

STIEGLER'S GORGE HYDROPOWER PROJECT
**THE REASONS BEHIND THE PROJECT
AND ITS FAR REACHING BENEFITS**

**THE REPORT ON RESPONSES AND
MITIGATIONS:** BEYOND THE TRUE COST OF POWER



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1. ABSTRACT.

This Report is the reactions of friends of environment and conservation on the concerns raised by foreign institutions regarding the decision of the Government of the United Republic of Tanzania to construct a much needed and long awaited Hydropower Dam on the small area within the Selous Game Reserve, herein called (SGR), and the World Heritage Site. The Report underscored the reasons behind the project and its far reaching benefits to the general population and the challenges ahead.

The authors strictly adhered to the specifics understanding of each concern and policy options attached to it and, therefore answered all concerns raised against the project.

In our findings we conclude that the reasons underlined by the World Bodies in objecting the project does not have any tangible effects that will call for the second thoughts, and as such the decision so taken by the Government to proceed with Stiegler's Gorge Hydropower project is by far the correct ones with no alternatives on hand that will assure the investors and other stakeholders of an affordable, reliable and sustainable electricity equivalent to 2115 MW.

Based on the above and the decision taken by the Government of the United Republic of Tanzania to set aside an area equivalent to 2% of 50,000 km² of the Selous Game Reserve, and the negative concern against the project as a TOTALLY DISASTROUSLY is unfounded,

without taking an understanding of the National AGENDA towards middle income economy by the year 2025 and the lowest cost per unit to produce electricity using hydropower at TZS 36 per unit compared with other sources of energy.

Other reasons includes; the drive to support industrialization, mining, high-speed standard gauge railways system, rural electrification and agro business with reliable and affordable energy. Electrification to provide more population (67.5% of the population have access to electricity) of which 32.5% of all population (majority of it is in the rural areas) in the country still does not have electricity. Therefore the injection of 2115 MW into the national grid is expected to increase access to electricity from the currently 67.5 % to 100 % in 2025. This will counter balance the rapidly depletion of forest reserves at an average of 412,300 hectares per annum by using wood fuels (BIOMASS) in exchange for an affordable hydroelectricity, that will reversed the trend in the context of global warming. Therefore the hydropower project by itself will be milestone conservation by limiting further deforestation in the country as a whole, compared to the CONTROLLED DEFORESTATION of volume of mass of about 0.009 % of the total mass in the Selous Game Reserve during the construction.

Further our findings revealed that apart from various efforts in the sixties and seventies, the idea to embark on hydropower project at River Rufiji was incepted in 1980, two years before the Selous Game Reserve was

placed under the World Heritage in 1982. Therefore the decision this time around is not new, and as such the relevant world bodies were aware of the desire to utilize the small part of the game reserve for other economic activities without affecting its ecosystem.

The hydropower project in Selous Games Reserve will strengthen security and therefore all areas in and around the ecosystem will be secured, and this will compliment the currently anti poaching activities at the SGR. Therefore the negative concern being raised that WILDLIFE in the Selous will be perished is unfounded, and TOURISM within the SGR will be severe affected by the project is also not scientifically argued. Because the security around the Selous will be enhanced due to the construction of the Dam and hence poaching will be reduced if not eradicated completely, and as such this will create positive impact, and in the ends wildlife population will flourish. Further, construction of all weather passable road that will also attract more tourists to visit the area from within the country and overseas, as the Dam will add value to the photo tourism safaris.

It is also revealed that, while the UN bodies are contemplating about negative impact of the Stiegler's Hydropower project on wildlife and other organisms due to air and noise pollution, we surprised to learn that there are 38 AIRSTRIPS in Selous Game Reserve of which 33 airstrips are very active and 5 are not in use but remained registered with Tanzania Air Traffic Authority. There are 11 LODGES and CAMPS in the Selous Game Reserve, with bed capacity of 284 people per night;

there are 44 HUNTING BLOCKS in the Selous of which 33 are currently in use supporting hunting safaris; The number of tourist visited the Selous Game Reserve in the year 2016 to 2018 is 76, 227 people, without counting the number of TOUR OPERATORS and VEHICLES within the Selous; Drivers, supporting staff managing lodges and camps and unspecified number of PROFESSIONAL HUNTERS and their equipment's/facilities within the ecosystem.

The presence of big number of Tourists, Professional Hunters, staff supporting hotels and lodges, wildlife conservation staff as well as other supporting staff within the Selous Game Reserve, show case the coexistence of human activities and wildlife in the same ecosystem without any negative impact.



FIG. 1: ONE OF THE 11 LODGES AND CAMPS IN THE SELOUS GAME RESERVE

In that understandings and the fact that we have never seen any negative impact on tourism or displacement of wildlife from the areas of dispersal due to human activities, air and noise pollution (due to the presence of motors vehicles, aircrafts and regularly roads construction) within the 50,000 km² of the Selous Game Reserve. Be as it is the Stiegler's Hydropower project will

not affect the ecosystem in the manner propounded by the World Heritage body and other foreign institutions.

Therefore, the same coexistence currently in place at the SGR will also prevail once the dam is constructed, such that wildlife will move to the areas of dispersal during the construction and returned after the completion.



FIG. 2: AIRCRAFT AND GIRAFFE AT MTEMERE AIRSTRIP – TCAA DESIGNATION CODE: TZ- 0048

The OUTSTANDING UNIVERSAL VALUES (OUV) as explained by the world heritage will not be affected by the Dam, since the area designated for the project is less than 2% of the 50,000 km² with little or minor impact on the ecosystem, as such, wildlife and other organisms that will be displaced by the project will move to the area of dispersal of more than 49,000 km² within the SGR ecosystem, therefore the impact so pronounced is very insignificant of not worrying at all.

Henceforth the issues relating to reduction of biodiversity, change in fish community, sedimentation deposits at the reservoir, water quality, and stratification of reservoir and GHG emissions, both will have very little impacts on the project at levels that will warrant any

course of actions, as the degree of occurrence is very insignificant.

However, the hydropower project will bring about positive impacts to the country and the people in general. Therefore, the Hydropower project before and after completion will have the following significant benefits:

- Increase of more than 365% of hydroelectricity by adding 2,115MW out of the current 573.7MW of affordable and reliable energy to support industrial development; urban and rural electrification, mining and agro business and creation of job opportunities during construction, with an estimated number of 12,000 people will be directly and indirectly employed.
- Enhancing Tourism industry through sports fishing, boat rides and photographic safaris as well as new investments in the accommodation (hotels, lodges and tented camps) as well ground and air services. Therefore changing lives of the people in and outside the project area through various economic and social activities such as agricultural (introduction of commercial farming in the lower Rufiji area through irrigation scheme for over 150,000 ha of land) and fishing (controlled fishing in reservoir and commercial fishing downstream) and increases government revenues.
- Other benefits will include floods control downstream of the River and its tributaries; conservation and anti poaching activities will be enhanced through improved Security and access roads within and outside the Selous Game Reserve as well as decrease the use of biomass as source of energy and hence decreasing deforestation.

Therefore, based on our findings and various collaborated studies, the hydropower project at Selous Game Reserve is viable in the context of environmental, conservation, financial and economic aspects with minor challenges. Some of the challenges are very normal during implementation of larger structure like hydropower Dam, but will be guided by various legislations, regulations, standards practices and international standards. The engagement of Arab Contractors, as the main contracting firm, with vast experiences in big projects like Aswan Dam and Cairo Metro line 3 – Phase 4B, we are certainly the observance of standards practices will be at its core agenda, in particular some of the mostly pronounced challenges like air pollution, noise pollution, water pollution and waste disposal.

2. INTRODUCTION

The 50,000 km² Selous Game Reserve (SGR) is one of the most important protected areas in Africa, and has been recognized as a World Heritage Site since 1982. Tanzania Wildlife Management Authority (TAWA) manages it as an IUCN category IV (habitat/species management) area, with some sort of permanent settlements, controlled hunting and tourism.

The Stiegler's Gorge dam site is located in the northern part of the SGR, 180 km upstream of the Indian Ocean. The Gorge is about 8 km long and 100 m deep. The site

was first identified in the 1950s, as part of the first survey of the water resources of the Rufiji River basin, Tanzania's largest river basin. Studies on Stiegler's Gorge were prepared with foreign support, but construction was postponed several times, while Tanzania developed smaller dams upstream in the Rufiji basin and in other parts of the country.

Downstream of Stiegler's Gorge the Rufiji River reaches the Rufiji-Mafia-Kilwa Marine Ramsar Site (RUMAKI), a 5,969 km² site designated by government in 2004 under the Ramsar Convention, after the ratification of the convention in 2000. The site includes the entire Rufiji delta (approximately 1,400 km², with 550 km² of mangrove forests), coastal areas south of the delta, the island of Mafia and the shallow coastal waters, islands and coral reefs in between.

Selous Game Reserve (SGR) is the home of African elephant (*Loxodontha africana*), black rhinoceros (*Diceros bicornis*) and wild hunting dog (*Lycaon pictus*). It also includes one of the world's largest known populations of hippopotamus (*Hippopotamus amphibius*) and buffalo (*Syncerus caffer*). There are also important populations of ungulates including sable antelope (*Hippotragus niger*) Lichtenstein's hartebeest (*Alcelaphus lichtensteinii*) greater kudu (*Tragelaphus strepsiceros*), eland (*Taurotragus oryx*) and Nyassa wildebeest (*Connochaetes albojubatus*)

In addition, there is also a large number of Nile crocodile (*Crocodilus niloticus*) and varieties of species of birds,

including the endemic Udzungwa forest partridge (*Xenoperdixudzungwensis*) and the rufous winged sunbird (*Nectariniarufipennis*). It also has an exceptionally high variety of habitats including Miombo woodlands, open grasslands, riverine forests and swamps, making it a valuable site for ecological and biological processes. The reserve also has a higher density and diversity of species more than 2,100 plants as well as an impressive large mammal and fauna.

Having the vast size equivalent to (5,120,000 ha), the Selous Game Reserve retains relatively undisturbed ecological and biological nature, which sustain a wide variety of species and habitats, and the fact that the SGR is embedded within a larger 90,000 km² Selous ecosystem, which includes national parks, forest reserves, paved and unpaved roads, airstrips, lodges and camps and limited permanent communities.

It doesn't matter whether the area is protected for specific uses or not, but the legal framework placed the area to the immediate control of TAWA, and as such it also neighbored more than one Region Administration and Districts. Taking into account its vast proximities there are number of socio economic activities in the Selous, that include hotels, lodges and tented camps, wildlife safaris, photo tourism safaris, boat safaris, hunting safaris, air safaris, the presence of roads, airstrips, wildlife management as well as human activities forming the coexistence of Human and Wildlife in the Selous Game Reserve for many years.



FIG. 3: TANZANIA – ZAMBIA RAILWAYS TRAIN ACROSS THE SELOUS GAME RESERVE

Selous Game Reserve is also linked with the 42,000 km² Niassa Game Reserve in Mozambique, to form a corridor stretching between the two countries and hence the challenges in the management of the conservation. The Tanzania Wildlife Management Authority (TAWA) manages the Selous Game Reserve, with a small area (8%) in the north dedicated to photographic tourism while most of the area is managed as a hunting reserve.

3. THE RUFJI RIVER HYDROPOWER PROJECT – THE REACTIONS

The documented impacts underlined by WWF and UNESCO were based on the initial proposal by a Brazilian firm called Odebrecht, which showed interest to build a hydropower project at Stielgler’s Gorge, and the decision of the Government of the United Republic of Tanzania to proceed with the project. The developer (Odebrecht) intended to finance the cost of the project under Power Purchase Agreement (PPA) with the Tanzania Electric Supply Company Limited (TANESCO). However, the Brazilian Company abandoned the project due to corruption allegations on its investments world wide, as well as lack of funds and hence the Stiegler’s

Hydropower Project was shelved.

In the event of emerging demands due to new drive to accelerate industrialization toward middle-income economy by the year 2025, the FIFTH PHASE GOVERNMENT sees to it the challenges in mitigating sharply increased in power consumption due to industrial and commerce uses. Other reasons and priorities beside industrial uses are such as:

- To provide affordable electricity to the rural communities by the year 2025 and to provide clean water for all,
- To supply affordable and sustainable power to the ongoing construction of health centers, dispensaries and district hospital each to be equipped with modern facilities and equipment's, in the quest of providing healthcare for all through National Health Insurance Fund and Community Health Services.
- Lastly the construction of high-speed standard gauge railways system namely SGR from Dar es Salaam to Mwanza and Kigoma.

The government explored further the need to embark on cheap, affordable and sustainable electricity, taking into account the cost per unit to produce electricity, lowest being the Hydropower with TZS 36 per unit, compared to Nuclear TZS 65, Wind 103.05, Solar 103.05, geothermal 114.50, coal 118, thermal (natural gas 147 and liquid fuel 546).

Nevertheless the abundance of highest natural gas reservoir and substantial amount of coal the country

possesses, hydro with the lowest cost per unit it is prudent to use Hydropower energy to electrify households, industrial and commercial uses. It's our understanding that when the developed world embarked on NUCLEAR ENERGY they were looking for sustainable and huge volume of electricity to power their industrial development and socio economic demands despite of the challenges came along with nuclear technologies, so as the hydropower project at River Rufiji also do have some challenges that can be mitigated as it was for the nuclear power.

Tanzania is the signatory of the World Heritage Convention of 1972, and member of the International Union for Conservation and Nature (IUCN), and is a fully committed member and adhered to norms and conditions of the Union, and has never been to the contrary when it comes to conservation. The commitment is so vividly shown in the light of setting up a larger portion of its land designated for conservation despite the public out cry demanding for more land for agriculture and live stocks farming.

- For instance the country has designated 40.5 % (about 383,000 km²) of its land for conservation, of which 29.5 % (about 279,000 km²) has been designated for wildlife management that includes, 28 Games Reserves, 42 Game Controlled Areas, 38 Wildlife Management Areas (WMAs) and 11% (about 104,000 km²) for 4 Ramsar Sites, forest reserves (about 35,257 km²) and marine parks.

Therefore the decision to use about 1,000 km² equivalent to 0.2% of land set aside for conservation which equal to 2% of 50,000 km² of the Selous Game

Reserve to build a Dam that will generate a total of 2115 MW, has been challenged by some International Institutions, without making a reference on the country energy proliferation in using wood fuels, of which BIOMASS is highly produced and consumed, which is not environmentally compatible.

Further commitments include the various legislations enacted to protect and conserve natural resources, set a full fledged Ministries responsible for conservation and environment of which the later is headed by the Vice President of the United Republic of Tanzania, through which National Environmental Management Council (NEMC) resides, and recently newly transformed the Tanzania Wildlife Management Authority - TAWA to a fully fledge semi military status so that it can combat any poaching threats with the same strength of the military proportion.

The number of tourists to the Selous Game Reserve will increased due to the construction of Stiegler's Hydropower Dam, construction of all weather passable road to the SGR and enhanced security in and around the ecosystem. Therefore Stiegler's Hydropower dam by itself will be an attraction not to miss for local and foreign visitors as we have seen a number of similar projects worldwide that do attract millions of tourists even without wildlife. Therefore we expect more tourists to visit Selous Game Reserve to see both wildlife and the Stiegler's Gorge Hydropower Dam.

- For instance, similar properties worldwide that attract millions of tourist are such as: Akasombo Dam in Ghana,

Kariba Dam bordering Zambia and Zimbabwe, Cahora Bassa Dam in Mozambique, Inga Dam in DRC, Uganda Nalubaale (Owen Falls Dam), Bhakra-Nangal, Idukki Dam, Srisaïlam Dam, Tehri Dam, Hirakund Dam and Nathpa Jhakri Dam in India. Other countries with similar property include: Pakistan, Canada, Cameron, China, USSR, USA, Kenya and SOUTH AFRICA just to mention only a few.



FIG. 4: TEHRI DAM – INDIA. THE DAM IS LOCATED WHERE THE BHAGIRATHI AND BHILANGNA RIVERS MEET



FIG. 5: THE WORLD'S LARGEST HYDROELECTRIC DAM - THE THREE GORGES DAM IN CHINA



FIG. 6: DANIEL-JOHNSON DAM AND MANIC-5 GENERATING STATION- QUEBEC- CANADA



FIG. 7: CAHORA BASSA DAM UPSTREAM VIEW- MOZAMBIQUE



FIG. 8: KARIBA DAM ZAMBIA/ZIMBABWE ON ZAMBEZI RIVER

The security at Selous Game Reserve will be strengthened during and after construction of the Dam, and this will add value to the existing anti-poaching activities of which we have noticed an increased number of elephant's population in the last two years. However, reasons attached to the reduction of elephants in the SGR ecosystem in the past has nothing to do with the Dam, as signified by WWF and UNESCO in press statements issued, when they referred to a NO project concept on which the number of endangered species has been decreased even with NO HYDROPOWER DAM on the ground.

On December 2018, the government of the United Republic of Tanzania formally engaged the contractor to start construction work. Following the decision to proceed with the project, UNESCO raised its concerns through public statement, which centered on a number of issues regarding the World Heritage Site and the decision taken despite of pending settlement regarding construction of a dam at the Selous Game Reserve.

The issues concerned the world body has been referred to the previously meetings and decision taken as far as the year 1982 when the SGR was placed in the world

heritage status due to the reasons so familiar, and the facts that the government showed interest to utilize a small area of land in the SGR for other economic purposes.

However, our studies revealed that the proposed DAM was conceived in 1960, 1972 and 1980, almost two years before the SGR was placed under the world heritage when the government advanced the idea to construct the dam on the Rufiji ecosystem. Therefore the decision taken this time around was not new and it was so known to the world body, as the various communications between the URT and UNESCO testified. Therefore, the communications between UNESCO and United Republic of Tanzania of which we have managed to see some regarding Uranium and Stiegler's Gorge Hydropower project for a number of years, with each part putting up its position regarding conservation on one side and its economic usage on the other. The area and the basin therefore, do have economic potential for the benefits of the large populations apart from wildlife habitations.

The URT requested UNESCO to remove the SGR from the list of world heritage sites in danger, however the later rejected it at its Decisions **36 COM 7B.5**, **36 COM 8B.43**, **40 COM 7**, **40 COM 7A.47** and **41 COM 7A.17**, adopted at its 36th (Saint-Petersburg, 2012), 40th (Istanbul/UNESCO, 2016) and 41st (Krakow, 2017) citing the dwindling of the number of elephants due to heavy poaching without furthering with studies to established the reasons. Since the SGR lies on the plain covering an area of more than 50,000

km² of forest, River Rufiji and its tributaries as well as SELOUS - NIASSA corridor to the Mozambique, with 42,000 km², both may have contributing factors to the deteriorating on the number of elephants population over those years in question due to the poaching.

It is of our interest to note that conservation by itself is nothing if does not give additional values to the general population, therefore the coexistence of conservation and economic development cannot be ignored if the former have to exist. That being the case and over a period of time and for that matter since early sixties, the country so desired to build a dam over Rufiji River, and further seventies up to 2000, the idea took a different turn when the project was included in the TANZANIA DEVELOPMENT VISION 2025 and subsequently in the TANZANIA POWER SYSTEM MASTER PLAN (2016).

The Vision and Power System Master Plan (2016) seek to mitigate the need to compliment the demand for affordable, reliable and sustainable electricity to drive the country socio economic demand towards a middle-income Economy by the year 2025. Therefore, reading carefully the Tanzania Power System Master Plan (2016) the emphasis is on the use of renewable energy, including hydropower.

The master plan indicates the high value of investments on other sources but did not negate completely the uses of hydropower, since the later has a high return on capital taking into account low investment criteria as explained by the construction cost per unit. The Plan also envisages the need to address the country's energy that

is affordable and sustainable by the year 2040. The URT expects to connect to the grid more than 90 per cent of its households of which account for more than 70 percent of the population live in rural areas, and use traditional fuels mainly wood fuel (Biomass) for their households.

The energy supply in Tanzania includes biomass (90%), petroleum (8), electricity (1.5%), and the others (0.5%). Further, less than 30% of Rural Tanzanians have access to electricity leaving aside more than 70% without access to electricity, which means 80% of energy delivered from the biomass is consumed in the rural areas. Therefore, such heavy dependence on BIOMASS has a bearing on destruction of our forest reserves, leading to heavy deforestation. Tanzania has a forest cover of 35,257 km² and loose approximately 412 km² annually.

Further the analysis showed that the lack of reliable and affordable electricity necessitated many consumers in the commercial, industrial and residential sectors to use diesel generators, and it has been found out that nearly 45 % of the businesses in Tanzania own diesel generators, due to unreliable power supply, despite the high prices of diesel and environmental catastrophes.

The magnitude of wood fuels that are being used as the main sources of energy in the rural communities and institutions, and the uses of the private owned diesel generators, the country has necessitated to seek for reliable and affordable electricity for all. This in the end will relieve country of the burden imposed on forestry reserves and therefore check the rate of deforestation

by the same magnitudes.

If we can manage to stop or reduce significantly consumption of wood fuels, certainly we will be able to mitigate the concerns regarding deforestation. There is an intrinsic relationship between forests and rain pattern, and preserved forests will lead to increased rainfall and thus increased water supply. The only way to reverse that trend is to provide the rural areas with reliable and affordable electricity and hence reduce heavily the dependence on biomass as source of energy.

Therefore, the decision to opt for hydroelectricity, as the source of energy is paramount, compared to natural gas, coal, fuel oil, geothermal, nuclear and so forth.

4. CONCERN RAISED BY WWF, UNESCO AND THE RESPONSES.

World Wide Fund (WWF) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) on different occasions both raised their concern after the Government of the United Republic of Tanzania decided to develop the Stiegler's Gorge Hydropower Project, and in particular, we quote UNESCO *"the tendering of logging rights for 143,638 ha within the SGR, considers that the resulting large-scale deforestation represents a clear potential danger to the property in accordance with Paragraph 180 of the Operational Guidelines, and decides to add this issue to the justification for the continued inclusion of the property on the List of World Heritage in Danger"*End of quote;

- UNESCO further reiterated its position that, *“the construction of dams with large reservoirs within the boundaries of World Heritage properties is incompatible with their World Heritage status, as well as the commitment made by the URT when the boundary modification was approved in 2012 not to undertake any development activities within Selous Game Reserve and its buffer zone without prior approval of the World Heritage Committee, and reiterates its requests to the URT to fully assess the cumulative impacts of the Stiegler’s Gorge hydropower project on the SGR and its wider landscape through a Strategic Environmental Assessment (SEA), undertaken to the highest international standards, and to consider alternative options to meet its power generation needs”*;

- Further they argue that the, *“URT should ensure that the planned logging and all other activities related to the Stiegler’s Gorge hydropower project, which will affect the property’s Outstanding Universal Value (OUV) and will be difficult to reverse, do not proceed prior to the completion of the SEA and its review by IUCN, and requests the URT to invite a joint World Heritage Centre/IUCN Reactive Monitoring mission to the site to review the status of the project, assess the state of conservation and to assist in the finalizing the desired state of conservation for the removal of the SGR from the List of World Heritage in Danger (DSOCR)”*;

The negative concerns raised by WWF (both significant and insignificant) have been drawn from the understanding that the project developer and contractor is the Brazilian firm called ODEBRECHT which showed interest to pursue the hydropower project at Stiegler’s Gorge in 2013 under the PPA modality. However, UNESCO raised its concern based on the recently engagement between Egyptian Company and

Government of the United Republic of Tanzania on the same project, therefore our reactions will be twofold starting with WWF and then UNESCO, as follows.

CONCERNS RAISED BY WWF

The two major concerns raised by WWF are as under:

- Inundation of terrestrial habitats by the 1,200 km² large reservoir; and series of downstream changes, starting with reductions in the seasonal variability of lows and in their sediment load, leading to changes in geomorphology, reductions in aquatic biodiversity and abundance, and finally reductions in ecosystem services for downstream inhabitants
- Relation among reservoir size and the inundated area; Impacts of associated infrastructure; the large contingent of workers necessary; potential impacts of the project in sediment transport and, consequently, on river morphology; and aspects related to water quality.

RESPONSE.

Therefore, the main text of the relevant concerns have been reviewed hereunder with our technical positions and policy actions thereto:

- **WWF.**

Reduction in aquatic biodiversity and abundance above reservoir. Some species are dependent on migration past Stiegler's Gorge, and would be stopped by the dam and the reservoir with unfamiliar low velocity flows

POSITION.

The dam allows passage of a considerable number of fish. Initially there may be some delay in passage, but later there will be passage of fish downstream unabated.

▪ WWF

Changed fish community in reservoir stretch of the Rufiji. The reservoir will provide habitat for different (and possibly non-native) species. Total biomass may increase, typically with an initial spike, and river species may be displaced. RUBADA speaks of 3,700 tons/year permanent yield, and 20,000 tons/year initial yield, primarily of tilapia

POSITION.

Fisheries department to provide guidance and capacity to manage the situation during the initial stages of the operation. The government has the capacity to control fishing practices, as has been done elsewhere in the country e.g. Lake Victoria etc.

▪ WWF

Sediment deposition at top of reservoir. Large amounts of sediment will settle out once the Rufiji slows down, creating environmental nuisances and possibly backwater effects.

POSITION.

The River will have less sediment because a large segment of the River passes through thick forests, which store fresh water with comparatively low sediment load. However, the cost of removing

sediment does not exceed that of generating electricity by fossil fuels.

- **WWF**

Eutrophication & invasive aquatic plants. Nutrients coming into reservoirs and high temperatures may induce high primary productivity, algae blooms, and plant pests. These can cause water quality issues and operational problems at hydropower station, but are unlikely to increase evaporation.

POSITION.

Eutrophication will be minimized due to conservation activities upstream such as REGROW, SAGCOT and most of nutrients will be captured by upstream reservoirs and Kilombero wetland. Invasive plants may invade the reservoir but the government may introduce dominant plants to counter their effectiveness, and as such the reservoir will be maintain regularly.

- **WWF**

Stratification of reservoir and GHG emissions. Reservoir will emit CO₂ and CH₄ at higher rates that the ecosystems that it replaces particularly if stratification into different layers occurs.

POSITION.

The effect of stratification of the reservoir is insignificant; GHG emissions will be limited, as the bushes in the area to be inundated will be cleared before filling the reservoir.

▪ **WWF**

Water quality. Under special conditions, water quality can be impaired by pollution of rivers, along shores, by atmospheric deposition, or by release of soil compounds (for example, mercury).

POSITION.

There are no threats of water quality in the Ruaha/Rufiji River Basins to cause threat. Mercury Deposits are likely to occur in areas where there is rudimentary gold mining, in which case there is **NO GOLD MINING** in the Ruaha/Rufiji Basin.

▪ **WWF**

Evaporation. Large water surface area increases evaporation rates; quantities will be significant

POSITION.

There will be more of evaporation, which may not cause harm to the ecosystem of the area; therefore the quantities will be of no threats.

▪ **WWF**

Shoreline wind erosion. Large exposed mudflats and sandbanks during the dry season can lead to dust storms.

POSITION.

Orchards will cover much of the area under mudflats and vegetable gardens both permanent and seasonal crops. The idea of exposure of mudflats will be insignificant, as the area under

irrigation will be wide and almost all the year round there will be vegetation cover.

- **WWF**

Inundation of terrestrial habitats. For comparison, 1,200 km² of wildlife habitat is larger than the majority of Tanzanian national parks. Terrestrial biodiversity and abundance of animals is large, because of the variety of landforms and habitats; the availability of food and water; and the large extension and remoteness. The Selous provides globally significant habitats for charismatic and endangered species; there is no information on species endemic to the project area.

POSITION.

In comparison, it is not true that 1,200 km² is larger than majority of Tanzania National Parks. Therefore, the project will not significantly change SGR characteristics. Moreover, will add other landforms in the SGR, which will support aquatic animals. However, the current efforts to conserve wildlife and WMA have shown positive impacts with the increased in the number of Elephants and other species.

- **WWF**

Increased access by poachers. Poaching is facilitated by access to the reserve and within the reserve created by permanent and temporary roads. Poachers are still using tracks created by oil exploration in the 1970's. The main access road is expected to be 120 km long, from Chalinze.

POSITION.

The presence of projects of a scale like Stiegler's Hydropower Dam will demand high security, as it is for similar properties in the country and elsewhere. Therefore, to articulate the increase in the number of poachers due to the proposed tarmac road to the Dam may not hold sense, as the case stands. The Dam will attract heavy security in and around the reserve, through which the entrance to the designated area will be regulated. Certainly, there will be security of its kind and for that matter covering both the Dam and Game Reserve, so the threat to poaching will be counter measured tremendously. This is possible from the experiences of hydroelectric dam in the country where security arrangements has been of its own and the newly reformed TAWA anti poaching unit. **Further, where on earth do poachers use good roads?**

▪ WWF

Temporary pressure on wildlife, firewood etc. by construction workers and camp followers. If camps are not self- contained, workers several thousand for a project of this scale) and camp followers will use natural resources.

POSITION.

Camps will be self contained, constructed within SGR to restrict camps followers and will use gas and electricity for workers social services (cooking, lighting etc). The government has engaged

sufficient rangers to patrol the SGR during construction aiming to safeguard the wildlife.

- **WWF**

Land disturbance for roads, transmission lines, camps, industrial areas, quarries, spoil deposits etc. Opening an industrial site can cause land disturbance on a major scale, which can take decades to heal in a dry forest and savanna environment.

POSITION.

The notable land activities within SGR will be under management of SGR general management plan (GMP) along with mitigation measures stipulated in the ESMP of the ESIA of the project.

- **WWF**

Temporary air, noise, solid waste, and wastewater impacts. Construction traffic, machinery, camps can generate significant amounts of pollution.

POSITION.

Analyses of impacts and mitigations at pre-construction, construction, operation and decommissioning stages have already been captured in the ESMP of the ESIA of the project.

- **WWF**

Reduction of attractiveness to tourists. Photo and hunting tourists are the main sources of revenue for the management of the Selous, and a factor for Tanzania, and may be deterred from visiting the area, which loses its character as the last remaining large wilderness. The

northern area, where Stiegler's Gorge is located and which is easier to access, is largely allocated to photo tourism. Photo tourism is a small industry, with only 248 beds in the northern camps, but has growth potential. Tourism near the dam site may partially recover once construction is finished. But tourism along the lower Rufiji lakes and in coastal areas might suffer increasing damage over time. Important economic.

POSITION.

The issue of decline of attractions to tourists is untrue. The wildlife will increase in numbers due to increased security and the dam itself will be a great attraction to tourists. Photo tourism will be an added advantage to the tourists from within and outside the country. The reservoir operation regime will consider the existence of the oxbow lakes and ecosystems downstream.

▪ WWF

Short-term fluctuations in flow releases. Due to its unique role in the power system, Stiegler's Gorge will have to provide both base load power and peak load power. During normal operations, flow releases will therefore vary with power demand. This may lead to sudden water level rises and drops below the dam.

POSITION.

The reservoir operation regime will consider existing ecological flow patterns.

- **WWF**

Reduction variability of flows in seasonal. The reservoir will eliminate smaller floods and reduce larger floods. This will reduce the ability of the downstream river to transport sediment, shape the river channel, connect to oxbow lakes within the Selous as well as in the downstream floodplain, and maintain the natural dynamics of the delta. Low-flow periods (which may be important, for example, to expose sandbanks for use by reptiles) will also be eliminated.

POSITION.

It is a truism that most coastal habitats with river inflows are exposed to **INTERTIDAL WATER REGIMES**; through which during dry seasons **FRESH WATER RECEDES** and in rainy seasons **FRESH WATER COMES CLOSER** to the sea. We see changes as normal and the systems are self-regulating. Reservoir operation regime will cater for the current river flow pattern. Therefore, water flow will continue unabated.

- **WWF**

Reduction in sediment load and changes in geomorphology. Except for some fine silt, which remains in suspension, initially no sediment will pass through the reservoir and replenish the downstream areas. The river downstream of the gorge will start eroding its banks and beds, and over time, will change its course, affecting human use and infrastructure as well as habitats in the floodplain and delta. The coastline is likely to retreat. Over time, trapping efficiency of the reservoir will diminish and more sediment will pass through.

POSITION.

The coastline changes are temporary. Based on existing dams upstream which were built in 1970's and 1980's along the same river system such phenomena has never been observed. In case happens, the design of the dam provides bottom and middle outlets to release sediments to replenish downstream areas. The ESMP proposed mitigation measures to be abided.

▪ WWF

Reduction in aquatic biodiversity and abundance below reservoir. Changes in flow quantities and variability, water quality (primarily turbidity and salinity, possibly temperature), access to upstream river stretches for part of life cycles, and geomorphology will change habitat conditions for all aquatic organisms, including endangered species (for example, Dugong and sea turtles), subsistence fishing species, and commercially relevant species (for example, prawns and shrimps). The impact of changed turbidity and nutrient delivery on coral reefs in the Mafia channel is uncertain.

POSITION.

Aquatic life downstream of the reservoir may experience temporary reduction of biodiversity and reduced abundance. Rufiji River had led to a great loss of human life in the past; therefore, control of river regime will reduce the risk of human life downstream.

▪ **WWF**

Reduction in ecosystem services for downstream inhabitants. Over 150,000 people inhabit the Rufiji Delta and floodplain, and another 50,000 the offshore islands. A majority relies for their livelihoods on the extraction of natural resources or on other activities dependent on ecosystem services (such as fishing, riverbank cultivation dependent on seasonal floods, and mangrove wood extraction for charcoal). Subsistence and small-scale commercial fisheries are important for protein supply. Poverty rates are higher than the national average.

POSITION.

It is now possible to regulate floods through formation of irrigation canals, early warning systems and building capacity of the communities regarding ways of reducing/avoiding risks and hazards. The Rufiji delta offers a large area of land suitable for irrigation. The said potential for irrigation is very much possible. Availability of reliable and affordable electricity will support additional means of livelihood such as agro processing industries thus reducing over dependence on the natural resources.

CONCERNS RAISED BY UNESCO AND RESPONSES.

The UN body reacted publicly following the signing of the accord to start preparatory work toward the construction of the Dam in the SGR, and as such, the URT granted the right of access to the Egyptian company within the Selous Game

Reserve, the World Heritage property. In its statement, the World Heritage body indicated that:

- The international community recognized the Outstanding Universal Value of SGR as one of the largest remaining wilderness areas in Africa, with relatively undisturbed ecological and biological processes and exceptional biodiversity.
- The potential damage to the site's values resulting from the hydropower dam at Stiegler's Gorge, located on the Rufiji River within the Selous Game Reserve World Heritage property.
- Expressed its 'grave concern' about Tanzania's decision to move forward on the project, and decided to add this issue to the justification for the continued inclusion of the property on the List of World Heritage in Danger (Decision **42 COM 7A.56**). The property was initially inscribed on the Danger List in 2014 owing to the poaching crisis that led to dramatic declines in the elephant population of the Selous ecosystem.
- URT to "fully assess the cumulative impacts of the Stiegler's Gorge hydropower project on the property and its wider landscape through a Strategic Environmental Assessment (SEA), undertaken to the highest international standards, and to consider alternative options to meet its power generation needs".
- The World Heritage body requested URT to invite a joint World Heritage Centre/IUCN Reactive Monitoring mission to the site to review the status of the dam

project and the overall state of conservation of the property.

RESPONSE.

Therefore, the mitigations of the aforementioned CONCERNED put forward by UNESCO are as follows:

▪ **UNESCO**

The impacts on outstanding universal value of SGR as one of the largest remaining wilderness areas in Africa.

POSITION

An area to be covered by the project is about 2% of the total area of Selous Game Reserve, out of which 1.9% will be inundated, while the remaining area will be used for construction of dam, powerhouse and other facilities (appurtenant structures). Therefore, wildlife and other organisms found in that small area will move to the area of dispersal, which constitutes much of the remaining area equivalent to 49,000 km², with animal species slotting into specific similar habitats found in the property.

▪ **UNESCO**

The potential damages to the site's values resulting from the hydropower dam at Stiegler's Gorge.

POSITION

Most of the tourists in the vicinity of the proposed project are engaged in photo tourism. The scenery view of the finished project will add value to the tourism industry. Similarly, the biodiversity of the area will be slightly affected but not significant enough to affect the values of SGR.

▪ UNESCO

Continued inclusion of the SGR on the list of world heritage in danger owing to the poaching crisis that led to dramatic declines in the elephant population of the Selous Ecosystem in the past and the implementation of the Stiegler's Hydropower Project.

POSITION

The project will enhance security in the SGR and the entrance to the designated area will be regulated. Certainly, there will be security of its kind and for that matter covering both the Dam and SGR, so the threat to poaching will be counter measured tremendously. The project will create the permanent water body (reservoir) which will provide water all around the year to animals and increase their population. In addition, the project will conduct SEA, which will assess the cumulative impacts on the property.

▪ UNESCO

URT to assess the cumulative impacts of the Stiegler's Gorge Hydropower project on the property and its wider landscape through a Strategic Environmental Assessment (SEA) and to consider alternative options to meet its power generation needs.

POSITION

Conducting a Strategic Environment Assessment (SEA) is good, but in itself cannot give solutions to the high demands for affordable electricity in the industrial and growing commercial and rural electrification program. Therefore, SEA will help to show the linkages of the project to other socio-economic activities in the Rufiji River basin and assess the cumulative impacts of the project to the property.

5. SUMMARY OF SOCIO-ECONOMIC BENEFITS, CHALLENGES AND MITIGATIONS

It is truism that in spite of some conservations, environmental, social, and economic concerns, especially those affecting upstream and downstream ecosystems and local people livelihoods, the existing Stiegler's Gorge hydropower project is well perceived by many Tanzanians for its expected contributions to the National Development Agenda.

There is consensus therefore, that without the proposed hydropower project the country may experienced

challenges towards full industrialization, electrifying the rural communities with affordable and reliable power to reduce heavily dependence on wood fuels and hence reduce the level of deforestation. Supplying power to the Standard Gauge Railways and other sectors of the economy namely health, education, agriculture, infrastructure and mining.

This positive perception has encouraged the government to proceed in the implementation of the project based on an assessment of technical, economic, political, and social conditions. In addition, there is skepticism among local people and other actors about the alternatives promoted in the context of electricity generation and the country development agendas, and as such the impression and attitude of some western organizations and countries towards Stiegler's Gorge Hydropower Project.

This seems to subvert the socio-economic development AGENDA of the country so as to undermine the construction of the hydropower dam, by promoting other alternatives without taking into account the investment and generation cost per unit. It is our understandings that pro-conservations, environmental and social campaigns, against the dam, are not based on altruistic belief in equity and social justice for local people but for the sole purposes of environmental protection and nature conservation, in which the two have to coexists in any ecosystem for each one survival.

Alternatives to Stiegler's Hydropower Project

International stakeholders suggested that natural gas, solar, wind, thermal, geothermal and small hydro projects as alternatives to the Stiegler's Gorge Hydropower, that these alternatives can achieve the same or even better benefits for the country with few or none of the social and environmental problems that could be associated with the proposed Stiegler's Gorge Hydropower Dam, to them these alternatives are, therefore, form the best options on the table. However, this is contested as follows.

First, it is argued that the costs of generating electricity from these alternatives are prohibitive. For instance, it is estimated that the "cost of generating a KWH OF ELECTRICITY PER UNIT WITH NUCLEAR POWER IS TZS. 65, WIND POWER TZS.103.05, SOLAR POWER TZS. 103.05, GEOTHERMAL TZS.114.50, COAL POWER TZS.118 AND THERMAL TZS.147 COMPARED TO HYDROPOWER AT TZS 36 PER UNIT,

Second, Nuclear, wind, solar, Geothermal, Coal, Thermal and liquid Fuel as sources of electricity cannot generate other positive benefits such as irrigation, agriculture, fisheries and photo tourism like the Hydropower Dam.

Third, Small hydropower generation is another alternative, which has proven to be incapable of substituting the Stiegler's Gorge Hydropower project, as the later will provide consolidated and substantive MEGAWATTS in a single project. However, over a period of time the small hydro

projects will be on the plate as per the country ENERGY MASTER PLAN, and as such the small hydro dams cannot serve as alternatives to the Stiegler's Gorge Hydropower project, which will have the capacity to generate 2115 MW.

Fourth, The use of Thermal to generate electricity will lead to the increased emission of greenhouse gases, which affects climate change. Such that, the increased use of thermal amplifies the discharges of carbon dioxide (co), Sulphur dioxide (so) and Nitrogen oxide (nox), with greater negatively effects and hence increase implications for climate change. Therefore, thermal energy is not an appropriate alternative to the Stiegler's Gorge Hydropower project when used in a larger scale. Subsequently, other renewables (solar and wind) lack ramp effect which is crucial in providing reliable power and security supply and is recommended not to exceed 30% of total grid capacity".

Lastly, Sustainable and reliable power supply requires improved energy mixed; as such Tanzania is promoting diversification sources into its energy mix. Other renewable energy such as solar small hydro, wind and geothermal are prioritized as well. However, given grid requirement, potential and security of supply, these alternatives cannot cope with ever-increasing energy demand of the country, thus Stiegler's Gorge Hydropower project is the best option.

The need for large dams, which proliferated in the 1950s and 1980s, is based on the provision of irrigation, water supply, flood control, and hydropower generation. The ability of countries to provide these services is correlated

with self-reliance, independence and economic and social progress.

- For instance, the transfer of water to drier areas is exemplified in the western United States, where huge water transfer facilities and large dams provided a stable water supply to states like California and made them habitable. Also, the sophisticated developments brought about by the Tennessee Valley project, which significantly transformed large part of land susceptible to devastating floods into an industrial hub, and prosperity in Western Europe, Asia and Canada, particularly in Sweden, Norway, Switzerland, India and Canada can partly be traced to hydroelectric power and flood control dams.
- The recent emergence of Spain as the custodian of large dams, also facilitated a major producer of irrigated horticultural produce scattered around the country.

These examples and many more demonstrate how large dams have been used over several decades by different nations to meet their development objectives. Therefore, large dams across the global encapsulate the choices and dilemmas faced by every society, of which the debate over large dams is a debate about the very meaning, purpose, and pathways for achieving development. In any case, all development choices and decisions on dams and their alternatives must respond to a wide range of expectations, objectives, and constraints with the big picture of the society to be abreast of the development. It is with those concerns this report focused on the country agenda for changes, which signify itself through the Country Vision 2025 and Sustainable Development Goals [SDGs]. The country

directed all its energy and resources toward making every citizen enjoy better life by providing better health care, sustainable education for all, improved social and economic activity, in particular agricultural which engages more than 65 percent of the population. Through these and the facts that the country has to ripfrog to achieve a middle-income economy by the year 2025, there is only one way to arrive at that juncture, through rising per capital income by way of accelerating the increase in GDP, at a growth rate of 8% per annum and above.

6. CONCLUSION

Tanzania is on the road to become a middle-income economy by the year 2025, through industrialization and agricultural transformation. To achieve these goals there is a coherent need to have affordable, reliable and sustainable electricity. Furthermore, the government has already indicated its desire to provide electricity to all villages by the year 2025 and to meet the demand for electricity to health centers, dispensaries, schools etc. However, we do believe that by providing electricity to the villages real rural economic transformation would emerge.

Despite its challenges, which have been identified in the main body of this Report, we do believe that the Stiegler's Gorge Hydropower Project will provide affordable, reliable and sustainable electricity to Tanzania's immediate energy needs. It is for the first time in the history of Tanzania's energy development that upon commissioning in 2022, a projected 2115 MW

would be connected to the Grid bringing a total of almost 5000 MW. Unfortunately, some of our experts at WWF have failed to see the bigger picture and totally ignored Tanzania's need and aspirations. Tanzania is highly committed to conservation and a signatory to the International Conventions and Protocols. It will do everything to its power to live up to these protocols and conventions. While doing that Tanzania's economic aspiration shall not be compromised.

In our findings we reiterate the decision taken by the Government in implementing the project based on socio economical aspects as well as coexistence of conservation, environment and human development. Therefore, we revisited some of the key issues put forward by the international institutions as follows:

Ending Power Cuts. The Stiegler's Gorge Hydropower project on its completion will be able to generate into the national grid an equivalent of 2115 MW, and therefore reduce the persistence power cuts with the reliable supply of electricity. The Hydropower project will compliment the currently capacity of about 1,700 MW, and therefore afford the utility company, TANESCO with enough electricity to balance supply and demand. The world bodies did not foresee this opportunity because in the planning context and that being the case the natural calamities may be contingencies forecasted. On that context, the reliability over long-term climate change will be answered by the size of the DAM and its discharges over a yearly period enough to adjust with any climate variability.

Economic Growth and Industrialization. Further to our previously ascertain regarding the Hydropower project rationale, and the acknowledgment of the parties in question, its indeed the additional of 2115 MW will compliment heavily the capacities on hand to afford a great deal in supporting the drives towards industrialization, as we quote WWF in its release

“ In the present context, electrification and industrialization have been the key economic themes under Magufuli’s new government, represented in 2016/17-2020/21 Five Year Plan” End of quote.

The additional energy from Stiegler’s Hydropower Dam will not only compliment 82% into the national Grid, but also compliment an AFFORDABLE AND RELIABLE POWER. In its long-term strategies, the country will attempt ever before to lower overhead cost per unit, and hence economic prosperity. We quote WWF in its release

“The Stiegler’s Gorge can aid Tanzania’s electrification through its provision of abundant power that is crucially cheap (predicted leveled cost to be 4.5 US cents/kWh) and therefore more affordable to the low-income, unconnected majority of citizens” End of quote.

Financial Risk of the Project. The business model concept articulated by the world bodies negatively objecting the project was based on the PPA principles, through which this undertaking is no longer based upon it. Therefore the context of negatively risk does not hold waters, therefore the government through its annually budgetary

allocations will implement the project and the cost of the project will be the initial capital investment that will be settled by the project itself. Therefore this undertaking is economical and financial viable to pursue.

Flood Control, Irrigation and Urban Water Supply.

The author pointed out some unwanted effects of the Stiegler's Hydropower project to the extent of concluding that this undertaking will eventually impact on a big number of habitats and as such the proposed water use system to accommodate floods occurrence will be irrelevant. On the contrary, the Dam will bring about many opportunities to the communities and the country, and as such there will be flood control since the water flows will be regulated physically.

Based on the above understandings and the facts that number of critical issues negatively conceived by the WWF and UNESCO has been reviewed thorough, and the facts that the Stiegler's Gorge Hydropower project is Financially, Economically and Environmental viable, the government with the capacity on hand is now implementing the project to its scale.

Owing to the various challenges both positive and negatives, its our understanding that as it was for other dams in the world, Stiegler's Gorge Hydropower project also will have some challenges in terms of its size and scale of power to be generated, therefore we understand the position and trade off between conservation and economic development in which both have to coexist. One would underscore the need to

undertake more aggressive anti poaching at SGR but with implementation of the project would be possible to protect the elephants and other species by improving living standards of the people around the vicinity.

Therefore with integrity and seriousness of the Government, it is very clear, the former will have more capacity to launch anti poaching activities at SGR while continue generating electricity, through which part of the revenue will be plowed back to the same area for wildlife conservation, environmental management programs and enhanced the social economic conditions of the people living in the vicinity and, the delta to enjoy the fruits of their existence within the ecosystem through fishing, agriculture, tourism, transportation and so forth.

In summary some of the major benefits of the Stiegel's George Hydropower Project on its completion will include the following:

- Increase of 2115 MW of affordable electricity equivalent to 82% to support country industrialization, rural electrification, mining and agro business activities.
- Creation of job opportunities to Tanzanians during construction and after the commissioning of the projects, and it is estimated that over 12,000 people will be directly and indirectly employed.
- Enhancing the tourism industry through sports fishing, boat rides and photographic safaris, new investments in accommodation facilities such as camps, hotels and lodges. Therefore changing lives of the people in and outside the project area through various economic and social activities such as agricultural and fishing.

- Construction of Dam will also control floods downstream of the project area where its population used to suffer due to uncontrolled waters.
- Conservation and anti poaching activities will be enhanced though more funding.
- Security within the perimeter ring of SGR will be enhanced, as the Dam will bring additional security measures never seen before, and therefore anti poaching drive will be complimented tremendously.
- Enhance accessibility to the Project area and the SGR through improved roads, Kibiti – Mtemere gate – Matambwe junction – Project Site and Ubena Zomozi – Kisasi- Matambwe Gate to Matambwe junction and Fuga station to Matambwe junction.”
- Source of water for domestic use in Dar es Salaam and Morogoro.
- Improved railways access route to the project site at Tazara Railway Station - Fuga Station and road from Fuga to Matambe Junction.
- Electrification of villages adjacent to the project.
- Increase access to electricity to the general population from the current 67.5 % to 100% by 2025.
- Decrease the use of biomass as source of energy and hence decreasing deforestation by more than 50 %.

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8. APPENDICES.

APPENDIX.I

CUMULATIVE MATRIX OF IMPACTS ON RUFJI HYDROPOWER PROJECT FROM VARIOUS STUDIES.

SN	IMPACTS	POLYI OPTIONS (RESPONSES)
1	<p>The impacts on the SGR OUTSTANDING UNIVERSAL VALUE (OUV)</p> <ul style="list-style-type: none"> a) Large undisturbed wildness area, b) Global significant population of large mammal. c) Diversity of mammals, birds and other animal taxa, d) Rare and endangered species, e) Diversity of vegetation types, f) Sand Rivers in the SGR 	<ul style="list-style-type: none"> • Presence of people cannot affect diversity of animal species. There can be decline in numbers of animals due to poaching, natural death, ecosystem dynamics (food web) etc. Even before the hydropower project starts there is a record decline in the number of animals and diversity. • Increases in the number of people in and around the facility would enhance security of the properties there.
2	Impaired landscape / aesthetics quality of SGR	The establishment of hydropower impacts will be long term and largely residual. The project will cover only 2% of the SGR. ESMP will enhance conservation and curb possible loss of landscape/ aesthetic quality. There will be enhanced picturistic view and attract photo tourism.
3	Water use conflicts	Afforestation schemes would enhance recharge of water into the basin. Control of water use with proper management can do good to land use. The No project option would probably do harm to water use the hydropower projects in place. Hydropower projects are always associated with better management of water use. Hydropower does not use water permanently. Water is held temporarily and released downstream. Proper land use management can regulate water use among other alternatives.
4	Degradation of the river bed bank of the lower Rufiji	Degradation of the River Bank is unlikely to occur when the dam is constructed. In order to ensure maximum protection of erosion of the River Bank, the 60-meter regulation of not doing man's activities should be cut down to a bare minimum strengthen riverbanks where necessary.
5	Liquid waste management	Introduce modern waste treatment plants no commonly used to recycle water and restore back to the environment. Liquid waste is mainly domestic sewage

		emanating from toilets (water closets – WC) and kitchens, grey water from shower/bath rooms and storm water. This sewage is enriched with organic matter, which can easily be biodegraded given the right conditions – like temperature and oxygen content. The use of septic tanks coupled with drainage fields as a preferred way of sewage treatment and disposed land around each facility is ample for other activities e.g. wastewater treatment and disposal.
6	Solid waste management	Sorting of solid waste to be done at points of generation be it plastic, paper, glass etc. these should be disposed to designated district authority dumpsite.
7	Deforestation	Loss of some plant species in an area 2% is insignificant as there species area found elsewhere in the properly (SGR). Loss of forest is more quantitative rather than qualitative (there will not be loss of species). Selected removal of trees can leave for some staff structures.
8	Soil erosion	Some temporary loss of soil through erosion is expected during various stages of the project. Proper landscaping and land use, development of drainage system can cut down soil erosion. Re planting of tress in the areas fringing SGR.
9	Introduction of alien exotic species	Invasive plants may invade the reservoir but the government may introduce dominant plants to counter their effectiveness.
10	Change in species and habitat diversity	Deploy monitoring mechanisms to assess and track ecological changes and responses of flora and fauna communities to inform adoptive management of the water and sediments budgets into the Rufiji delta.
11	Enhanced noise pollution	Noise pollution will be experienced temporarily through vehicles and other heavy equipment. During operation of the project noise levels will be minimal.
12	Enhanced air pollution	Air pollution may result during construction. Regular wetting of land would cut dust levels significantly.
13	Enhanced water pollution	Water pollution will be minimal if any. Current pollution of water has not raised any significant alarm to the ecosystem. The ecosystem has its own regeneration mechanism to cut down minor pollution through bioremediation.
14	Increased risks of HIV/AIDS and STDs	Hazards to public and construction workers i. Ensure workers and visitors are escorted

		<p>by guards during transit in the night times and provide reliable security system</p> <ul style="list-style-type: none"> ii. Station PA rangers to safeguard construction workers and visitors from wildlife attacks and provide due instruction in wildlife hazards. iii. Train staff in occupational health and safety risk management and emergency response, administer all requisite PPE and post safety signage iv. Provide health insurance for workers and basic first aid amenities. v. Sensitize workforce to HI/AIDS prevention and treatment vi. Ensure hygienic and safe environments for guests and staff, and adequate sanitation facilities meet minimum requirements.
15	Increased level of crimes and insecurity	SGR project will require heavy security. Relevant local authority will engage heavy security to ensure safety of community and property.
16	Increased accidents, risks and hazards	Local district councils and responsible ministries to engage organized and proper traffic management.
17	Increase pressure on social services	The operation of the project would attract both social and economic services. Private sector will open up business and the Government will benefit through revenue collection
18	Change in local population characteristics	Tanzania is a plural society. There is greater social mobility Students and workers study and work anywhere in Tanzania free according to the laws and regulations of the country. There is no significant local protection. Local communities should mitigate bad practices and enhance new ones brought by other cultures within the country.
19	Increased pressure on local infrastructure	Local government and relevant ministries will assess the needs of local infrastructure and mitigate the situation accordingly. E.g. expansion of road network and increase communication services to and from the area.
20	Increase pressure on social services	The operation of the project would attract both social and economic services. Private sector will open up business and the Government will benefit through revenue collection

APPENDIX.II

MATRIX OF IMPACTS RAISED BY WWF AND POLICY OPTIONS (RESPONSES)

NO	IMPACT RAISED BY WWF	DESCRIPTION	MITIGATION OPTIONS	LEVEL OF CONCERN AFTER MITIGATION	POLICY OPTIONS (RESPONSES)
1	Reduction in aquatic biodiversity and abundance above reservoir	Some species are dependent on migration past Stiegler's Gorge, and would be stopped by the dam and the reservoir with unfamiliar low velocity flows	In practical terms, none. No upstream fish passage could be designed for this high dam, and in any case, fish that could pass the dam would have to navigate an unfamiliar lake environment. Catch and release is unlikely to be practical. Downstream passage as larvae depends on flow velocity, and as adult fish on mortality in turbines	Medium. Fish biodiversity and life cycles are poorly known, but no major migrations have been reported. Little concern for upstream fishery productivity (not an important source of protein today, and new species may take ecological niches left by migratory fish)	The dam allows passage of a considerable number of fish. Initially there are may be some delay in passage, but later there will be passage of fish downstream.
2	Changed fish community in reservoir stretch of the Rufiji	The reservoir will provide habitat for different (and possibly non-native) species. Total biomass may increase, typically with an initial spike, and river species may be displaced.	In principle, research could be conducted to select desired fish species, and a managed fishery could be established. But introduction is difficult to control, and establishment	Medium. Unclear whether high productivity fishery could be established, even if fish are introduced; also unclear whether Tanzania could effectively	Fisheries department to provide guidance and capacity to manage the situation during the initial stages of the operation. The government has the capacity to control fishing practices as

		RUBADA speaks of 3,700 tons/year permanent yield, and 20,000 tons/year initial yield, primarily of tilapia	of fishery and presence of fishermen potentially conflicts with conservation objectives	control entry of fishermen	has being done elsewhere in the country e.g. Lake Victoria etc.
3	Sediment deposition at top of reservoir	Large amounts of sediment will settle out once the Rufiji slows down, creating environmental nuisances and possibly backwater effects.	In practical terms, none. In some reservoirs with high-value navigation, dredging is carried out. Deposition will take many decades before it affects storage space	Low. No particular interests at tail end of reservoir, and very long reservoir lifespan.	The river will have less sediment because a large segment of the river passes through thick forests, which store fresh water with comparatively low sediment load. However the cost of removing sediment does not exceed that of fossil fuels.
4	Eutrophication & invasive aquatic plants	Nutrients coming into reservoirs and high temperatures may induce high primary productivity, algae blooms, and plant pests. These can cause water quality issues and operational problems at hydropower station, but are unlikely to increase evaporation	Initial spike in primary productivity inevitable, and invasive plants such as hyacinth and fern likely, but manageable through low-tech mitigation (plant removal near intakes), probably not requiring chemical treatment.	Low. Overall level of nutrients and organic materials in river inflows, soils and vegetation is limited; like most large reservoirs and natural lakes in East Africa more likely to be oligotrophic.	Eutrophication will be limited, as much of the catchment area upstream does not contain much agriculture practices. Invasive plants may invade the reservoir but the government may introduce dominant plants to counter their effectiveness.
5	Stratification of	Reservoir will	In practical terms,	According to	The effect of

	reservoir and GHG emissions	emit CO ₂ and CH ₄ at higher rates than the ecosystems that it replaces particularly if stratification into different layers occurs	none.	the UNESCO/IHA risk screening tool, medium risks of significant GHG emissions	stratification of the reservoir is in significant GHG will be limited as the area under the project is 2% of the total Selous game reservoir
6	Water quality	Under special conditions, water quality can be impaired by pollution of rivers, along shores, by atmospheric deposition, or by release of soil compounds (for example, mercury)	In practical terms, none.	Low because of low human populations and large capacity of dilution and self-purification	There are no threats of water in the Ruaha /Rufiji river basins to cause threat. Mercury Deposits are likely to occur in areas where there is rudimentary gold mining.
7	Evaporation	Large water surface area increases evaporation rates; quantities will be significant	Keeping the reservoir as empty as possible; diking off shallow reservoir arms	Medium. Reduces power generation and downstream water use accordingly, may lead to increased salinity in delta, minor impact on microclimate	There will be more of evaporation, which may not cause harm to the ecosystem of the area; therefore the quantities will be of no threats.
8	Shoreline wind erosion	Large exposed mudflats and sandbanks during the dry season can lead to dust storms.	Keeping the reservoir as full as possible	Medium. Very large areas may be exposed. Dust storms may be a familiar natural phenomenon in area, but would increase	Orchards will cover much of the area under mudflats and vegetable gardens both permanent and seasonal crops. The idea of exposure of mudflats will be

				because of unconsolidated soils with no vegetation cover	insignificant.
9	Inundation of terrestrial habitats	For comparison, 1,200 km ² of wildlife habitat is larger than the majority of Tanzanian national parks. Terrestrial biodiversity and abundance of animals is large, because of the variety of land forms and habitats; the availability of food and water; and the large extension and remoteness. The Selous provides globally significant habitats for charismatic and endangered species; there is no information on species endemic to the project area.	Compensation by managing remaining habitat better and/or by expanding Selous by equivalent habitats (biodiversity offsets, likely upstream or downstream along the Rufiji River, at least by the same amount lost to the project)	High. For various reasons, compensation is unlikely to be feasible (lack of political will to use available resources for better management, lack of replacement land, irreplaceability of Rufiji ecosystem). Effects on internal migration routes uncertain, animals will adapt to some extent. Impact on migration corridors outside the Selous unlikely.	2% of land under the project cannot have big impact; various initiatives done by the Government since independence have experienced a lot of losses in wildlife. The current efforts to conserve wildlife and WMA have shown positive effects. While we recognize some of these minor change the nation has to put all these parameters on an Environmental Socio economic Equation to evaluate the true cost of hydro power project
10	Increased access by poachers	Poaching is facilitated by access to the reserve and within the reserve	Depends largely on political will to allocate resources to anti-poaching operations, and to	Medium. Could be managed with effective entry control system to the	Presence of projects of a scale like S.G will demand high security. Therefore, there will be great

		created by permanent and temporary roads. Poachers are still using tracks created by oil exploration in the 1970's. The main access road is expected to be 120 km long, from Chalinze	reduce demand for ivory and other resources	reserve, and surveillance within the reserve, supported by project funds; however Tanzania has poor track record in this regard	security of the area and no threat to poaching will occur.
11	Temporary pressure on wildlife, firewood etc. by construction workers and camp followers	If camps are not self-contained, workers several thousand for a project of this scale) and camp followers will use natural resources	Depends largely on willingness and ability of contractors to enforce control over work camps, and camp followers	Low. Odebrecht has shown ability to run well-managed camps; low need for permanent operational staff	The Government will engage rangers and forestry staff to safeguard the area from fire. Essential EMP will be used to monitor work done by the contractor.
12	Land disturbance for roads, transmission lines, camps, industrial areas, quarries, spoil deposits etc	Opening an industrial site can cause land disturbance on a major scale, which can take decades to heal in a dry forest and savanna environment	Smart construction planning can minimize disturbance to some extent (for example, quarries in future reservoirs, reuse of excavated material in saddle dams or for landscaping, land rehabilitation with native species). Some areas will remain permanently disturbed, but infrastructure can be sited and designed to minimize impacts on high-	Medium. Odebrecht has shown ability to minimize construction impacts, but some permanent impacts are unavoidable.	There are notable quarries within the area. Industrial establishment are by law subject to follow environment management plan as stipulated by EIA and EA 2005 therefore the Government will reinforce all these activities.

			conservation value areas.		
13	Temporary air, noise, solid waste, and wastewater impacts	Construction traffic, machinery, camps can generate significant amounts of pollution		Low. Odebrecht has shown ability to minimize construction impacts. Animals will avoid areas temporarily but return, as they do to tourist camps.	Analysis of impacts and mitigations at pre-construction, construction, operation and decommissioning stages will be done to put pollution to bare minimum acceptable standards.
14	Reduction of attractiveness to tourists	Photo and hunting tourists are the main sources of revenue for the management of the Selous, and an factor for Tanzania, and may be deterred from visiting the area, which loses its character as the last remaining large wilderness. The northern area, where Stiegler's Gorge is located and which is easier to access, is largely allocated to photo tourism. Photo tourism is a small industry, with only 248 beds in the	Minimization of disturbance, as described above, will also reduce impacts on tourists. Alternative sites may be developed for tourists, and road and services improvements will provide some benefits.	Medium. The Selous is currently visited by less than 1% of visitors to Tanzania, and the dam site and reservoir area are difficult to access and not currently high on the tourists' agenda. However, the tourist potential of the Selous is high, and the discussion on the project and the possible loss of the World Heritage status will deter tourists. Also, downstream areas of high attractiveness will be impacted	The issue of decline of attractions to tourists is untrue. The wildlife will increase in numbers due to increased security and the dam itself will be a great attraction to tourists. Photo tourism will be an added advantage to tourists.

		<p>northern camps, but has growth potential.</p> <p>Tourism near the dam site may partially recover once construction is finished. But tourism along the lower Rufiji lakes and in coastal areas might suffer increasing damage over time. Important economic</p>		<p>(for example, lakes that depend on annual flow pulses).</p>	
15	<p>Short-term fluctuations in flow releases</p>	<p>Due to its unique role in the power system, Stiegler’s Gorge will have to provide both base load power and peak load power. During normal operations, flow releases will therefore vary with power demand. This may lead to sudden water level rises and drops below the dam.</p>	<p>Ramp-up and ramp-down rules determine how quickly river levels can be changed.</p>	<p>Low. Limited impact because Stiegler’s Gorge is likely to be operating continuously to supply base load, and because river valley broadens below Stiegler’s Gorge, so that any increases in water levels dissipate</p>	<p>Water flow upstream and downstream is a phenomenon that has not been shown scientifically to affect biodiversity of ecosystems.</p>
16	<p>Reduction variability of flows in seasonal</p>	<p>The reservoir will eliminate smaller floods and reduce larger floods. This will reduce the ability</p>	<p>In principle, the reservoir can be operated to mimic natural variability of flows. Keeping the reservoir full at</p>	<p>High. Combined with the lack of sediments (described below), the reduced</p>	<p>There are more advantages than disadvantages. Water flow will continue normally. It is a truism that</p>

		<p>of the downstream river to transport sediment, shape the river channel, connect to oxbow lakes within the Selous as well as in the downstream floodplain, and maintain the natural dynamics of the delta. Low-flow periods (which may be important, for example, to expose sandbanks for use by reptiles) will also be eliminated.</p>	<p>all times means that inflows equal outflows, the reservoir is essentially operated as run-of-river, and downstream flows are unchanged from natural conditions. However, in practice, the generation gain from increasing the head is overcompensated by the generation loss from spilling and evaporation, and run-of-river operations are therefore commercially not viable.</p>	<p>variability will significantly affect the natural dynamics of downstream freshwater and coastal ecosystems, and prime habitats of many species.</p>	<p>most coastal habitats with river in flows are exposed to intertidal water regimes. During dry seasons fresh water reseeds and in rainy seasons fresh water comes closer to the sea. We see changes as normal and the systems are self-regulating.</p>
17	<p>Reduction in sediment load and changes in geomorphology</p>	<p>Except for some fine silt, which remains in suspension, initially no sediment will pass through the reservoir and replenish the downstream areas. The river downstream of the gorge will start eroding its banks and beds, and over time, will change its</p>	<p>Stiegler's Gorge has a bottom release, which can be used to flush sediments from reservoir, but this requires emptying the reservoir and foregoing power generation. It is more likely that the bottom outlet would only be used for emergency drawdowns of the reservoir, and</p>	<p>High. Changes to downstream morphology are inevitable and may lead to major disruptions over time. The biggest unknown is how much sediment the river can remobilize by eroding the alluvial floodplain, before the</p>	<p>The coastline changes are temporary. There will be self-regulation and man planned farming, irrigation can be done to take advantage of the regular flow of water. Flow of water downstream will be regulated physically.</p>

		course, affecting human use and infrastructure as well as habitats in the floodplain and delta. The coastline is likely to retreat. Over time, trapping efficiency of the reservoir will diminish and more sediment will pass through.	possibly in the very distant future when sediment starts affecting the intakes.	effects reach the delta.	
18	Reduction in aquatic biodiversity and abundance below reservoir	Changes in flow quantities and variability, water quality (primarily turbidity and salinity, possibly temperature), access to upstream river stretches for part of life cycles, and geomorphology will change habitat conditions for all aquatic organisms, including endangered species (for example, Dugong and sea turtles), subsistence fishing species, and commercially relevant species	The cumulative impact of multiple changes listed above, will affect different species differently in ways that are impossible to predict, and it is unlikely that the reservoir would be operated to reduce impacts. There may be some mitigation and compensation measures to improve natural resource management and conservation in the floodplain, delta, and adjacent marine areas.	High. The Rufiji-Mafia-Kilwa Ramsar Site is of international importance, and even among Ramsar sites is unique for its combination of different tropical coastal ecosystems	Aquatic life downstream of the reservoir may experience temporary reduction of biodiversity and reduced abundance In the past flooding within the delta of Rufiji river had led to a great loss of human life. Control of river regime will reduce the risk of death of humans downstream.

		(for example, prawns and shrimps). The impact of changed turbidity and nutrient delivery on coral reefs in the Mafia channel is uncertain.			
19	Reduction in ecosystem services for downstream inhabitants	Over 150,000 people inhabit the Rufiji Delta and floodplain, and another 50,000 the offshore islands. A majority relies for their livelihoods on the extraction of natural resources or on other activities dependent on ecosystem services (such as fishing, riverbank cultivation dependent on seasonal floods, and mangrove wood extraction for charcoal). Subsistence and small-scale commercial fisheries are important for protein supply. Poverty rates are	The impacts originate in reservoir operations and subsequent biological and physical changes, but are too complex to be effectively managed. There may be some mitigation and compensation measures, as mentioned above. Protection from floods should not be overestimated, as large floods will still occur and the elimination of smaller floods may create a false sense of security. There schemes in the Rufiji, and these may be easier to implement with funds from the	High. Given the pre-existing poverty and pressures on natural resources, household livelihoods and living standards are vulnerable to further disruptions.	It is now possible to regulate floods through formation of canals, early warning systems and building capacity of communities regarding ways of reducing/ avoiding risks and hazards. The Rufiji delta offers a large area of land suitable for irrigation. The said potential for irrigation is possible.

		<p>higher than the national average.</p>	<p>Stiegel's Gorge project and easier to operate with higher dry season flows, but will also be vulnerable to large floods. RUBADA speaks of 80,000 hectares as suitable for irrigated agriculture, producing 450,000 tons of paddy, 7,000 tons of maize and 3,000 tons of cotton. This appears overly ambitious, as the total area in large irrigation schemes in Tanzania is 61,000 ha, and the crop yield would be above global averages are plans for formal irrigation</p>		
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APPENDIX.III

LIST OF AIRSTRIPS IN SELOUS GAME RESERVE

NO	AIRSTRIp NAME	SECTOR	CONDITION
1	MATAMBWE	MATAMBWE	IN USE
2	MTEMERE	MATAMBWE	IN USE
3	SIWANDU	MATAMBWE	IN USE
4	STIGLER'S	MATAMBWE	IN USE
5	MKONDO/SIMBAZI	MATAMBWE	IN USE
6	BEHOBEHO	MATAMBWE	IN USE
7	KIBAMBWE	MATAMBWE	IN USE
8	MBUYU SELOUS	MATAMBWE	IN USE
9	MTENDE	MATAMBWE	NOT IN USE
10	KINYANGURU	MATAMBWE	IN USE
11	KINGUPIRA	KINGUPIRA	IN USE
12	BARANI	KINGUPIRA	IN USE
13	NAMKONGO	KINGUPIRA	IN USE
14	MKANGIRA	LIWALE	IN USE
15	MADABA	KINGUPIRA	IN USE
16	KIBESA	KINGUPIRA	NOT IN USE
17	KIHURUMILA	LIWALE	NOT IN USE
18	KINJACHA	LIWALE	IN USE
19	KIBAONI	KALULU	IN USE
20	NJENJE/RURILA	KALULU	IN USE
21	MKUYU	KALULU	IN USE
22	LIKUYU AIRSTRIP	SEKAMAGANGA	IN USE
23	RUHANYANDO	SEKAMAGANGA	IN USE
24	LOGOMBE	SEKAMAGANGA	IN USE
25	MBARANG'ANDU	SEKAMAGANGA	IN USE
26	MBUGA	ILONGA	IN USE
27	MAHUNGUI	ILONGA	IN USE
28	LUKULA	ILONGA	IN USE
29	FOROWALA	ILONGA	IN USE
30	LUWEGU	ILONGA	IN USE
31	MSOLWA	MSOLWA	IN USE
32	RUAHA	MSOLWA	NOT IN USE
33	MANANE	MSOLWA	NOT IN USE
34	MLAI	MSOLWA	IN USE
35	K5	MSOLWA	IN USE
36	R2	MSOLWA	IN USE
37	U1	MSOLWA	IN USE
38	MIGURUWE	MIGURUWE	IN USE

SOURCE: TANZANIA WILDLIFE MANAGEMENT AUTHORITY (TAWA) - 2019

APPENDIX. IV

NUMBER OF TOURIST VISITED SGR (2016 – 2018), NUMBER OF LODGES AND CAMPS, BED CAPACITY IN SELOUS GAME RESERVE AND HUNTING BLOCKS

NO	DETAILS	FIGURES
1	TOURISTS ARRIVAL 2016 – 2018 FOR PHOTOGRAPHIC TOURISM	76,227
2	NUMBER OF LODGES AND CAMPS	11
3	BED CAPACITY FOR LODGES AND CAMPS	284
BED CAPACITY IN SELOUS GAME RESERVE		
NO	LODGE/CAMP	BED CAPACITY
1	SELOUS SIWANDU	26
2	LAKE MANZE CAMP	24
3	MBUYU CAMP	34
4	RUFIJI RIVER CAMP	34
5	MALALA. A. LODGE	30
6	MALALA. B. LODGE	24
7	AZURA LODGE	20
8	RETREAT LODGE	24
9	BEHOBEHO LODGE	22
10	SANDRIVER CAMP	26
11	IMPALA LODGE	20
HUNTING BLOCKS IN SELOUS GAME RESERVE		
NO	DETAILS	FIGURE
1	TOTAL HUNTING BLOCKS IN SELOUS	44
2	HUNTING BLOCKS CURRENTLY IN USE	33
3	HUNTING BLOCKS NOT IN USE	11

SOURCE: TANZANIA WILDLIFE MANAGEMENT AUTHORITY – (TAWA) - 2019

APPENDIX. V

STIEGLER'S GORGE HYDROPOWER PROJECT – SITE PLAN

