Councils, Wards and village government – all contributing towards efficient management of water resources in the basin. Briefly the roles and responsibilities of the Basin Water Office include; water allocation, pollution control, monitoring, flood and drought management, information management, and basin planning.

As for management of the Rufiji hydropower project the various institution outlined will have the responsibility to address various environmental and management issues arising from the development of the hydropower project. The Selous being a Game Reserve the management of the reserve is under the mandate of Tanzania Wildlife Authority (TAWA) under the ministry of Natural Resources and Tourism. In addition to being a Game Reserve, Selous is a World Heritage Site Criteria (ix) and (x) inscribed in 1982 due to its significant Universal Outstanding Values overseen by UNESCO. Therefore the institution arrangement in the management of the Rufiji Hydropower project will be complex multi sectoral institutions involving the legally recognized environmental organs (VPO- Ev, NEMC, Local Govt),

TAWA, TFS, TANESCO, Ramsar site Committee, UNESCO and other interested parties in safeguarding the sustainability of the project and the integrity of the Selous Game Reserve.

CHAPTER FOUR: EXISTING BASELINE CHARACTERISTICS

4.1 Physical Environment

4.1.1 The Rufiji basin

The Rufiji Basin covers an area of 183,791 km^2 (about 20% of Tanzania), is the largest of the nine basins and extends over six Tanzanian regions: Coast, Morogoro, Iringa, Mbeya, and Dodoma. The basin is situated between Longitudes 33°55'E and 39°25'E and between Latitudes 5°35'S and 10°45'S. Figure 4.1 shows the administrative boundaries within the basin. The altitude of the basin rises from 0 meters above mean sea level (mamsl) at the Indian Ocean to above 2,960 mamsl in the highlands (Kipengere ranges and Poroto Mountains) Iringa and Mbeya Regions. The annual average runoff is about 900 m^3/s near Stiegler's gorge with a catchment area of 158,000 km^2. The basin is characterised by many wetlands in both the highlands and the lowlands. The major wetlands are the Utengule in the Great Ruaha and the Kibasila in the Kilombero. The mangrove at the Rufiji river delta, are also a special type of vegetation in the Basin.

The Rufiji Basin is made up of the four principal sub-basins. The principal sub-basins are composed of numerous river systems. The contribution of each sub-basin to the annual runoff with respect to the entire basin is shown in Table 4.1

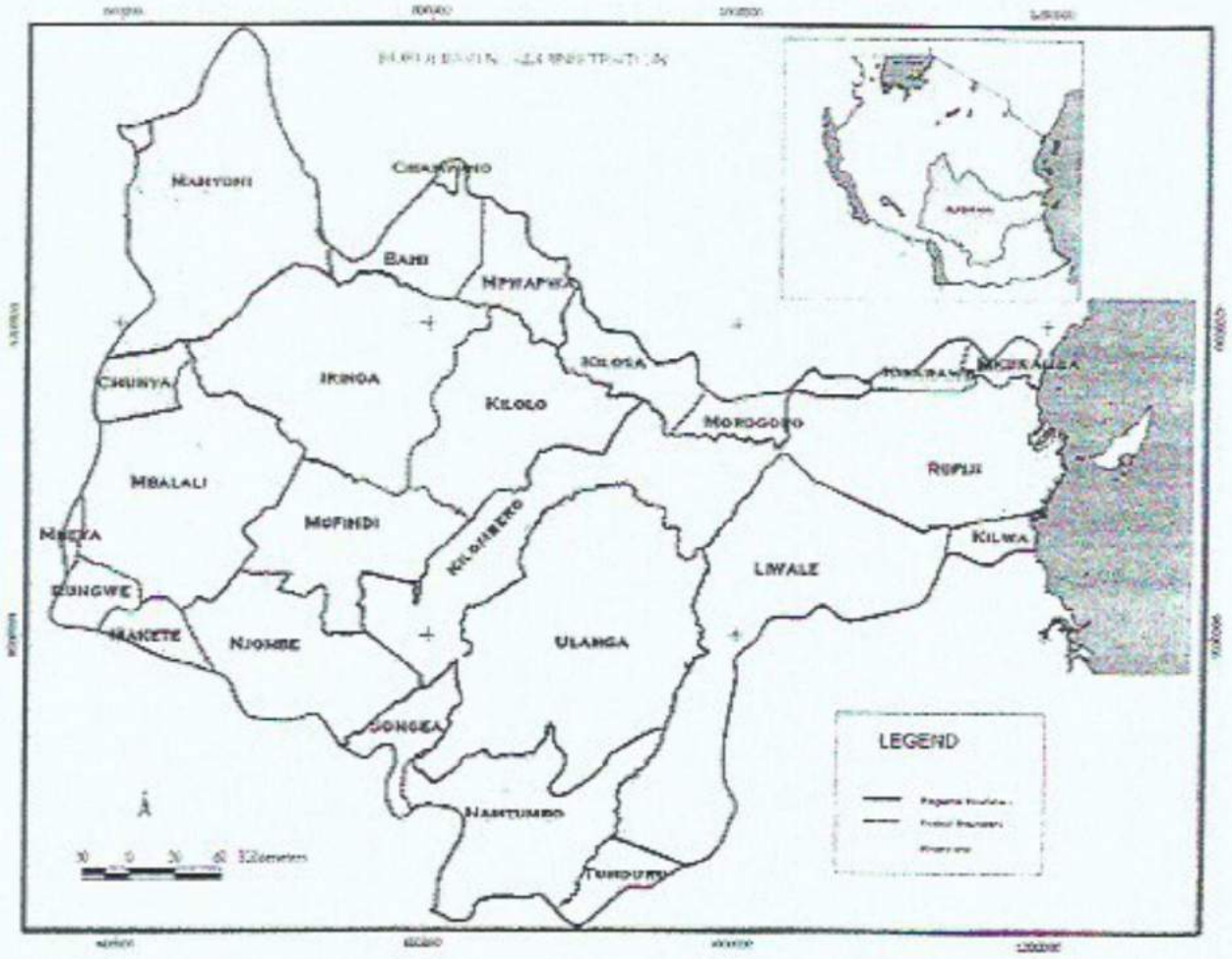


Figure 3: Rufiji Basin Map with Administrative Boundary

Table 2: Major Rivers in the Rufiji Basin

Sub-Basin	Drainage Area (Km^2)	% of Total	Annual Average Rainfall (mm)	Annual Average Flow (bcm/yr)	% of Total
Great Ruaha	85,554	46.5	400 – 1200	3.3	14.9
Kilombero	40,330	21.9	1000 – 1800	13.8	62.2
Luwegu	25,288	13.8	800 – 1400	4	18.0
Lower Rufiji	32,619	17.7	650 – 1100	1.1	5.0
Total	**183,791**	100		**22.2**	100.0

Source: Rufiji Basin Water Office, 2010

The Kilombero valley is surrounded by high mountains on both sides. The mountains rise from a very flat and wide plain on the Great Ruaha side and slope abruptly down into the Kilombero valley on the other side. The ridge drops from more than 1800 amsl to 300 amsl in a few kilometres. The Kilombero valley contains one of the largest freshwater wetlands in East Africa and designated as Ramsar Site.

The Great Ruaha has its source in the Poroto Mountains and the Kipengere Range in the south-western corner of the Rufiji Basin. A number of perennial tributaries contribute to the flow at the headwaters of the Great Ruaha. After entering the Usangu plain, the river traverses an increasingly dry region on its way down to Mtera.

The Selous has the distinction of being the oldest wildlife reserve in Africa, with part of it having been gazetted by the Germans in 1896. By 1912 there were four small reserves in the area at Mahenge (essentially the area between the Kilombero and Great Ruaha rivers), Muhoro which is the photographic tourist area of the Northern Selous), and Matandu near Liwale (SGR GMP, 2005). In 1922 the British Government consolidated these areas into one Reserve whose primary purpose to protect for migratory elephants. After Independence in 1961, the Tanzanian Government pursued a policy of "villagization", this further depopulated the Selous and the government adjusted and enlarged the boundaries of the Reserve to the present boundaries formally declared in 1974.

4.1.2 Topography

The altitude of the basin rises from 0 meters above mean sea level (m amsl) at the Indian Ocean to above 2,960m amsl in the highlands (Kipengere ranges and Poroto Mountains) Iringa and Mbeya regions (Fig. 4.2). The Rufiji Basin can easily be identified through its physiology in that the delta and the flood plain of the Lower Rufiji forms one portion of the basin gradually rising into a plateau of the coastal hinterland into the Southern highlands and the Central Plateau of Tanzania. The soils of Basin are derived from the geology as it's the result of weathering of the parent rocks in the area. According to the geology of the area major soils of the basin are sand, slit and clay soils from weathered sandstone, shales and siltstones in the Lower Rufiji. The Great Ruaha Catchment is dominated with reddish-brown silt/clay, sand and silt in the downstream of the Great Ruaha and Kilombero. The upstream of the Great Ruaha is dominated with sandy soils, fine silt and clay volcanic soils resulting from the weathering of the gneiss, hornblende, quartzite's, gabbro, amphibolites, shales and

mudstones. The flood plains in Lower Rufiji, Great Ruaha and Kilombero Catchments are dominated with the black clay soil and scarcely distributed sand and silt soils.

The Luwegu Catchment is dominated with reddish course to medium grained sand, silt and clay soils from weathering of metamorphosed sandstone, mudstone, shales and siltstone of continental origin.

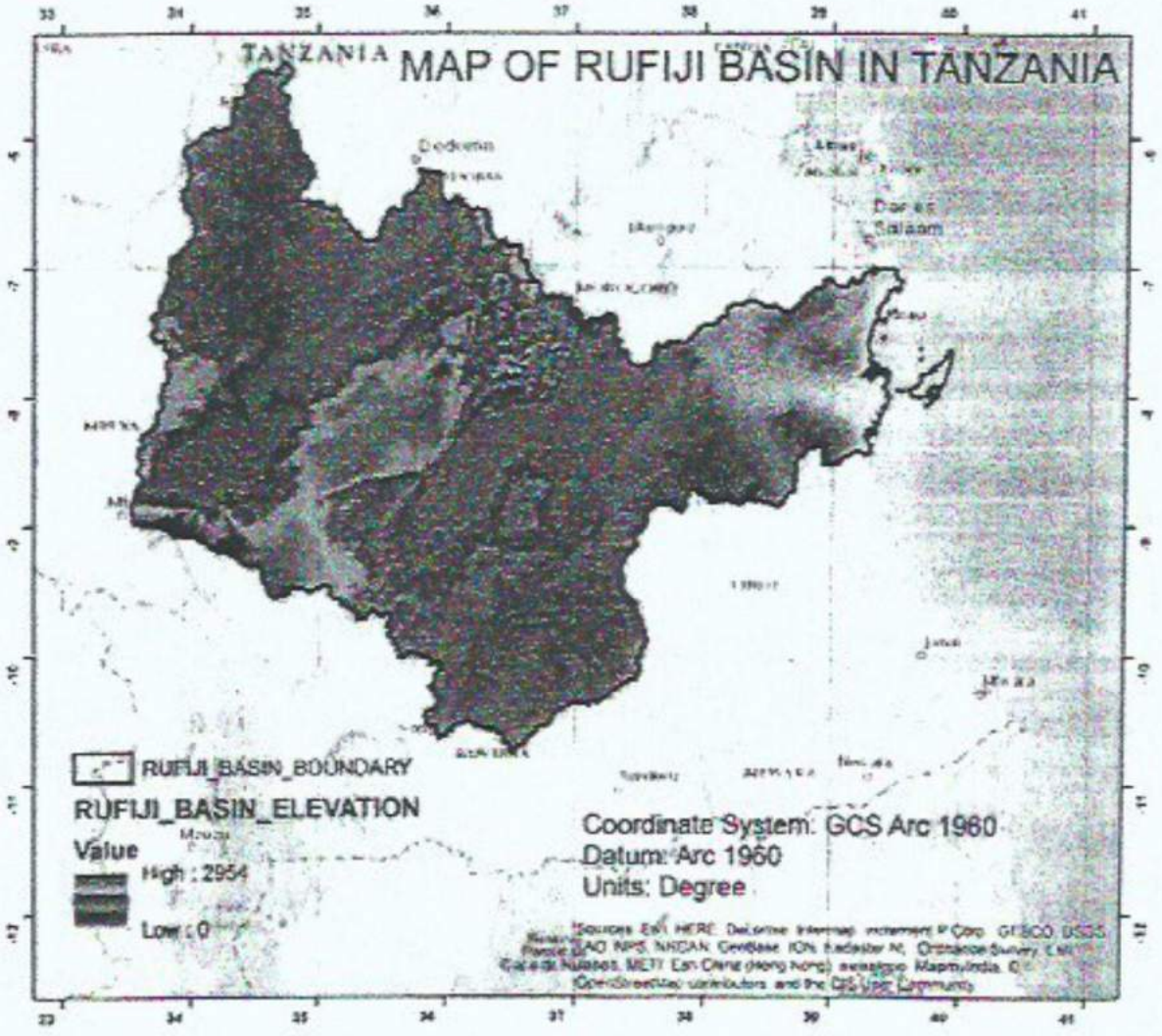


Figure 4: Rufiji Basin Elevation

4.1.3 Climate

The Rufiji River Basin varies greatly in climatic and hydrological conditions. The climate of the basin is generally tropical and differs from the coast to the highlands in the upper parts of the catchments. The basin has a humid and hot climate at the coast and in the Kilombero

valley. The climate is hot and dry in the North-Western part of the Great Ruaha River Basin, while in the mountainous regions it is cold. Except for the lower parts of the basin, which experience two rainy seasons, the largest portion is characterized by unimodal rainfall. Rainfall is high along the mountain chain in the western Kilombero valley. The annual rainfall in Kilombero ranges from 1,000 mm to 1,800 mm with an annual average of around 1,400 mm. Rainfall decreases towards the middle of Great Ruaha subbasin where annual rainfall ranges from 400 mm to 1,200 mm with an average of about 800 mm. High rainfall is also received around the Mahenge Hills in the Morogoro Region. Rainfall in the Lŭwegu sub-basin is estimated to range between 800 mm and 1,400 mm annually with an average of 1,100 mm. Rainfall is also temporally uneven with the highest falling from November to May, and the remainder of the year receiving very little rain.

The Selous GR has a uni-modal rainfall distribution, the dry season lasting from late May to early November. The 6 months of wet season begins with torrential storms in late November. Annual rainfall ranges from about 750 mm in the east to 1300 mm in the west. Temperatures in Selous GR range from about 13^0C to about 41^0C, with higher temperature occurring in the lower, eastern areas. The mean monthly maximum temperatures range from 37.3^0 C in November to 30.7^0 C in June, while the mean monthly minimum temperatures range from 25.3^0 C in January to 17.9^0 C in June (SGR GMP, 2005).

4.1.4 Landscape and physical environment

Selous GR has a gradual variation in altitude, rising from 80 m in the east to 750m in the south, and to 1,300 m in the Mbarika Mountains in the south-west. The terrain in the south of Selous GR is hilly and rugged, while the flat central lowlands east of Madaba is broken only by a few sheer extruding hills rising to 750 m. The Uluguru and the Mahenge Mountains are high landforms to the west of the Reserve. Geologically the landscape of Selous GR is derived from the Karoo sandstone system of Jurassic/Cretaceous period. Through the Cenozoic period the land surface was degraded by successive cycles of erosion, accompanied in the late Cenozoic/Pleistocene period by the deposition of alluvial grits and sands in river systems. This has resulted in the undulating landscape characteristic of miombo areas of southern and western Tanzania. In the Recent period, further erosion resulted in the deposition of alluvial clays in many river valleys (SGR GMP, 2005).

4.1.5 Soils

Four major soil types characterize the Selous Game Reserve (op. cit.). Non-lateritic red and yellow soils on sandstones; characterized by poorly differentiated old red soils, highly weathered and infertile. This soil type dominates the drier sites, upper slopes, and ridge tops. Leached ferruginous soils in valley bottoms; these have higher clay content and occur in valley bottoms with a poor and sluggish drainage. An Alkaline-sodic soil with hardpan characteristics occurs on the river terraces. This soil type is widespread in the southern Selous and along the rivers whereas alluvial clay is restricted to recently deposited flood plains. These soils have allowed the growth of heterogeneous vegetation characterizing the game reserve.

4.1.6 Hydrology

- ***Streamflow variability and trends***

The Rufiji streamflow is highly seasonal. The highest flows occur in March, April and May and the lowest in August, October and November. Figure 4.3 shows the long term mean monthly stream flows at Kidatu (Great Ruaha), Swero (Kilombero) and Stiegler's Gorge (Lower Rufiji). Figures 4.4 & 4.5 show the observed and simulated mean and minimum monthly streamflows at Stiegler's Gorge. The observed data from (1957 to 1978) indicates that the mean annual flow was about 900 m^3/s while between 1980 and 2016 it was bout 800 m^3/s. The simulated flows from 1980-2005 during the development of the Integrated Water Resources Management and Development Plan (IWRMDP) indicates a rather low estimate of about 500 m^3/s. This clearly shows the decreasing trend of streamflow from the 1950s.

The monthly Flow Duration Curve (FDC) at Stiegler's Gorge is as shown in Figure 4.6. The flow-duration curve is a cumulative frequency curve that show the percent of time specified discharges were equalled or exceeded during a given period. It combines in one curve the flow characteristics of a stream throughout the range of discharge, without regard to the sequence of occurrence. The curve, drawn to average the plotted points of specified discharges versus the percent of time during which they were equalled or exceeded, thus represents an average for the period considered rather than the distribution of flow within a single year. From the figure, it can be noted that the Rufiji streamflow is highly variable

entailing management challenges for droughts and floods. The streamflow varies from over 5000 m^3/s (high flows) to low flows (Q_{95}) of about 200 m^3/s.

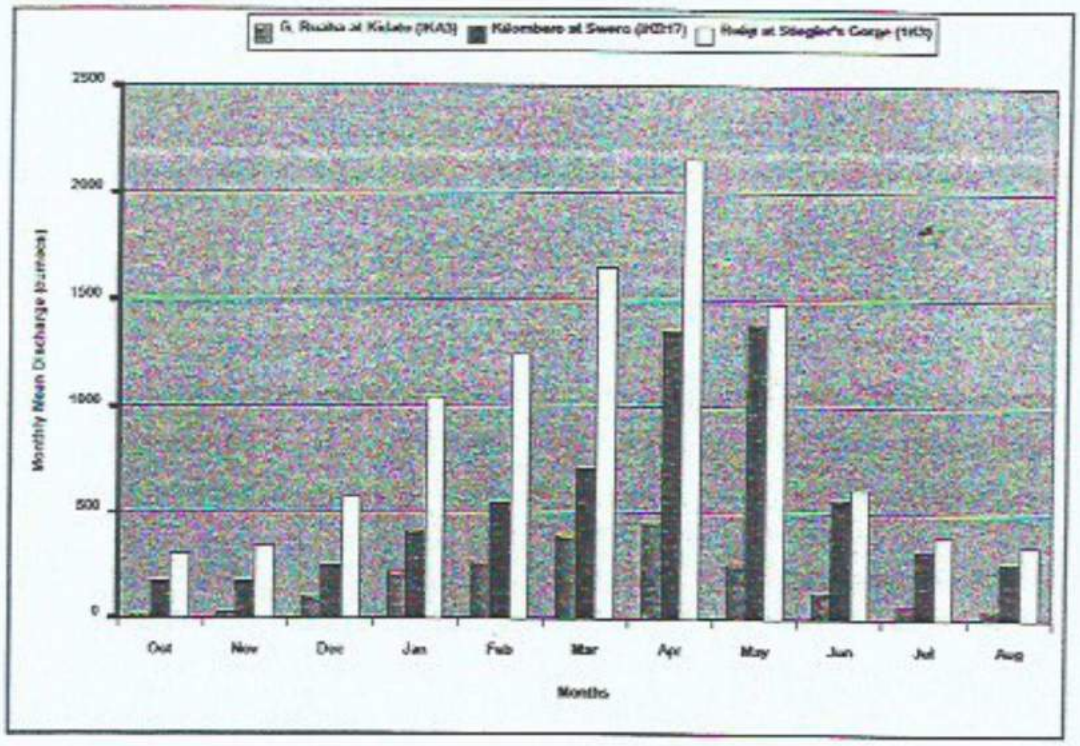


Figure 5: Monthly Mean Discharge at Kidatu, Swero and Stiegler's Gorge
Source: MoWI/URT, 2011

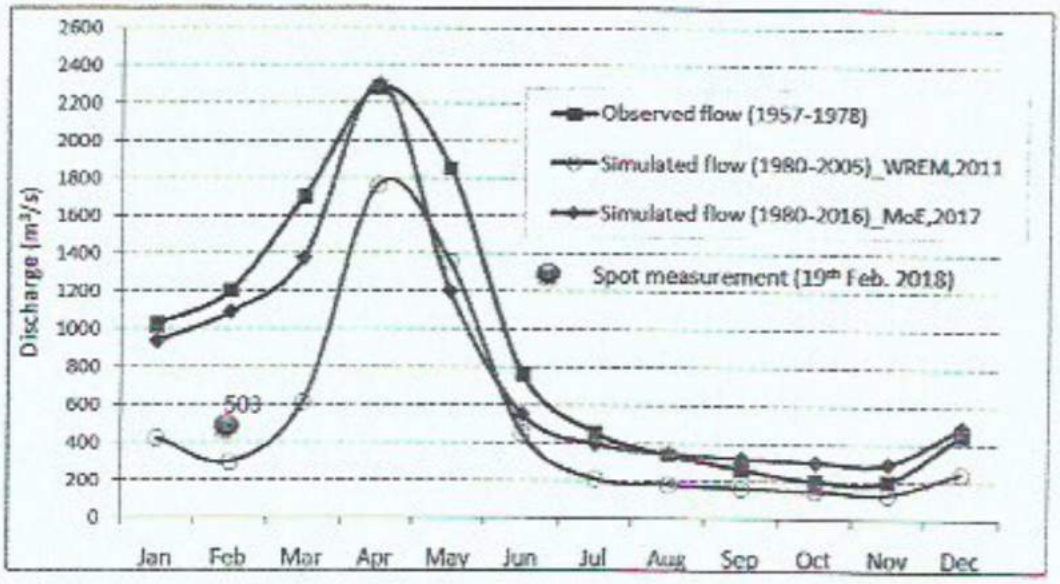


Figure 6: Long-Term Monthly Mean Discharge at Stiegler's Gorge

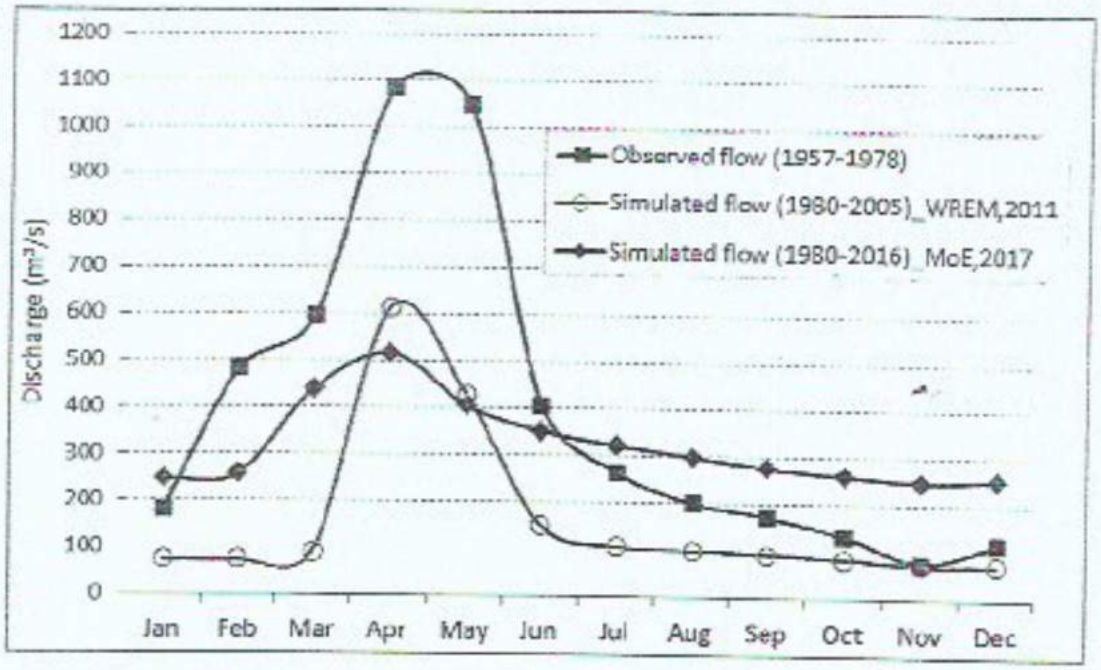


Figure 7: Long-Term Monthly Minimum Discharge at Stiegler's Gorge

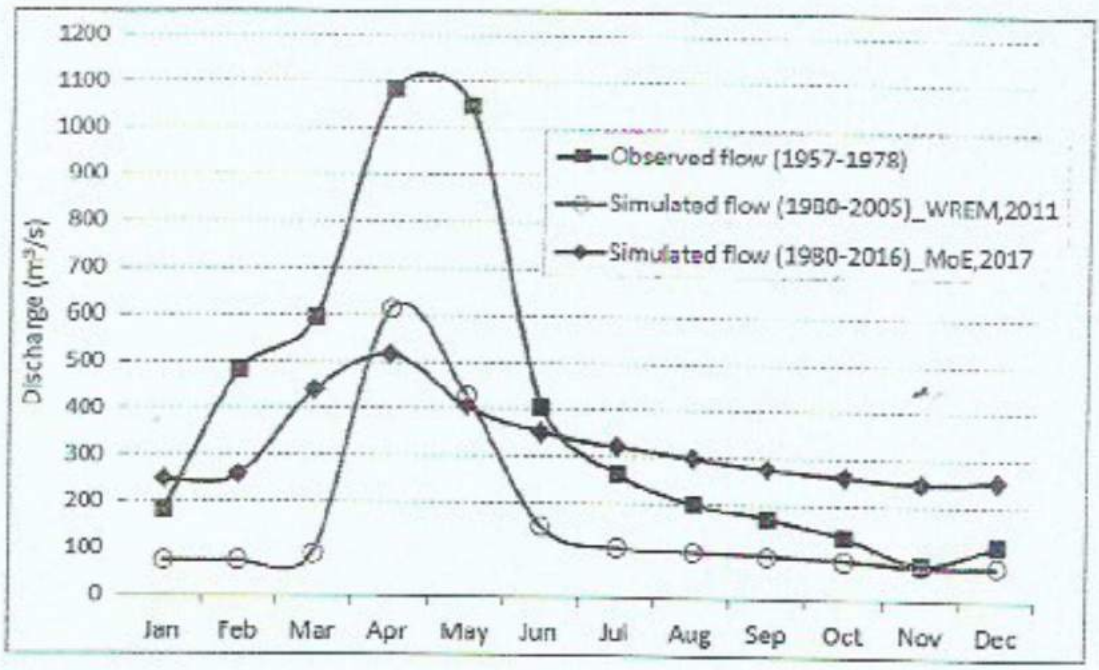


Figure 7: Long-Term Monthly Minimum Discharge at Stiegler's Gorge

- ***Sediment inflow***

Most of the sediments at Stiegler's Gorge are mainly contributed from Kilombero and Luwegu rivers. The Great Ruaha catchment contribution is minimum due to sediment deposits in Mtera and Kidatu dams. The Kilombero and Luwegu catchments are the major sources of the sediments. According to soil erosion assessment done under TEEB/UNEP project (2017), high soil erosion in Kilombero basin occurs in the highland areas (Njombe region). Most of these sediments are deposited in the Kilombero wetlands and hence reducing significantly the sediment load transport to Stiegler's Gorge site. The data for suspended load at Stiegler's Gorge are available for the period commencing 1954/55 (hydrological year) up to 1969/70 as shown in Figure 4.7. The mean annual sediment transport for the 16 years was about 17 million tons.

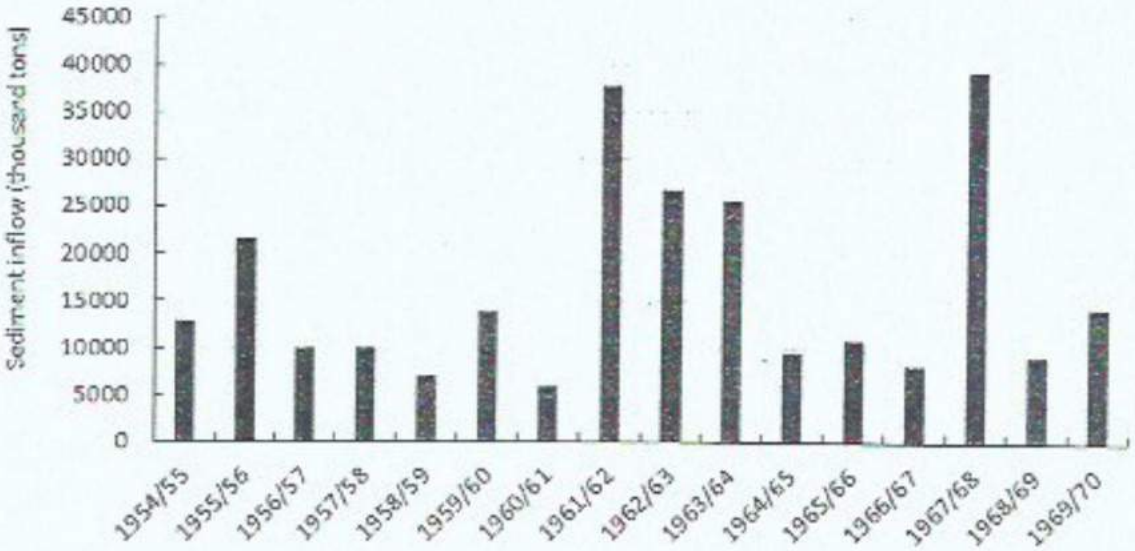


Figure 9: Suspended Sediment Load at Stiegler's Gorge

The other available data is from FAO 1960 reconnaissance survey. From the monthly total sediment transport data from 1955-1960, the annual average sediment was estimated to be 15.9 Million ton. Temple and Sudborg (1972) in the Journal of Geografiska Annaler also reported a relatively similar figure of 15.6 to 17.8 Million ton per year. The mean monthly sediment inflow at Stiegler's Gorge for the measurement conducted in 1960s and 1970s are as presented in Figure 4.8:

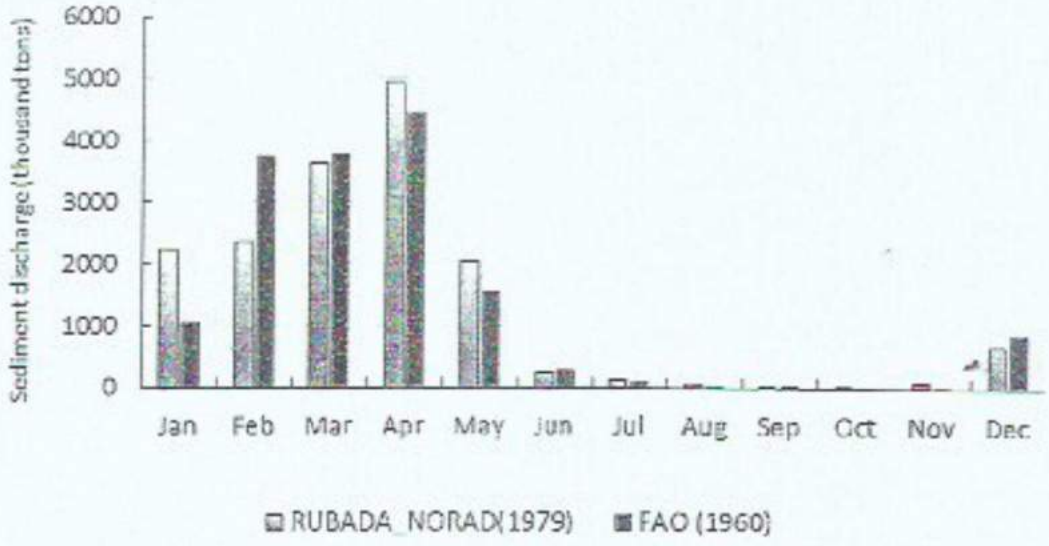


Figure 10: Mean Monthly Sediment Inflow at Stiegler's Gorge

- ***Sediment retention in the reservoir***

Out of the total quantity of sediments brought to the planned reservoir through the channel system of the catchments, a major portion of the sediment is deposited in the reservoir-t-be area and the balance would be moved downstream by overflow and reservoir withdrawals. The amount of sediment likely to be trapped in the reservoir is of importance in the long-term planning and operation of the reservoir. The ability of a reservoir to trap and retain incoming sediment is known as trap efficiency and is usually expressed as a percent of sediment yield of the catchment retained in the reservoir.

The Brune's curves (Figure 4.9) were used to assess the trap efficiency of the reservoir, namely the percentage of the total inflowing sediment that is retained in the reservoir. Trap efficiency of a reservoir depends on a host of parameters, the most important being (a) sediment characteristics, (b) detention-storage time, (c) nature of the outlets, and (d) reservoir operation.

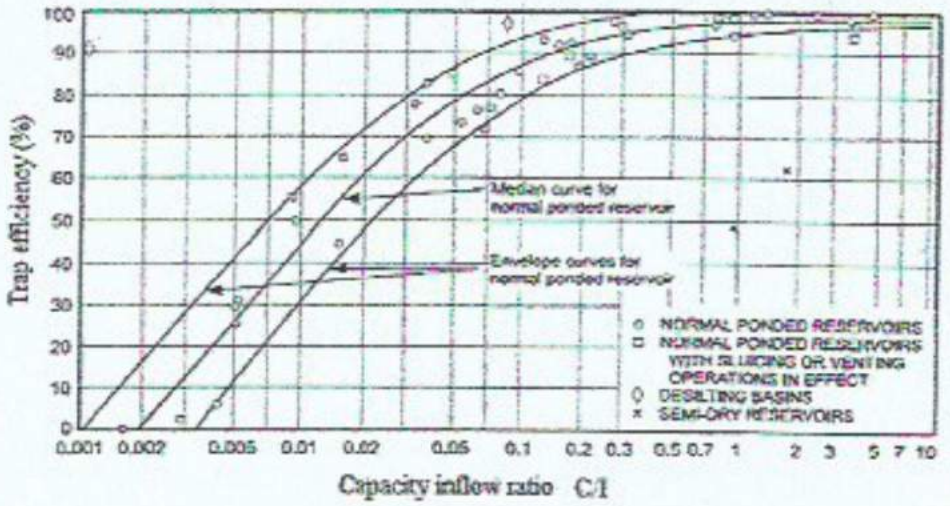


Figure 11: Reservoir Trap Efficiency as a Function of Capacity Inflow Ratio (Brune, 1953)

Figure 4.10 shows the median and the envelope curves for normal ponded reservoir, relating the trap efficiency (η_t) with capacity-inflow ratio (C/I). Approximate Stiegler's Gorge storage volumes for various water levels are as shown in Figure 2.8. Dead storage being defined as storage below 158 masl.

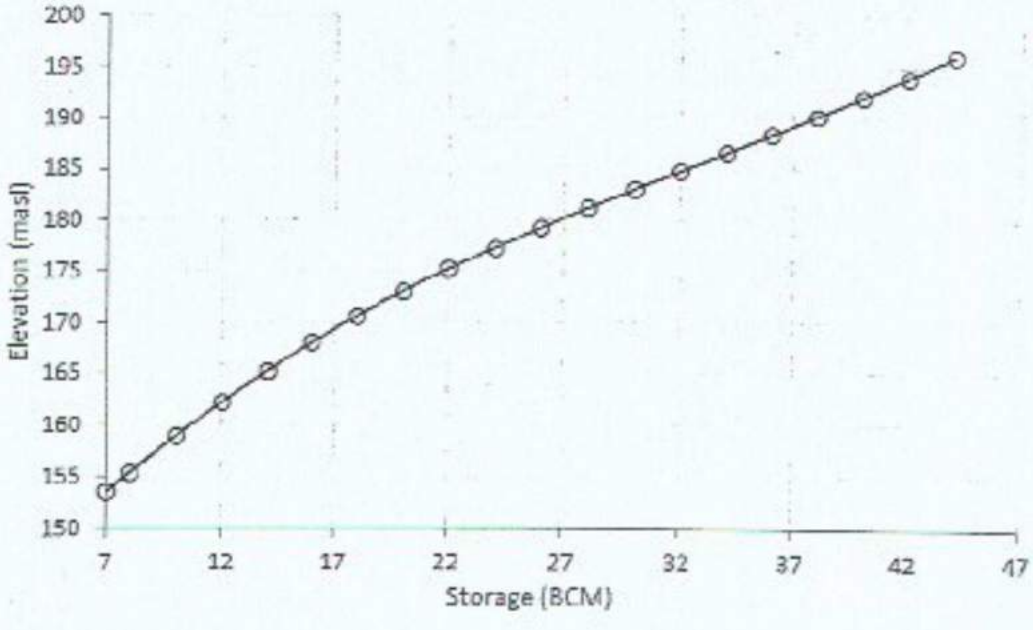


Figure 12: Stiegler's Gorge – Elevation-Storage Curve
Source of data: MoWI/Rufiji DSS, 2011

The inflow at Stiegler's Gorge (I) is 28 BCM and the capacity of the reservoir at flood release level (FRL) (C) is 36 BCM, which implies that the ratio of capacity to inflow (C/I) is approximately 1.2. From Brune curves, the trap efficiency is about 98%. The average annual sediment inflow at the Stiegler's Gorge is about 16 million tons per year. Assuming sediment density of 1,250 kg/m^3, this is equivalent to 12.8 mil. m^3 of sediment deposits annually. Reduction of the reservoir storage in 100 years will be about 4% and 13% of the total storage capacity and dead storage, respectively. This clearly shows that the storage volume of the reservoir will not be influenced by the sedimentation within the economic life-time.

- ***Water quality***

During the development of the Integrated Water Resources Management and Development Plan (IWRMDP) for the Rufiji Basin, water quality data for the years 2000 to 2001 were collected from the basin water quality laboratory. Also, in this study, water quality sampling and measurement of parameters was conducted for the selected sites in the Lower Rufiji. The summary of pH and turbidity variation in surface waters in Great Ruaha and Kilombero sub-basins is as presented in Figures 4.11 & 4.12. The rivers in Great Ruaha sub-basin have a weakly alkaline character while those in Kilombero mostly have a weakly acidic character. In terms of turbidity and colours, Great Ruaha sub-basin rivers have more serious colour and turbidity problems than Kilombero subbasin rivers.

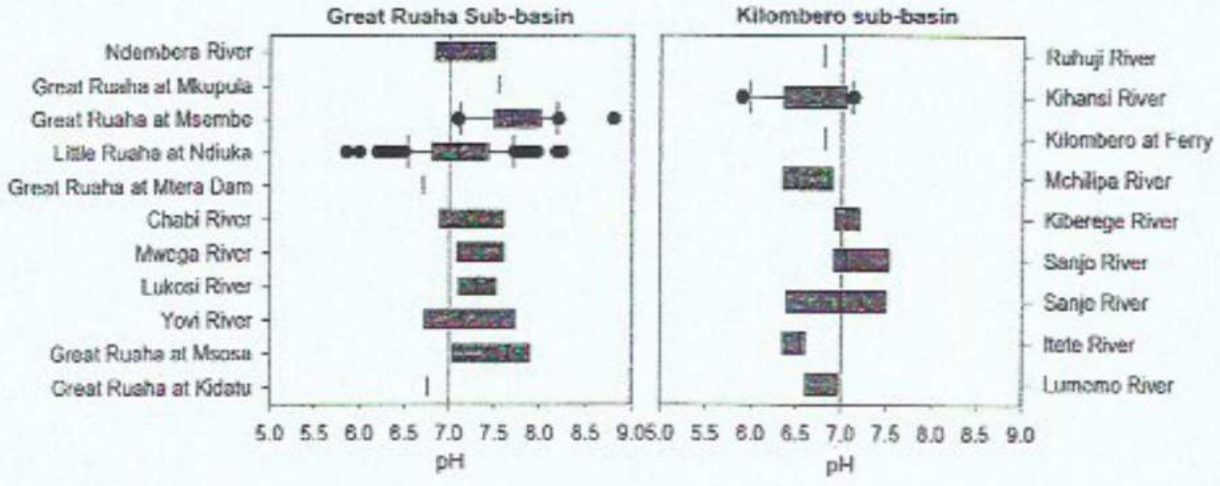


Figure 13: Variation of pH in Surface Water for Great Ruaha and Kilombero Sub basins.

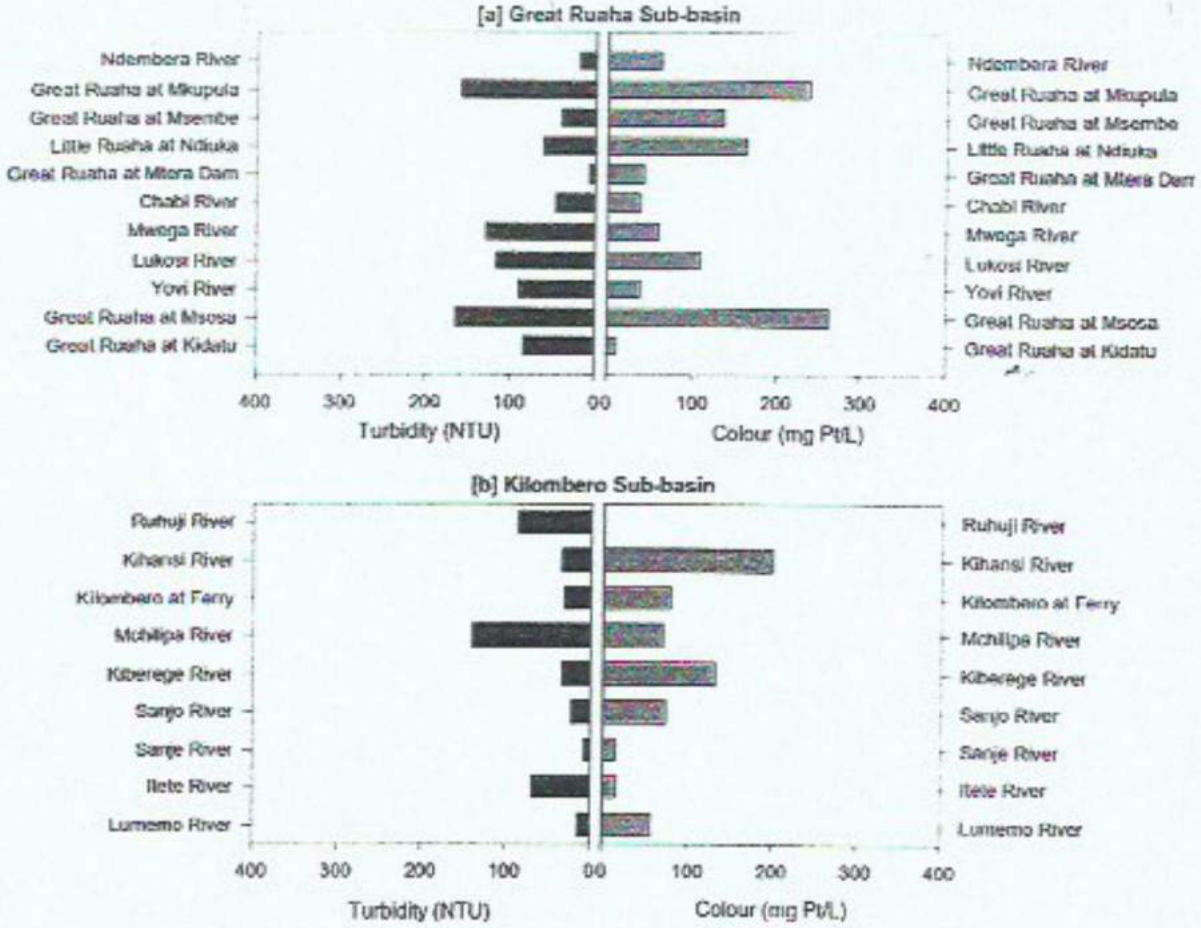


Figure 14: Variation of Turbidity and Ccolour in the Major Rivers in (a) Great Ruaha Sub-basin; and (b) Kilombero Sub-basin Source: MoWI, URT (2011)

The results of the field measurements conducted on 19th February 2018 are as presented in Table 4.2. The assessment of the physical and chemical parameters relied on comparison of the results of water quality analysis with the corresponding parametric values of the latest Tanzania Standard, in this case the Drinking (potable) water (latest TZS 789:2008). According to physical and chemical parameters analyzed, the water should be treated for colour and turbidity removal and pH adjusted to the acceptable limit before being used for domestic purposes

Table 3: Water Quality Assessment Results

S/N	Parameters	Sampling points and corresponding water quality parameters			Remarks
		Stigler's Gorge at Old Intake	Stigler's Gorge at Serena	Lower Rufiji at Mloka	
1	pH	5.7	5.5	5.4	pH is not within the acceptable limits (6.5-9.2), to be adjusted to the acceptable limit before used for domestic purposes
2	Temp. (°C)	30.8	30.8	30.82	-
3	Tubidity(NTU)	114	86.2	131.435	High turbidity, Acceptable limits: 5-25
5	Colour (mgPt/l)	176	182	215	Above the recommended limit (50 mgPt/L)
7	Total Dissolved solids (mg/L)	32	47.1	59.9	Acceptable
8	Conductivity at 25 °C uS/cm	79.8	115.5	149.3	
11	Total alkalinity as $CaCO_3$	18.3	38	62.0	
12	Carbonate(mg/l)	14.3	36.1	47.7	
15	Non-carbonate (mg/l)	0	0	0	
14	Calcium (mg/l)	3.9	5.7	6.4	

15	Magnesium (mg/l)	1.1	5.4	7.8	
16	Sodium (mg/l)	7	8.8	9.6	
17	Potassium(mg/l)	5	1.7	4.5	
18	Chloride(mg/l)	10.7	10.7	10.7	
19	Orthophosphate(ml/l)	0.106	0.151	0.129	
20	Nitrate(mg/l)	1.184	0.348	1.699	
21	Nitrate Nitrogen(mg/l)	0.267	0.078	0.384	
22	Iron(mg/l)	0.713	0.803	0.777	
23	Manganese(mg/l)	0.525	0.099	0.383	
24	Sulphate(mg/l)	6.7	10.5	5.2	

- *Water resources assessment*

Irrigation water use

Irrigation is mainly practiced in the Great Ruaha and the Kilombero River catchments, where there is large potential. A significant part of the basin falls within national protected areas and cannot therefore be used for farming purposes. Eighty five percent of the Upper Great Ruaha River Catchment is within the Rungwe and Kisigo Game Reserves and the Ruaha National Park. The Rufiji, Kilombero, and Luwegu River systems are also largely enclosed within the Selous Game Reserve and to a lesser extent the Udzungwa Mountains National Park. Table 4.3 shows potential irrigation areas in the Rufiji basin.

Table 4: Potential Irrigation Areas in the Rufiji Basin

Valley	Potential (ha)	Percentage (%) of Total
Usangu	208,000	33
Little Ruaha	4,800	1
Kilombero	329,600	53
Lower Rufiji	80,000	13
Basin Total	622,400	100

Currently, withinr the Great Ruaha sub-basin, there are three large-scale paddy irrigation farms, Mbarali State Farm, Kapunga State Farm, and Madibira Small Holder Scheme. Tea, coffee, and tree plantations are found in the upland areas. Table 4.4 shows the summary of water use and abstractions for the selected schemes.

Table 5: Summary of Total Abstraction from Great Ruaha Sub-basin Rivers

Irrigation Scheme	Estimated Gross Demand (l/sec)	Actual Abstraction (l/sec)	Excess Withdrawals over requirements (l/sec)
Mbarali (Farm off-take)	350	2000 – 4000	1650 – 3650
Kimani River (Various off-takes)	40 – 50	200 – 500	150 – 350
Hassan Mulla (Mbarali River)	110	150 – 200	40 – 90
Kapunga (Ruaha River)	200 - 300	600 - 1200	300 - 900
Total			2140 - 5000

Source: Machibya et al. (2005)

However, the current major irrigation water abstraction is by Kilombero Sugar Company, the Mufindi Paper Mill, and Unilever Tea Tanzania Limited. Figure 4.13 shows the existing major water abstractors and the amounts approved by RBWO.

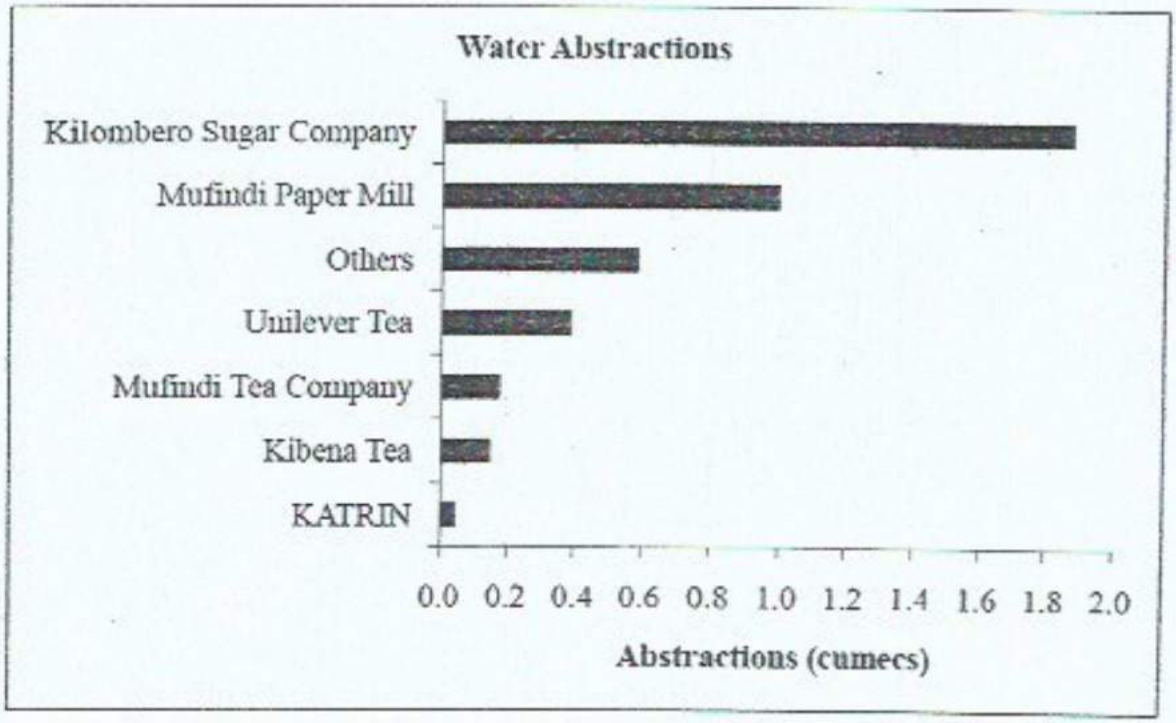


Figure 15: Existing water abstractions in Kilombero subbasin
Source: Ministry of Water and Irrigation, URT/WREM, 2011

In the Lower Rufiji Valley, about 114,000 ha are estimated as suitable for irrigation, of which about 57,000 ha are highly suitable for agriculture (especially rice production) (WREM, 2011). Some 33,000 ha were rated as moderately suitable, and the balance of 24,000 ha, mostly in the delta, was marginally suitable due to potential salinity problems. There are currently several plans for irrigation development in the sub-basin. Two irrigation schemes, one in Nyamwage (300 ha of rice paddy) upstream of Utete and another in Ngorongo on the northern bank of the Rufiji River, are in advanced planning stages.

Hydropower planning in the basin

The Mtera, Kidatu, and Kihansi hydropower plants are currently operational, while several other sites have been identified as having significant hydropower development potential (Table 4.5). Hydropower is commonly assumed to be a non-consumptive water use. However, often there is a significant reservoir evaporation loss. Thus, the first and direct aspect of a hydropower water use assessment is to assess the evaporation losses from the reservoirs that enable hydropower generation. The second important aspect of the assessment is to establish the hydropower generation amounts associated with different water availability levels. This indirect water use aspect is not related to water consumed by the hydropower generation process; rather, it is related to water that must be in the river to enable hydropower at certain generation levels (URT/WREM, 2011).

Table 6: Operational and Planned Hydropower Stations in the Rufiji Basin

Operational Hydropower Plants	Capacity (MW)	Potential Hydropower Plants	Capacity (MW)
1. Kidatu	200	1. Stiegler's Gorge	2100
2. Mtera	80	2. Ruhudji	500
3. Kihansi	180	3. Mpanga	160
		4. Mnyera	485
		5. Lukuse	130
		6. Iringa	87
		7. Shughali Falls	464
		8. Ikondo	340
		9. Kingenena	Not determined
Total	**460**	**Total**	**4,266**

Four scenarios are modelled in the Rufiji DSS, which includes six hydropower projects: Mtera, Kidatu, Kihansi, Ruhudji, Mpanga, and Stiegler's Gorge. The features of the scenarios are as follows:

Scenario A: Includes the three existing storage and hydropower projects (Mtera, Kidatu, and Kihansi). No irrigation withdrawals are assumed to take place upstream Mtera.

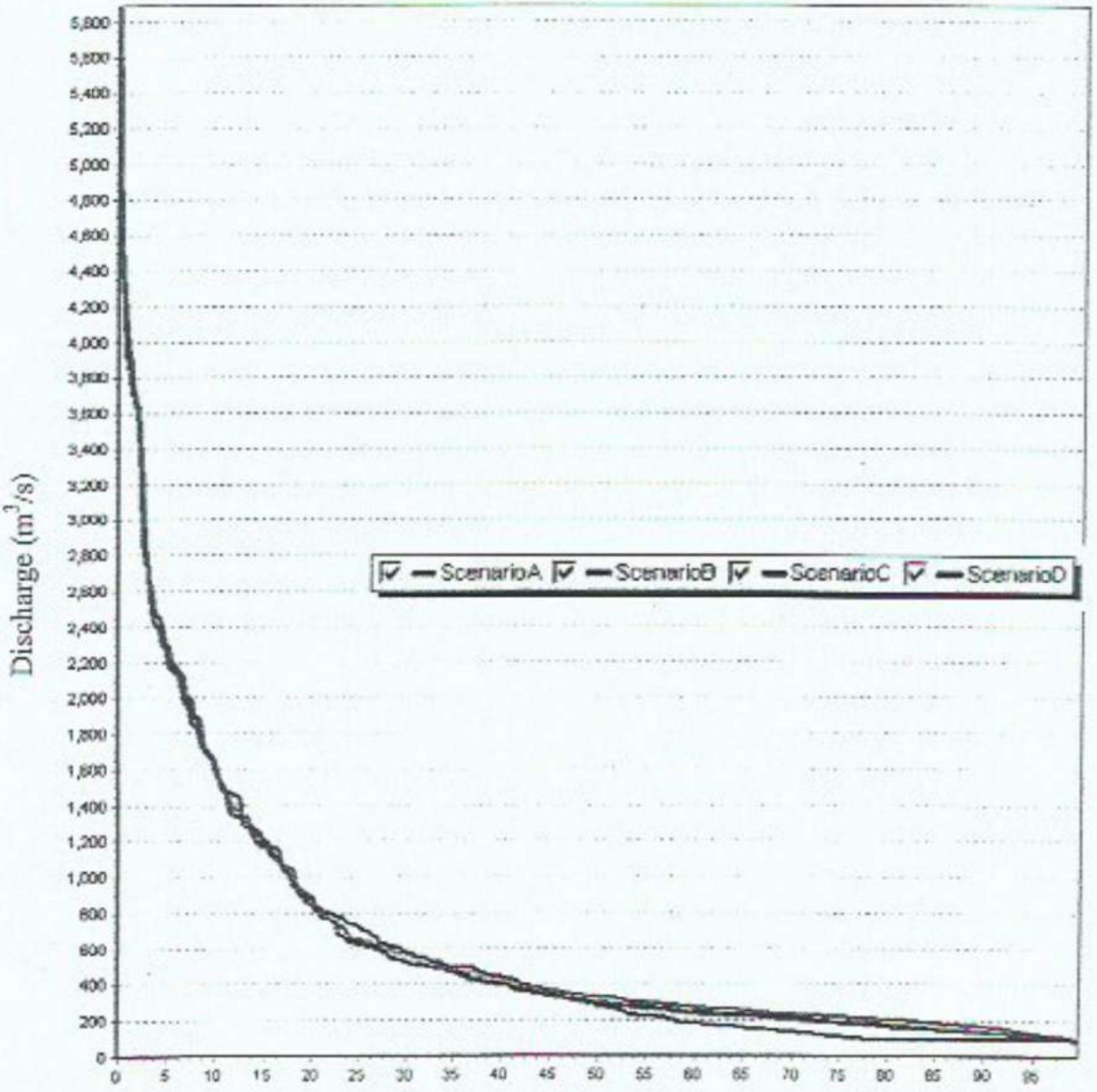
Scenario B: Serves as the baseline scenario representing the current conditions. It has the same setup as Scenario A, but it assumes that irrigation withdrawals upstream Mtera are at their currently estimated level of 25.9 m^3/s.

Scenario C: Similar to B but assumes 20% increased irrigation withdrawals (31 m^3/s).

Scenario D: Designed to evaluate the hydroelectric energy generation benefit and water resources impacts of the planned hydropower projects. In this case, all existing and planned reservoirs (Mtera, Kidatu, Kihansi, Ruhudji, Mpanga, and Stiegler's Gorge) are assumed to be operational. Irrigation withdrawals are at the current level of 25.9 m^3/s.

The assessment results under scenario D (existing and planned plants with current irrigation withdrawals), indicates that the system average annual energy generation increases to 10,083 GWH and the firm energy generation to 7,099 GWH. The Stiegler's Gorge firm energy

generation is 3,011 GWH, while its maximum annual generation is 8,763 GWH. The flow frequency curves downstream of Stiegler's Gorge under the four scenarios are as shown in Figure 4.14. In the low flow region, however, they exhibit differences, with Scenario A maintaining the highest low flows, followed fairly closely by Scenarios B and C, and, at some distance, by Scenario D. Thus, in Lower Rufiji and the Delta, upstream irrigation and hydropower developments have the potential to impact the river regime in the low flow season. However, it is possible to rectify the low flows impacts by proper (adaptive) management of the Stiegler's Gorge releases during the low flow season.



generation is 3,011 GWH, while its maximum annual generation is 8,763 GWH. The flow frequency curves downstream of Stiegler's Gorge under the four scenarios are as shown in Figure 4.14. In the low flow region, however, they exhibit differences, with Scenario A maintaining the highest low flows, followed fairly closely by Scenarios B and C, and, at some distance, by Scenario D. Thus, in Lower Rufiji and the Delta, upstream irrigation and hydropower developments have the potential to impact the river regime in the low flow season. However, it is possible to rectify the low flows impacts by proper (adaptive) management of the Stiegler's Gorge releases during the low flow season.

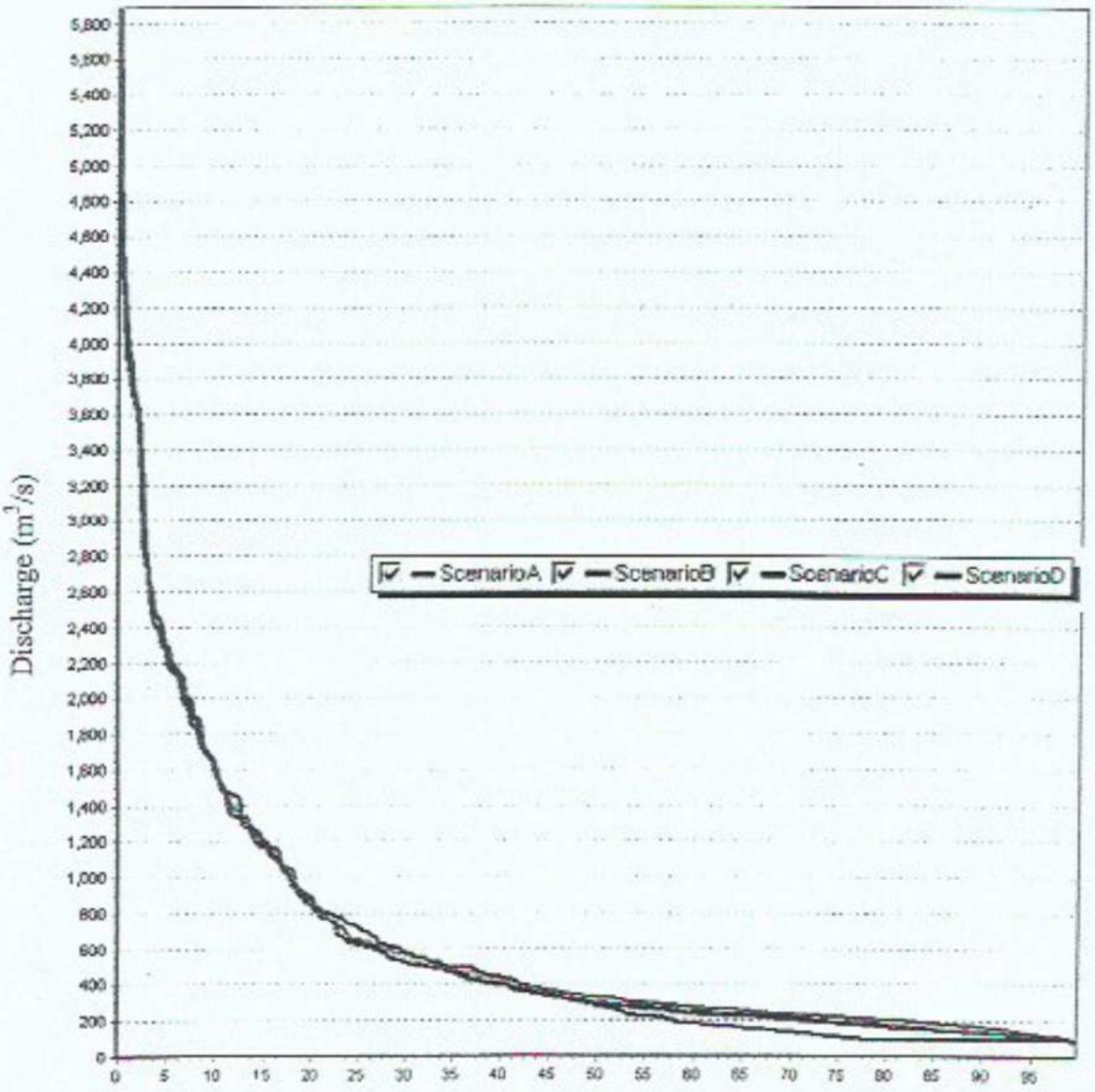


Figure 16: Lower Rufiji Monthly Flow Duration Curves (A, B, C, and D)

4.2 Biological/Ecological Environment

4.2.1Vegetation

Being part of the Zambezian regional centre of endemism, Selous Game Reserve (SGR) possesses a very diverse flora with an estimated total of over 1800 plant species (Vollesen, 1980). Miombo woodlands cover some 75% of Selous GR, as well as most of the peripheral areas of the ecosystem. The remaining portion is characterized by ground water forest in seepage areas, where *Phoenix reclinata* is common; riverine Forest along the major rivers; and coastal dry evergreen forest in higher areas of the western watershed receiving over 1000 mm of rainfall per annum are common. The Great Ruaha and Rufiji rivers form a barrier between the miombo woodland in the south of SGR and the *Acacia-Combretum* wooded grassland of the north. This open wooded grassland occurs on alluvial hardpan and is also characterized by *Terminalia spinosa*. Along the Rufiji River the extensive, swamps and lakes with their tall *Borassus aethiopum* palms are characteristic.

The Selous Game reserve has an exceptionally high variety of habitats including Miombo woodlands, open grasslands; riverine forests and swamps, making it a valuable laboratory for on-going ecological and biological processes. Habitats include grassland, typical Acacia savanna, wetlands and extensive Miombo woodlands (Selous, 2018). The site for the proposed development is a deep gorge with rocky characteristics whereby the shallow soils developed support costal evergreen type of vegetation. The characteristic species include *Spirostachys africana, Holarrhena pubescens Milletia usaramensis, Albizia gurmiferae Brachystegia speciformis, Afzelia quanzensis, Albizia gummifera, Albizia amara, and Albizia veucosa*. The reservoir site north of the Rufiji River is mainly covered by Combretum bushland changing into Combretum-Commiphora woodland. Along the Ruaha River Riverine forest dominates. The characteristic species on Combretum bushland /woodland include *Combretum apiculetum, Combretum hereroense, Combretum molle, Commiphora africana, Acacia spirocarpa, Acacia seyal, Dalbergia melanoxylon, Cordia cinensis and Terminalia sericea.* The site earmarked for staff quarter is dominated by miombo woodland with species *Brachystegia speciformis, Afzelia quanzensis, Albizia gummifera, Milletia stuhlmanii, Pteleopsis myrtifolia, Albizia amara, and Albizia verucosa.*

The above vegetation types will also be impacted by development of access roads to various components of the project. On the lower Rufiji and Tagalala Lakes the vegetation is more open woodlands with *Terminalia sericea* and *Terminalia spinose* dominating in some areas, whereas riverine species such *Phoenix rectina, Rauvofia sp, Syzygium sp, Borrasus aethiopicum and Hyphaene compressa,* are characteristics in some area. This type of vegetation extending into ex-bow Lakes down-stream. The ground layer is covered by grass species such as *Pannisetum sp, panicum maximum, Eriochloa parvifolia, Echnochloa haploclada, Echnochloa colunum, Chloris gayana* and Sedges mainly cyperus sp; along the rivers reeds and typha are dominant.

The Rufiji delta is characterized by mangrove forests gazetted as forest reserve (Tanzania Forest Policy, 1998). Eight (8) species of mangrove occur (*Avicennia marina*; *Bruguirea gymnorrhiza*; *Ceriops tagal*; *Lumnitzera alba*; *Sonneratia alba*; *Rhizophora mucronata*; *Xylocarpus granatum*; and *Heritiera littoralis*). A recent rapid assessment in the northern delta estimated above- and below ground biomass of 120 tons ha^{-1} and 50 tons ha^{-1} respectively. The latter represent carbon stock of 60 Mg ha^{-1} and 25 Mg ha^{-1} of above- and below-ground pools. Soil carbon analysis indicates that mangrove sediments of up to a depth of 1 meter in the delta store about 850 Mg ha^{-1}. Total carbon pool for the Rufiji delta therefore is estimated to be about 935 Mg ha^{-1}. This total carbon pool size is comparable to global estimates (Donato*et al.* 2011; Kauffman *et al.* 2011; Alongi 2014) that demonstrate mangroves as one of the carbon rich ecosystems and therefore important carbon sinks for climate change mitigation.

Forest inventory carried by TFS in the project area to characterized volume of the valuable timber species that can be salvaged from the project area, indicate that large part of the project area is characterized by species forming class IV of the valuable timber species classification (Figure 4.15) (TFS 2018). Similarly the report indicates that out of 107 tree species recorded nine dominant tree species includes *Pseudolachnostylis maprouneifolia, Sclerocarya birrea, Manilkara mochisia, Xeroderris stuhlmanii, Pteleopsis myrtifolia, Terminalia sericea, Pterocarpus angolensis, Diospyros kirkii* and *Afzelia quanzensis* (Table 4.6)

Table 7: Dominant Tree Species by Total Volume

Dominant Tree spp	Total Volume (m3)
Pseudolachnostylis maprouneifolia	447,220.770
Sclerocarya birrea	252,252.808
Manilkara mochisia	192,579.128
Xeridoris schuhlmanii	187,993.268
Pteleopsis myrtifolia	185,789.729
Terminalia sericea	166,307.413
Pterocarpus angolensis	159,435.780
Diospyros kirkii	154,543.931
Afzelia quanzensis	149,696.692
Others	1,599,543.305
Total	**3,495,362.823**

Source TFS Forest Inventory Survey 2018

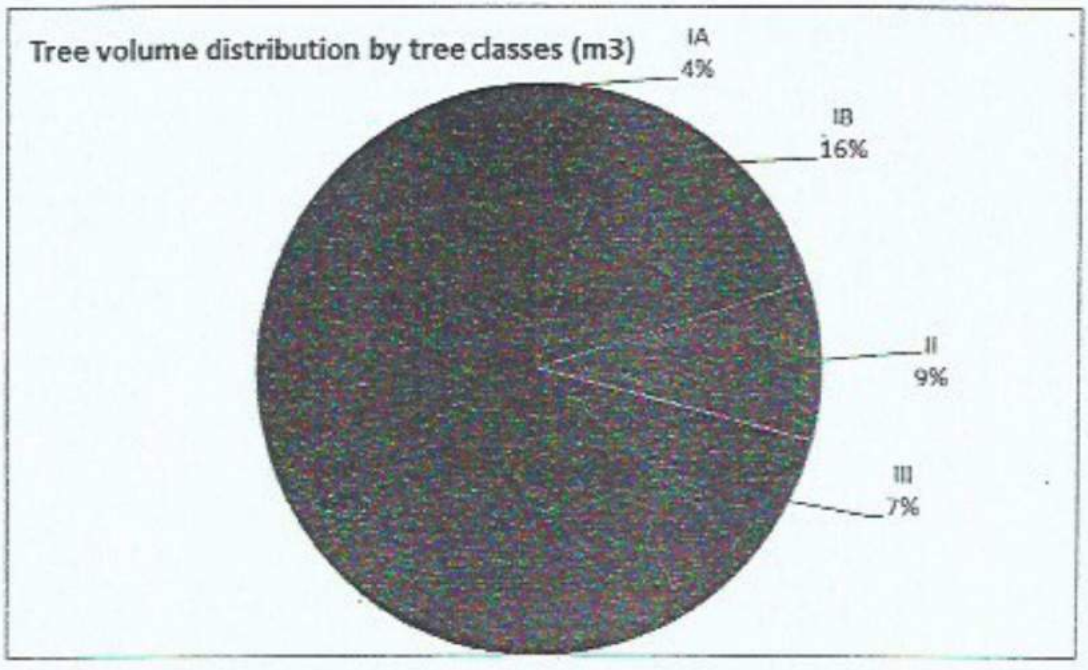


Figure 17: Volume distribution of valuable timber species by class; Source TFS Forest Inventory Survey 2018

4.2.2 Wildlife

The Kilombero River, which is part of the Selous Ecosystem and the Rufiji River System, contains 70% of the world's Puku (*Kobus vardoni*) population, the only viable population of Puku in Tanzania. Puku is an atypical floodplain antelope and is not represented in any existing National Park or Game Reserve in the country. The wetland is a braided channel floodplain. Pressures on natural resources in the area include teak plantations that have replaced substantial Miombo woodland, timber logging of *Miletia excelsa* , wildlife hunting and overfishing in the Kilombero River. With regard to ecological threats in the Kilombero Valley, poor agronomic practices especially the slash-and-burn agriculture with its shifting agriculture attribute, has been blamed for the the extensive clearance of vegetation, hence the observed desertification and loss of wildlife habitats (TAWIRI, 2009; 2012). In recent years there has been large concentration of herds of cattle around the Kilombero Valley and this has resulted into overgrazing and destruction of habitats and water sources. Use of illegal fishing gears destroys fish breeding sites, while a number of other fishing methods are detrimental to the regeneration of the fishing stocks. Apart from the ecological hazards of these methods, breeding grounds in these areas are completely destroyed. Apart from river siltation, the use of cyanide and mercury to extract gold poses both environmental and health effects to people around the area, while poaching of wildlife and trophies has been a major conservation problem.

Most of the population in the Great Ruaha Basin depends on irrigation and other water-related activities (fishing and livestock keeping) to sustain their livelihoods. Irrigated paddy is the main water user in the basin. Due to these abstractions, downstream wetlands have zero or very minimal flows in the dry season. This has resulted in transforming the western wetland from permanent to seasonal wetland and diminishing the amount of water supplied to the main Ihefu wetland. Below the Ihefu wetland, the Great Ruaha River (GRR) has been drying up completely during the dry season for many years. As the GRR is the major source of water for the Ruaha National Park (RNP), this has caused significant ecological change of both aquatic ecosystems and wildlife in the park. Downstream of the RNP is the Mtera Reservoir, which generates about 80 MW of electricity and acts as a regulating reservoir for the large Kidatu hydropower scheme, which generates some 204 MW. According to the Rufiji Environment Management Project

(REMP) (2001), it is the dry season flows which have been reduced, and there is little fresh water in the Ruaha National Park during the rainy season contributing to serious water use conflicts, human-wildlife conflict due to displaced animals, and decreased revenues from tourism in the Usangu Game Reserve and the Ruaha National Park.

The fertile Lower Rufiji Floodplain is up to 20 km wide and is traditionally planted with rice and maize. In a number of places the floodplain is characterised by lakes on the elevated terraces and linked to the Rufiji River and where fisheries is another important livelihood activity. The river has constructed a vast delta, partially covered by some 500 km2 of mangrove, the largest stand in East Africa (Duvail & Olivier Hamerlynck, 2007). Much of the delta zone is within the Rufiji District. The Rufiji District land has an area of 13, 340 km2 (1,334,000 ha) of which almost 47% constitutes the Selous Game Reserve; 36% is general land where settlements and activities such as agriculture are permitted; 12% is protected forest where settlements and agricultural activities are prohibited; and about 5% of the area consists of rivers, swamps, lakes and the sea (Arvidson *et. al.,* 2009).

At the time of inscription of the Selous Game Reserve as a World heritage site it had some of the largest remaining populations of Africa's iconic mega-fauna, including more than 100,000 elephants, 200,000 buffalo, 2,000 black rhino, 18,000 hippopotamus and a healthy population of wild dog. Approximately 750,000 large mammals of 57 species were recorded in 1986 (UNESCO, 1982). The reserve had a higher density and species diversity than any other area of miombo woodland, with one of the world's Endemic Bird Areas, and 450 species of birds. Other rare and endemic species include the lion, cheetah, Sanje crested mangabey and Udzungwa red colobus monkey. Amongst the birds, globally threatened species include the wattled crane (*Grusca runculatus*), lesser kestrel (*Falco n aumanni*), the endemic Udzungwa forest partridge (*Xenoperdix udzungwensis*) and rufous-winged sunbird (*Nectarinia rufipennis*). However, recent wildlife census in SGR (TAWIRI, 2014) indicated that some animal population estimates had changed significantly to approximately 78,231 for buffalo; 23,756 for hippopotamus; 23,677 for impala; 15,217 for elephant; 16,240 for zebra; 16,939 for wildebeest and 3,155 for giraffe compared to the situation during the inscription of the SGR as a World Heritage Site. These results indicate significant decline in elephant and buffalo while zebra, impala, hippopotamus

and wildebeest remained unchanged. Rhino significantly declined and appears to be close to local extinction, since the last one was spotted in Matambwe in 2013 and to-date only indirect signs of their presence can be noted. The cheetah appears also to have locally gone extinct most probably due to their habitat degradation. It is apparent that decline and almost complete disappearance of iconic mega-fauna as well as endangered and rare species has already taken place even without the Stiegler's project.

4.3 Socio-Economic Environment

4.3.1 Introduction

The Rufiji watershed is critical for Tanzania's development, particularly as it relates to food and water security. Many projects that relate to agriculture and water as part of the Big Results Now (BRN) initiative are planned in the Rufiji basin. Notably, there are competing water use and land use options in the basin including; forestation of mountain grasslands in the upland areas, dam construction for irrigation and power generation, and water-intensive farming, all of which make it a challenge to sustainably manage the watershed. The Rufiji Basin has great potential for irrigation agriculture. Over 622,400 hectares are suitable for irrigation farming, comprising of: Usangu Plains in the upper reaches of the Great Ruaha River (208,000 ha), the Little Ruaha floodplain near Iringa (4800 ha), the Kilombero floodplain (329,600 ha) and the Lower Rufiji floodplain (80,000 ha) (Mwalyosi, 1990) (Figure 4.16). For many years in the past, rain fed agriculture and traditional irrigation farming has been carried out in the basin, mainly on a small scale. Irrigation has been largely based on annual river floods and traditional river canalization in some places. Mechanized farming has been mainly prohibited by high investment costs and frequent disastrous floods (Mwalyosi 1990). The only significant mechanized irrigation farms have been developed at Mbarali (10,000 ha) in the 1960s, Madibira (8,500 ha) and Kapunga in the 1970s. In the late 1990s a 5,000 ha paddy farm formerly under rainfed agriculture, now 100% under irrigation has been jointly developed by Kilombero Plantations Ltd (a joint venture between RUBADA and InfEnergy (T) Ltd.

More recently in 2014, and in order to achieve the Tanzania Development Vision 2025, the Government of Tanzania and other private and public institutions have designed various

strategies and plans country-wide including the Big Result Now (BRN), the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) (Figure 4.17), the *Kilimo Kwanza* Initiatives, and other Regional and District agricultural development plans.

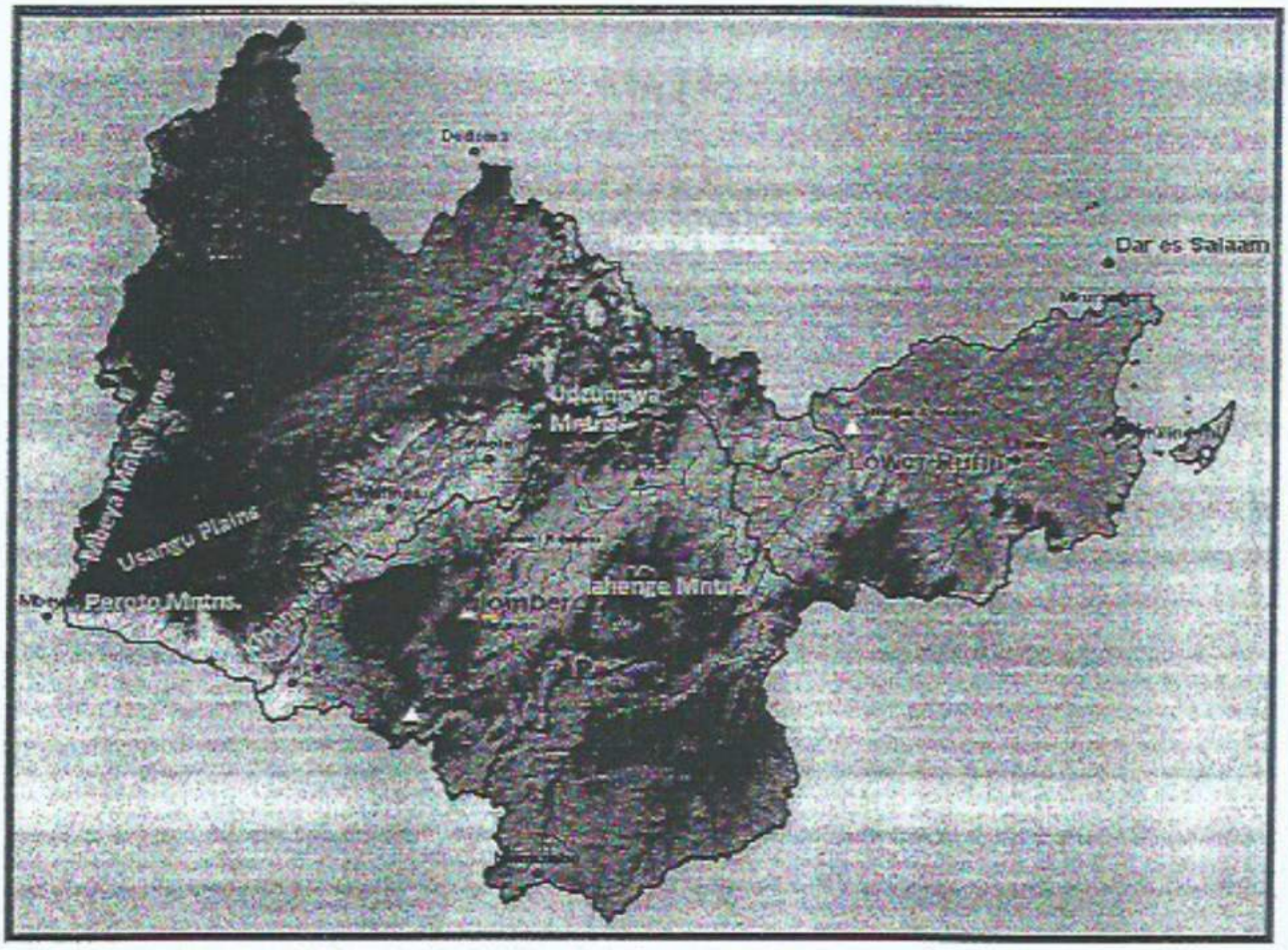


Figure 18: The Rufiji River Basin Showing the Three Major Sub-basins

SAGCOT for example, was intended to work hand-in-hand with BRN to acquire development (project) areas and initiate development plans in the agriculture sector by providing opportunities for smallholder producers to engage in profitable agriculture under the umbrella of BRN. Thus, by 2030 SAGCOT expected to have; (i) 350,000 hectares in profitable production, (ii) 10,000 smallholders would become commercial farmers, while (iii) annual value of farming revenue would be $1.2 billion (Ministry of Agriculture, 2012), all under the Business as Usual (BAU) scenario. Such developments were likely to have significant impact on ecosystem services in Tanzania including the Rufiji River Basin.

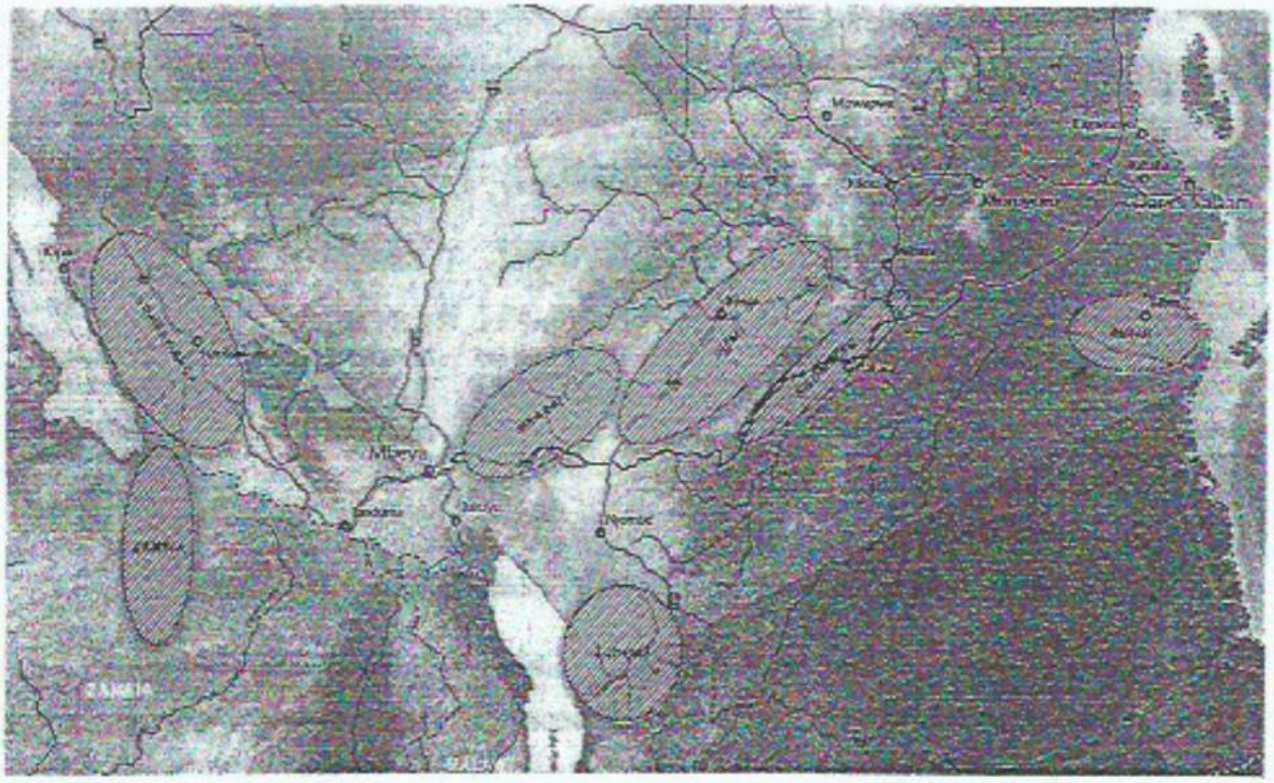


Figure 19: Map of the Southern Corridor (SAGCOT Centre, 2013)

However, SAGCOT has currently changed its focus and objectives and become a public-private partnership mandated to develop commercial agriculture and catalyze an agricultural transformation in Tanzania's Southern Highlands. It has a particular focus on smallholder farmers' support and development within viable commodity value chains. SAGCOT is now delivering results through (i) supporting private-sector led ***inclusive*** and ***sustainable*** growth in key agricultural value chains, (ii) stimulating infrastructural investment, (iii) guiding private-sector investment and financial support particularly related to ***sustainable*** smallholder development, and (iv) creating a critical mass of connected and coordinated small- and large-scale farmers and agribusinesses in the series of six clusters namely Ihemi, Mbarali, Sumbawanga, Kilombero, Ludewa and Lower Rufiji. Most of the growth is sought via building capacity of the smallholders and converting existing brown field investments.

Box: Current SAGCOT's Broad Objectives for 2030 (Kirenga Pers. Commn.)

- Put 350,000 hectares into profitable production, serving regional and international markets;
- Enable over 100,000 smallholders' farmers to become commercial farmers, with access to efficient irrigation technologies, finance and weather insurance;
- At least 420,000 new employment opportunities created in the agricultural value chains;
- More than two million people permanently lifted out of poverty;
- Annual value of farming revenues $1.2 billion; and assured egional food security and nutrition

4.3.2 Demographics and population distribution in Rufiji and Kibiti districts

According to the Tanzania Population and Housing Census of 2012, the Rufiji and Kibiti districts had a population of 217,274 people of which 104,851 were males and 112,423 were females with an average house hold of 4.8 persons (Table 4.7).

Table 8: Population Distribution by Ward in Rufiji and Kibiti Districts

Ward	2012 Population(census)		
	Male	Female	Total
Ikwiriri	5,808	6,392	12,200
Mgomba	4,298	4,729	9,027
Umwe	5,182	5,754	10,936
Utete	2,794	3,084	5,878
Mkongo	2,199	2,420	4,619
Ngorongo	5,902	6,044	11,946
Mwaseni	3270	3121	6,391

Kibiti	7,150	8,006	15,156
Bungu	8,884	9,835	18,719
Mahege	2,831	3,137	5,968
Mchukwi	3,411	3,590	7,001
Chumbi	7,933	8,401	16,334
Mbwara	4,598	5,111	9,709
Mtunda	3,998	4,137	8,135
Ruaruke	3,450	3,779	7,229
Salale	4,462	4,614	9,076
Mbuchi	2,992	3,033	6,025
Kiongoroni	2,433	2,463	4,896
Maparoni	2,788	2,995	5,783
Chemchem	2,446	2,687	5,133
Ngarambe	1,253	1,200	2,453
Dimani	2,701	2,744	5,445
Mtawanya	3,251	3,521	6,772
Mjawa	5,606	6,439	12,045
Mlanzi	2,549	2,667	5,216
Mwambao	2,662	2,520	5,182
Total	**104,851**	**112,423**	**217,274**

Source: National Bureau of Statistics: Tanzania Population and Housing Census, 2012

The districts are largely rural although the population is clustered around Utete (Rufiji District headquarters), Ikwiriri, Kibiti and Bungu townships. Rufiji District is home to several ethnic groups. A growing population in the Rufiji district has led to increased demand for land, and shifting cultivation systems have resulted in extensive clearance of mangroves in some areas of the delta. A remote sensing study by Wang *et al.* (2003) showed that during the period 1990 to 2000, 1,769 hectares of mangrove were lost in the Rufiji Delta. Most of the loss occurred at the upper end of the river mouths and near the edge of the mangroves and was caused by the expansion of agricultural activities. In addition some areas of mangroves have been cleared and replaced with solar evaporation pans for the production of salt.

Without strong management interventions and enforcement strategies, the unregulated clearance of mangroves has the potential to impact upon seagrass habitats utilized by foraging marine turtles since mangroves play an important role in maintaining water clarity by trapping sediments released by land based activities. The success of the artisanal prawn fishery in the Rufiji Delta is dependent on the survival of nursery grounds within mangrove forests and in this respect, prawn fishers have an important role to play in protecting mangrove habitats from clearance for agriculture.

4.3.3 Main economic activities of the people in Rufiji and Kibiti districts

- *Agriculture*

The main economic activity of the people in Rufiji and Kibiti is subsistence farming relying on the periodical flooding of alluvial soil for rice and maize farming. Other crops that are found include cassava, millet, sesame, coconut, cashew nuts and fruits that grow mostly on elevated land. Animal husbandry and associated farming practices have started to emerge recently with the influx of Sukuma people from the Western and Lake Zones.

Figure 20: Agricultural activities in the Lower Rufiji

Agricultural cultivation in the Rufiji District is dominated by the flood plain agriculture. Estimates show that about two thirds of the population in the district is dependent on flood plain

agriculture (Havnevik, 1981). Another two agricultural systems - which are of less importance, are the hill agriculture and the Delta agriculture. According to Lema (1979), the Rufiji flood plain agriculture is characterized by two cultivation periods, which overlap each other. These are the masika (flood period) and the mlau (flood recession period). The main characteristics defining flood plain agriculture, includes the domination of soils by clay - which are associated with high moisture retention capacity, but difficult to till. Other dominant soils are the 'mbaringa' soils, which are found in elevated grounds. These are medium textured soils with excellent physical properties. Another important feature is the floods.

The floods have various roles in the Rufiji valley and Delta as follows: (i) compensating for shortage of rainfall; (ii) regeneration of soil fertility and; (iii) creation of favourable conditions for dry season cultivation and sustaining a large mangrove forest in the Rufiji Delta. The Rufiji Delta agriculture, according to Havnevik (1981) can be divided into two categories. The first category is the 'outer Delta' characterized by a shortage of land, sandy soils and high salinity due to tidal water. The floods of Rufiji River (if favourable) bring a lot of fresh water that lowers the salinity, and creates conditions favourable for rice production (Plate 4.1). This makes the agriculture flood dependent. During low floods the water becomes more saline and hence lowers the crop output. The second category is the 'higher ground' - on some Delta islands, where rain-fed rice and other crops like coconut can be produced. However, in some villages, coconut production has drastically declined due to diseases attributed to coconut lethal yellow. The major food crops grown in Rufiji include maize, paddy, cassava and sorghum. The major cash crops are cashew nuts, simsim and fruits such as orange, mangoes etc. Table 4.8 and 4.9, shows the estimated production trends of major food and cash crops in Rufiji and Kibiti Districts from 2007 to 2012.

Table 9: Estimated Production (tons) of Major Food Crops, Rufiji District; 2007/8-2011/12

Crop	2007/08	2008/09	2009/10	2010/11	2011/12
Maize	14,475.5	16,836.9	23,289.2	13,755.0	17,625.0
Paddy	43,757.9	41,070.4	29,184.1	20,824.0	16,042.0
Cassava	175,680.1	183,415.4	168,455.0	164,739.5	218,497.0
Sorghum	687.2	1101.0	1231.3	1616.0	1,450.0
Total	**234,600.7**	**242,423.7**	**222,159.6**	**200,934.5**	**253,614.0**

Table 10: Estimated Production (tons) of Major Cash Crops, Rufiji District; 2007/8 – 2011/12

Crop	2007/08	2008/09	2009/10	2010/11	2011/12
Cashewnuts	4360.2	5156.6	5229.01	4,500.0	4,228.0
Simsim	363.0	470.4	3,415.9	3,930.6	877.6
Cotton	1.3	3.0	3.1	5.3	6.5
Oranges	19,870.0	23,870.0	24,240.0	25,870.0	27,000.0
Total	**24,594.5**	**29,500.0**	**32,888.0**	**34,305.9**	**32,112.1**

- ***Fishing***

Fishing is the second major economic activity in Rufiji and Kibiti districts. Small-scale fishermen using poor fishing gear dominate the fishing activities. Fishing is carried out in the Rufiji River, the Delta and some inland lakes formed by the flooding of the river. In good rainfall years, the lakes are replenished by fresh water. Some fish are also able to migrate to the lakes. The main outlet for the fish catches is the local market. A fish processing company located at Nyamisati used to be a big market for prawns. However, the plant is no longer operating. It is estimated that a total of 7,000 people (about 20% of the delta population) make a living from fishing there (Shagude, 2004). Most freshwater fishing takes place in the numerous permanent lakes of the floodplain, which provide breeding habitat for fish and are replenished in most years by floods. In the delta, fishing takes place in estuaries and in the shallow inshore waters along the coast. The majority of fishers use nets, although traditional traps and hooks are also still commonly used. The last Marine Fisheries Frame Survey, conducted in 2009 by the Ministry of

Livestock and Fisheries Development, recorded 1,369 fishing vessels in operation and more than 14,000 gill nets which were the most common type of gear. More than 30 fish species are fished in the delta, the most important being dagaa (a general term for several small fishes such as mullet). The total annual finfish catch is estimated to be around 1,403.50 metric tons in Rufiji District (MLFD, Annual Fisheries Statistics Report, 2012).

The prawn fishing industry is the most important of the marine fisheries in the Rufiji Delta in terms of income and export value and employs more than 3,000 artisanal fishermen. Catches are in the order of 134.66 metric tons per year (Mhitu &Mwakosya, 2008). Artisanal operators have dominated the Tanzania prawn fishery since the closure of the commercial prawn trawling industry in 2008 due to a serious decline in yield. Prawn resources, together with other finfish species, contribute to the social and economic welfare of coastal communities in the delta. Artisanal fishermen sell fish products in major towns, especially Dar es Salaam. The marketing of fish and prawns from the Rufiji Delta is well organized and is largely controlled by businessmen from Dar es Salaam who provide boats, engines, cooling facilities and transport to the city.

- ***Livestock Keeping***

Although traditionally, livestock keeping was not an important economic activity in the Rufiji and Kibiti, the influx of agro – pastoralists and pastoralists from the North- west part of Tanzania has introduced this economic activity in the area and it is becoming an important undertaking in the many villages. The government through the district councils had managed to survey and identifies areas for grazing. The district has managed to set aside more than 78,784.51 hectares for pastoralists in 7 villages for pastoralists. The exercise to identify and survey areas for livestock grazing was done in the following villages; Nyamwage, Tawi, Mbwara, Chumbi "C", Chumbi "A", Chumbi "B" and Muyuyu. The estimated numbers of livestock in Rufiji and Kibiti districts for the year2012 are shown in Table 4.9.

Table 11: Estimated Livestock Population by Ward, Rufiji District; 2011/12

Ward	Cattle	Goats	Sheep	Donkeys	Dogs	Indigenous chicken
Ikwiriri	74	619	4	0	22	25059
Mgomba	500	50	20	0	2	23987
Umwe	7495	585	250	0	44	27564
Utete	9228	1326	1087	0	144	35542
Chemchem	1520	232	311	1	37	20456
Mkongo	4744	239	208	3	57	18765
Ngorongo	2868	488	595	0	73	12087
Kipugira	1290	115	123	0	11	16543
Dimani	26	261	16	0	15	14908
Kibiti	49	35	0	0	0	33650
Mjawa	1054	53	49	0	24	10896
Bungu	397	73	0	3	31	35210
Mwambao	297	97	0	0	9	10800
Mahege	4	9	0	0	0	15435
Chumbi	36790	9313	6084	105	794	30321
Mbwara	3890	294	394	20	50	21780
Mtunda	29766	2084	8810	0	84	10680
Ruaruke	723	57	32	0	0	20421
Salale	1004	436	290	15	23	12090
Mbuchi	3199	128	34	24	35	10225
Kiongoroni	576	398	13	0	0	21084
Maparoni	1240	88	37	0	13	23045
Total	**106,734**	**16980**	**18,357**	**171**	**1,468**	**450,548**

- ***Forest products***

The forests in the district contain a variety of valuable hardwood species. Three major ways exist in exploiting Rufiji forests for cash income. These are mangrove exploitation, charcoal

production and logging (timber). These are normally allowed by obtaining a license from the District Forest Officer.

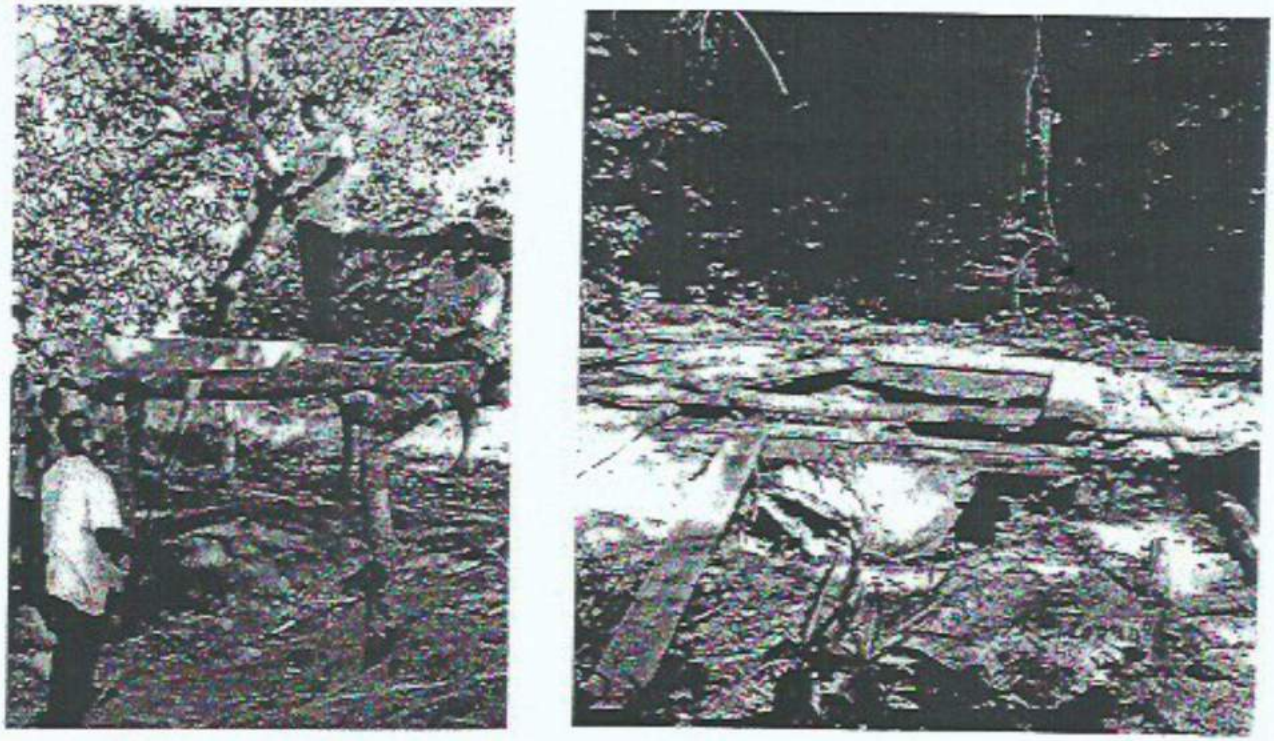


Figure 21: Logging and Lumbering in Utete Area in Rufiji District

4.3.4 Social Services in Rufiji and Kibiti Districts

- ***Education***

Nursery school and pre-primary school Education is so much insisted by the government. This is because of Tanzania education policy which insists that, children who will be given priority of registration for standard one are those who already have been registered for nursery and pre-standard one and undergone such education. Rufiji and Kibiti districts by 2012 had 101 public and 12 private pre-primary schools. There are 115 primary schools with the sum of 63,072 pupils. Among them by are 30,626 boys and girls 32,446. Therefore percentage wise boys 48.6% and girls are 51.4% of the total number of pupils in the district. The number of secondary schools was 19 public schools and 2 private secondary schools.

- *Water Supply and Sanitation*

Availability of adequate supply of clean potable water for the residents of Rufiji and Kibiti District Councils is of utmost importance. This is because water is very useful to human beings, livestock and agriculture. According to the Iringa Region results of National Sample Census of Agriculture 2007/08, piped water was the main source of drinking water for 36 percent of the agriculture households during dry season and 37 percent during wet season followed by unprotected well (25 and 21 percent in the dry and wet season respectively). In urban areas however, piped water accounted for about 51 per cent of the households and unprotected well and river/stream water catchment accounted for 15 percent each. Since Rufiji and Kibiti Districts like most districts is dominated by the rural population, the district mainly focused on supplying water through the provision of water pipes and wells. Figure 4.18 shows that the main source of water for the rural population in Rufiji District is the piped water followed by River/ Stream and unprotected wells.

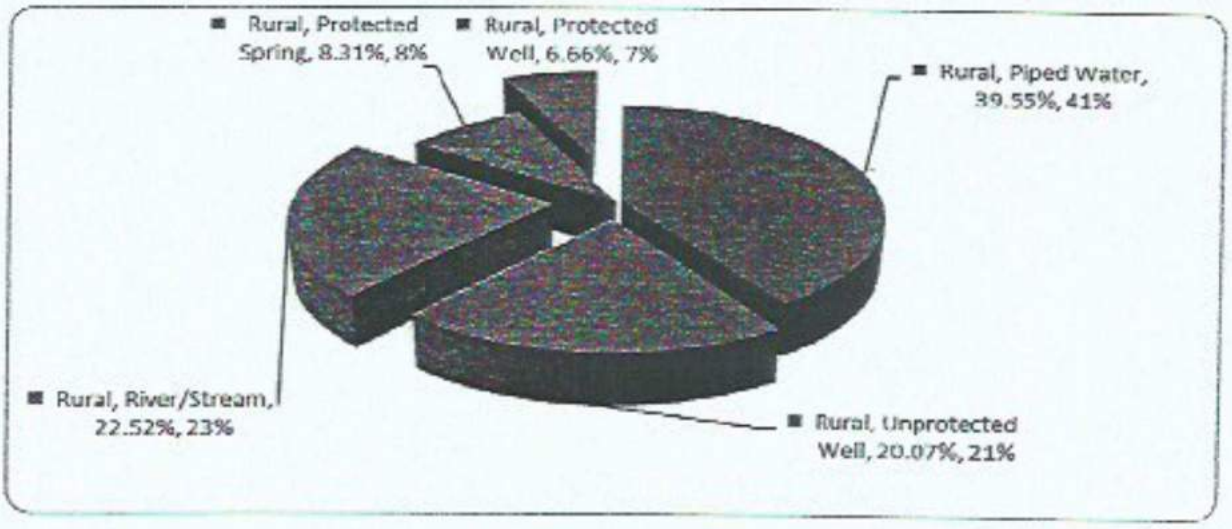


Figure 22: Percentage of Rural Water Source, Rufiji and Kibiti Districts 2012

Source: District Executive Director's Office (Water Supply and Sanitation Department), Rufiji District Council, 2013

At ward level, springs and river water were the most common sources of water accounting for 59.5 and 22.0 percent respectively followed by piped scheme (8.4 percent). The least source of

water is bore holes accounting for only 1.2 percent. The most ward was Salale (5), Mkongo (6), and and Kiongoroni (8). The well endowed wards with many water sources were Mgomba (89), ikwiriri (76), Umwe (58), Kibiti (58),Bungu (35), Mahege(31), Chumbi (29), Utete (20), Mchukwi (17),Mwambao (16), Mbwara (15), Mbuchi (15), Ruaruke (14), Mwaseni (14), Mtunda(13) and Maparoni (10).

The district has 56 health facilities. They include two hospitals (one government and one mission), five government health centers and 48 government dispensaries. A private dispensary based at Kibiti offers mobile clinic services in some parts of the district. Over the counter drugs are available from many private shops and kiosks in the villages. Many people also obtain services from traditional healers including traditional birth attendants. Malaria and waterborne diseases such as cholera and diarrhea are the major health problems of the area as reported through the health services and as perceived by local people (Table 4.10). Major causes of mortality include acute febrile illnesses including malaria, acute lower respiratory infections, tuberculosis, AIDS, and parental causes. Immunization coverage ranges from 85% for BCG (tuberculosis) to 66% for measles in children 12- 23 months of age. About 89% of the population, live within 5 kilometers of a 6 formal health facility. All villages and health facilities in the district have been positioned by GPS and mapped in a GIS database of district health resources

Table 12: List of the Ten Most Commonly Reported Causes of Mortality (In Patients Only), Rufiji and Kibiti District; 2007 and 2012

Number	2007		2012	
	Disease	**Number of Occurrences**	**Disease**	**Number of Occurrences**
1.	Severe malaria	70	Severe malaria	16
2.	Uncomplicated malaria	48	Other diagnosis	12
3	Pneumonia	36	Pneumonia	10
4	UTI	14	Anaemia	10
5	Clinical AIDS	11	ARI	8
6	Diarrhoea diseases	8	Diarrhoea diseases	7

7	Perinatal and Neonatal conditions	8	Neoplasm	7
8	Complications of Pregnancies	7	Clinical AIDS	5
9	Severe PEM	4	Severe PEM	4
10	Other conditions	3	Other conditions	3
Total		**209**		**82**

Source: Rufiji district socio-economic profile, 2016

- ***Infrastructure and access to markets***

Despite the fact that there are a number of road networks within the district, they are only passable during the dry season. Road connections between the district and other parts of the country are fairly good. A road from Dar es Salaam to Lindi passes through Kibiti and Mohoro through the Ndundu or Utete ferries. Despite the frequent operational problems such as breakdowns and shifting of the sandbanks of Rufiji River (URT District profile, 1997), the connection has been very important to the district and neighbouring regions to the North and South. According to DANIDA (1998), transport infrastructure falls into the classified and unclassified categories. Classified transport infrastructure (which includes trunk, regional, district and feeder roads) gives detailed information regarding the length and condition of the infrastructure. DANIDA, (1998) points out that the length of classified roads in Rufiji district is 982 km. District and feeder roads in the district are mainly earth roads with very few gravel roads. Unclassified transport infrastructure comprises of tracks and footpaths, which are used principally by bicycles or people walking on foot. It is reported in DRDP (2000) that the Mkongo-Kipo road is used by more than 2000 bicycles, considered to be less than those on foot. DRDP (2000) further points out that there are two main categories of bicycle users. The first consists of households or individuals who own bicycles and the second consists of those hiring for personal travel as well as transporting various loads.

Waterway transport in Rufiji District can be divided into the mainland and Delta areas (DANIDA, 1998). The mainland waterway transport is predominantly the Rufiji River. As

already mentioned, there are two ferries crossing the river at Ndundu and Utete, while canoes primarily dominate the rest of the transport. In the Delta areas the dominant mode of transport are canoe and by foot. There are numerous points, which are served by the canoes in the Delta areas. The canoes are useful in people as well as agricultural and other essential goods transport. In most cases harvested mangrove poles are also transported using canoes to the main collection points. However, the Delta water is governed to large extent by tidal water, which necessitates timing in order to have smooth navigation. The main constraints in waterway transport can be summarised as: Difficult to haul large loads at a time because of the use of canoes; Problem of mud in many waterways as a result of erosion in upper Rufiji river and; Problems of crocodiles and hippopotamus.

CHAPTER FIVE: STAKEHOLDERS ENGAGEMENT

5.1 Importance of Stakeholders Involvement

Section 89 of the EMA No. 20 of 2004 emphasizes the importance of stakeholder participation by providing guidance on public participation. Regulation 17 of the EIA and Audit Regulations (URT, 2005) provides further directives and procedures for public participation in the EIA process. Stakeholder participation involves processes whereby all those with interest in the outcome of a project participate in decisions on planning and management of the proposed development. Stakeholders share information and knowledge, and may contribute to the project activities. Apart from the fact that they help the consultant to harness traditional knowledge, which conventional approaches may overlook, they help the EIA address relevant issues including those perceived as being important by local communities. Also, stakeholders help to influence project design, so that it responds to their needs. In this ESIA process stakeholder was given a very broad definition to include all different government agencies, beneficiaries, private sector, individuals, politicians and all other formal or informal groups associated with the project. It should be noted that views and concerns from stakeholders will largely be reflected in the scoping and Final ESIA document and will contribute to the project alternatives, identification of impacts as well as mitigation and enhancement measures for the identified impacts.

5.2 Stakeholders Identification

The range of potential stakeholders to ESIA greatly depends on the definition of boundaries for that project but it is important to be 'inclusive' rather than 'exclusive'. Stakeholders in the EIA process can be categorized in various ways including; primary, secondary or key. Primary stakeholders for example, are those who gain materially from the project or who make direct contribution of resources or services to the project. Key stakeholders on the other hand are those who have significant power or influence to determine the direction and outcome of the project. This section outlines a range of key and primary stakeholders consulted during the ESIA Process.

5.3 Stakeholders analysis

A thorough understanding of stakeholders-who they are, what their concerns may be, what interests they have, is required in any ESIA process. In this ESIA the objective was to permit relevant stakeholders to participate in decision making and keep the general population informed about the development of Stigler's Gorge hydropower plant. The process of identifying stakeholders entailed reviewing the databases of key government ministries and institutions, public and private sectors as well Non-Governmental Organizations and identifying and listing stakeholders who will be directly or indirectly affected by the proposed development in order to be fully representative of the wider stakeholder interests.

Dependent upon the issues and organizations/institutions involved, different groups were engaged in different ways. In recognition of this, three basic stakeholder groups have been identified, together with the methods and merits of involving each group.

These groups are:

i. Client Stakeholder's Group
ii. Key Stakeholder's
iii. Other Stakeholders

- ***Client Stakeholders Group***

The Client Stakeholders Group (CSG) has overall responsibility for the delivery of the ESIA. The CSG initiated the ESIA development process, undertake any ESIA tasks required, procure technical inputs required to complete the ESIA, and manage the development and adoption processes. Administrative and financial responsibility entirely remained the responsibility of this group, although some technical responsibilities were shared with other groups. The client stakeholders involved the following:-

i. Vice President Office – Division of Environment – VPO –DoE
ii. Ministry of Energy – Task Force
iii. Ministry of Finance and Planning
iv. TANESCO

Roles and Responsibilities include:

i. Deciding on the scope and extent of the ESIA.
ii. Procures and manages the services of the ESIA
iii. Works in partnership with the Consultant to develop:
    - The overall Terms of Reference of the ESIA
    - The issues to be dealt with by the ESIA
    - The priority of the issues
    - The objectives for the ESIA
    - Provides listing of initial consultees to Consultant.
iv. Directs further consultation, including methods and material to be employed.
v. Oversees public consultation exercise.

The CSG were involved throughout the ESIA process. Key stages include;

i. Scoping
ii. Full ESIA study
iii. Technical and administrative development
iv. Consultation
v. Finalization
vi. Adoption

- ***Key Stakeholders Group***

The Key Stakeholder Group (KSG) acts as focal point for discussion and consultation through development of the ESIA. The membership of the group should provide representation of the primary interests within the ESIA frontage, ensuring consideration of all interests during the preparation of ESIA study. Inclusion of this group offered a more participatory process. The group was involved through meetings/workshops. The incorporation of this group as an additional component provides direct feedback and information to the Consultant, and acts as a focal point for the consultation process.

It was also possible to adopt a more of a partnership approach to the KSG, by developing a collaborative decision-making forum. Under this approach certain responsibilities normally held

by the Client Stakeholders Group were shared by the KSG in order to increase the level of stakeholder ownership of the final ESIA. The key stakeholders comprises of:-

i. Ministry of Natural Resource and Tourism
ii. Ministry of Land, Housing and Human Settlements Development
iii. Ministry of Agriculture and Food Security
iv. Ministry of Water and Irrigation
v. Ministry of Livestock and Fisheries
vi. Ministry of Trade, Industries and Marketing
vii. Tanzania Commission for Irrigation
viii. Tanzania Wildlife Authority (TAWA)
ix. Rufiji Water Basin Board

Roles and Responsibilities include:

i. Comprise representatives of the key stakeholder organizations/interests likely to be affected by the proposed development. .
ii. Suggests issues and their priorities to be considered within the ESIA
iii. Receives reports and draft proposals from the Consultant.
iv. Meets periodically throughout the production of the ESIA.
v. Provides comment on proposals being made by the Client Stakeholders Group and the Consultant.

- ***Other Stakeholders Group***

There will always be large numbers of individuals, public and private organizations who are likely to be affected by the decisions of the ESIA. It is unlikely to ever be practical to involve all these stakeholders on one of the three groups outlined above; therefore there will remain a group of 'Other Stakeholders'. This group was contacted directly by the ESIA Consultant. The list of other stakeholders includes:-

i. Morogoro Regional Secretariat
ii. Coast regional Secretariat
iii. Rufiji District Council
iv. Kibiti District Council

v. Ulanga District Council
vi. Kilombero District Council
vii. Zonal Irrigation Office
viii. SAGCOT
ix. Tanzania – Zambia Railway Authority
x. Tanzania Forest Service
xi. RAMSAR official based in Ifakara
xii. Tanzania Meteorological Agency
xiii. UNESCO
xiv. WWF
xv. Tourist facilities operators in Selous Game Reserve.
xvi. Wards and Village governments in the Lower Rufiji River

5.4 Methods of Stakeholder's Participation

Stakeholder participation involves processes whereby all those with a stake in the outcome of a project actively participate in decisions on planning and management. They share information and knowledge, and may contribute to the project design or even alternatives, so as to enhance the success of the project and hence ultimately their own interests. Effective public/stakeholder involvement requires attention to improving the opportunities for such involvements as well as enhancing awareness among the public/stakeholders of those opportunities (Hughes, 1998). Thus, having identified the relevant stakeholders, the ESIA team had to establish clear lines of communication and interaction with the stakeholders. The techniques used varied from one stakeholder group to another. However, simple methods such as individual discussions, focused group discussion and interviews were used.

The consulting team started the scoping exercise with various stakeholders as well as securing and reading through several documents related to hydropower generation and environmental characteristics of the project area. The consultation started with kick off meeting with the client representatives (TANESCO) which was held at TANESCO's office. The kick off meeting was followed by field visits in Coast and Morogoro regions where various consultations were

undertaken with different stakeholders from 19th – 22nd December, 2017 and 03rd to 5th January, 2018. The consultation process was preceded by sending prior information through letters to the Regional Administrative Secretaries of Morogoro and Coast regions. The Regional administrative Secretaries allowed the consultants to proceed with consultation in Kilombero, Ulanga and Rufiji districts. The second phase of consultation during the scoping focused on tourist hotels and SGR management at Matambwe within Selous Game Reserve.

During the full ESIA study which was undertaken from 12th March to 24th April 2018 the consultation focused on villages in Lower Rufiji River including villages in the Rufiji Delta, government ministries, and government agencies such as TMA and International organizations including UNESCO, WWF and National Commission for Irrigation. Table 5.1 highlights some of these methods and lists advantages of using them.

Table 13: Some of the Methods used for Stakeholders Engagement and their Advantages

Consultation Method	Objective of Consultation	Justification for Methodology	Target Audience
Focus Group Discussion (FGD)	• To provide information about the Project. • To allow community members to raise issues and concerns related to the project. • Allow issues to be verified, tested and solutions developed	• Increased ownership by participants. • Allows for wider consultation and debate related to selected issues and topics. • Smaller forum encourages participation of all present stakeholders without intimidation or fear	Regional and District officials, WWF

		(especially people who will not normally speak out in large gatherings). • Allows issues to be verified, tested and solutions developed.	
One-to-One Meetings	• To provide information about the project activities. • To allow key informants to raise issues and concerns about the project. • To verify some of the information provided by the communities.	• Allows for follow up on issues and unexpected information. • Consultation by invitation only, so it is easier to predict and prepare for the types of issues that are likely to be raised. Allows issues to be verified, tested and solutions developed	Interest Groups such as Tanzania Wildlife Authority, Tanzania Forest Service, Tourist Hotel management in SGR and World Wildlife Fund (WWF).
Public Meeting and household survey (specifically selected villages in the downstream of Rufiji River)	• Share information about the proposed project. • Provide opportunity for stakeholders to raise issues and concerns about the proposed project. • Provide responses to project related questions.	• Increased ownership by participants • Allows for wider consultation and debate related to selected issues and topics.	Villagers in selected villages

	• Record stakeholder comments and concerns for consideration in the ESIA. • Document on the socio-economic characteristics of people living in the Lower Rufiji River.	• Allows issues to be verified, tested and solutions developed.	
Tele-conference	• Discussion with UNESCO – Paris on the implications of the proposed development on the Universal Outstanding Value of SGR	• Allow for wider consultation with international stakeholders on the potential impact of the project and discussion on mitigation and enhancement measures	UNESCO -Paris

5.4.1 Consultation with Regional and District Officials

The consultation was undertaken with Morogoro and Coast regions secretariats which were followed by consultation in Kilombero, Ulanga, Rufiji and Kibiti district councils. Within the districts discussion and interviews were conducted with District Executive Directors' offices, Land Office as well as Natural Resources and Environment offices. The aim of these consultations was to explain to them about the ESIA process, share the layout of the proposed hydropower project and its associated infrastructure, discuss various impacts associated with the project, give them an opportunity to air their views and concerns regarding the proposed project as well as determine alternatives for the project and additional potential stakeholders within their areas of jurisdiction.

Figure 23: Consultation in Kilombero District

Figure 24: One of the public meetings in Mloka village in Rufiji district

5.4.2 Consultations with Other Relevant Stakeholders

In Morogoro consultation was conducted by visiting and discussing with key stakeholders such as TAWA, TFS and RAMSAR officials based in Ifakara as well Wami/Ruvu Water Basin – Sub office also based in Ifakara. In Dar es Salaam, consultation was made with the Tanzania Meteorological Agency and academic Institutions such as the Institute of Resource Assessment at the University of Da er Salaam.

5.5 Identified Issues and Concerns

- *Population increase*

Stakeholders in the study area believed that there would be an increase in population due to in-migration or resettlement of others to villages such as Kisaki and Mloka. Most seemed to feel this would be positive since it would bring increased economic opportunities with it such as a larger market for farm produce. However, stakeholders were concerned about the possible increase in crime in the local area.

- *Opportunities for Improved Roads infrastructure and electricity.*

Stakeholders felt that the proposed development would bring improvements to roads and transportation network of goods and people. Although the proposed development will be located

in a game reserve, the transportation of construction materials will require improvement of roads which will beneficial to tourists and hotel owners in Selous Game Reserve. Another main benefit mentioned by stakeholder was the connection of villages and hotels to the national electricity grid. At the moment many villages close to the proposed development have no electric and the hotels use generators which are very expense and increase the running costs of the hotels. It was thought that in addition to giving electricity to private homes and hotels, it would enable cottage industries in the villages to develop (such as fish preservation).

- ***Impacts on Fishing (Downstream)***

Stakeholders in Rufiji district were concern that the change in the flow regime and possible silting of the river downstream could result in a decline in fish resources. The extent to which the directly affected communities downstream of the proposed Stigler's Dam utilise fish as a main source of food must still be determined during the full ESIA study. During the operation phase, it is assumed that the river will return to current flow regimes. There is the potential for local fishing to be negatively impacted on as a result of the Project.

- ***Health and Safety Issues***

Although there are no settlements near the proposed project, the stakeholders were concerned that during the Hydro Power project construction stage dust, noise and vibration will be generated, therefore, will have impact on health and safety of workers. In addition, the in-migration of labour force from different parts of the country, associated with workers misbehavior and socio-cultural differences in the area which have inadequate healthcare facilities has the potential to increase diseases such as HIV/AIDS, STDs and potential conflicts of migrant workers and the local communities.

- ***Disturbance Due to Dust, Noise and Safety Hazards from Traffic***

The construction of the Project infrastructure could require building material and other supplies (fuel, supplies to the construction village etc.), all of which will be delivered to the Project Site by trucks that are likely to pass by homesteads. The road to the Project Site is unpaved and the traffic through these homesteads could result in disruption from dust and noise from passing traffic. Due to the rural nature of potential homesteads, they may not be familiar with these types

of traffic conditions, increasing their susceptibility to disturbance. Safety could also be an important issue for residents who are unused to much traffic.

- *Employment opportunities*

Stakeholders expressed their concerned about lack of employment among the youth in villages. Since the proposed will require a number of skilled, semi-skilled and unskilled workers, the stakeholders requested that the majority of labour force, especially for works which does not specific skilled should come from communities surrounding the Project Area such as Kisaki, Mloka and other villages downstream of Rufiji River.

- *Poaching*

Stakeholders were concern that the construction of the project would include construction traffic, noise, dust and waste and the quarries and workers, negatively affecting OUV. Work-camps would need building for the estimated 1200 people necessary for construction, with Odebrecht officials noting that these could be quality, long-lasting living areas61. This fits with the company's camps in other projects and with their reputation for good working and training conditions. Positive effects could include improved transport for those living along the roads and for tourists. Negative impacts are likely to be increased pollution as well as in poaching. This is partly because the roads increase access for poachers, but also because poaching could increase with a new population living inside the current reserve. This likelihood is supported by the precedent of poaching increasing with Shell's oil exploration throughout the Selous that involved road construction and the TAZARA railway line which cuts through the northern edge of the reserve's core area and was built in the 1970s. Poaching is a key threat to the park's OUV currently, so the risk of further wildlife loss is particularly significant

- *Impact on tourism industry*

The distinction between effects and impacts is important, because small changes (effects) may have large impacts (value): a small reduction in the volume of visitors may have large impacts for the tourist industry and the local community

Hydropower and road developments produce preliminary change of environmental qualities, such as noise and pollution during the construction stage. Preliminary variation in water flows during the operation of hydropower stations can also influence recreation use (Giffen and Parkin, 1991; Shelby et al, 1992; Teigland, 1992b). The consumers can adapt to such non-permanent changes by using the area as before, but timing their activities to the less influenced periods. That is an internal displacement effect — not in space, but in time.

Impacts on the tourist and recreation industry Change in the behaviour of consumers who are using a nature setting or area for recreation purposes may affect producers and suppliers of services in the core area where the project takes place (as an internal effect). The tourist and recreation industry outside the core area can be influenced too (external effects). Internal and external effects on the tourist industry can be linked. A new road can reduce the traffic on older roads in the neighbourhood, if the new road is a useful alternative for consumers. The building of new roads can have redistribution effects in such cases and directly affect established tourist companies along existing roads. If a new road does not increase total traffic volume in a region, alternative roads and the tourist companies there will lose traffic. The key issues and concerns with regard to the proposed development which were raised by stakeholders throughout the ESIA study are shown in Annex A.

CHAPTER SIX: ASSESSMENT OF IMPACTS AND CONSIDERATION OF ALTERNATIVES

6.1 Impact Identification

Impact identification in the EIA seeks to ensure that all potential significant impacts are identified and addressed. Several 'tools' are available to assist in impact identification. The simplest, and most frequently used, is a checklist of impacts, although matrices, network diagrams and map overlays can also be used. In this EIA a simple checklist of impacts and matrix were used. Most of the impacts of proposed development were identified drawing from the scoping report and updating the checklist following detailed field assessment.

6.1.1 Impacts related to the physical environment

- *Impacts of upstream catchment activities on the project*
- *River bed/bank degradation in the Lower Rufiji*
- *Impaired surface water quality*
- *Impaired fish migration along the river*
- *Improved local infrastructure*
- *Impact on the "Tagalala" lakes*
- *Potential for reservoir sedimentation*
- *Change in salinity regime in the Rufiji delta*
- *Enhanced ecological integrity of the Rufiji delta*
- *Solid waste management*
- *Liquid waste management*
- *Generation of overburden soil material*
- *Blockade of fish migrationalong the Rufiji River*
- *Impacts on archaeological and cultural artifacts*

6.1.2 Impacts related to the biological/ecological environment

- *Loss of wildlife*
- *Deforestation*
- *Enhanced introduction of alien exotic species*
- *Change in species and habitat diversity*

6.1.3 Impacts related to the landscape/aesthetic environment

- *Impacts on the SGR outstanding universal values(L)*
- *Impaired landscape/aesthetic quality of the SGR(L)*

6.1.4 Impacts related to the socio-economic environment

- *Enhanced government revenues*
- *Enhanced flood control in the Lower Rufiji Floodplain*
- *Enhanced local employment opportunities*
- *Enhanced floodplain irrigation agriculture opportunities*
- *Increase potentials for recreation in the reservoir*
- *Enhanced agro-processing/value addition opportunities*
- *Enhanced floodplain fisheries*
- *Improved health of the Rufiji delta ecosystem*
- *Change in noise pollution*
- *Change in air pollution*
- *Change in water pollution*
- *Increased risks of HIV/AIDs and STDs*
- *Increased level of crime and insecurity*
- *Increased accidents, risks and hazards*
- *Increased pressure on local social services*
- *Change in local population characteristics*
- *Improved photographic tourism*
- *Enhanced hunting tourism*

- *Accelerated vibration*
- *Improved local infrastructure*

6.1.5 Impacts related to the archaeological and cultural environment

- *Destruction and loss of archaeological heritage*
- *Changes on cultural values and norms*

6.2 Impact Prediction

Impact prediction or estimation of the magnitude, extent or duration of the impacts was done by comparison with the situation without the project. The initial baseline condition prior to project implementation provided the basis for forecasting the future scenario with or without the project and compared the changes with existing established standards, relevant national and sectoral laws and regulations while taking cognizance of stakeholder views and concerns. The approach to impact prediction was to give ratings for each identified potential impact and producing a correlation matrix (Table 5.1). In the matrix ratings ranged from 0 to +3 for positive impacts and from 0 to –3 for negative ones, where:

+3 - Very High Positive Impact

+2 - High positive Impact

+1 - Minor Positive Impact

0 - No Impact

-1 - Minor Negative Impact

-2 - High Negative Impact

-3 - Very High Negative Impact

Based on the above mentioned criteria and the score on the rating scale, impacts identified were grouped in phases i.e. impact related to construction, operation and decommissioning of the project. The impacts were cross-referenced with the project activities in a correlation matrix presented below.

Table 14: Correlation Matrix for Impact Prediction for Stiegler's Gorge Hydropower Project

		Mobilization phase					**Construction Phase**					**Operation Phase**					**Decommissioning Phase**			
		Construction of access roads	Mobilization of equipment and materials	Recruitment of labour	Sites clearance & management of biomass	Construction of workers camp & staff quarters	Construction of dam and associated structures	Construction of saddle dams structures	Construction of power station	Construction of tailrace	Construction of substation	Reservoir filling	Power generation	Reservoir management	Flood control	Maintenance of the power plant	Layoff of workers	Demolition of infrastructure	Site rehabilitation	Spoil management
A:Impacts Related to the Physical Environment																				
1	Impaired surface water quality	-1	-1	0	-2	-3	-3	-1	-2	-2	-2	-2	-2	-2	-2	-1	0	-2	+2	-2
2	River bed/bank Degradation of the Lower Rufiji	0	0	0	-1	-1	-2	-1	-1	-1	-1	-2	-2	-2	-3	0	0	-1	+1	-1
3	Blockade of fish migration along the Rufiji river	0	0	0	0	0	-2	-1	0	-2	0	-2	-2	-2	-2	0	0	+1	+1	-1
4	Impact on the "Tagalala" Lakes	0	0	0	-1	0	-2	-1	0	0	0	-2	-2	-2	-3	0	0	+1	-1	-1
5	Reservoir sedimentation	0	0	0	0	0	0	0	0	0	0	-2	-2	-3	-2	0	0	-1	+1	-1
6*	Soil erosion	-2	-1	0	-2	-1	-2	-1	-1	-1	-1	0	-2	-2	-3	0	0	-1	-1	-2
7	Change in salinity regime in the Rufiji delta	0	0	0	0	0	0	0	0	0	0	-3	± 2	± 2	± 3	0	0	+1	+1	-1
8	Enhanced ecological integrity of the Rufiji delta	0	0	0	+1	+1	-1	+1	+1	+1	+1	-2	+2	+2	+3	+1	0	-1	-1	0

		Mobilization phase					Construction Phase					Operation Phase					Decommissioning Phase			
		Construction of access roads	Mobilization of equipment and materials	Recruitment of labour	Sites clearance & management of biomass	Construction of workers camp & staff quarters	Construction of dam and associated structures	Construction of saddle dams structures	Construction of power station	Construction of tailrace	Construction of substation	Reservoir filling	Power generation	Reservoir management	Flood control	Maintenance of the power plant	Layoff of workers	Demolition of infrastructure	Site rehabilitation	Spoil management
9	Liquid waste management	-2	-1	-1	-1	-3	-3	-1	-1	-1	-1	0	-1	-1	-1	-1	0	-1	+1	-1
10	Solid waste management	-2	-2	-1	-3	-2	-3	-1	-2	-1	-1	0	-1	-1	-1	-1	+2	-2	+1	-2
11*	Generation of overburden soil material	-2	0	0	-2	-2	-2	-1	-1	-2	-1	0	0	0	0	0	0	0	+1	+1
B: Impacts Related to the Ecological/Biological																				
12	Deforestation	-2	0	0	-3	-3	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	+2	+1
13*	Loss of biodiversity	-2	-1	-1	-2	-3	-3	-2	-2	-1	-2	-3	±2	±2	± 3	-2	0	-1	+2	-2
14	Enhanced introduction of alien exotic species	-2	-2	-2	-2	-2	-3	-1	-2	-1	-1	-1	-1	-1	-1	0	+1	-1	+1	-2
15	Loss of rare, endemic and endangered species	-2	-1	-1	-2	-3	-3	-2	-2	-1	-2	-3	±2	±2	± 3	-2	0	-1	+2	-2
16*	Change in species and habitat diversity	-2	-1	-1	-2	-3	-3	-2	-2	-1	-2	-3	±2	±2	± 3	-2	0	-1	+2	-2
17	Loss of wildlife	-2	-2	-2	-2	-2	-3	-2	-2	-1	-2	-2	-1	-1	-1	0	0	0	+1	-1
C: Impacts Related to the Landscape/ Aesthetics																				
18	Impaired landscape/aesthetic quality of the	-2	-1	-2	-2	-2	-3	-1	-2	-1	-1	-2	-3	-3	± 2	0	0	-2	−2	-1

		Mobilization phase					Construction Phase					Operation Phase					Decommissioning Phase			
		Construction of access roads	Mobilization of equipment and materials	Recruitment of labour	Sites clearance & management of biomass	Construction of workers camp & staff quarters	Construction of dam and associated structures	Construction of saddle dams structures	Construction of power station	Construction of tailrace	Construction of substation	Reservoir filling	Power generation	Reservoir management	Flood control	Maintenance of the power plant	Layoff of workers	Demolition of infrastructure	Site rehabilitation	Spoil management
	SGR																			
19	Erosion of the SGR outstanding universal values	-2	-1	-1	-2	-3	-3	-2	-2	-1	-2	-3	±2	±2	± 3	-2	0	-1	+2	-2
D: Impact on socio-economic Environment																				
20	Enhanced government revenues	−2	+2	0	+1	+2	+3	+1	+1	−1	+1	0	−3	−1	+1	+1	-3	+1	−1	+1
21	Enhanced flood control in the Lower Rufiji Floodplain	0	0	0	0	0	−2	+2	0	0	0	+2	+2	+2	−3	0	0	-3	0	0
22	Enhanced local employment opportunities	+2	+2	+3	+2	+2	+3	+1	+1	+1	+1	0	+1	+1	−1	+1	-2	+1	+1	+1
23	Enhanced floodplain irrigation agriculture	0	0	0	0	0	+2	+1	0	0	0	-3	0	−2	+3	0	0	0	0	0
24	Improved local infrastructure	−3	0	0	0	−1	+3	+2	+1	+1	+1	0	0	0	0	+1	0	0	0	0
25	Potentials for recreation in the reservoir	0	0	0	0	0	-2	-1	-1	-1	0	+2	0	+2	-1	0	0	0	-3	0
26	Increased	−2	0	0	0	0	+2	+1	+1	+1	+1	-2	+3	+3	+2	−2	0	0	0	0

		Mobilization phase					Construction Phase					Operation Phase					Decommissioning Phase			
		Construction of access roads	Mobilization of equipment and materials	Recruitment of labour	Sites clearance & management of biomass	Construction of workers camp & staff quarters	Construction of dam and associated structures	Construction of saddle dams structures	Construction of power station	Construction of tailrace	Construction of substation	Reservoir filling	Power generation	Reservoir management	Flood control	Maintenance of the power plant	Layoff of workers	Demolition of infrastructure	Site rehabilitation	Spoil management
	opportunity for agro-processing/value addition																			
27	Enhanced floodplain fisheries	−1	0	0	0	+1	+2	+1	+1	+1	+1	-3	−2	+2	+2	+1	-2	0	0	0
28	Enhanced photographic tourism	-2	-1	0	-2	-2	-2	-2	-1	-1	-1	-2	+2	+2	-1	0	0	-2	+2	-2
29	Change in hunting tourism	-1	-1	0	-1	0	-1	-1	-1	-1	-1	-1	-2	-2	-2	0	0	-1	+1	-1
30	Increased water use conflicts	0	0	0	0	-1	-1	-1	0	0	0	-3	-2	-2	-2	0	0	+2	+1	-1
31	Change in local population characteristics	-2	-1	-2	-2	-2	-3	-2	-2	-1	-1	0	-1	-1	0	0	-2	-1	0	-1
32	Increased pressure on social services	-2	-1	-2	-2	-3	-3	-2	-2	-1	-1	0	-1	-1	0	0	-2	-1	0	-1
33	Increased crime and insecurity	-2	-1	-2	-2	-3	-3	-2	-2	-1	-1	0	-1	-1	0	0	-2	-2	0	-2
34	Increase in risks hazards and accidents	-2	-2	-2	-3	-2	-3	-2	-2	-2	-2	-2	-2	-2	-3	0	-1	-2	-2	-2
35	Increased risk of HIV/AIDS and	-2	-2	-2	-2	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2

		Mobilization phase					Construction Phase					Operation Phase					Decommissioning Phase			
	other STDS	Construction of access roads	Mobilization of equipment and materials	Recruitment of labour	Sites clearance & management of biomass	Construction of workers camp & staff quarters	Construction of dam and associated structures	Construction of saddle dams structures	Construction of power station	Construction of tailrace	Construction of substation	Reservoir filling	Power generation	Reservoir management	Flood control	Maintenance of the power plant	Layoff of workers	Demolition of infrastructure	Site rehabilitation	Spoil management
36	Increased noise pollution,	-3	-2	0	-3	-2	-3	-2	-1	-1	-1	0	0	0	0	0	0	-2	-1	-1
37	Increased water pollution	-2	-2	0	-2	-2	-2	-1	-1	-1	-1	-3	-2	-2	-1	-1	0	-2	+1	-2
38	Increased air pollution	-2	-1	0	-2	-2	-1	-1	-1	-1	-1	0	0	0	0	0	0	-2	+1	-2
E. Archaeological and cultural heritage values																				
39	Destruction and loss of archaeological heritage	-2	0	0	-2	-2	-2	-1	-1	-1	-1	0	0	0	0	0	0	-1	0	0
40	Changes on Cultural Values and Norms	-2	-1	-2	-1	-2	-2	-1	-1	-1	-1	0	-1	-1	-1	-1	0	-1	-1	-1

6.3 Impact Evaluation and Mitigation/Enhancement Measures

Evaluation of impacts significance is a critical component of impact assessment. The interpretation of impact significance bears directly on project costs and condition setting, Similarily, impact significance provides the key to selecting project alternatives. Determination of significance also contributes to internalization of impact costs in the overall project costs. Thus, mitigation measures are developed for impacts that are considered to be significantly negative, while enhancement measures are developed for impacts that are considered significantly positive.

Thus, significantly negative impacts are all that scored -2 and-3, whereas significantly positive ones were those that scored +2 and +3. Judgement of significance can be based on one or more of the following:

- Comparison with laws, regulations and or accepted standards
- Consultation with relevant decision makers
- Reference to pre-set criteria such as protected areas, features or species
- Consistency with government policy objectives
- Acceptability to the local community or general public

Those with a score +/-1 were considered as insignificant, but were further considered under cumulative and incremental impacts where relevant. Sub-sections 6.3.1 to 6.3.4 provide evaluation of impacts under different categories.

6.3.1 Significant positive impacts

- ***Enhancement of government revenue***

Some significant benefits to Government would accrue from a large number of employees who will be paying their taxes to the government as "Pay-as-You Earn (PAYE) during mobilization and construction phase. More highly significant benefits from the project to the government will be realized during the **operation phase** under power generation and management. The main

target for this power generation is industrial development in the country. These industries will have significant contribution to the National economy and the government will get revenues from shares, value added tax (VAT) and other loyalties. Also, the government will benefit from improved electricity power which shall be utilized to increase industrial production elsewhere and could be sold to neighboring countries and get foreign currency. This impact is highly significant and long term as the power generation will last for over 50 years. The Stiegler's Gorge power generation and other emerging projects are likely to raise the electricity GDP and the National economy significantly.

Enhancement measures

1. Improve tax collection mechanisms
2. Government to facilitate infrastructure development
3. Review energy and other related policies for a *win-win* benefits sharing between investors (particularly local and small-medium scale) and the government,
4. Provide tax education and enhance tax collection mechanisms.
5. Give employment priority to local communities with relevant skills.
6. Sustain tax base for government through investing in other activities using revenue from electricity generation.

- ***Enhanced local employment opportunities***

The Stiegler's Gorge Hydropower Project (SGHP) would attract significant numbers of people seeking for direct employment in the project and other indirectly related activities and service provisions like transportation, accommodation and food supplies, particularly during the mobilization and construction phases when a large workforce will be required including experts and labourers. During the ***mobilization phase***, activities such as mobilization and transportation of equipment and construction materials will require a large number of mobile workers whereas during **construction phase** recruitment of workers for the construction of the dam and related infrastructure (spillway, power station etc., workers quarters/camp, and auxiliary facilities) will be required altogether increasing the workforce to more than 12,000 people. Assuming that

family members will accompany these workers, the increase in population and associated activities is likely to be relatively high up to 15,000 strong, increasing market demand for food commodities, construction materials, transport, accommodation and other natural resource related products (e.g. timber, poles and honey) over the spell of 3 years of expected construction. In addition the large number of new comers is likely to attract new settlements in the nearby villages (e.g. Mloka and Kisaki), prompting increased market value of land and increased land prices following increased speculation for the forthcoming project.

Enhancement measures

1. Increase smallholder farm productivity through improved extension services, input use and employment of irrigation agriculture.
2. Facilitate farmers to produce high value foods e.g. vegetables, fruits, milk, chicken, meat and organic products to feed the large volume of workforce.
3. Facilitate farmers to form farmer's cooperatives to improve bargaining powers and ensure easy access to services such as credits and extension services.
4. Provide market information outside the district after the project decommissioning.
5. Improvement of infrastructure e.g. access roads, communication towers, education, water, sanitation and health facilities.
6. Give employment priority and gender equitability to the local community with relevant skills
7. Provide awareness on forthcoming investment and employment opportunities.

- ***Increased opportunity for agro-processing/value addition in the country***

The influx of people into Morogoro Rural and Rufiji Districts attracted by potential employment opportunities could stimulate some significant innovations in agro-processing and value addition around the project area (Kisaki and Lower Rufiji Floodplain). The potential high yielding/value crops in Morogoro and Rufiji include paddy, tropical fruits, vegetables, cassava, cereals, beans etc. Agro-processing and value addition is likely to begin during the **mobilization phase** and into the **operation phase**. This impact would be further enhanced if the Local District Councils

would be facilitated to access electricity generated directly from the project. These development projects are likely to stimulate growth and spread of SMEs, that may be engaged in a variety of activities, including service provision as per the requirement of the Small and Medium Enterprises Development Policy (SMEDP) (URT, 2003). Therefore, the cumulative impact is likely to be significant and long-term.

Enhancement measures

1. Facilitate communities to access electricity services from the project
2. Enhance food production at farm level through access to extension services, input use and irrigation agriculture.
3. Build capacity of local communities on entrepreneurship and value addition skills.
4. Facilitate communities to access credits from banks and other financial institutions.
5. Facilitate establishment of community banks in rural areas.

- ***Enhanced flood control in the Lower Rufiji Floodplain***

One of the objectives of the Stiegler's Gorge project is to control damaging floods to the crop fields, settlements and properties in the Lower Rufiji Floodplain. River impoundment will create approximately 1,000km^2 of reservoir in the SGR. The design flood is estimated at 28, 227.76 m^3/s (for 1 in 10,000 years). Based on the recorded river flow measurements (Hafslund, 1980) it is predicted that spilling of water from the river course into the flood plain begins at a discharge of about 1,500 m^3/s at Stiegler's Gorge, and at 2,000 m^3/s overtopping the dam once constructed would occur. The "Controlled Flood" is a release of water from the reservoir at a maximum discharge, which does little or no damage to the crops in the Lower Rufiji floodplain. However, such a release would be dependent on the flood conditions in the reservoir and may not be timed to suit crops downstream.

The current basic dam and turbine designs suggest that with nine (9) turbines (each releasing 229m^3/s) would release a total of 2,061m^3/s during full operation. In addition, the lower level and middle level outlets would discharge a maximum of 1,494m^3/s. The total maximum discharge into the lower Rufiji river would be approximately 3,455m^3/s. Given the high demand for water

for modern and traditional irrigation, maintenance of floodplain lakes fisheries and Rufiji delta ecology, reservoir operation for controlling floods in excess of 2,500m^3/s should be possible. This is by all means a highly significant positive impact compared to the design situation in 1980 (Hafslund, 1980). Should this be achieved, it will be a relief to many villagers in the Lower Rufiji Floodplain who were worrying about the continued destruction of infrastructure and disruption of their livelihoods associated with damaging floods without the dam in the Lower Rufiji Floodplain during very wet years.

Enhancement measures

1. Strictly abide to the rules of reservoir operation whereby all obligatory downstream water release demands are respected.
2. Tanzania Meteorological Authority should ensure efficient climatic weather predictions in the country and the Rufiji Basin in particular, to enable easy detection of incoming damaging floods.
3. The SAGCOT and traditional irrigation farmers should maximize the utilization of the flood water releases in the Lower Rufiji Floodplain
4. Gradually mobilize the Lower Rufiji traditional farmers to transform into modern irrigation farmers.
5. No further water abstractions should be contemplated or made above or from the Stiegler's Gorge reservoir.
6. The water permit for the Stiegler's Gorge Project (2,200m3/s) should be respected and accorded first priority in the Rufiji river Basin management.

- ***Enhanced development of floodplain irrigation agriculture***

Another objective of the SGHPP (though not clearly stated), is to release water from the reservoir of such magnitude that the floodplain areas are adequately irrigated. Based on river flow measurements, it is reported that irrigation flood releases of 2,000 m^3/s magnitude are necessary for effective Lower Rufiji floodplain irrigation (Hafslund, 1980). These releases may depend on the reservoir level and the designed dam outlet location. The current basic dam and turbine designs suggests that with nine (9) turbines (each releasing 229m3/s), plus releases from the lower level and middle level outlets would discharge a maximum of 3,455m3/s into the

Lower Rufiji river. Given that currently discharges of 1,500 m^3/s at Stiegler's Gorge, begins to spill water into the flood plain, it is expected that the Lower Rufiji SAGCOT Cluster development and traditional floodplain irrigation farming could benefit significantly from such discharges and thus contribute to the socio-economic transformation of the plain and Tanzania in general.

However, it is feared that the planned reservoir would trap substantial amounts (i.e. 25 million tones) of river borne sediments would be trapped by the planned reservoir every year and deprive the Lower Rufiji Floodplain of natural fertilizers for subsistence and commercial agriculture (Mwalyosi, 1988). Also, since the water uptake for turbines would largely come from the hypolimnion, and later discharge into the Lower Rufiji, it will have higher kinetic energy (without sediment load), and lead to relatively more intensive degradation of the river bed/bank of the Lower Rufiji river. This would lead to lowering the river bed and thus raising the need for higher water discharge to enable the necessary spill-over to take place in the floodplain far above the $1,500m^3/s$ at Stiegler's Gorge. The lowering of the river bed could have highly unfavourable and possibly hazardous conditions to irrigated agriculture and floodplain fisheries. Such concerns were also raised by most villagers in the Lower Rufiji Floodplain.

Enhancement measures

1. Develop optimum reservoir operation policy (water allocation model) with consideration for the environmental flow requirement
2. Establish modern community based irrigation schemes
3. Provide farmers' awareness raising and training on flood based irrigation.
4. Introduce and promote crop varieties suitable for irrigation schemes in the lower Rufiji floodplain which is currently characterized by traditional crop varieties.
5. Promote organic farming through use of farm yard manure and composite manure as sources of fertilizers.
6. Undertake regular flora and fauna species inventories and their population monitoring schemes to ensure ecosystem health and functioning.

7. Determine the level of river bed/bank degradation likely to occur given the current potential increase in potential water releases from the dam at Stiegler's Gorge and the potential irrigation levels in the Lower Rufiji Floodplain.

- *Enhanced photographic tourism in the SGR*

Within the approximately 1000km^2 planned reservoir, the shallow parts of the reservoir along the shoreline are likely to become significant for various fish productivity. However, the shoreline would change seasonally due to the drawdown of the reservoir for hydropower generation and flood control. Thus, should some flood zone vegetation develop in the relatively large areas which fall dry during low-water level, the drawdown may be significantly beneficial to fish resources development. It must be emphasized that if the water quality in the reservoir would be improved by appropriate slow filling of the reservoir, fish resource development will be promoted and vice versa.

Euroconsult (1980) estimated that approximately 470 tons of fish could be available in the reservoir 20 years after commencement of dam construction. However, such a beneficial fishery development would depend on reservoir management (operation). Concern was raised by a number of conservation authorities and individuals on possibilities to allow establishment of any reservoir fishery because this would encourage more settlement of fishers and their families around the reservoir in a game reserve which is against the law. Instead, this man-made lake would best serve to enhance biodiversity of SGR, as a facility for research and training in inland fisheries and as a natural nursery. Environmentally therefore, the project is likely to lead to increased reservoir fish species diversity contributing to overall biodiversity increase in the SGR.

After damming at Stiegler's Gorge the reservoir would create an additional environment for recreation, as long as its water level is not varying widely and making water easily available and accessible. This is because the average annual drawdown is likely to change during the dry years and seasons. Otherwise an environment will be created for establishment of new tourism facilities and activities including boat rides and sport fishing (especially tiger fishing) safaris. Facilitated by a bridge over the proposed dam, the project will provide another tourism destination and package in Matambwe photographic tourism area. Currently, only Azura and

Retreat Camps are located upstream the Gorge, otherwise most of tourist facilities are downstream the gorge especially around the Tagalala Lakes due to increased wildlife habitats associated with water and pasture abundance that attracts a variety of wildlife species and numbers. Inundation of the area upstream the gorge and creation of a reservoir will open up room for lodges and camps around the reservoir. Boat and fishing safaris would be possible due to the large size of the reservoir, thus providing an alternative tourism package in Matambwe area and the SGR at large. Fishing safaris might be a very good new tourism package especially tiger fishing. This is because water in the reservoir will attract wildlife and boat drive and fishing in the reservoir will be an added advantage for facilities around the reservoir. The new visitor facilities will offer more employment opportunities for Tanzanians in the tourism industry. This would be in support of the National Tourism Policy (URT, 1999) to diversify and develop new tourism products in the country. However, the average yearly drawdown area is likely to change during the dry years and affect tourism to some degree.

It must also be pointed out that the hunting blocks that will be affected by the project around the reservoir will have to be changed into photographic tourism block thereby further expanding the area for the latter tourism.

Enhancement measure

1. Determine the annual variations in the lake surface area for recreation development.
2. Review the Integrated Tourism Master Plan to include sport fishing and water sports
3. Designate potential tourism investment sites around the reservoir
4. Identify potential tourism activities within the project impact area
5. Ensure slow reservoir filling to provide conducive environment for increased fish production in the reservoir

- *Enhanced floodplain fisheries*

It is generally assumed that in a tropical flood plain environment the fish protein production per unit area is very high because of the seasonal change in water levels caused by considerable changes in annual flooding, which provide the fish with great amount of food (insects, debris and minerals) (Euroconsult, 1980). Broadly speaking, fish production is proportional to the depth and

the length of flooding (ibid). Lower Rufiji Floodplain (Figure 5.1) stakeholders have expressed their fear that any significant reduction of flooding to the downstream areas would have deleterious impact on floodplain fisheries. This fear is supported by previous river degradation model predictions (Euroconsult 1980) that strong river-bank and river-bed erosion, of up to 5m deeper-than-normal (without the dam) could take place during the first years of river impoundment.

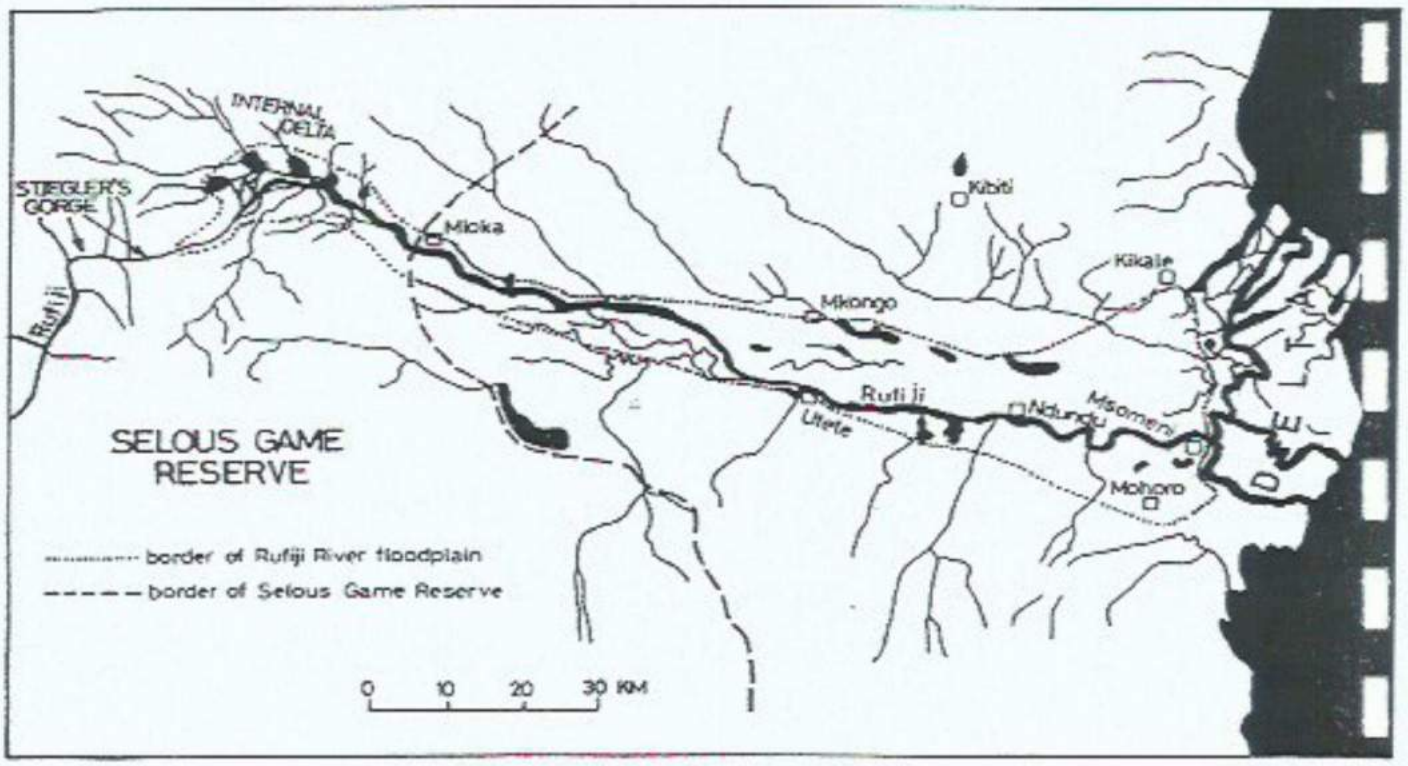


Figure 25:Lower Rufiji Floodplain (Source - RUBADA)

According to the 1980 dam design and operation models (Hafslund, 1980), changes in the flooding regime in the lower Rufiji floodplain would have very deleterious impacts on fish and fisheries. For example, turbidity and silting during construction phase would affect the conditions for fish life and cause changes in the species composition as well as the physical patterns of habitats. During the filling phase, the through flow would be much lower than 900m^3/s and would affect aquatic life (including fish) and fisheries very negatively as most of the floodplain lakes would be detached from the Rufiji river. However, according to the current basic dam and turbine designs, during operation phase, up to a total maximum of 3,455m^3/s of

water would be discharged into the Lower Rufiji river from the turbines and lower level and middle level outlets. Thus, the amount of released water would far exceed the 2000m^3/s amount, enough to keep the floodplain lakes connected to the Rufiji river for most of the months of the year and thus sustain floodplain fish production and fisheries to a significant level.

Enhancement measures

1. Develop optimum reservoir operation policy (water allocation model) with the consideration of the environmental flow requirement

- ***Improved health integrity of the Rufiji delta ecosystem***

The balance between freshwater flowing in from the river and salt water from the ocean form a dynamic ecosystem and productive habitat for many species of flora and fauna in the Rufiji delta. However, salinity tolerances and preferences vary by species, and the distribution and abundance of different species relies on the location, extent and dynamics of the freshwater-saltwater interface. As the saltwater enters with the rhythm of the tides and is diluted by the freshwater flowing in from the river, the position of the freshwater- saltwater interface shifts, depending upon such other factors as season, the tide range, amount of precipitation, water diversions, and delta outflow. As such, salinity patterns that benefit native delta species can conflict with human uses of the delta especially for crop production (paddy) and fish exploitation. For instance the shift of freshwater course from the southerly to northerly direction reported to occur in the 1970s changed the salinity regime of the southern block and consequently the pattern of ecosystem services and human dependence.

Under natural river regime, flows vary from a few hundred m^3/s during the dry season up to peaks of several thousands of m^3/s during the rainy season. At present it is normal for low flows to occur for a limited time (several months). An increase in salinity during this period is then flushed and leached out by the very high flows in the rainy season. Euroconsult (1980) observed that once the reservoir becomes operational, the flow would tend to be of a more average level i.e. during the dry season, the relatively higher flows would push salt water further seaward, while in the rainy season when the flows are relatively low the flushing and leaching effect will be less. It was feared that any prolonged period of low flows (e.g. reservoir level to maximize on

electricity generation) would lead to high salinity intrusion further inland from the sea shore given the characteristic high tidal range which reaches up to 4 m high.

The current design modifications suggest that the total maximum discharge into the Lower Rufiji river would be far beyond the current discharge of 1,500 m^3/s at Stiegler's Gorge, that begins to spill water into the flood plain and further push salt water seawards. This is likely to significantly alter the geochemistry of the delta in favour of maintaining the optimum balance of salinity regime to ensure ecological integrity of the delta and the pattern of its ecosystem services. The Rufiji Delta is protected as part of the Rufiji-Mafia-Kilwa Ramsar area and needs to be protected as such.

Enhancement measures

1. Maintain and balance freshwater needs and river flow into the delta from the discharges at the dam and subsequent abstraction for irrigation in lower Rufiji floodplain.
2. Monitor the ecological responses (functions and processes) of flora and fauna communities and populations (mangroves and fishes) during earlier years of operation phase to inform adaptive management of the water discharges into the lower Rufiji.
3. Develop optimum reservoir operation policy (water allocation model) with the consideration of the environmental flow requirement , to sustain the conservation flow

- ***Improved photographic tourism***

In the Lake Tagalala area (Figure 5.2), the boundary between the floodplain and the adjacent, non-alluvial land is subject to change with the project. This is because the Rufiji has been shifting its curved course further northward making use of the lower reaches of the Gumba river system and spilling into several other lakes in this relatively low-lying area, thereby encroaching on the Tagalala lake. It is feared that the consequences of the gradual incision of the Rufiji might be deepened due to degradation. The latter could sweep through the other lakes and drain them. It is feared that this process could affect wildlife and resulting tourism dynamics in the area as these lakes serve as watering places for large herds of wild animals from the Selous Game Reserve and are permanently surrounded by moist grazing lands.

However, no significant change in the ecology and hydrology of the area is anticipated in the near future and affect wild animal population and distribution so much as to disrupt the current photographic tourism industry which is very significant in the area and the SGR in general. The new aquatic environment created by the reservoir and associated lake shore ecosystems is likely to attract a variety of wildlife species populations and boost tourism in the SGR by offering additional tourism products. Boat trips are one of the favourite things tourists already do while in the Selous (the Lake Tagalala area and gorge area) and where photographing birds, Crocodiles or Hippo takes place (.

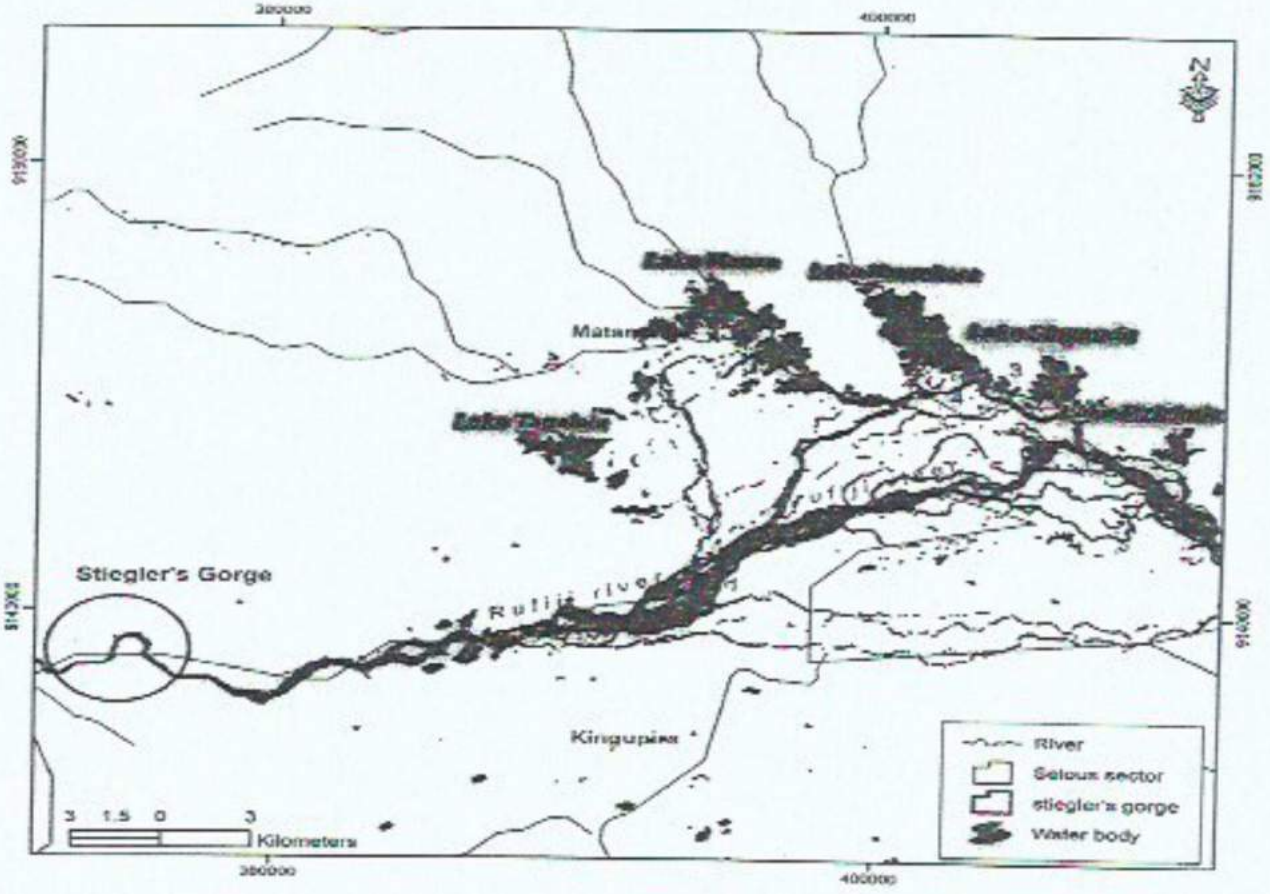


Figure 26: Location and Characteristics of the Lake Tagalala Area as Generated from Google

However, the project might have impact on few existing tourist facilities and products as they are likely to be affected during inundation of the planned reservoir area or in case of accidental failure of the dam. Examples include the Azura River Lodge (Figure 2) and those immediately downstream the dam close to the gorge.

Enhancement measures

1. Undertake detailed study on the hydro-geology and ecology of the Lake Tagalala area to understand potential future trends
2. Develop a tourism master plan around the reservoir for new lodges, campsites and walking safaris
3. Monitor wildlife and habitat development around the reservoir to establish trends for informing tourism investment opportunities

6.3.2 Significant Negative Impacts

- ***Impacts on the SGR outstanding universal values***

The specific attributes which qualified this site for world heritage status can be summarized as follows:

i. **Large undisturbed wilderness area:** At the time of inscription as a World Heritage Site SGR was one of the largest undisturbed wilderness areas in Africa, occupying approximately 50,000 km2 that was free of human settlement, grazing or cultivation. It is located within a wider ecosystem of adjoining protected areas and community Wildlife Management Areas allowing free movement of elephants and other large herbivores over an area of some 90,000 km2, with further connectivity to the Niassa Game Reserve (42,000 km2) in northern Mozambique. The size and complexity of this extensive protected area complex ensures the functioning of on-going ecological and biological processes.

ii. **Globally significant populations of large mammals:** It supported some of the largest remaining populations of Africa's iconic mega-fauna, including (at the time of world heritage inscription) more than 100,000 elephants, 200,000 buffalo, 2,000 black rhino, 18,000 hippopotamus and a healthy population of wild dog. Approximately 750,000 large mammals of 57 species were recorded in 1986.

iii. **Diversity of mammals, birds and other animal taxa:** The reserve has a higher density and species diversity than any other area of miombo woodland, lying in one of the world's Endemic Bird Areas, and 450 species of birds.

iv. **Rare and endangered species:** There are several rare and endangered mammals and birds, including elephants, black rhino, wild dog, lion, cheetah, hippopotamus, Sanje crested mangabey and Udzungwa red colobus monkey. Amongst the birds, globally threatened species include the wattled crane (*Grusca ruruculatus*), lesser kestrel (*Falco n aumanni*), the endemic Udzungwa forest partridge (*Xenoperdix udzungwensis*) and rufous-winged sunbird (*Nectarinia rufipennis*).

v. **Diversity of vegetation types:** Reflects variations in altitude (from 80-1,300 metres), soils, rainfall, seasonal flooding patterns and other abiotic factors. The vegetation is predominantly deciduous miombo woodland, punctuated with seasonally flooded sand rivers, interspersed with rocky Acacia-clad hills, forests and swamps. The northern 17% of the reserve (the project impact area) is composed of more open wooded grassland with floodplain swamps and tracts of borassus (*Borassus aethiopium*) and doum palms (*Hyphaen ethebaica*).

vi. **Sand river in the Selous Game Reserve.** The network of seasonally dry rivers that exist as dry sandy river beds for most of the year and become raging torrents during the seasonal rains, often flooding their banks, are a special feature of the Selous landscape sand rivers and associated floodplains.

The 1980 Impact Identification study (Euroconsult, 1980 and Mwalyosi, 1988) observed that development of hydropower project at Stiegler's Gorge at that time would have significant impact on the sand rivers downstream the gorge where river flow along these streams was likely to be continuous throughout the year given the relatively higher river discharge at the dam. It was predicted that endangered mammals including elephants, black rhino, wild dog, lion, and cheetah were likely to be significantly affected by activities and permanent presence of many people working on the power project, thus affecting the animal species diversity. In 1986 it was recorded that there were more than 100,000 elephants, 200,000 buffalo, 2,000 black rhino, 18,000 hippopotamus and a healthy population of wild dog. Approximately 750,000 large mammals of 57 species were recorded in 1986.

The wilderness value of the Matambwe Zone of the SGR where the hydropower project is likely to be impaired by human occupation (> 12,000 workers and their families during the construction phase (3years), construction activities, transportation and access patterns, biomass removal in the reservoir area, etc. Wildlife species of commercial value could become vulnerable to poaching owing to increased human presence and improved access by road and water to the formerly remote area of the reserve. However, these impacts would be largely manageable and are likely to be minimized to a great degree

The approximately $1000k^2$ reservoir would encourage development of reservoir or lake regime resulting in increased fish diversity in the area in particular and the SGR in general. However, increased human population in the project area could encourage illegal fish hunting – contrary to the conservation regulations of the SGR. However, this can be avoided or minimized by locating workers' camp outside the SGR boundaries and strict management of the reservoir.

Recent wildlife census in SGR (TAWIRI, 2014) indicated that the population estimates were approximately 78,231 for buffalo; 23,756 for hippopotamus; 23,677 for impala; 15,217 for elephant; 16,240 for zebra; 16,939 for wildebeest and 3,155 for giraffe. These results indicate significant decline in elephant and buffalo while zebra, impala, hippopotamus and wildebeest remained unchanged. Rhino significantly declined and appears to be close to local extinction, since the last one was spotted in Matambwe in 2013 and to-date only indirect signs of their presence can be noted. The cheetah appears also to have locally gone extinct most probably due to their habitat degradation. It is apparent that implementation of the project would take various derections among these species. For example, widespread or catholic animal species in both the reservoir and the Lake Tagalala area would not be in any way at risk, because they would be easily absorbed elsewhere if they were displaced. However, species of commercial value (e.g. Elephant) would be highly at risk, from socio-ecological changes due to human intrusion in the area. But there is likely to be no impact on Rhinoceros and Cheetah as these have almost become extinct in The SGR, while elephant population appears to be stabilizing. Species selecting riparian habitats such as Waterbuck (*Kobus ellipsiprymus*), would be affected by inundation of the reservoir area. "Specialist" species such as Giraffe, Wildebeest, and Zebra, would remain stable because no significant changes are expected in the hydrology and ecology of the Lake

Tagalala area. Animal species that inhabit very small and limited patches (e.g. Crocodile and Hippopotamus) would most likely increase in the reservoir area and Lake Tagalala area due to increased water availability. In the downstream floodplain area, Hippopotamus would also increase, but Crocodiles would probably not. Increased populations of Crocodiles and Hippos would be a great menace to fishermen using light craft (dugout canoes), and Hippos could destroy farmers' crop (see also Mwalyosi, 1988).

Diversity of vegetation and sand rivers in the project impact area would not significantly change in the SGR. Whereas the miombo are so extensive inside the reserve and in Tanzania the removal of about 1000km^2 of such forest would not constitute a significant loss, the sand rivers would remain largely without change.

All in all the power project will result in relatively more improvement of the outstanding universal values than has been the current trend including: (i) the creation of a reservoir in an extensive terrestrial area in the SGR and providing alternative areas for photographic tourism packages (because it is likely to attract more wildlife and fish diversity) including sport fishing and boating safaris; (ii) the current dam design modifications suggest that there will be relatively high discharges into the Lower Rufiji river including the delta (> 1,500m^3/s) enough to maintain the optimum balance of salinity regime and ensure ecological integrity of the delta and the pattern of its ecosystem services; and (iii) such releases of water would also be enough to keep the floodplain lakes connected to the Rufiji river for most of the months of the year and thus sustain floodplain fish production and fisheries to a significant level. These arguments are further strengthened by the high possibility of establishing the workers camp outside the SGR and avoiding the introduction of reservoir fisheries inside the reserve.

Mitigation measure

1. Establish the workers' camp outside the SGR e.g. at Kisaki, so that only very few necessary staff should be permanently located at the Stiegler's Gorge site
2. Minimize construction time to less than 3years
3. Limit fisheries activities in the reservoir to recreation and research activities as per the legal requirement of Game Reserves in Tanzania.

4. Establish a strong militaristic Project Management (from TAWA and TANESCO) to maintain order and keep out unnecessary entry permits into the project area
5. Allow an international monitoring consortium (including for example IUCN and UNESCO) to support the government in monitoring the management and impact of key project operations of the project.
6. TAWA to consider introducing a special fire management plan (component of Rangeland management) for Miombo woodland areas that are adjacent to the reservoir- before and during the construction phase. The cool burning will enable most plains game species (Wildebeest, Zebra, Eland, warthog etc.) to access and utilize flushes of grasses within the woodlands in compensation to lost grazing pastures in the flooding process. This would potentially also reduce the displacement/movement of these species towards the floodplains/Lake Tagalala area.
7. Strengthen law enforcement and intelligence to combat human intrusion and illegal activities in the Game Reserve and in case of non-performance extend photographic tourism to the whole reserve and disband wildlife hunting
8. Establish Tourism Master Plan for SGR to regulate photographic tourism activities and facilities around the established reservoir.

- ***Impaired landscape/aesthetic quality of the SGR***

Establishment of a modern 2,100MW hydropower plant and its associated infrastructure including a 130m high dam, saddle dams, dam water outlets, power station, staff accommodation and worker's camp etc. Other establishments are the creation of the approx. 1,000km^2 reservoir in currently terrestrial woodland and the operation of the power plant (for more than 50 years) in a relatively remote and pristine miombo woodland of the SGR. All these will dramatically change the landscape of the area following massive deforestation, drilling, excavation, construction and relatively major human settlement disturbances. Similarly scenic sites like Rufiji-Ruaha River confluence (Figure 1) and others (Figure 2) will disappear as will be submerged into the reservoir. The impacts from these established structures will be long-term and largely residual. In addition, the projects would attract job seekers and various service providers as well as visitors and tourists. In the absence of land use planning around the project outside the SGR, the areas could easily turn into a squatter development with significant and

costly long-term implications on human and environmental health. During project decommissioning, demolition of structures would generate substantial rubble and spoil material which could become an eye sore and impair the local aesthetics.

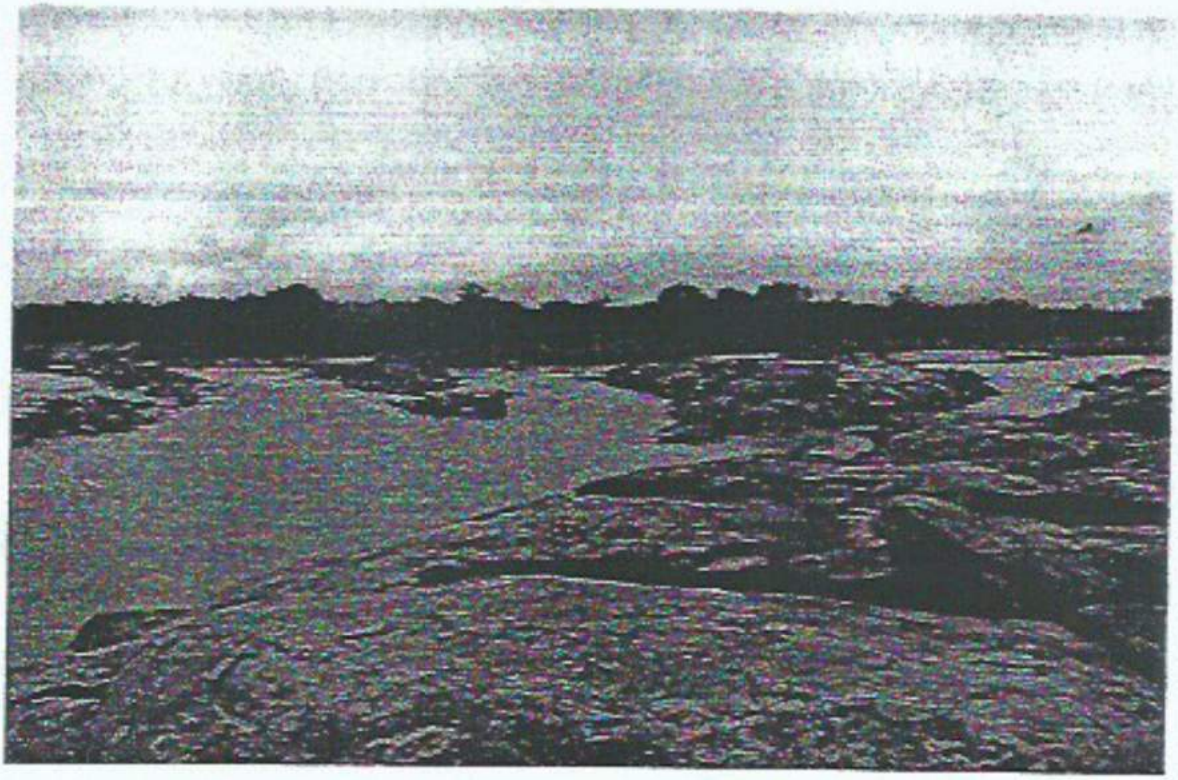


Figure 27: Rufiji-Ruaha Confluence, a tourist spectacle likely to be submerged during reservoir filling

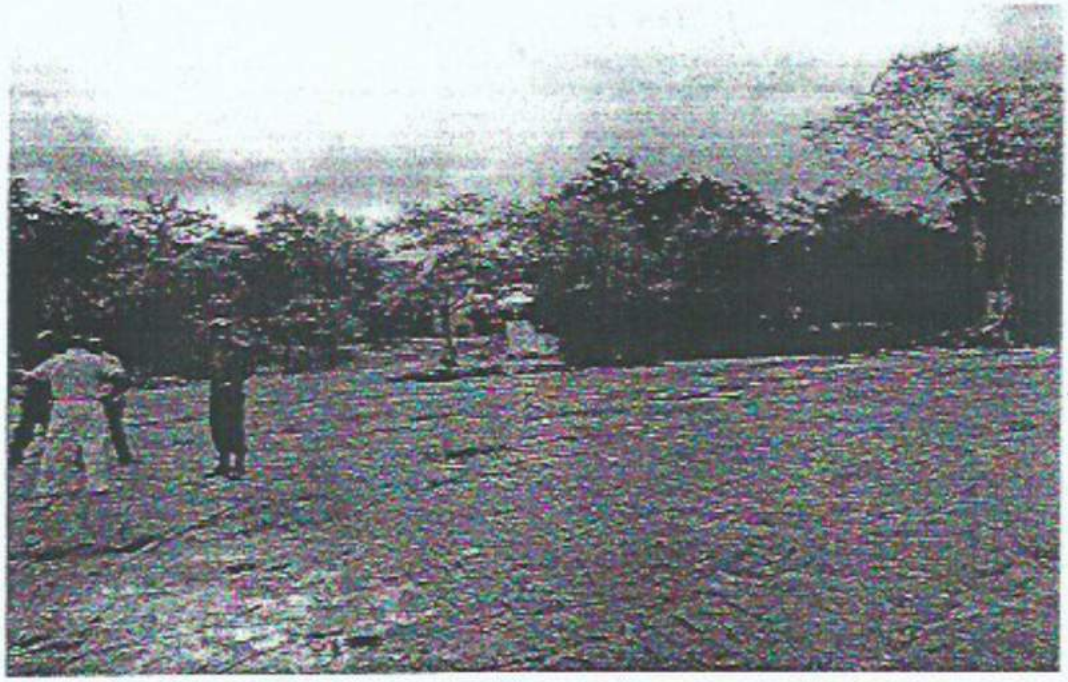


Figure 28: Azura River Lodge- one of the hotels likely to be submerged during reservoir filling

Mitigation measures

1. Confine vegetation clearance only to necessarily designated areas
2. Prepare and enforce land use plans in areas adjacent but outside the SGR
3. Where possible rehabilitate disturbed areas
4. Construct underground power station
5. Use of underground power lines inside the protected area

- ***Water use conflicts***

Notably, there are many competing water use options associated with the hydropower project including: forestation of mountain grasslands with pines and eucalyptus species leading to increased surface runoff and less groundwater recharge in the higher catchment area, development of dams for irrigation and power generation, and water-intensive farming practices in the river floodplains, which make sustainable management of the Rufiji watershed a challenge. The Southern Agriculture Growth Corridor of Tanzania (SAGCOT) initiative was developed by the government of Tanzania to deliver rapid and sustainable agricultural growth in predefined areas (clusters) in Southern Tanzania, and includes the Kilombero, Ihemi, Lower

Rufiji and Usangu clusters (SAGCOT Centre, 2013), all within the Rufiji river basin. The SAGCOT development plan acknowledges the potential emergence of conflicting interests within the agriculture sector that cause unsustainable behavioural patterns e.g. the competition for land and water resources between farmers and livestock owners. The Rufiji river basin is also critical in relation to food and water security. Although the SAGCOT plan assumes that it would foster economic development in the agricultural sector, the plan also acknowledges that it should account for the negative impacts of land use/cover and climate change in the river catchment with respect to water quantity and quality. In other words, the implementation of SAGCOT within the Kilombero and Usangu clusters and careless water management may otherwise have the risk of water overuse and erosion of the capacity of the clusters, the Rufiji delta, and subsequently affect the water supply to and sustainability of the Stiegler's Gorge Hydropower project, particularly in the context of global and local climate change..

A number of stakeholders within the immediate impact area of the Stiegler's Gorge Project including communities in Kilombero and Lower Rufiji were doubtful of the adequacy of water for the proposed hydropower project considering the amount and type of developmenst in the catchment area of the Rufiji river including the other water demanding development projects including the Kilombero SAGCOT cluster development.

Mitigation measures

- Discourage further and new irrigation development in the Kilombero and Usangu Clusters while emphasizing on development of the Lower Rufiji Cluster
- Stop or discourage forestation of mountain grasslands with pines plantations which encourage increased surface runoff instead of infiltration into groundwater reservoirs
- Ensure that responsibility for catchment management and conservation should be a legal responsibility of one agreed and empowered institution
- Ensure land use management plans (especially at the village level) in the Rufiji river catchment are respected and enforced
- Set different prices for wet and dry seasons abstraction.

- *Degradation of the river bed/bank of the Lower Rufiji*

With the establishment of a 130m high dam at Stiegler's Gorge, it is most likely that a greater part of the sediments supplied by the contributing rivers (Luwegu, Kilombero and Great Ruaha) will be trapped in the Stiegler's Gorge Reservoir. Since the water uptake through the turbines is likely to come from the hypolimnion, and later discharge downstream into the Lower Rufiji will have higher kinetic energy (without sediment load), it would result in relatively strong degradation of the river bed/bank of the Lower Rufiji river. Notably, the amount of water discharged would be far higher than what was designed in 1980, and hence the degradation is likely to propagate rapidly in downstream areas and lead to lowering of the water levels along the river. Such "incising" or degradation and lowering of water levels could affect agriculture, gravity irrigation, structures and floodplain lakes fisheries. However, the erosive power of the Lower Rufiji after the Stiegler's Gorge would be minimized by major sediment input from a number of river catchments including Kibanji, Behobeho, Gumba, and Mhango 1 & 2 and reducing the expected amount river bed/bank erosion in the Lower Rufiji floodplain.

Mitigation measures

1. Establish and strictly enforce flood control programme
2. Ensure relatively accurate forecast of weather conditions in the country
3. Deploy and maintain gauging stations to monitor the river flow dynamics in the Rufiji Basin and inform on the adaptive measures.

- *Liquid waste management*

Liquid wastes would be generated mainly during project mobilization and construction and to some degree during project decommissioning. Generated liquid wastes shall include sewage (from offices, accommodation, kitchen and sanitary facilities), mechanical maintenance (which include oils, fuels, grease), storm water runoff and water treatment sludge. Also, assuming the per capita generation of waste water to be 16 litres, the total liquid wastes generated by about 12,000 workers per day would be 192,000 litres per day or 2,304,000litres per month. Poor management of these wastes would not only expose the workers to hazardous wastes and poor sanitary conditions but, may lead to decreased COD, increased BOD, high or low pH and increased nutrients in nearby waterways particularly the Lower Rufiji river. These as well as oil

spills and leaks during project construction could also have a potential negative impact on water quality and productivity. Furthermore, petroleum fuels such as heavy fuel oil (HFO) or distillate diesel fuels contain a number of potentially toxic compounds some of which may be carcinogenic. All these would need appropriate disposal, which will be relatively complex in a game reserve. Therefore, the cumulative generation of liquid waste and their associated secondary and tertiary impacts would be very highly significant in the short and medium-term.

Mitigation measures

1. Waste water treatment facilities should be appropriately designed to prevent waste water infiltration and seepage of contaminants into the soil and water receiving bodies and meet national environmental standards.
2. Fuels, chemicals, and oils should be stored in appropriately sealed vessels to ensure containment of potential leakages and spills and subsequently disposed appropriately

- ***Solid waste management***

Site clearance for construction of the dam and related infrastructure, workers camp and clearance of the reservoir area (during **mobilization and construction phases**), would generate large quantities of vegetation biomass, top soil overburden and excavated material. Additional solid wastes would include garbage (food wastes), rubbish (paper, cardboards, wood, tree leaves and branches, tires, bottles, metals, plastic materials, drums, containers, packaging materials and yard trimmings). Others would be medical or clinical wastes from first aid and other health facilities including medicines sharp objects (e.g. needles). Assuming per capita solid waste generation of about 0.5 kg/day and approximately 12,000 workers employed by the project, about 6,000kg of solid wastes would be generated daily or about 72 tons per month during the construction phase. By all standards, this amount of waste generation is highly significant and if not appropriately disposed may become an eye sore and environmental and health hazard. Poor solid waste management might result into water and environmental contamination/pollution as well as outbreak of diseases including diseases that are shared between animals and people (zoo noses).

The huge amounts of biomass wastes likely to be generated inside the Game Reserve would be highly unmanageable in terms of complexities of treatment inside the reserve or long

transportation to outside (the reserve) for disposal. This necessitates the establishment of Workers camp outside the reserve where waste disposal should be easier and less costly. Site rehabilitation following project closure (**decommissioning phase**) would entail demolition of structures and disposal of spoil material as well as landscaping to rehabilitate the site close to its original state. This would definitely improve the quality of the environment which would be a positive impact.

Mitigation measures

- Introduce mobile toilet services and on-site bins for daily operations at the sites before subsequent appropriate final disposal e.g. via incineration, compositing, controlled tipping/burying, or ploughing in fields outside the SGR.
- Clinical wastes should be appropriately disposed using specialized incinerator established outside the SGR.

- ***Deforestation***

Significant amount of deforestation is anticipated due to vegetation clearing for implementation of various activities of the project such as clearing for dam construction and access roads, establishment of workers' camp and staff accommodation, establishment of transmission line and substation and establishment of a 1,200 km^2 reservoir. The magnitude of loss and extent of de-vegetation is expected to be highly significant and long term as most of those cleared areas would remain devoid of vegetation (especially trees) permanently. Deforestation will also significantly contribute to loss of plant biodiversity as many plant species will be lost. A quick field survey revealed that about 53 plant species will be affected by clearing. The most affected species would include *Spirostachys africana, Pseudilachnostylis maproneunfolia, Combretum apiculatum, Combtretum hereroense, and Combretum molle*,

Moreover, in the process of clearing vegetation, commercial species and/or rare/endangered ones could be involved, requiring special attention. Rapid field assessment indicated that significant loss of valuable timber species will be associated with ridges where soils are well drained including most of the construction sites for workers camp, staff accommodation, transmission line, power station and access roads (Plate 6.1). All these areas contain valuable timber species

or species that can produce significant volume of charcoal. The valuable timber species to be affected are: *Pterocarpus angolesis, Afzelia quanzensis, Combretum comstrictum, Swatzia madagascariensis, Milletia usambarensis, Milletia stuhlmanil* and *Dalbergia melanoxylon*. It would be highly beneficial if such valuable trees could be appropriatcly harvested.

Figure 29: Afzelia *quenzis* one of the valuable timber species to be affected by construction of staff quarters

Within the reservoir area much of the vegetation is dominated by *Combretum ssp* basically of less timber value which however can be harvested for charcoal and fuelwood (Plate 6.2).

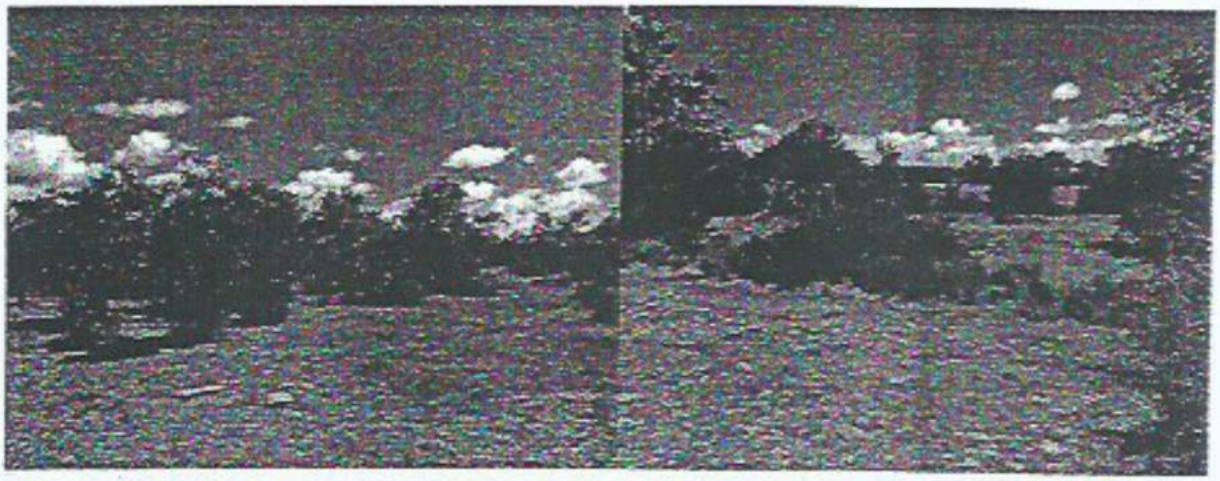


Figure 30: *Combretum ssp* dominating the planned reservoir area

Mitigation measures

- Avoid new clearance of vegetation in areas earmarked for staff quarters construction instead utilize spaces where previous buildings were located
- Vegetation clearance should be confined only to necessarily designated sites
- Minimize the number of workers residing within the SGR by establishing camps outside the SGR preferably Kisaki village
- TFS to coordinate harvesting woody biomass including valuable timber and charcoal species and clear the reservoir. Proceeds from disposal of harvested biomass to be shared between TFS and TAWA based on an agreed formular

- ***Soil erosion***

Soil erosion is expected mainly project mobilization, construction, and decommissioning phases. Site clearance, removal of soil overburden, actual road construction and management of workers camp (or site office), as well as during periodic road maintenance when the access road becomes operational, and during demolition of infrastructure in the event the road or power plant is decommissioned. Soil erosion and land sliding is particularly predicted when construction is done on the slopes of the gorge because in some cases the latter is of steep gradient, and deep and unconsolidated soils, especially if construction is done during the rainy season when precipitation can rise above 1000 mm/annum. Cut and fill effects along the road, creation of drainage channels and hardening of the road itself will create a lot of surface runoff which will accelerates soil erosion and landslides especially on steep slopes

Mitigation measures

- Stabilize the slope edge according to contours and revegetate using indigenous plants species growing in the area
- Adopt engineering design that dampen or break the power of flowing water current where drainage empty water to the environment
- Use of pitched stones and wire mash to control soil erosion on vertical edges
- Cut and fill slopes shall be kept gentle less than 45^0 to minimize landslides

- Stored soil overburden should be bounded (to confine it to the designated area), and regularly wetted (during the dry season) to minimize wind erosion
- Install and maintain sediment control structures to minimize surface runoff prior to discharge to receiving surface water bodies
- Movement of workers, vehicles and machines should be confined to designated routes/tracks
- No (trees) plant should be unnecessarily cut down, while native vegetation should be planted to prevent erosion
- Rehabilitation areas should be totally protected from use until adequate site recovery is achieved following project decommissioning
- As part of project decommissioning, undertake site landscaping and re-vegetation using indigenous local species

- ***Introduction of alien exotic species***

Spread of alien and exotic species might be enhanced by the presence of relatively large numbers of workers (>12,000) implementing various project activities within the Stiegler's gorge Hydropower Project area. Other sources could include materials brought in by vehicles and construction materials as well as those seeds brought in the reserve by rivers carrying sediments from upstream areas like Kilombero, Luwegu, Ruaha and other upstream area. Exotic invasive species once introduced reproduce fast and are not easy to eradicate and attempts to do so are usually costly. The spread of alien plants is reported to be accelerating, including *Mimosa pigra*, *Lantana camara* and the floating aquatic plant, *Pistia stratiotes* (*http://naturalworldheritagesites.org/sites/selous-game-reserve/*).

Mitigation measures

- Obtain some of the construction materials from within the SGR or within the project area
- Proper inspection of goods and materials being taken into the construction area for packaging to avoid spillage on the way

- Once spotted, invasive alien species should be destroyed immediately
- Raise awareness to workers and communities on dangers of alien and invasive sp.

- *Change in species and habitat diversity*

Significant change in species and habitat diversity is anticipated from the project due to implementation of various components and activities of the project. Clearance of vegetation and establishment of reservoir will have significant impact on wildlife habitats of the area and therefore contribute to changes in species diversity of the area following removal of vegetation and wildlife shifts and displacements. A quick field survey revealed that about 53 plant species will be affected by clearing. The most affected species would include *Spirostachys africana, Pseudilachnostylis maproneunfolia, Combretum apiculatum, Combtretum hereroense, and Combretum molle,*

Mitigation measures

- Deploy monitoring mechanisms to assess and track ecological changes and responses of flora and fauna communities to inform adaptive management of the water and sediment budgets into the Rufiji delta.

- ***Enhanced noise pollution***

Particularly during the **construction phase**, substantial amount of noise is likely to be generated due to operation and movement of heavy construction and excavation machines and equipment including: concrete mixing, stone quarrying trucks and vehicles, as well as noise from construction staff including casual labourers. Noise from the various sources will particularly disturb and drive resident wildlife from the project impact zone, the extent of displacement varying from species to species. Some wildlife species might slowly get used to the noise depending on the magnitude and frequency of noise. During the operation phase, most of the construction and excavation equipment, gear and machines will be withdrawn from the project area, including the construction workforce. However, noise will continue to be generated by turbines and a few remaining vehicles for project management staff, although this impact will be

insignificant. Therefore, noise will be a significant issue on the short and medium term (mobilization and construction phases ~3 years).

Mitigation measures

- Train and enforce occupational health and safety practices (including PPE) to workers
- Confine movement of vehicles/machines/equipment along designated routes
- Maintain equipment and machinery at peak working condition to minimize air pollution from exhaust emissions
- Use machinery and plant equipment which generate low noises
- Limit size of charges in blasting
- Provide and enforce agreeable blasting schedules to surrounding communities

- ***Enhanced air pollution***

The main impact on air quality will be felt during the **construction phase** resulting from the exhaust emissions and servicing of construction, blasting, concrete mixing and excavation equipment, machines and trucks. Pollution especially from dust and vehicle emissions will contaminate pasture and water bodies and therefore affect negatively air and water quality for wildlife and humans use. Ambient air quality was not measured during scoping, but it is generally regarded to be fine due to limited human activities, thus any compromise will largely be of short and medium –term problem (during mobilization and construction). During the operation phase, there will be minimal pollution from vehicles on unpaved road, mainly to the power house and settlement area of operational TANESCO staff.

Mitigation measures

- Use vehicles to sprinkle water every morning before construction activities especially for construction of roads and settlements.
- Trucks transporting construction materials must be covered with bays and ensuring the cover remain intact
- Train and enforce occupational health and safety practices (including PPE) to workers

- Confine movement of vehicles/machines/equipment along designated routes which avoid settlements

- *Enhanced water pollution*

Water quality in the reservoir would be influenced by the residence time, the chemical-biological processes, and the mixing behaviour in the reservoir. The critical parameter for water quality would be the oxygen budget. Especially during the filling period, the water quality would be strongly influenced by the rate of filling, which in turn would determine the rate at which degradable material would be brought into the water. A fast filling rate would put a strong demand on the oxygen budget of the water body. This budget could be further influenced by the thermal stratification behaviour which could result in anaerobic water conditions, thus affecting the aquatic life. Fast reservoir filling would increase the chance of poor water quality in the reservoir, and strongly influence the ecosystems-especially in the downstream area.

One of the results of damming the Rufiji river will be the trapping of sediments (especially the courser sediments and some of the fine mineral and organic particulates) from the upstream catchment in the reservoir. It is feared that such sediment deposition would lower the effective volume of the reservoir (i.e. water storage capacity) and hence the energy production. Also, following the retention of sediments in the reservoir, it is feared that the supply of sediments and nutrients to the downstream flood plain would therefore be reduced. However, in previous studies (Hafslund/Norad, 1979 and VHL, 1979) it was established that the effective volume of the reservoir is not expected to be lowered rapidly and that sediments will not be deposited at unfavourable locations. It has been further shown that the Great Ruaha contributes most of the sediments into the Lower Rufiji and mostly fine suspended sediments as the courser ones are trapped into the Mtera and Kidatu dams further upstream. Moreover, the Stiegler's Gorge dam has been designed with low-level outlets partly for flushing the bottom water when the reservoir stratifies. However, during such low-level withdrawals, the river water below the dam would become very anoxic over considerable distances. Under such conditions, wildlife, fish and fisheries downstream the dam would strongly suffer. Irrigation and drinking water supply as well as recreation, would also be affected. Selective withdrawals using the middle gates on the other hand, would worsen the water quality in the reservoir.

Mitigation measures

- Ensure regular flushing of the reservoir especially during reservoir filling, including during high demands of power generation
- As much as possible avoid selective withdrawal of water using middle gates
- Determine and as much as possible avoid fast reservoir filling

- ***Increased risks of HIV/AIDS and STDS***

HIV/AIDS is one the health, social and economic challenges in Tanzania. The pandemic has affected all walks of life, sectors of the economy and the war seems to be still far from ending. There is no current statistics of HIV/AIDS prevalence in Morogoro Rural and Rufiji districts. However, discussions with health officials and Home Based Care service providers in Kisaki and Mloka villages acknowledged the existence of the problem. It was reported that in Kisaki for example, there were more than 150 people who are living with HIV/AIDS. This is just the number of people who are receiving HBC services from two service providers, as such there must be a significant number of patients who have not declared their health status to service providers. Since large numbers of people are likely to be attracted to the project areas, the proposed project could increase the risk of spreading the pandemic in the surrounding districts thereby increasing the burden on health care. The disease's risks will be equally high throughout the project phases due to unavoidable interaction between the local people in Morogoro Rural and Rufiji Districts and incoming people from different parts of the country.

Mitigation measures

- Provide awareness on HIV/AIDS and other communicable diseases.
- Provide Voluntary Counselling and Testing (VCT) centres for HIV/AIDs at work place.
- Enforce HIV/AIDS law and regulations that prohibit stigma, discrimination and responsibility of taking care of the affected people.

- *Increased level of crime and insecurity*

Discussions with various stakeholders at district and village levels revealed that the level of crime is relatively low compared to the large cities and towns in Tanzania. While currently the living conditions in Kisaki and Mloka villages are characterized by rural, traditional life and strong family ties, this is likely to change with the development of the hydro power project at Stigler's Gorge due to the influx of non-locals into the villages which might have some adverse impacts on local lifestyles. Some of the behaviours may be offensive to local norms, customs and practices of the local community.

The potential for the above impact is likely to be significant during the **construction phase** because more people from different parts of the country and outside will be recruited by the project. During operation phase the impact is expected to be minimal because few people will remain at the project site, thus reduce the number of people in the villages. The social control perspective, emphasizes that population growth weakens informal mechanisms of social control which, in turn, result in more crime and delinquency. From these perspectives, the mobilization and construction phases will attract and involve a number of people from within and outside the country. As more people migrate into the area social vices such as crime, theft of construction materials and other properties, alcoholism and sexual laxity/ prostitution are likely to occur as they are associated with migrant workers living alone, away from their families.

Mitigation measures

- Construct police post station at Kisaki and Mloka villages to monitor and stamp down crime
- People entering SGR should be well screened and provided with special identity cards
- Sensitize local communities to form community police (*polisi jamii*) to fight crime and maintain the security of the project area and facilities.
- Contractor to provide own security mechanism for the project goods and facilities.

- ***Increased accidents, risks and hazards***

Construction of the proposed hydropower project will include a number of activities involving mechanical operations of heavy machines and equipment which are susceptible to accidents, risks and hazards. The risks and hazards will also be associated with mobilization but in both cases the impact is expected to be significant but short-term. Stigler's Gorge, being located in a SGR with dangerous terrain and wild animals poses great risks for the people who will be involved in construction and operation of the proposed development including body injury, diseases infections, and even loss of life. These impacts will largely be short-term. Other risks and hazards associated with accidents may result from human error due to fatigue, overworking, prolonged working hours or lack of personal protective gears.

There would also be an increase in number of trucks and vehicles transporting equipments and construction materials. Therefore, communities and tourist will experience this increase in vehicle traffic, which will also increase risks of traffic accidents, especially involving tourist, locals, wildlife and livestock. However, such impacts are expected to be of short term and mainly during construction phase.

Another kind of risk and associated hazards would relate to some tourist facilities especially those perching precariously on the edge of the Stiegler's Gorge below the planned dam. The risk would be particularly serious during reservoir water discharge for flood control or just in case the dam fails as it would destroy and wash down these facilities. Such impact would be very highly significant.

Mitigation measures:

- Provide training on relevant safety measures, first aid procedures and emergency response to workers
- Raise awareness to workers on the dangers of working in a wildlife reserve
- Provide full package of first aid kit at work places and workers' camps
- Provide and enforce use of PPEs
- Provide security to workers from injury and being attacked by wild animals

- Prior to damming conduct a vulnerability assessment of tourist facilities that are likely to be affected and give them first priority to select alternative sites around the reservoir area.

- *Increased pressure on social services*

It is anticipated that about 12,000 people will be involved in the proposed project. Since the project site is within SGR, it is expected that the majority of people will be residing at Kisaki or Mloka villages. The presence of such large number of people in few locations will certainly put great pressure on the already limited socio-economic services (health, education, water). According to the Morogoro Rural socio-economic profile, the district has only one government hospital, two private hospitals, 6 health centers and 43 dispensaries (URT, 2009a). The Rufiji District on the other hand has one district hospital at Utete (URT, 2009b. There are also five health centers and about 50 dispensaries. Most of these health facilities lack medicine and personnel.

While the districts' social services status is relatively poor, the same situation was observed in Kisaki and Mloka villages. Most of the villages visited did not have adequate services and the situation was generally bad in terms of health services and schools to meet the demand of the existing and the anticipated growing population. For example, field assessment in Kisaki Village revealed that in the village there are only two primary schools both in one location. The two primary schools are ill-equipped with overcrowded classes and limited number of teachers and classrooms. There is only one government dispensary providing services to more than 2,000 people. Thus, with increasing numbers of people, availability of these social service will definitely be a problem.

Pressure on local social services will occur in all phases of the project but more significantly during the **construction phase** of the project. Activities at Stigler's Gorge will be characterised by accidents, risk and hazards. As a result, social services such as hospitals and water infrastructure need to be adequately available. Also these people are likely to come with their children who will increase pressure on local education facilities (schools, books, and toilets etc).

Mitigation measures

- The Developer to provide social services for its workers and surrounding communities
- Improve existing social services in the district in tandem with increase population.

- ***Change in local population characteristics***

According to the 2012 census, Morogoro Rural and Rufiji (including Kibiti) districts had a total population of 2,218,492 and 217,274 respectively. The average population growth rate stood at 2.4 and 2.2% per annum. It is expected that the the project will attract more to the respective regions and the districts.

The underlying assumption is that population growth is a function of migration and natural increase. Bilsborrow (1997) argued that migration often occurs much more rapidly and less predictably than natural population growth, thus through migration, growth in an area can happen much more quickly. Since migration is normally characterized by young people who are in the active age of reproduction, it is likely that the population growth in the area will also be accelerated by the natural increase. These situations will possibly change population size, structure and composition in Morogoro Rural and Rufiji Districts (and specifically in Kisaki and Mloka villages) as a result of migration in search for employment and other opportunities.

The potential impacts to the host populations are expected to be significant during the construction phase due to the presence of a large workforce likely to come from outside the project area. Construction of Hydropower plant and its associated components will attract large numbers of job seekers and migrants to the project area. Apart from those who will be directly involved in project construction, it is expected that, other people will come to undertake small scale businesses such as restaurants, food vendors and those who will be involved in the provision of services such as health and education.

Increase in population size and change in the population age structure and composition have implication on resource demand and dependence burdens ranging from expenses for young to health care, gender imbalance in employment opportunities as well as household income generation. The impact of change in population characteristics is expected to persist for the whole life of the project, although it is expected to go down during operation and decommissioning when a number of workers will be laid off.

Mitigation measures

- Employ unskilled labour from the local communities.
- Train farmers and out growers on proper use and handling of agrochemicals
- Provide a clear communication of all available employment positions to minimize population influx.
- Ensure gradual and phased withdrawal of personnel at the end of mobilization and construction phases.

- ***Increased pressure on local infrastructure***

During the **mobilization phase** in particular, activities such as the purchase and transportation of equipment and construction materials will be undertaken. It is expected that the heavy machines and other equipment will be transported by train to Kisaki (Fuga) station, where they will be transported by upgraded road to the project site (Stiegler's gorge). There is possibility for other equipment to be transported by road from Morogoro town. The current road from Morogoro to Kisaki and from Kisaki to Stiegler's Gorge is relatively poor and almost impassable during the rainy season. It is expected that these roads will be improved to enhance transportation of equipment and machines to the project site. This will be highly beneficial, not only to Kisaki village but also to other villages along the roads. It is also anticipated that workers camps will be established in Kisaki village, and these will be associated with provision of social services which will also benefit the people in Kisaki village and other nearby villages.

Mitigation Measures

- Improve road infrastructures from Morogoro to Kisaki and from Kisaki to Stiegler's Gorge before the project start-up
- On decommissioning, staff houses and other useful infrastructure should be handed over to the District Authority for other use e.g. accommodation, school, health centre, etc

- ***Changes on cultural values and norms***

The increase in number of people (project workers and their families, job seekers and other people visiting the project from different parts of the world may bring different cultures to the community to which some of them might be contravening local culture and norms. This is especially important for the youth who are quickly attracted to adopting foreign cultures (e.g. smoking marijuana; wearing clothing against local traditions and norms etc). This concern was strongly raised by community of Kisaki and Mloka area and other parts of Rufiji and Morogoro Rural districts where power generation project will take place. The concern of protecting natural and cultural heritage has been also raised in the Environmental management Act, CAP 191, section 73(1) that requires protection and conservation of natural and cultural values to take into account on the protection of environment. This negative impact will occur mainly during construction and operation phases of project where more people will be migrating to the project area seeking for employment. Once the local culture is invaded and changed, it takes time to reverse the situation again, though it can be reversed or prevented using tight relevant measures.

Mitigation measures

- Raise awareness to foreigners on local culture, norms and values.
- Sensitise the community on importance of preserving local culture and traditions.
- Promote and sensitize the performance of local traditional dances and drama

6.3.3 Cumulative Impacts

The most critical cumulative impacts associated with the Rufiji Hydropower Project relate to impacts of the existing upstream hydropower dams, irrigation schemes, mining, oil and gas exploitation on the Rufiji river flow and water quality of the rivers in the entire Rufiji Basin. Another critical set of impacts relates to the proximity and ecological implications on the relationships between the Selous Game Reserve (and associated impacts of the Rufiji Hydropower development) and the Kilombero Valley Floodplain Ramsar site upstream Stiegler's Gorge on the one hand, and the Rufiji-Mafia-Kilwa Marine Ramsar site downstream the Gorge, on the other. This relationship may contribute to cumulative loss of wildlife in all the above protected areas largely due to further habitat fragmentation and degradation and human activities.

The delta and off-shore stretch to Mafia Island can be considered significant in terms of large populations of resident and migratory fauna. Many of these are linked to the river's seasonality with prawns spawning and whale sharks visiting in response to the river's seasonal sediment pulse. The delta is also home to endangered species including five species of turtle and the Dugong. The collective ecological importance is highlighted by the area being designated a RA MSAR site (Rufiji-Mafia-Kilwa Marine RAMSAR site).

Mitigation measures

- Designate/maintain wildlife corridors among all the related protected areas to ensure free movement and interaction of wildlife so as to continually re-build populations and maintain ecosystem population balance.
- Enforce land use planning and management in all the relevant catchment areas to avoid natural resources degradation

6.3.4 Residual Impacts

Residual impacts are those that cannot be mitigated. In this particular project they would include: landscape change of the Rufiji Project Impact Are including: establishment of an imposing 131m high dam on a ridge at Stiegler's Gorge; creation of a relatively large water body (reservoir) in

the middle of the Selous Game Reserve; change in the Rufiji river natural discharge regime downstream the Dam; and the consequent change in the ecology and biology of the Rufiji delta. Changes would also relate to the whole of the SGR due to the implementation of some other planned developments such as the uranium mining operations, Kidunda dam construction and the SAGCOT irrigation programme.

6.4 Consideration of Alternatives

6.4.1 The "No Project" Alternative

The "***no project***" project alternative literally means that the SGHPP should not be implemented. From this perspective, it follows that the identified potential negative and positive impacts associated with the project would not happen or occur, which is good. But, choosing this alternative does not mean that the baseline conditions in the project impact area will remain the same or will not change. To the contrary, this study has shown that the number of some (including threatened) terrestrial mammals in the Selous Game Reserve has declined in the past 28 years in the absence of the project e.g. from 200 black rhinoceros to near local extinction to-date; 100,000 elephants to 15,000; 200,000 buffaloes to 78,000 in 2014. This means there are other factors that significantly contribute to changes in the biological/ecological and physical environment probably even more than would be caused by the SGHPP.

6.4.2 Development of other power generation options

The rapidly increasing human population, desire for industrialization and other development related activities in the country will make the need for more electric power indispensable, and will force development of other power generation options including gas and coal that tend to generate more GHG emissions and therefore resulting into serious environmental and social impacts, probably more than the SGHPP. Thus, despite the availability of many other alternatives for power generation in the country (gas, geothermal, wind, solar, biomass, coal, nuclear), at least for now and the near future, hydropower power generation offers a good prospect to solving the immediate need of adequate electric power in the country. Likewise, there are a number of alternatives to hydropower development, but the SGHPP offers the best prospect to generate high amount of power (2100 MW) at a goal compared to any other hydropower sources in

the country. Therefore, the SGHPP appears to have an overall acceptable environmental, social and economic performance.

6.4.3 Planned investment in tourism and tourist infrastructure alternative

The World Bank is proposing a $100 million infrastructure loan for southern Tanzania to boost tourism, while the German government has signed a contract for an €18 million 5-year conservation plan for Selous. These support programmes are coming in following the desire of the country (Tanzania) to ensure that future tourism is sustainable and contributes to the national economy and livelihood of its people through improvement of tourism infrastructures, tourism product development, marketing systems and increased community participation and that emphasis would be tourism development in the Southern Circuit. However, the success of this programme will very much depend on the provision of adequate and reliable supply of power, and hence the importance and urgency of the SGHPP. Natural gas although relatively abundant in Southern Tanzania, it has various other uses primarily as energy source and feedstock for producing other commodities. Apart from power generation, it is used for cooking and heating in households, in vehicles and many other applications. Also it is used as raw material to produce a large range of products like fertilizers, methanol and many other products. All these applications have developmental significance.

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Mitigation is a critical component of the ESIA process. It aims to prevent adverse impacts from happening and to keep those that do occur within an acceptable level. Opportunities for impact mitigation or enhancement usually occur throughout the project cycle. The objectives of mitigation/enhancement are to:

1. Find better alternatives and ways of doing things;
2. Enhance the environmental and social benefits of a proposal;
3. Avoid, minimise or remedy adverse impacts; and
4. Ensure that residual adverse impacts are kept within acceptable levels.

In this project, early links were established between the ESIA and project design team to identify mitigation/enhancement opportunities and incorporate these into consideration of alternatives and design options. In fact mitigation or enhancement is being emphasized following reasonable understanding of the extent of the potential impacts of the proposed project, a process which typically takes place following impact identification, prediction and evaluation. Usually, these measures will be incorporated into the terms and conditions of project approval (by the ESIA Agency) to be met by the developer when implementing the project (i.e. environmental certification). However, these conditions have to be implemented during the impact management stage of the ESIA process. Therefore, the objectives of impact management are to: (i) ensure that mitigation measures are implemented; and (ii) establish systems and procedures for this purpose;

An ESMP therefore describes the mitigation/enhancement management required to ensure proper implementation of agreed mitigation/enhancement measures and verification of predicted environmental impacts (Brew and Lee, 1996). The proposed impact mitigation/enhancement plan for the proposed Stiegler's Gorge Hydropower project is summarized in Table 6.1. The table indicates the predicted impact, proposed mitigation/enhancement measures, and time frame to implement the interventions. The ESMP also shows the responsible institutions for implementing the plan, and cost estimate for implementing the mitigation/enhancement measures. Approximately TZS 3, 305,000,000 (3.305Billion) have been coasted for most of the mitigation and enhancement interventions. However, in a few impact cases (i.e. enhancement of government revenues, enhanced local employment opportunities, enhanced floodplain irrigation

agriculture, improved local infrastructure and increased water use conflicts), the cost of mitigation/enhancement could not be estimated, instead these were left to be estimated later during construction and operation phases. It is anticipated that the developer will at least set aside these funds to implement the mitigation and enhancement measures highlighted in the plan.

Table 15: Environmental and Social Mitigation Plan for the Proposed Stiegler's Gorge Hydropower Project

SN	*Identified Impact*	*Mitigation/Enhancement measures*	*Responsible institution*	*Time frame*	*Indicative Cost*
1	*Impaired surface water quality*	• *Ensure regular flushing of the reservoir especially during reservoir filling, including during high demands of power generation* • *Avoid selective withdrawal of water using middle gates* • *Ensure slow filling of the reservoir*	*TANESCO*	*Operation phase*	*No cost*
2	*River bed/bank Degradation of the Lower Rufiji*	• *Establish and strictly enforce flood control programme* • *Ensure accurate forecast of weather conditions in the country* • *Install and maintain gauging stations to monitor the river flow dynamics in the Rufiji Basin system* • *Develop and implement adaptive measures to prevent river bed/bank degradation*	*TANESCO TMA RBWO*	*Design, construction and operation phases*	*300,000,000*
3	*Impaired fish migration along the Rufiji river*	• *Designate Lake Tagalala area (Inland delta) as a fish sanctuary* • *Regularly release short duration floods to maintain the hydrological regime of inland delta*	*TAWA TANESCO*	*Design, Construction and Operation phase*	*5,000,000*
4	*Impact on the "Tagalala" Lakes*	• *Determine and enforce environmental flow for the Rufiji River system* • *Develop optimum reservoir operation policy (water allocation model) with the consideration of the environmental flow requirement , to sustain the conservation flow* • *Proper regulation of reservoir to ensure dry season flow are restored to natural level and seasonal flow pattern maintained*	*RWBB TANESCO*	*Design, Construction and Operation phase*	*100,000,000*
5	*Reservoir sedimentation*	• *Manage the reservoir sedimentation through sediment sluicing drawdown flushing*	*TANESCO*	*Operation phase*	*No cost*

6	*Soil erosion*	• *Stabilize the slope edges according to contours and revegetate using indigenous plant species* • *Adopt engineering design that dampen or break the power of flowing water where drainage empties water to the receiving environment* • *Use pitched stones and wire mesh (gabions) to control soil erosion on vertical edges* • *Cut and fill slopes shall be kept gentle -<450 to minimize landslides* • *Stored soil overburden should be bounded (to confine it to the designated area), and regularly wetted (during the dry season) to minimize wind erosion* • *Install and maintain sediment control structures to minimize surface runoff prior to discharge to receiving surface water bodies*	*Contractor*	*Construction phase*	*50,000,000*
7	*Change in salinity regime in the Rufiji delta*	• *Determine and enforce environmental flow for the Rufiji River system* • *Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow and sustain downstream demands* • *Proper regulation of reservoir to ensure dry season flow are restored to natural level and seasonal flow pattern maintained*	*RWBB TANESCO*	*Design, Construction and Operation phase*	*Covered in 4 above*

8	*Enhanced ecological integrity of the Rufiji delta*	• *Maintain and balance freshwater needs and river flow downstream the dam* • *Monitor the ecological responses (functions and processes) of flora and fauna communities in the Rufiji delta.* • *Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow and sustain downstream demands* • *Undertake regular flora and fauna species inventories and their population monitoring schemes to ensure ecosystem health and functioning.*	*RWBB TANESCO*	*Operation phase*	*200,000,000*
9	*Liquid waste management*	• *Introduce mobile toilet services for daily operations at the site* • *Design and use appropriate waste water treatment facilities to meet National and International environmental standards.* • *Fuels, chemicals, and oils should be stored in appropriately sealed vessels*	*TANESCO CONTRACTOR MoHCDEC*	*Mobilization ,Construction and Operation phases*	*100,000,000*
10	*Solid waste management*	• *Introduce on-site bins for daily operations at the site* • *Sort and dispose solid waste at designated sites* • *Reduce, Recover, Reuse and Recycle solid waste* • *Raise awareness to workers on environmental and safety issues* • *Use overburden materials to rehabilitate exhausted burrow pits and quarry sites* • *Clinical wastes should be appropriately disposed using specialized incinerator established outside the SGR.*	*TAWA Contractor TANESCO MDC*	*All project phases*	*150,000,000*
11	*Overburden soil management*	• *Stored overburden soil should be bounded and regularly wetted to minimize wind erosion and pollution* • *Use overburden soil to rehabilitate exhausted borrow pits and quarry sites* • *Use appropriate top soil for landscaping*	*Contractor*	*Construction phase*	*20,000,000*
B: Impacts Related to the Ecological/Biological					

12	*Deforestation*	• *Construction camp and operator's village should be located outside the SGR preferably Kisaki village* • *For the other small camps utilize spaces where previous structures were located* • *Vegetation clearance should be confined only to necessarily designated sites* • *TFS to coordinate harvesting woody biomass including valuable timber and charcoal species and clear the reservoir.*	*Contractors TANESCO TFS TAWA*	*Mobilization, construction and operation phases*	*600,000,000*
13	*Loss of biodiversity*	• *Raise awareness to workers and communities on dangers of alien and invasive species* • *Destroy exotic and invasive species once identified* • *Any construction materials from outside the SGR should be screened* • *The exposed slopes should be allowed to regenerate naturally*	*TAWA TAFORI Contractor*	*Mobilization, construction and operation phases*	*50,000,000*
14	*Enhanced introduction of alien exotic species*	• *Proper inspection of goods and materials being taken into the construction area for packaging to avoid spillage on the way* • *Once spotted, invasive alien species should be destroyed immediately* • *Raise awareness to workers and communities on dangers of alien and invasive species*	*TAWA TAFORI Contractor*	*Mobilization, construction and operation phases*	*Covered in 13 above*
15	*Loss of rare, endemic and endangered species*	• *Designate/maintain wildlife corridors to other protected areas to ensure free movement and interaction of wildlife* • *Plan and implement rescue measures to rare, endemic, endangered, sessile and slow moving animal species within reservoir area*	*TAWA TAWIRI*	*Mobilization, construction and operation phases*	*50,000,000*
16	*Change in species and habitat diversity*	• *Deploy monitoring mechanisms to assess and track ecological changes and responses of flora and fauna communities*	*TAWA TAFORI TAWIRI TAFIRI*	*Mobilization, construction and operation phases*	*200,000,000*

17	*Wildlife harassment*	• *Create awareness to workers on protected area's operation code of conduct* • *Drivers to observe and adhere to traffic rules within protected area*	*TAWA Contractor*	*Mobilization, construction and operation phases*	*10,600,000*
18	*Loss of wildlife*	• *Designate/maintain wildlife corridors among all the related protected areas to ensure free movement and interaction of wildlife* • *Enforce land use planning and management in the Rufiji basin*	*TAWA TAWIRI LGAs MLHSD*	*Mobilization, construction and operation phases*	*30,000,000*
C: Impacts Related to the Landscape/ Aesthetics					
19	*Impaired landscape/aesthetic quality of the SGR*	• *Construction camp and operator's village should be located outside the SGR preferably Kisaki village* • *For the other small camps utilize spaces where previous structures were located* • *Confine vegetation clearance only to necessarily designated areas* • *Prepare and enforce land use plans in areas adjacent but outside the SGR* • *Allow natural regeneration on disturbed areas*	*TANESCO Contractor TAWA*	*Mobilization, construction and operation phases*	*Covered under deforestation and loss of wildlife*

20	*Erosion of the SGR outstanding universal values*	• *Construction camp and operator's village should be located outside the SGR preferably Kisaki village* • *Limit fisheries activities in the reservoir to recreation and research activities* • *Establish collaborative Project Management between TAWA and TANESCO* • *Allow an international consortium (including for example WWF and IUCN) to support the government in implementation of mitigation and monitoring plans* • *Strengthen law enforcement and intelligence to combat illegal activities in the Game Reserve* • *Designate/maintain wildlife corridors to other protected areas to ensure free movement and interaction of wildlife* • *Plan and implement rescue measures to rare, endemic, endangered, sessile and slow moving animal species within reservoir area* • *Raise awareness to workers and communities on dangers of alien and invasive species* • *Destroy exotic and invasive species once identified* • *Enforce land use planning and management in the Rufiji basin* • *Change hunting blocks affected by reservoir into photographic tourism blocks* • *Review Tourism Master Plan for SGR to regulate photographic tourism activities and facilities around the established reservoir.* • *Enforce the operational policy for location of staff settlement outside the protected areas*	*TAWA* *TANESCO* *WWF* *IUCN* *UNESCO* *TAWIRI* *TAFORI* *TAFIRI* *MNRT*	*All project phases*	*300,000,000 for game drive access and preparation of photographic management plan* *-the rest are covered against respective impacts*
D: Impact on socio-economic Environment					

21	*Enhanced government revenues*	• *Improve tax collection mechanisms* • *Government to facilitate infrastructure development* • *Provide tax education and enhance tax collection mechanisms.* • *Give employment priority to local communities with relevant skills.* • *Sustain tax base for government through investing in other activities using revenue from electricity generation.*	*MoFP* *TRA* *Ministry of Industry-MoIT* *PO-RALG* *LGAs*	*All project phases*	*TBD*
22	*Enhanced flood control in the Lower Rufiji Floodplain*	• *Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow and sustain downstream demands* • *Tanzania Meteorological Authority should ensure efficient climatic weather predictions* • *The water permit for the Stiegler's Gorge Project (2,200m3/s) should be respected and accorded first priority in the Rufiji river Basin.*	*TANESCO* *TMA* *RWBB*	*All project phases*	*No cost*
23	*Enhanced local employment opportunities*	• *Give employment priority and gender equitability to the local community with relevant skills* • *Provide awareness on forthcoming investment and employment opportunities*	*TANESCO* *Contractor* *LGAs*	*All project phases*	*TBD*

24	*Enhanced floodplain irrigation agriculture*	• *Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow and sustain downstream demands* • *The SAGCOT and traditional irrigation farmers should maximize the utilization of the flood water releases in the Lower Rufiji Floodplain* • *Gradually mobilize the Lower Rufiji traditional farmers to transform into modern irrigation farmers.* • *Establish modern community based irrigation schemes* • *Provide farmers' awareness raising and training on flood based irrigation.* • *Introduce and promote crop varieties suitable for irrigation schemes in the lower Rufiji floodplain* • *Promote organic farming through use of farm yard manure and composite manure as sources of fertilizers.* • *Determine the level of river bed/bank degradation likely to occur due to project operation*	*TANESCO* *MoA* *Irrigation commission* *SAGCOT center* *LGAs* *TAWA* *TMA*	*All project phases*	*TBD*
25	*Improved local infrastructure*	• *The Government to ensure all infrastructures intended to support the project are in place*	*MoF* *TANROADS* *TARURA* *TANESCO* *LGAs*	*All project phases*	*TBD*
26	*Increased opportunity for agro-processing/value addition*	• *Facilitate communities to access electricity services from the project* • *Enhance food production at farm level through access to extension services, input use and irrigation agriculture.* • *Build capacity of local communities on entrepreneurship and value addition skills.* • *Facilitate communities to access credits from credit facilities*	*MoA* *MoIT* *LGAs* *Credit facilities*	*All project phases*	*50,000,000*

27	*Enhanced floodplain fisheries outside the SGR*	• *Develop optimum reservoir operation policy (water allocation model) with the consideration of the environmental flow requirement* • *Ensure controlled fishing and improved marketing in the flood plain lakes outside SGR*	*TAFIRI* *MoLF* *LGAs* *MoIT*	*All project phases*	*50,000,000*
28	*Change in photographic tourism*	• *Designate potential tourism investment sites around the reservoir* • *Review the Tourism Master Plan for Selous Game Reserve to include sport fishing* • *Undertake detailed study on the hydro-geology and ecology of the Lake Tagalala area to understand potential future trends* • *Review a tourism master plan around the reservoir* • *Monitor wildlife and habitat development around the reservoir to establish trends for informing tourism investment opportunities*	*TAWA* *MNRT*	*Operation phase*	*200,000,000*
29	*Change in hunting tourism*	• *Review the Integrated Tourism Master Plan to reflect changes in the Selous Game Reserve*	*MNRT* *TAWA* *Tourism division*	*All project phases*	*10,000,000*

30	Increased water use conflicts	• The water permit for the Stiegler's Gorge Project (2,200m3/s) should be respected • Discourage further and new irrigation development in the Kilombero and Usangu Clusters • Discourage forestation of mountain grasslands with pines and eucalyptus plantations • The government to establish a dedicated governance system for management of catchment and water use in the Rufiji basin • Ensure that responsibility for catchment management and conservation is entitled to one agreed and empowered institution • Ensure land use management plans in the Rufiji river catchment are respected and enforced	MNRT MoWI LGAs RWBB TFS	All project phases	TBD
31	Change in local population characteristics	• Employ unskilled labour from the local communities. • Provide clear communication of all available employment positions to minimize population influx. • Ensure gradual and phased withdrawal of personnel at the end of mobilization and construction phases.	PM-LEYD LGAs Contractor TANESCO TAWA	All project phases	No cost
32	Increased pressure on social services	• The Developer to provide social services for its workers and surrounding communities • Improve existing social services in the district in tandem with increase population.	TANESCO Contractor LGAs	All project phases	600,000,000
33	Increased crime and insecurity	• Construct police post/ station at Kisaki and Mloka villages to monitor and stamp down crime • People entering SGR should be well screened and provided with special identity cards • Strengthen security in the project site • Sensitize local communities to form community police (polisi jamii) • Contractor to provide own security mechanism for the project goods and facilities.	MoIA TAWA LGAs TANESCO Contractor	All project phases	20,000,000

34	*Increase risks, hazards and accidents*	• *Provide training on relevant safety measures, first aid procedures and emergency response to workers* • *Raise awareness to workers on the dangers of working in a wildlife reserve* • *Provide full package of first aid kit at work places and workers' camps* • *Provide and enforce use of PPEs* • *Provide security to workers from injury and being attacked by wild animals* • *Conduct vulnerability assessment for tourism facilities that are likely to be affected by the project to provide adaptive solution* • *Affected facilities be offered first priority elsewhere*	*MNRT* *TAWA* *TTB* *TATO* *OSHA* *TANESCO* *Contractor*	*All project phases*	*300,000,000*
35	*Increased risk of HIV/AIDS and other STDS*	• *Provide awareness on HIV/AIDS and other communicable diseases.* • *Provide Voluntary Counselling and Testing (VCT) centres for HIV/AIDs at work place,* • *Enforce HIV/AIDS law and regulations that prohibit stigma, discrimination and responsibility of taking care of the affected communities.*	*MoHCDGEC* *TACAIDS* *LGAs* *NGOs*	*All project phases*	*30,000,000*
36	*Increased noise pollution,*	• *Use machinery and plant equipment which generate low noises* • *Limit size of charges in blasting* • *Provide and enforce agreeable blasting schedules to workers* • *Provide construction workers with appropriate PPEs like earplugs, or earmuffs and training them in their use* • *Ensure regular servicing of construction equipment and machinery* • *Use equipment that meet TZ/WHO/IFC noise standards* • *Confine construction activities to designated area*	*MNRT* *TAWA* *PM-LEYD* *OSHA* *TANESCO* *Contractor*	*All project phases*	*Covered in xx above*

37	Increased water pollution	• Regular maintenance of equipment and machinery to be done outside the Selous Game Reserve to minimize oil leakage • Provide oil skimmers at all designated maintenance bays and dispose through registered oil collectors • Discharged waste water to meet National and International environmental standards. • Raise awareness to workers/staff/ on environmental and safety issues	MNRT TAWA PM-LEYD OSHA TANESCO Contractor	All project phases	Covered in xxx above
38	Increased air pollution	• Use vehicles to sprinkle water to minimize dust in work places • Cover trucks transporting construction materials with bays and ensure cover remain intact • Train and enforce occupational health and safety practices (including PPE) to workers • Confine movement of vehicles/machines/equipment along designated routes • Maintain equipment and machinery in good working condition to avoid pollution	TANESCO Contractor OSHA	All project phases	Covered in xx above
E. Archaeological and cultural heritage values					
39	Destruction and loss of archaeological heritage	• Conduct shovel test pits in the project area • Adopt Chance Finds Procedure when implementing various activities of the project.	MNRT Antiquities department TANESCO Contractor	Mobilization and Construction phases	20,000,000
40	Changes on Cultural Values and Norms	• Raise awareness to foreigners on local culture, norms and values. • Sensitise the community on importance of preserving local culture and traditions. • Promote and sensitize the performance of local traditional dances and drama	MNRT LGAs MoICAS NGOs	All project phases	10,000,000

CHAPTER EIGHT: ENVIRONMENTAL AND SOCIAL MONITORING PLAN

ESIA follow up and effective monitoring has become a matter of concern among EIA practitioners (IAIA, 2005) and in the EIA policies of many countries. Mitigation options and enhancement measures are meaningless without effective and consistent follow up i.e. monitoring. Tanzania is facing this problem and the EMA (URT, 2004) and the EIA Regulations (URT, 2005) defines measures that have to be taken to address this issue. Monitoring must include checking for effectiveness or otherwise of mitigation and enhancement measures. EMA No. Cap 191 of 2004 defines roles for monitoring where the National Environment Management Council (NEMC) is empowered to enforce compliance to the environmental permits issued prior to development and follow in monitoring to ensure implementation of the Environmental Management Plans (EMP). NEMC is therefore required to conduct monitoring activities in collaboration with relevant sectors and other stakeholders.

Monitoring refers to the systematic collection of data through a series of repetitive measurements over a long period-of time to provide information on characteristics and functioning of environmental and social variables in specific areas over time. The proposed Environmental and Social monitoring plan for the Stiegler's Gorge Hydropower Project is summarized in Table 7.1. The table indicates the predicted impact, proposed mitigation measures, and time frame to implement any intervention; it also shows the responsible institution for implementing the plan, the opportune time for undertaking each mitigation/enhancement measure and cost estimate for implementing the mitigation/enhancement measures. Furthermore, it indicates the frequency of monitoring, reporting and monitoring indicators to follow or measure to check the compliance with the acceptable limit of acceptable use or change. The estimated total cost of monitoring is estimated at TZS585,000,000. It is anticipated that the developer will set aside these funds to implement the monitoring plan developed.

Table 16: Environmental and Social Monitoring Plan for the Proposed Stiegler's Hydropower Project

SN	Identified Impact	Mitigation/Enhancement measures	Responsible institution	Monitoring indicator	Monitoring frequency	Means of verification	Indicative Cost
1	Impaired surface water quality	• Ensure regular flushing of the reservoir especially during reservoir filling, including during high demands of power generation • Avoid selective withdrawal of water using middle gates	TANESCO	Presence / absence of reservoir stratification	Biannually	Field measurements Water quality reports	10,000,000
		• Ensure slow filling of the reservoir		Presence/absence of reservoir filling schedule	Once	Physical observation	
				Reservoir water levels over time	Monthly during filling	Field measurements	
2	River bed/bank Degradation of the Lower Rufiji	• Establish and strictly enforce flood control programme	TANESCO TMA RWBB	Presence/absence of flood control program	Once	Physical observation	5,000,000
				Frequency of floods	Once after every ten years	Reports	
		• Ensure accurate forecast of weather conditions in the country		Accuracy of predictions	Annually	Reports	
		• Install and maintain gauging stations to monitor the river flow dynamics in the Rufiji Basin system	TANESCO RWBB	Presence/absence of gauging stations	Annually	Field observation and reports	
		• Develop and implement adaptive measures to prevent river bed/bank degradation		Presence/absence of adaptive measures			

3	Impaired fish migration along the Rufiji river	• Designate Lake Tagalala area (Inland delta) as a fish sanctuary	TAWA TANESCO	Presence/absence of designated fish sanctuary	Annually	Field observation	5,000,000
		• Regularly release short duration floods to maintain the hydrological regime of inland delta		Frequency of flood release		Reports	
4	Impact on the "Tagalala" Lakes	• Determine and enforce environmental flow for the Rufiji River system • Develop optimum reservoir operation policy (water allocation model) with the consideration of the environmental flow requirement , to sustain the conservation flow • Proper regulation of reservoir to ensure dry season flow are restored to natural level and seasonal flow pattern maintained	RWBB TANESCO	Presence /absence of determined environmental flow Level of compliance to environmental flow	Once Monthly	Field measurements and Reports	15,000,000
5	Reservoir sedimentation	• Manage the reservoir sedimentation through sediment sluicing drawdown flushing	TANESCO	Presence/absence of implemented sediments sluicing schedule	Annually	Report	10,000,000
				Sediments accumulation over time in the reservoir Sediments accumulation over time in the lower Rufiji flood plain and delta		Field measurements	
6	Soil erosion	• Stabilize the slope edges according to contours and revegetate using indigenous plant species	TAWA	Extent of vegetated slopes and type of plant species used Extent of erosion and siltation	Bianqually	Field observation	

		• *Adopt engineering design that break the power of flowing water where drainage empties water to the receiving environment*	*TANESCO Contractor*	*Presence /absence of implemented designs reflecting proposed mitigation measures*	*Quarterly*	*Field inspection*	*5,000,000*
		• *Use pitched stones and wire mesh (gabions) to control soil erosion on vertical edges*		*Extent of use of pitched slope and wire mesh*	*In tandem with construction activities*		
		• *Cut and fill slopes shall be kept gentle -<45^0 to minimize landslides*		*Extent of erosion an d landslide*			
		• *Stored soil overburden should be bounded (to confine it to the designated area), and regularly wetted (during the dry season) to minimize wind erosion*		*Presence/absence of bounded and wetted overburden*			
		• *Install and maintain sediment control structures to minimize surface runoff prior to discharge to receiving surface water bodies*		*Presence/absence of functional sediment control structures*	*Biannually*		
7	*Change in salinity regime in the Rufiji delta*	• *Determine and enforce environmental flow for the Rufiji River system* • *Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow and sustain downstream demands* • *Proper regulation of reservoir to ensure dry season flow are restored to natural level and seasonal flow pattern maintained*	*RWBB TANESCO*	*Presence /absence of determined environmental flow*	*Once*	*Field measurement and report*	*Covered in 5 above*
				Level of compliance to environmental flow	*Monthly*		
				Level of salinity in the delta	*Biannually*		
8	*Enhanced ecological integrity of the Rufiji delta*	• *Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow*	*RWBB TANESCO*	*Presence /absence of determined environmental flow*	*Once*		

		and sustain downstream demands • *Maintain and balance freshwater needs and river flow downstream the dam*		*Level of compliance to environmental flow*	*Monthly*	*Established permanent monitoring plots* *Field survey reports*	*50,000,000*
				Level of salinity in the delta	*Biannually*		
		• *Monitor the ecological responses (functions and processes) of flora and fauna communities in the Rufiji delta.*		*Changes in ecological pattern over time*	*Biannually*		
		• *Undertake regular flora and fauna species inventories and their population monitoring schemes to ensure ecosystem health and functioning.*		*Change in species composition and distribution over time*			
9	*Liquid waste management*	• *Introduce mobile toilet services for daily operations at the site*	*TANESCO CONTRACTOR NEMC MoHCDEC*	*Presence /absence of functional mobile toilet*	*Monthly*	*Field inspection*	*50,000,000*
		• *Design and use appropriate waste water treatment facilities to meet National and International environmental standards.*		*Presence/absence of waste water treatment facility* *Level of compliance with standards*	*Quarterly*	*Field inspection and reports*	
		• *Fuels, chemicals, and oils should be stored in appropriately sealed vessels*		*Presence/absence of functional storage facilities*	*Quarterly*	*Field inspection*	
10	*Solid waste management*	• *Introduce on-site bins for daily operations at the site*	*TAWA Contractor TANESCO MDC*	*Presence /absence of functional facilities*	*Monthly*	*Field inspection*	*20,000,000*
		• *Sort and dispose solid waste at designated sites*		*Presence/absence of sorted waste material at disposal site*	*Quarterly*		

		• *Reduce, Recover, Reuse and Recycle solid waste*		*Presence/absence of functional recycling facility*	*Quarterly*		*20,000,000*
		• *Raise awareness to workers on environmental and safety issues*		*Presence/absence of awareness programmes*	*Quarterly*	*Reports*	
		• *Use overburden materials to rehabilitate exhausted burrow pits and quarry sites*		*Number and types of material used for rehabilitation of burrow pits*	*Monthly*	*Field inspection*	*50,000,000*
		• *Clinical wastes should be appropriately disposed using specialized incinerator established outside the SGR.*		*Presence/absence of appropriate incinerator*	*Quarterly*		
11	*Overburden soil management*	• *Stored overburden soil should be bounded and regularly wetted to minimize wind erosion and pollution*	*TANESCO Contractor TAWA*	*Presence/absence of dust from overburden materials*	*Monthly*	*Field inspection*	*30,000,000*
		• *Use overburden soil to rehabilitate exhausted borrow pits and quarry sites*		*Number and types of material used for rehabilitation of burrow pits*	*Monthly*		
B: Impacts Related to the Ecological/Biological							
12	*Deforestation*	• *Construction camp and operator's village should be located outside the SGR preferably Kisaki village* • *For the other small camps utilize spaces where previous structures were located*	*Contractors TANESCO TFS*	*Location of camps in relation to SGR*	*Monthly*	*Field inspection*	*5,000,000*
		• *Vegetation clearance should be confined only to necessarily designated sites*	*TAWA*	*Size of land cleared outside the core project area*			

		• *TFS to coordinate harvesting woody biomass including valuable timber and charcoal species and clear the reservoir.*		*Institution mandated to coordinate clearing*	*Monthly*	*Field inspection*	
13	*Loss of biodiversity*	• *Raise awareness to workers and communities on dangers of alien and invasive species* • *Destroy exotic and invasive species once identified*	*TAWA TAFORI Contractor*	*Presence/absence of alien species*	*Biannually*	*Reports*	*10,000,000*
		• *Any construction materials from outside the SGR should be screened*		*Presence/absence of operational screening facility*	*Monthly*	*Reports*	
		• *The exposed slopes should be allowed to regenerate naturally*		*Species composition of regenerating slopes*	*Biannually*	*Field inspection and reports*	
14	*Enhanced introduction of alien exotic species*	• *Proper inspection of goods and materials being taken into the construction area for packaging to avoid spillage on the way* • *Once spotted, invasive alien species should be destroyed immediately* • *Raise awareness to workers and communities on dangers of alien and invasive species*	*TAWA TAFORI Contractor*	*Presence/absence of alien species*	*Biannually*	*Field inspection*	*Covered in 13 above*
15	*Loss of rare, endemic and endangered species*	• *Designate/maintain wildlife corridors to other protected areas to ensure free movement and interaction of wildlife*	*TAWA TAWIRI*	*Presence/absence of operational wildlife corridor*	*Biannually*		

		• Plan and implement rescue measures to rare, endemic, endangered, sessile and slow moving animal species within reservoir area		Presence/absence of functional rescue measure executed	Once	Reports	30,000,000
				Number and types of species rescued	Quarterly	Field survey and reports	
16	Change in species and habitat diversity	• Deploy monitoring mechanisms to assess and track ecological changes and responses of flora and fauna communities	TAWA TAFORI TAWIRI TAFIRI	Presence/absence of effective tools	Biannually	Field observation and reports	10,000,000
17	Wildlife harassment	• Create awareness to workers on protected area's operation code of conduct	TAWA TANESCO Contractor	Presence/absence of awareness programmes	Biannually	Reports	5,000,000
		• Drivers to observe and adhere to traffic rules within protected area		Reported cases of non - compliance	Quarterly		
18	Loss of wildlife	• Designate/maintain wildlife corridors among all the related protected areas to ensure free movement and interaction of wildlife	TAWA TAWIRI LGAs MLHSD	Presence/absence of operational wildlife corridor	Biannually	Field observation and reports	30,000,000
		• Enforce land use planning and management in the Rufiji basin		Presence/absence of operational plans	Annually		
C: Impacts Related to the Landscape/ Aesthetics							
19	Impaired landscape/aesthetic quality of the SGR	• Construction camp and operator's village should be located outside the SGR preferably Kisaki village • For the other small camps utilize spaces where previous structures were located	TANESCO Contractor TAWA	Location of camps in relation to SGR	Monthly	Field inspection	Covered in 12 above
		• Confine vegetation clearance only to necessarily designated areas		Size of land cleared outside the core project area			

		• *Prepare and enforce land use plans in areas adjacent but outside the SGR*		*Presence/absence of operational plans*	*Annually*	*Field observation and reports*	
		• *Allow natural regeneration on disturbed areas*		*Species composition of regenerating slopes*	*Biannually*	*Field survey and reports*	
20	*Erosion of the SGR outstanding universal values*	• *Construction camp and operator's village should be located outside the SGR preferably Kisaki village*	*TAWA TANESCO WWF IUCN UNESCO TAWIRI TAFORI TAFIRI MNRT*	*Location of camps relative to SGR*	*Once*	*Field observation*	*Covered in 19 above*
		• *Limit fisheries activities in the reservoir to recreation and research activities*		*Level of compliance*	*Quarterly*	*Reports*	*TBD*
		• *Establish collaborative Project Management between TAWA and TANESCO*		*Functional collaborative plans in place*	*Annually*		
		• *Allow an international consortium (including for example WWF and IUCN) to support the government in implementation of mitigation and monitoring plans*		*Presence /absence of functional consortium*			
		• *Strengthen law enforcement and intelligence to combat illegal activities in the Game Reserve*		*Trends of illegal activities in SGR*	*Quarterly*		
		• *Designate/maintain wildlife corridors to other protected areas to ensure free movement and interaction of wildlife*		*Presence/absence of operational wildlife corridors*	*Biannually*	*Field observation and reports*	*Covered in 13 and 15 above*
		• *Plan and implement rescue measures to rare, endemic, endangered, sessile and slow moving animal species within reservoir area*		*Presence/absence of functional rescue measure executed*	*Monthly*		
				Number and types of species rescued			
		• *Raise awareness to workers and communities on dangers of alien and invasive species*					*Covered in 14 above*

		• *Destroy exotic and invasive species once identified*		*Presence/absence of alien species*	*Biannually*	*Field surveys and reports*	
		• *Enforce land use planning and management in the Rufiji basin*		*Presence /absence of effective plans*	*Annually*	*Reports*	*TBD*
		• *Change hunting blocks affected by reservoir into photographic tourism blocks*		*Level of compliance*			
		• *Review Tourism Master Plan for SGR to regulate photographic tourism activities and facilities around the established reservoir.*		*Presence/absence of reviewed plan*			
		• *Enforce the operational policy for location of staff settlement outside the protected areas*		*Level of compliance*			
D: Impact on socio-economic Environment							
21	*Enhanced government revenues*	• *Improve tax collection mechanisms*	*MoFP TRA Ministry of Industry-MoIT PO-RALG LGAs*	*Number of new tax collection mechanism*	*Quarterly*	*Reports*	*50,000,000*
		• *Government to facilitate infrastructure development*		*Number and types of infrastructures developed*	*Annually*		
		• *Provide education to tax payers*		*Presence/absence of awareness programmes*			
		• *Increase tax base for government through investing in other activities using revenue from electricity generation.*		*Trend of revenues due to Government*	*Quarterly*		

22	Enhanced flood control in the Lower Rufiji Floodplain	• Develop optimum reservoir operation policy (water allocation model) to maintain required environmental flow and sustain downstream demands	TANESCO TMA RWBB	Presence/absence of flood control program Magnitude of occurring floods	Annually	Reports	5,000,000
				Frequency of floods	Once after every ten years		
		• Tanzania Meteorological Authority to ensure efficient climatic weather predictions		Accuracy of predictions	Annually		
		• The water permit for the Stiegler's Gorge Project (2,200m3/s) should be respected and accorded first priority in the Rufiji river Basin.		Level of compliance water user right	Biannually		
23	Enhanced local employment opportunities	• Give employment priority and gender equitability to the local community with relevant skills	TANESCO Contractor LGAs	Number of local people employed based on gender and types of jobs	Annually.	Field observation and Reports	5,000,000
		• Provide awareness on forthcoming investment and employment opportunities		Presence /absence of awareness raising programmes			
24	Enhanced floodplain irrigation agriculture	• Increase smallholder agricultural productivity • Facilitate farmers to produce high value foods.	TANESCO MoA Irrigation commission SAGCOT center LGAs TAWA	Level of agricultural productivity	Annually	Field observation and reports	10,000,000
		• Facilitate farmers to form farmer's cooperatives		Presence/absence of high value food varieties	Biannually		
		• Establish medium and large scale irrigation farming		Number of farmers association present	Annually		

		• *Maintain optimum reservoir operation policy*		*Level of compliance*	*Biannually*		
		• *Provide farmers' awareness raising and training on flood based irrigation.*		*Presence /absence of awareness raising programmes*	*Annually*		
		• *Introduce and promote crop varieties suitable for irrigation schemes in the lower Rufiji floodplain*		*Types of introduced crop varieties*			
		• *Promote organic farming*		*Level of organic farming application*			
25	*Improved local infrastructure*	• *Ensure all infrastructures intended to support the project are in place*	*MoF TANROADS TARURA TANESCO LGAs*	*Number and types of infrastructures are in place*	*Annually*	*Field observation and reports*	*5,000,000*
26	*Increased opportunity for agro-processing/value addition*	• *Facilitate communities to access electricity services from the project*	*MoA MoIT LGAs Credit facilities*	*Number of local people accessing electricity*	*Annually*	*Field observation and Reports*	*5,000,000*
		• *Build capacity of local communities on entrepreneurship and value addition skills.*		*Presence/ absence of capacity building programmes*			
				Number of local people trained			
		• *Facilitate communities to access credits from credit facilities*		*Presence /absence of credit facilities*			
				Number of local communities accessing credits			

27	Enhanced floodplain fisheries outside the SGR	• Develop optimum reservoir operation policy with the consideration of the environmental flow requirement	TAFIRI MoLF LGAs MoIT	Level of compliance	Biannually	Reports	10,000,000
		• Ensure controlled fishing and improved marketing in the flood plain lakes outside SGR			Quarterly	Field observation and reports	
28	Change in photographic tourism	• Designate potential tourism investment sites around the reservoir • Review the Tourism Master Plan for Selous Game Reserve to reflect the changes	TAWA MNRT TAWIRI TTB	Number and location of tourism investment sites	Once during operation	Field observation and Reports	10,000,000
		• Undertake detailed study on the hydro-geology and ecology of the Lake Tagalala area to understand potential future trends		Number and types of study commissioned	Annually	Reports	TBD
		• Monitor wildlife and habitat development around the reservoir to establish trends for informing tourism investment opportunities		Trends of habitats and wildlife	Biannually	Field survey and reports	
29	Change in hunting tourism	• Review the Integrated Tourism Master Plan to reflect changes in the Selous Game Reserve	MNRT TAWA Tourism division	Number and location of tourism investment sites	Once during operation	Field observation and reports	Covered in 28 above
30	Increased water use conflicts	• The water permit for the Stiegler's Gorge Project (2,200m3/s) should be respected	MNRT MoWI LGAs RWBB TFS	Level of compliance water user right	Annually	Reports	10,000,000
		• Discourage further and new irrigation development in the Kilombero and Usangu Clusters while emphasizing on development of the Lower Rufiji Cluster		Number of newly established irrigation schemes upstream the dam		Field observation and reports	
		• Discourage forestation of mountain grasslands with pines and eucalyptus plantations		Number and size of newly forested hectors			

		• *Establish a dedicated governance system for management of catchment and water use in the Rufiji basin*		*Dedicated governance system established*		*Reports*	
		• *Ensure village land use plans in the Rufiji river catchment are respected and enforced*		*Presence /absence of functional land use plans*			
31	*Change in local population characteristics*	• *Employ unskilled labour from the local communities.*	*PM-LEYD LGAs Contractor TANESCO TAWA*	*Number of local people employed based on gender and types of jobs*	*Annually*	*Reports*	*5,000,000*
		• *Provide clear communication of all available employment positions to minimize population influx.*		*Presence/absence of clear advertised jobs*	*In tandem with project phases*	*Field observation and Reports*	
		• *Ensure gradual and phased withdrawal of personnel at the end of mobilization and construction phases.*		*Presence/absence of withdrawal programmes*		*Reports*	
32	*Increased pressure on social services*	• *The Developer to provide social services for its workers and surrounding communities*	*TANESCO Contractor LGAs*	*Number and types of social services provided*	*Annually*	*Field observation and reports*	*5,000,000*
		• *Improve existing social services in the district in tandem with increase population.*		*Number and types of social services improved*			
33	*Increased crime and insecurity*	• *Construct police post/ station at Kisaki and Mloka villages to monitor and stamp down crime*	*MoIA TAWA LGAs TANESCO Contractor*	*Presence/absence/functional police post/station*	*Annually*	*Field observation and reports*	*10,000,000*
				Trends of crime incidences			
		• *Screen people entering SGR*		*Presence /absence of functional screening procedures*	*In tandem with employment schedule*	*Reports*	
				Community complains	*Annually*	*Field survey and reports*	

		• Strengthen security in the project site		Presence/absence of functional security system			
		• Sensitize local communities to form community police (polisi jamii)		Presence/ absence of effective sensitization programmes			
				Number of functional community police formed			
		• Contractor to provide own security mechanism for the project goods and facilities.		Presence /absence of security mechanism	Quarterly		
34	Increase risks, hazards and accidents	• Provide training on relevant safety measures, first aid procedures and emergency response to workers	MNRT TAWA TTB TATO OSHA TANESCO Contractor	Number of workers trained	Annually	Reports	
		• Provide full package of first aid kit at work places and workers' camps		Presence/absence of functional first aid kit Frequency of incidence	Quarterly	Field observation and reports	5,000,000
		• Provide and enforce use of PPEs		Number of workers complying with PPE use	Quarterly		
		• Provide security to workers in the Game Reserve		Presence/absence of operational security programme	Annually	Surveys and Reports	5,000,000
		• Conduct vulnerability assessment for tourism facilities		Presence/absence of vulnerability assessment programmes			
35	Increased risk of HIV/AIDS and other STDS	• Provide awareness on HIV/AIDS and other communicable diseases.	MoHCDGEC TACAIDS LGAs NGOs	Presence/absence of awareness programmes	Annually	Field survey and reports	15,000,000
		• Provide Voluntary Counselling and Testing (VCT) centres for HIV/AIDs at work place,		Presence/absence of functional VCT centres			

		• *Enforce HIV/AIDS law and regulations.*		*Trends of HIV/AIDS prevalence*			
36	*Increased noise pollution,*	• *Use machinery and plant equipment which generate low noises*	*MNRT TAWA PM-LEYD OSHA TANESCO Contractor*	*Presence/absence of noise*	*Quarterly*	*Field measurements*	*10,000,000*
		• *Limit size of charges in blasting*		*Noise level as per TZS/ WHO/IFC standards*			
		• *Use equipment that meet TZ/WHO/IFC noise standards*					
		• *Provide and enforce agreeable blasting schedules to workers*		*Presence/absence of blasting schedule*			
		• *Provide construction workers with appropriate PPEs*		*Number of workers complying with PPE use*		*Field survey and reports*	*5,000,000*
		• *Ensure regular servicing of construction equipment and machinery*		*Presence/absence of servicing schedule*			
		• *Confine construction activities to designated area*		*Extents of construction outside designated areas*			
37	*Increased water pollution*	• *Regular maintenance of equipment and machinery to be done outside the Selous Game Reserve to minimize oil leakage*	*MNRT TAWA PM-LEYD OSHA TANESCO Contractor*	*Location of maintenance workshop in relation to SGR*	*Once*	*Field observation*	*10,000,000*
		• *Provide oil skimmers at all designated maintenance bays and dispose through registered oil collectors*		*Presence/absence of functional waste oil collection facilities*	*Quarterly*		
		• *Discharged waste water to meet National and International environmental standards.*		*Level of compliance to standards*		*Fields measurements and reports*	
		• *Raise awareness to workers/staff/ on environmental and safety issues*		*Presence /absence of awareness programmes*	*Annually*	*Reports*	
38	*Increased air pollution*	• *Use vehicles to sprinkle water to minimize dust in work places*	*TANESCO Contractor*	*Level of dust as per TZS/WHO/IFC*	*Quarterly*	*Field measurements*	*10,000,000*

		• Cover trucks transporting construction materials with bays and ensure cover remain intact • Maintain equipment and machinery in good working condition	OSHA	Level of compliance to the standards		and reports	
		• Train and enforce occupational health and safety practices (including PPE) to workers		Presence/absence of training programmes	Annually	Reports	
		• Confine movement of vehicles/machines/equipment along designated routes		Level of trespassing	Quarterly	Field observation	
E. Archaeological and cultural heritage values							
39	Destruction and loss of archaeological heritage	• Conduct shovel test pits in the project area	MNRT Antiquities department TANESCO Contractor	Number of shovel pit test and finds	Once during mobilization	Field inspection and reports	30,000,000
		• Adopt Chance Finds Procedure when implementing various activities of the project.		Number of chance finds procedure undertaken and finds	Once during mobilization and construction		
40	Changes on Cultural Values and Norms	• Raise awareness to foreigners on local culture, norms and values. • Sensitise the community on importance of preserving local culture and traditions. • Promote and sensitize the performance of local traditional dances and drama	MNRT LGAs MoICAS NGOs	Presence /absence of a functional sensitization programs	Biannually	Surveys and Reports	10,000,000
				Presence/absence of functional promotion programs			

CHAPTER NINE: DECOMMISSIONING OF THE PROJECT

Decommissioning is a stage the project or activity of the project is formally ending. Tanzania has experience challenges in dealing with the decommissioning of most of the development projects including mines, since many of these were decommissioned without addressing the social and environmental implications arising from the decommissioning process. The Regulations for Environmental Impact Assessment (URT, 2005) directs developers to address the implication of decommissioning process as part of the ESIA process. This chapter highlights the decommissioning of the proposed hydropower project at Stiegler's gorge

The proposed project constitutes activities such as construction of workers camp, construction of dam wall, construction of power plant, substation, development of access and operation roads, and staff quarters. So far the developer of the project has not set a specific time for the decommissioning of the project. However experience from other hydropower project indicates that highly engineered dams can last for more than 70 years. There will be some components of the project that will be closed as soon as their requirement has come to the end. For example, closing workers camp after construction, closing access roads after construction or work in the area and eventual closure of the whole project when the resources or other factors have necessitated that to happen.

Several impacts (negative and positive) are likely to occur as result of the decommissioning. All impacts associated with decommissioning have been described and assessed in chapter 6; Mitigation measures and management plan have also been suggested in chapter 7 and monitoring plans that covers aspects of mitigation measures associated with decommissioning has been highlighted in chapter 8 of this report. Nonetheless *preparation and implement of dam a Closure and Restoration Plan with set aside sufficient funds for post operation activities in important to maintain the life of the Selous Game Reserve after the project.* The project Closure and Restoration Plan should include the demolition of structures and rehabilitation of the project site to regain its status.

CHAPTER TEN: CONCLUDING SUMMARY AND RECOMMENDATIONS

The need to implement the Stiegler's Gorge Hydropower Project in SGR is paramount because of one major/critical reason i.e. the current trend of Tanzania's economic growth and changes in economic policies that has raised great demand for electrical power in the country. Lack of reliable electricity is currently a major production cost component as any slight increase of tariff has been a subject to soaring of prices of goods and services. This electricity unreliability needs to be addressed promptly, particularly following the increase of population and continual deterioration of other generation plants and transmission lines. The Stigler's Gorge can aid Tanzania's electrification through its provision of abundant power that is crucially cheap (predicted level led cost to be 4.5 cents/kWh) and therefore more affordable to the low - income, unconnected majority of citizens. Moreover, the volume of megawatts and low cost of the power make Stiegler's Gorge capable of supporting the desired industrialization by 2025.

The most significant observation in this ESIA is that the proposed development touches on the two criteria for qualifying the Selous Game Reserve as having Outstanding Universal Values (OUV). Some of the direct impacts addressed in chapter six potentially degrade to some extent both criteria IX and X that qualifies SGR as OUV. However, the analysis of the impacts and the mitigation measures developed are adequate enough to address the impacts both direct and cumulative that poses potential damage to the OUV of the Selous Game Reserve.

Several benefits at both local and national level in terms of revenue generation and increased reliability of relatively cheap electricity and creation of employment opportunities have been highlighted in this document. Apart from these positive implications there are some negative primary and secondary impacts on the natural resources, biological and aesthetic settings associated with vegetation clearing and waste management. These impacts have been carefully assessed and evaluated and mitigation measures proposed in a comprehensive environmental management plan (EMP). Some of the impacts such as creation of a permanent water reservoir in the middle of the SGR and landscape changes associated with establishment of a high dam at Stiegler's Gorge are difficult to mitigate and will largely remain residual requiring special

control measures to minimize their severity. A comprehensive monitoring plan is also proposed to follow up on the effectiveness of mitigation/enhancement implementation.

This ESIA concludes that apart from the highly significant benefits to the national and local economy, most of the observed negative impacts can be mitigated or minimized. Therefore, the development project is ecologically suitable, socially desirable and economically viable. The proposed development largely conforms and is in support of various national policies and is likely to make significant contribution to the national and local economics. ***The main recommendation therefore is that the proposed Stiegler's Gorge Hydropower Project should be considered for development as it meets the relevant policy objectives.*** However, the proposed mitigation and enhancement measures recommended in this ESIA must be implemented in order to ensure that negative impacts are minimized while benefits are realized or optimized.

CHAPTER ELEVEN: REFERENCES

Arvidson, A.; Noel, S.; Axberg, G. N.; Johnson, F. X.; Liwenga, E.; Ngana, J.; Senzota, R. (2009). Environmental Risks and Opportunities of Large-scale Biofuels Production in the Rufiji District. A report prepared for SEKAB BioEnergy (T) Ltd. University of Stockholm and Dar essalaam.

Arvidson, A.; Noel, S.; Axberg, G. N.; Johnson, F. X.; Liwenga, E.; Ngana, J.; Senzota, R. (2009). Environmental Risks and Opportunities of Large-scale Biofuels Production in the Rufiji District. A report prepared for SEKAB BioEnergy (T) Ltd. University of Stockholm and Dar essalaam.

A/S Hafslund (1980). Stiegler's Gorge Power and Flood Control Development: Project Planning report, Vol. 1 (Main Report), July 1980

A/S Hafslund (1980). Stiegler's Gorge Power and Flood Control Development: Project Planning report, Vol. 3 (Annex I-V), July 1980

A/S Hafslund (1980). Stiegler's Gorge Power and Flood Control Development: Project Planning report, Vol. 2 (Annex VI-XI), July 1980

Bernacsek, , G.M. (1980). Freshwater Fisheries and Industry in the Rufiji River Basin, Tanzania. Department of Zoology, University of Dar es Salaam.

Brune, G.M. 1953. Trap Efficiency of Reservoirs. Transactions of American Geophysical Union, 344(3)

Bell, R.M. (1970). The use of the herb layer by grazing ungulates in the Serengeti. In *Annual populations in relation to their food resources*, pp 111-23, ed. A. Watson, Oxford: Blackwell.

Borner, M. (1981). Black rhino disaster in Tanzania. *Oryx*, XVI (1), 59-66.

Bradley-Martin, E. (1979). *The international trade in rhinoceros products*. A Report to the World Wildlife Fund. December, 1979.

Estes, R.D. and Small, R. (1981). Large herbivore populations of Ngorongoro Crater. *East African Wildlife Journal*, 19, 175-86.

Kabigumira, J.D.L. (1988). The ecology and behavior of elephants in Ngorongoro Crater. MSc Thesis, University of Dar es Salaam.

Homewood, K.M. and Rodgers, W.A. (1991). Maasai land Ecology: Pastoralist development and wildlife conservation in Ngorongoro, Tanzania. Cambridge University Press.

Sinclair, A. (1985). Does interspecific competition or predation shape the African wildlife community? *Journal of Animal Ecology*, 54, 899-918.

Moehlman, P.D; Runyoro, V.A.; and Hofer, H. (1997). Wildlife Population Trends in the Ngorongoro Crater. In; Thompson, D.M. (Ed.), Multiple Land-Use The Experience of the Ngorongoro Conservation Area, Tanzania. IUCN Protected Area Programme.

Pascale Pierre, Alexa Bresson, Sylvain Junean, Guy Dore and Richard Pleau (2006). Evaluation of Interlocking Concrete Pavement Performance in an Urban Northern Context. International Conference on Concrete Block Paving, November 6 2006, San Fransisco, Carlifornia, USA.

Berry, L. 2009. Ngorongoro Conservation Area Tanzania, United Nations Environmental Programme-World Conservation M

NCAA GMP, 2010. Ngorongoro Conservation Area Authority general management plan 2006-2016 reviewed January 2010

Bennett, M.R., Harris, J.W., Richmond, B.G., Braun, D.R., Mbua, E., Kiura, P., . . . Gonzalez, S. (2009). Early hominin foot morphology based on 1.5-million-year-old footprints from Ileret, Kenya. *Science, 323*(5918), 1197-1201.

Duvail, S. and Hamerlynck, O., (2007). The Rufiji River flood: plague or blessing? *International Journal of Biometeorology* 52:33–42.

Euroconsult delft hydraulic laboratory (1980), Identification Study on the Ecological Impacts of the Stiegler's Gorge Power and Flood Control Project, Part I-IV, November 1980

FAO – The Rufiji Basin, Tanzania. Report No. 1269 FAO Rome 1961

Ministry of Water, URT, 2011: Integrated Water Resources Management and Development Project for the Rufiji River Basin, Interim Report, Volume I, Water Resources Availability Assessment, developed by WREM International Inc., Atlanta, Georgia, USA, 149 pg.

Mwalyosi, R.B.B. (1990). Evaluation of Wildlife Corridors and Buffer Zones for Lake Manyara National Park and its immediate Environment, Tanzania

Ngusaru, A.S., Mgaya, Y.D., Francis, J. and Sosovele, H., (2001). Root Causes of Biodiversity Loss in Rufiji-Kilwa-Mafia and Mnazi Bayruvuma Estuary in Tanzania. A Report Prepared for the WWF East African Marine Ecoregion (EAME) Programme, 63p.

Norconsult (1984). Rufiji Basin Hydropower Master Plan. Rufiji Basin Development Authority, United Republic of Tanzania

Nindi S J, Machano H and Rubens J. 2014. Remote sensing study of mangrove vegetation change in rufiji delta, Tanzania from 1990 to 2010.WWF Tanzania Country Office, Dar es Salaam. 48pp.

Paul H. Temple & Åke Sundborg (2017) The Rufiji River, Tanzania Hydrology and Sediment Transport, Geografiska Annaler: Series A, Physical Geography, 54:3-4, 345-368, DOI: 10.1080/04353676.1972.11879873

Pethick, J. and Spencer, T., (1990). Mangrove response to sea level rise: The Rufiji Delta, Tanzania. Frontier-Tanzania Interim Report, 8p.

Rufiji Basin Development Authority (RUBADA) (1980). Identification Study on the Ecological Impacts of the Stiegler's Gorge Power and Flood Control Project. United Republic of Tanzania.

Rufiji Environmental Management Project, REMP, (2003): Development of a Computerized Flood Warning Model and Study of Hydrological Characteristics of the Lower Rufiji Floodplain and Delta.

Rufiji Basin Multi-purpose development, the United Republic of Tanzania (1979). Stiegler's Gorge and flood control Development by NORAD

Rufiji Basin Water Office (2010). Rufiji Basin Annual Hydrological Report

SAGCOT Centre. (2013b). *Applying an Agriculture Green Growth Approach in the SAGCOT Clusters: Challenges and Opportunities in Kilombero, Ihemi, and Mbarali.*

Selous Game Reserve General Management Plan 2005

Selous Game Reserve (PDF). Retrieved on 28 February 2018.

TFS 2018. Forest inventory report for the rufiji hydro - power project march, 2018

United Republic of Tanzania (URT) (2003). The National Energy Policy, Ministry of Energy and Minerals, Dar es Salaam.

United Republic of Tanzania (URT) (2004). Environmental Management Act (EMA). Government Printer, Dar es Salaam.

United Republic of Tanzania (URT) (2005). Environmental Impact Assessment and Audit Regulations. G.N. No 339. Government Printer, Dar es Salaam.

United Republic of Tanzania (URT): Power System Master Plan, 2016 Update (2016). Ministry of Energy and Minerals, Dar es Salaam.

United Republic of Tanzania (URT) (2016). The Five Year Development Plan 2016/17 -2020/21. Ministry of Finance and Planning

United Republic of Tanzania, Ministry of Energy (2017). Basic Design of Rufiji Hydropower Project

Vollesen K, 1980. Annotated check-list of the vascular plants of the Selous Game Reserve, Tanzania Published. Lund, Sweden : Lund Botanical Society ; Stockholm, Sweden

CHAPTER TWELVE: ANNEXES

Annex A: Views and Concerns of Stakeholders Consulted

S/N	Stakeholders	Date of Consultation	Views/Concerns
	Morogoro Region - Regional Administrative Secretary	19.12.2017	•
	Coast region – Regional Administrative Secretary	19.12.2017	• The proposed development project has come at the right time because the country need reliable source of energy for its development. • The coast region is highly pushing for establishment of industries and it has allocated several hectares of land for industrial development. The intention for industrial development will not be realized if the issue of electricity availability will not be solved. • For many Rufiji district has been depending on subsistence agriculture and fishing which are all poorly undertaken. Therefore, the proposed development is likely to stimulate development by establishment of small scale industries.
	TAWA	19.12.2017	•
	WAMI – Rufiji Water Board	19.12.2017	• Catchment degradation (especially Kilombero basin) - the basin has experienced serious encroachment in the recent years and the

			Ministry of Water and Irrigation has some plans in place, implementation of the plans will require collective efforts as the ministry has already the system in place, they can assume the coordination role. • Water availability for other upstream users - there are existing irrigation schemes and planned in the Kilombero and Great Ruaha catchments, revision of the permits is required for the sustainability of the Stiegler's gorge project. • Climate change- the last few decades has seen a number of frequent droughts and growing variability in rainfall. Long-term global forecasts predict increasing rainfall for East Africa but indicate extreme floods and droughts will also increase. This poses the risks for the sustainability of the project. • Kilombero contributing roughly 60% of the Rufiji flow - has a number of wetland environments used by migratory fish. • Damming the gorge has the potential to disrupt the connectivity of the habitats to the Rufii delta and sea
	SAGCOT Chief Executive Officer Geoffrey Kirenga – and John Banga – E & SS - SAGCOT	14.03.2018	•

	Ministry of Agriculture Eng. Martin Mtigumwe	14.03.2018	• The project is good, however, deliberately efforts should be done to ensure that there is sufficient water to sustain the project.
	Ministry of Natural Resource and Tourism Dr. Fabian Kigadye Dr. Emmanuel Bwasiri Mr. NtanduChristowaja Nsoko Edwin and RajabuHochi	14.03.2018	• Selous is a World Heritage Site ascribed by criteria (ix) and (x) so any development inside a World Heritage Site has to be cleared by UNESCO. As for UNESCO development of Stiegler's project such as putting dam structures, staff quarters increased access and others is seen as threat to Universal Outstanding Values of the Selous. to this UNIESCO has issued a statement to request Tanzania to abandon the Stiegler's project • The Government of Tanzania has prepared write up advocating sustainable development of the project in the Selous taking into consideration preparation of ESIA to justify the development. the prepared document will be sent to UNESCO through the Ministry Foreign affairs and East African Cooperation • The Ministry through TFS will carry out inventories to document all species present in the project area and prepare a harvesting plan to salvage valuable timber species. However in terms of archaeological resources no much research has been done in the Selous to document available materials, nonetheless the anticipated remain could constitute Dinosaurian and ironage remains. During implementation of

			the project chance finding procedures will have to be adopted to rescue any discovery • During dam feeling there will be some effect to flora and fauna that need to be addressed in detail ESIA. Similarly, there should be a need to develop a strong collaboration among all stakeholder to manage not only the Selous but the entire Selous ecosystem include the upstream areas
	Ministry of Water and Irrigation consultation, Dodoma) Chaired by Mr. Hamza Sadiki (Director, Water Resources	15th 03. 2018	• For sustainability of the project, upstream activities need to be monitored system – TMA, Ministry of Water and Irrigation and Basin Board – need to be linked. • The Basin board has approved a permit of 2,200 m^3/s in December 2017 for the Stiegler's gorge project. • Catchment degradation (especially Kilombero basin) - the basin has experienced serious encroachment in the recent years and the Ministry of Water and Irrigation has some plans in place, implementation of the plans will require. • Collective efforts as the ministry has already the system in place, they can assume the coordination role. • Water availability for other upstream users - there are existing irrigation schemes and planned in the Kilombero and Great Ruahacatchments, revision of the permits is required for the sustainability of the Stiegler's

			gorge project. • For the proper operation of the reservoir and for the flood early warning.
	WWF – meeting on Meeting chaired/coordinated by Dr. Amani Ngusaru (Country Director – WWF)	16th 04.2018	• Climate change- the last few decades has seen a number of frequent droughts and growing variability in rainfall. Long-term global forecasts predict increasing rainfall for East Africa but indicate extreme floods and droughts will also increase. This poses the risks for the sustainability of the project/water availability for the hydropower project. • Kilombero contributing roughly 60% of the Rufiji flow - has a number of wetland environments used by migratory fish. Damming the gorge has the potential to disrupt the connectivity of the habitats to the Rufiji delta and sea. • Construction activities - pollution and poaching: The Selous is difficult to access. Construction or upgrading of roads would be required. Impacts near the dam site would include construction traffic, noise, dust waste, quarries, workers - negatively affecting the Outstanding Universal Values (OUV). Work-camps for about 1200 people will encourage poaching. • Flood events have over time changed the course of the river, creating 6-large oxbow lakes outside the reserve that provide reach habitat. These lakes are only reconnected to the river in

			seasonal floods, and often unconnected in years of drought. SGR may result to biodiversity loss. • The area immediately downstream of the project is the main tourist area of the park, containing photographic tourist blocks. The construction process, roads, vehicles and people would reduce the wilderness feeling currently drawing over 16,000 tourists a year. If there are substantial loss of big fauna and bird wildlife from poaching or dam's operation, this would reduce tourist economy.
	Ulanga District Council	20.12.2017	• The proposed project development is timely and important to the nation. • In to ensure sustainability of the project there is to ensure that the catchment areas for three rivers which the Rufiji are well protected and conserved. • There is a need to have one organ which will be responsible for the conservation of Kilombero valley.
	KilomberoDistrict Council	• 20.12.2017	• The influx of agro-pastoralists in the Kilombero valley will threaten the sustainability of the project. There is a need to ensure that all agro-pastoralists are removed in the valley.
	Rufiji District Council	22.12.2017	•

	Kibiti District Council	22.12.2017	
	Alex Fox Director- FoxTreks Limited Director/Board Member - Hotels Association Tanzania (HAT)	04. 01.2018	• Personally, I feel that if the key tourism sector players are brought into the process early on and their concerns mitigated, you may be pleasantly surprised that they do not object to the project - unlike other highly publicized objection to the Serengeti highway and dams on the Kenyan side of the Mara River etc. • Many of the operators of tourist lodges and camps in Selous also operate lodges/camps in Ruaha national park, and all are very environmentally - conscious. So if you can mitigate the negative effects of the Stieglers project with positive mitigation effects even as far upstream as the Great Ruaha River (GRR) in Ruaha National Park, then I'm sure that the tourism operators will understand this. • There are still several private sector endorsement logos that weren't on that document. • You should consider supporting the idea so that we have a multi-sectoral approach and common position - i.e. More efficient planning of water use so that ALL sectors get full use of the water before it evaporates and/or spills into the Indian Ocean. The

			analogy being that rather than butchering the cow first (i.e. Using up the water in usangu before all the other stakeholders who are located downstream), we should be butchering the cow AFTER we have milked it, made cheese, and grown vegetables with its manure. • Without solving the GRR water crisis, Stieglers has little chance of viability. Furthermore, the cost of producing power at Kidatu and Mtera is extremely low - because they are only costing wear & tear and salaries. • With the Great Ruaha River Task Force also on the job with high level support, I believe that we may still have a slight chance of success in making a difference - as long as we all act together (Water Management Agencies, Power Generation, Wildlife Protection & Tourism) to persuade Agriculture that they can actually make more food, more money, and more profit by growing rice in Lower Rufiji. Furthermore, with the recent removal of a minister from the cabinet who has alleged involvement in rice farms in Usangu, a further obstacle is now reduced (although there are apparently some more...). • The point is that we don't need to move *people* per se to downstream of Selous, but rather the *activity* of growing rice. The

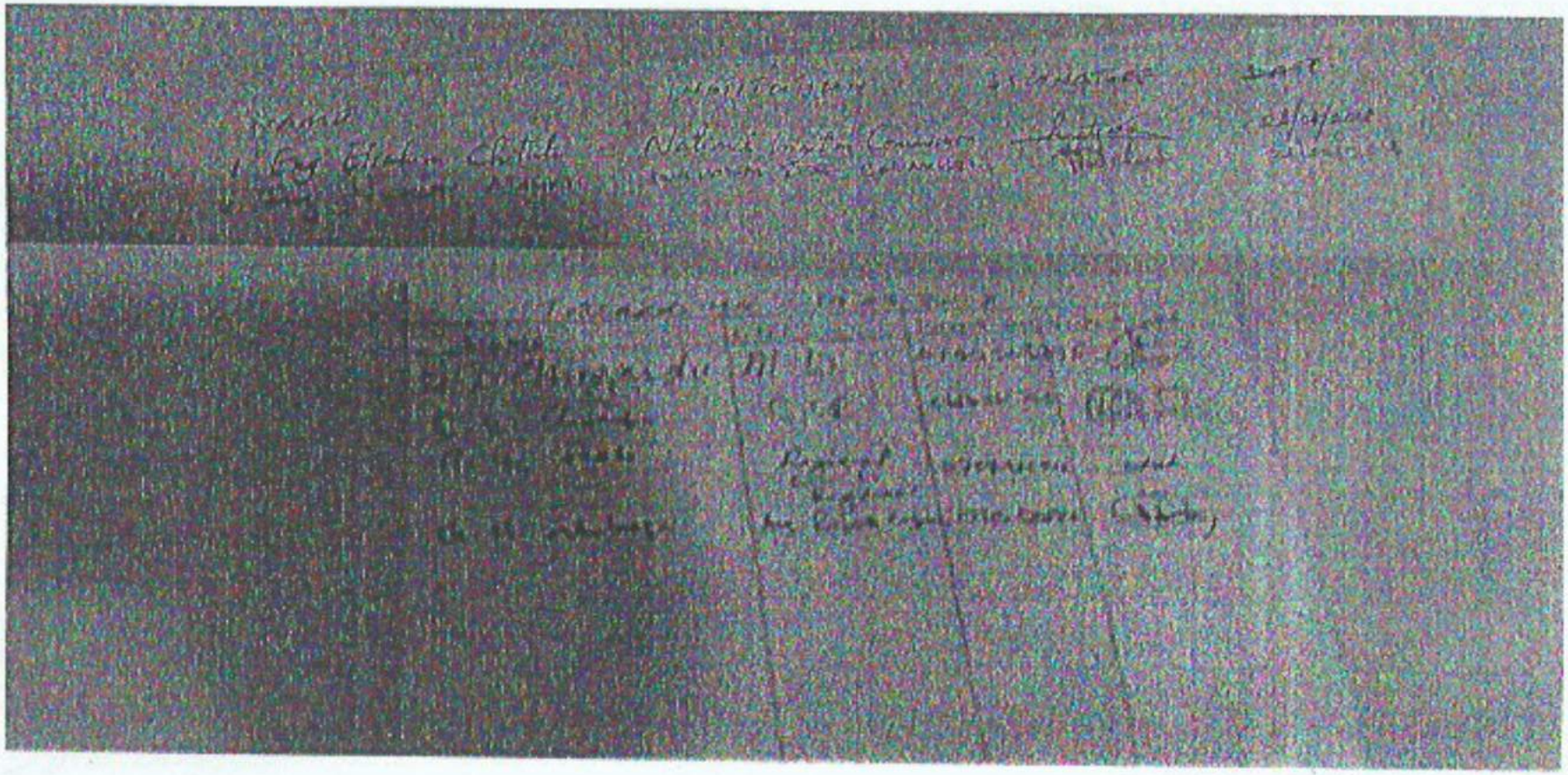
			commercial rice growers will be attracted to the new area by the possibility of THREE rice harvests (enabled by the flow stabilization of Mtera, Kidatu&Stieglers) instead of the one harvest they get in Usangu. Those who wish to remain in usangu will need to be trained in the growing of other, non irrigated cash/subsistence crops - such as sweet potato, ground nuts etc.
	Villages in Lower Rufiji	11.02. - 12.03.2018	• The project is important for the nation; however, we are worried about our livelihood which dependent on agriculture, especially, after floods. What will be status of water availability in the River Rufiji. • Will the project completely close to the downstream? If that will be the case, how are we going survive because our livelihoods depends on agriculture and fishing? • What about employment opportunities? Are we going to be allowed to work in the Selous Game Reserve? How are going to get access to the site? • There have a problem of electricity in our villages, frequent power cut is a common, and will the generation of electricity at Stigler Gorge help to solve this problem?

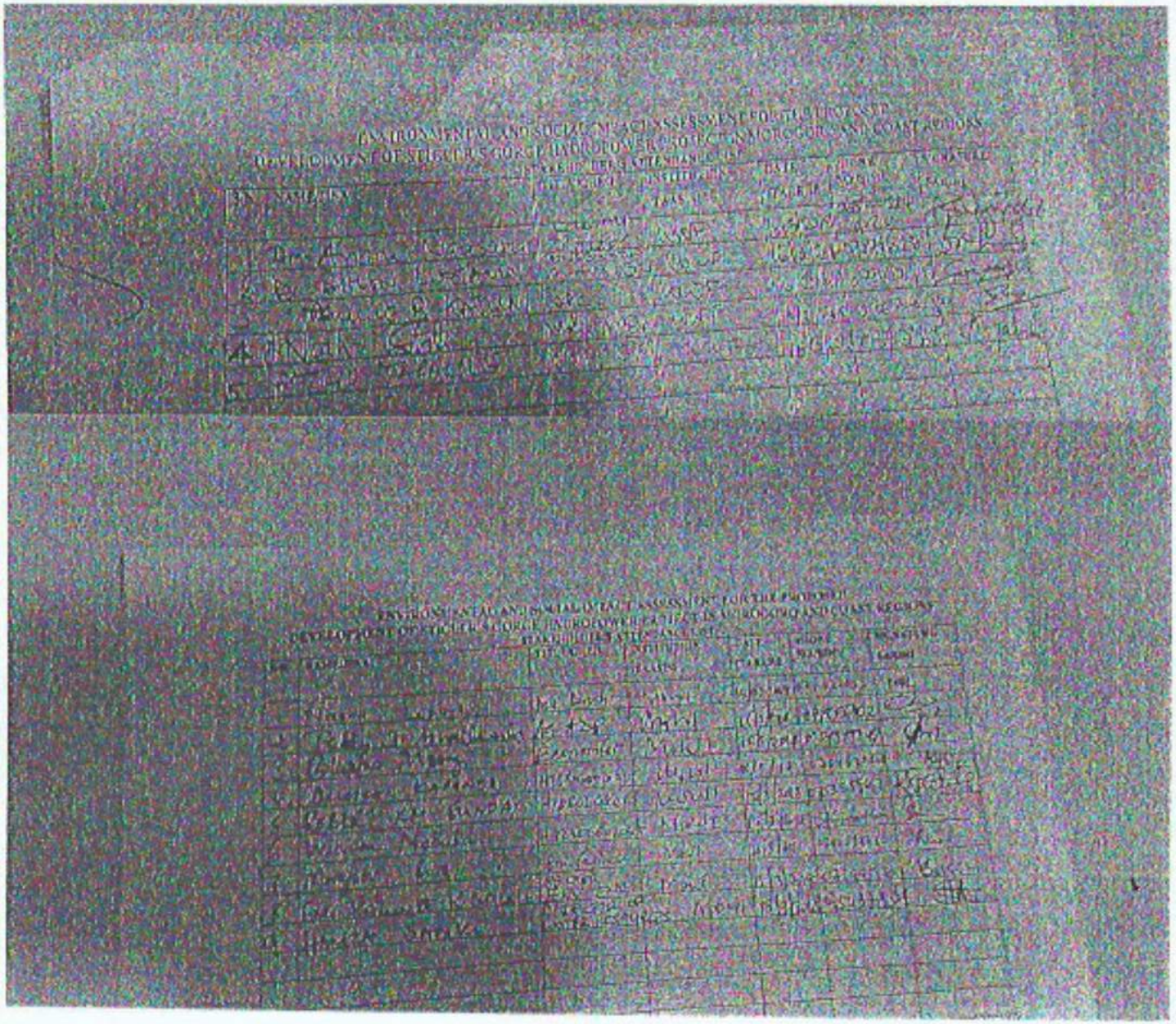
	Villages in the Rufiji Delta	12 – 16. 03.2018	• Impaired delta fisheries following disrupted river flow downstream the reservoir. • Disrupted agriculture and therefore food insecurity, characterized by lack of alternatives as delta communities are traditionally conservatives. • Disruption of traditional flooding that have of decades supported off-season farming and enhances food security. • Looming/speculations on eviction/relocation as there have been political stalemate over the proposed eviction of communities from villages in the delta. This requires awareness raising on the socio-economic value of the SGR HPP, but also that the project is not linked to eviction in any way. • Communities in the lower flood plain and delta will be the most affected ones, and so they should be given priority in the supply of power.
	Pro. Dos Santos Silayo- Chief Executive Tanzania Forest Service	19th.03.2018	• The implementation of the Stieglers power project will generate large amount of power which will enable the country to mini9mize dependence level on nature based source of energy. the increased supply of energy will improve the living standards of people • To able to generate enough energy to supply to the National grid will minimize the cost and allow more people to connect which in turn will reduce significant over reliance on forests for energy sources. Hydropower

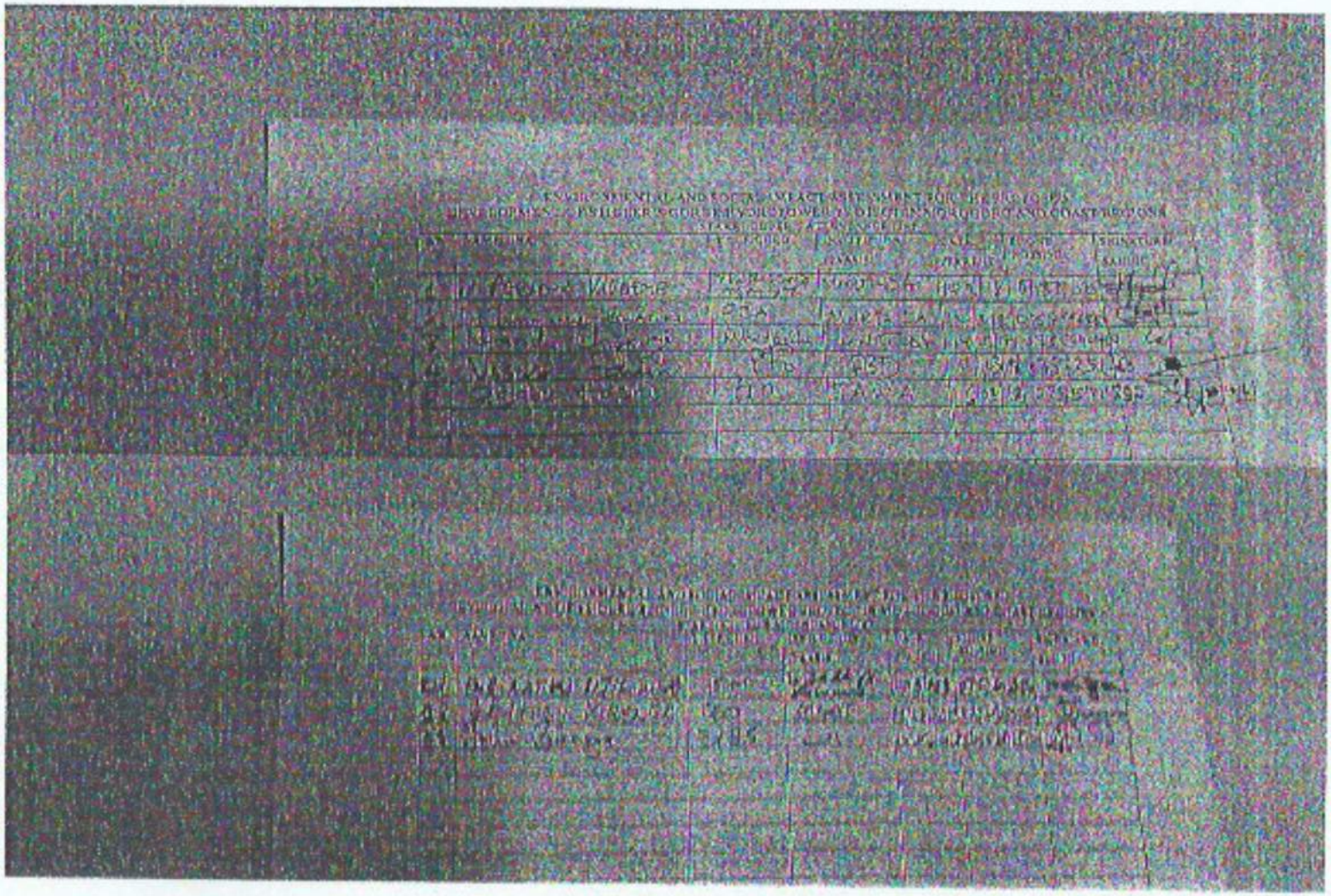
			source is considered clean energy thus increased generation from clean sources will enable the Country to meet its obligation toward meeting global climate change objectives. • The implementation of the project will cause some effect to species present in the area, however due to the size of the Selous Game Reserve, such impact is too minimal to cause species extinction • If you compare the amount of forest loss occurring due to other land uses like agriculture (shifting cultivation), mining activities, fire and others have more significant contribution to forest loss than the contained planned damage that will be caused by the Stiegler's gorge hydropower project. • The anticipated loss from this project will be limited to specific areas requiring removal, and such removal will be done in sach a way that all valuable resources will be salvaged. • The biomass removed from reservoir site and other part of the project will be sold and the resources obtained can contribute to other Government spending as the money generated is Government money anyway.
	Tanzania – Zambia Railway	19th 03.2018	•

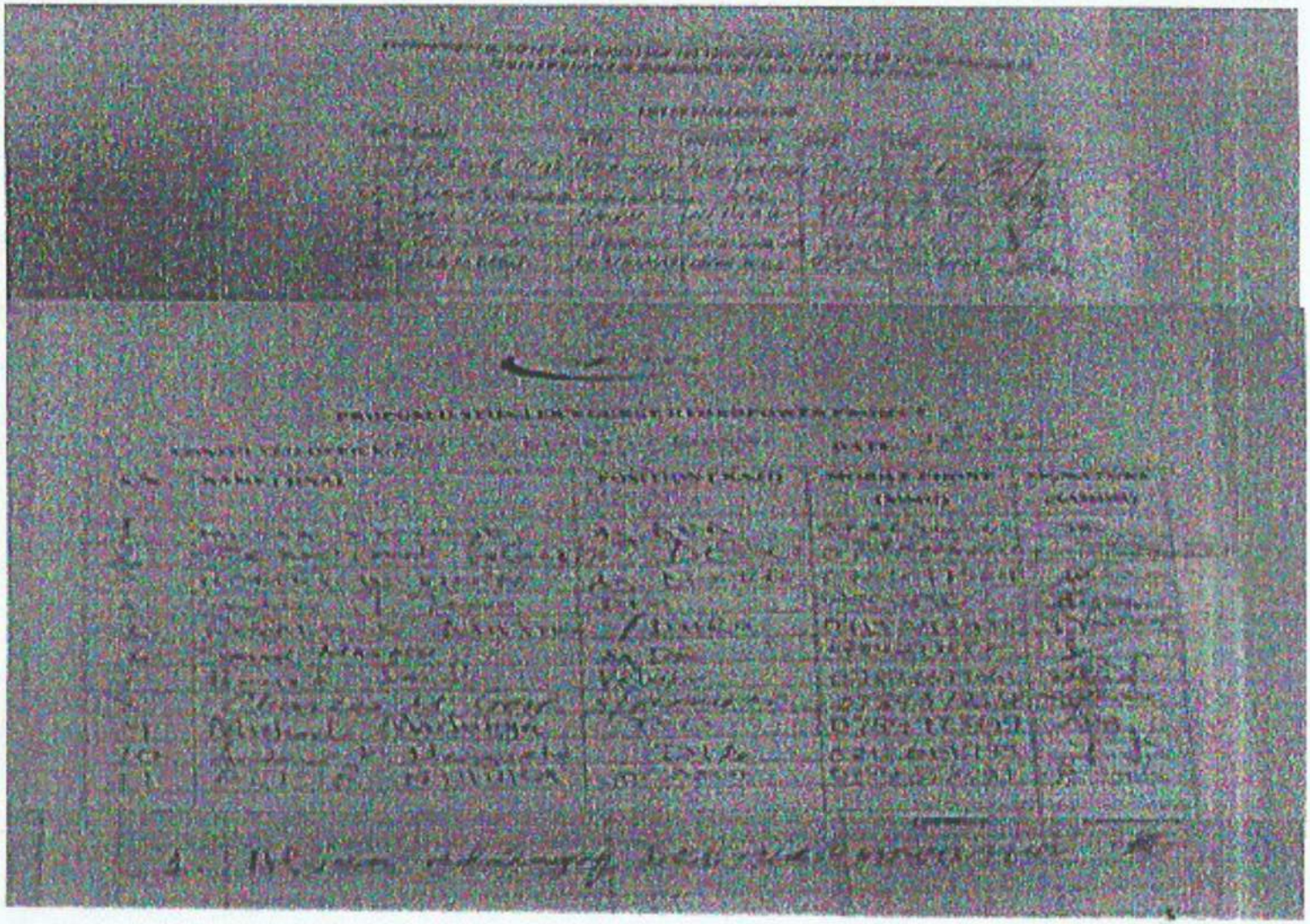
	National Irrigation Commission Eng. EliakimChitutu and Eng. NicksonMashafi	24.04.2018	• The government through the commission has prepared Irrigation Master Plan which covers the Lower Rufiji area. • The first irrigation program covers the period of 2018 to 2030. • The villages to be involved in the program are Muhoro, Kipugira, Mkongo and Lukulilo. • Currently, the major sources for irrigation include ground water and rain water. • The utilization of Rufiji River irrigation will highly depend on the availability of water in the river, therefore, it is important to ensure that the design of dam and its operation release sufficient water for downstream users

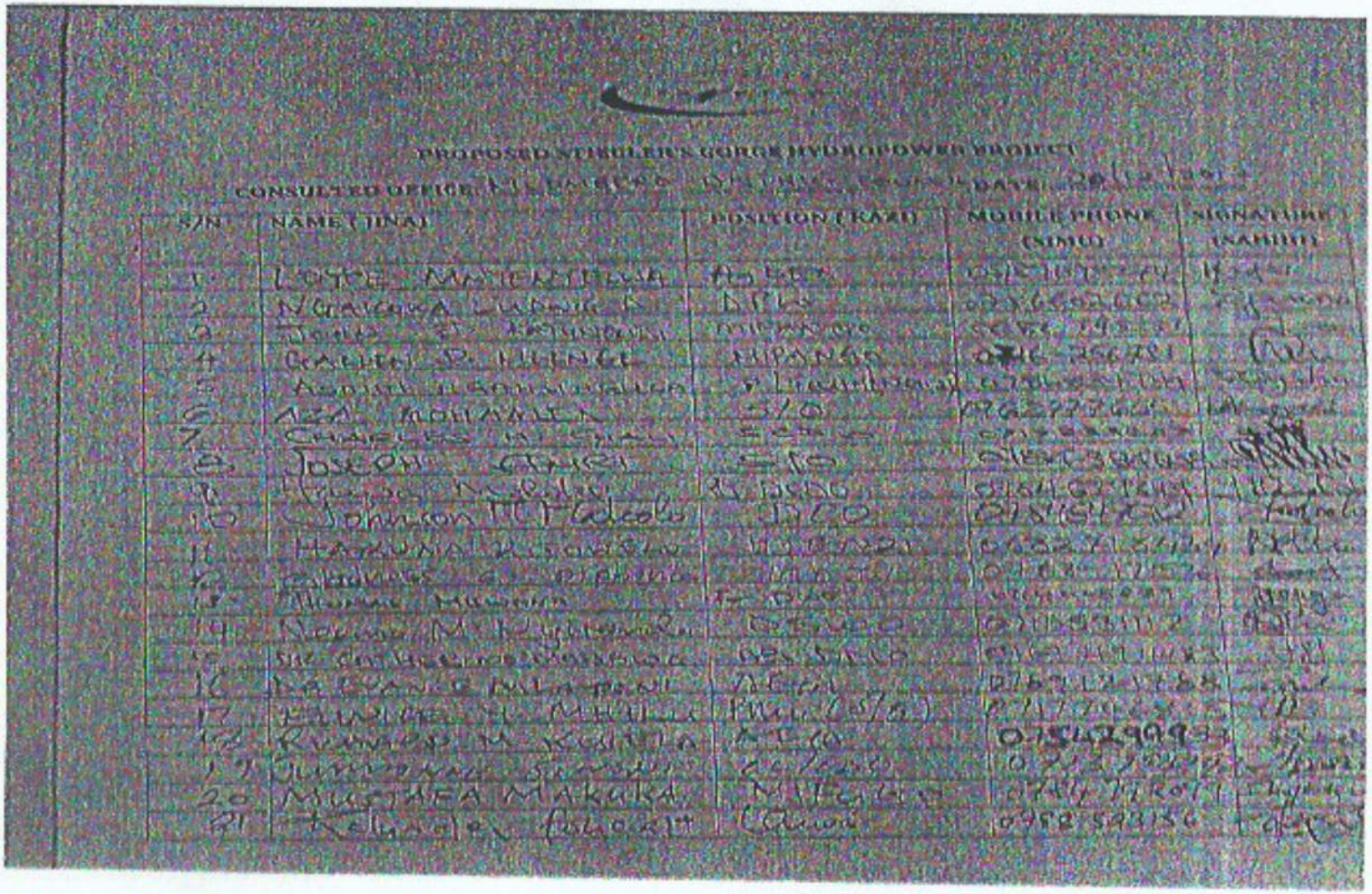
Annex B: List of Stakeholder's Engaged and their Signature







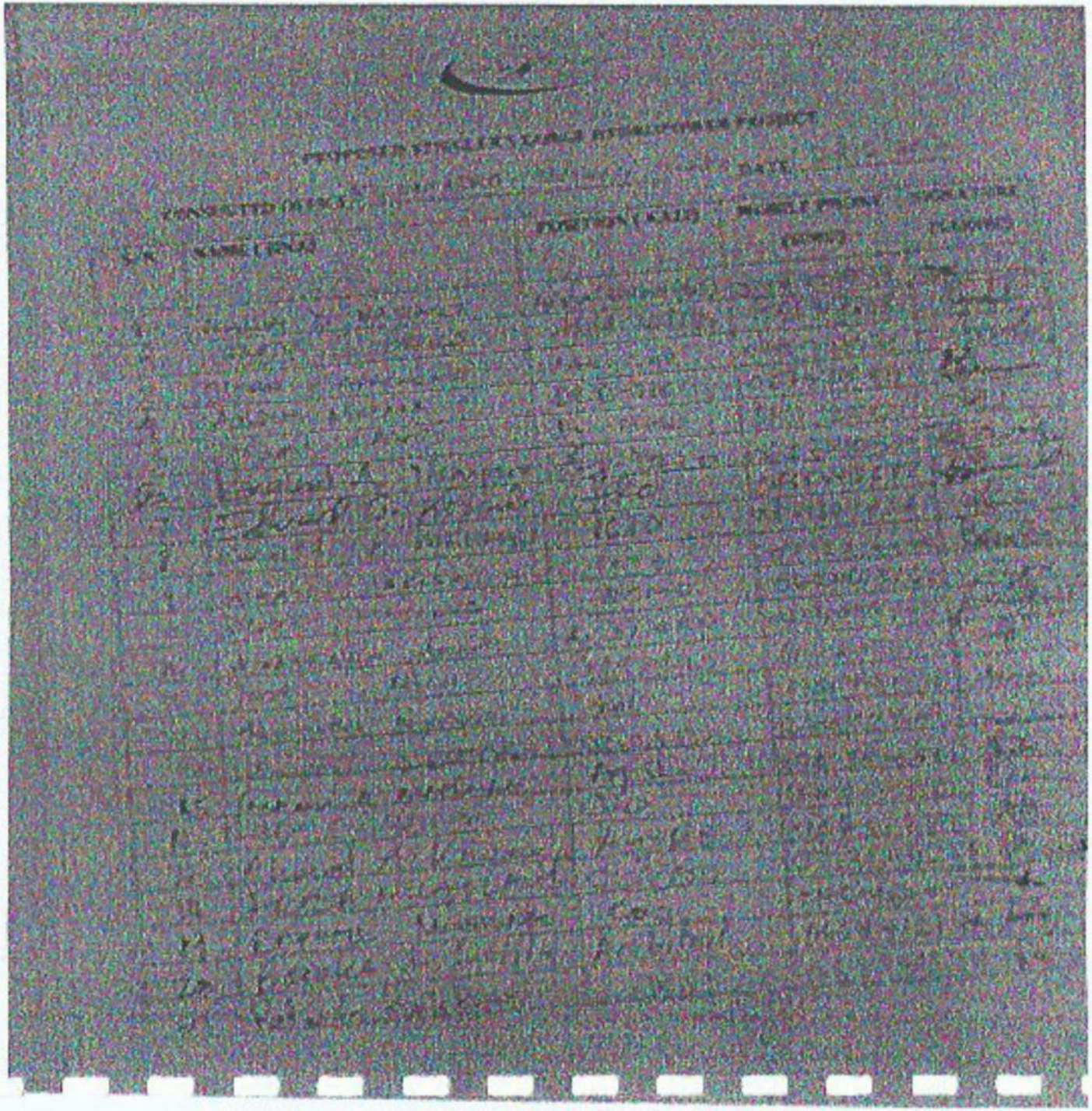


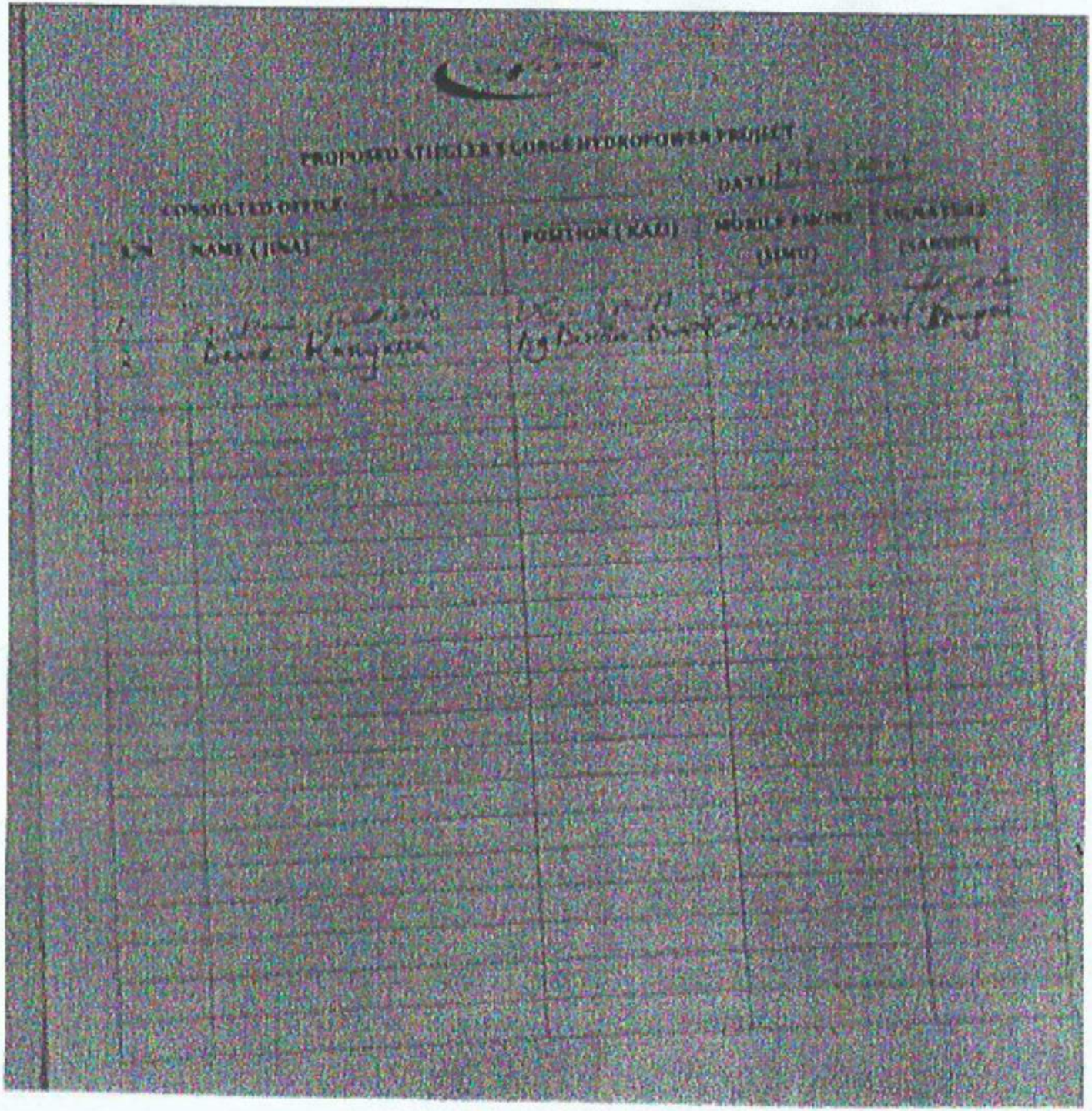


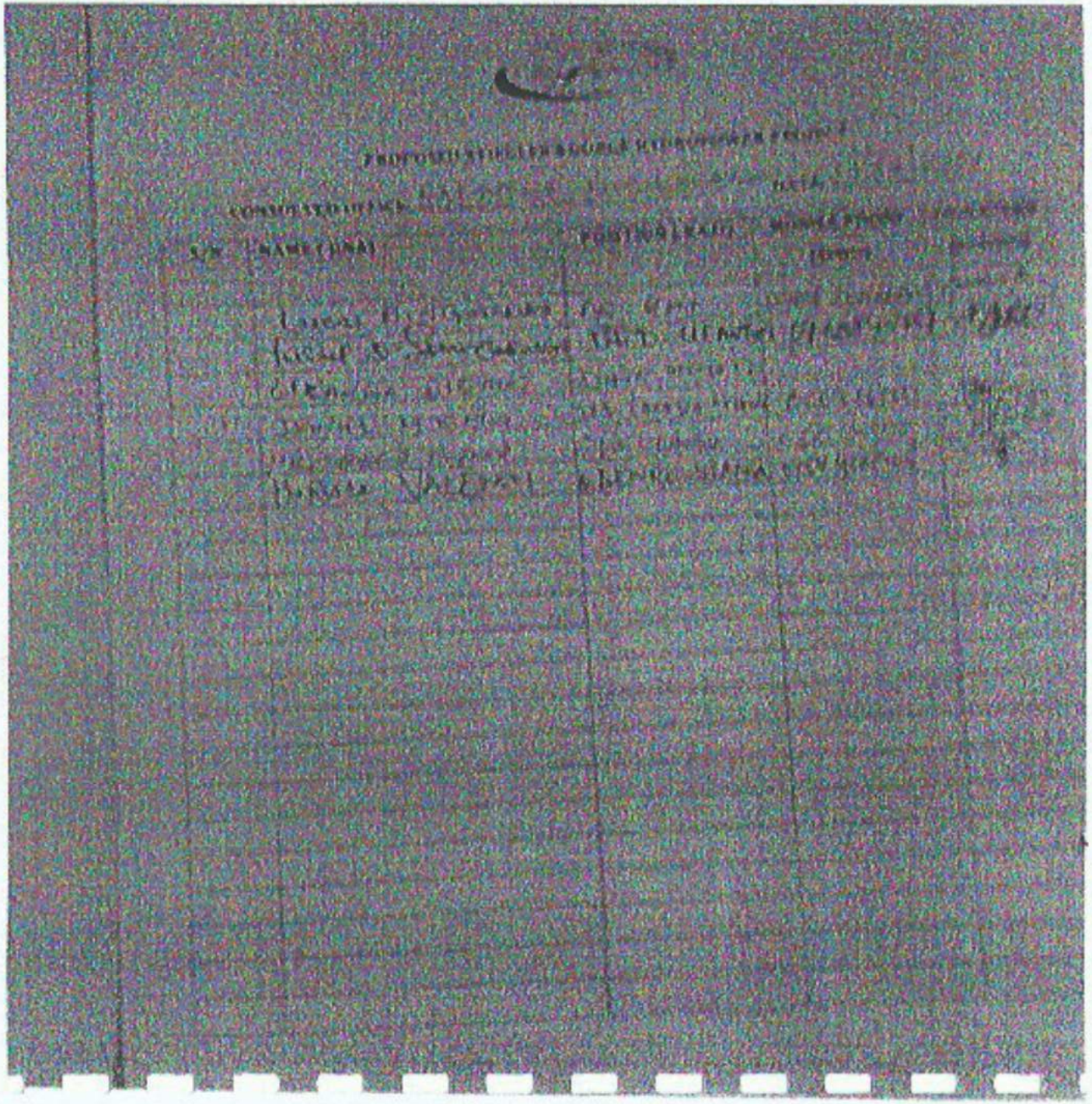
PROPOSED STIEGLER'S GORGE HYDROPOWER PROJECT

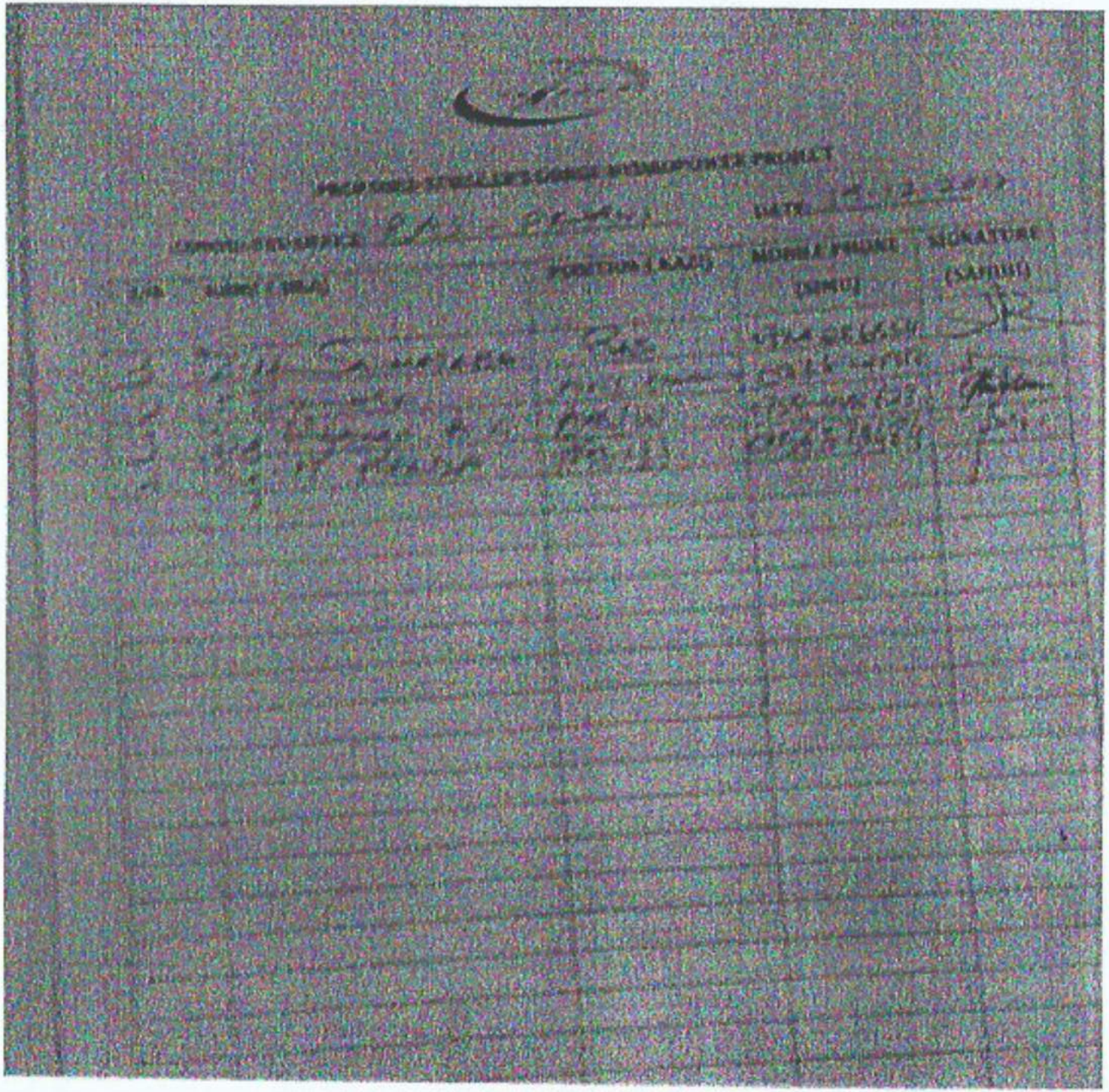
CONSULTED OFFICE: ... DATE: ...

S/N	NAME (JINA)	POSITION (KAZI)	MOBILE PHONE (SIMU)	SIGNATURE (SAHIHI)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.	MUSTAFA MAKAKA			
21.				




PROPOSED STIEGLER'S GORGE HYDROPOWER PROJECT
DATE
CONSULTED OFFICE
S/N
NAME (IN)
POSITION (RANK)
MOBILE PHONE (MNO)
SIGNATURE (SIGNATURE)





ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

SN	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHISII
1	HATUJUANI A. LUKARI	Ag DED	MORO DC	12/2/18	[illegible]	[signature]
2	Iddi Ndabhona	Mwenyekiti	MDC	12/2/18	0767936313	[signature]
3	GODFREY CHOGA	[illegible]	MDC	12/2/18	0659-[illegible]	[signature]
4	George Chaluks	Ag. DTO	MDC	12/2/2018	0712 694586	[signature]
5	MAIMUNA [illegible]	Ag. CDO	MDC	12/2/2018	0714 330[illegible]	[signature]
6	MICHAELA GUNELE	Afisa Utumishi	MDC	12/2/2018	07[illegible]	[signature]
7	CHRISTINA W. MFULE	MAANIBU	MDC	12/2/2018	0756217[illegible]	[signature]
8	RHODA S. MURUSURI	Ag DEO(P)	MDC	12/02/2018	0713[illegible]	[signature]
9	DR. ELIZABETH OMINGO	DMO	MDC	12/02/18	0713-313021	[signature]
10	BOLIPU E. [illegible]	DALO	MDC	12/02/2018	0750-[illegible]	[signature]
11	[illegible]	[illegible]	MDC	12/02/2018	[illegible]	[signature]
12	Mary Marge Kayoza	DEMO	"	"	[illegible]	[signature]
13	PETRIA MBIKUZI	Ag DBC	MDC	"	074[illegible]	[signature]
14	[illegible]	CLO	MDC	"	0[illegible]	[signature]
15	Ndelisha Mashi	Ag DICO	MDC	"	0754[illegible]	[signature]
16	DAVID K. MLOWE	Ag. DPEO	MDC	"	0758 581180	[signature]
17	DINAH [illegible]	DCSQA	MDC	"	0784605335	[signature]
18	RABIA K. NTALLO	K/TSC	MDC	12/02/2018	07[illegible]	[signature]
19	Wahida S. Beleko	Ag DNRO	MDC			
20	Salome Lymo	DLO	MDC	12/02/2018	07[illegible]	[signature]
21	Florence Mwambene	DCDO	"	12/2/2018	0719 [illegible]	[signature]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S 'AHIKI
1	DICKSON PETER	MJUMBE	KISAKI	12/2/18	0732997	
2	ADRIANI FRANCIS	MJUMBE	KISAKI	12/2/18	0688810	
3	JUSTIN ZINGA		KISAKI	12/2/18	- -	
4	STEPHEN KAYUPAYUPA	MJUMBE	KISAKI	12/02/2018	0758079092	
5	MUSSA BAKARI CHINGA	MJUMBE	KISAKI	12/02/2018	0786226152	
6	MUSSA N. NYEYA	MJUMBE	KISAKI	12/02/2018		
7	MAURIDY. MOHAMED	MJUMBE	KISAKI	12/02/18		
8	MUSSA HANGI	MJUMBE	KISAKI	12/02/18		
9	ABDALLAH NGUTA	MJUMBE	KISAKI	12/2/18		
10	YUSTER Y. KASUGA	MJUMBE	KSK	12/2/18		Y. KASUGA
11	DAMIAN MWAMBENE	MJUMBE	KSK	12/02/18		
12	TAUSI HENRY	MJUMBE	KSK	12/2/18		
13	ADJA BEN	MJUMBE	KSK	12/2/18		
14	HALIDI JONGE	MJUMBE	KSK	12/2/2018		
15						
16						
17						

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURES SAHIHI
	[illegible] YERO	[illegible]	FUNDI	12/02/2018	[illegible]	[signature]
	MOHAMED ZIWANI	MKEZI	MIRUKIMA	12/02/2018	0789656705	[signature]
	IDDI BAKAWA	MJUMBE	KISAKI	"	0788 807555	[signature]
	SHABAN O. KILUKYA	MJUMBE	KISAKI	"	0789 581052	[signature]
	EMMANUEL MWITA	MJUMBE	KISAKI	"	0784 85079	[signature]
	KULWA ATHUMAN KATEYE	MJUMBE	KISAKI	"	0782 597925	[signature]
	RAYMOND MHOKI	MJUMBE	KISAKI	"	0785833081	[signature]

KILIMANI MASHARIKI – 16.02.2018

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURES SAHIHI
1	KASSIM M. MAKEO	Mjbt	WIJI	16/02/2018	[illegible]	[signature]
2	BAKARI A. [illegible]	VEO	"	"	[illegible]	[signature]
3	MOSHI MOLLER	Mwalimu	"	"	0787 [illegible]	[signature]
4	SEFU RASHIDI	"	"	"	[illegible]	[signature]
5	MRISHO M. NGWESE	"	"	"	[illegible]	[signature]
6	HAMAD JOHN MWOLA	"	"	"	[illegible]	[signature]
7	[illegible] SAID NGORAYA				[illegible]	[signature]
8	U. MTETUMA	"	"	"	[illegible]	[signature]
9	ERODIE SALUM	"	"	"	[illegible]	[signature]
10	MOSHI MUSA [illegible]	"	"	"		[signature]
11	HAMIS S. [illegible]	"	"	"	[illegible]	[signature]
12	RASHID M. KINDAMBA	"	"	"	[illegible]	[signature]
14	JUMANNE A. MWAN	"	"	"	[illegible]	[signature]
15	ALIFE J. NGONDA	VEO	"		[illegible]	[signature]
16	SAIDI [illegible]				[illegible]	[signature]
17	ZAWADI J. MPANDUKA	"	"	"	[illegible]	[signature]
18	[illegible]	"			[illegible]	[signature]

KILIMANI MASHARIKI 16.02.2018

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
	FADHILI M. LUKONGO	MKULIMA	—	16-2-2018	0687501650	[signature]
	MOHAMEDI S. KOKO	—	—	—	0782712194	KOKA
	SAIDI N. AMARI	—	—	—	0686296662	[signature]
	ASHA B. MUHAMBAMBO	—	—	—	0682505637	[signature]
	BAKARI S. MTIKIKO	—	—	—	0682308762	[signature]
	MWAMVITA H. MKUMBA	—	—	—	0786890811	[signature]
	ATHUMANI S. MKIMA	—	—	—	0689278877	[signature]
	SALUMU A. MLIMA	—	—	—	[illegible]	[signature]
	ABDALA O. MPAKANANGO	—	—	—	0686471980	[signature]
	YAHAYA H. M. MNINGE	—	—	—	0787882119	[signature]
	SAID A. Hemed	—	—	—	07838[illegible]	[signature]
	KOBO A. MPANGE	—	—	—	0787602202	[signature]
	MOHAMEDI N. MAJIMBA	—	—	—	0787916374	[signature]
	MOSHI O. KISOKORA	—	—	—	0685170062	[signature]
	SIRDI S. KILILI	—	—	—	[illegible]	[signature]
	ALLY A. MBOTA	—	—	—	—	[signature]
	ATHUMANI J. NYANGALIO	—	—	—	0682945481	[signature]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
	BAKARI ATHUMANI [illegible]	MKulima	KISAKI STATION	12/2/2018	0682[illegible]	[illegible]
	Juma Mpogo	Maramoja	—"—	12/2/2018	07[illegible]9870	[illegible]
	Hassani Kasimu	mkulima	—"—	12/2/2018	0787[illegible]	[illegible]
	HALID HASANI KAPEMBA	MKULIMA	—"—	12/2/2018	0686[illegible]	[illegible]
	Juma [illegible]	mkulima	—"—	12/2/2018	0789[illegible]	[illegible]
	Hamisi [illegible]	mkulima	—"—	12/2/2018	0782[illegible]	[illegible]
	D. ABDI HALIMI [illegible]	mkulima	KISAKI STATION	12/2/2018	0693[illegible]	[illegible]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
1	EMANUEL M. [illegible]	mkulima	KISAK. Kituo	12/02/2018	0788[illegible]	[illegible]
2	ISSA [illegible] Chole	mkulima		12/2/2018	07[illegible]	[illegible]
3	ABUBAKAR. H. NYEA	MKULIMA		12/2/18	068[illegible]	[illegible]
	HAMADI ALLY NYAMATO	MKulima	R. Kisaki	12/2/2018	0684[illegible]	[illegible]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
	BAKARI ATHUMANI [illegible]					
	Juma Mpago	Mkulima	KISAKI STATION	12/2/2018	0682664???	
	HASANI Kasimu	Maranga[illegible]	— " —	12/2/2018	07585?8??	
	HALID HASANI KAPERA	mkulima	— " —	13/2/2018	0787937??	
	Juma Lukwa	mkulima	— " —	13/2/2018	0686?0?25	
	Hamisi Luwagwa	mkulima	— " —	12/2/2018	078460?0??	
	D. RASHIDI HALIDI mwenyekiti	mkulima	— " —	12/2/2018	07827?24??	
		mkulima	KISAKI STATION	12/2/2018	0693202??	

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURES AHIHI
EMMANUEL M. [illegible]	mkulima	KISAKI Kituoni	12/02/2018	0788?2???	
ISSA MGANTHON CHOLE	mkulima		12/2/2018	07??????	
ABUBAKAR . H. NYEA	MKULIMA		12/2/18	0681???	
AMADI ALLY NYAMAFU	MKULIMA	K. Kituoni	12/2/2018	0684?8???	

KIZIMANI MASHARIKI 16.02.2018

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/ SAHIHI
				16-2-2018		

KILIMANI MASHARIKI 16.02.2018

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
	Fadhili M. Lukumbu	Mwalimu	—	16-2-2018	0657561550	[illegible]
	Mohamedi S. Koko				07[illegible]	[illegible]
	Saidi [illegible] Chamba				[illegible]	[illegible]
	Abba. B. [illegible] Kambo				[illegible]	[illegible]
	Bakari [illegible] Mtumike				[illegible]	[illegible]
	Mwanaisha [illegible] Mfaume				[illegible]	[illegible]
	Athumani [illegible] Kikinda				[illegible]	[illegible]
	Salum [illegible] Mkila				[illegible]	[illegible]
	Adam [illegible] Mbaruku				[illegible]	[illegible]
	Yahaya H. A. Mninze				0782[illegible]	[illegible]
	Seif [illegible] Hemed				07[illegible]	[illegible]
	Kibe A. Mpange				0685190062	[illegible]
	Mbaraka N. Mariabu				[illegible]	[illegible]
	Mo[illegible] Msokora				[illegible]	[illegible]
	Mo[illegible] S. Kilili				06[illegible]	[illegible]
	Sui[illegible] A. Mbota					
	Ali [illegible] Mwenda					
	Ali [illegible]					

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
1	CHAJA ALLY CHAJA	MKULIMA		12/02/2018	0786450405	[signature]
2	TRIFONI A ABSONGA	MKULIMA		12/2/2018	0683205[illegible]	[signature]
3	JOSEPH JOHN	MKULIMA		12/2/2018	0789[illegible]	[signature]
4	ABDALLAH MYAMAPU	DISEGVA		—"—	0786179911	[signature]
5	SALIMU HOZA MAOTE	MKULIMA		12/02/2018	0782[illegible]	[signature]

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED
DEVELOPMENT OF STIGLER'S GORGE HYDROPOWER PROJECT IN MOROGORO AND COAST REGIONS

STAKEHOLDER'S ATTENDANCE LIST

S/N	NAME/JINA	TITLE/CHEO	INSTITUTION /TAASISI	DATE /TAREHE	PHONE NO./SIMU	SIGNATURE/S AHIHI
	BENERIA E LISHANDA	MJUMBE	KISAKI	12/02/2018	[illegible]	[signature]
	ISSA [illegible]	[illegible]	KISAKI	12/02/2018	[illegible]	[signature]
	ABED SOMARI	MJUMBE	KISAKI	12/02/2018	[illegible]	[signature]
	RAJABU TOMA	[illegible]	KISAKI	12/2/2018	[illegible]	R.J.[illegible]
	YUSSUPH A. JABU	[illegible]	Kisaki [illegible]	12-02-2018	[illegible]	[signature]
	FLORENCE SIMON	VEO/KISAKI	KISAKI-[illegible]	12/02/2018	0782[illegible]	[signature]

MUHTASARI WA MKUTANO MAALUMU KATIKA KIJIJI CHA NGORONGO-MASHARIKI ULIOFANYIKA KATIKA UKUMBI WA NGORONGO-MASHARIKI TAR 15/02/2018

AGENDA ZA MKUTANO

1. KUFUNGUA MKUTANO
2. MAELEZO YA MRADI WA STIGO JUU YA TATHIMINI YA ATHARI YA MAZINGIRA NA JAMII.
3. KUFUNGA MKUTANO

HALMASHAURI YA KIJIJI
REG. NO. 191
NGORO-MASHARIKI
TAR.
WILAYA YA

AGENDA NO; 1 KUFUNGUA MKUTANO

Mwenyekiti alianza kwa kuwashukuru wananchi kwa mahudhurio yao na kuwataka wawe watulivu ili waweze kufahamu jambo walioitiwa. Kisha akatamka mkutano umefunguliwa saa 10:44 Jioni

AGENDA NO: 2, MAELEZO YA MRADI WA STIGO JUU YA TATHIMINI YA ATHARI YA MAZINGIRA NA JAMII

Katibu wa mkutano aliwakaribisha wageni kutoka wilayani ili waweze kutoa ufafanuzi juu ya mradi wa stigo akaanza kwa kusema kuwa tumepewa kazi na shirika la umeme Tanzania TANESCO juu ya Athari za mradi wa stigo katika jamii kwahiyo thamira yetu ni kufufua mradi huu, Tuna shida sana ya umeme katika nchi yetu hii inaonesha kuwa tuna umeme mchache sana. Tunaelekea kuenye nchi ya viwanda kwa hiyo ni muhimu sana kuwa na umeme.

Mradi utahusisha katika kujenga bwawa kubwa katika kuendesha umeme tunategemea kuzalisha umeme wa kutosha na kusambaza katika sehemu mbalimbali. Tutatumia mud- ...

(12) • Mjumbe ameuliza Mpango gani Umewekwa ine
(1) pangwa kwa ajili ya maendeleo ya wakulima Hawa
• potowea athari ya kufunguwa maji, Kutoka kwa
nyc bwawa la Mradi,

(13)
(ii) Mjumbe ameuliza — watafaidika na nini? ~~Kuhusu~~ Kupitia
Mradi —

- Mtoa mada amejibu - wananchi watanufaika na
- Umeme utakao zalishwa,
- Ajira za muda mfupi pamoja na muda mrefu
- Kilimo cha Umwagiliaji,
- Ustawi wa misitu, uoto wa bahari, Ustawi wa viumbe baharini

* ~~Hal~~ Wajumbe wameshauri: kuwe na uwazi na mfumo mzuri na uwiano wa wakazi wa Rufiji kuweza kunufaika na Mradi, ~~Hasa~~ hasa katika eneo Ajira, kuweza taarifa kuwafikia jamii kwa ujumla

* Wajumbe kwa pamoja wamepokea na kujadili. Wameridhika, maswali na majibu yalikuwa...