ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED CONSTRUCTION OF 40 MW KITUI SOLAR PARK PROJECT AT KITUI

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JUNE 2018

SUBMISSION OF DOCUMENTATION

I, **Prof. Jacob K. Kibwage** on behalf of Africa Waste and Environment Management Centre submit the following Environmental Impact Assessment Study Report for the proposed construction of a 40MW Solar Power Farm in Kitui County. To my knowledge, all information contained in this report is an accurate and truthful representation of all findings as relating to proposed project and project description and other information given by the proponent.

Signed at **NAIROBI** on this.....18th..... day of **June 2018.**

Signature: .....

Designation: **Lead Environmental Consultant. NEMA Firm Reg. No 0527**

SUBMISSION OF DOCUMENTATION

I, **Soichiro Nakamura** on behalf of Looop Inc submit the following Environmental Impact Assessment Study Report for the proposed construction of a 40MW Solar Power Farm in Kitui County. To my knowledge, all information contained in this report is an accurate and truthful representation of all findings as relating to proposed project and project information we gave to the EIA firm of Experts.

Signed at **Tokyo** on this.....20th..... day of **June 2018.**

Signature.....

Designation: **President CEO, Looop Inc**

PROPOSED CONSTRUCTION 40MW SOLAR POWER FARM
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT
LIST OF PLANNING AND PARTICIPATING CONSULTANTS

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ACRONYMS

^{0}C	Degrees Celsius
AC	Alternating Current
AfDB	African Development Bank
asl	Above sea level
CGoK	County Government of Kitui
CPP	Consultation and Public Participation
DC	Direct Current
EMCA	Environmental Management Coordination Act
ERC	Energy Regulatory Commission
ESAP	Environmental and Social Assessment Procedures
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGDs	Focused Group Discussions
FiT	Feed-in-Tariff
GDC	Geothermal Development Company
GHGs	Green House Gases
GoK	Government of Kenya
HWM	Household Waste Management
IEA	Initial Environmental Audit
IFC	International Finance Corporation
IPPs	Independent Power Producers
JICA	Japan International Cooperation Agency
KeFRI	Kenya Forestry Research Institute
KM	Kilometers
Kwh	Kilowatts hour
KWS	Kenya Wildlife Services
LPG	Liquefied Petroleum Gas
LV	Low Voltage
MoE	Ministry of Energy
MW	Mega watts
NEC	National Environment Council
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NLC	National Lands Commission
NPEP	National Poverty Eradication Plan
O&M	Operation and Maintenance
PPAs	Power Purchase Agreements

PPE	Personal Protective Equipment
PV	Photovoltaic technology
RES	Renewable Energy Sources
SDGs	Sustainable Development Goals
SWM	Solid Waste Management
TOR	Terms of Reference
UNEP	United Nations Environmental Programme
VAT	Value Added Tax
WRA	Water Resources Authority

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EXECUTIVE SUMMARY

Introduction

The Proponent; Looop Inc. is proposing to construct a solar photovoltaic (PV) facility for electricity generation with total capacity of 40MW and additional facilities (substation and Transmission line) in Kitui County, Republic of Kenya. The electricity generated in the power plant will be fed to the national grid and sold under Power Purchase Agreement (PPA) between Looop and Kenya Power Lighting Company (KPLC). In order to complete PPA Looop will be applying for feed-in-tariff following FEED-IN-TARIFF POLICY ON WIND, BIOMASS, SMALL-HYDRO, GEOTHERMAL, BIOGAS AND SOLAR RESOURCE GENERATED ELECTRICITY (FiT policy) issued by the Ministry of Energy (MOE). The major objective of the project is to utilize the ample solar energy resource in Kenya to generate clean electricity and feed it to the National grid in order to meet the country's electricity energy requirements while displacing electricity produced by burning fossil fuels that contribute to production of Green House Gases (GHG) that cause global warming; this will be done by creating a Solar P.V. Power Plant that will generate electricity from solar energy to be injected into the national grid infrastructure through a Power Purchase Agreement (PPA) with Kenya Power Lighting Company (KPLC). Based on the current legislation on solar tariffs available at national and county level in Kenya to promote sustainable and eco-friendly energy development, Looop Inc. through partnership with CGoK plans to develop, and seek financing, for construction and operation of the 40 MW solar photovoltaic (PV) power plant. This infrastructure will significantly contribute towards growth, availability, and stability of the electrical power produced locally. It is expected that the monthly average electricity generation of this facility will be approximately 5,100,000 kWh. This figure is estimated to be the monthly energy consumption of 30,000 people in Kenya. The solar PV power plant will also contribute to reducing the use of fossil fuels resulting in lower Green House Gases (GHGs) emissions. This expectation is in line with Kenya Vision 2030 objective: "To increase national power generation, provide the energy required to accelerate growth and mobilize private sector capital for generation of electricity from renewable energy".

Based on the current legislation on solar tariffs available at national and county level in Kenya to promote sustainable and eco-friendly energy development, Looop Inc. planned the development, financing, construction and operation of the 40MW power plant based on solar photovoltaic technology (PV) in auspices with the County Government of Kitui to be installed on Kitui farm in Kitui County. This infrastructure will significantly contribute towards growth, availability, and stability of the electrical power produced locally, based on clean technology.

It is projected that the negative environmental impacts which will be associated with the project will be minimal and will be greatly outweighed by the environmental benefits of reduced diesel burnt to produce electricity and the corresponding reduction of CO_2 emissions and other greenhouse gases associated with burning diesel. There is no known endangered flora or fauna species occupying the land and a large portion of the land is currently fallow and unused. It is

against this background the project was subjected to an Environmental and Social Impact Assessment study process to ensure any negative impacts resulting from the proposed project implementation are adequately addressed and mitigated thereof.

Environmental Impact Assessment is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) No.8 of 1999 second schedule 9 (1), and Environmental (Impact Assessment and Audit) regulation, 2003, new projects must undergo Environmental Impact Assessment. The report of the same must be submitted to National Environment Management Authority (NEMA) for approval and issuance of relevant certificates. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development through sustainable use of natural resources without interfering with the environment. In accordance with the 2nd Schedule of the Environmental (Impact Assessment and Audit) Regulations of 2003, contained in Kenya Gazette Supplement No. 56, Legal Notice 101, the proposed project requires an Environmental and Social Impact Assessment Study.

Scope Objective and Criteria of the Environmental and Social Impact Assessment (ESIA)

Africa Waste and Environment Management Centre, a NEMA registered firm of experts in Environmental Impact Assessment and Auditing, was appointed as a Consultant to conduct the Environmental Impact Assessment of the proposed 40MW solar power project. The scope of the assessment covered impacts directly or indirectly associated with the construction and operation /routine maintenance activities of the proposed project, supply of equipment-solar panels, inverters and other accessories. The output of this work was an Environmental and Social Impact Assessment Study Report for the purposes of applying for an EIA License.

The Environmental Management and Coordination Act (EMCA, 1999) Cap 387 and its subsequent regulations have been used to guide the methodology and provide the framework for the Project ESIA. The consultant prepared the ESIA study report in accordance with the outline contained in Part IV, Section 18 (1) of the above regulations. The consultant, on behalf of the proponent conducted the ESIA by incorporating but not limited to the following terms of reference:

- Project description
- Proposed location of the solar power project;
- Description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- Environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;

- EMP proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the cost, time frame and responsibility to implement the measures;
- Consideration of the viable project alternatives

The Study Methodology

Based on the magnitude of the proposed Kitui Solar Park, the ecological and biophysical aspects of the area, an Environmental and Social Assessment (ESIA) study was undertaken to determine the impacts of the project. Preliminary scoping and screening field visits were undertaken in January 2018 whereas detailed study and public participation meetings were conducted later on February 2018. The general steps followed in environmental and social impact assessment were as follows:

- Environmental screening, in which the project was identified as among those requiring Environmental Impact Assessment under schedule 2 of EMCA, Cap 387.
- Environmental scoping that identified the key issues to be addressed in the ESIA study.
- Desktop studies to gather any relevant secondary data and information on the impacts of solar projects on the environment and possible mitigation measures by making use similar reports for other infrastructural projects that have been undertaken before.
- Public participation by conducting interviews, discussions and public meetings with key stakeholders including members of the community affected by the project to obtain their views on the impacts of the project and possible mitigation measures. This is as per the Kenyan Constitution, EMCA Cap 387, and Multilateral Environmental and Social Impact Guidelines.
- ESIA study report preparation, publication and submission.
- Integration of recommendations of the ESIA study into the design and implementation of the proposed solar project**.**

Project Description

Project location

The proposed project site is in Katoteni area in Kitui West Sub County which is situated within the western side of Kitui County. The site is easily accessible from Kibwezi–Kitui road which is a National Trunk Road connecting Kibwezi and Kitui towns. The proposed 40MW Solar PV power plant project is expected to occupy 210 acres of land to be alienated from 53,309 acres currently held in trust by Kitui County. Looop Inc. will be executing Feed-In-Tariff application, designing of the plant and financing. The County Government of Kitui (CGoK) is expected to officially make the site available by obtaining required approvals from the National Land Commission.

Scope of works

The scope of works to be executed will comprise mainly of but not limited to the following:-

- Vegetation clearance and ground preparation
- Erection of a site boundary metallic fence
- Minor leveling and grading of areas where the solar arrays will be installed to remove steep slopes and undulations. The tracker to be installed will go along the slope of the land
- Leveling of temporary hard-standing areas;
- Installation of solar trackers
- Mounting the solar panels
- Installation of inverters and other accessories
- Construction of transmission line
- Construction/upgrading of on-site access roads.
- Commissioning of the project

Technical specifications

A photovoltaic power station, also known as a solar park, is a large-scale photovoltaic system designed for the supply of merchant power into the electricity grid. They are differentiated from most building-mounted and other decentralized solar power applications because they supply power at the utility level, rather than to a local user or users. They are sometimes also referred to as solar farms or solar ranches, especially when sited in agricultural areas as the one proposed. The power conversion source is via photovoltaic modules that convert sun light directly to electricity. This differs from the other large-scale solar generation technology, concentrated solar power.

Energy resource assessment results for the solar irradiance were based on NASA meteorological datasets. Upon commissioning of the proposed solar farm, the planned installed capacity will be 40MW and the farm is expected to generate, approximately, 99,275 MWh/year, integrating the category of renewable projects above the 10 MW installed capacity.

Estimated Cost

The estimated cost of the project development is **Six billion (*6,000,000,000*) Kenyan shillings.**

Impacts and Mitigation Measures

There are both positive and negative impacts anticipated to be associated with the proposed solar power farm project. In general the following positive impacts are associated with the proposed development;

- Additional power capacity to the national grid, this is in line with the Kenya governments target to increase electricity production by 5000 MW by 2030.

- Solar energy reduce the environmental impacts of combustion associated with fossil fuel energy generation, such as impacts from greenhouse gases and other air pollution emissions. Contribute towards the reduction of GHGs in Kenya.
- Unlimited Renewable source of energy
- The cost of importing fuel will decrease
- Source of energy supply not vulnerable to international policies or to the oil market.
- Construction of the proposed solar farm will lead to both direct and indirect employment opportunities within and without the area
- The project will earn revenue for the country from the statutory payments leading to gains in the local and national economy
- Growth of nearby urban centres such as Kitui town, Ndekeleni, Musingi, Kavenge Nzokani and Kathiani market centers.
- Improved transportation facilities and network within the area
- Increase of business opportunities due to growth of towns and an influx of people to the area.

A summary of key negative impacts associated with the proposed solar farm and their mitigation measures are listed in table 0-1 below

Table 0-1: A summary of negative impacts and mitigation measures

Possible Impacts	**Mitigation measures**
Displacement of People	• Hold consultations and negotiations with the affected community members • Conduct a Resettlement Action Plan on the resettlement and meaningful compensation of the affected persons
Clearance of Vegetation	• Clearing vegetation only in construction areas and demarcating areas where no clearing will happen • Rehabilitation or ecological restoration during and after the construction phase will be undertaken with locally indigenous plants eg. mukau • Maintaining of re-vegetated areas after rehabilitation has taken place • Ensure that all human movement and activities are contained within designated construction areas in order to prevent peripheral impacts on surrounding natural habitat.
E-Waste generation	• Contract a legitimate and reputable enterprise licensed by the relevant regulatory agency to undertake recycling of e-waste and require them to follow good international industry practice for the waste being handled • Use of solar panels and equipments that have a long lifespan
Visual Intrusion	• Ensure installation of solar panels with lower reflectivity • Siting the solar farm with due consideration to landscape views and important environmental and community features.
Impact on Surface waters	• Design and construct drainage systems within the facility so that storm water generated during construction does not end up at Kyenze earth dam • Fuel, oil and used oil storage areas should have appropriate secondary containment (i.e. bunds) to prevent underground water contamination • Vehicles and machine will be properly surfaced and well maintained to reduce risk of potential oil and fuel spills and leakages.

Conclusion

It is quite evident that the construction of Kitui Solar Power Farm, substation and the transmission line will bring positive impacts in the project area including adding the power capacity to national grid, creation of employment, gains in the Local and National Economy**,** increased business opportunity, growth of urban and peri-urban settlements around the project site among others. However, although the project will come with various positive impacts, negative impacts will also be experienced hence the need to mitigate them. The negative impacts of this project include but are not limited to: displacement of people; clearance of vegetation, E-waste generation, visual intrusion and impacts on surface water.

The project will add to the reliability of the regions power supply and thus cushioning current consumers against losses occasioned by power failures and blackouts. As well, expansion of power supply will improve access by new consumers and thus facilitate investments hitherto constrained by lack of electricity. Having said that the project is key to Kenya's development agenda since it would allow increased electricity access rates, reduced power losses, increased supply capacity and increased reliability of power supply in the regions.

Solar Energy Technologies (SETs) provide significant socio-economic benefits. It is proposed that the environmental impact of the facility will be minimal and greatly outweighed by the environmental benefits of less diesel burnt to produce electricity and the corresponding reduction of CO_2 emissions and other greenhouse gases associated with burning diesel. On the other hand, it must be realized that no man-made project can completely avoid some impact on the environment, neither can SET installations. Potential environmental burdens are associated with loss of amenity, depend on the size and nature of the project and are often site specific. However, adverse effects are generally small and can be minimized by appropriate mitigation measures, technologies or techniques that may involve the use of air emission or odor control equipment, design tools for optimal design and siting of the installations, best practice guidelines, improved pieces of equipment (such as gearless or lubricant-free motors), or, completely innovative design (e.g., closed-cycle plants, submerged plants, etc.). It is up to the involved factors (investors, developers, and permitting authorities) to make the appropriate decisions by taking environmental issues into serious consideration.

Considering the positive socio-economic and environmental benefits that will accrue as a result of the proposed development, and the ESIA study having found no major impacts to arise from the development, it is our recommendation that the project be allowed to proceed with the understanding that the proponent will adhere to the mitigation measures recommended herein and will further still implement the proposed Environmental and Social Management Plan (ESMP) to the letter. An initial environmental audit will also be

carried within a period of 12 months after commencement of the operations to check compliance to the set policies, standards and laws and the proponent will contract a licensed firm to provide Environmental Health and Safety Services for the construction phase of the proposed development.

1 INTRODUCTION

1.1 Background and Rationale for an Environmental Impact Assessment

In the recent years, the government of Kenya through the Ministry of Energy has been formulating laws, regulations and policies to guide sustainable energy in Kenya. This is in a bid to beat the high demands of energy in Kenya in pursuant of the Sustainable Development Goals (SDG) and the Kenya's vision 2030 and current government effort of developing 5000MW+ capacity. Renewable energy is derived from naturally occurring resources mainly solar, biomass, hydro, geothermal, and wind. Other renewable energy resources include tidal waves and municipal waste. These resources, which are abundant in Kenya, are regenerative and can therefore provide continuous and unlimited supply of energy.

In such pursuant, a breakthrough was made through the enactment of *Energy Act 2006*, which empowered the Feed-in-tariffs policy of which renewable energy falls under. Kenya is hugely dependent on hydro power and this has come with its share of challenges. As we grapple with the global warming, it is more hostile in the Sub-Saharan region where Kenya falls, it is clear that large dams' power plants have recently proved unreliable due to high dependency on expansive water catchment areas and large floods required to run their turbine generators. Solar photovoltaic energy provides clean electricity through the action of solar radiation on photovoltaic cells or sheets manufactured from semiconductor materials.

The generation of solar photovoltaic energy is based on the so-called photovoltaic effect, which occurs when light is directed onto semiconductor materials. This effect generates a flow of electrons and a difference in potential that can be harnessed to supply electricity for domestic consumption in isolated areas or fed into the national grid.
The prime objectives for the development of energy agenda in Kenya are four and include:

- Solar energy accelerates development (economic and empowerment) in the poor rural areas where majority people live.
- Development of solar energy at a level which will affect domestic economy with a goal to increase accessibility of affordable energy.
- Enhancing the solar power to improve reliability of the national grid.
- Reduce dependence on the expensive imported fossil fuels, thus reducing cost of electricity to the final consumer, as well as reducing outflow of foreign currency.

It is the mandate of the Ministry of Energy to support the feasibility study and the feed-in-tariffs policy framework.

Kenya has great potential for the use of solar energy throughout the year because of its strategic location near the equator with 4-6 kWh/m2/day levels of insolation. Presently solar energy is utilized in photovoltaic solar home systems, most of which are rated

between 10W and 20W and generate 9GWh of electricity annually, primarily for lighting and powering television sets. However, there are no grid connected solar systems in Kenya despite the supply deficit that plagues the interconnected system.

Looop Inc (Looop) proposes to construct a solar photovoltaic (PV) facility for electricity generation with total capacity of 40MW in Kitui County, Republic of Kenya. The electricity generated in the power plant will be fed to the national grid and sold under Power Purchase Agreement (PPA) between Kenya Power Lighting Company (KPLC) and Looop Inc. In order to complete the PPA Looop will be applying for feed-in-tariff following Feed-in-Tariff Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity (FiT Policy) issued by the Ministry of Energy and Petroleum.

The government of Kenya recognises that renewable energy sources (RES) which include wind, biomass, small hydros, geothermal, biogas, solar and municipal waste energy, have potential to generate income and employment, over and above contributing to the electricity supply and diversification of generation sources. The National Energy Policy as enunciated in Sessional Paper No. 4 of 2004 and operationalized by the Energy Act No. 12 of 2006, encourages implementation of these indigenous renewable energy sources to enhance the country's electricity supply capacity. The Sessional Paper incorporates strategies to promote the contribution of the renewable energy sources in generation of electricity.

Section 6.4.1 (i)-(iv) of the *Sessional Paper No. 4 of 2004 on Energy* provides for the government to undertake pre-feasibility and feasibility studies on the potential for RES and for the packaging and dissemination of information on renewable energy sources to create investor and consumer awareness on the economic potential offered by other renewable sources of energy.

Pursuant to these policy strategies and in recognition of the potential of renewable energy sources in Kenya, the Ministry of Energy has encouraged potential Independent Power Producers (IPPs) to carry out feasibility studies on renewable energy generation on the basis of which Power Purchase Agreements (PPAs) with the Off-taker can be negotiated. Based on the current policy and legislation on solar energy generation available at national and local level in Kenya is to promote sustainable and eco-friendly development in the production of energy. Looop Inc. planned the development, financing, construction and operation of a 40 MW power plant based on solar photovoltaic technology (PV plant). The proposed 40MW Solar PV power farm project is expected to occupy 210 acres of LR. 12010 land (Community Land) currently held in trust by Kitui County. The proposed project site is behind the Ministry of Works (MoW) Workshop Kyenze Village (Lower Yatta Sub-County) situated within the western side of Kitui County. The site lies approximately 1.2Km from the T- junction of Mwingi – Garissa road and the road to Kitui Town. This infrastructure can significantly contribute to the growth of the electrical power availability, produced locally, and based on a clean technology that converts sun light into electricity.

In order to decrease the dependency of the Kenya's on international fuel prices, to enhance security of supply and to shift patterns of energy supply and demand into a more sustainable direction, the Government of Kenya, initiated an Energy Strategy, it set ambitious goals for the development of renewable energies. By the year 2030 as per our vision, the share of renewable energies in primary energy supply is to increase from the current 5% to 25% basing on the proposed energy Act 2010. Several single targets have been set, such as for wind power 1500MW Geothermal (5000 MW), solar power (600 MW) and solar water heaters (share of 30% by 2030), in addition to waste/energy (80-120MW) apart from Hydro.

In view of the time and resources required to undertake feasibility studies, the Ministry of Energy and Petroleum prepared a *Position Paper* in FY 2007/08 proposing to set Feed-in-Tariffs (FiT) for electricity generated from renewable energy sources; A Feed-in-Tariff **(FiT)** is an instrument for promoting generation of electricity from renewable energy sources. A Feed-in-Tariff allows power producers to sell renewable energy generated electricity to an Off-taker at a pre-determined tariff for a given period of time. Renewable energy sources in Kenya include wind power, biomass, small hydro, solar, biogas and geothermal. The Kenyan Feed-in-Tariffs (FiT) Policy issued in March 2008 (reviewed in January 2010 and December 2012), provides a framework that allows for the purchase of power during a 20 year period by the Kenyan utility to Independent Power Producers (IPPs). This policy promotes investment security, political and market stability that justifies the decision to undertake the Kitui Solar Power Project. The model that is proposed is very recent and will contribute into bringing new financing and operation models to this region and Africa as a whole.

The project will stabilize power supply and thus cushion current consumers against losses occasioned by power failures and blackouts. As well, expansion of power supply will improve access by new consumers and thus facilitate investments hitherto constrained by lack of electricity. As such, the project is key to Kenya's development agenda since it would allow increased electricity access rates, reduced power losses, increased supply capacity and increased reliability of power supply in the regions. The project is consistent with the socio-economic development policy of Kenya which seeks to improve the living conditions of the population in the country and the achievement of the Sustainable Development Goals (SDG) and Kenya's Vision 2030 as it will result in improved reliability of the power system as a result of strengthening of the transmission system, and provide stable access to affordable power in rural areas in so doing contribute towards improving the quality of life for women and children through time saving on gathering firewood and through increased employment opportunities.

It is against this background the proposed project was subjected to an ESIA study process to ensure any negative impacts resulting from the project implementation are adequately mitigated.

1.2 The Energy Sector in Kenya

The power sector in Kenya falls under the Ministry of Energy (MoE) and is regulated by the Energy Regulatory Commission (ERC). The latter regulates the entire energy sector having replaced Electricity Regulatory Board (ERB) after repeal of Electric Power Act of 1997 and consequent enactment of Energy Act of 2006. The new Act also led to creation of Rural Electrification Authority (REA), responsible for government's Rural Electrification Programme, historically managed by KPLC. KETRACO was also created and is a government company charged with the development of the transmission grid. KETRACO can also be contracted to build transmission lines for a private company. The Act provides for establishment of a special purpose Geothermal Development Company to undertake geothermal resource assessment and steam production drilling. In essence, the energy sector in Kenya has been devolved significantly thereby making it favorable for investment.

The Feed-in-Tariffs policy was created through parliament Sessional Paper 1 of 2004 in Energy and now soundly based on Energy Act of 2006. It provides three excellent features; by the fact that it has pre-negotiated pricing and procedures, exempts the investor from going through the normal government procurement process since it was pre-negotiated and approved with all necessary details. Thirdly, the approval of investor to be an Independent Power Provider (IPP) under the feed-in-tariff is approved by the Feed-in-tariff Committee made up of Kenya Power and Lighting Company (KPLC), Ministry of Energy and ERC without a charge as it covered in other business licenses.
The Kenyan interconnected power transmission and distribution network is owned and operated by KPLC. The main public sector generator is Kenya Electricity Generating Company (KenGen) which supplies 70% of the national electricity demand, with the balance being supplied by Independent Power Producers (IPPs). KPLC and the Uganda Electricity Transmission Company Limited (UETCL) have an electricity exchange contract currently with net power export to Uganda. Tsavo Power Company Limited which runs the Kipevu (II) power plant generating 76MW and Mumias Sugar Company and currently injects up to 26 MW are among the local IPPs supplying to the grid its sugar factory in Western Kenya. The current national installed interconnected capacity is about 2,294.82 MW comprising of 827.02 MW hydroelectric, 751.3 MW thermal, 592 MW geothermal, 60MW biomass, 38MW cogeneration, and 25.5 MW Wind.

Kenya's electricity supply remains erratic in view of the country's over-reliance on hydro-power which is susceptible to hydrological conditions particularly along the River Tana cascade. This has made power supply unreliable and consequently the government's decision to diversify into geothermal and other sources which are forecast to replace hydro sources as the base load in the near future. Apart from unreliability, the inadequate installed power generation capacity in Kenya leaves the country with a very small reserve margin. The Government is therefore encouraging investment in power generation by independent power producers in order to complement its efforts and power the country's Vision 2030. The total net energy is projected by the government to increase from 7,032 GWh in 2008/09 to 55,544 GWh in 2028/29 for an average growth rate of 10% in the

forecast period. The Vision 2030 development blue-print envisages a 10% economic growth per annum and the country's attainment of a middle income economy status by 2030. This would be difficult to achieve with the current levels of electricity generation. The industrial and domestic customer categories will continue to be the main drivers to continued growth in electricity demand in Kenya. Increased electricity consumption will come from growing applications of electronic technologies and from more automation in general as well as increased connectivity in the country hence a continued upsurge in electricity demand in Kenya.

The global approach to power generation has shifted to renewable energy sources as world leaders' grapple with the challenge of climate change and global warming partly attributed to power generated from fossil fuels. The Government of Kenya on its part is encouraging the development of projects relying on renewable energy sources such as geothermal, solar, Hydros, wind, biomass, ocean waves among others. To this end, the Ministry of Energy has put in place a feed-in-tariff policy that provides tariff information based on the nature of the renewable energy project. This serves as a useful input to promoters' financial models aimed at assessing the viability of their projects.

1.3 Scope objective and criteria of the Environmental and Social Impact Assessment (ESIA)

1.3.1 Objective of the study

The main objective of this study is to analyse all the baseline environmental conditions, evaluate and reduce, or prevent the direct and indirect negative cumulative effects on the biophysical, ecological, social and cultural environment associated with the proposed project; with the essence of establishing if there are reliable facts supporting the extraction of electricity. This is to ensure that the anticipated output capacity of 40MW potential is ascertained and maximum utilization of the potential is made useful. Further is to establish that all the studies undertaken can be relied to firm up commitments by the developer, financial institutions and the partners for the objective of exporting electricity to Kenya Power through a PPA under the feed-in-tariffs policy framework.

1.3.2 Scope

The Kenya Government policy on all new projects, programmes or activities requires that an environmental impact assessment be carried out at the planning stages of the proposed undertaking to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of the facility. The scope of this Environmental Impact Assessment, therefore, covered:

- The baseline environmental conditions of the area,
- Description of the proposed project,
- Provisions of the relevant environmental laws,
- Identification and discuss of any adverse impacts to the environment anticipated from the proposed project,
- Appropriate mitigation measures,

- Provision of an environmental management plan outline

1.3.3 Terms of Reference (TOR) for the ESIA Process

Africa Waste and Environment Management Centre (AWEMAC), a NEMA registered and licensed Lead Expert in Environmental Impact Assessment and Auditing was appointed as a Consultant to conduct the Environmental and Social Impact Assessment of the proposed construction of 40MW Solar Power farm. The scope of the assessment covered impacts directly or indirectly associated with the construction and operation /routine maintenance activities of the proposed project, supply of equipment-solar panels, inverters and other accessories. The output of this work was a comprehensive Environmental and Social Impact Assessment study report for the purposes of applying for an ESIA License.

It was recognised that any form of development such as the proposed Solar Power construction is likely to impact the site and the surrounding environment hence, before any commencement of any work, there was an urgent need to carry out an Environmental and Social Impact Assessment (ESIA) in compliance with the Environmental Management and Coordination Act (EMCA) Cap. 387 and Environmental Impact Assessment and Audit Regulations, 2003.

The Environmental and Social Impact Assessment included the necessary specialist studies to determine the environmental impacts relating to the biophysical, health and safety and socio-economic aspects and to determine the issues or concerns from the relevant authorities and interested and/or affected parties. The appropriate measures to ensure co-existence of the proposed development with other social and economic activities in the area are provided as part of Environmental Management Action Plan.

The main objective of the assignment was to assist the proponent to prepare a report after carrying out an Environmental and Social Impact Assessment (ESIA) of the construction of 40MW Solar Power Farm, to ensure the proposed development takes into consideration appropriate measures to mitigate any adverse impacts to the environment. The study identified existing and potential environmental impacts and possible concerns that interested and/or affected parties have with the development, as well as the associated prevention and mitigation measures for the negative impacts as stipulated in the Environmental and Social Management Plan (ESMP) proposed.

The consultants on behalf of the proponent conducted the study by committing themselves to the following terms of reference among others:-

- Proposed location of the solar power project;
- Description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- Objectives of the project;

- Technology, procedures and processes to be used in the implementation of the project;
- Materials to be used in the construction and implementation of the project;
- Products, by-products and wastes generated by the project;
- Description of the potentially affected environment;
- Environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;
- Alternative location, technologies and processes available and reasons for preferring the chosen technology and processes;
- Analysis of alternatives including project site, design and technologies and reasons for preferring the proposed site, design and technologies;
- ESMP proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the cost, time frame and responsibility to implement the measures;
- Provision of an Action Plan for the prevention and management of foreseeable accidents and hazardous activities caused by carrying out activities or major industrial and other development activities;
- Measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies;
- Identification of gaps in knowledge and uncertainties which were encountered in compiling the information;
- Economic and social analysis of the project;
- Indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures; and
- Other such matters as the National Environment Management Authority (NEMA) may require.

1.3.4 Data collection procedures

First, the Consultant undertook environmental screening and scoping to narrow down into the most critical issues requiring attention in the study. The data collection was carried out through questionnaires/standard interview schedules, use of checklists, observations and photography, site visits, consultative meetings and desktop environmental studies, where necessary in the manner specified in Part V (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003.

1.3.5 ESIA organization and structure

The ESIA was carried out to full completion within a period of about ninety (90) days from the date of undertaking. The Consultant (Lead Expert) coordinated the day-to-day functions and any related institutional support matters. Otherwise, all formal communications were directed to NEMA through the proponent.

1.3.6 Reporting and documentation

The ESIA Study Report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted by the proponent for consideration and approval. The Consultant ensured constant briefing of the client during the exercise. Description plans/maps and sketches showing various activities are part of the Appendices.

1.3.7 Responsibilities and undertaking

The Consultant (Lead Expert) undertook to meet all logistical costs relating to the assignment, including those of production of the report and any other relevant material. The consultant arranged for own transport and travels during the exercise. On the site, proponent provided all the information required by the consultant. The proponent also provided site plan/map(s) showing roads, service lines/layout and other site details, details of raw materials, proposed process outline and anticipated by-products, future development plans, operation permits and conditions. The output from the consultants includes the following:-

- An Environmental Impact Assessment study report comprising of an executive summary, study approach, baseline conditions, anticipated impacts and proposed mitigation measures,
- An Environmental Management Plan Outline which also forms part of the report recommendations.

1.3.8 Methodology outline

The proposed project site covers an area which is currently utilized for settlements and agriculture especially crop farming. The land is also covered with indigenous trees species and shrubs. Taking into account that the immediate environment along within and outside the proposed project site has rich natural resources which could be adversely affected by the project activities, a comprehensive Environmental and Social Impact full study report was undertaken. The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring environmental impact assessment under the second schedule of EMCA, 1999 including its 2015 amendments.
- Environmental scoping that provided the key environmental issues
- Desktop studies and interviews
- Physical inspection of the site and surrounding areas
- ESIA Public participation via the use of questionnaires
- Reporting

1.3.8.1 Environmental screening

An environmental screening process was conducted in January 2018. This step was applied to determine whether an environmental impact assessment was required and

what level of assessment was necessary. This was done in reference to requirements of the EMCA, Cap. 387, and specifically the second schedule. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

1.3.8.2 Environmental scoping

The scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects.

1.3.8.3 Desktop study

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others.

1.3.8.4 Site assessment and public participation

Field visits, public participation meetings and stakeholder engagements were conducted all through the month of February 2018. This was meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts. The project consultants and engineers, the general public and key interested/affected stakeholders were interviewed. The information gathered was subsequently synthesized and incorporated into the ESIA study report.

1.3.8.5 Reporting

In addition to constant briefing of the client, this Environmental and Social Impact Assessment study report was prepared. The contents were presented for submission to NEMA as required by law for approval.

2 PROJECT DESCRIPTION

2.1 Introduction

The Proponent; Looop Inc. (Looop) proposes to construct a solar photovoltaic (PV) facility for electricity generation with total capacity of 40MW and its additional facilities (Substation and Transmission line) in Kitui County, Republic of Kenya. The electricity generated by the farm will be fed to the national grid and sold under Power Purchase Agreement (PPA) between Kenya Power Lighting Company (KPLC) and Looop. In order to complete the PPA, Looop will be applying for feed-in-tariff following the Feed-in-Tariff Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity (FiT Policy) issued by the Ministry of Energy and Petroleum.

Looop is a Japanese Company named after the wish for realization of a society in which renewable energy is used in a loop. Each of the three "o" s represent solar, wind and hydro; the three sources of renewable energy that the company focuses on. Looop's main line of business focuses on development, sale, installation, management and maintenance of solar power generation systems, installation and management of company-owned solar power plants, online sale of stand-alone solar power generation systems and peripherals, planning, development and sale of products using renewable energy, property insurance agency services electricity retail services and electricity retail business outsourcing.

2.2 Project Rationale

Kenya's installed power generation capacity is actually 1,591 MW, dominated by hydroelectricity (49%), geothermal (29%) and diesel (21%), although increasing demand and the volatility of the hydroelectric generation are leading to a surge in the diesel based generation. Kenya's National Climate Change Action Plan (2013-2017) sets a low carbon development strategy that considers the renewable energy generation sector as one base option for the country. Although geothermal is the most promising renewable energy source, Kenya also has an excellent solar resource (about 2.160 kWh/m^2/year of solar horizontal irradiation). Therefore, the client proposes to venture into this untapped natural renewable resource.

The monthly average electricity generation of the proposed solar power plant facility is estimated to 5,100,000 kWh. This figure equals the monthly energy consumption of 30,000 people in Kenya. This solar PV power plant will also contribute to reduction in the use of fossil fuels resulting in lower Green House Gases (GHGs) emissions and the alleviation of global warming. This expectation follows the objective of the project "Energy Generation of 23,000MW and Distribution" in Kenya Vision 2030: "To increase national power generation, provide the energy required to accelerate growth and mobilize private sector capital for generation of electricity from renewable energy".

The proposed project is also expected to make a contribution on the local community, as well as the nation. Not to mention improvement of electricity supply's benefiting Kitui County, Kitui County government estimates this project will employ about 3,000 people

mainly local residents with 2,000 initially during the construction period and a further 1,000 once operational mainly on maintenance of the plant. In addition, other businesses such as social amenities like schools, health and hospitality facilities can benefit through improved energy supply within the County.

2.3 Location and size of the project

The proposed site is located on plot number (LR.12010) at Katoteni area, Lower Yatta Sub-County, west end of Kitui County. The boundaries for the site are on co-ordinates (1.120568S, 37.712845E); (1.111706S,37.717747E); (1.115082S,37.723613E); (1.123736S, 37.718352E). The land has an easy access to Kibwezi–Kitui road which is a National Trunk Road connecting Kibwezi and Kitui. The land is community land held in trust by Kitui County, currently part of land is left unused with some low vegetation, while another part is used for farming and some part is developed with permanent and semi-permanent structures. The total available community land on LR. 12010 is about 30,200 acres from which 210 acres will be alienated for this solar PV power plant project. Looop will be executing feed-in-tariff application, designing of the plant and financing. Kitui County government has a role of having the site officially available for construction of this facility by obtaining approval by National Land Commission.

Figure 2:1: Google Earth representation showing the proposed project site

2.4 Project's surrounding

The map in figure 2-2 below gives a Google Earth representation of the project surrounding it also highlights the visibility of the solar park in the surrounding.

The villages around Kyenze, in a radius of 1-2Km will be exposed to solar park with high magnitude and the intensity will be long term. The area also has some settlements highlighted in red and scattered farm land. Road users approaching the junction to Kitui-

Kibwezi and Mwingi direction will also be exposed for the 1-3Km distances within the proposed plant.

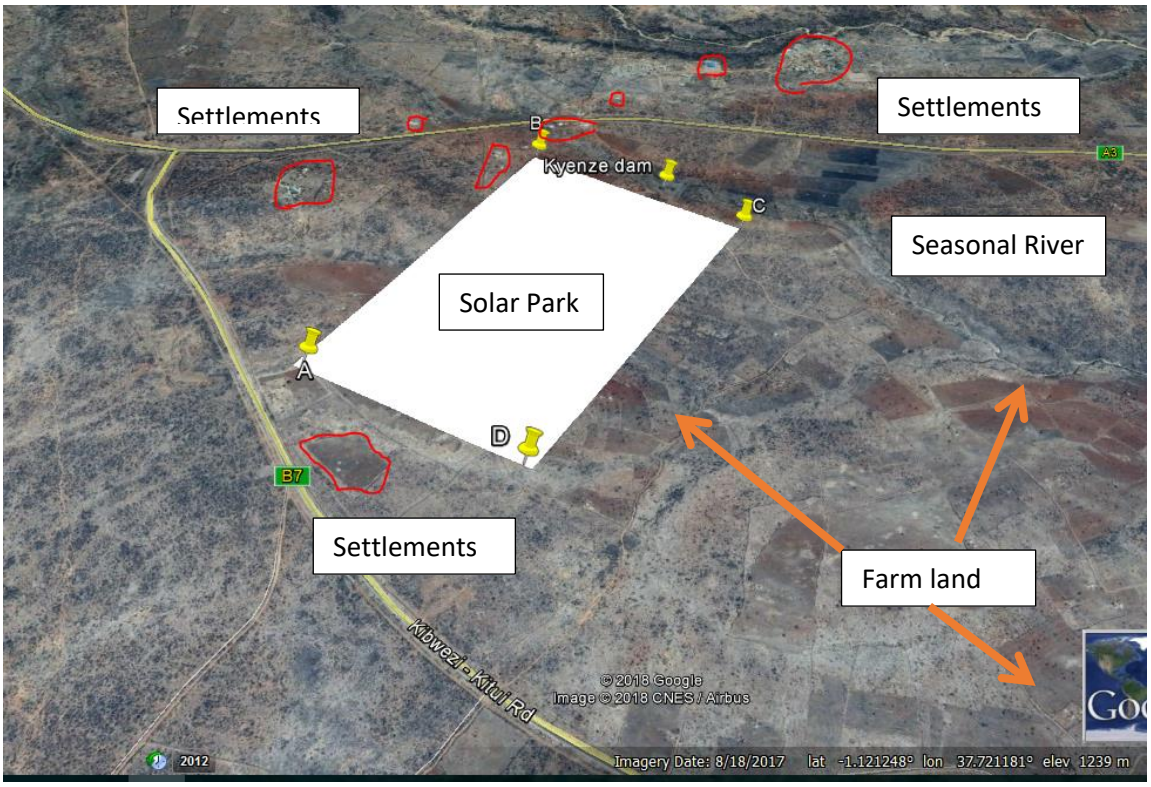


Figure 2:2: Google Earth representation of the visibility of Kyenze village

2.5 Project Technical Description

2.5.1 PV Plants Concept

A photovoltaic power plant generates electricity using the sun's energy by means of solar panels (or PV modules) that convert the solar irradiation into Direct Current (DC). Grid-connected PV systems require conversion of generated power into grid-compatible Alternating Current (AC) electricity, which is then supplied to the national or local grid. The Solar PV Plant will be connected to the national grid. Figure 2-6 below shows the main components of a grid connected solar PV plant.

Plate 2:1: An example of a solar farm layout

2.5.2 Transmission Line

One of the additional facilities that will accompany the solar farm is a transmission line. The transmission line will be used to connect the solar farm to the main national grid. The transmission line will be 132kV double circuit with a trace (RoW) of 40 meters width from the substation and will be joined to a 133kV national transmission line. The possible point of connections to the national grid were studied in the Grid Connectivity Studies (GCS) and are summarized in section 2.5.3 below.

2.5.3 Grid Connectivity

The possible interconnection options that were identified by engineers are as listed below:

2.5.2.1 OPTION 1: CONNECTION TO KIAMBERE-RABAI 220 KV LINE

One point of connecting the solar is breaking into the Kiambere- Rabai 220 kV line by constructing a 12km, 175mm2 ACSR conductor from the site. An 11/220 kV substation will be established at the solar farm. The 220 kV lines to be terminated at point of common coupling would create two 220 kV lines; Kiambere – Katoteni and Katoteni – Rabai lines. It is expected that the collection system for the solar farm will be 11 kV system with step-up transformers to 220KV located immediately after the solar farm LV inverters.

The proposed interconnection is shown in the single line schematic diagram of Fig 2-3 below,

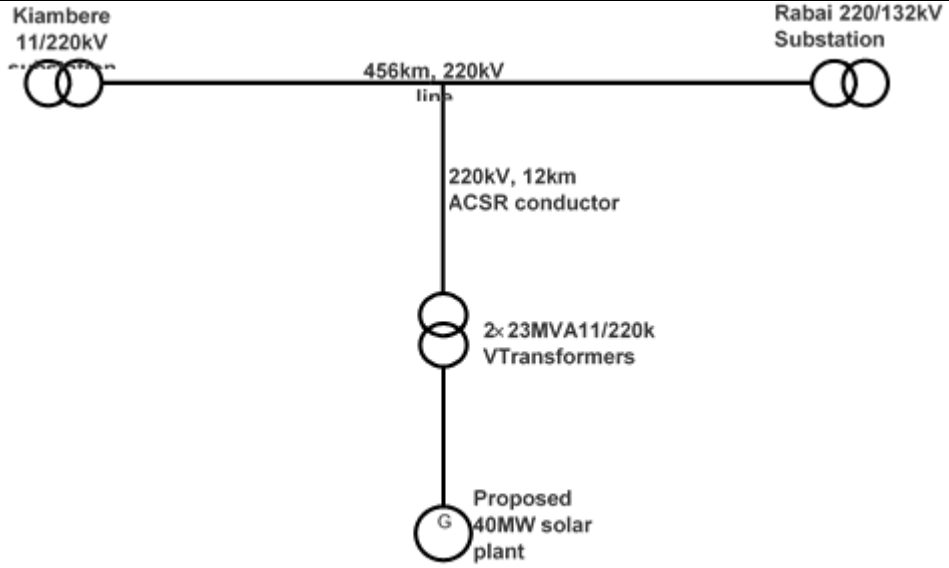


Figure 2:3: Option I interconnection Option

2.5.2.2 OPTION 2: CONNECTION TO MATUU-MWINGI 33 KV LINE

This is considered as one of the nearest points of connection for the solar power plant. This involves the construction of 5km, 300mm^2 ACSR double circuit conductors from the proposed solar plant farm 33 kV switch yard to Kithyoko 33kV switching station.

The proposed interconnection is shown in the single line schematic diagram of Fig 2-4 below;

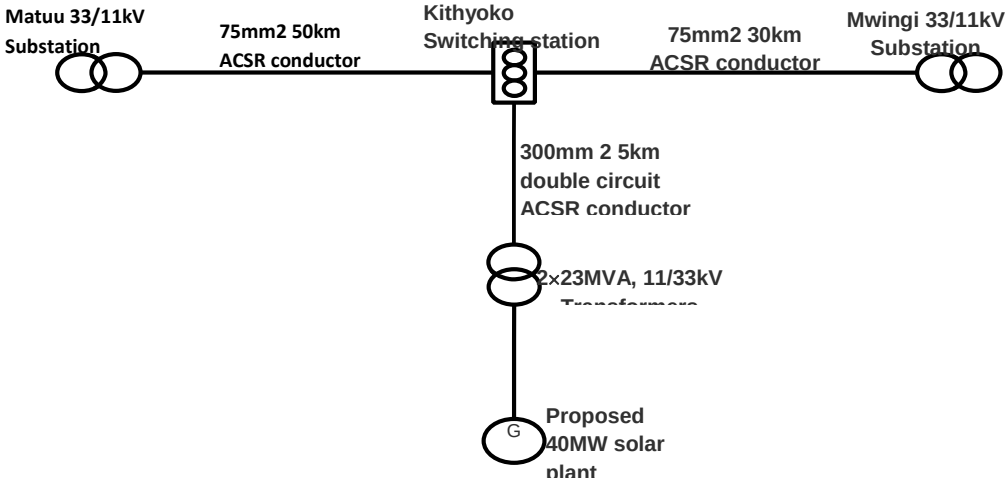


Figure 2:4: Option 2 interconnection option

Another point of connecting the solar is breaking into the Mwingi- Wote 132 kV line by constructing a 15km, 175mm^2 ACSR conductor from the site. An 11/132 kV substation will be established at the solar farm. The 132 kV lines to be terminated at point of common coupling would create two 132 kV lines; Mwingi – Katoteni and Katoteni – Wote lines. It is expected that the collection system for the solar farm will be 11 kV system with step-up transformers to 132KV located immediately after the solar farm LV inverters.

The proposed interconnection is shown in the single line schematic diagram of Fig 2-5 below,

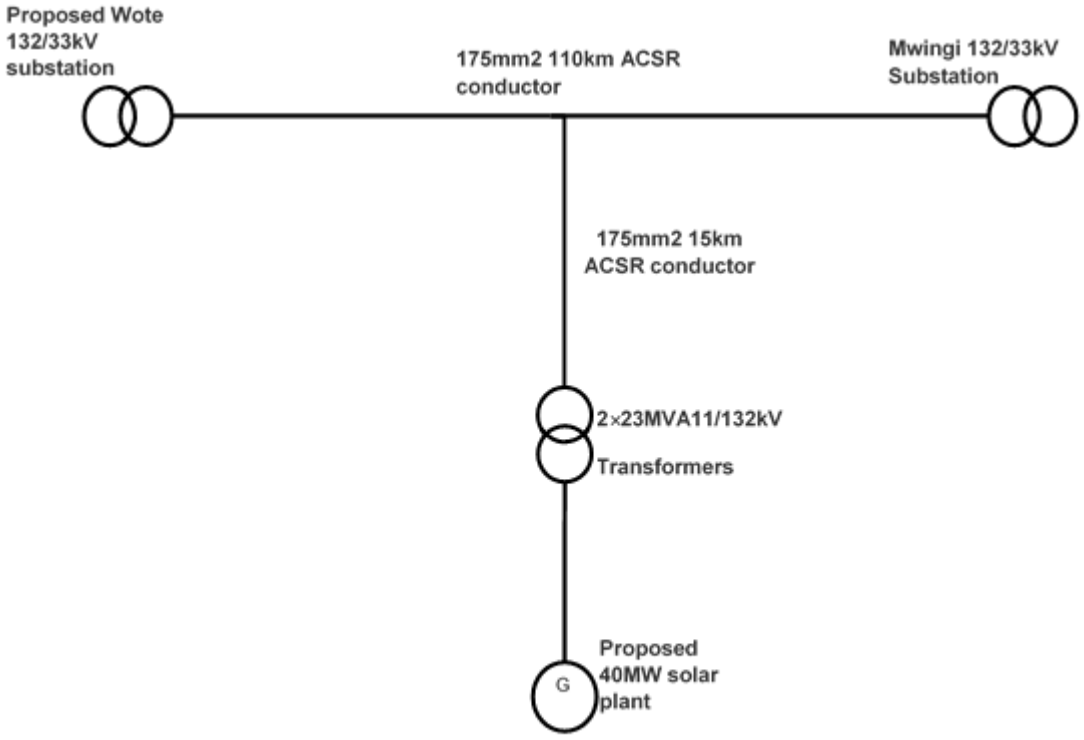


Figure 2:5: Option 3 interconnection option

From the grid connectivity studies, the likely options for the solar farm interconnections are:

- OPTION 1: CONNECTION TO KIAMBERE-RABAI 220 KV LINE
- OPTION 3: CONNECTION TO MWINGI-WOTE 132 KV LINE

The above options are the most likely points of interconnection to the power plant because of the following major reasons:

I. The 33KV network is unreliable since it's prone to faults both permanent and transient.

II. According to the Grid Code, the transmission code states that 40MW cannot be transmitted on a 33KV network because of the thermal rating and power carrying capacity of the 33kv network.

2.6 Descriptions of the project's pre-construction activities

For the energy production simulations the proponent considered the available area for the solar power installation which is exposed to the solar irradiation and free of obstacles like structures, vegetation, elevation, capable of creating shadows on the solar installation.

2.7 Description of the project's construction activities

2.7.1 Site preparation works

The proposed project site is currently fallow and utilized for seasonal agricultural activities; though, some part is developed with permanent and semi-permanent structures. The site preparation will involve clearing of vegetation, mild excavation works and transportation of construction materials. This will be undertaken in a phased approach to mitigate soil erosion and the impacts of excessive dust generation. Due to the large-scale nature of the proposed project, construction will involve the use of heavy machinery such as cranes and hammer driving piles. The engineers will also utilize human labour where necessary so as to create employment to the local residents especially the youth.

2.7.2 Storage of materials

Construction materials such as transformer centers, screws piles will be stored on site. Bulky materials such as metallic structure of the trackers will be carefully piled at designated areas on site. To avoid piling large quantities of materials on site, delivery of bulk materials will be in quotas and where possible delivery will be timed at the time of installation.

2.7.3 Structural steel works and related activities

Since the whole idea of using solar energy is to reduce the impact on the environment, it only makes sense that the installation of solar panels be done as environmentally friendly as possible. Unfortunately, concrete piles, which have been common, are anything but friendly. Taking cognizance of this, the proponent intends to utilize screw piles, which are much more environmentally and economically friendly than concrete. Not only do they create less environmental damage to install, but they are also easily removable and reusable, should the solar panel arrays be moved. Solar panel installations, which use screw piles as the solar base, are a logical choice as they save time, cost, and the environment. Removing concrete on the other hand is an expensive and a messy operation.

The solar arrays on Kitui PV Farm will be supported by screw pile foundations, which are known to be more environmental friendly than the concrete foundations. Trained professionals will be used for installation. This foundation choice provides an excellent support for solar panels that fits well with the entire green energy movement by being environmentally friendly.

2.7.4 Machinery Required

Crane A crane is a type of machine, generally equipped with a hoist, wire ropes or chains, and sheaves that can be used both to lift and lower materials and to move them horizontally. It is mainly used for lifting heavy things and transporting them to other

places. It uses one or more simple machines to create mechanical advantage and thus move loads beyond the normal capability of a man. A crane will be utilized during construction of the proposed solar farm to unload the materials (transformer centers, connection center, etc.). 1 month for each 5 MW. Anticipated Fuel consumption for the crane will be 40l/100km.

Forklift: A forklift truck is a powered industrial truck used to lift and transport materials. One or two forklifts will be required during the construction of the solar farm for each MW, anticipated fuel consumption will be 30 l/100 km.

Hammer driving pile: A pile driver is a mechanical device used to drive piles into soil to provide foundation support for buildings or other structures. The term is also used in reference to members of the construction crew that work with pile‐driving rigs. In our case we use this machine for the foundations (screw or piles) of the mounting structures.

Generator: An electric generator is a device that converts mechanical energy to electrical energy. A generator forces electric current to flow through an external circuit.

2.8 Description of the project's operational activities

Operational activities will involve power generation and supply to the national grid as outline below:

2.8.1 Inverter and Transformer station

All the inverter's specifications are taken into consideration when designing the PV plant and setting up the number of modules in series (fixing the voltage value) and the number of strings in parallel (fixed power). Another relevant fact on the inverter is its nominal power (AC Power). As closer as it works to this value, the better it will perform. Some of the main features of this equipments are; Isolation protection, DC and AC over voltage protection.

2.8.2 Electrical system details

This will involve the Low Voltage (LV) circuit which is the circuit between the photovoltaic and the LV injection point. In the photovoltaic installation two different electrical circuits will be considered i.e. Direct current circuit and the alternating current circuit.

2.8.2.1 Direct Current (DC) circuit

The electricity generated by the photovoltaic modules is direct current. The direct current is compound by the equipment and cables to the inverters. The photovoltaic panels are compound by the connection box with two different terminals (negative and positive). These panels will be connected in series to achieve the inverter operating voltage. At the final of the series of photovoltaic panels the two terminals cross the installation until the junction boxes. After this equipment the cables are placed on the cable tracks until the inverters and their diameter is calculated according the distance.

2.8.2.2 Alternated current circuit

The alternated current circuit begins after the inverter is conducted to the main LV switch board. The electrical meter will be installed just before the electrical injection point.

Alternated current protections

- Ground fail: to avoid this problem, a differential protection in the electrical board is installed ;
- Unbalanced grid: it will include an automatic switch for connection-reconnection operations. This switch will also allow manual disconnection. This system is inverter integrated and will ease anti-island protection, avoiding the PV installation functioning when it is not grid connected;
- Internally the inverter has protections against short circuit and high voltage. Additionally in the installation electrical board.

2.8.3 Surveillance and security system

The surveillance and security system main components are:

- Intruder Alarm System – Video analysis and Infrared technology, to ensure an effective protection around the perimeter;
- Video Surveillance System– Cameras (dome cameras) able to inspect the whole PV Plant area, as well as the required equipment to manage all the video information;
- Control Centre, Transformer Centre and Inverter Centre Protection – Security system, able to detect intruders;
- Suppressive Lighting – A suppressive light system, triggered by an alarm sent by any of the systems (Intruder Alarm System, Video Surveillance System, Transformers Centre and Control Centre).

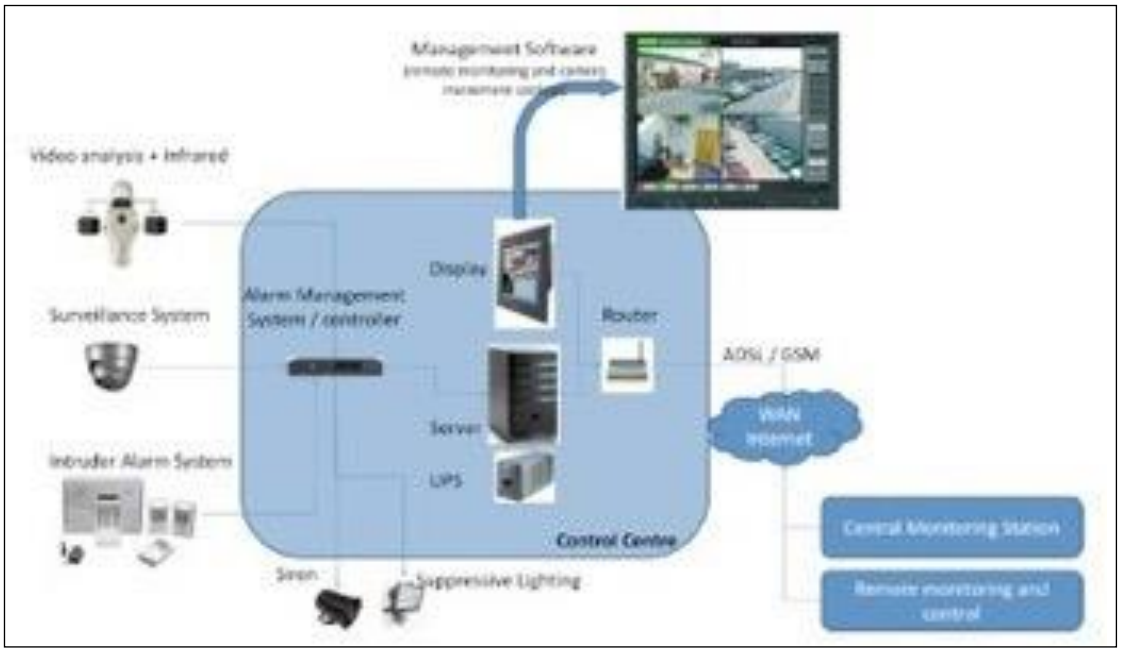


Figure 2:6: Proposed Surveillance System

2.9 Estimated Project Investment Cost

The estimated investment cost for the project is Kenya shillings ***six billion (6,000,000,000) Kenyan shillings***. The cost is based on current material and building costs and does not take into consideration any future price escalations, cost of land, professional fees and finance charges.

3 DESCRIPTION OF THE PROJECT ENVIRONMENT

3.1 Introduction

This chapter describes the current environmental setting around the Solar Power farm project site. The information presented here has been obtained from primary and secondary sources. It will be noted that baseline survey on bio-physical and socio-economic aspects are discussed in this report too. The proposed project site is in Katoteni locality (Lower Yatta Sub-County) situated on the western side of Kitui County. The site is easily accessible from Kibwezi–Kitui road which is a National Trunk Road connecting Kibwezi and Kitui towns. Kitui County is located in lower Eastern Kenya at 1°22′S 38°01′E/1.367°S 38.017°E. It boarders the following counties: Tana River to the East and South East, Taita Taveta to the South, Makueni and Machakos to the West, Embu to the North West, Tharaka Nithi and Meru to the North (figure 3-1). The County has a population of 1,149,332 (KNBS, 2009) and an area of 30,462 km^2.

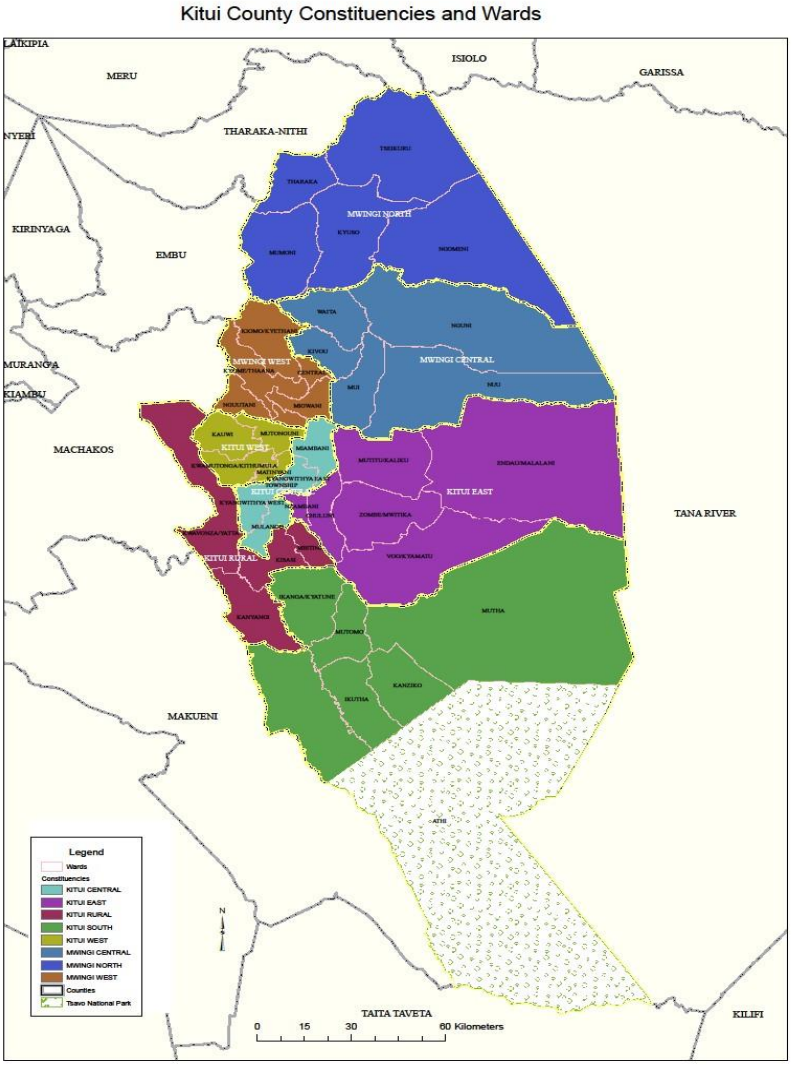


Figure 3:1:Map of Kitui County

Source: Kitui CIDP, 2013-2017

3.2 Project Location

The proposed 40MW solar plant project is expected to occupy 210 acres of land to be alienated from 30,200 acres of plot L.R 12010, a community land currently held in trust by Kitui County. The project lies in Lower/Yatta Sub-County. The Sub-County has a total population of 104,443 and an area of 1,560.80 Sq. Km and comprises of four (4) Wards that is Kisasi (pop. 26,759), Mbitini (pop. 24,858), Kwa Vonza/Yatta (pop. 30,732) and Kanyangi (pop. 22,094). Katoteni locality, which houses the project, falls under the Kwa Vonza/Yatta ward (Figure 3-2). Geographically, the proposed project site, which is rectangular in shape, lies in between the following latitudes and longitudes: (0356787, 9876112), (0357332, 9877092), (0357985, 9876719) and (0357400, 9875762). The elevation of the project site ranges between 1243-1260m above the sea level.

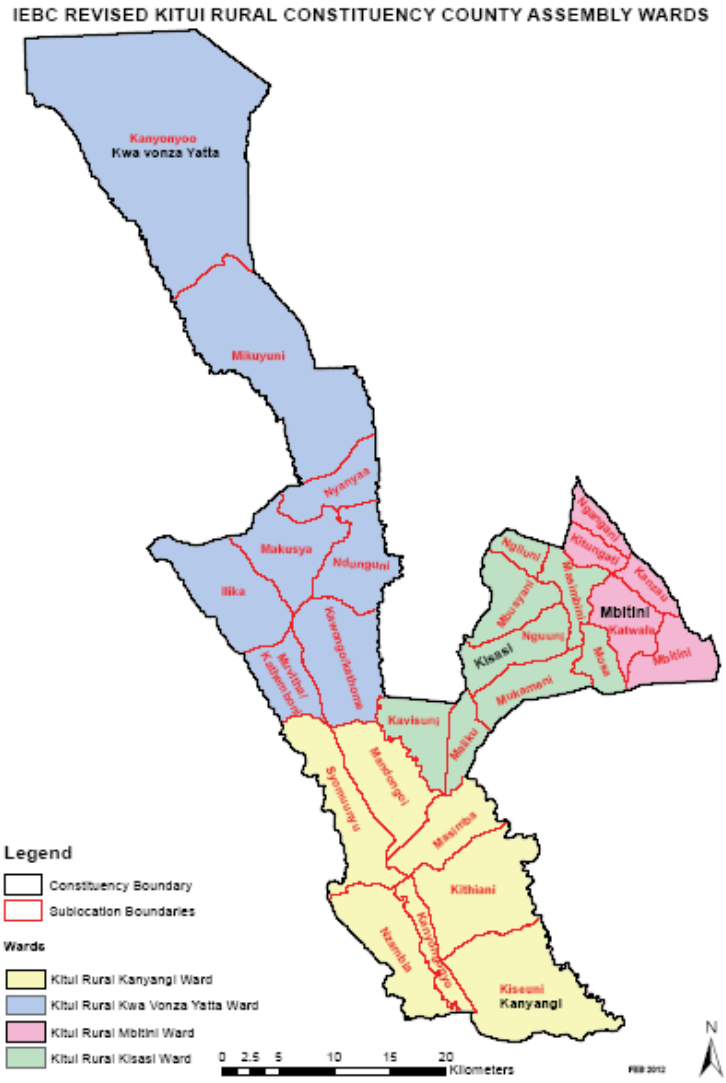


Figure 3:2: Location of Kwa Vonza/Yatta ward which houses the project site

Source: IEBC 2013

3.3 Demographic Features

3.3.1 Population Size and Composition

Population dynamics form an integral part of socio-economic and cultural development for the county. According to KNBS (2009), the county has population of 1,012,709. According to KNBS (2009) 531,427 are females while 481,282 are males. The population was projected to grow to 1,065,330 by 2013. The population growth rate of the county at 2.1% is slightly lower than the national rate of 2.6%. High population exerts pressure on social and natural resources, and it is imperative for the county to develop strategies in addressing the population growth rate. Table 3-1 provides information on the county population projections by gender and age cohorts with 2009 as at the base year. The figures are given at intervals for ease of analysis and planning.

Table 3-1: Population Projections by Gender and Age Cohorts (*Source: KNBS 2009)*

Age group	2009 (Census)			2012			2013			2015 (Projections)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	81,525	79,977	161,502	84,800	82,446	167,246	85,809	83,080	168,889	87,882	84,418	172,300
5-9	82,382	80,314	162,696	86,242	83,298	169,540	87,267	83,938	171,205	89,376	85,290	174,666
10-14	75,021	72,529	147,550	78,632	75,293	153,925	79,567	75,872	155,439	81,489	77,094	158,583
15-19	62,151	59,368	121,519	65,117	61,651	126,768	65,891	62,125	128,016	67,483	63,126	130,609
20-24	32,655	40,691	73,346	34,241	42,262	76,503	34,648	42,586	77,234	35,485	43,272	78,757
25-29	23,699	35,961	59,660	24,914	37,393	62,307	25,210	37,680	62,890	25,819	38,287	64,106
30-34	21,875	30,969	52,844	22,966	32,214	55,180	23,239	32,462	55,701	23,801	32,985	56,786
35-39	20,588	27,287	47,875	21,621	28,382	50,003	21,878	28,600	50,478	22,407	29,061	51,468
40-44	14,818	19,310	34,128	15,597	20,136	35,733	15,782	20,291	36,073	16,164	20,618	36,782
45-49	13,329	17,758	31,087	14,027	18,509	32,536	14,193	18,651	32,844	14,536	18,951	33,487
50-54	10,932	13,736	24,668	11,481	14,310	25,791	11,617	14,420	26,037	11,898	14,653	26,551
55-59	9,977	12,090	22,067	10,480	12,585	23,065	10,605	12,682	23,287	10,861	12,886	23,747
60-64	8,695	11,759	20,454	9,117	12,253	21,370	9,226	12,347	21,573	9,449	12,546	21,995
65-69	6,033	7,223	13,256	6,335	7,533	13,868	6,410	7,591	14,001	6,565	7,713	14,278
70-74	5,903	7,260	13,163	6,187	7,562	13,749	6,261	7,620	13,881	6,412	7,743	14,155
75-79	3,731	4,137	7,868	3,910	4,308	8,218	3,956	4,342	8,298	4,052	4,411	8,463
80+	7,724	10,829	18,553	8,123	11,179	19,302	8,219	11,265	19,484	8,418	11,447	19,865
TOTAL	481,038	531,198	1,012,236	503,790	551,314	1,055,104	509,778	555,552	1,065,330	522,097	564,501	1,086,598

The county has a high population of children, as shown in the 2009 census report, where the population between the ages of 0-14 years, was 238,928 male and 232,820 females which represented 46.6% of the total population. The population between 65-80 years was 23,391 males and 29,449 females translating to 5.2% of the entire population. This implies a higher dependency of children between 0-14 years than elderly population between 65-80 years. The county should take note of this because it means that there are more people to feed, more schools to build and pressure to create more employment opportunities.

3.4 Administration

Kitui County has eight (8) sub-counties namely Kitui Central, Kitui West, Kitui East, Kitui South, Kitui Rural, Mwingi North, Mwingi Central and Mwingi West. It is further sub-divided into forty (40) wards. The sub-counties are administrated by the Sub-county administrators and the wards by the ward administrators. The County has proposed through a bill to create 200 villages and recruit village administrators to oversee the villages which will be the lowest level of the county administrative units. Table 3-2 below shows the sub-counties and the wards in each sub-county within Kitui.

Table 3-2: County's electoral wards by Sub-County/Constituency

Sub-County / Constituency	No. of Wards	Wards
Kitui Central	5	Miambani, Kitui Township, Kyangwithya West, Mulango, Kyangwithya East
Kitui West	4	Mutonguni, Kauwi, Matinyani, Kwamutonga/Kithumula
Kitui East	6	Zombe/Mwitika, Nzambani, Mutitu/Kaliku, Chuluni, Voo/Kyamatu, Endau/Malalani
Kitui South	6	Ikanga/Kyatune, Mutomo, Mutha, Ikutha, Kanziko, Athi
Kitui Rural	4	Kisasi, Mbitini, Kwa Vonza/Yatta, Kanyangi.
Mwingi North	5	Ngomeni, Kyuso, Mumoni, Tseikuru,Tharaka
Mwingi West	4	Kyome/Thaana, Nguutani, Migwani, Kiomo/Kyethani
Mwingi Central	6	Kivou, Nguni, Nuu, Mui, Waita, Mwingi
TOTAL	**40**	

Source: Kitui County Integrated Development Plan 2013-2017

From the table above, Mwingi Central, Kitui East and Kitui South sub counties / constituencies have the highest number of County assembly wards (six), while Mwingi West, Mwingi North, Kitui West and Kitui Rural have the lowest number (four).

3.5 Human settlements and urban centres

The proposed project site is occupied by 30 households. Majority of the households have put up homesteads within the proposed project area. In isolated cases, some land owners have farmlands in the proposed project area but reside elsewhere. Permanent, semi-permanent and temporary houses (Plate 3-1) characterize the proposed project area. All the human settlements inside the proposed project area will need to be relocated to pave way for the project. Landholding per household predominantly ranged between 5-20 acres. The land is predominantly used for livestock keeping and subsistence crop growing.

Plate 3:1: Housing structures at the proposed project site

No urban/market centres are inside the 210 acres proposed for the project. However, several market centres such as Musingi (0362981, 9877751), Ndelekeni (0357495, 987700), Nzokani (0361121, 9872230) and Katoteni/Kapenguria (0361461, 9869962) are in the neighbourhood of the proposed project area. Ndelekeni market is the closest to the project area (less than 500m away). The markets are characterized by permanent, semi-permanent and temporary housing structures. No structures in these markets will be directly affected by the proposed project. The type of trade in these centres is mainly small-scale businesses.

3.6 Infrastructure and Access

3.6.1 Roads

The proposed project area and its environs have adequate road network. The proposed project area is served by two major roads namely the Kibwezi-Kitui-Mwingi and Thika-Mwingi-Garissa roads. Plate 3-2 below shows the T-junction of the two roads at latitudes and longitudes of 0356233 and 9877082 respectively. Some sections of the Kibwezi-Kitui-Mwingi road are being tarmacked but the sections serving the proposed project area are tarmacked and in good condition. Figure 3-3 shows detailed maps indicating the key road infrastructure at the proposed project area and its environs.

Plate 3:2: The T-junction of Kibwezi-Kitui-Mwingi and Thika-Mwingi-Garissa roads

Feeder roads exist at the proposed project area. The feeder roads connect the residents of the proposed project area to the neighbourhood markets. One of the key feeder roads (Plate 3-3) traverses through the proposed project area. Though it is a public road, it will definitely be closed to pave way for the project. Currently, most of the feeder roads are in a fair state though occasionally maintained by the County government of Kitui.

Plate 3:3: A section of a feeder road passing through the proposed project site

3.6.2 Postal and Telephone Services

The nearest postal services at the proposed project area are in Kithyoko and Kabati markets. The entire proposed project area and its environs have mobile phone network. Generally, according to Kitui County Integrated Development plan 2013-2017, the County is served by 10 post offices and 6 sub-post offices which are run by the Postal Corporation of Kenya which is in charge of mail and parcel delivery as well as offering data communication services using the satellite-based Very Small Aperture Technology (VSAT) to access the internet.

Kitui County has fibre terminated at the County Commissioner's headquarters but it is yet to be extended to serve other departments in the County. The County Government recognises the potential of ICT- enabled services and innovative applications in delivery of services such as education, healthcare, governance, financial management and agricultural research development.

3.6.3 Electricity Supply

Though the proposed project site is not connected to the national grid, the neighbourhood is well supplied with electricity. Power lines (Plate 3-4) exist along the Kibwezi-Kitui-Mwingi and Thika-Mwingi-Garissa roads. Figure 12 gives further details on electricity supply network at the project site and its environs. The high voltage 133kV transmission line is located at Kavenge market approximately 10km from the proposed project site.

Plate 3:4: Electricity power lines in the neighbourhood of the proposed project site

Wood fuel is mainly inform of charcoal and firewood obtained from the expansive savannah woodland vegetation that characterize the proposed project site. According to the local residents, solar energy is largely under-utilized with limited use of M-Kopa solar lamps mainly for domestic lighting.

Household surveys conducted indicate that the popular type of fuel used for cooking in the project area is firewood at 90.5% among the household while charcoal is 6.8% (Figure 3-3). Further to this, those who use kerosene and Liquefied Petroleum Gas (LPG) are both at 1.4% respectively. In lighting, 56.8% of the population use solar energy while 41.9% use lanterns. Those who use electricity are 1.4%.

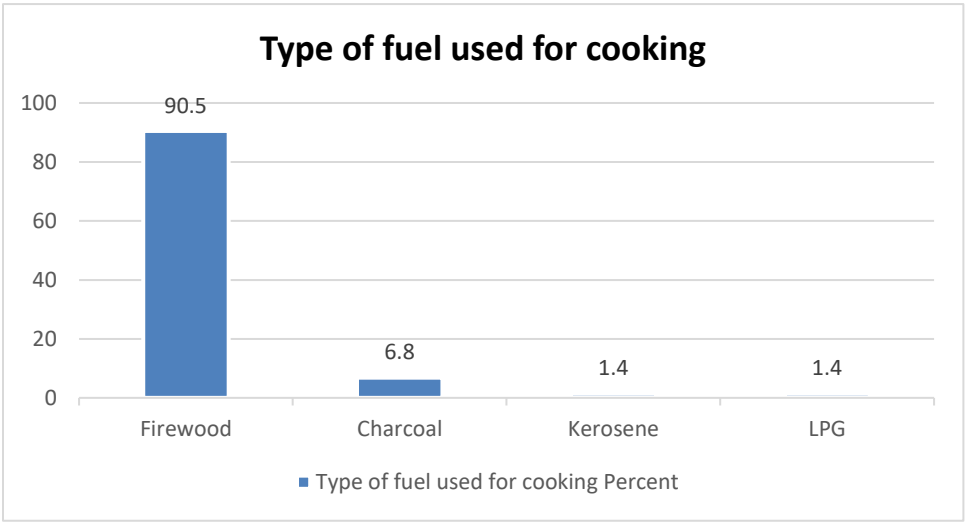


Figure 3:3: Types of fuel used for cooking

3.6.4 Area Infrastructure in relation to the Proposed Solar Park

The proposed solar park can be accessed through the Mwingi-Garissa Highway or through the Thika-Kitui road. There is also an established electricity infrastructure with an existing 33kv line passing nearby and also 220Kv line. A map showing of these infrastructural representation is shown in figure 3-4 below.

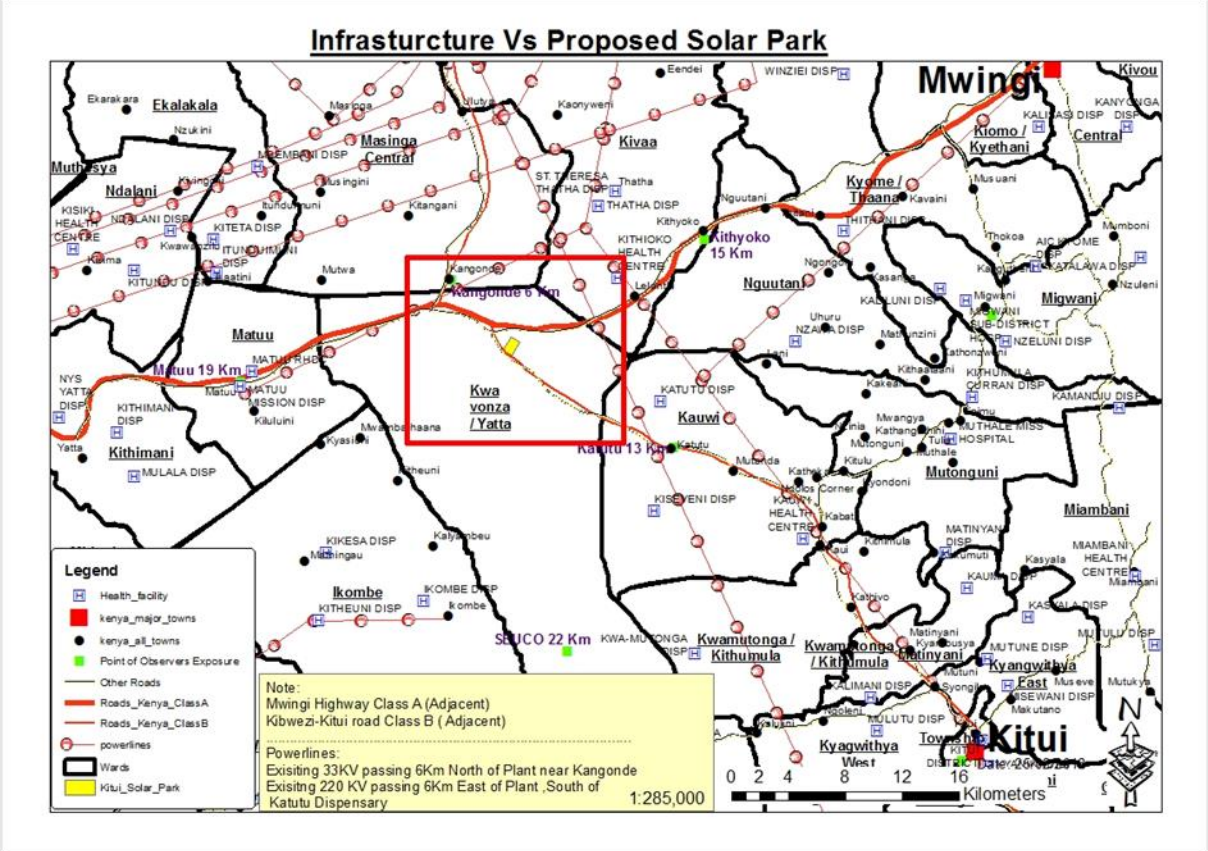


Figure 3:4: A map of the area infrastructure in relation to the proposed solar park

3.7 Education

According to the results of household socio-economic surveys, 48.6% of the households are headed by those who have attained primary education while 36.5% of the households have secondary education (Figure 3-5). Further to this 9.5% of the households are headed by those who do not have a formal education while 5.4% of them have tertiary education. In further interrogating the literacy levels, 74.3% household heads are able to speak English, Kiswahili and Kamba. Those who are able to speak English alone constitute 5.4% of the population, while those who speak Kamba are at 9.5% and Swahili also forming 9.5% of the population.

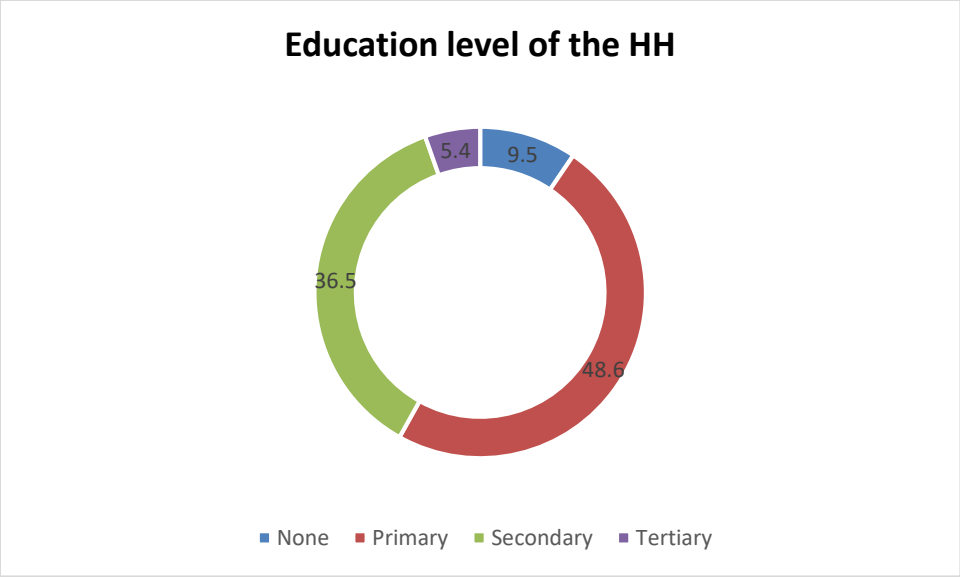


Figure 3:5: Education level of the household head

Inside the 210 acres proposed for the solar plant, no educational institution exists. However, Kyenze primary school borders the proposed project area at latitudes and longitudes of 0357332 and 9877092 respectively. Other primary schools away from the project area include Katoteni central, Kyandwia, Maiuni and Kavingo. At the proposed project area and its environs, no secondary schools and tertiary institutions.

3.8 Health and Sanitation

The proposed project area and its environs lack health facilities. According to local residents, the nearest health facility is situated in AP training camp at Ndelekeni. Other health facilities, though far away, are located at Mutanda, Kithyoko and Kabati markets. In some cases, local residents are forced to travel long distances in search of health services. Figure 3-6 below shows accessibility of the health facilities at the proposed project area and its environs. On whether there are health facilities near the respondents, 87.8% of the respondents affirmed this with 12.2% disagreeing that they have health facilities near them. In the context of how far, 39.2% of the respondents submitted that the health facilities are not very far, 32.4% responded that health facilities are moderately far, 25.7% that they are very far while 2.7% did not respond.

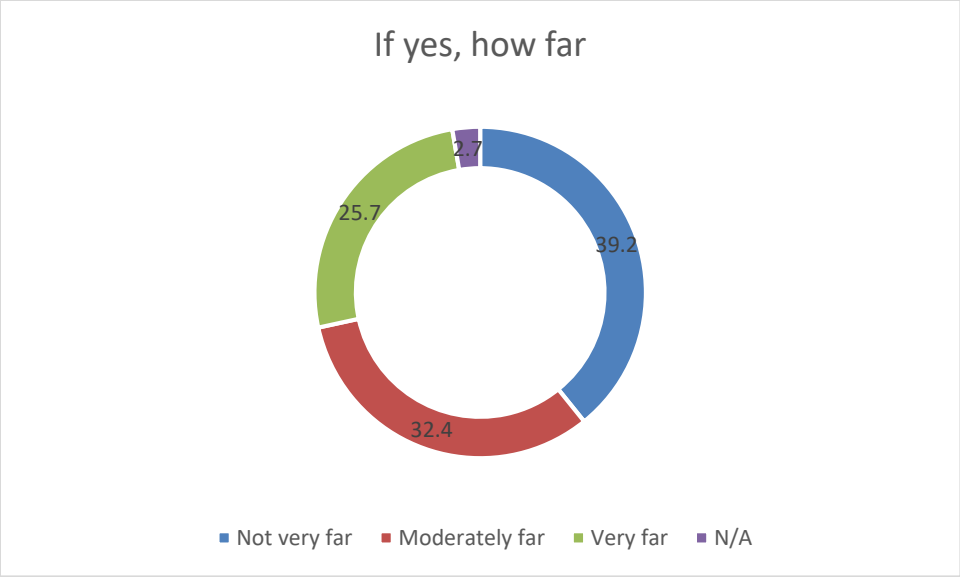


Figure 3:6: Accessibility of health facilities at the proposed project area

Further, according to results of household socio-economic surveys, the most prevalent disease in the project area is malaria at 66.2% followed by cancer that has affected 4.1% of the households (Figure 3-7). Further to this, respiratory infections stands at 1.4%, eye problems also at 1.4%, measles 1.4% and malnutrition also at 1.4%.

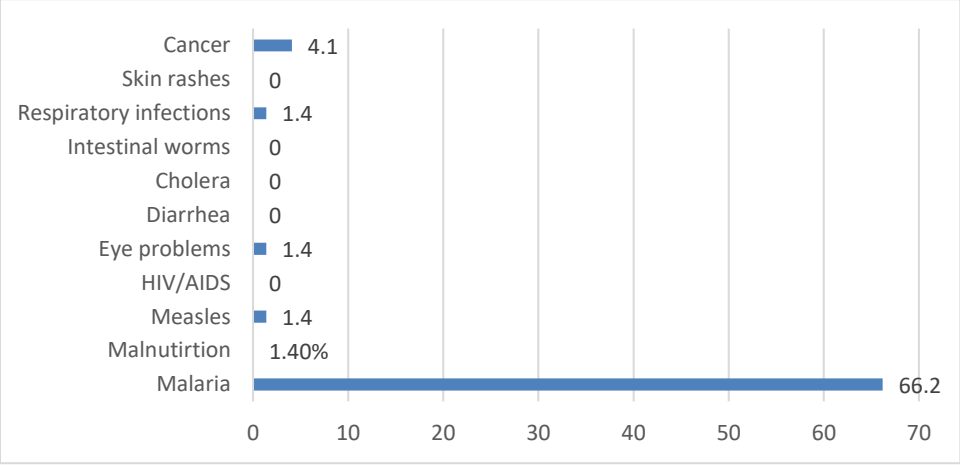


Figure 3:7: Disease prevalence at the proposed project area

3.8.1 Land Tenure and Land Use

The proposed 40MW Solar PV power plant project is expected to occupy 210 acres of land to be alienated from 53,309 acres currently held in trust by Kitui County. However, the land has since been occupied by the local community. B2 Yatta Ranch Cooperative Society Limited and Katoteni Nguamka Farmers and Environmental Conservation Group are having a dispute over the land with B2 Yatta Ranch claiming ownership rights of the entire 30,200

acres whereas Katoteni Nguamka Farmers and Environmental Group has an allotment letter of the same land within which the 210 acres proposed for the solar plant has been allocated to 30 households with land holding ranging between 5-20 acres.

Based on the field survey, the current prices of leasing land for agricultural use in the area is Ksh. 3,000 per season bringing it to a total of Ksh. 6,000 per annum for the two seasons in a year.

According to household surveys, the residents of the project area and its environs have lived in their present resident area for varying number of years. Figure 16 below shows length of residence of some of the interviewed residents. Majority (70%) of the respondents have been living in the current project area or less than 18 years those who have been living in the project area for 19-35years constitute 24% of the population while who have been in the area as a dwelling place for 36-60years and above 60 years are 4% and 2% respectively.

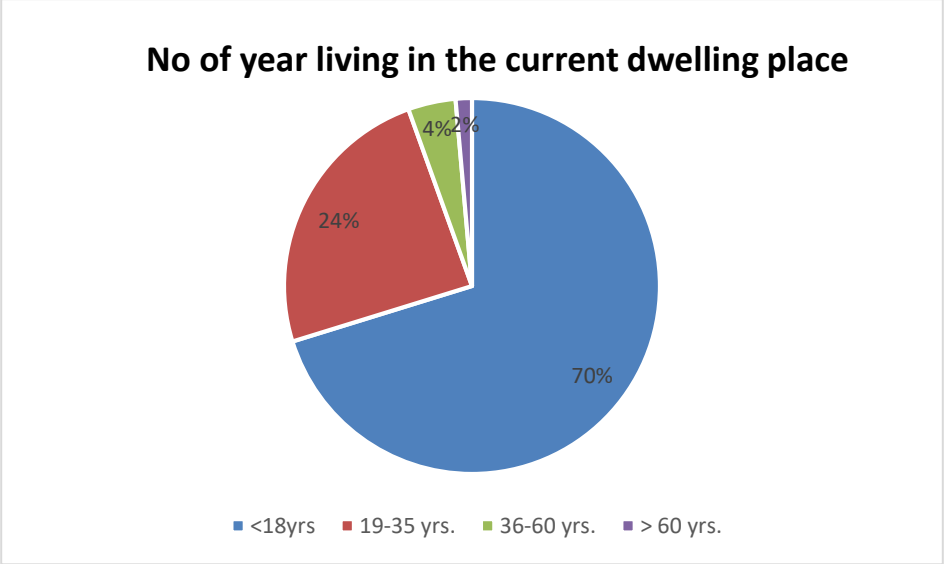


Figure 3:8: Residence period at the project area and its environs

3.8.2 Pastoralism

Livestock keeping is one of the main land use activities at the proposed project area and its environs. The savannah woodland vegetation offers a suitable ecosystem for browsing and grazing (Plate 3-5). Dominant livestock include cattle, goats, sheep, donkeys and poultry. The livestock is kept for both subsistence and commercial purposes.

Plate 3:5: Livestock keeping at the proposed project area

The potential for livestock keeping is curtailed by lack of adequate water at the project site and its environs. Kyenze earth dam is the main source of water for livestock. However, the dam is small to withstand the high number of livestock dependent on it (Plate 3-6). The high dependence coupled with other water uses and evaporation makes the earth dam dry up during dry seasons. In absence of water from the dam, livestock farmers are forced to trek long distances in search of water.

Plate 3:6: Livestock flock into the almost dry Kyenze earth dam for water

According to socio-economic surveys conducted, the most popular livestock kept in the project area are donkeys and majority 33.8% of the households keep at least 1 to 2 donkeys

(Figure 3-9). This is followed by those who keep cows at the household level being 1-2 being 16.2% while 3-4cows being at 16.2% while those having 5-6cows are 13.5%. Sheep are not a very popular livestock among the population in the proposed project area.

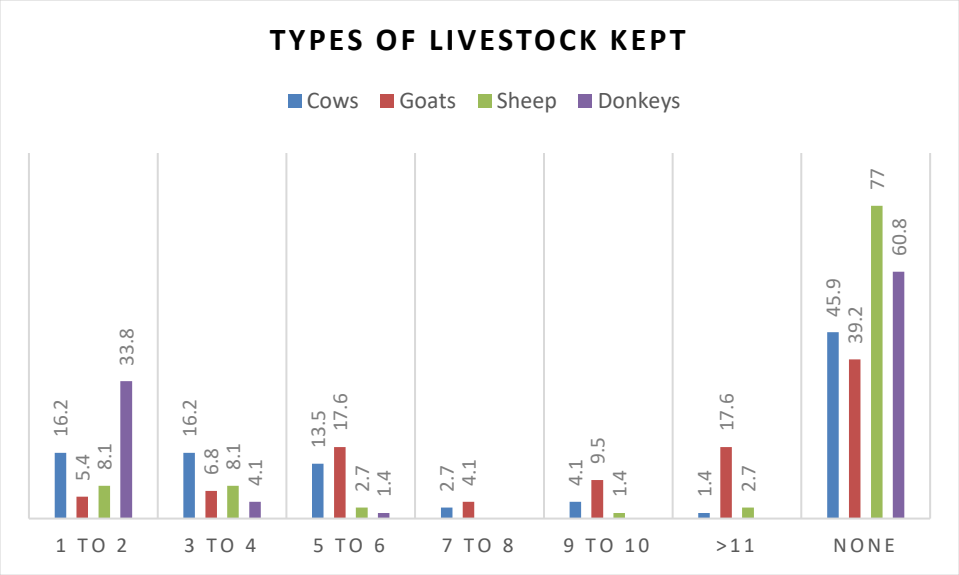


Figure 3:9: Types of livestock kept at project area and its environs

The popularity of donkeys in the proposed project area and its environs is due to its importance as a beast of burden. During dry seasons when most of the nearby water sources have dried, donkeys (Plate 3-7) are used to ferry water over long distances. Donkeys are also very important in transporting farm produce in the proposed project area and its environs. With the opening up donkey abattoirs in Kenya, demand for donkey meat for export is high. A donkey abattoir has been proposed in Kitui County.

Plate 3:7: Use of donkeys to transport water in Ndelekeni market

3.8.3 Crop growing

Subsistence crop growing is another main land use at the proposed project area and its environs. All the 30 households occupying the 210 acres proposed for the solar plant have cleared part of their farmlands for subsistence crop growing. Though the potential for crop growing is huge, its full exploitation is curtailed by erratic and unreliable rainfall regimes. For instance, the short rains of October-December 2017 resulted to complete crop failure (Plate 3-8).

Plate 3:8: Withered maize crop in a farmland in Ndelekeni

The potential for irrigated agriculture is huge though its exploitation is curtailed by lack of water. For instance, in areas with substantial supply of water such as Kyenze Earth dam, small scale vegetable growing (Plate 9) exist at latitudes and longitudes of 0357834 and 9876961 respectively. Key horticultural crops grown in the irrigated farm include kales, spinach amongst others. The vegetables are grown for subsistence purposes. However, this kind of irrigated agriculture is not sustainable given that Kyenze earth dam is small and ends up drying during dry periods. For instance, by the time of this survey, most of the vegetables were drying up (Plate3-9). It is projected that water to be harvested from the solar panels can generate substantial water for large scale irrigation purposes.

Plate 3:9: Small scale irrigated horticulture adjacent Kyenze earth dam

According socio-economic surveys conducted, the popular crop among the population in the project area is maize at 66.2% while beans come second at 63.5% (Figure 3-10). Further to

this, 9.5% of the population plant mangoes while cassava and cashew nuts are at 4.1% and 2.7% respectively. With most of the farms being outside the proposed project site.

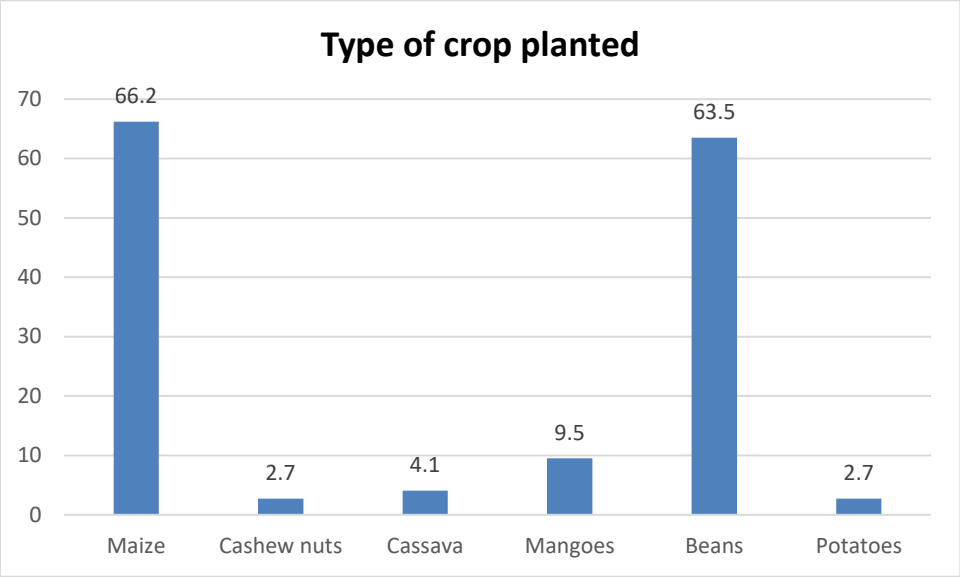


Figure 3:10: Crops grown at the proposed project area

3.8.4 Bee keeping

Bee keeping presents another untapped economic opportunity at the proposed site for solar plant. The predominant vegetation *Acacia tortilis* and *Acacia mellifera* provide forage for bees. Though the Kambas are traditionally known bee keepers, the residents of the proposed project area and its environs have not invested in the sector. The African log beehives (Plate 3-10) occurred in isolated cases at the proposed project area.

Plate 3:10: An African log beehive at the proposed project area

3.9 Physical and Topographic features

Kitui County has a low lying topography with arid and semi-arid climate. Its rainfall distribution is erratic and unreliable. The highlands namely, Migwani, Mumoni, Kitui Central, Mui, Mutitu Hills and Yatta plateau receive relatively high rainfall compared with lowlands of Nguni, Kyuso and Tseikuru. Due to their altitudes, they receive more rainfall than other areas in the county and are the most productive areas. The topography of the county can be divided into hilly rugged uplands and lowlands. The general landscape is flat with a plain that gently rolls down towards the east and northeast where altitudes are as low as 400 metres. The altitude of the Kitui county ranges between 400m and 1800m above sea level. The central part of the county is characterised by hilly ridges separated by wide low lying areas and has slightly lower elevation of between 600m and 900m above sea level to the eastern side of the county. To the western side of the county, the main relief feature is the Yatta Plateau, which stretches from the north to the south of the county and lies between Rivers Athi and Tiva. The plateau is characterised by plain wide shallow spaced valleys. At the neighbourhood of the proposed project area, Thatha hilltop (Plate 3-11) stands prominently amidst the predominantly flat terrain.

Apart from the Yatta Plateau and the range of hills in the central part of the county, the topography is undulating, and gives way to plains toward the east. A few hills rise as inselbergs in the plains rising to an altitude of 1,747 metres above sea level. These isolated hills usually affect communication within the county.

The generally flat relief of the Kitui County provides an opportunity for low cost of installing/building of infrastructure such as roads and power lines. It also means putting up buildings is relatively cheaper due to low landscaping costs as compared to counties that have steep slopes and unstable soils.

Plate 3:11: Thatha hilltop at the background of the proposed project area

3.10 Climatic Conditions

The climate of the Kitui County is hot and dry with unreliable rainfall. The climate falls under two climatic zones i.e., arid and semi-arid with most of the County being classified as arid. The County experiences high temperatures throughout the year, ranging from 14˚C to 34˚C. The hot months are between September and October to January and February. The maximum mean annual temperature ranges between 26˚C and 34˚C whereas the minimum mean annual temperature ranges between 14˚C and 22˚C. July is the coldest month with temperatures falling to a low of 14˚C while the month of September is normally the hottest with temperature rising to a high of 34˚C.

Due to the high temperatures experienced in the county throughout the year the rate of evaporation is high with a mean annual potential evaporation in the central and north-western regions of the county ranging between 1800 to 2000mm while in eastern and north-eastern regions, the range is from 2200 to 2400mm. The bulk of the County falls within 1800 to 2200mm range.

The rainfall pattern is bi-modal with two rainy seasons annually. The long rains fall in the months of March to May. These are usually very erratic and unreliable. The short rains which form the second rainy season fall between October and December and are more reliable. The rest of the year is dry and the annual rainfall ranges between 250mm-1050 mm per annum with 40% reliability for the long rains and 66% reliability for the short rains. Rainfall is highly unpredictable from year to year.

3.11 Ecological Conditions

The County of Kitui is endowed with various natural resources such as forests, permanent and seasonal rivers, hills, rocks, wildlife among others. Apart from the natural resources, the county can also be divided into nine Agro Ecological Zones which include: UM3, which is very small (in pockets), and Semi-arid farming zones which include; UM3-4 the transitional marginal coffee zone around Migwani and Kitui Central. The UM4 is considered as the sunflower- maize zone or Pigeon peas-maize zone. LM3 is the cotton zone, is very small and many are steep slopes mainly for forest reserves, while LM4 is marginal cotton zone. LM5 is the livestock-millet zone which is suitable for livestock and millet production, while LM6 and IL6 are the ranching zones; here no rain-fed agriculture is suitable except with runoff-catching techniques. IL5 is suitable for both livestock and millet production.

These semi-arid zones have good potential for agricultural development and are currently either cultivated or lying fallow under woodland. Due to population pressure the less fertile semi-arid ranching areas are currently used for food crops production and livestock keeping which leads to frequent crop failures as these areas are not suitable for growing of certain crops under rain-fed agriculture.

3.12 Water Resources

According to Kitui County Integrated Development Plan 2013-2017, the County has scarce water resources due to the inadequate and unreliable rainfall and limited surface water sources. The major sources of surface water are seasonal rivers that form during the rainy seasons and dry up immediately after the rains. The Athi and Tana Rivers are the only perennial rivers in the County, and form the borders with neighbouring counties. The drainage system of the Kitui County is largely comprised of the Athi and Tana River catchments. The seasonal rivers within the County flow in a general north, north-west direction and drain into Tana River. Seasonal rivers include Rivers Nzeeu, Tiva, Mwita Syano and Thua in Kitui while in Mwingi there is Tyaa, Enziu, Kamuwongo, Katsee, and Muoo.

The main sources of water include 150 dams, 153 water pans/earth dams, 683 shallow wells, 264 boreholes, 33 protected springs, two permanent rivers namely Tana River and Athi River and 5 unprotected springs. Only a total of 4,774 households have roof catchment systems to harvest rainwater and the potential to increase this is high. The County has inadequate water for both domestic and agricultural use. The majority of the population depends on surface and sub-surface dams which often do not hold sufficient water due to low rainfall and high evaporation rates during the dry seasons.

Treated water is only available in Kitui town, Mwingi town and along Masinga pipeline. There are also minor supply systems at Mutomo, Migwani, Kwa Vonza, and Ukasi. This is insignificant in relation to the water used by the households in the County.

At the proposed project site (Katoteni locality), very few water resources exists. The area faces acute shortage of water for both domestic and agricultural uses. A small seasonal stream (Plate 3-12) exists at the neighbourhood of the proposed project area. The stream acts as the main catchment for Kyenze earth dam which borders the proposed project site.

Plate 3:12: Sections of a seasonal stream near the proposed project area

Other larger but seasonal streams are located a few kilometres from the proposed project site. Such streams include Kithyoko and Nguutani (Plate 3-13). The stream flows are characterized by very low or no flows (base flows) in dry season and moderate to high flows during rainy seasons, i.e. April-May and November-December. Most of these ephemeral streams generally become dry within one month after the rainy season (Borst and De Haas, 2006). The flows are usually fast and turbid due to high sediment concentration associated with soil erosion in the Kithyoko-Nguutani catchment area.

Plate 3:13: Sections of Nguutani stream

Kyenze earth dam (Plate 3-14) located at latitudes and longitudes of 0357750 and 9876931 respectively lie less than 200m from the proposed solar plant project. The dam is a key source of water for domestic and livestock purposes. It is important to note that the dam ends up drying up during dry seasons mainly because of its low capacity and excess pressure from the users. In absence of water from the dam, the local community is forced to obtain water from other sources such as earth dams namely Mbitini, Kavingo, Kyoani, Ilovi, Kitula including Nzokani borehole. These alternative sources are far from the proposed project site.

Plate 3:14: Sections of Kyenze earth dam near the proposed project area

At the periphery of the proposed project site is a second but private earth dam situated at latitudes and longitudes of 0357232 and 9875864 respectively and a general elevation of 1251m a.s.l. Just like the Kyenze earth dam, the dam is small and dries up during the dry seasons due to the high water abstraction and evaporation rates. Efforts by some local residents to excavate shallow wells have proved futile due to the low water table. However, near a small and seasonal wetland, a shallow well (Plate 3-15) has been excavated probably due to the likely high water table in the wetland environs.

Plate 3:15: A shallow well at the neighbourhood of the project area

Figure 3-11 below represents the major hydrological features within the locality of the proposed solar park

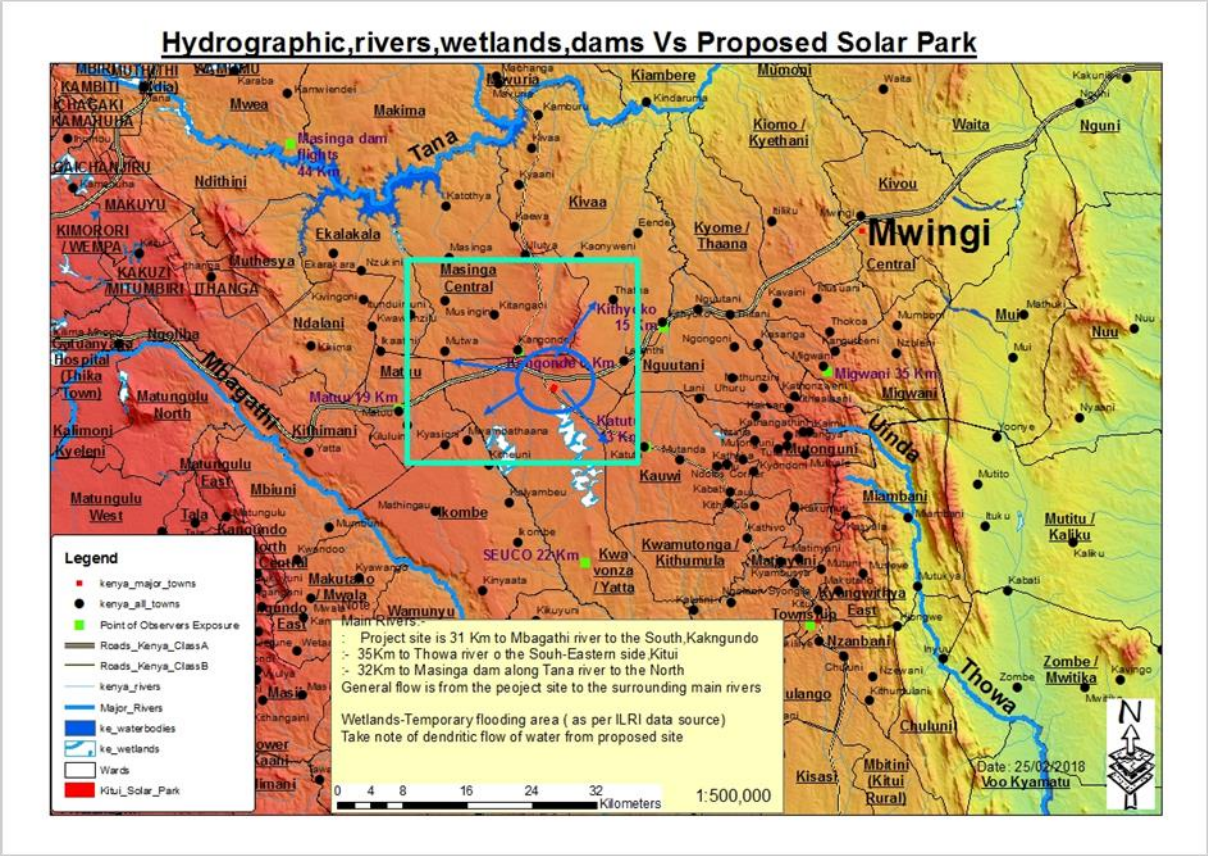


Figure 3:11: A map showing hydrographic, rivers, wetlands and dams within the proposed solar park

3.12.1 Water Quality

Environmental baseline survey of the proposed project area was undertaken in February 2018. Water quality samples of Kyenze earth dam which is the major source of domestic water within the proposed project area were collected to provide data that will act as a reference for monitoring water resources in the project area in future. The concentration levels of the analyzed parameters were compared with the first schedule on quality standards for sources of domestic water (GoK 2006). Twenty water quality parameters were determined and analyzed (Table 3-3). The water quality parameters analyzed, showed that there were variations although generally within the NEMA standards/guideline values and World Health Organization standards (WHO). The pH range was within the acceptable levels in the sampled points.

The values of Turbidity were observed to be relatively high. This could be linked to the high disturbance of the water by people and livestock. The laboratory water quality analysis results are appended in appendix J of this report.

Table 3-3: Water analysis results for Kyenze Earth dam

Sampling point/Parameter	Kyenze Earth Dam, Katoteni	WHO	NEMA Guideline values
GPS- Coordinates	$01^0$06'47.8"N $37^0$43'16.9"E		
pH	7.6	6.5 – 8.5	6.5 – 8.5
Colour mgPt/l	150	Max 15	Max 15
Turbidity (NTU)	229	Max 5	Max 5
Conductivity (μScm^{-1})	867	< 2500	-
Iron(mgl-1)	3.45	<0.3	<0.3
Manganese (mgl-1)	<0.01	<0.1	<0.5
Calcium (mgl-1)	16	<100	<150
Magnesium (mgl-1)	26.73	<100	<100
Sodium (mgl-1)	100	<200	<200
Potassium (mgl-1)	50	50	-
T. hardness (mgl^{-1})	150	< 500	300
T. alkalinity (mgl^{-1})	372	< 500	-
Chloride	41	250	250
Fluoride	1.15	<1.5	<1.5
Nitrates (mgl^{-1})	<0.01		10
Nitrites (mgl^{-1})	<0.01	< 0.1	0.003
Sulphate (mgl^{-1})	<0.3	< 450	1.5
Free Carbon Dioxide	12	-	-
TDS (mgl^{-1})	537.54	<1500	1000

3.13 Soils and Geology

Generally, soils are predominantly sandy to loamy sand texture, hence they are susceptible to erosion and are limited in their capacity to retain water and nutrients. The major soil type of the proposed project area is lixisols (red soils). Alluvial deposits (fluvisols) occur in isolated patches along rivers and on hill slopes. The soils are generally poorly drained and easily eroded by runoff (Borst and De Haas, 2006).

The proposed project area is overlain by red well drained sandy loam soils which have quartz and feldspar grains and felsic gravel rock fragments. Soil depths (thickness) vary from between 1.2m (upslope) to nearly 2.0m at the downslope side near Kyenze earth dam. The project site has a similar geology composed of high grade regional metamorphic granitoid granulites which are composed of quartz and feldspars (over 90%) and mafic

hornblende and pyroxenes (about 10% or less). The maps below shows the soil and geological characteristics of the proposed project area.

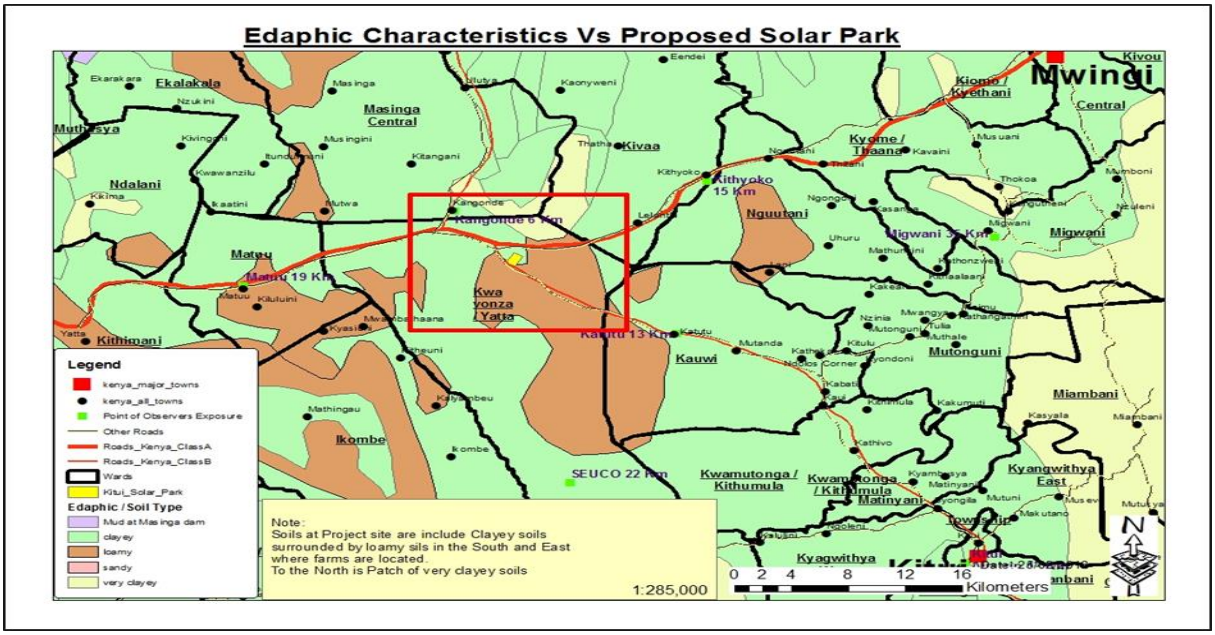


Figure 3:12: A map of edaphic characteristics within the locality of the proposed solar park

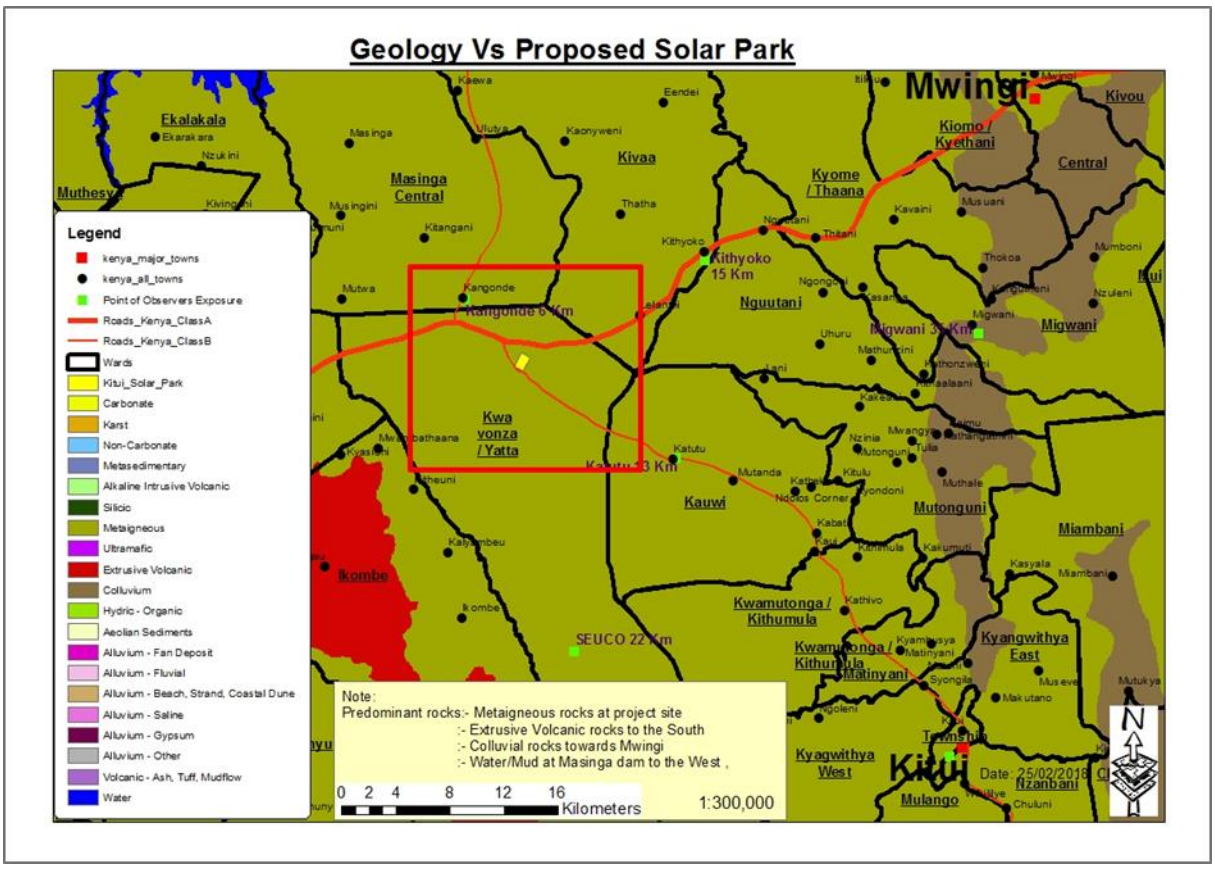


Figure 3:13: Geology of the proposed project area

3.14 Vegetation

The proposed solar farm site lies in typical savannah woodland characterized by closed and open woodlands dominated by livestock keeping and crop growing. Farm forestry in the proposed project area is limited due to semi-arid nature of the proposed project area and its environs. Urban forestry is only restricted at the neighbourhood market centres. There are no gazetted forests within the vicinity of the proposed project area. However, gazetted forests exist in Mutonguni in Kitui West Sub-County. Generally, vegetation is important in landscaping, reducing heat by providing cooling effects, shade, wind break, fodder, fruits, construction materials, soil erosion control, bee foraging, medicinal value, fuel wood, nitrogen fixation among others (Cheboiwo & Langat, 2006). Vegetation cover and land use affects the runoff by controlling the volume, hydrograph base time and hence the peak flow. Figure 3-14 below gives a map representation of the land cover within the project area and key vegetation types at the proposed project are briefly discussed below.

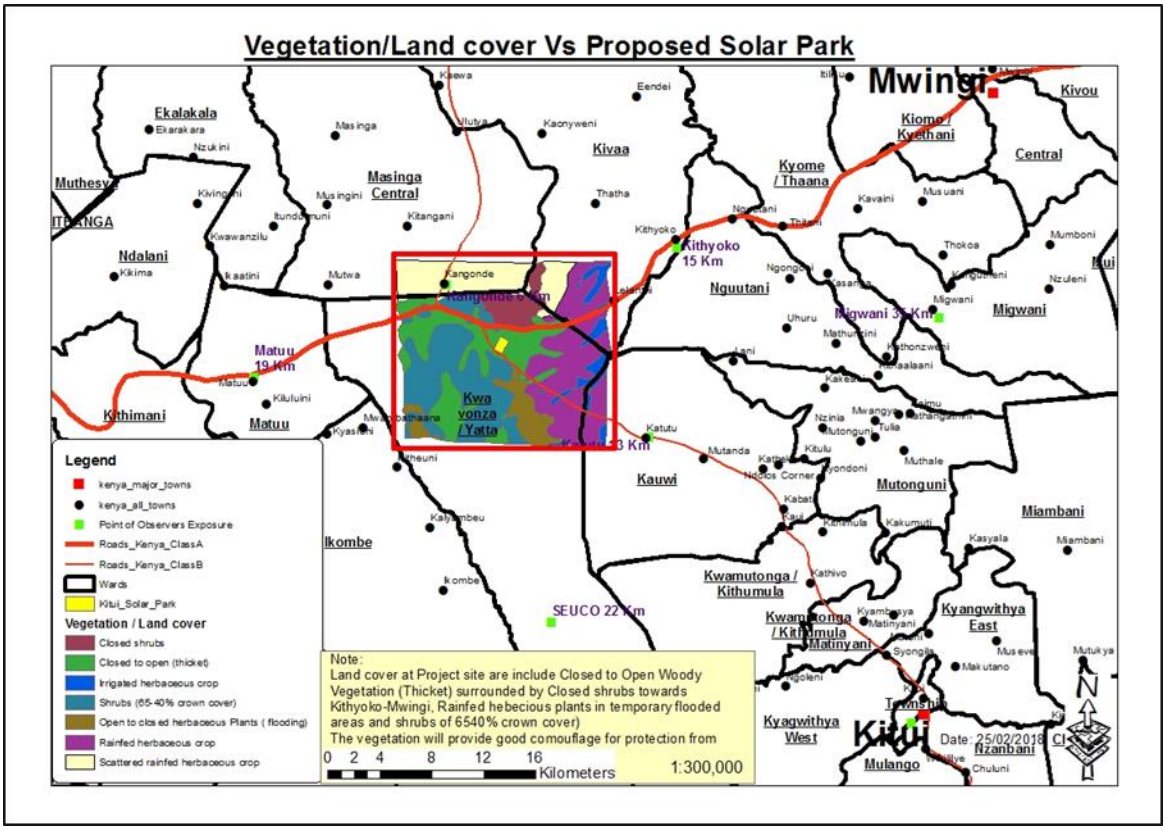


Figure 3:14: Vegetation/Land cover forms within the proposed project area

3.14.1 Indigenous Vegetation

The entire 210 acres proposed for the solar farm is characterized by savannah woodland typical of ASALs. In some sections, the woodland forms a closed vegetation formation with open spaces where land owners have opened the woodland for crop growing. At point 0356233 and 9877082 near the Public Works Camp site, the indigenous vegetation is characterized by *Commiphora* plant formation interspersed with isolated stems *Acacia tortilis, Acacia mellifera* and *Terminalia brownii*. In sections around 0356995 and 9876110, *Delbegia melanoxylon*, which is a valuable and endangered species, appear as isolated stems amidst the *commiphora* formation. At zone 0357446 and 9876715, which is a seasonal wetland, *Acacia xanthophloea* dominates the *commiphora* plant formation. Generally, the heavy presence of *commiphora* species makes the entire proposed project area take the shape of a homogenous ecosystem.

3.14.2 Key indigenous species in the proposed project area

Different dry land species characterize the entire site proposed for the solar farm. The key species that make the major plant formations/associations/mosaics include *Commiphora*

holtiziana, Commiphora myrrh, Acacia tortilis, Acacia drepanolobium, Acacia mellifera, Delbegia melanoxylon and Acacia xanthophloea. Other species at the project site include *Grewia bicolour, Vangueria infausta, Garcinia livingstonei, Acacia seyal, Acacia senegal, Balanites eagyptica, Caesalpinia volkensii, Ficus sur, Acacia seyal, Acacia nilotica, Rubus pinnatus, Caesalpinia decapetala, Maytenus senegalensis, Rhus vulgaris, Sesbania sesban, Euphorbia candelabrum, Terminalia brownii, Plectranthus barbatus, Pappea capensis, Premna resinosa, Zanthoxylum chalybeum, Vangueria apiculata, Vangueria madagascariensis, Cordia africana, Euphorbia turicali, Acacia brevispica* among others. Below is a description and uses of the key tree species at the project site.

3.14.2.1Commiphora myrrh and Commiphora holticiana

The *Commiphora* plant formations at the proposed solar farm are basically composed of two *Commiphora* species namely *Commiphora myrrh* and *Commiphora holticiana* (Plate 15). The two species of *commiphora* are common in drylands of Kenya. The species produce good quality gum especially for export market. Despite the high potential of the *commiphora* species in gum production, the local people at the project site including the larger Kitui County have not exploited the species. However, in other Counties such as Wajir, gum from *Commiphora* species is the second largest export after livestock. For instance, gum from *Commiphora myrrh* retails at 800 shillings per Kg while *Commiphora holticiana* goes for 400 shillings per Kg. The gum is usually exported to China and Far East countries mainly to be used in pharmaceutical, paint, cosmetic and confectionaries industries amongst others. Elsewhere in Isiolo County, according to Wesonga *et al* (2016), gum from *Commiphora holtiziana* retails for Ksh. 100 while for *Commiphora myrrh* goes for Ksh. 500. The leaves of *Commiphora* species are not widely eaten by livestock such as cattle, goats, sheep and even many wild animals. However, during periods of severe scarcity, they can act as fallback resource. The fruits are edible by a wide range of bird species, monkeys and other small game.

Plate 3:16: Commiphora species at the proposed project area

It is important to note that *Commiphora sp* can be regenerated through vegetative methods by use of cuttings. As such, one of the key uses of the species by the local community at the proposed project area is provision of live fence. The locals use the species cuttings to erect live fence (Plate 3-17) in farmlands and cattle sheds. The cuttings are also used as boundary markers. Once the cuttings develop roots, they form a permanent boundary fence.

Plate 3:17: A Commiphora species live fence at the proposed project area

3.14.2.2Acacia tortilis

The species (Plate 3-18) is common at the proposed project area. *A. tortilis* is a typical dryland species with a wide distribution in Kenya. The species is an important livestock and wildlife tree providing a wide range of benefits such as forage, fuel, shelter to birds and shade to humans, livestock and wild game. The pods of the species provide excellent fodder to both big and small livestock and wild game during dry seasons. The pods are usually ready for consumption during the months of August-September when most parts of the country are not only dry but also facing acute fodder shortage. When temperatures are extremely high, the big acacia trees comes at hand by providing shade to the wild game and livestock thereby reducing the effects of heat stroke. Its umbrella shaped crown makes the species suitable for shade provision. The species is also important for honey production although very few bee farmers exist at the proposed project site. According to Wesonga *et al* (2016), the species is important for forage, timber, charcoal and fuelwood.

Plate 3:18: Acacias tortilis at the proposed project area

3.14.2.3 Acacia mellifera

A. mellifera is another common species in the proposed project area. The species is a typical ASALs species with a wide distribution in Kenya. The leaves and the pods are highly nutritive to livestock and wild game. Among the many *acacia* species, *A. mellifera* is known to produce excellent honey. Due to its intimidating thorns, the tree branches are used to fence cattle bomas in many African communities. According to the local residents, *A. mellifera* produces excellent charcoal and fuelwood.

3.14.2.4 Delbergia melanoxylon

At the proposed solar farm site another dryland species *Delbergia melanoxylon* (Plate 3-19) is common. The species has been listed as endangered species by the IUCN. It produces the best wood for carving and the Kamba community traditionally being wood carvers have over the years over-exploited the species. Its high demand has driven the species to local extinction in some drylands. It is also important to note that the species takes over 60 years to mature and its natural regeneration is poor.

Plate 3:19: Delbergia melanoxylon at the proposed project area

3.14.2.5 Acacia drepanolobium

At latitudes and longitudes of 0357369 and 9876668 respectively, *Acacia drepanolobium* also called whistling thorn (Plate 3-20) forms the dominant vegetation type. The species forms an important source of food for livestock and wild game. Due to its high palatability, the species has a tendency of being over browsed by livestock. However, to keep off browsers, the species has intimidating thorns and mutualistic associations with ants that keep browsers away. This ensures the species survival amidst the browsers. The species has a very hard wood and is used for fencing around cattle bomas.

Plate 3:20: Acacia drepanolobium in sections of the proposed project area

3.14.2.6 Acacia xanthophloea

In a small and seasonal wetland situated at latitudes and longitudes of 0357446 and 9876715 respectively adjacent the proposed project area is another major savannah woodland species *Acacia xanthophloea* (Plate 3-21). The species, also called yellow-barked

acacia or Naivasha thorn or fever tree is always associated with raised water table and as such widely occurs in wetlands, along rivers and streams. Just like other acacias, the species forms a top diet to browsers. It also produces excellent charcoal and its wood is used to make assorted farm tools. It also provides excellent foraging site for bees.

Plate 3:21: Acacia xanthophloea at the proposed project area

3.14.3 Farm Forestry

Farm forestry entails planting of trees in agricultural farms. The practice increases farm productivity since the agroforestry tree species provide a wide range of benefits such as timber, fuelwood, fodder, poles, posts, soil erosion control, nitrogen fixing, shade amongst others. On-farm tree planting at the 210 acres proposed for the project is very poor. Lack of land tenure security coupled with harsh climatic conditions make on-farm tree growing a challenging venture. Fruit trees such as *Mangifera indica* (mangoes) and *Carica papaya* (pawpaw) make up the most preferred farm forestry species. *Senna siamea* and *Azadiratch indica* have also be planted in farms (Plate 3-22) near the proposed project site.

Plate 3:22: Tree planting in a farmland near the proposed project area

3.14.4 Urban tree planting

Urban forestry entails planting of trees and shrubs in urban environment. Urban forestry plays a critical role in urban environments by providing aesthetic through improvement visual appearance of urban landscapes. The tree component also plays critical roles such as provision of shade, reduction of dust, reduction of noise pollution, removal of soil and water pollutants and general amelioration of the urban microclimate. Due to harsh climatic conditions at the proposed project area and its environs, urban tree planting, typical of urban forestry is restricted to the market centres and institutions near the proposed project site. For instance, at the Public Works Campsite adjacent the proposed project area, assorted and multipurpose urban tree species have been planted (Plate 3-23). The urban forestry species contribute greatly to high diversity of plant species in the project area. Multi-purpose tree and shrub species are common with benefits ranging from provision of fruits, shade, aesthetic value, fodder among others. Key component of urban forestry is the integration of assorted flower species for urban landscaping and live fence.

Plate 3:23: Urban tree planting at a camp site adjacent the proposed project site

3.15 Wildlife Resources

The proposed project site is not rich in wild animals. According to local residents, only small game such as dikdiks, rabbits, antelopes, monkeys amongst others exist at the proposed project site. However, hunting for game/bush meat coupled with continued clearance of the savannah woodland for crop growing has decimated the small game. It is important to note that the proposed project area and the larger B2 ranch used to be very rich in terms of small and big game. However, human encroachment has over the years fragmented the habitat making it unsuitable for wild game. Though most of the big game were killed in the process of habitat loss, some were successfully relocated to the nearby and protected Mwea national game reserve. According to local residents, big game such as giraffes, buffaloes, zebras amongst others occasionally stray from the game reserve and find their way to the project site and its environs. It is important to note that the proposed project falls in small valley (0357400, 9875762) locally called the buffalo valley. According to local residents, a sickly buffalo stayed in the valley for many days before it was relocated to Mwea game reserve by KWS officers.

3.16 Solar Visual Impact Analysis

During the baseline survey, a detailed solar visual impact analysis of observers, road users, flights and nearby centres in relation to the proposed solar park was conducted. Field data and GIS maps were analysed and interpreted as presented in the below section. Figure 3-15 shows a visual impact analysis from observer points at Kitui airstrip, Matuu, Kithyoko, Migwani, Katutu, SEUCO, Kangundo and Masinga dam.

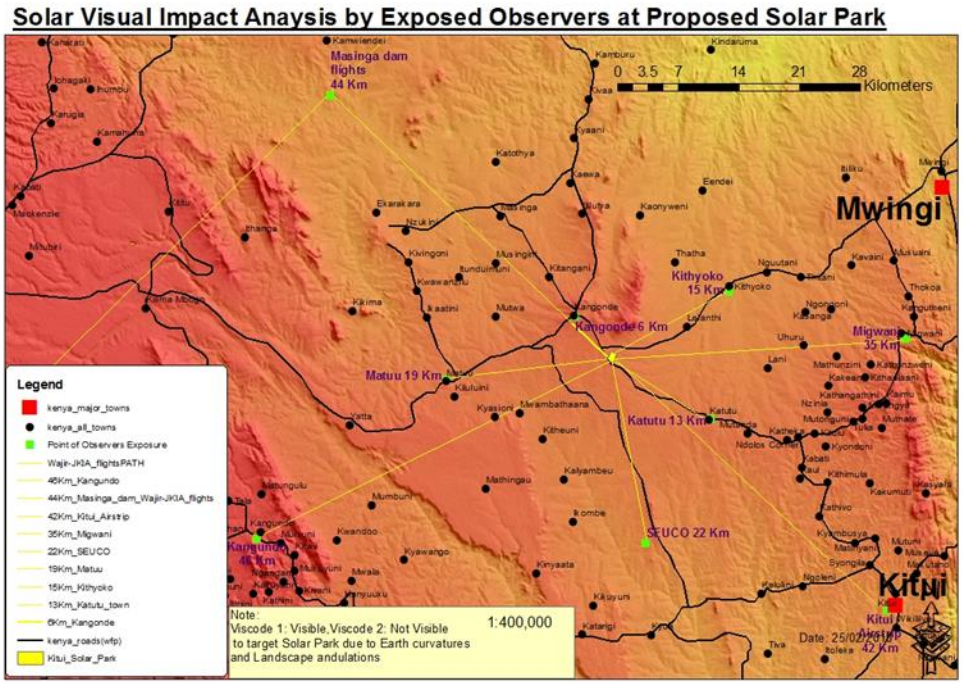
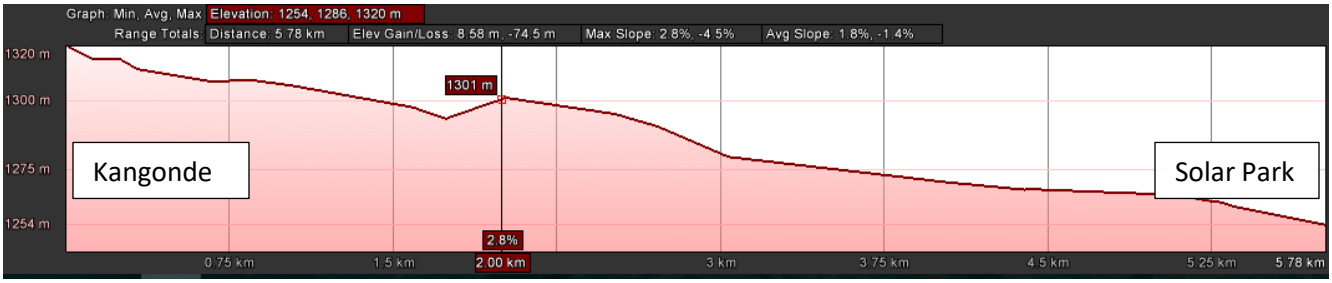


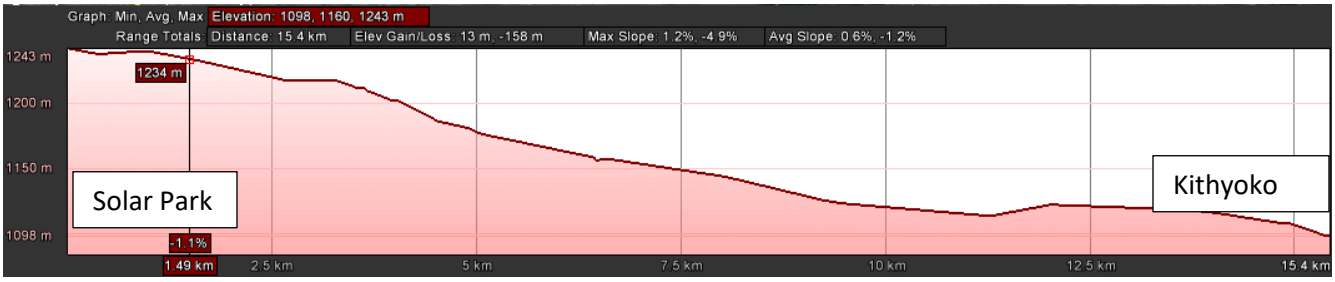
Figure 3:15: Solar visual impact analysis by exposed observers at proposed solar park

Kyenze-Kangonde town 6Km to the North



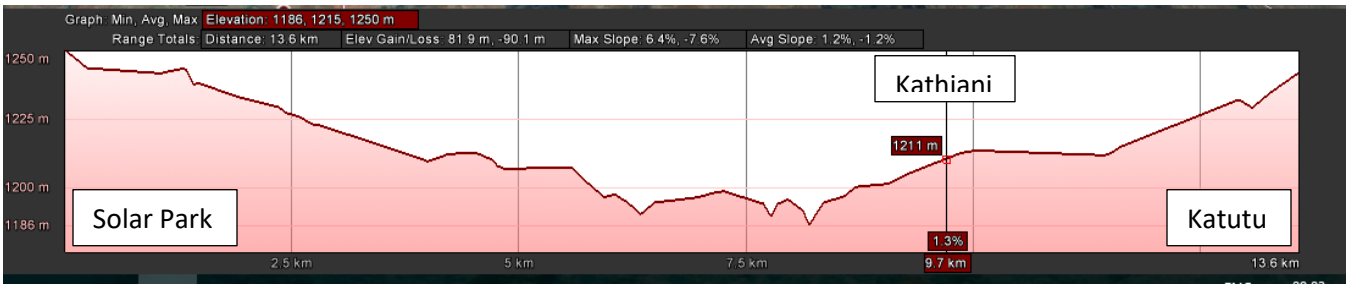
Inter-visibility: Kangonde town occupants will be Visible exposed 6Km away at an altitude of 1320m above sea level while the solar plant is proposed is in the valley at 1241m above sea level. The slope is undulating downward from Kangonde with a hill in between at 1301m a.s.l but cannot block rays from the valley, solar plant.

Kyenze-Kithyoko town 15Km to the North -East



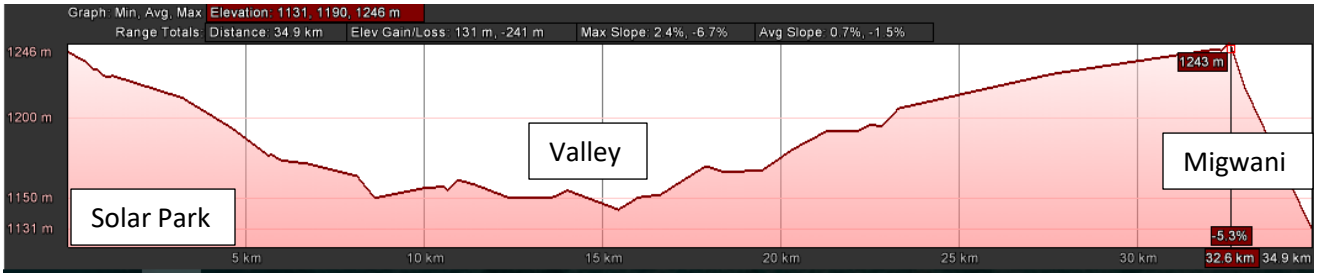
Inter-visibility: Kithyoko town occupants in the valley will be Visible to the Solar Park 15Km away at an altitude of 1098m above sea level while the solar plant is proposed at 1241m above sea level. The slope is undulating downward from solar park to the valley at 17% slope. Observers along Mwingi road will have the same visibility experiences, except for area with tree cover and turns obstructed by small hills-Thus such observers will be intermittently exposed.

Kyenze-Katutu town to the South- East of Solar Plant



Inter-visibility: Katutu town occupants will be Visible 13Km away at an altitude of 1242m above sea level while the solar plant is proposed at 1243m above sea level. The slope deeps into a valley as one moves from Katutu until Kathiani town, located 9.7Km where there is a gentle climbing towards Kyenze area where the proposed plant is sited. Other towns in the same environment behind Katutu include Mathunyani. Observers along the road from Mathunyani –Katutu-Kathiani will have the same visibility experiences, except for area with tree cover and turns obstructed by small hills-Thus such observers will be intermittently exposed.

Kyenze-Migwani Observers 35Km to the East

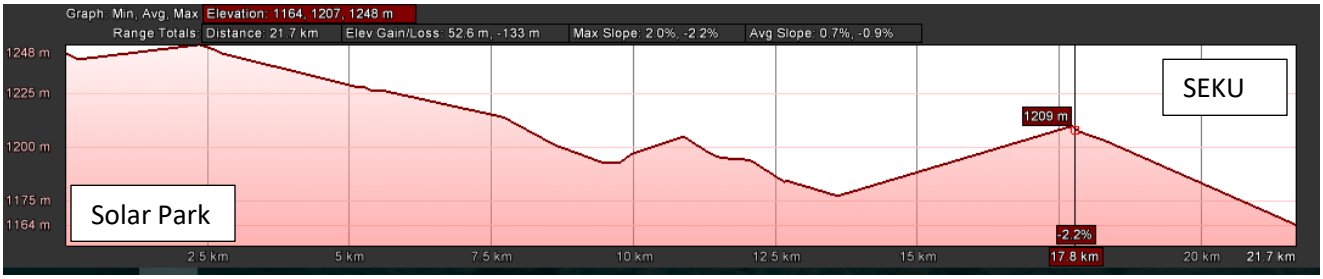


Inter-visibility: Migwani town occupants will NOT be Visible 35Km away at an altitude of 1131m above sea level while the solar plant is proposed at 1241m above sea level. Observer from this direction will be exposed when at 32.5Km aerial distance from the solar park at 1246m.a.s.l. Migwani is located in a valley at 1131m a.s.l.

Kyenze-Matuu Observers 19Km to the West

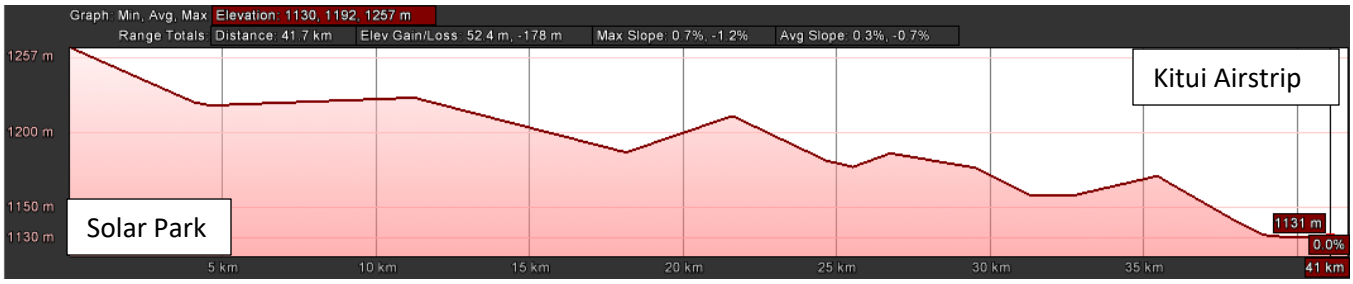
Inter-visibility: Matuu town occupants will NOT be Visible 19Km away at an altitude of 1229m above sea level while the solar plant is proposed at 1256m above sea level. Observer from this direction will NOT be exposed at all if stationary, until approaching the solar park 600m closer. The barriers are located at 1240m a.s.l, 4.8km near Matuu, and the second barrier located at 15.7Km and 18Km away from Matuu, 1263m a.s.l and 1264m a.s.l respectively. Towns like Kangundo, Machakos and Ngulini also will NOT be exposed due to existence of an escarpment.

Kyenze-SEKU university Observers 22Km to the South



Inter-visibility: SEKU occupants will NOT be Visible 22Km away at an altitude of 1163m above sea level while the solar plant is proposed at 1243m above sea level. Stationary observer from this area will NOT be exposed within the first 4Km, until crossing the barrier at 17.8Km away from proposed solar plant at altitude of 1209m. Those living in the valley 13.6Km, 1117m a.s.l. away from solar plant will also not be exposed.

Kyenze-Kitui Airstrip Observers 42Km to the South



Inter-visibility: Flights from Kitui airstrip will not be exposed until they fly at 1253m a.s.l. The area has some barriers as shown in the profile above.

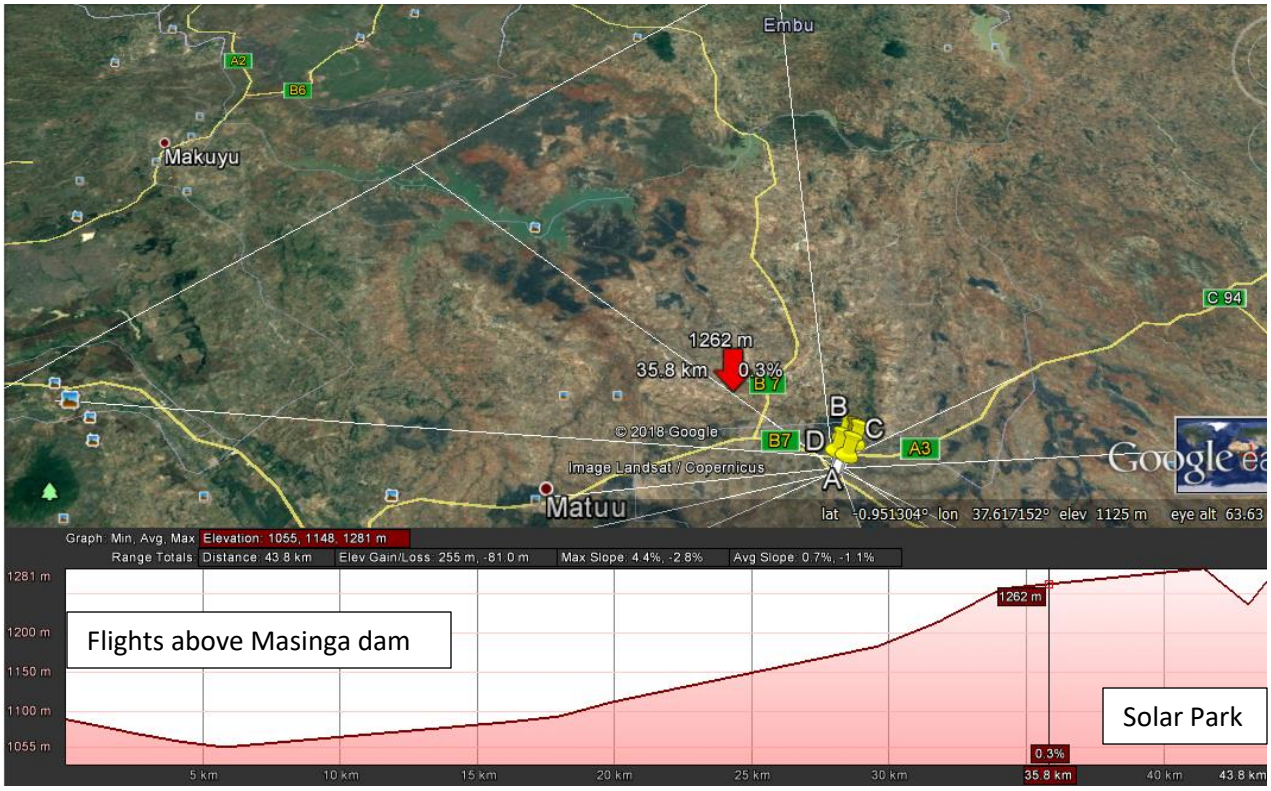


Figure 3:16: A Google Earth representation of Kyenze-flights above masinga dam, 53Km to the North West

Inter-visibility: Flights from or approaching Jomo Kenyatta International Airport (JKIA), usually fly above Masinga dam. Those landing will experience minimal visibility interference as opposed to those taking off due to existence of barrier at 1357m above sea level. In this area, flights gaining height will be exposed sometime within a distance of 1-2Km if flying at 10,000 feet above sea level.

4 RELEVANT POLICY, LEGISLATIVE AND REGULATORY FRAMEWORK

4.1 Introduction

Laws governing environmental protection and conservation in Kenya are derived from the constitutional statutes and the ratified international conventions. These laws regulate the establishment and operation of development projects such as the proposed solar power farm project, banking halls, restaurants, shopping complexes and associated activities, which may impact negatively on the environment, human health and socio-economic well-being of the people who interact with such projects.

Kenya is today faced with grave environmental problems and challenges. Among these are land degradation, loss of biodiversity and pollution of the environment (air, soil and water). The situation is aggravated by lack of awareness and inadequate information in the public domain on the consequences of their actions on the environment. There is also limited involvement of the local communities in the participatory planning and management of their environment and natural resources and the environment in general. The Government of Kenya has put in place a wide range of legislative arrangements to address the causes of environmental degradation in the country.

Until the enactment of the Environmental Management and Coordination Act (EMCA) Cap. 387, Kenya did not have a consolidated legislation for the protection and management of the environment. It had about 77 statutes that touched on various aspects of environmental management. Some of the legislative instruments have been in place for many years and are duplicated in other legislations. Environmental protection and sustainable use of natural resources have also been stated in all development plans since independence. The sessional papers and presidential directives have also emphasized the need to conserve the environment and manage the natural resources sustainably. Lack of consolidated legislation offered inadequate protection for the environment due to the absence of legal and institutional framework. Today, the National Environmental Management Authority (NEMA) coordinates all environmental activities in Kenya.

4.2 National Legal Framework

The Republic of Kenya has numerous statutes that guide environmental management and conservation, energy sector and developments in general. Most of these statutes are sector specific and cover a wide range of issues including public health, soil conservation, protected areas conservation, endangered species, public participation, water rights, water quality, air quality, excessive noise control, vibration control, land use, among others. The relevant legislations are described in table 4-1 below

Table 4-1: Relevant gazetted Kenyan Legislation

Key Laws	Major Provisions
The Constitution of Kenya, 2010	The Constitution of Kenya has taken on board various issues that are related to environmental management. Article 42 of the Bill of Rights contained in the Constitution provides that '*every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures*'. Chapter 5 of the Constitution is dedicated to land and the environment. The constitution requires that land be used and managed in a manner that is equitable, efficient, productive and sustainable. Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources. Article 69 in Part 2 provides that the state shall provide encourages efforts towards sustainable of natural resources, increasing of the national forest cover public participation in the management, protection and conservation of the environment, protection of genetic resources and biodiversity, environmental impact assessment, environmental audit and monitoring of the environment, etc.
Environmental Management and Coordination Act (EMCA) Cap. 387	The National Environment Management Authority (NEMA) was established is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment. Under the second schedule, oil and gas exploration and production and distribution infrastructure are listed as high-risk projects that require Environmental Impact Assessment and Audit. The Act prohibits discharge of hazardous substances, chemicals and materials or oil into the environment and outlines basic guidelines on the spiller's liability. Subsidiary EMCA Cap. 387 legislations include: • Environmental Management and Coordination (Environmental Impact Assessment and Audit) Regulations, 2003; (Amendment) Regulations, 2016 • Environmental Management and Co-ordination (Water Quality) Regulations, 2006

Key Laws	Major Provisions
	• Environmental Management and Co-ordination (Waste Management) Regulations, 2006 • Environmental Management and Coordination (Controlled Substances) Regulations, 2007 (Legal Notice No.73 of 2007) • Environmental Management and Coordination (Conservation of Biodiversity) Regulations, 2006 • Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009 • Environmental Management and Coordination (Air Quality) Regulations, 2014 • E-Waste Management Draft Regulations, 2013
National Land Commission Act, 2012(No. 5 of 2012)	The National Land Commission of Kenya is an independent government commission whose establishment was provided for by the Constitution of Kenya to, amongst other duties, manage public land on behalf of the national and county governments, initiate investigations into present or historical land injustices, recommend appropriate redress, monitor and have oversight responsibilities over land use planning throughout the country. It was officially established under The National Land Commission Act, 2012. The mandate of the National Land Commission is drawn from the National Land Policy of 2009, Constitution of Kenya 2010, National Land Commission Act, 2012, the Land Act 2012 and the Land Registration Act of 2012. Under the National Land Commission Act, the Commission shall among other duties monitor the registration of all rights and interests in land and ensure that public land and land under the management of designated state agencies are sustainably managed for their intended purpose and for future generations. Also, the commission is required to manage and administer all unregistered trust land and unregistered community land on behalf of the county government and develop and encourage alternative dispute resolution mechanisms in land dispute handling and management. The Commission is also required in consultation and cooperation with the national and

Key Laws	Major Provisions
	county governments, to establish county land management boards for the purposes of managing public land.
The Land Registration Act, 2012	This is an Act of Parliament that revises, consolidates and rationalizes the registration of titles to land, to give effect to the principles and objects of devolved government in land registration, and for connected purposes. The Act requires that proper marking and maintenance of boundaries. An interested person who has made an application to the Registrar for his/her boundaries to be ascertained, the Registrar shall give notice to the owners and occupiers of the land adjoining the boundaries in question of the intention to ascertain and fix the boundaries. With regard to the maintenance of boundaries, the Act requires every proprietor of land to maintain in good order the fences, hedges, stones, pillars, beacons, walls and other features that demarcate the boundaries, pursuant to the requirements of any written law.
The Land Act, 2012	The Land Act was enacted by Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land based resources, and for connected purposes. The Act applies to all land declared as (a) public land under Article 62 of the Constitution; (b) private land under Article 64 of the Constitution; and (c) community land under Article 63 of the Constitution and any other written law relating to community land. The Land Act guarantees security of tenure for land under (a) freehold; (b) leasehold; (c) such forms of partial interest as may be defined under the Act and other law, including but not limited to easements; and (d) customary land rights, where consistent with the Constitution and guarantees equal recognition and enforcement of land rights arising under all tenure systems and non-discrimination in ownership of, and access to land under all tenure systems. Under the Lands Act 2012, The Wayleaves Act, Cap 292 and The Land Acquisition Act, Cap. 295 have been revoked but Sections 8 and 9 allow for Compulsory Acquisition as an option in acquiring land for public utility.

Key Laws	Major Provisions
The Community Land Act, 2016	The Community Land Act, No. 27 of 2016 (the Act) came into force on 21 September 2016. The Act aims at: 1. Giving effect to Article 63 of the Constitution of Kenya, 2010 (the Constitution) which provides for a classification of land known as community land. To this end, the Constitution provides that community land shall vest in and be held by communities. 2. Providing for; • The recognition, protection and registration of community land rights. • The management and administration of community land. • The role of county governments in relation to unregistered community land and related matters. The Act repeals the Land (Group Representatives) Act (Chapter 287 of the Laws of Kenya) and the Trust Lands Act (Chapter 288 of the Laws of Kenya). This project shall uphold the requirement of all the relevant land legislations, involving key administrative stakeholders and the affected parties (i.e. the community) facilitating in coexistence with the surrounding community.
Environment and Land Court Act, 2011	This is an Act of Parliament to give effect to Article 162(2) (b) of the Constitution to establish a superior court to hear and determine disputes relating to the environment and the use and occupation of land. The Environment and Land Court is one of the Courts contemplated by article 162(2). It is a Superior Court and has the same status as the High Court. The court is established under section 4 of the Environment and Land Court Act No. 19 of 2011. It has jurisdiction to hear any other dispute relating to environment and land. The jurisdiction of the court is provided under section 13 of the Act. The Court has original and appellate jurisdiction to hear and determine all disputes in accordance with Article 162(2) (*b*) of the Constitution and with the provisions of the Act or any other written law relating to environment and land. The court has powers to deal with disputes relating to land administration and management. The court is also empowered to hear cases relating to public, private and community land and contracts or other instruments granting any enforceable interests in land. The court also exercises appellate jurisdiction over the decisions of subordinate courts or local

Key Laws	Major Provisions
	tribunals in respect of matters falling within the jurisdiction of the Court. The court further exercises supervisory jurisdiction over the subordinate courts, local tribunals, persons or authorities in accordance with Article 165(6) of the Constitution.
The Climate Change Act, 2016	Establishes the National Climate Change Council whose main function is to advise the national and county governments on legislative and other measures necessary for mitigating and adapting to the effects of climate change Provides the legal and institutional framework for the mitigation and adaption to the effects of climate change; to facilitate and enhance response to climate change; to provide for the guidance and measures to achieve low carbon climate resilient development and for connected purposes
Occupational Safety and Health Act, 2007 (OSHA)	The Occupational Safety and Health Act 2007applies to all workplaces where any person is at work, whether temporarily or permanently. The purpose of the Act is to secure the safety, health and welfare of persons at work and protect persons other than persons at work against risks to safety and health arising out of, or regarding, the activities of persons at work. Section 19 of the Act provides that an occupier of any premises likely to emit poisonous, harmful, injurious or offensive substances, into the atmosphere shall use the best practicable means to prevent such emissions into the atmosphere and render harmless and inoffensive the substances which may be emitted. Section 16 provides that no person shall engage in any improper activity or behavior at the workplace, which might create or constitute a hazard to that person or any other person. It is thus recommended that all Sections of the Act related to this project, such as provision of protective clothing, clean water, and insurance cover are observed to protect all from work related injuries or other health hazards. The report advices the Proponent on safety and health aspects, potential impacts, personnel responsible for implementation and monitoring,

Key Laws	Major Provisions
	frequency of monitoring, and estimated cost, as a basic guideline for the management of Health and Safety issues in the proposed project.
Energy Act, 2006	This is an Act of Parliament to amend and consolidate the law relating to energy, to provide for the establishment, powers and functions of the Energy Regulatory Commission and the Rural Electrification Authority, and for connected purposes. The provisions of this Act apply to every person or body of persons importing, exporting, generating, transmitting, distributing, supplying or using electrical energy; importing, exporting, transporting, refining, storing and selling petroleum or petroleum products; producing, transporting, distributing and supplying of any other form of energy, and to all works or apparatus for any of these purposes. The Act establishes a Commission known as the Energy Regulatory Commission, that among other roles, is expected to regulate (i) importation, exportation, generation, transmission, distribution, supply and use of electrical energy, (ii) importation, exportation, transportation, refining, storage and sale of petroleum and petroleum products; (iii) production, distribution, supply and use of renewable and other forms of energy. The Act in section 67 establishes a rural electrification authority. Among other tasks, this authority is mandated to: • Facilitate the access to electricity in rural areas • Promote the development of renewable energy (including solar, wind and micro hydro) • Levy a fee on all electricity sold for the rural electrification fund • Nothing in the Act prevents the authority from using funds collected under the rural electrification fund for financing renewable energy - it is not a special fund just for grid electricity. • The Act prescribes the manner with which licenses shall be obtained for generating, transmitting and distributing

Key Laws	Major Provisions
	electricity. It clearly exempts private users from these licensing requirements for any power less than 1MW generated at the user's premises. • However, a license is required if: • Generating is more than 1MW or • The power requires a transmission system from the generation site to the consumption site or • The power will be distributed to others (members of the public) • The specific requirements e.g. how much to pay for a license shall be determined by the energy commission. There is an unclear clause exempting power up to 3MW from some licensing issues, but this seems to be excluded by the specific exemptions that use the 1MW figure. Section 41(A) makes provisions for treating several licenses belonging to the same licensee as one (e.g. if you have several solar energy sites and you wish to compile one amalgamated annual report). The Act requires electrical installations to be done by a registered electrician. The Act also requires that all accidents and fatalities at energy facilities be reported officially to the commission.

Key Laws	Major Provisions
The Energy (solar photovoltaic systems) Regulations, 2012	These regulations applies to a solar PV system manufacturer, importer, vendor, technician, contractor, system owner, a solar PV system installation and consumer devices and also where alternate current electricity is involved the Electric Power (Electrical Installation Work), Rules, 2006, shall apply. The regulations states that "A person shall not design or install any solar PV system unless he is licensed by the Commission". It continues to state that to be licensed by the Commission as a technician; a person shall be required to have the prescribed qualifications and experience as set out in the First Schedule, and appropriate certification recognized by the Commission. The regulations also require a person not to engage in the business of manufacture of any solar PV system and components unless he applies for and obtains a license from the Commission.
The Water Act, 2016	The water Act, 2016 provides the legal framework for the management, conservation, use and control of water resources and for the acquisition and regulation of right to use water in Kenya. It also provides for the regulation and management of water supply and sewerage services. In general, the Act gives provisions regarding ownership of water, institutional framework, national water resources, management strategy, and requirement for permits, state schemes and community projects. Part IV of the Act addresses the issues of water supply and sewerage. Specifically, section 59 (4) of the Act states that the national water services strategy shall contain details of: • Existing water services • The number and location of persons who are not being provided with basic water supply and basic sewerage • Plans for the extension of water services to underserved areas • The time frame for the plan; and • An investment programme The project shall have no adverse impact on the local water supply during operations as there are no requirements for the installation of water supply and sanitation facilities on-site. Observation of the requirements

Key Laws	Major Provisions
	of the Act shall be observed by the Proponent especially during the construction phase.
The Forest Management and Conservation Act, 2016	The Forest Conservation and Management Act, 2016 gives effect to Article 69 of the Kenyan 2010 Constitution about forest resources; to provide for the development and sustainable management, including conservation and rational utilization of all forest resources for the socio-economic development of the country and for connected purposes. The Act applies to all forests on public, community and private lands. The principles of the Act lay emphasis on (a) good governance in accordance with Article 10 of the Constitution; (b) public participation and community involvement in the management of forests; (c) consultation and co-operation between the national and county governments; (d) the values and principles of public service in accordance with Article 232 of the Constitution; (e) protection of indigenous knowledge and intellectual property rights of forests resources; and (f) international best practices in management and conservation of forests. 5. Public Forest Policy (1) The Cabinet Secretary shall, in consultation with the county government. Further, the Act forms the baseline to develop a national forest policy and formulate a public forest strategy for the sustainable use of forests and forest resources. In addition, the Act, establishes the Kenya Forest Service to conserve, protect and manage all public forests in accordance with the provisions of this Act.
The Wildlife Conservation and Management Act, 2013	The Wildlife and Conservation Act deals with the conservation and management of wildlife in Kenya. The Act provides that wildlife should be conserved to yield optimum returns in terms of cultural, aesthetic, scientific and economic benefits. The Act requires that full account be taken of the inter-relationship between wildlife conservation and land use. The Act controls activities within the national parks, which may lead to the disturbance of wild animals. Unauthorized entry, residence, burning, damage to objects of scientific interest, introduction of plants and animals and damage to structure are prohibited under this law.
The Agriculture, Fisheries and Food	Legislative control over soil conversation and land development remain controlled within this Act. The Cabinet Secretary, on the advice of the Authority, and in consultation with the National Land Commission for the purposes of the conservation of the soil, or the prevention of the adverse

Key Laws	Major Provisions
Authority Act, 2013	effects of soil erosion on, any land, may, prescribe national guidelines for any or all of the following matters-- a) prohibiting, regulating or controlling the undertaking of any agricultural activity including the firing, clearing or destruction of vegetation when such prohibiting, regulating or controlling is deemed by the Cabinet Secretary to be necessary for the protection of land against degradation, the protection of water catchment areas or otherwise, for the preservation of the soil and its fertility; b) requiring, regulating or controlling-- i. the afforestation or re-afforestation of land; ii. the drainage of land, including the construction, maintenance or repair of drains, gullies, contour banks, terraces and diversion ditches; iii. Salination, acidification and saltification of soil; c) requiring the uprooting or destruction, without payment of any compensation, of any vegetation which has been planted in contravention of a land preservation order; i. requiring the supervision of unoccupied land; ii. prohibiting, restricting or controlling the use of land for any agricultural purpose excluding livestock
The Physical Planning Act, Cap 286	This Physical Planning Act, Cap. 286 provides for the preparation and implementation of physical development plans. Section 36 of the Act provides for environmental impact assessments and states that 'if in connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment

Key Laws	Major Provisions
	report'. The proponent and contractors of the proposed solar farm will need to comply with the requirements of this Act
The County Governments Act, 2012	This is an Act of parliament to give effect to Chapter Eleven of the Kenyan Constitution; to provide for County government's powers, functions and responsibilities to deliver services and for connected purposes. Section 113 of the Act makes public participation in County planning processes compulsory
The Standards Act, Cap 496	The Act is meant to promote the standardization of the specification of commodities, and to provide for the standardization of commodities and codes of practice; to establish a Kenya Bureau of Standards, to define its functions and provide for its management and control. Code of practice is interpreted in the Act as a set of rules relating to the methods to be applied or the procedure to be adopted in connection with the construction, installation, testing, sampling, operation or use of any article, apparatus, instrument, device or process. The Act contains various specifications touching on electrical products. The Proponent shall ensure that commodities and codes of practice utilized in the project adhere to the provisions of this Act.
The Public Health Act (Chapter 242) Revised Edition 2012	The public Health Act regulates activities detrimental to human Health. An environmental nuisance is one that causes danger, discomfort or annoyance to the local inhabitants or which is hazardous to human health. Although the Act is primarily concerned with domestic water supplies and sources of water used for human consumption, its regime may be extended to cover rivers, streams, lakes and underground water resources since these are the basic water sources for the majority of Kenya's population. It also outlines the standards of construction of various facilities of any place. In terms of air pollution thermal plants are said to emit a variety of gases, volatile organic compounds and particulate matter depending on the amount and type of fuel used and method used for burning. It is therefore necessary to monitor the air pollution. The Act prohibits activities (nuisances) that may be injurious to health. The primary purpose of the Act is to secure and maintain public health. It defines

Key Laws	Major Provisions
	nuisances on land and premises and empowers public health authorities to deal with such conditions. Part IX, section 115, of the Act states that no person/institution shall cause nuisance or condition liable to be injuries or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to be injuries or dangerous to human health. On responsibility of the Local Authorities Part XI, section 129, of the Act states in part "It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its County has a right to use and does use for drinking or domestic purposes. Section 130 provides for making and imposing regulations by the local authorities and others the duty of enforcing rules in respect of prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in section 129. This provision is supplemented by section 126A that requires local authorities to develop by laws for controlling and regulating among others private sewers, communication between drains, power lines, and sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter. Part XII, Section 136, states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitates the breeding or multiplication of pests shall be deemed nuisances and are liable to be dealt with in the matter provided by this Act. The Proponent shall observe policy and regulatory requirements and implement measures to safeguard public health and safety.
Employment Act No 11 of 2007	This Bill gives effect to the Constitution, international treaties and conventions on marine pollution, provide for the prevention, mitigation and control of pollution of the sea from ship transport operations, preparedness and response for pollution emergencies arising from ship transport operation, liability and compensation for pollution damage arising from shipping transport operations or pollution damage resulting from exploration and exploitation of seabed mineral resources and for

Key Laws	Major Provisions
	connected purposes. The Act is enacted to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratization of trade unions and employers organizations and federations. Its purpose is to promote sound labour relations through freedom of association, the encouragement of effective collective bargaining and promotion of orderly and expeditious dispute for the protection and promotion of settlement conducive to social justice and economic development for connected purposes. This Act is important since it provides for employer – employee relationship that is important for the activities that would promote management of the environment within the energy sector.
Labour Institutions Act No. 12 of 2007	The purpose of the Act is to establish labour institutions and to provide for their function, powers and duties. The Act provides for the establishment of National Labour Board, which provides advice to the Minister on all matters concerning employment and labour.
Penal Code Cap 63	Section 191 of the penal code states that if any person or institution that voluntarily corrupts or foils water from public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same Act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighbourhood or those passing along public way, commit an offence. The Proponent shall observe the guidelines as set out in the environmental management plan laid out in this report as well as the recommendation provided for mitigation/ minimization/ avoidance of adverse impacts arising from the project activities.
HIV/AIDS Act, 2006	Section 3 of The Act indicated the purpose of the legislation including public awareness and rights to people living with HIV/AIDS. Public awareness shall be achieved through education, public campaigns even at workplaces. This Act's provisions then give the guidelines unto which the project shall follow in educating workers and staff and providing of incentives to combat HIV/AIDs.

Key Laws	Major Provisions
National Gender and Equality Commission Act, 2011.	The Commission was established through an Act of parliament and is mandated but not limited to perform the following functions: (a) promote gender equality and freedom from discrimination in accordance with Article 27 of the Constitution; (b) monitor, facilitate and advise on the integration of the principles of equality and freedom from discrimination in all national and county policies, laws, and administrative regulations in all public and private institutions; (c) co-ordinate and facilitate mainstreaming of issues of gender, persons with disability into the overall national development framework.

Table 4-2: Relevant policy

Key Policies	Major Provisions
The Kenya Vision 2030	The development blueprint recognizes Kenya's electrification as a prerequisite in attaining the different projects for the national development. Moreover, Environment's cleanliness and security is ensured via protection and conservation and conservation of sensitive areas such wetlands and wildlife corridors and migratory routes which can be done by conducting project's Environmental and Social Impact Assessments and developing of comprehensive mapping of land use patterns in Kenya.
National Energy and Petroleum Policy, 2015	This policy was formulated to beef up the Sessional Paper No. 4 on Energy. The overall objective of the policy is to ensure affordable, competitive, sustainable and reliable supply of energy to meet national and county development needs at least cost, while protecting and conserving the environment. On solar energy, the policy recommends that there should be regular review of standards for solar energy technologies and equipment, provide a framework for connection of electricity generated from solar energy to national and isolated grids, through direct sale or net metering and RD&D should be undertaken on solar technologies.

Key Policies	Major Provisions
The Feed-in-Tarrif (FiT) Policy, 2008	This is an instrument to promote the generation of electricity from renewable energy sources. It enables a utility to produce Renewable Energy Sources Generated Electricity (RES-E) and sell the output to a distributor at a pre-determined tariff for a given period of time. The objectives of the FiT Policy are to: • Facilitate resource mobilization by providing investment security and market stability for investors in electricity generation from Renewable Energy Sources. • Reduce transaction and administrative costs and delays by eliminating the conventional bidding process and lengthy negotiations of PPA. • Encourage private sector investors to operate their plants prudently and efficiently so as to maximize returns.
Sessional Paper No. 3 of 2016, National Climate Change Framework Policy	This Policy was developed to facilitate a coordinated, coherent and effective response to the local, national and global challenges and opportunities presented by climate change. An overarching mainstreaming approach has been adopted to ensure the integration of climate change considerations into development planning, budgeting and implementation in all sectors and at all levels of government. This Policy therefore aims to enhance adaptive capacity and build resilience to climate variability and change, while promoting a low carbon development pathway.
Sessional paper No.4 on Energy, 2004	The Sessional paper No.4 on Energy of Kenya's vision is to promote equitable access to quality energy services at the least cost while protecting the environment and thus it does recognize the importance of harnessing and utilizing solar energy. Additionally, the Sessional Paper states that; the Government recognizes the great potential of this source of energy and will encourage the development and utilization of appropriate technologies in attaining its vision. Where the Commission finds that any provisions of these Regulations have been contravened by a manufacturer, importer, vendor, technician or contractor, or that a condition has arisen which may lead to the

Key Policies	Major Provisions
	contravention of these Regulations, the Commission or its agent may issue a non-compliance notice in that respect.
The Kenya National Climate Change Response Strategy	The purpose of this strategy is to put in place robust measures needed to address most of the challenges posed by climate variability and change through thorough impact assessments and monitoring of various projects. In the Energy sector, priority research areas include energy efficient innovations and technologies, and both low-carbon appliances and tools; the development of eco-friendly energy resources such as wind, solar, biogas, small hydros, etc; as well as research on the sustainability of biofuels especially Life Cycle Assessment (LCA) of biodiesel.

4.3 Institutional Framework

Sessional Paper No. 4 of 2004 and the Energy Act No.12 of 2006 restructured the sector in a bid to facilitate high level performance. The Policy has enabled increased private sector participation in the development of the sector whilst focusing on improved management and delivery of energy services. This was intended to enable the sector achieve its mission of providing clean, sustainable, affordable, reliable and secure energy services at least cost while protecting the environment. The table below outlines the key actors in the sector.

Table 4-3: Key actors in the energy sector

Key Actors	Major Roles
Ministry of Energy	Under the leadership of a Cabinet Secretary, the ministry is responsible for formulation and articulation of energy policies through which it provides an enabling environment for all stakeholders. Its tasks include national energy planning, training of manpower and mobilization of financial resources.
Energy Regulatory Commission (ERC)	It was established as an energy sector regulator under the Energy Act, 2006, with responsibility for economic and technical regulation of electric power, renewable energy, and downstream petroleum sub-sectors. Its functions also include tariff setting, review, licensing, enforcement, dispute settlement and approval of power purchase and network service contracts

Key Actors	Major Roles
Energy Tribunal	This quasi-judicial body was established under section 108 of the Energy Act, 2006. It came into operation in July 2007 to primarily hear appeals against the decisions of ERC. It also has jurisdiction to hear and determine all matters referred to it relating to the energy sector
Kenya Power	A State Corporation with Government of Kenya (GoK) shareholding of 50.1% and private shareholding of 49.9% as at June 2014. It purchases electrical energy in bulk from KenGen and other power producers and carries out transmission, distribution, supply and retail of electric power.
Kenya Electricity Generating Company Limited (KenGen)	A State Corporation with GoK shareholding of 70% and private shareholding of 30% as at June 2014. It is mandated to generate electric power, currently producing the bulk of electricity consumed in the country. The company currently utilises various sources including hydro, geothermal, thermal and wind to generate electricity.
Rural Electrification Authority (REA)	REA was established under section 66 of the Energy Act of 2006 as a corporate body with the principal mandate of extending electricity supply to rural areas, managing the rural electrification fund, mobilizing resources for rural electrification and promoting the development and use of renewable energy.
Kenya Electricity Transmission Company Limited (KETRACO)	This is a GoK wholly owned company established to be responsible for the development, maintenance and operation of the national transmission grid network. It is also responsible for facilitating regional power trade through its transmission network.
Geothermal Development Company Limited (GDC)	This is a 100% state-owned company established by the Government of Kenya as a Special Purpose Vehicle for the development of geothermal resources in Kenya.

4.4 Kenya Power Codes and Regulations

4.4.1 Kenya Power Land Acquisition Procedure

4.4.1.1 Power Lines for Low Voltage

A reconnaissance survey is first done to search for the best possible route. It is Kenya Power policy to avoid existing structures as much as possible. Once the best route has been established, a meeting between the Kenya Power staff, the locals and the local administration is arranged. During this meeting Kenya Power formally requests for permission to survey the area. Once this is agreed upon, the surveyor moves to site and takes detailed profiles of the area and also places pegs where the poles are to be located. The surveyor then prepares a cadastral map of the area showing the plot numbers and the route of the power lines as well as the position of the poles.

The Way leaves Section of the Kenya Power then prepares a way leaves agreement showing the specific affected plot and the proposed route. The individual owner is then approached with this proposal and his consent is requested. The owner is compensated for buildings or crops that are on the land. However, the owner is not allowed to grow anything higher than 12 feet within five meters of the poles or line.

Kenya Power also consult with other relevant institutions such as Telkom Kenya, County Councils, Airport Authorities, Kenya Pipeline Company, Kenya Ports Authority, Department of Defense, Kenya Wildlife Service, Conservatoire of Forests and Ministry of Public Works and Housing to ensure that their proposal is in harmony with other proposed developments.

4.4.1.2 High Voltage Lines

A similar procedure is undertaken in assessing the best route as in the case for the low voltage lines. The land required is of 30 meters width. Once the best route is established the landowner is approached with this proposal and his consent is requested. The owner is compensated for the land through negotiations to agree on a compensation rate. The owner is also compensated for buildings or crops that are on the land.

4.4.2 Kenya Electricity Grid Code & Kenya Safety Code

The consultant also reviewed the Kenya Electricity Grid Code, which sets out detailed arrangements for the regulation of the Kenya electricity supply industry and is enforceable under the Electric Power Act, No 11 of 1997. In addition to the Kenya Electricity Grid Code, the consultant reviewed the Kenya Safety Code, which recognizes the Factories Act, 1962 (Rev.1972) which requires an employee to use any means or appliance provided by the Employer for securing safety and also not willfully to do anything likely to endanger himself or others.

4.5 Relevant International Conventions and Treaties

Kenya is signatory to several international conventions and treaties that would need to be adhered to in implementing this project and are geared towards environmental protection and conservation. Some of these include;

a) ILO Conventions ratified by Government of Kenya- Kenya have ratified 43 ILO conventions and those that are relevant to this study includes
   - Safety and Health in Construction Recommendation, 1988
   - Recruiting of Indigenous Workers Convention, 1936 (No.50)
   - Contracts of Employment (Indigenous Workers) Convention, 1939 (No. 64)
   - Minimum Age Convention, 1973 (No. 138) Minimum age specified: 16 years
   - Migrant Workers (Supplementary Provisions) Convention, 1975 (No. 143)

b) Convention on Biodiversity (CBD)
c) Convention on the Conservation of Migratory Species
d) United Nations Framework Convention on Climate Change(UNFCCC): Paris Agreement
e) United Nations Convention to Combat Desertification(UNCCD)
f) The World Heritage Convention
g) New Partnership for Africa Development (NEPAD)

The Ministry of Foreign Affairs deals with international treaties at the primary stages of negotiation. The ministry offers advisory guide to the government on the need to ratify such a treaty if considered to be of national interest. Implementation portfolio then moves to the line ministry, relevant departments and co-operating agencies.

4.6 Lenders Requirements

The project proponent is yet to finalise on the lenders or funding agency for the Solar Farm. Nonetheless there are already ongoing discussions with AfDB and JICA. In this essence, the consultant has reviewed the key ESIA compliance requirements for the two prospective lenders.

4.6.1 JICA - Guidelines for environmental and social considerations

Japan International Cooperation Agency (JICA) Business Protocol and Mid-term Plan clearly state that JICA implements cooperation activities in accordance with the environmental and social considerations guidelines (2010). JICA encourages host country governments, including local governments, borrowers, and project proponents, to implement the appropriate measures for environmental and social considerations when engaging in cooperation activities. At the same time, JICA provides support for and examinations of environmental and social considerations in accordance with the guidelines.

The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support

for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., to facilitate the achievement of these objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

JICA recognizes the following seven principles to be very important.

i. A wide range of impacts must be addressed. The types of impacts addressed by JICA cover a wide range of environmental and social issues.
ii. Measures for environmental and social considerations must be implemented from an early stage to a monitoring stage. JICA applies a Strategic Environmental Assessment (SEA) when conducting Master Plan Studies etc. and encourages project proponents etc. to ensure environmental and social considerations from an early stage to a monitoring stage.
iii. JICA is responsible for accountability when implementing cooperation projects. JICA ensures accountability and transparency when implementing cooperation projects.
iv. JICA asks stakeholders for their participation. JICA incorporates stakeholder opinions into decision-making processes regarding environmental and social considerations by ensuring the meaningful participation of stakeholders to have consideration for environmental and social factors and to reach a consensus accordingly. JICA replies to stakeholders' questions. Stakeholders who participate in meetings are responsible for what they say.
v. JICA discloses information. JICA itself discloses information on environmental and social considerations in collaboration with project proponents etc., to ensure accountability and to promote the participation of various stakeholders.
vi. JICA enhances organizational capacity. JICA makes efforts to enhance the comprehensive capacity of organizations and operations for project proponents etc., to have consideration for environmental and social factors, appropriately and effectively, at all times.
vii. JICA makes serious attempts at promptness. JICA addresses request of acceleration for the prompt implementation of projects while undertaking environmental and social considerations.

JICA classifies projects into four categories according to the extent of environmental and social impacts, considering an outline of project, scale, site condition, etc.

- **Category A:** Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect an area broader than the sites or facilities subject to physical

construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas. An illustrative list of sensitive sectors, characteristics, and areas is provided in Appendix 3.

- **Category B:** Proposed projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.
- **Category C:** Proposed projects are classified as Category C if they are likely to have minimal or little adverse impact on the environment and society.
- **Category FI:** Proposed projects are classified as Category FI if they satisfy all of the following requirements: JICA's funding of projects is provided to a financial intermediary or executing agency; the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal); and those sub-projects are expected to have a potential impact on the environment.

When necessary, JICA can change a category even after screening. This might occur such as when a new significant impact has come to light as a result of the cooperation project process, or in other specific situations. JICA reviews the categorization accordingly after projects have been identified with a progression of studies. JICA requests that Project proponents fill in the guidelines screening form whose information acts as a reference for the categorization of proposed projects. Based on the ESIA studies, the solar power farm project falls under category B of JICA ESIA guidelines. The project proponent will therefore ensure full compliance of the guidelines to meet the lenders compliance criteria.

4.6.2 AfDB- Environmental and Social Assessment Procedures (ESAP)

According to the Africa Development Bank (AfDB) Environmental and Social Assessment Procedures (ESAP), the proposed project is a Category 2 project i.e. "*projects likely to induce detrimental, site-specific environmental and/or social impacts that can be minimised by including mitigation measures in an ESMP and in an Abbreviated Resettlement Action Plan (ARAP), when applicable."* therefore necessitating the need for this ESIA study.

The AfDB has further developed safeguard policies that are to be considered in reference to development projects. Below is a highlight on the safeguard policies and their possible trigger/none trigger by the proposed development:

- Operational Safeguard 1: Environmental Assessment: this operational safeguard is triggered since the proposed project falls under category 2 and is subject to a de facto environmental and social impact assessment;
- Operational Safeguard 2: Involuntary Resettlement – this operational safeguard is triggered since the project entails resettlement;
- Operational Safeguard 3: Biodiversity, Renewable Resources and Ecosystem Services: this operational safeguard is not triggered since the project does not affect areas with biodiversity or ecosystem services potential.
- Operational Safeguard 4: Pollution Prevention and Control, Greenhouse gases, hazardous materials and efficient use of resources: This operational safeguard is not triggered since the proposed project is a green and environmentally friendly project; and
- Operational Safeguard 5: Working Conditions, Health and Safety: this operational safeguard is triggered since there are risks to the health and safety during the various phases of the project.

5 PUBLIC PARTICIPATION

5.1 Introduction

The Consultation and Public Participation (CPP) Process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated by EMCA (Cap 387) section 58, on ESIA for achieving the fundamental principles of sustainable development. This chapter describes the process of the public consultation and public participation followed to identify the key issues and impacts of the proposed project. Views from the local residents, local leaders, surrounding institutions and development partners for the proposed construction of the 40MW Kitui solar power farm project who in one way or another would be affected or have interest in the proposed project, were sought through interviews and public meetings as stipulated in the Environment Management and Coordination Act (Cap 387).

5.2 Objectives of the consultation and public participation

The objective of the consultation and public participation was to:

1) Disseminate and inform the public and stakeholders about the project with Special reference to its key components and location
2) Create awareness among the public on the need for the EISA for the proposed project
3) Gather comments, suggestions and concerns of the interested and affected parties
4) Incorporate the information collected in the ESIA study

In addition, the process enabled the establishment of a communication channel between the general public and the team of consultants, the project proponents and the Government; and the concerns of the stakeholders to be known to the decision-making bodies at an early phase of project development.

5.3 Methodology used in the CPP

The public consultation and participation was conducted through;

1. Household socio-economic survey
2. Key stakeholder interviews
3. Public Meetings
4. Focused Group Discussions

The procedures used for each of the above are outlined below;

5.3.1 Household socio-economic survey

Household socio-economic surveys were conducted during the field visits. This was done using structured questionnaires (Sample Questionnaire attached in Appendix I) to assess the socio-economic status of the project area.

5.3.2 Key Stakeholder Consultation

Key stakeholder consultative meetings were conducted on 7th March 2018. The key stakeholder engagements were conducted to foster better and mutual understanding of public concerns as well as incorporate key stakeholders' opinions to this report.

The following stakeholders were consulted:

- Kitui County Wildlife Department
- Water Resources Authority-Kitui
- State Department of Agriculture
- State Department of Livestock
- Rural Electrification Authority (REA)
- Ministry of Environment and Energy Kitui County
- Ministry Agriculture Water and Livestock-Kitui County
- Ministry of Education ICT and Youth Development
- Ministry of Lands Infrastructure Housing and Urban Development Kitui County
- Ministry of Health and Sanitation Kitui County
- Ministry of Trade Cooperative and Investment
- Sub-County Administrator Yatta/ Kwa Vonza Ward
- Katoteni Nguamka Farmers Environmental Conservation Group
- Kenya Forest Research Institute (KeFRI)
- County Assembly Environment Committee
- South Eastern Kenya University (SEKU)
- National Lands Commission-Kitui
- National Youth Council
- Directorate of Occupational Health and Safety-Kitui
- Sustainability Consult
- National Drought Management Authority
- Local
- Kenya Meteorological Department
- Kitui Chamber of Commerce
- Charcoal Producers Federation of Kenya
- CARITAS-Kitui
- Kitui Development Centre
- Anglican Development Services- Eastern
- ADRA(Adventist Development and Relief Agency) Kenya
- Kenya Electricity Transmission Company

The plates below show photos of the key stakeholders meeting that was held on 7th March 2018 at Melia Hall KeFRI Kitui.

Plate 5:1: The ESIA consultant engaging the Key stakeholders

Plate 5:2: A stakeholder giving his views on the project

Plate 5:3: A stakeholder raising his concerns about the proposed project

5.3.3 B2 Yatta Ranch key Stakeholders meeting

Another key stakeholders meeting was held on 15th May 2018 at Nyumbani County Club in Kanyonyo Centre. This meeting specifically targeted B2 Yatta Ranch Co-operative Society Limited who claimed land ownership on the project site. The meeting was aimed at collecting the B2 Yatta Ranch Committee opinions to assist in the project study. Minutes of the meeting are attached in the appendix.

Plate 5:4 B2 Yatta Ranch Committee Stakeholders meeting

5.3.4 Focused Group Discussions (FGDs)

FGDs were conducted for specific groups of people such as youth, women and the elderly within the community. A structured guideline was used to get their specific views with regards to the project.

Views from the local community, local leaders, surrounding institutions and development partners for the proposed Kitui Solar farm project, who in one way or another would be affected or have interest in the proposed project were sought through interviews and public meetings as stipulated in the Environment Management and Coordination Act, EMCA Cap 387.

5.3.5 Public meetings

Three public participation meetings were conducted in three market centres within the proposed project site i.e. Musingi, Kapenguria and Ndelekeni. The local chief was used to mobilize the public to attend the meetings, at least 150 Public Participation Notices were issued per centre; they were displayed in prominent locations like markets, mosques, churches and schools. The announcements for the meetings were also made in places of worship and chiefs barazas. A total of 239 people (138 Male and 102 Female) participated in the public meetings while 92 questionnaires were administered to capture the key concerns of stakeholders within the project area. The minutes of the meetings are appended in Appendix F of this report. Below is summary of the number of people targeted as well as photos from some of the meetings held.

Table 5-1: Summary of Public Meetings and Key Stakeholders Meetings Conducted

S/No.	Market Centre/Venue	Number of Participants			Date of Meeting
		Male	Female	Total	
1.	Musingi	71	41	112	22nd February 2018
2.	Kapenguria	34	38	72	23rd February 2018
3.	Ndelekeni	32	23	55	23rd February 2018
4.	KeFRI Hall Kitui	31	9	40	7th March 2018
5.	Nyumbani County Club Kanyonyo Centre. (B2 Yatta Meeting)	15	1	16	15th May 2018
Total Participants		183	112	295	

Plate 5:5: Public Consultative Meeting at Musingi Market Centre

Plate 5:6: A member of the community at Musingi market centre raising his views

Plate 5:7: A woman raising her views for the proposed project

Plate 5:8: Public participation meeting at Kapenguria market centre

Plate 5:9: Public participation meeting at Ndelekeni market centre

5.4 Issues Emerged From the Consultations

The Construction of the 40MW Solar Power Farm Project was received with mixed reactions by the community as they anticipated numerous impacts both negative and positive alike.

The local community members and major stakeholders independently gave their views, opinions, and suggestions as in the best of their interest and in the interest of the factors that affected the circumstances, influences, and conditions under which their organizations exist in.

5.4.1 Positive impacts

5.4.1.1 Employment to local youths and the community

Youths were quick to ask whether they will be employed as both skilled and unskilled workers during construction and operational stages. They were informed that throughout the construction phase local youths (3000) will benefit as manual laborers and later a few will be trained and absorbed as technical personnel. It was further clarified that the employment will include youths from Katoteni area who will be given priority. Direct and indirect employment opportunities were said to arise as soon as construction begins. The local youths will be employed as casual labourers during Construction phase to earn a living thus improving living standards. The food vendors (especially women) and transporters are likely to benefit from the construction workers thus creating indirect employment opportunities.

5.4.1.2 Business opportunities

The residents indicated that during the construction and operation, the project would provide more business opportunities to the community at the centers near the project site which include: Musingi, Katoteni, Nzokani, Kapenguria and Kanyonyoo thereby improving their livelihoods.

5.4.1.3 Expansion of local market centres

The residents were optimistic that the local centres such as Ndelekeni, Nzokani, Musingi and Kanyonyoo will expand to accommodate the workers who will be working in the project. This in turn will lead to infrastructure development especially housing within the area

5.4.1.4 Benefits to local institutions

The locals wanted the assurance that the proposed development will prioritize on benefiting the neighboring schools, dispensaries, hospitals, camps and other infrastructure. The ESIA Consultant explained to them that the output energy will be connected to the national grid, after which Kenya Power and KETRACO will facilitate supply from High voltage power lines to local areas in required quantity for consumption. Depending on availability of funding, the Proponent will carry out some social infrastructural projects in the area on the priority of the community.

5.4.1.5 Increase in Land value

The local community expressed their optimism with respect to increase in land value in the area as a result of establishment of the proposed development. The ESIA Consultant

explained that there is potential for increase in land value in the area because of increased population due to construction and operation of the facility, availability of electricity, business expansion and improvement of social infrastructure and this will likely attract land buyers from other Counties and regions.

5.4.1.6 Provision of market for local construction materials

The local community enquired about creation of opportunities for local suppliers to supply raw materials for the project construction. The communities were informed that the project will require supply of construction materials such as metals, sand and cement most of which will be sourced locally. However, most of the required materials like solar panels will be imported from Japan since they are not manufactured in the Country.

5.4.1.7 Boost in Agriculture

The local community were hopeful that the proposed project, through CSR activities would fund water projects which will provide water for the irrigation of their farms. The project area has a high potential for agriculture since it has very fertile black-cotton soils. However, there is a challenge is lack of water for irrigation since the local community only relies on rain-fed agriculture.

5.4.2 Negative Impacts

5.4.2.1 Displacement of Project Affected Persons

The Community needed a clarification on how the displacement of persons currently residing in the proposed including those who use the land for livestock rearing and crop farming will be addressed by the Proponent. The ESIA Consultant responded by stating that prior to displacement an analysis of alternatives sites will be undertaken and if avoidance of resettlement is not feasible, the Proponent will carry out a RAP and offer choices among feasible resettlement options which include adequate replacement housing or cash compensation at full replacement costs for the property lost.

5.4.2.2 Loss of trees/vegetation

The stakeholders and the local community were concern that the proposed project location site has indigenous trees which will be cleared for the construction of the solar farm. Consequently, being a semi-arid area, the trees are valuable in the area.

The consultant informed them that this will be mitigated by the proponent through a revegetation exercise while in consultations with key stakeholders such as the County Government of Kitui and KeFRI.

5.4.2.3 Loss of agricultural/ grazing land

The community members were concern that part of the land is used by the locals for agricultural activities. They were uncertain if they will still be allowed to use the area for their farming/grazing activities. The consultant informed them that the entire land will be fenced but there will be gates for the provision of goats to graze at the site.

5.4.2.4 Increased insecurity in the area surrounding the project

The community was concerned that the development of the Solar Power Project would lead to increase in insecurity in the area due to influx of workers. The Consultant responded by explaining that insecurity would be addressed through enhanced community policing and close collaboration between the Administration Officers whose camp is within Katoteni area and the public. He added that the Proponent will offer security for its premises by employing security personnel.

5.4.2.5 Spread of diseases such as HIV/AIDS

Members of the community were also concerned that due to influx of population in the area, this would have an impact on the social and moral values among the people characterized by change of lifestyle and this will likely lead to spread of diseases such as HIV/AIDS among the people. The Consultant explained that there will be sensitization initiatives locally to sensitize the people on HIV/AIDS prevention.

5.4.2.6 Increase Traffic

The residents were concerned that the proposed development will cause an increase in traffic especially during the construction phase because of movement of trucks carrying construction materials to the site. The Consultant explained that the proponent will undertake traffic assessments around the proposed site to identify potential impacts and provide technical recommendations for mitigating the potential traffic impacts.

5.4.2.7 Solid Waste generation

The residents were concerned that the project will lead to generation of solid wastes such as broken metals and papers among others and needed information on how the proponent intends to manage these solid wastes. The Consultant stated that the proponent will develop an integrated solid waste management system which considers prevention, reduction at the source, recycling, re-use, recovery, treatment and disposal at permitted landfills. He explained that the proponent will implement technically, financially and cost-effective measures to manage the solid wastes generated.

5.4.2.8 E-Waste generation.

Through the consultations that were carried out, the residents of Katoteni area were concerned about the potential health and safety impacts resulting from the broken solar panels during the operational phase of the proposed project. The residents were assured that the potential impacts of the solar project will be addressed through recycling of the broken solar panels when the project life ceases. They were also informed that the lifespan for solar panels is approximately 30-40yrs after which they will be replaced by new panels

while the old ones will be recycled. This will be carried out by legitimate enterprises registered licensed by competent government authority (NEMA).

5.4.2.9 Soil erosion/ Storm water management

The communities living around the proposed project site needed clarification on how the proponent will manage the storm water run-off/erosion emanating from its facility during operations since the storm water was likely to affect the quality of water in the nearby Kyenze Earth Dam. It was clarified that ambient water quality levels of Kyenze Earth Dam would be established during the ESIA study and the water quality of the Dam will be monitored periodically as practicable during the operational phase of the facility.

5.4.2.10Social Impacts

The locals were concern about social impacts that might arise because of the proposed development. They gave reference of how other projects that were a blessing to the community had led to social vices such us gender-based violence, sexual and child exploitation and abuse etc. The consultants informed the members that the proponent will put into consideration these issues and develop programmes for the education of both workers and community members on these issues. Further, an office for reporting and dealing with such issues will be operational throughout the project timeline.

5.4.2.11Injuries to workers

There was a concern that the workers are likely to be exposed to work place hazards and risks in both construction and operational phases of the facility with the likelihood to cause accidents and injuries to workers. The residents were assured that the adequate control measures will be implemented to manage occupational hazards and risks which include the provision of PPE's in conjunction with other facility control and safety systems.

6 POTENTIAL ENVIRONMENTAL IMPACTS

6.1 General

Environmental and Social Impact Assessment (ESIA) is used as a tool to guide environmentally sustainable decisions. The proposed 40MW solar power farm construction is envisaged to generate direct and indirect impacts. Potential impacts discussed in this chapter are also linked to the different stages of the project which are identified as construction, operation and decommissioning. The potential Impacts are derived from the proposed project activities discussed in Chapter 2 and the baseline information contained in Chapter 3.

6.2 Identification of Environmental Impacts

In order to identify the potential impacts, the study team ensured that the public and key stakeholders were consulted to come up with a detailed list of these impacts. Scoping discussions were held with various interested and affected parties within the solar power project's site environs during the fieldwork. In these discussions key environmental issues relating to solar power project implementing activities were identified. The study team used both structured questionnaires/ interviews and non-structured discussions to solicit for information. The potential impacts of the proposed project are categorized into construction, operational and decommissioning phases as listed below. A detailed ESMP in Chapter 10 of this report outlines the considered mitigation measures for each of the listed negative impacts.

6.3 Positive impacts during Construction Phase

6.3.1 Job creation

Throughout the lifetime of the proposed facility, job opportunities shall be created, these being the need for about 3000 casuals and trained personnel during the construction phase spanning over 12 months; around 200 personnel required to operate the facility over a period of 20 to 25 years. The project will also assist the Government in its policy of employment creation, enhancing and promoting Green energy projects in line with Vision 2030.The project through the generation of employment will stimulate other economic activities and also enhance the casuals' skill levels through intensive and well-structured technology transfer.

6.3.2 Provision of market for local construction materials

The project will require some supply of construction materials such as metals and fencing materials most of which will be sourced locally within Kenya. However, most of the required materials like solar panels will be imported since they are not manufactured in the Country. In turn this will enhance people who directly or indirectly depend on this business.

6.3.3 Boost of the surrounding business enterprises

The project will employ quite a number of people to work in the facility. This people need goods and services to be supplied by the business enterprises within the project site. For instance, *bodabodas* will be ferrying workers to and from the site. There enterprises within the project area will benefit from increased customer base from construction crew as well as people who will be visiting the solar power project during operational phase of the solar project.

6.3.4 Transfer of Skills

The project will employ a substantial number of skilled employees some of whom might not be available in the project locality. As such, through the interaction of the locals with the skilled employees from without the area, they will acquire new skills.

6.3.5 Expansion of local centres

During the construction stage of the project, it is anticipated that local centres will expand due to the volumes of people, businesses and transactions that will be carried out within the area. Also, the influx of workers within the project will cause an immediate expansion of the local infrastructure e.g. housing.

6.3.6 Gains in the local and national economy

There will be gains in the local and national economy. Through consumption of locally available materials including: fencing materials among others. The consumption of these materials, fuel oil and others will attract taxes including VAT which will be payable to the government. The cost of the materials will be payable directly to the producers.

6.4 Negative Impacts during Construction Phase

6.4.1 Displacement of people

The current proposed project location is inhabited by people. There are approximately 10 families that have developed permanent and semi-permanent houses on the land while at least 30 individuals claim to have ownership of the land. As such, there is expected to be displacement of people during the construction phase of the project.

6.4.2 High demand of raw materials

The nature and the magnitude of the proposed project will lead to an increase in demand for raw materials needed for construction of the facility. These materials will be sourced locally or if unavailable they will be sourced from the neighbouring counties and they will include: rocks, sand and cement, fencing material among others.

6.4.3 Vegetation and tree loss

Destruction of flora and fauna within the site during site clearance to pave way for the project will be inevitable. The project site contains a few mature indigenous tree species such as acacia, comiphorous, terminalia, ras natalensis among others which will be cleared during site preparation. There are no known protected species or significant habitats that will be adversely impacted by the construction of this project. There is also no conservation area to be affected by the project.

6.4.4 Storm water, run-off and Soil Erosion

The proposed project has the potential to generate storm water and run-off based on the nature of activities that will be carried out during construction and will also lead to loss of productive land due to soil erosion. Soils can be impacted as a result of compaction with heavy machinery used for the establishment of panel stands and the transmission line. These impacts can be managed by restricting the use of heavy machinery and vehicles to designated work areas and installing soil protection works in areas sensitive to erosion prior to construction.

6.4.5 Impacts on Surface Waters

The project site is characterized by Kyenze Earth Dam on the North East side of the proposed project site. Neighboring residents use the dam as a watering point for their animals. Construction of the solar power farm may lead to potential impacts on the dam as a result of soil erosion and storm water movements when not managed effectively. Some of the potential impacts on the dam will include: siltation and water quality degradation.

6.4.6 Loss of agricultural and grazing land

The proposed site is currently being utilized for crop growing and livestock grazing. The construction activities and the establishment of the proposed facility will result in a reduction in the area of land that is available for agricultural use. In addition, the residents in the adjacent community land use the project site for livestock activities such as a grazing land and for watering points. It is important to note that livestock like sheep (not goats or cattle because they are destructive) can be allowed to graze below the panels.

6.4.7 Solid Waste and excavated material

The project doesn't envisage major excavation works, thus, the solid waste will be minimal. Solid topsoil wastes from the sites will be the main form of solid waste. Some of the excavated soil through leveling some points will be reused, as backfill while the rest will be disposed of to the designated areas. Other solid wastes will include metallic pieces, wooden planks, and

stone debris. All these wastes will be disposed of according to the legislation guiding the same.

6.4.8 Dust and vehicle emissions

During construction stage the air quality of the area will be directly affected and made worse by dry, windy and dusty weather. The impact will be a major challenge especially during site clearance and solar panel mounting structure construction and movement of building materials to and from the site. The frequent upwelling of dust as consequence of construction may impact on workers causing asthma and other respiratory conditions. Further, increase movement of construction equipment will also increase the emission of pollutants. The people in the immediate project vicinity as well as commuters in open vehicles will be affected directly. Gasoline and diesel vehicles and engines used during the construction period will emit pollutants such as carbon dioxide, suspended particulates, nitrogen dioxide, vaporized lead and sulfur dioxide.

6.4.9 Noise pollution

During the construction, there is the potential for permissible/acceptable human noise levels that may be temporarily exceeded due to the operation of lorries, moving machines and equipment in the working zone of the solar power project site. To be affected mostly, are the site workers since noise beyond some level is a nuisance if not maintained within acceptable limits. Noise abatement measures will be taken within the project site including scheduling working time and provision of the correct PPE.

6.4.10 Increased energy consumption

The proposed development will lead to increase in energy consumption through lighting of the construction area and temporary shelters housing the administrative staff and other technical workers. In addition to this, the operation of machinery and vehicles during construction works will also lead to increased energy consumption in the form of electricity, diesel and gasoline.

6.4.11 High water demand

The proposed project is likely to impact on existing water resources in the area as water will be used to meet the construction demands in construction of solar panel stands and other associated facilities that are essential for the viability of the project. Water will also be utilized to meet the sanitary demands such as drinking and washing by the personnel working in the project.

6.4.12 Occupational Health and Safety

There is possibility of accidents occurring in the process of construction. This is likely to be experienced by the construction staff. Project management will provide first aid and possibly primary health care services to staff and other personnel. Emergency and serious cases can be sent to the most accessible clinics and hospitals.

6.4.13 Hazardous material spillage

As a result of the spillage of lubricant, fuel, during construction, soil condition may deteriorate. The spillage of such chemicals will negatively impact the condition of the soil, as this cannot degrade without human intervention. Pollution in soils can further impact on the quality of groundwater and surface water. The construction machines on site may be containing moving parts which will require continuous oiling to minimize the usual corrosion or wear and tear. Possibilities of such oils spilling and contaminating the soil and water on site are real. Likewise, moving vehicles on site may require oil change. But these dangers are contained by maintaining the machinery in specific areas designed for this purpose.

6.4.14 Public Health

Increase in risk of sexually transmitted diseases, such as HIV/AIDS etc. due to influx of migrant workers; solid waste and effluent discharge from construction camps; risk of increase in vectors of schistosomiasis and malaria due to stagnant water associated with construction works/borrow pits etc.

6.4.15 Social vices

An influx of construction workers, competing for available jobs with the local community is expected. This will lead to increased crime rate, competition for limited jobs and competition for housing. Due to limited housing and related services, as well as the isolation of the project due to geographical distance from nearby towns and isolation, the influx of outsiders will not be significant.

6.5 Positive Impact during operation phase

6.5.1 Climate change mitigation and adaptation

Solar energy is a clean type of energy. However, Kenya has over relied on fossil fuels for the provision of energy to meet the energy needs. Fossil fuels have been the major culprits on the issue of climate change being caused by the release of greenhouse gases such as CO_2 in the atmosphere. Consequently, solar energy is among the clean sources of energy one of the. As such, the solar PV power plant will also contribute to reducing the use of fossil fuels

resulting in lower greenhouse gases (GHGs) emissions thus promoting the mitigation and adaptation of climate change. It is anticipated that the project will have a carbon sequester or carbon emission reduction of 40,868 tones /year.

6.5.2 Increase in soil humidity

The Solar PV facility will also lead to increase in soil humidity in the area as a result of the cleaning of solar panels during the operation phase.

6.5.3 Additional Power Capacity

With the additional 40MW generated from solar power connected to the national grid, the Kenya Power and Lighting Company Limited will be able to increase its electric power reliability and power supply capacity. This additional capacity would have a positive impact on the meeting power demands across the areas since KPLC would be able to supply more electric power, which cannot be supported by the existing line.

6.5.4 Security Improvement

Once the project has been implemented a competent security firm will be contracted to man the facility in addition to government police officers. Moreover, the facility will be lit throughout its vicinity. This will greatly boost the security in the project site and its neighboring environs.

6.5.5 Use of appropriate technology

The project will emphasize on the use of appropriate technology in solar power construction. It is estimated that 14% of the population have access to electricity. Additional generation with associated transmission and distribution is necessary to reach a greater percentage of the population and support economic growth. The situation is aggravated by the over reliance (approximately 50%) on hydropower which has been often unreliable in the dry seasons. Therefore, the proposed project will utilize the free solar energy to generate power, which will be reliable in supply. Technology will also be applied to ensure that the project is furnished with up graded facilities as required by the laws of the locals and international standards.

6.5.6 Growth of centers within the project site

The construction of the proposed project will certainly lead to the growth and development of urban centres, such as Musingi, Ndelekeni, Kanyonyoo and Nzokani. In addition, a new centre might come up at the project site.

6.5.7 Employment opportunities

Once the project is complete, there will be about 2000 people who will be employed permanently to operate the facility. This will include managers, electricians, technicians, and security officers, gardeners among others. Consequently, the employees will indirectly employ people within the site through provision of services such as transportation and catering services.

6.5.8 Poverty reduction

The growth of trading centres in the area and creation of employment opportunities will consequently lead to poverty reduction among the people.

6.6 Negative Impact during operational stage

During operational stage, the project will have minimal negative impacts as highlighted below.

6.6.1 Solid waste generation

The facility will be repaired regularly therefore there is some construction materials which will be rendered unusable. Change of inverters among other things fittings. Appropriate waste management systems are called for.

6.6.2 Hazardous Waste generation.

The Solar PV facility is likely to generate small quantities of hazardous wastes through a variety of activities such as equipment and facility maintenance which include: spent oil, spent oil filters, spent solvents, cleaning rags, out of date chemicals and old paints. Hazardous waste storage activities will also be subject to special management actions, conducted by the resident project manager, the contractor and employees who have received specific training in handling and storage of hazardous wastes.

6.6.3 E-waste generation and management

E- waste is a priority waste stream that will need to be managed by the proponent. E- waste generation will result from broken and out of date solar panels and other electrical and electronic equipment with the potential to cause impacts on human health and environment if not effectively managed.

6.6.4 Liquid waste release.

The facility will also generate liquid wastes specifically sanitary wastewater as a result of construction of administrative buildings. This will require an adequate and safe handling to

avoid or if avoidance is not feasible to minimize potential risks and impacts on public health, land and water resources.

6.6.5 Energy Use

Energy resources will be utilized by the project during the operational phase to facilitate efficient operations such as lighting and machine operation. For any energy using system such as this Solar PV facility, a systematic analysis of energy efficiency improvements and cost reduction opportunities will be undertaken, and feasible measures implemented.

6.6.6 Increased Storm Water Flow

The solar panels may lead to increased volume and velocity of storm water or run-off flowing across the area covered by the panels. This may lead to increased amounts of storm water entering the drainage systems, resulting in overflow and damage to such systems in addition to increased erosion or water logging in the area. This negative impact will be eliminated by allowing grass below the panels to control any form of soil erosion.

6.6.7 Occupational health and safety risks

During operational several workers will be employed permanently to operate the solar farm. The will be exposed to several occupational health and safety risks such as accidents within the work place, emergencies such as fire among others. Though the proponent will ensure this is kept to minimal by ensuring the whole facility is adequately labelled and provision of material data sheets to workers as well as trainings. In addition, the foundations and racking system will be designed to withstand powerful cyclones, which will limit the probability of generation unavailability as well as reducing any potential hazard of panels being lifted up and blown onto adjacent properties

6.6.8 Safety and Security risks

The nature and size of the facility will require enhanced security measures in the area so as to ensure safety and security of the solar panels other electrical and electronic equipment and the personnel who will be operating the project.

6.6.9 Increased pressure on infrastructure

The construction and operational phase of the solar power will lead to increased pressure on existing infrastructure such as roads, service lines etc. due to the increased number of people who will be using these facilities which will directly translate into increased volume of the relevant parameter.

6.6.10 Visual intrusion and Visual contrast

There will be some visual impact with the installation of solar panels in the facility, including the possibility of some glare from the panels, even though they are designed to absorb the incident solar radiation because the solar panels will occupy a large space and alter the visual environment considering that the pre-development visual context in this area is natural.

6.7 Positive Impacts during decommissioning phase

6.7.1 Rehabilitation

Upon decommissioning the project, rehabilitation of the project site will be carried out to restore the site to its original status. This will include replacement of topsoil and re-vegetation that will lead to improved visual quality of the area.

6.7.2 Employment Opportunities

Several employment opportunities will be created for demolition staff.

6.8 Negative Impacts during decommissioning phase

6.8.1 Solid Waste generation

Demolition of the project buildings and related infrastructure will result in large quantities of solid waste. The waste will contain the materials used in construction including, metals and panels which will undergo recycling. Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials. In addition, even the generally non-toxic chemicals such as chloride, sodium, sulphate and ammonia, which may be released as a result of leaching of demolition waste, are known to lead to degradation of groundwater quality.

6.8.2 Dust

Some minimal quantities of fugitive dust will be generated during demolition works. When decommission is undertaken the proponent will not need to clean up soil since he will just have to unscrew modules and metallic structure from the trackers and pull out the piles from the trackers.

6.8.3 Noise and Vibration

The demolition works will lead to insignificant deterioration of the acoustic environment within the project site and the surrounding area.

6.9 Environmental and Social Risks to the Project

6.9.1 Land issues

There are people who have settled in the proposed project site and two groups (Katoteni Nguamka Farmers Environmental Conservation Group and B2 Yatta Ranch Cooperative Limited) claiming ownership of the project site. The people on the project site fear forceful eviction and may lead to their opposition of the project. As such, proper consultations and negotiations needs to be done with the people who are residing at the project site to minimize this risk. However, the land is community land as per records at the Kitui County Government. A detailed due diligence of the land is explained in Chapter 8 of this report.

6.9.2 Land Court Case

The project site land has a court case in relation to land ownership disputes between Katoteni Nguamka Farmers Environmental Conservation Group and B2 Yatta Ranch Cooperative Limited. The land dispute case is in Machakos High Court (Case No.9 of 2008). As such, it is prudent to ensure due diligence is conducted to ensure all parties claiming land ownership are duly consulted and a memorandum of understanding (MOU) reached to avert possibility of court injunctions which could end up affecting the project. However, the land is community land as per records at the Kitui County Government.

6.9.3 Climate Change

Climate change is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, webpage). Climate change may affect the solar farm based on different scenarios. An increase in seasonal precipitation and intensity may cause flooding with possible resultant damage, disruption or destruction of the Solar farms related infrastructure including access roads, telecommunication equipment and utilities, inverter and transformer stations, surveillance and security systems, and related equipment, inter alia. Higher temperatures and humidity may also affect the Solar farm by posing environmental on related equipment such as the inverter and transformer station, monitoring system and security and surveillance systems. This will necessitate installation of cooling equipment to prevent overheating while high levels of humidity may lead to rusting and reduction of the lifespan of Solar Farm equipment. It is ideal for the project proponent to develop, train staff, implement and periodically review a disaster management plan for the Solar Farm. Monitor baseline and environmental change indicators over time at project site and surrounding community; and periodically test contingency plans and improve post-disaster management plans.

7 MITIGATION MEASURES AND MONITORING PROGRAMMES

This section highlights the mitigation measures for the expected negative impacts of the proposed solar power farm project. The potential impacts and the possible mitigation measures have herein been analyzed under two categories: construction and operational.

7.1 Mitigation of Construction Phase Impacts

7.1.1 Displacement of people

The following is recommended;

- Hold consultations and negotiations with the affected community members
- Conduct a Resettlement Action Plan on the resettlement and ensure meaningful compensation of the affected persons

7.1.2 Minimizing High demand of raw materials

No much of raw materials for the construction are expected to be harvested locally.

To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage; damage or loss (through run-off, wind, etc.) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials.

In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites

7.1.3 Minimization of vegetation disturbance and tree cutting

Clearance of part of the vegetation at the project site to pave way for construction will be inevitable. However, the proponent will ensure proper demarcation of the project area to be affected by the construction works. This will be aimed at ensuring that any disturbance to flora and fauna is restricted to the actual project area and avoid spill over effects on the neighbouring areas. In the same vein, there will be strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works.

Another important measure aimed at reducing tree cutting in the project area will be preservation of individual trees within the site. In addition, the proponent has committed itself to re-vegetation of some of the disturbed areas through implementation of a well-designed landscaping programme. It is recommended that part of the topsoil excavated from the construction site be re-spread in areas to be landscaped to enhance plant ecology.

7.1.4 Minimization of storm water, run-off and soil erosion

The proponent will put in place some measures aimed at minimizing soil erosion and associated sediment release from the project site during construction. These measures will include allowing growth of grass under the panels to reduce run-off velocity and increase infiltration of rain water into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off.

7.1.5 Minimizing Impacts on Surface Waters

The following is recommended

- Design and construct drainage systems within the facility so that storm water generated during construction does not end up at the Earth Dam
- Monitor the quality of water at the dam during the construction phase and record any changes in water quality.

7.1.6 Mitigating loss of agricultural and grazing land

The following is recommended

- Before construction a detailed RAP should be done
- Monitor the implementation of RAP so as to ensure that all the socio-economic impacts are fully addressed.

7.1.7 Minimizing Solid Waste and excavated material

It is recommended that demolition and construction waste be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses. In this regard, the proponent is committed to ensuring that construction materials left over at the end of construction will be used in other projects rather than being disposed of.

The proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted and to ensure that the amount of construction materials left on site after construction is kept minimal.

It is further recommended that the proponent should consider the use of recycled or refurbished construction materials. Purchasing and using once-used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste.

Additional recommendations for minimization of solid waste during construction of the project include: -

- Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3. Composting and reuse 4. Combustion 5. Sanitary land filling
- Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials
- Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed of.
- Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects
- Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents.
- Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time
- Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements
- Purchase of perishable construction materials such as paints should be done incrementally to ensure reduced spoilage of unused materials
- Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste
- Use construction materials containing recycled content when possible and in accordance with accepted standards.
- Reuse packaging materials such as cartons, empty metal and plastic containers to reduce waste at the site
- Dispose waste more responsibly by dumping at designated dumping sites or landfills only.
- Waste collection bins to be provided at designated points on site
- Private waste disposal company to be contracted to transport and dispose the solid waste from site
- Running an educational campaign amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste

7.1.8 Mitigating Dust and vehicle emissions

Dust emissions will be controlled by the following measures:

- Ensure strict enforcement of on-site speed
- limit regulations
- Avoid excavation works in extremely dry weathers
- Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles
- Personal Protective equipment to be worn
- Watering all active construction areas as and when necessary to lay dust.
- Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.
- Pave, apply water when necessary, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with physical sweepers) all paved access roads, parking areas and staging areas at construction sites.
- Fencing of the construction site and possible use of dust nets.

7.1.9 Minimizing Noise pollution

Significance of noise impacts depends on whether the project would increase noise levels above the existing ambient levels by introducing new sources of noise. Noise impacts would be considered significant if the project would result in the following:

- Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels.
- A substantial permanent increase in ambient noise levels (more than five dBA) in the project vicinity above levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The proponent, shall put in place several measures that will mitigate noise pollution arising during the construction phase. The following noise-suppression techniques will be employed to minimize the impact of temporary construction noise at the project site:

- Install portable barriers to shield compressors and other small stationary equipment where necessary.

- Provision of PPE to workers
- Use of equipment designed with noise control elements.
- Co-ordinate with relevant agencies regarding all substation construction activities in the residential areas.
- Install sound barriers for pile driving activity.
- Limit pick-up trucks and other small equipment to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- Construction/Demolition works should be done during the day when people are away and also the outside environment is also noisy.
- Adhere to the provisions of Noise Prevention and Control Rules, 2005, Legal notice no. 24 regarding noise limits at the workplace.

7.1.10 Reduction of energy consumption

The proponent shall ensure responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used. In addition, proper planning of transportation of materials will ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. Complementary to these measures, the proponent shall monitor energy use during construction and set targets for reduction of energy use.

7.1.11 Minimization of water use

The proponent shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water use. The proponent will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff.

7.1.12 Mitigating Occupational Health and Safety incidents

The following is recommended;

Approval of building plans	▪ Ensure that all building plans are approved by the Local Authority and the local Occupational Health and Safety Office
Registration of the premises	▪ Registration of the premises under the Occupational Safety and Health Act, 2007 Laws of Kenya is mandatory

General register	▪ A general register should be kept within the facility as stipulated in Sec 122&123 of the Occupational Safety and Health Act, 2007.
Posting of abstract of Act, rules and notices	▪ There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices as stipulated in section 121 of the OSHA, 2007.
Incidents, accidents and dangerous occurrences.	▪ Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place. ▪ Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.
Insurance	▪ Ensure that the premises are insured as per statutory requirements (third party and WIBA)
Safety, health and environment (SHE) policy	▪ Develop, document and display prominently an appropriate SHE policy for construction works
Health and safety committee	▪ Provisions must be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented
Sanitary conveniences	▪ Suitable, efficient, clean, well-lit and adequate sanitary conveniences should be provided for construction workers
Medical examination	▪ Arrangements must be in place for the medical examination of all construction employees before, during and after termination of employment
Machinery/equipment safety	▪ Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded ▪ Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain

	▪ All machines and other moving parts of equipment must be enclosed or guarded to protect all workers from injury ▪ Arrangements must be in place to train and supervise inexperienced workers regarding construction machinery use and other procedures/operations ▪ Equipment such as fire extinguishers must be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued
Storage of materials	▪ Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse ▪ Ensure that items are not stored/stacked against weak walls and partitions
Safe means of access and safe place of employment	▪ All floors, steps, stairs and passages of the premises must be of sound construction and properly maintained ▪ Securely fence or cover all openings in floors ▪ Provide all staircases within the premises with suitable handrails on both sides ▪ Ensure that construction workers are not locked up such that they would not escape in case of an emergency ▪ All ladders used in construction works must be of good construction and sound material of adequate strength and be properly maintained
Emergency preparedness and evacuation procedures	▪ Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency ▪ Such procedures must be tested at regular intervals ▪ Provide measures to deal with emergencies and accidents including adequate first aid arrangements ▪ Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body.

Construction Hazards	▪ Develop and enforce measures to ensure work zone safety for construction workers and the public. ▪ Use protective barriers to pedestrians from vehicular traffic, regulation of traffic flow by warning lights, avoiding the use of flaggers if possible, design of the work space to eliminate or decrease blind spots, and ensure reduction of vehicle speeds in work zones. ▪ Training of workers in safety issues related to their activities, such as the hazards of working on foot around equipment and vehicles. ▪ Ensure safe practices for work at night and in other low-visibility conditions, including use of high-visibility safety apparel and proper illumination for the work space (while controlling glare so as not to blind workers and passing motorists). ▪ Barricade the area around which elevated work is taking place to prevent unauthorized access. Working under personnel on elevated structures should be avoided. ▪ Hoisting and lifting equipment should be rated and properly maintained, and operators trained in their use. ▪ Elevating platforms should be maintained and operated according to established safety procedures including use of fall protection measures (e.g. railings). ▪ Maintenance of work vehicles and machinery to minimize air emissions. ▪ Reduction of engine idling time in construction sites; Use of extenders or other means to direct diesel exhaust away from the operator; Ventilation of indoor areas where vehicles or engines are operated or use of exhaust extractor hose attachments to divert exhaust outside.

7.1.13 Controlling hazardous material spillage

The proponent will control the dangers of oil, grease and fuel spills during construction by maintaining the machinery in specific areas designed for this purpose. Machinery site repair will be discouraged, and repair work restricted to only approve garages to avoid pollution from oil, grease and fuel.

7.1.14 Public Health Safety and Awareness

i. The proponent should ensure public health and safety through the following measures: Provide a small section of the construction site with a shed and a water stand where the food can be served to the construction workers to promote hygiene and health of the employees.
ii. Have a fully equipped first aid kit at the site.
iii. Ensure that the contractor has a workmen's compensation cover as required by law (Work Injury Benefits Act, No 13 of 2007), as well as relevant ordinances, regulation and union's agreements.
iv. The workers, immediate neighbour and other stakeholders should be sensitized on the dangers and risk associated with the construction works for enhanced self-responsibility on personal safety.
v. The proponent should ensure that the completed buildings are fitted with safety facilities including fire detectors, firefighting equipment, fire exits, adequate access and buffer between the residential premises.
vi. Disabled access features and safety signage should be placed strategically around and within the facility.
vii. Appropriate sanitation conveniences should be provided at the site as required in the OSHA, 2007 and echoed in the Public Health Act.

7.1.15 Minimizing Social vices

The following is recommended;

- Establish sensitization initiatives /programs targeting locals e.g. on HIV/AIDS prevention
- Establish a grievance redress mechanism (GRM) for the project and to ensure effective management of arising issues.
- Mainstream issues of gender, persons with disability into the overall project framework.
- Prioritise employment of local labour where possible

7.2 Mitigation of Operation Phase Impacts

7.2.1 Ensuring efficient solid waste management

The proponent will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as waste bins and skips for temporarily holding domestic waste generated at the site. In addition, the proponent will ensure that such disposed of regularly and appropriately. An integrated solid waste management system is recommendable. First, the proponent will give priority to Reduction at Source of the materials. This option will demand

a solid waste management awareness programme in the management and the residents. Secondly, Recycling, Reuse and compositing of the waste will be the second alternative in priority. This will call for a source separation programme to be put in place. The recyclables will be sold to waste buyers within project area. The third priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy. Finally, sanitary landfilling will be the last option for the proponent to consider. The proponent will adhere to the Environmental Management and Coordination (Waste Management) Regulations, 2006.

7.2.2 Storm water management

The proponent will ensure that there are adequate means for handling the small quantities of storm water to be collected from the solar arrays. A well planned drainage system by allowing growth of grass has been planned for diverting storm water runoff. .

7.2.3 Ensure efficient energy consumption

The proponent plans to install an KPLC accepted energy-efficient lighting systems at the Project site. This will contribute immensely to energy saving during the operational phase of the project. In addition, workers at the solar farm will be sensitized on the importance of energy conservation.

7.2.4 Ensure general safety within the premises

A perimeter fence will be erected round the solar power farm and a security lighting system installed. A competent security firm may be engaged to ensure the general safety and security at all times within and around the facility.

7.3 Mitigation of Decommissioning Phase Impacts

7.3.1 Efficient solid waste management

Solid waste resulting from demolition or dismantling works will be managed as described in Section 7.2.1.

7.3.2 Reduction of Dust Concentration

Levels of dust concentration resulting from demolition or dismantling works will be minimized as described in Section 7.1.1.

7.3.3 Minimization of Noise and Vibration

Significant impacts on the acoustic environment will be mitigated as described in 7.1.2

8 Resettlement Action Plan (RAP)

8.1 Introduction

During the baseline field survey, it was noted that the area where the proposed project will be sited is inhabited by people. As such, a preliminary census of structures and families likely to be affected was conducted to ensure adherence to set guidelines and procedures in mitigating the adverse impacts that might occur during the project implementation.

The key findings for the census as detailed in Chapter 3, section 3.6-3.9 on baseline information of the project area were that a total of 30 families are currently residing within the 210 acres of land that is to be utilized by the project. These people have been using the land for farming activities. Approximately 10 of these families have also built structures on the land. The ESIA consultant has therefore outlined below, a due diligence that is to be followed in order to avoid conflicts during the implementation of the project.

8.2 Land Due Diligence

- The ownership to the land registered under LR. 12010, where the project land is to be alienated from, should be clearly identified. LR. 12010 measures approximately 30200 acres with Katoteni Nguamka Farmers Environmental Conservation Group allegedly indicating they have the land allotment letter and B2 Yatta Ranch Cooperative Limited claiming ownership rights of the same parcel of land.
- The objection that Katoteni Nguamka Farmers Environmental Conservation Group filed in response to the Gazette notice of completion of Development Plan for project PDP No. KTI/271/2017/01 should not be ignored and should be taken into consideration for the goodwill of the project.
- It is prudent to ensure land due diligence is conducted to ensure all parties claiming land ownership, Nguamka Farmers Environmental Conservation Group and B2 Yatta Ranch Cooperative Limited, are duly consulted and a memorandum of understanding (MOU) reached.
- The project site land has a court case in relation to land ownership disputes. The land dispute case is in Machakos High Court (Case No.9 of 2008). It is therefore important to understand the current existing court case orders which could end up affecting the project.

8.3 Community support for the solar project

Despite the dispute of land ownership, both groups (Katoteni Nguamka Farmers Environmental Conservation Group and B2 Yatta Ranch Cooperative Limited) and their members fully approved the project. They only need full involvement during the implementation and operationalization stages.

9 ANALYSIS OF PROJECT ALTERNATIVES

This chapter contains an analysis of alternatives in terms of project site, design, construction techniques and "no project alternative".

9.1 No Project Alternative

The No project alternative option implies that the status quo is maintained. This option is a suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. The No project option however, is the least preferred from a socio-economic and partly environmental perspective due to the following factors:

- The power supply status of Kenya would remain unchanged or decline.
- The local and international technological skills would remain unutilized
- Reduced interaction both at local and international levels
- Increase in the numbers of unemployed Kenyans
- Inadequacy of sufficient energy for industrial development in the country
- The solar project is friendly to the environment.

From the analysis above, it becomes apparent that the No project alternative is no alternative to the Kenyan government, investor and local people.

9.2 Project sitting

Alternative site option means that the project will be relocated to a different site; it is an option available for the project implementation. At the present the proponent does not have an alternative site. This means that the proponent must look for the land. From the ESIA field survey, it was noted that the proposed project site sits on land (LR. 12010) which is allegedly allotted to Katoteni Nguamka Farmers and Environmental Conservation Group. In addition, B2 Yatta Ranch Cooperative Society Limited also claims to have land ownership rights of the project site (LR. 12010). Key consultation is therefore prudent to ensure an MOU is reached by the groups disputing over land.

In case of an alternative site, the community recommended the B2 ranch site at Kivandeni market centre next to Kanyonyoo market centre which is currently unutilized and with no major vegetation. B2 Yatta Ranch Committee members also recommended another parcel of land located on GPS Coordinates 1°07'34.0"S 37°35'56.7"E within B2 Yatta Ranch (figure 9:1).

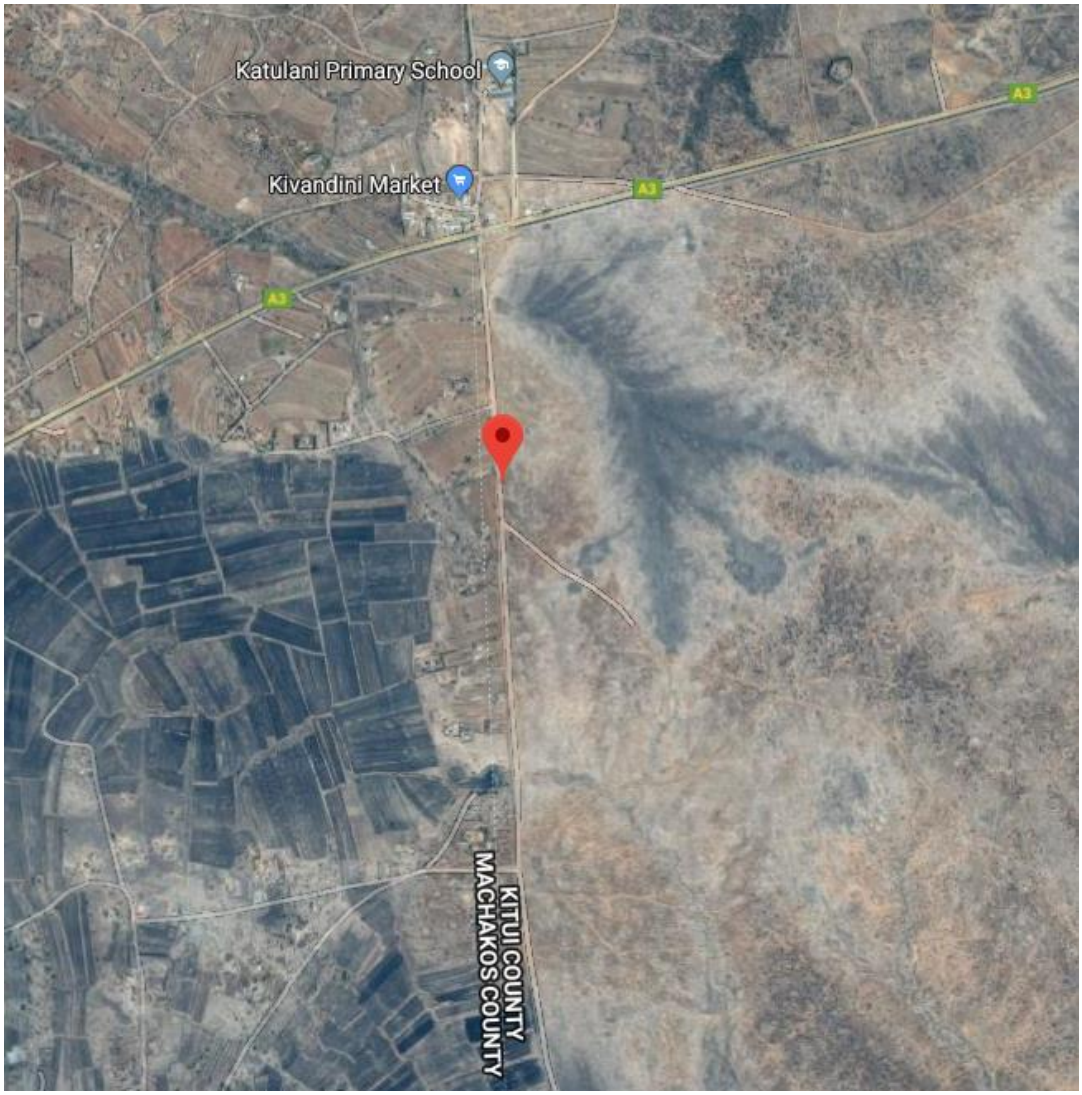


Figure 9:1 Map showing alternative project siting

This will cause the developer to spend another one year or so on project logistics and other project planning activities to adjust to the new site conditions. Project design and planning before the stage of implementation will cost the developer a large sum of money, whatever has been done and paid to date will be counted as a loss to the proponent.

Assuming the project will be given a positive response by the relevant authorities including NEMA, this project would have been delayed for about three year's period before implementation. This would also lead to a situation like no project alternative option. The other consequence of these is that it would be a discouragement for private/local investors. In consideration of the above concerns and assessment of the current proposed site alternative of the project is not viable option.

9.3 Electric Power Alternatives

The generation of adequate and affordable electricity is a very crucial factor for the economic development of Kenya. The current energy policy puts emphasis on the need for energy availability and accessibility at cost effective prices. Currently, there are

several alternatives for generation of electric power including hydro, geothermal, thermal, solar energy, bio gas, wind and power alcohol. The bulk (60%) of the electric power capacity in Kenya is, however, based on hydropower while geothermal and thermal powers virtually supply the rest of the power requirements.

Faced with the current situation where Kenya's electricity supplies are unreliable and expensive, the construction of the solar power farm will play a significant role in the stabilization of power situation in the country. More importantly, the introduction of 40MW in the Kenyan grid will aid towards alleviate power outages, especially during the dry seasons, and help to reduce the country heavy reliance on the power production from the oil and diesel power generators as well as contribute towards the envisioned additional 5000MW electricity generation by 2030.

9.4 Project design

Energy resource assessment results for the solar irradiance were based on NASA meteorological dataset. Upon commissioning of the proposed solar farm, the planned installed capacity will be 40MW and the farm is expected to generate 99,275 MWh/year. Therefore the project is highly recommended because it will reduce the County's overreliance in hydropower which is prone to outages during dry seasons.

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT/MONITORING PLAN

10.1 Introduction

The proponent of the proposed solar power project acknowledges the fact that the proposed project activities will have some impacts on the biophysical environment, health and safety of its employees and members of the public, and socio-economic well-being of the residents. Thus, the focus will be on reducing the negative impacts and maximizing the positive impacts associated with the project activities through a programme of continuous improvement.

An Environmental and Social Management Plan has been developed to assist the proponent in mitigating and managing environmental impacts associated with the life cycle of the project. The EMP has been developed to provide a basis for an Environmental Management System (EMS; ISO 14001 principles) for the project. IFC Policy on Social and Environmental Sustainability including the IFC Performance Standards (PS) and the Environmental, Health & Safety (EHS) Guidelines which cover key areas of environmental and social impacts and issues has been used in developing the ESMP. It is noteworthy that key factors and processes may change through the life of the project and considerable provisions have been made for dynamism and flexibility of the ESMP. As such, the ESMP will be subject to a regular regime of periodic review. In general, monitoring for the project will include the following:

Construction phase

- Monitor that occupational health and safety measures are carried out in accordance with IFC's General Environmental, Health and Safety Guidelines.
- Monitor that impacts from construction such as erosion and sedimentation, solid and sanitary waste disposal, hazardous materials (including fuels and lubricants) management, are being mitigated in accordance with IFC's General Environmental, Health and Safety Guidelines Erosion.
- If applicable, monitor that any cultural heritage that may be found or affected during construction is treated in accordance with IFC P.S. 8.
- Respond to and record community grievances.
- If applicable, monitor habitat and species impacts in accordance with IFC P.S. 6 and/or the Project's biodiversity management plan.
- If applicable, monitor that temporary worker housing is constructed and maintained in accordance with Workers' Accommodation: Processes and Standards: A Guidance Note by IFC

Operation and decommissioning phases

- Monitor for potential cumulative impacts.
- Ensure that restoration of any disturbance during construction and demolition has occurred.

Tables 10-1, 10-2 and **10-3** are the core of this ESMP for the construction, operational and decommissioning phases of the proposed project respectively. In general, the tables outline the potential safety, health and environmental risks associated with the project and detail all the necessary mitigation measures, their financial costs, as well as the persons responsible for their implementation and monitoring. The ESMP will be used as checklist in future environmental audits.

10.2 Construction Phase Environmental and Social Management Plan

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the construction phase of the proposed project are outlined **Table 10-1** below;

Table 10-1 Construction Phase Environmental and Social Management Plan for the Proposed Project

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs.)
Avoid the displacement of persons without a proper resettlement and/or compensation mechanism				
Displacement of Persons	Hold consultations and negotiations with the affected community members	County Government of Kitui/Proponent	Pre-Construction Phase	————
	Conduct a Resettlement Action Plan on the resettlement and meaningful compensation of the affected persons	County Government Kitui/ Proponent	Pre-Construction Phase	**Approx. 6,000,000**
		County Government Kitui/ Proponent	Pre-Construction Phase	————
Minimize extraction site impacts and ensure efficient use of raw materials in construction				
High Demand of Raw materials	Source building materials from local suppliers who use environmentally friendly processes in their operations	Project Manager & Contractor	Throughout construction period	**0**
	Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered	Project Manager Contractor	Throughout construction period	**240,000 p.a.**
	Ensure that damage or loss of materials at the construction Site is kept minimal through proper storage.	Project Manager Contractor	Throughout construction period	**60,000 p. a**

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Use at least 5%-10% recycled, refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills.	Project Manager Contractor	Throughout construction period	**0**
Minimize vegetation disturbance at and or around construction site				
Vegetation disturbance and Tree cutting	Ensure proper demarcation and delineation of the project area to be affected by construction works.	Contractor, Civil engineer & Project Manager	1 month	**200,000 p. a**
	Specify locations for trailers and equipment, and areas of the site which should be kept free of traffic, equipment, and storage	Contractor/Civil Engineer	1 month	**100,000 p. a**
	Designate access routes and parking within the site	Civil Engineer, Architect and Project Manage	1 month	**200,000 p. a**
	Introduction of vegetation (trees, shrubs and grass) on in some public and community land spaces	Proponent/KeFRI Kitui	Monthly Annually	**200,000 p. a**

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Design and implement an appropriate programme to help in re-vegetation of the surrounding of the project area after construction by donating some seedlings to the community	Proponent/ KeFRI Kitui	2 months	**200,000 p. a**
Reduce storm-water, runoff and soil erosion				
Increased storm water, runoff and soil erosion	A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structure will be designed	The Civil Engineer, Mechanical Engineer and Project Manager	1 month	**200,000 p. a**
	Apply soil erosion control measures such as leveling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil.	The Civil Engineer, Mechanical Engineer and Project Manager	1 months	
	Ensure that construction vehicles are restricted to existing graded roads to avoid soil compaction within the project site	The Civil Engineer, Mechanical Engineer and Project Manager	Throughout construction period	
	Ensure that any compacted areas are ripped to reduce run-off.	The Civil Engineer, Mechanical Engineer and Project Manager	2 months	

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs.)
	Open drains all interconnected will be provided on site	Civil Engineer	Throughout construction period	**60,000 p. a**
Minimizing impact on surface waters				
Impact on Surface waters	Design and construct drainage systems within the facility so that storm water generated during construction does not end up at the Earth Dam	Civil engineer/CGoK/ WRA	One-off	**200,000 p. a**
	Monitor the quality of water at the dam during the construction phase and record any changes in water quality.	Project manager and contractor/ WRA	Continuous	**120,000 p. a**
Minimizing Impact on agricultural and grazing land				
Impact on agricultural and grazing land	Before construction a detailed RAP should be done	Proponent/ CGoK	One-off	–
	Monitor the implementation of RAP so as to ensure that all the socio-economic impacts are fully addressed.	Proponent/ County Government of Kitui	Continuous	–
Minimize solid waste generation and ensure efficient solid waste management during construction				
Increased solid waste generation	Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3. Composting and reuse 4. Combustion 5. Sanitary land filling	Project Manager & Contractor	Throughout construction period	**240,000 p. a**

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials	Project Manager & Contractor	One-off	**0**
	Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed of.	Project Manager & Contractor	One-off	**0**
	Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects	Project Manager & Contractor	One-off	**0**
	Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents.	Project Manager & Contractor	One-off	**0**
	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time	Project Manager & Contractor	Throughout construction period	–
	Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements	Project Manager & Contractor	One-off	**120,000 p. a**
	Purchase of perishable construction materials such as paints should be done incrementally to ensure reduced spoilage of unused materials	Project Manager & Contractor	Throughout construction period	**0**

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste	Project Manager & Contractor	Throughout construction period	**0**
	Use construction materials containing recycled content when possible and in accordance with accepted standards.	Project Manager & Contractor	Throughout construction period	**0**
	Reuse packaging materials such as cartons, empty metal and plastic containers to reduce waste at the site	Project Manager, Mechanical Engineer & Contractor	Throughout construction period	**0**
	Dispose waste more responsibly by dumping at designated dumping sites or landfills only.	Project Manager, Mechanical Engineer & Contractor	Throughout construction period	**180,000 p. a**
	Waste collection bins to be provided at designated points on site	Project Manager, Mechanical Engineer & Contractor	Throughout construction period	**60,000 p. a**
	Private waste disposal company to be contracted to transport and dispose the solid waste from site	Project Manager, Mechanical Engineer & Contractor	Throughout construction period	
	Running an educational campaign amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste	Project Manager, Mechanical Engineer & Contractor	Throughout construction period	
Reduce dust emissions				
Dust emission	Ensure strict enforcement of on-site speed limit regulations	Project Manager & Contractor	Throughout construction period	**180,000 p. a**

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs.)
	Avoid excavation works in extremely dry weathers	Project Manager & Contractor	Throughout construction period	
	Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles	Project Manager & Contractor	Throughout construction period	
	Personal Protective equipment to be worn	Project Manager	Throughout construction period	
Minimization of exhaust emissions				
Exhaust emission	Vehicle idling time shall be minimized	Project Manager & Contractor	Throughout construction period	**0**
	Alternatively, fueled construction equipment shall be used where feasible equipment shall be properly tuned and maintained	Project Manager & Contractor	Throughout construction period	**0**
	Sensitize truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and to switch off or keep vehicle engines at these points	Project Manager & Contractor	Throughout construction period	**0**
	Comply with the provisions of Air Quality Regulations, 2014 regarding ambient air quality levels.	Project Manager & Contractor	Throughout construction period	**120,000 p. a**
Minimization of Noise and Vibration				

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
Noise and Vibration	Sensitize construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Project Manager & Contractor	Throughout construction period	**36,000 p. a**
	Sensitize construction drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as residential areas	Project Manager & Contractor	Throughout construction period	**36,000 p. a**
	Ensure that construction machinery is kept in good condition to reduce noise generation	Project Manager & Contractor	Throughout construction period	**60,000 p. a**
	Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels	Project Manager & Contractor	Throughout construction period	**120,000 p. a,**
	The noisy construction works will entirely be planned to be during daytime when most of the neighbours will be at work.	Project Manager & all site foremen	Throughout construction period	**0**
	Comply with the provisions of Noise Prevention and Control Rules 2005, Legal notice no. 24 regarding noise limits at the workplace	Project Manager & all site foremen	Throughout construction period	**120,000 p. a,**
Minimization of Energy Consumption				
Increased energy consumption	Ensure electrical equipment, appliances and lights are switched off when not being used	Project Manager & Contractor	Throughout construction period	**0**

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy	Project Manager & Contractor	Throughout construction period	**120,000 p. a,**
	Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts	Project Manager & Contractor	Throughout construction period	**0**
	Monitor energy use during construction and set targets for reduction of energy use.	Project Manager & Contractor	Throughout construction period	**60,000 p. a,**
Minimize water consumption and ensure more efficient and safe water use				
High water demand	Install water conserving taps that turn-off automatically when water is not being used	Project Manager & Contractor	One-off	**120,000 p. a,**
	Promote recycling and reuse of water as much as possible	Project Manager & Contractor	Throughout construction period	**24,000 p. a,**
	Install a discharge meter at water outlets to determine and monitor total water usage	Project Manager & Contractor	One-off	**20,000**
	Promptly detect and repair of water pipe and tank leaks	Project Manager & Contractor	Throughout construction period	**12,000 p. a,**
	Sensitize staff to conserve water by avoiding unnecessary water use	Project Manager & Contractor	Throughout construction period	**12,000 p. a,**

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs.)
	Ensure taps are not running when not in use	Project Manager & Contractor	Throughout construction period	**12,000 p. a,**
Minimizing Occupational Health and safety incidents				
Incidents, accidents and dangerous occurrences .	Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.	Project Manager, Developer & Contractor	Continuous	**12,000 p. a,**
	Enforcing adherence to safety procedures and Preparing contingency plan for accident response in addition, safety education and training shall be emphasized.	The Contractor, Project Manager& Site Safety Officer	Continuous	**240,000 p. a,**
Insurance	Ensure that the premises are insured as per statutory requirements (third party and workman's compensation)	Developer	Annually	–
Safety, Health and Environment (SHE) policy	Develop, document and display prominently an appropriate SHE policy for construction works	Project Manager, Developer & Contractor	One-off	**1,000**
Health and safety committee	Provisions must be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented	Project Manager	One-off	**120,000 p. a,**

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs.)
Sanitary conveniences	Suitable, efficient, clean, well-lit and adequate sanitary conveniences should be provided for construction workers	Project Manager	One-off	**120,000 p. a**
Medical examination	Arrangements must be in place for the medical examination of all construction employees before, during and after termination of employment	Project Manager, Developer & Contractor	Continuous	**200,000 p. a**
Machinery/ equipment safety	Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction do comply with the prescribed safety and health standards and be appropriately installed, maintained and safeguarded	Project Manager, Developer & Contractor	One-off	–
	Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain	Project Manager, Developer & Contractor	Continuous	–
	All machines and other moving parts of equipment must be enclosed or guarded to protect all workers from injury	Project Manager	One-off	–
	All machine guards must be of substantial construction, constantly maintained and kept in position while the machines being guarded are in motion or in use.	Project Manager	Continuous	–

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Ensure that no equipment or portable power tools shall be used in an environment that contains or is likely to contain flammable vapors or substances unless they are intrinsically safe for such environments.	Project Manager	Continuous	–
	Arrangements must be in place to train and supervise inexperienced workers regarding construction machinery use and other procedures/operations	Project Manager	Continuous	**120,000 p. a**
	Equipment such as fire extinguishers must be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued	Project Manager	Continuous	**50,000 p. a**
	Reports of such examinations must be presented in prescribed forms, signed by the examiner and attached to the general register	Project Manager	Continuous	-
Storage of materials	Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse	Project Manager	Continuous	**10,000 p. a**
	Ensure that items are not stored/stacked against weak walls and partitions	Project Manager	Continuous	–
	Ensure that materials are stored in such a manner as not to interfere with the adequate distribution of natural or artificial light and the natural ventilation systems	Project Manager	Continuous	–

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Ensure that materials are stored on firm foundations not liable to overload any floor.	Project Manager	Continuous	–
Safe means of access and safe place of employment	Securely fence or cover all openings in floors	Project Manager & Contractor	One-off	—
	Ensure that construction workers are not locked up such that they would not escape in case of an emergency	Project Manager & Contractor	Continuous	–
	Necessary precautions including warning signs must be put in place to prevent injury to employees and other persons at workplace from falling objects and objects ejected from machines and work processes.	Project Manager Contractor	Continuous	–
	All ladders used in construction works must be of good construction and sound material of adequate strength and be properly maintained	Project Manager & Contractor	One-off	–
Emergency preparedness and evacuation procedures	Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency	Project Manager & Contractor	One-off	**50,000 p. a**
	Such procedures must be tested at regular intervals	Project Manager & Contractor	Every months	
	Ensure that adequate provisions are in place immediately stop any operations where there is an imminent and serious danger to health and safety and to evacuate workers	Project Manager & Contractor	One-off	

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Kshs.)**
	Ensure that the most current emergency telephone numbers are prominently and strategically displayed within the construction site	Project Manager & Contractor	One-off	**50,000 p. a**
	Provide measures to deal with emergencies and accidents including adequate first aid arrangements	Project Manager & Contractor	Continuous	
First Aid	Well stocked first aid box which is easily available, accessible and of prescribed standard should be provided within the premises	Project Manager & Contractor	One-off	**50,000 p. a**
	Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body.	Project Manager & Contractor	One-off	**100,000 p. a**
Ensure the general safety and security of the site and surrounding areas				
Increased Pressure on Infrastructure	Coordinate with other planning goals and objectives for the Region	Architect, Project Manager, Contactor and the Developer	Continuous	**250,000 p. a**
	Upgrade existing infrastructure (schools, water, healthcare) and services, if and where feasible.	Proponent	Continuous	
Insecurity	Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site.	Security Officer, Project Manager & Police	Continuous	**150,000 p. a**

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs.)
	Body-search the workers on entry, to avoid getting weapons on site and when leaving site to ensure nothing is stolen.	Security Officer	Continuous	
	Ensure only authorized personnel get to the site	Security Officer	Continuous	
	Security alarms will be installed	Security Officer	Continuous	
Social vices	Establish sensitization initiatives /programs targeting locals e.g. on HIV/AIDS prevention Establish a grievance redress mechanism (GRM) for the project and to ensure effective management of arising issues. Mainstream issues of gender, persons with disability into the overall project framework. Prioritise employment of local labour where possible	Project Manager & Contractor	Continuous	**250,000 P.a**
Environmental monitoring of the project				
Environmental concern during the construction phase	Due to the magnitude of the project the proponent will liaise with the environmental consultants through out the construction phase and ensure that the Conditions of approval are adhered to.	Proponent, Contractor and AWEMAC	Throughout construction phase	-

10.3 Operational Phase ESMP

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the operational phase of the project are outlined in **Table 10-2**

Table 10-2 Environmental and Social Management Plan for the Operational Phase of the Solar Power Proposed Project

Expected Negative impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
1. Minimization of solid waste generation and ensuring more efficient solid waste management				
Solid waste generation	Provide solid waste handling facilities such as waste bins and skips	Proponent	One-off	120,000 p. a
	Ensure that solid waste generated is regularly disposed of appropriately at authorized dumping sites	Proponent	Continuous	120,000 p. a
	Donate redundant but serviceable equipment to charities and institutions	Proponent	Continuous	0
	Comply with the provisions of Environmental Management and Co-ordination (Waste Management) Regulations 2006	Proponent	Continuous	0
2.Minimization of Hazardous waste generation and ensuring more efficient Hazardous waste management				
Hazardous Waste generation	Provide temporary storage of hazardous wastes such as used oil, spent solvents, cleaning-rags on-site in portable tanks and dispose of in permitted hazardous landfills in accordance with applicable regulatory requirements or in their absence consistent with GIIP as reflected in IFC's General EHS guidelines.	Proponent	One-off	30,000 p. a

Expected Negative impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost (Ksh)**
	Implement monitoring activities such as regular visual inspection of hazardous waste storage and collection areas, regular audits, tracking of waste generation by type and amount and keeping manifests that document the amount of waste generated and its destination.	Proponent	One-off	_
3.Minimization of E-Waste generation and ensuring more efficient management				
Expected Negative impacts	**Recommended Mitigation Measures**	**Responsible party**	**Time Frame**	**Cost (Ksh)**
E-Waste generation	Contract a legitimate and reputable enterprise licensed by the relevant regulatory agency to undertake recycling of e-waste and require them to follow good international industry practice for the waste being handled.	Proponent	Continuous	_
	Ensure compliance with NEMA e-waste guidelines of 2010 on collection, sorting, recycling and disposal of e-waste so as to ensure enhanced environmental conservation.	Proponent	Continuous	_
4.Minimize risks of liquid waste release into environment				

Expected Negative impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Liquid waste release into the environment	Provide adequate and safe means of handling liquid waste at the premises such as by designing and installing septic tanks specifically for the treatment and disposal of domestic effluent that will be discharged from staff quarters and residentials.	Proponent	One-off	-
	Conduct regular water quality analysis for Kyenze earth dam water	Proponent/ WRA	Continuous	180,000 p. a
	Comply with the provisions of Environmental Management and Co-ordination (Water Quality) Regulations 2006	Proponent	Continuous	0
5.Minimize energy consumption				
Energy Use	Switch off electrical equipment, appliances and lights when not being used	Proponent	Continuous	_
	Monitor energy use during the operation of the project and set targets for efficient energy use through implementation of energy management programs.	Proponent	Continuous	24,000 p. a
	Sensitize workers to use energy efficiently	Proponent	Continuous	-
6. Storm water management				

Expected Negative impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Storm Water Management	Ensure a well-planned drainage system with concrete lining Allow growth of grass below the panels to control erosion and the quantity of runoff Have a detailed storm water management plan for the project	Proponent and contractor	Continuous	120,000 p. a
	Harness systems for harvesting rain water which could be used by the local community for irrigation during dry seasons	Proponent	Continuous	100,000 p. a
	Run-off from process and storage areas should be segregated from potentially less contaminated run off.	Proponent and contractor	Continuous	_
	Sludge from storm water catchments or collection and treatment systems should be disposed in compliance with local regulatory requirements or in their absence disposal should be consistent with protection of public health and conservation and long-term sustainability of water and land resources.	Proponent and contractor	Continuous	_
7.Minimization of health and safety impacts				

Expected Negative impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Health and safety risks	Implement all necessary measures to ensure health and safety of workers, occupants and the general public during operation of the commercial building as stipulated in the Occupational Safety and Health Act,2007	Proponent	Continuous	_
8.Ensure the general safety and security of the premises and surrounding areas				
Safety and security risks	Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises.	Proponent	Continuous	140,000 p. a
9. Minimize the pressure on infrastructure				
Pressure on infrastructure	Develop a traffic management plan for site access roads.	Proponent	One-off	50,000 p. a
	Consultations with the community to identify areas within the community land where construction of affordable housing can be undertaken to meet the demand of housing created by the development.	Proponent	Continuous	_
	Consider assisting the community in improving water supply systems (construct water pans and drill boreholes) in the area to ensure adequate water is available for consumption in the area.	Proponent	Continuous	500,000 p. a
10.Minimize visual intrusion and visual contrast				

Expected Negative impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Visual Intrusion and contrast risks	Ensure installation of solar panels with lower reflectivity	Proponent	One-off	_

10.4 Decommissioning Phase

In addition to the mitigation measures provided in **Tables 10-1** and **10-2,** it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the project have ceased. The necessary objectives, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project are outlined in **Table 10-3.**

Table 10-3 Environmental and Social Management Plan for the Decommissioning Phase of the Proposed Project

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
1. Demolition waste management				
Demolition waste	Use of an integrated solid waste management system i.e. through hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling	Resident Project Manager & Contractor	One-off	100,000 p.a
	All buildings, machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible	Resident Project Manager & Contractor	One-off	0
	All materials must be removed a recycled, reused or disposed of a licensed disposal site	Resident Project Manager & Contractor	One-off	0

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site	Resident Project Manager & Contractor	One-off	0
	Donate reusable demolition waste to charitable organizations, individuals and institutions	Resident Project Manager & Contractor	One-off	0
2. Rehabilitation of project site				
Site degradation	Implement an appropriate re-vegetation programme to restore the site to its original status (where possible)	Resident Project Manager & Contractor	One-off	0
	Consider use of indigenous plant species in re-vegetation	Resident Project Manager & Contractor	One-off	0

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	Trees should be planted at suitable Locations so as to interrupt slig lines (Screen planting), between the adjacent area and the development.	Resident Project Manager & Contractor	Once-off	0
3.Fugitive dust emissions management				
Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible party**	**Time Frame**	**Cost(Kshs)**
Fugitive dust emissions	Sprinkle water on graded access routes when necessary to reduce fugitive dust emissions during decommissioning phase	Resident project Manager and Contractor	Throughout the decommissioning phase	_
	Creating access roads for the vehicles involved in transportation of materials from the site during the decommissioning phase	Proponent and contractor	One-off	_
	Workers involved in decommissioning work should be trained on such work especially in handling of hazardous and e-waste.	Resient Project Manager and Contractor	One-off	_

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	Workers should be provided with appropriate PPE's for undertaking decommissioning work.	Project Manager	Throughout the decommissioning phase	–
4. Noise and vibration Management				
Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible party**	**Time Frame**	**Cost (Kshs)**
	Sensitize construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Project Manager and Contractor	Throughout the decommissioning phase	12, 000
	Sensitize construction drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as residential areas	Project Manager and Contractor	Throughout the decommissioning phase	12,000
	Ensure that construction machinery is kept in good condition to reduce noise generation	Project Manager and Contractor	Throughout the decommissioning phase	50,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels	Project Manager and Contractor	Throughout t decommissioning phase	100,000
	The noisy construction works will entirely be planned to be during daytime when most of the neighbours will be at work.	Project Manager and all site workers	Throughout t decommissioning phase	0
	Comply with the provisions of Noise Prevention and Control Rules 2005, Leg notice no. 24 regarding noise limits at the workplace	Project Manager and all site workers	Throughout the decommissioning phase	0

11 CONCLUSION AND RECOMMENDATIONS

The proposed construction of 40MW solar power farm and its additional facilities (substation and transmission line) project is due to the pressing need for such an exercise triggered by the current state of power supply within the country. The project will essentially have numerous positive impacts and will not only add power capacity, enhance economic growth at local level but also contribute to the national, regional and international economy. The integration of environmental concerns in the implementation strategy of the project will enhance sustainable development and improve accessibility to potential economic and social sectors.

The insignificant negative environmental impacts that will result from establishment of the project include; minimal soil erosion, minimal waste generation, minimal storm water, minimal noise pollution, minimal dust emissions, minimal oil spills, possible workers accidents and hazards during construction among others which can be adequately mitigated as outlined in the report.

The proponent of the proposed project shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects.

Considering the positive socio-economic and environmental benefits that will accrue as a result of the proposed development, and the ESIA study having found no major impacts to arise from the development, it is our recommendation that the project be allowed to proceed with the understanding that the proponent will adhere to the mitigation measures recommended herein and will further still implement the proposed Environmental and Social Management Plan (ESMP) to the letter. An initial environmental audit will also be carried within a period of 12 months (as required by EIA/EA Regulations of 2003) after commencement of the operations to check compliance to the set policies, standards and laws and the proponent will contract a licensed firm to provide Environmental Health and Safety Services for the construction phase of the proposed development.

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13 APPENDICES

Appendix A: Certificate of incorporation
Appendix B: Project Land Survey Map
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Appendix E: List of public meeting attendants
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