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FINAL REPORT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE UNIVERSITY OF ILORIN INTERCONNECTED SOLAR-HYBRID PROJECTS UNDER THE NIGERIA DISTRIBUTED ACCESS THROUGH RENEWABLE ENERGY SCALE-UP (DARES) - REA-NEP/DARES/C/CQS/071/2025

Submitted to

Federal Ministry of Environment

Mabushi, FCT, Abuja.

September 2026

FINAL ESIA REPORT

Of the Proposed Solar Power Plant and Associated Infrastructure at the Federal University of Ilorin

Under the Nigeria Distributed Access Through Renewable Energy Scale-up (DARES)

Submitted

Federal Ministry of Environment

Mabushi, FCT, Abuja.

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LIST OF ACRONYMS AND ABBREVIATIONS

APPI	Area of Potential Project Influence
ARAP	Abbreviated Resettlement Action Plan
BMP	Biodiversity Management Plan
BOD	Biochemical Oxygen Demand
COPE	Care of the People
CWD	Coarse woody debris
DRG	Debt Relief Gains
EA	Environmental Assessment
ECN	Energy Commission of Nigeria
EMS	Environmental Management Strategy
ERSED	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEPA	Federal Environmental Protection Agency
FGN	Federal Government of Nigeria
FMEnv	Federal Ministry of Environment
GPS	Global Positioning System
NEEAP	National Energy Efficiency Action Plan
NEP	Nigeria Electrification Project
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission
NESREA	National Environmental Standards and Regulations Enforcement Agency
NIMET	Nigerian Meteorological Agency
NML	Noise Management Level
NOx	Nitrogen oxides
NSITF	National Social Insurance Trust Fund
NUC	National University Commission
O&M	Operations and maintenance
PAPs	Project Affected Persons
PCT	Plant Community Type
PESCP	Progressive Erosion and Sediment Control Plan (aka ESCP)
PMP	Project Management Plan
REA	Rural Electrification Agency
SWMP	Soil and Water Use Management Plan
TCN	Transmission Company of Nigeria
TCP	Traffic Control Plans
TMP	Traffic Management Plan
VLMP	Vegetation and Land Management Plan
WMP	Waste Management Plan

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ES01: INTRODUCTION

Nigeria has prioritized expanding electricity access through initiatives such as the Nigeria Electrification Project (NEP), launched in 2018 and implemented by the Rural Electrification Agency with support from the World Bank and African Development Bank. Through mini-grids and solar systems, NEP provided electricity to over seven million people and encouraged private sector participation. Despite these achievements, many rural communities still lack reliable power, making universal electricity access by 2030 a significant challenge.

To address this gap, the Nigeria Distributed Access through Renewable Energy Scale-Up (DARES) Project was introduced as a follow-up initiative. Supported by $750 million in funding, DARES aims to provide electricity access to over 13 million people by expanding mini-grids and solar home systems while attracting private investment through innovative financing and risk-reduction mechanisms. The project builds on the successes of NEP by addressing challenges such as high infrastructure costs and limited financing opportunities. It also supports Nigeria's clean energy and climate objectives by promoting renewable energy solutions and reducing dependence on fossil fuels.

In compliance with Nigeria's Environmental Impact Assessment Act, the proposed project underwent an Environmental and Social Impact Assessment (ESIA) to support informed decision-making and ensure environmental compliance. The ESIA seeks to promote sustainable development by identifying and minimizing potential environmental, socio-economic, and cultural impacts during the planning stage. It also provides baseline environmental data, assesses project risks, and develops a cost-effective Environmental and Social Management Plan (ESMP) for impact mitigation throughout the project lifecycle.

The applicable legal and institutional framework to the proposed Project includes, but is not necessarily limited to, the following:

- EIA Act CAP E12 LFN 2004
- National Policy on the Environment, 1989 (revised in 1999 and 2017)
- World Bank Safeguard Policies on Environmental Assessment
- National Environmental (Energy Sector) Regulations, 2014
- National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991, S.I.9
- National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991, S. I. 15
- National Environmental (Sanitation and Wastes Control) Regulations, 2009
- National Environmental (Noise Standards and Control) Regulations, 2009
- Kwara State Ministry of Environment Laws on Environmental Protection
- Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal
- The United Nations Framework Convention on Climate Change
- Declaration of the United Nations Conference on Human Environment
- International Labour Organisation (ILO): ILO-OSH 2001 - Guidelines on Occupational Safety and Health (OSH) Management Systems

ES 02: PROJECT JUSTIFICATION

The chapter highlights the project's expected benefits, including improved academic and research activities, reduced operational costs, enhanced campus security through solar-powered lighting, and

capacity building via a renewable energy training centre. It also emphasizes broader socio-economic impacts such as job creation, local economic growth, and strengthened institutional partnerships. Project sustainability is addressed from technical, environmental, economic, and social perspectives, supported by robust system design, reduced reliance on fossil fuels, long-term cost savings, and active stakeholder engagement. The involvement of experienced contractors, institutional oversight, and compliance with environmental and social management frameworks further support the project's long-term viability.

Additionally, Chapter Two evaluates site selection and technological alternatives, confirming the suitability of the proposed site based on topography, environmental factors, and security considerations. Photovoltaic (PV) solar technology and lithium-ion battery storage were selected as the preferred options due to their efficiency, cost-effectiveness, and lower environmental impact. The chapter also assesses alternative scenarios, including the "no project" and "delayed project" options, both considered unviable because of persistent energy challenges and economic drawbacks. Consequently, the "go-ahead" option is identified as the most beneficial, offering significant environmental, social, and economic advantages while aligning with national development and clean energy objectives.

ES 03: PROJECT DESCRIPTION

The project is expected to deliver significant socio-economic benefits, including improved healthcare services, sanitation, and reduced mortality rates. It will also enhance tertiary education through improved learning facilities and capacity building in renewable energy technology for staff and students. In addition, the project supports Nigeria's climate and clean energy commitments under the Paris Agreement and contributes to broader government initiatives such as the Nigeria Health Sector Renewal Investment Initiative (NHSRII) and the Nigeria Education Sector Renewal Initiative (NESRI), including the promotion of Science, Technology, Engineering, and Mathematics (STEM) education.

ES 04: THE BASELINE ENVIRONMENT

The study adopted a multidisciplinary approach involving field sampling, stakeholder consultations, and literature review to assess the biophysical, socio-economic, and health conditions of the project area. Data were collected using standardized methods and equipment for air quality, noise, soil, vegetation, and wildlife assessments, supported by laboratory analysis and statistical evaluation. Quality assurance and control procedures were implemented throughout the study to ensure accuracy, reliability, and compliance with regulatory and international standards. Findings indicate that the project area lies within the Sudan savanna ecological zone, characterized by a tropical continental climate with average temperatures ranging from 30–40°C and annual rainfall of about 600–1,000 mm. Air quality results showed low concentrations of pollutants, with particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2) remaining within permissible regulatory limits. Ambient noise levels ranged between 45–65 dB(A), which is within acceptable standards for residential and institutional environments. Soil analysis revealed predominantly sandy to loamy soils with moderate fertility, pH values ranging from 6.2–7.4, and heavy metal concentrations below regulatory thresholds. Vegetation was mainly composed of grasses, shrubs, and drought-resistant trees such as acacia and baobab, while wildlife species observed were typical of savanna ecosystems, though some are under pressure from farming, grazing, and habitat degradation. Socio-economic findings showed that over 60% of residents depend on agriculture and informal trading as their primary sources of livelihood. The population is largely young to middle-aged, with moderate literacy levels and access to healthcare and sanitation facilities. Although electricity infrastructure exists, supply is unreliable, with many households relying on generators and solar systems as alternative energy sources. Stakeholder consultations indicated strong community support for the proposed solar project, with expectations of improved electricity supply, job creation, and economic growth. However, the study recommends

continuous environmental monitoring, enhanced stakeholder awareness, and targeted measures to address social concerns, including gender-based vulnerabilities, to ensure sustainable project implementation.

ES 05: Potential and Associated Impacts

This chapter assesses the potential environmental and social impacts of the proposed solar power plant throughout its lifecycle, including the pre-construction, construction, commissioning, operation, and decommissioning phases. The assessment applied a structured methodology involving impact identification, interaction matrix screening, and risk evaluation based on impact magnitude, duration, reversibility, and receptor sensitivity.

The findings indicate that the project will generate significant environmental and socio-economic benefits, although some negative impacts may occur, particularly during construction and operation. Key positive impacts include improved electricity supply, reduced dependence on fossil fuels, lower greenhouse gas emissions, improved air quality, job creation, enhanced economic activities, and capacity building through a renewable energy training centre. The project is also expected to support improved educational outcomes and increased productivity within the host community.

Potential adverse impacts identified during the construction phase include vegetation clearing, soil disturbance, soil erosion resulting from land clearing and earthworks, dust emissions, increased noise levels, traffic congestion, occupational health and safety risks, and social concerns such as gender inequality and increased social vices. If not properly managed, soil erosion may lead to the loss of topsoil, sedimentation of nearby drainage channels, and localized degradation of land quality. During operation, impacts are generally minor and include occupational hazards, limited waste generation including e-waste, possible groundwater abstraction, and localized soil degradation associated with maintenance activities. Decommissioning activities may result in temporary environmental disturbances, including soil exposure and erosion risks, increased waste generation, and the loss of project-related employment opportunities.

Overall, the assessment concludes that the identified adverse impacts can be effectively mitigated through the implementation of appropriate environmental and social management measures, while the long-term environmental, economic, and social benefits of the project are expected to outweigh the potential negative effects.

ES 06: Mitigation Measures Impacts

A comprehensive risk assessment matrix, as indicated in Figure 6.1, was used to determine the mitigation requirements for each of the impacts identified. The frequency, severity, sensitivity, scale, longevity, political, economic, legal, reputation/ image, and communication/complaints were factors taken into consideration during these assessments.

ES 07: Environmental and Social Management Plan

An Environmental and Social Management Plan (ESMP) comprises several interconnected components designed to manage environmental and social impacts throughout the project lifecycle. Key elements include mitigation measures to prevent, minimize, or compensate for identified impacts, supported by a monitoring plan that defines monitoring parameters, frequency, performance indicators, and responsible parties. The ESMP also establishes institutional arrangements that clarify the roles and responsibilities of project proponents, contractors, supervising agencies, and regulatory authorities to ensure accountability and effective implementation. In addition, the ESMP incorporates environmental and social management procedures such as occupational health and safety (OHS) guidelines, waste management systems, emergency response plans, stakeholder engagement strategies, and grievance redress mechanisms (GRM). It also provides capacity building and training, reporting and documentation systems, and a dedicated implementation budget covering mitigation, monitoring, training, and stakeholder activities. By integrating these requirements into project design and contractual agreements, the ESMP ensures compliance and provides a practical framework for sustainable environmental and social risk management.

ES 08: Stakeholder Engagement and the Grievance Redress Mechanism

Stakeholder engagement and the grievance redress mechanism (GRM) are key components of the ESIA process, ensuring transparency, inclusiveness, and effective communication throughout the project lifecycle. A Stakeholder Engagement Plan (SEP) was developed to guide consultations through meetings, interviews, and focus group discussions, with particular attention given to vulnerable groups. The engagement process enabled stakeholders to receive project information, review disclosed ESIA documents, and provide input that informed project planning and mitigation measures. Stakeholders generally expressed support for the project due to its potential to improve electricity supply, economic opportunities, and public services. However, concerns were raised regarding land acquisition, compensation, environmental impacts during construction, and local employment opportunities. Socio-economic assessments showed that host communities mainly depend on agriculture and small-scale trading, with limited access to reliable electricity, healthcare, and clean water. The project therefore aims to ensure equitable benefits, particularly for vulnerable groups such as women and low-income households. The chapter also highlights the Grievance Redress Mechanism (GRM), which provides a structured process for receiving, recording, and resolving complaints within defined timelines, including confidential procedures for sensitive issues such as gender-based violence. Overall, the ESIA for the proposed solar power plant at the Nigeria Police Academy confirms that the project aligns with Nigerian environmental regulations and the World Bank Environmental and Social Standards. An Environmental and Social Management Plan (ESMP) was developed to guide mitigation, monitoring, and compliance activities, with the Rural Electrification Agency responsible for implementation and regulatory compliance.

ES09: Conclusion and Recommendations

The study integrates environmental and social considerations into project planning and implementation in line with the Nigerian EIA Act and the World Bank Environmental and Social Standards. It supports informed decision-making and sustainable development through the early identification and management of potential environmental and socio-economic impacts.

The assessment included stakeholder consultations, field surveys, data collection, and literature reviews to establish baseline environmental and social conditions and evaluate potential project impacts. Based on the findings, mitigation measures were developed using established health, safety, and environmental best practices. An Environmental and Social Management Plan (ESMP) was also prepared to guide

mitigation implementation and monitor key environmental parameters such as air quality, noise, and groundwater. The Rural Electrification Agency will oversee compliance with regulatory requirements set by the Federal Ministry of Environment and the World Bank.

Key Recommendations

- Ensure full implementation of the Environmental and Social Management Plan (ESMP) throughout the project lifecycle.
- Conduct regular environmental monitoring for air quality, noise, groundwater, and waste management.
- Maintain continuous stakeholder engagement and effective community communication.
- Prioritize local employment, capacity building, and renewable energy training opportunities.
- Implement strong occupational health and safety measures, including emergency response systems.
- Establish and maintain an efficient Grievance Redress Mechanism (GRM) for timely resolution of complaints.
- Promote proper waste management, including safe disposal of hazardous and electronic waste.
- Ensure compliance with regulatory requirements through continuous oversight by the Rural Electrification Agency and relevant authorities.

ACKNOWLEDGEMENTS

The Rural Electrification Agency would like to thank the ESIA Consultant – Chalton Consult Limited for their commitment to the success of the ESIA study. We also thank the World Bank, Federal Ministry of Environment, the Kwara State Ministry of Environment, the management of the Federal University of Ilorin, Kwara State, and other stakeholders, including the local communities in the Project area, for their valuable contributions and support.

CHAPTER ONE
INTRODUCTION

1.1 Background Information

The Federal Government of Nigeria, in partnership with the World Bank, launched the Distributed Access through Renewable Energy Scale-Up (DARES) Project, a US$750 million initiative aimed at expanding electricity access to approximately 17.5 million Nigerians living in rural and underserved communities. The project builds on the successes recorded under the Nigeria Electrification Project (NEP), which has already delivered clean, reliable, and sustainable electricity to over seven million Nigerians. The DARES Project comprises the following key components:

Component 1: Solar Hybrid Mini-Grids for Rural Economic Development

This component has an International Development Association (IDA) commitment of US$410 million to support the deployment of solar hybrid mini-grids aimed at stimulating rural economic growth and improving energy access in underserved communities.

Component 2: Stand-alone Solar Systems for Households and MSMEs

This component has an IDA commitment of US$300 million to facilitate the deployment of stand-alone solar systems for households as well as micro, small, and medium-sized enterprises (MSMEs), thereby enhancing energy access and supporting productive economic activities.

Component 3: Technical Assistance

This component has an IDA commitment of US$40 million dedicated to technical support, institutional strengthening, and capacity-building activities necessary for effective project implementation. The Rural Electrification Agency (REA) is implementing the DARES Project through its existing Project Management Unit (PMU). Significant progress has already been recorded under the initiative, including the deployment of over 200 mini-grids across the country. In addition, the REA has signed grant agreements with eight renewable energy companies for the deployment of solar home systems and mini grids targeted at electrifying underserved communities and promoting inclusive economic growth.

In compliance with the Environmental Impact Assessment (EIA) Act No. 86 of 1992 (now codified as CAP E12, Laws of the Federation of Nigeria, 2004), as well as other relevant environmental regulations and extant laws of the Federal Republic of Nigeria, the proposed project is subject to the Environmental Impact Assessment process to ensure informed decision-making and proper consideration of potential environmental and social impacts.

1.2 The Applicant

The Rural Electrification Agency (REA) is a Nigerian government agency responsible for ensuring electricity reaches every part of the country. REA focuses on rural electrification projects, providing power solutions for on-grid and off-grid areas with an emphasis on renewable energy. As the Implementing Agency of the Federal Government of Nigeria, the team at REA is tasked with the electrification of rural and unserved communities across Nigeria. MISSION To provide access to reliable electric power supply for rural dwellers irrespective of where they live and what they do, in a way that would allow for a reasonable return on investment through an appropriate tariff that is economically responsive and supportive of the average rural customer. MANDATE - Promote Rural Electrification in the Country - Co-ordinate Rural Electrification Programs in the country - Administer the Rural Electrification Fund (REF) to promote, support, and provide rural electrification through

Public and Private Sector Participation. The Abuja Office is located at No. 15 Constitution Avenue, Central Business District, FCT-Abuja.

1.3 Objectives of the ESIA

The objectives of this ESIA report are:

- To provide necessary data/evidence that will form the Environmental Impact Statement (EIS) of the proposed installation activities.
- To establish the existing environmental condition/profile of areas that shall include a qualitative and quantitative description of the physical, chemical, biological, hydrological, and social environment of the project areas.
- To review the proposed activities, thereby identifying the potential impacts and associated effects of any hazards posed by the execution of the project.
- To recommend control measures to prevent and/or mitigate identified potential/associated adverse impacts of the installation activities.
- To develop and document a cost-effective Environmental and Social Management Plan (ESMP) that recommends plans and procedures to manage the consequences of the installation activities on the environment at different phases of the project.

1.4 Scope of the ESIA Study

- In line with the Terms of Reference (TOR), the scope of the ESIA study covers the following:
- Description of all actions/activities that will be carried out in the course of the Project development and implementation.
- Review of applicable local and international laws, regulations, standards and industry codes that apply to the proposed Project.
- Desktop review of relevant documents about the Project and the environment where the Project would be located. These documents include the Nigerian Electrification Project (NEP) environmental and social management framework (ESMF), amongst others.
- Perimeter survey of the Project site, including development of survey maps.
- Field data gathering covering biophysical and socio-economic components of the Project's Area of Influence.
- Consultations with relevant stakeholders, including government institutions, project-affected people, University management representatives,
- Impacts identification and evaluation, and development of appropriate and practicable mitigation measures and EMP.
- Laboratory analysis of field samples and data analysis report preparation and disclosure.

1.5 The Study Area

The University of Ilorin, in Ilorin East Local Government of Kwara State, North Central Nigeria. Geographic Coordinates: Latitude: 8.5375° N, Longitude: 4.6468° E and 8° 28' 47" N, 4° 31' 56" E. Situated along the Old Jebba Road, the hospital serves as a major healthcare facility for the surrounding communities and beyond.

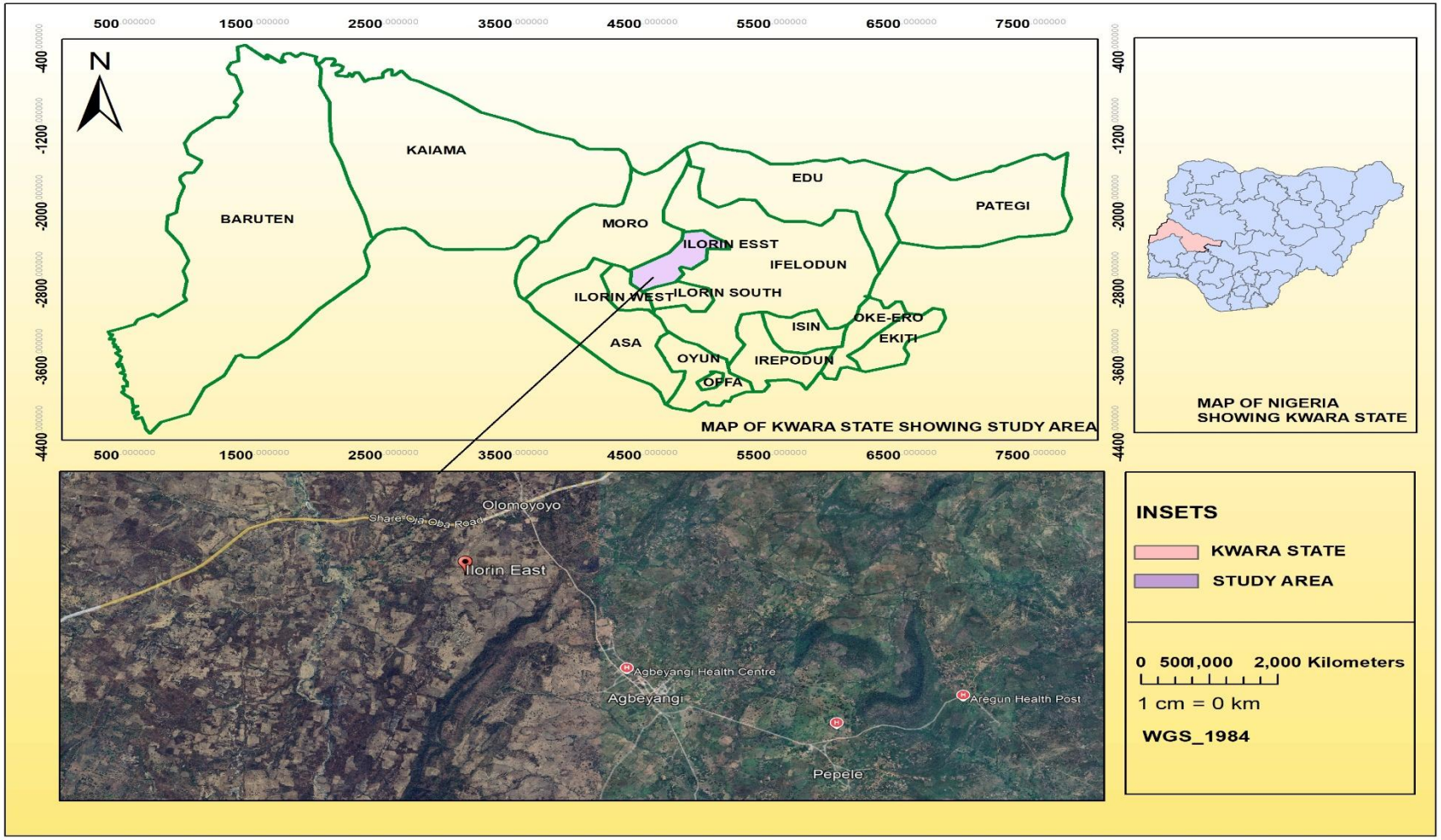

Figure 1: Map of Kwara State Showing Ilorin

1.6. Study Approach/ Methodology

The ESIA methodology adopted a systematic and participatory approach, beginning with a reconnaissance survey to gain an understanding of site-specific conditions and potential environmental and social issues. This was complemented by a comprehensive desktop review of relevant project and programme documents to establish the regulatory, institutional, and technical context for the proposed intervention. A scoping study was conducted in consultation with the beneficiary university authorities and representatives of the host community to capture stakeholder perceptions of the project and to identify key environmental and social concerns. This engagement informed the focus of subsequent studies and ensured that locally relevant issues were adequately addressed. Field data collection was carried out to establish baseline environmental and social conditions at the proposed project sites. This included primary and secondary data gathering on noise levels, air quality, water quality, soil characteristics, ecology, and biodiversity. Samples obtained during field surveys were subjected to laboratory analysis to provide quantitative evidence for baseline conditions and impact prediction.

Based on the baseline data and stakeholder inputs, potential environmental and social risks and impacts associated with the project were identified and assessed. Appropriate mitigation and enhancement measures were then developed to address identified risks. These measures were consolidated into an Environmental and Social Management Plan (ESMP), which outlines specific actions, implementation timelines, and institutional responsibilities for managing impacts throughout the project lifecycle.

The ESIA process concluded with the compilation of the assessment report and the execution of required regulatory procedures, including disclosure of the ESIA report in line with national regulations and international best practice. The Federal Ministry of Environment (FMEnv) developed guidelines to be used by project proponents in conducting EIA, in compliance with the EIA Act. Accordingly, the ESIA process follows the steps sequentially as outlined in the procedural guideline indicated in Figure 1.2.

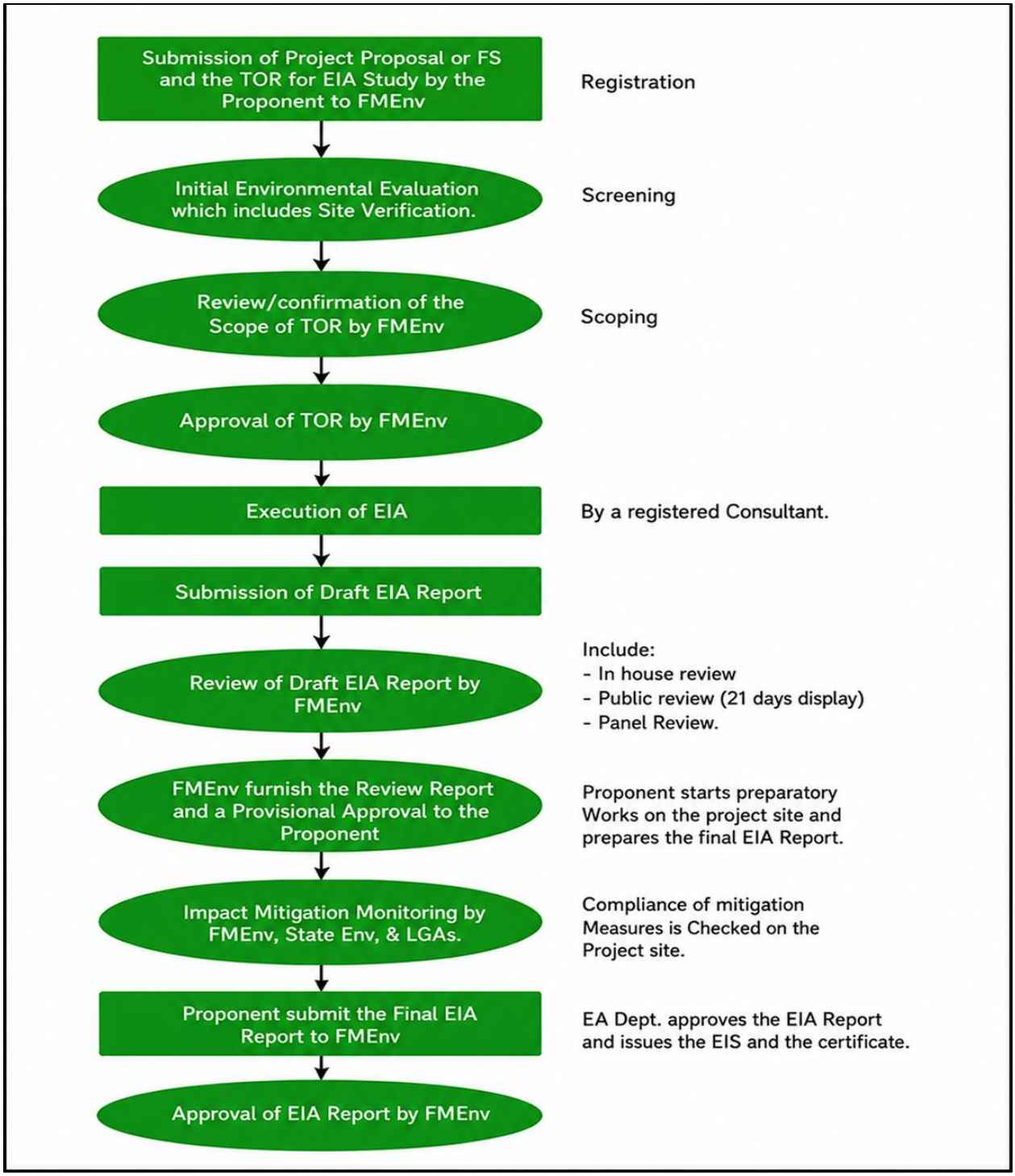

Figure 1.2: Federal Ministry of Environment Environmental Impact Assessment Process

(Source: Environmental assessment department, Federal Ministry of Environment)

1.7 Limitations of the ESIA Study

This is not unusual - predicting environmental effects can be complex, and some factors might not be fully understood until the project is underway. To manage this uncertainty, a robust Environmental and Social Management Plan (ESMP) is in place. This plan will monitor the project's environmental and social performance throughout its lifecycle, allowing for adjustments as needed to mitigate any unexpected impacts.

1.8 Policy, Legal and Administrative Framework

The proposed Project is part of the Federal Government of Nigeria's Energizing Education Programme, a component of the Nigeria Electrification Project being implemented by the Rural Electrification Agency. Several laws and regulations apply to the energy sector in Nigeria. In addition to the above, several laws, regulations, policies, and instruments have been established to support environmental and social management and the EIA process in Nigeria. This section provides an overview of the relevant statutory regulations, legislation, and guidelines for the proposed Project and the ESIA study. The project shall ensure compliance with the relevant and applicable local and international regulations, policies, and standards throughout its life cycle.

1.8.1 FGN Requirements and Relevant Legislation

The Constitution of the Federal Republic of Nigeria (1999), as the national legal order, recognizes the importance of improving and protecting the environment and makes provision for it. The relevant sections are:

- **Section 20** makes it an objective of the Nigerian State to improve and protect the air, land, water, forest, and wildlife of Nigeria.
- **Section 12** establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria; and
- **Sections 33 and 34,** which guarantee fundamental human rights to life and human dignity, respectively, have also been argued to be linked to the need for a healthy and safe environment to give these rights effect.

1.8.2 Policy, Legal, and Institutional Framework

The Policy, Legal, and Institutional Framework guiding the Environmental and Social Impact Assessment (ESIA) for the proposed project is anchored on applicable national policies, laws, and institutional arrangements, as well as relevant international standards. At the national level, the framework is defined by the Federal Ministry of Environment (FMEnv) regulations, including the Environmental Impact Assessment Act Cap E12 LFN 2004, FMEnv Procedural Guidelines (2017), and other sectoral environmental, social, health, and safety regulations. The assessment also aligns with the objectives of the Nigeria Electrification Project and the Rural Electrification Agency's implementation framework. At the international level, the ESIA is guided by the African Development Bank Integrated Safeguards System, alongside international good practice such as the IFC Performance Standards and relevant ISO standards, ensuring that the project complies with both national regulatory requirements and global environmental and social sustainability benchmarks.

1.8.3. Policy Framework

1.8.3.1. National Environmental Policy/ National Policy on the Environment (Revised 2016) The national environmental policy launched by Government in November 1989 revised in 2016, prescribed guidelines for achieving sustainable development in fourteen vital sectors of the nation's economy, namely: Human Population; Land Use and Soil Conservation; Water Resources Management; Forestry, Wildlife and Protected Natural Areas; Marine and Coastal Area Resources; Sanitation and Waste Management; Toxic and Hazardous Substances; Mining and Mineral Resources; Agricultural Chemicals; Energy Production; Air Pollution; Noise in the Working Environment; Settlements; Recreational Spaces, Green Belts, Monuments, and Cultural Property.

It also contains Nigeria's commitment to ensure that the country's natural and built environment is safeguarded for the use of present and future generations. This commitment demands that efficient resource management and minimization of environmental impacts be the core requirements of all development activities. Accordingly, this Policy seeks to promote good environmental practices through environmental awareness and education. The goal of the National Policy on the Environment is to 'ensure environmental protection and the conservation of natural resources for sustainable development'. Its strategic objective is to coordinate environmental protection and natural resources conservation for sustainable development.

1.8.3.2 Social Protection Policies

Social protection policy has been on the agenda since 2004, when the National Planning Commission, supported by the international community, drafted a social protection strategy. More recently, the National Social Insurance Trust Fund (NSITF) drafted a social security strategy. The social protection policy approached social protection using a life cycle and gender lens, recognizing both economic and social risks, including, for example, job discrimination and harmful traditional practices. The policy was organized around four main themes: social assistance, social insurance, child protection and the labour market.

However, only a few of the instruments of this approach were adopted in the national implementation plan, most notably the provision of specific and limited social assistance, social insurance (such as expanding national health insurance to the informal sector) and labour market programmes (such as developing labour-intensive programmes). Moreover, in practice, programmes to date have been focused largely on conditional cash transfers and two health financing mechanisms driven by the federal government with little inter-sectoral or state-federal coordination. A significant number of actors are involved in funding and implementing social protection, including those from government, donors, international non-governmental organisations and civil society. Federal government-led social protection includes three main programmes:

i. the conditional cash transfer in Care of the People (COPE) (funded initially through the debt relief gains (DRG fund) targeted at households with specific social categories (those with children of school-going age that are female-headed or contain members who are elderly, physically challenged, or are fistula or HIV/ AIDS patients).

ii. the health fee waiver for pregnant women and children under five (financed through the debt relief gains (DRG fund); and

iii. the community-based health insurance scheme, which was redesigned in 2011 because the previous scheme had design challenges.

Other social assistance programmes are implemented in an ad hoc manner by various government ministries, departments and agencies at state level, and some are funded by international donors. These include conditional cash transfer programmes for girls' education (in three states), child savings accounts, disability grants, health waivers, education support (such as free uniforms) and nutrition support. HIV and AIDS programming at state level also include social protection sub-components (although not as the primary objective), including nutrition, health and education support. Labour market programmes include Federal and State level youth skills and employment programmes, and Nigeria also has agricultural subsidies/inputs.

1.8.3.3 National Policy on Climate Change/ National Climate Change Policy for Nigeria 2021-2030

Given Nigeria's status as a fossil-fuel dependent economy with a large climate sensitive agricultural sector, the development of a climate change policy and response strategy is critical, as climate change presents a serious threat to poverty eradication and sustainable development in general. One of the key pillars of Vision 20:2020 is investment in low-carbon fuels and renewable energy. Achieving the goal of low carbon, high-growth and resilient socio-economic system for equitable and sustainable socio-economic and environmental development faces some challenges which include stability and sustainability of the enabling environment, adequate institutional and human resource capacity and availability of adequate resources to address mitigation and adaptation initiatives to address climate change. Thus, the Government needs to ensure that economic growth, resource management and climate change mitigation and adaptation can all happen simultaneously if this will be done effectively (Department of Climate Change 2017).

The National Climate Change Policy for Nigeria 2021-2030 was established to promote a lowcarbon, climate-resilient and gender-responsive sustainable socio-economic development. The revised National Policy on Climate Change was to define a new holistic framework to guide the country's response to the development challenge of climate change.

1.8.3.4 The National Electric Power Policy (NEPP), 2001

In order to ensure a safe, steady, reliable and progressively improved electric power sector in Nigeria, the Electric Power Reform Implementation Committee (EPIC) was inaugurated by the BPE and resulted in Federal Executive Council (FEC) of Nigeria approving the National Electric Power Policy in September 2001, which recommended, amongst others: establishment of the electric power sector regulator and the privatisation of the electric power sector. The National Electric Power Policy (NEPP), 2001 outlines the realization of an adequate and reliable supply of electricity in three phases - the privatization of the state-own utility NEPA and the introduction of the Independent Power Producers (IPPs); increasing the competition between market participants, partial removal of subsidies, and sale of excess power to distribution companies (DISCOs); and the freedom to select suppliers by large consumers and the creation of a fully liberalized and competitive market.

In 2004, the National Integrated Power Project (NIPP) was initiated to boost power supply by the launch of gas-powered stations. The National Electric Power Policy (NEPP) of 2001 resulted in the Electric Power Sector Reform (EPSRA) Act of 2005 establishing the Nigerian Electricity Regulatory Commission (NERC). The EPSRA provided the statutory basis for the privatisation of the power sector.

1.8.3.5 The National Energy Policy (NEP) 2013

The National Energy Policy (NEP) 2013 is a revised version of the NEP 2003, emphasizes the effective and efficient use of energy and proposes major areas to be considered for energy efficiency and conservation including amongst others: transportation, services/commercial sector, and energy efficient building designs.

1.8.3.6 The National Energy Efficiency Action Plans of Nigeria

The first version of the National Energy Efficiency Action Plans (NEEAP) for Nigeria (2015 2030) was approved on July 14, 2016, by the National Council on Power (NACOP). It has been formulated within the framework of United Nations' Sustainable Energy for All (SE4All) and adopted by the Inter-Ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE). The NEEAP includes baseline data and information on energy efficiency activities and programmes in Nigeria, barriers to the development and promotion of energy efficiency in the country and suggested achievable energy efficiency targets, including gender disaggregated indicators, based on national potentials and socio-economic assessments. The implementation of the NEEAP is being monitored by the Federal Ministry of Power.

1.8.4 National Legal Framework

1.8.4.1 The Environmental Impact Assessment Act No. 86, 1992/Environmental Impact **Assessment Act Cap E12 LFN 2004**

The EIA Act makes it mandatory for any person, authority, corporate body private or public, to conduct EIA before the commencement of any new major development or expansion that may likely have significant effects on the environment. The Act sets out the EIA objectives and the procedures for consideration of EIA of certain public or private projects. The programme is a minor development, which is expected to have minimum impact on the environment. Hence, the programme is categorized as Category II (B) EIA. The EIA guidelines (procedural and sectoral) issued by the FMEnv derive from this Act and the programme proponents shall conduct their activities in conformance with these guidelines.

1.8.4.2 **Electricity Act 2023**

It is more accurate to refer to the Electricity Act 2023 as the replacement Act, rather than simply calling it an amendment to the EPSRA. The 2023 Act expressly repealed the EPSRA 2005 and established a more comprehensive framework governing generation, transmission, system operation, distribution, supply and trading of electricity, as well as consumer rights and renewable energy. One of its most important changes is decentralisation. States can now establish and regulate their own intrastate electricity markets, while NERC continues to regulate matters involving interstate electricity, the national grid, transmission, system operation and other federally regulated activities.

1.8.4.3 Energy Commission of Nigeria Act CAP 109 LFN 1990

The Act was promulgated to create the Energy Commission of Nigeria (ECN) with responsibility for coordinating and general surveillance over the systematic development of the various energy resources of Nigeria. Subject to this Act, the ECN is charged with responsibility for the strategic planning and co-ordination of national policies in the field of energy in all its ramifications. The mandates of ECN include statistical analysis of Electricity Generation, Transmission and Distribution.

1.8.4.4 Land Use Act of 1978 and Resettlement Procedures

The Land Use Act (Cap 202, 1990), now Cap L5 Laws of the Federation of Nigeria 2004, is the key legislation that has direct relevance to this project. Relevant sections of these laws that may relate to this project with respect to land ownership and property rights, resettlement and compensation are summarized in this section. The Land Use Act is the applicable law regarding ownership, transfer, acquisition and all such dealings on Land. The provisions of the Act vast on every parcel of Land, in every State of the Federation, in the Executive Governor of the State. He holds such parcels of land in trust for the people and government of the State.

The Act categorized the land in a State to urban and non-urban or local areas. The administration of the urban land is vested in the Governor, while the latter is vested in the Local Government Councils. At any rate, all land irrespective of the category belongs to the State while individuals only enjoy a right of occupancy as contained in the Certificate of Occupancy, or where the grants are "deemed".

The concept of ownership of land as known in the western context is varied by the Act. The Governor administers the land for the common good and benefits of all Nigerians. The law makes it lawful for the Governor to grant statutory rights of occupancy for all purposes, grant easements appurtenant to statutory rights of occupancy and to demand rent. The Statutory Rights of Occupancy are for a definite time (the limit is 99 years) and may be granted subject to the terms of any contract made between the state Governor and the Holder.

The Local Government Councils may grant customary rights of Occupancy for agriculture (including grazing and ancillary activities), residential and other purposes. But the limit of such grants is 500 hectares for agricultural purposes and 5,000 for grazing, except with the consent of the Governor. The local Government, under the Act, is allowed to enter, use, and occupy for public purposes any land within its jurisdiction that does not fall within an area compulsorily acquired by the Government of the Federation or of the relevant State, or subject to any laws relating to minerals or mineral oils.

The State is required to establish an administrative system for the revocation of the rights of occupancy and payment of compensation for the affected parties. So, the Land Use Act provides for the establishment of a Land Use and Allocation Committee in each State that determines disputes as to compensation payable for improvements on the land (Section 2 (2) (c)).

In addition, each Local Government is required to set up a Land Allocation Advisory Committee to advise the Local Government on matters related to the management of land. The holder or occupier of such revoked land is entitled to the value of the unexhausted development as at the date of revocation. (Section 6) (5). Where land subject to customary rights of Occupancy and used for agricultural purposes is revoked under the Land Use Act, the local government can allocate alternative land for the same purposes (section 6) (6).

If Local Government refuses or neglects, within a reasonable time, to pay compensation to a holder or occupier, the Governor may proceed to effect assessment under section 29 and direct the Local Government to pay the amount of compensation to the holder or occupier. (Section 6) (7).

Where a right of occupancy is revoked on the ground that the land is required by the Local, State or Federal Government for public purposes or for the extraction of building materials, the holder and the occupier shall be entitled to compensation for the value at the date of revocation of their unexhausted improvements. Unexhausted improvement has been defined by the Act as:

> *"anything of any quality permanently attached to the land directly resulting from the expenditure of capital or labour by any occupier or any person acting on his behalf, and increasing the productive capacity the utility or the amenity thereof and includes buildings plantations of long-lived crops or trees, fencing walls, roads and irrigation or reclamation works, but does not include the result of ordinary cultivation other than growing produce*."

Developed Land is also defined in the generous manner under Section 50(1) as follows: land where there exists any physical improvement in road development services, water, electricity, drainage, building, structure or such improvements that may enhance the value of the land for industrial, agricultural or residential purposes.

It follows from the foregoing that compensation is not payable on vacant land on which there exist no physical improvements resulting from the expenditure on capital or labour. The compensation payable is the estimated value of the unexhausted improvements at the date of revocation.

Payment of such compensation to the holder and the occupier as suggested by the Act may appear confusing, as it raises the following question: Does it refer to the holder in physical occupation of the land or to two different parties entitled to compensation, perhaps in equal shares?

The correct view appears to follow from the general tenor of the Act.
First, the presumption is more likely to be the owner of such unexhausted improvements. Secondly, the provision of section 6 (5) of the Act, which makes compensation payable to the holder and the occupier according to their respective interests, gives a pre-emptory directive as to who shall be entitled to what.

Again, the Act provides in section 30 that where any dispute arises as to the amount of compensation calculated in accordance with the provisions of section 29, such disputes shall be referred to by the appropriate Land Use and Allocation Committee. It is clear from section 47 (2) of the Act that no further appeal will arise from the decision of such a committee. If this is so, then the provision is not only retrospective but also conflicts with the fundamental principle of natural justice, which requires that a person should not be a judge in his own cause.

The Act must, in making this provision, have proceeded on the basis that the committee is a distinct body quite different from the Governor or the Local Government. It is submitted, however, that it will be difficult to persuade the public that this is so since the members of the committee are all appointees of the Governor. Where a right of occupancy is revoked for public purposes within the state of the Federation, or on the grounds of the land for the extraction of building materials, the quantum of compensation shall be as follows:

- *In respect of the land, an amount equal to the rent, if any, paid by the occupier during the year in which the right of occupancy was revoked.*

• *In respect of the building, installation or improvements therein, for the amount of the replacement cost of the building, installation or improvements to be assessed based on the prescribed method of assessment as determined by the appropriate officer, less any depreciation, together with interest at the bank rate for delayed payment of compensation. With regard to reclamation works, the quantum of compensation is such cost as may be substantiated by documentary evidence and proof to the satisfaction of the appropriate officer.*

• *In respect of crops on land, the quantum of compensation is an amount equal to the value as prescribed and determined by the appropriate officer.*

Where the right of occupancy revoked is in respect of a part of a larger portion of land, compensation shall be computed in respect of the whole land for an amount equal in rent, if any, paid by the occupier during the year in which the right of occupancy was revoked less a proportionate amount calculated in relation to the area not affected by the revocation; and any interest payable shall be assessed and computed in the like manner.

Where there are any building installation or improvement or crops on the portion revoked, the quantum of compensation shall follow that outlined in paragraph (ii) above and any interest payable shall be computed in like manner.

1.8.4.5 The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004

The Urban and Regional Planning Act is aimed at overseeing realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. In this regard, the following sections are relevant:

• **Section 30 (3)** requires a building plan to be drawn by a registered architect or town planner.

• **Section 39 (7)** establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.

• **Section 59** makes it an offence to disobey a stop-work order. The punishment under this section is a fine not exceeding ₦10,000 (Ten thousand naira) and in the case of a company, a fine not exceeding ₦50,000.

• **Section 72** provides for the preservation and planting of trees for environmental conservation.

1.8.4.6 Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004

The Harmful Waste Act prohibits, without lawful authority, the carrying, dumping or depositing of harmful waste in the air, land or waters of Nigeria. The following sections are notable:

• **Section 6** provides for a punishment of life imprisonment for offenders as well as the forfeiture of land or anything used to commit the offence.

• **Section 7** makes provision for the punishment accordingly, of any conniving, consenting or negligent officer where the offence is committed by a company.

• **Section 12** defines the civil liability of any offender. He would be liable to people who have suffered injury as a result of his offending act.

1.8.4.7 The Endangered Species Act, CAP E9, LFN 2004

This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction because of overexploitation. These sections are noteworthy:

- **Section 1** prohibits, except under a valid license, hunting, capture or trade in animal species, either presently or likely, in danger of extinction.
- **Section 5** defines the liability of any offender under this Act.
- **Section 7** provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.
-

Most of the proposed program locations are on virgin land that serves as wildlife habitats, which will be impacted by the programme. Hence, the programme activities shall be carried out to comply with the relevant provisions.

1.8.4.8 Inland Fisheries Act, Cap I10, LFN 2004

The Inland Fisheries focused on the protection of the water habitat and its species. The following section is relevant:

- **Section 6** prohibits the taking or destruction of fish by harmful means. This offence is punishable with a fine of ₦3,000 or an imprisonment term of 2 years, or both. One of the integral components of solar hybrid systems is battery storage. During the operational phase of the project, there may be the possibility of battery leakages, which may leach into water bodies for project locations with flowing rivers. The chemical contents of these batteries are toxic to aquatic life (fisheries), which necessitates the relevance of this Act.

1.8.4.9 National Commission for Museums and Monuments Act, Cap. N19, LFN 2004

The Act provides for the dissolution of both the Antiquities Commission and the Federal Department of Antiquities and to create a National Commission for Museums and Monuments, with the responsibilities to establish and administer national museums, antiquities and monuments, including, antiquities, science and technology, warfare, African, Black and other antiquities, arts and crafts, architecture, natural history and educational services among others. Sections 12 to 18 provide the process/steps for the declaration of antiquities as national monuments, while section 19 deals with the restriction of excavations for the purpose of finding antiquities as well as the issuance of permits and section 20 deals with accidental discoveries. In case of any accidental find, the Commission shall be notified within seven (7) days.

1.8.4.10 The Factories Act, 1987 (Factory Act cap 126, LFN, 1990)

The Factories Act, as contained in the Laws of the Federation of Nigeria 1990, seeks to legislate and regulate the conduct of health and safety in the Nigerian work environment. It was enacted in June 1987 with the objective of protecting the workers and other professionals against exposure to occupational hazards. The Director of Factories at the Federal Ministry of Employment, Labour and Productivity is responsible for the administration of the provisions or requirements of this Act. Section 13 allows an inspector to take emergency measures or request that emergency measures be taken by a person qualified to do so, in cases

of pollution or nuisances. This Act deals with working conditions at work sites, including construction sites, such as those to be undertaken under the EEP III. Hence, the occupational requirements applicable to construction sites, as well as other work sites to be used by the program, shall be subject to the provisions of this Act.

1.8.4.11 Labour Act, Cap. L1, LFN 2004

This Act deals with labour issues, including payment of wages, recruitment, discipline, employee welfare, employment of women and child labour. Sections 54 to 58 which deal with employment of women, prescribed period of absence from work for nursing mothers and allows her half an hour twice a day during her working hours to attend to the baby for a period of up to six months after she resumes work. Section 55 also exempted women from night work, except when they are employed as nurses. Sections 59-64 deal with the employment of young adults.

1.8.4.12. Wages Boards and Industrial Councils Act, Cap. W1, LFN 2004

The Act provides for the establishment of a National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries. It empowers the Minister to order or direct that an industrial wages board be established to perform, in relation to the workers described in the order and their employers, the functions specified in the provisions of this Act, including minimum wage. The minimum wage is currently ₦30,000.00 per month, and all individuals contracted/employed in relation to this programme shall not earn less than the minimum wage.

1.8.4.13. Employees' Compensation Act, 2010

The Act makes provisions for the payment of compensation to workmen for injuries suffered in the course of their employment. The compulsory insurance covers employees for injury or death resulting in the course of work or in workplaces. All types of workers are covered, including those employed under a contract for service or an apprenticeship with an employer, whether by way of manual labour, clerical work or otherwise, and whether the contract is expressed or implied, is oral or in writing. The programme will employ both skilled and non-skilled labour and shall be subject to this law as applicable.

1.*8.4.14 National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2007*

Administered by the Ministry of Environment, the National Environment Standards and Regulations Enforcement Agency (NESREA) Act of 2007, replaced the Federal Environmental Protection Agency (FEPA) Act. It is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources. The following sections are worth noting:

- **Section 7** provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitoring and regulatory measures.
- **Section 8 (1)(K)** empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances, and other forms of environmental pollution and sanitation.
- **Section 27** prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding 1,000,000 (One

Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of ₦50,000 for every day the offence persists.

1.8.4.15 National Environmental Regulations:

Section 34 of the NESREA Act, 2007 empowers the Minister of Environment to make regulations for safe and sustainable environment. In exercise of this power, the minister issued the national environmental regulations covering various environmental components and sectors of development. The regulations relevant to the programme are as follows:

- National Environmental (Energy Sector) Regulations, 2014. S.I. 63.
- National Environmental (Electrical/Electronic Sector) Regulations, 2011, S.I. No. 23
- National Environmental (Wetlands, Riverbanks and Lake Shores) Regulations, 2009. S. I. No. 26.
- National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28.
- National Environmental (Watershed, Mountainous, Hilly and Catchment Areas) Regulations, 2009. S. I. No. 27.
- National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28.
- National Environmental (Noise Standards and Control) Regulations, 2009. S. I. No. 35.
- National Environmental (Air Quality Control) Regulations, 2013, S. I. No. 64,
- National Environmental (Soil Erosion and Flood Control) Regulations, 2010. S. I. No. 12.
- National Environmental (Surface and Groundwater Quality Control) Regulations, 2010. S. I. No. 22.
- National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2010. S. I. No. 20.

1.8.4.16. EIA Procedural Guidelines:

This procedure prescribes the steps to be followed in the EIA process from project conception to commissioning and post-commissioning impact mitigation, to ensure that the program is implemented with maximum consideration of environmental factors. This ESIA study will be conducted in compliance with this guideline.

1.8.4.17 EIA Sectorial Guidelines (Infrastructures):

This provides general guidelines for EIA of projects in the infrastructure sectors of Nigeria, with specific details for sub-sectors.

1.8.4.18 FMEnv ESMP Guidelines for Solar Mini-Grid Projects in Nigeria

The ESMP Guidelines for Solar Mini-Grid Projects in Nigeria was developed as an abridged form of the EIA Procedures Guidelines with the aim of simplifying the method of preparing ESMPs for proposed solar mini-grid projects. The simplified method is also to optimise the mini-grid projects' EIA timeline and the cost of development.

1.8.5 International Legislation

The International Conventions, to which Nigeria is a signatory, relevant to this programme are as follows:

- African Convention on the Conservation of Nature and Natural Resources

- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals 1973
- Framework Convention on Climate Change 1992
- Convention to Combat Desertification 1994
- Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW)
- Human and Peoples' Rights on the Rights of Women in Africa 2005
- Civil and Political Rights Covenant
- Economic, Social and Cultural Rights Covenant
- Convention on the Elimination of All Forms of Violence Against Women
- Convention on the Rights of the Child

1.8.6 Institutional Framework

This section highlights the relevant institutions through which the planning and implementation of the program will be affected. Several institutions have been identified and will be involved in the overall implementation of this programme. These include:

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Power
- Transmission Company of Nigeria (TCN)
- Federal Ministry of Environment (FMEnv)
- Nigerian Electricity Regulatory Commission (NERC)
- National Environmental Standards and Regulatory Enforcement Agency (NESREA)
- National Universities Commission (NUC)
- Relevant State Agencies: State Ministry of Lands, State Ministry of Environment and State Environmental Protection Agencies
- Local Government Authority (LGA)

The responsibilities and roles of each of the institutions are discussed below.

1.8.6.1 The Federal Government of Nigeria

Section 20 of the Constitution of Nigeria makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively, can also be linked to the need for a healthy and safe environment to give these rights effect. The Executive Council of the Federation approves all national policies including the National Policy on Environment.

1.8.6.2 Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the country. It has the responsibility for EIA implementation, approval and issuance of certificates. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures when the project commences. They can also issue directives to

the project on specific actions related to the environment in the project area. The Ministry normally involves the states and sometimes local governments in this responsibility depending on the specific activity.

1.8.6.3** The **National Environment Standards and Regulations Enforcement Agency (NESREA) ensure the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources are monitored and complied with. NESREA ensures that the operational phase of the solar power system minigrid project complies with national environmental standards and regulations.

1.8.6.4 The National Universities Commission

The National Universities Commission (the Commission) was established in 1974 by the National Universities Commission Act CAP N81 to advise the Federal and state governments of all aspects of university education and the general development of universities in Nigeria. It is the dynamic regulatory agency acting as a catalyst for positive change and innovation for the delivery of quality university education in Nigeria. It is also the agency for channeling all external aid to the universities in Nigeria; To receive block grants from the Federal Government and allocate them as appropriate.

1.8.6.5 The Federal Ministry of Power

The Federal Ministry of Power is the policy-making arm of the Federal Government with the responsibility for the provision of power in the country. The Ministry is guided by the provisions of the Electricity Act No 28 of 1988, the National Electric Power Policy, 2001, the Electric Power Sector Reform Act, 2005, the Roadmap for Power Sector Reform, 2010, and the National Energy Policy, 2013 as described earlier in section 1.6.4. The following parastatals are under the ministry: Energy Commission of Nigeria (ECN) Nigerian Electricity Regulatory Commission (NERC) Power Holding Company of Nigeria (PHCN) Rural Electrification Agency (REA). The responsibilities of the Federal Ministry of Power are as follows:

- Initiating and formulating broad policies and programmes on the development of the power sector Initiating concessions in the power sector Licensing of electrical contractors and electric generating sets of 1MW capacity and below
- Conducting investigation on electrical accidents and to ensure safety in the electricity industry in Nigeria
- Conducting statutory tests and certification of electric poles (concrete, wooden, steel etc.) and other major electrical materials before they are used on the grid and networks in Nigeria
- Implementing renewable energy programmes/ initiatives (solar, wind, biomass, small hydro etc.) Coordinating activities of the power sector
- Handling policy matters relating to research and development in the power sector
- Promoting the development of hydro power plants through public-private partnership (PPP), participating in bilateral and multilateral relations affecting the power sector
- Facilitating the overall coordination of the activities of the parastatals under their supervision

1.8.6.6 Nigerian Electricity Regulatory Commission (NERC)

The Nigerian Electricity Regulatory Commission (NERC) is an independent regulatory agency. NERC was established in 2005 as part of the economic reform agenda of the Obasanjo administration. The Electric Power Sector Reform Act of 2005 was the legislation that led to the establishment of NERC.

The Commission is required to carry out the following, amongst others:

i. Monitor and regulate the activities of the electricity industry in Nigeria.
ii. Issue licenses to market participants; and
iii. Ensure compliance with market rules and operating guidelines.

To create an enabling investment climate for rural electrification projects, NERC established the Mini-Grid Regulation in 2016; regulatory guidelines for mini-grids less than 100 kW and a light-handed regulation for mini-grids between 100 kW and 1 MW.

1.8.6.7 Transmission Company of Nigeria (TCN)

TCN emerged from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors on April 1, 2004. TCN was incorporated in November 2005. Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), TCN was issued a transmission License on 1st July 2006. It was subsequently issued two licenses on June 10, 2013, for electricity transmission and system operations.

1.8.6.8 Rural Electrification Agency

The Rural Electrification Agency was set up by Section 88 of the Electric Power Sector Reform Act 2005 as the Implementing Agency of the FGN tasked with the electrification of rural and unserved communities. The mission is to provide access to a reliable electric power supply for rural dwellers irrespective of where they live and what they do, in a way that would allow for a reasonable return on investment through an appropriate tariff that is economically responsive and supportive of the average rural customer.

1.8.6.9 Federal Ministry of Women Affairs and Social Development

Promote actions to achieve the National Gender Policies and a gender budget among policymakers. The goals of the gender policy, among others, include:

- Eliminate cultural/religious gender-based biases and harmful cultural and religious practices which rise to inequalities in gender-role relations in Nigerian society. A culture that is amenable to development must be dynamic.
- Tap the potential of women for development.
- Eliminate all forms of gender-based violence.
- Ensure equal access to women, boys and girls to both formal and informal education. Women's education is a priority because it is the key to gender equity, justice, and poverty reduction, improved skills and technological knowledge, as well as the general socioeconomic development of the nation.

1.8.6.10 State Institutions

Kwara State Ministry of Environment

The Ministry of Environment is currently responsible for environmental service matters and resources in the state. Other objectives include initiating formulation, execution, and monitoring of all issues relating to all environmental matters, solid waste management, and mineral resources. A recent law passed established the Kwara State Environmental Law 2021.

Kwara State Ministry of Women Affairs and Social Development

The ministry seeks to empower women and youth, promote the participation of women in governance, pay attention to women in rural areas, enhance the economic self-reliance of women, create awareness, and campaign against gender-based violence, etc.

1.8.7 Funding Agency Requirements

This programme is funded by the World Bank Therefore, the World Bank Environmental and Social safeguard Standards will be integrated in the project cycle as well as other national and international environmental and social protection requirements, to comply with the best international practices. Both the main environmental and social requirements that the project needs to comply with are described in the following sections.

1.8.7.1 The World Bank Environmental and Social Framework and Standards

The World Bank policies on environmental and social safeguards are the fulcrum of its support towards sustainable poverty reduction, particularly in developing countries. The policies are aimed at preventing and mitigating undue harm to the people. As indicated in Table 1.1, the compliance status of the proposed project along the various phases is presented below.

Table 1.1: Safeguard Compliance Matrix for the Power Project

1. Pre-Construction Phase

Aspect	Nigeria Legal Requirements	World Bank Standards triggered	International Agreements	Key Compliance Actions
Environmental Assessment	EIA Act (Cap E12 LFN 2004)	ESS1: Assessment of Environmental & Social Risks	Paris Agreement	Conduct EIA/ESIA; obtain approval from the Federal Ministry of Environment
Land Acquisition	Land Use Act (1978)	ESS5: Land Acquisition & Resettlement	International Labour Organization (land & livelihood rights)	Secure land titles; compensate affected persons
Stakeholder Engagement	National environmental guidelines	ESS10: Stakeholder Engagement	Aarhus Convention (principles)	Public consultations; disclosure of project info
Biodiversity Screening	NESREA Act	ESS6: Biodiversity Conservation	Convention on Biological Diversity	Identify sensitive habitats; avoid critical areas
Permits & Licensing	NERC mini-grid regulation	ESS1 compliance	NA	Obtain generation/distribution permits

2. Construction Phase

Aspect	Nigeria Legal Requirements	World Bank Standards triggered	International Agreements	Key Compliance Actions
Occupational Health & Safety	Factories Act; Labour Act	ESS2: Labor & Working Conditions	International Labour Organization conventions	Provide PPE; enforce safety procedures
Waste Management	NESREA Regulations	ESS3: Resource Efficiency & Pollution Prevention	Basel Convention	Proper disposal of hazardous waste (e.g., batteries)
Community Health & Safety	Public Health Act	ESS4: Community Health & Safety	WHO guidelines	Traffic management; site safety measures
Noise & Air Pollution	NESREA Air Quality Regulations	ESS3- Resource Efficiency & Pollution Prevention	Paris Agreement	Control emissions, dust, and noise
Cultural Heritage	National Commission for Museums Act	ESS8: Cultural Heritage	UNESCO conventions	Chance finds procedures in place

3. Operation & Maintenance Phase

Aspect	Nigeria Legal Requirements	World Bank Standards triggered	International Agreements	Key Compliance Actions
Energy Efficiency	National Energy Policy	ESS3: Resource Efficiency	Paris Agreement	Optimize system performance; reduce losses
Waste (Batteries, Panels)	NESREA e-waste regulations	ESS3- Resource Efficiency & Pollution Prevention	Basel Convention	Safe recycling/disposal systems
Labor Conditions	Labour Act	ESS2: Labor & Working Conditions	International Labour Organization	Fair wages, worker rights compliance
Community Relations	Local governance laws	ESS10: Stakeholder Engagement	NA	Maintain grievance redress mechanism
Safety & Risk Management	Nigerian Electricity Safety Code	ESS4: Community Health & Safety	NA	Routine inspection and maintenance

4. Decommissioning Phase

Aspect	Nigeria Legal Requirements	World Bank Standards triggered	International Agreements	Key Compliance Actions
Environmental Restoration	EIA Act (closure requirements)	ESS1: Assessment of Environmental & Social Risks	Convention on Biological Diversity	Site rehabilitation and restoration
Waste Disposal	NESREA Regulations	ESS3- Resource Efficiency & Pollution Prevention	Basel Convention	Dispose of solar panels and batteries safely
Worker Safety	Labour Act	ESS2: Labor & Working Conditions	International Labour Organization	Safe dismantling procedures
Community Safety	Public Health Act	ESS4: Community Health & Safety	NA	Secure site; prevent hazards post-closure
Asset Removal & Land Return	Land Use Act	ESS5: Land Acquisition & Resettlement	NA	Restore land to its original or agreed condition

1.9 Institutional Arrangements for Environmental and Social Management

REA is responsible for selecting an Engineering, Procurement and Construction (EPC) contractor (through a competitive process) to build, operate, and maintain the proposed power plant, and also build and equip the associated training center. The selected EPC will also be considered for a ten-year operation and maintenance (O&M) contract for the power plant. In the long run, the University will be responsible for operating and maintaining the Project. REA has established a Project Management Unit (PMU), which includes experienced Environmental and Social Safeguard Specialists. The REA-PMU will provide oversight functions for the management of potential environmental and social issues associated with the Project throughout its life cycle. The PMU, in conjunction with the University's Department of Works and Physical Planning, will monitor the hired contractor's E&S performance. The implementation of mitigation measures for potential environmental and social impacts associated with the Project (at various stages) will also be monitored by FMEnv, NESREA, Kwara State Ministry of Environment, and other relevant regulatory agencies, as part of their statutory responsibilities. In addition, the World Bank will provide overall supervision, facilitation, and coordination of the Project and monitor Project performance indicators.

1.10. Report on the ESIA Structure

In line with the FMEnv guidelines, this report is structured as follows:

- Preliminary Sections: containing table of contents, lists of ESIA preparers, Executive Summary, amongst others.
- Chapter One: Introduction containing an overview of the proposed Project, the ESIA objectives and study approach, and applicable legal and administrative framework.
- Chapter Two: Project Location and Justification, containing a rationale for the proposed Project as well as the analysis of Project alternatives and development options.
- Chapter Three: Project Description containing the technical elements of the Project. It concisely describes the proposed Project and its geographic and temporal context, including the Project's associated infrastructure.
- Chapter Four: Description of the Environment. It details the baseline data that is relevant to decisions about the Project location, design, development, and operation.
- Chapter Five: Potential and Associated Impacts. This takes into account all relevant environmental and social risks and impacts of the proposed Project, including cumulative impacts.
- Chapter Six: Mitigation measures for the identified negative environmental and social impacts, as well as the enhancement measures for the identified positive impacts.
- Chapter Seven is the ESMP. It summarizes the key environmental and social measures and actions, and the timeframe, including responsibility for the implementation of the recommended measures. Aso, discusses the decommissioning and remedial plan for the proposed project.
- Chapter Eight: describes the stakeholder engagement activities carried out during the ESIA and an overview of the grievance redress mechanism for the Project.
- Chapter Nine: Conclusion and Recommendations

The report also includes references and appendices.

CHAPTER TWO
PROJECT JUSTIFICATION

2.1 General

This chapter presents the justification for the proposed solar-hybrid power plant and associated infrastructure in the University and Teaching Hospital, as part of the Federal Government of Nigeria (FGN) proposed Nigeria Electrification Project Phase III under the DARES. It also includes the description of alternatives and development options considered for the proposed Project.

2.2 Need for the Project

Federal Universities in Nigeria continue to experience serious electricity supply challenges despite being the preferred choice for many candidates seeking tertiary education. The University and Teaching Hospital currently receives only about two hours of electricity daily from the national grid, resulting in a heavy dependence on diesel-powered generators. This situation has increased operational costs, maintenance demands, and environmental pollution, while also affecting teaching, research, and administrative activities.

To address these challenges, the Federal Government of Nigeria (FGN), through the Rural Electrification Agency (REA) and with support from the World Bank, is implementing the Nigeria Electrification Project (NEP). The project is designed to improve access to reliable and sustainable electricity through renewable energy solutions in underserved and off-grid areas.

Under the NEP, the Energizing Education Programme (EEP) aims to provide a clean, stable, and dedicated power supply to selected Federal Universities and their affiliated Teaching Hospitals nationwide. The programme also aligns with Nigeria's climate commitments under the Paris Agreement by supporting the country's target of reducing carbon emissions by 20–30 percent by 2030.

The proposed intervention is expected to significantly improve the University's energy situation by reducing dependence on diesel generators and ensuring a more reliable power supply. Additional benefits of the project include the establishment of a renewable energy training centre to promote capacity building and professional certification, as well as the installation of solar-powered street lighting to improve campus security and create a safer and more conducive environment for learning and research.

2.3 Value of the Project

The Nigeria Electrification Project (NEP) is a major initiative by the Federal Government of Nigeria, implemented by the Rural Electrification Agency with support from the World Bank, to expand access to reliable electricity, especially in underserved and off-grid communities. One of its key components is the Energizing Education Programme (EEP), which focuses specifically on providing sustainable power to federal universities and teaching hospitals.

The US $150 million sovereign loan facility approved by the World Bank is part of the broader NEP financing structure. Because it is a *sovereign loan*, it is borrowed directly by the Federal Government of Nigeria (not private entities), meaning the government is responsible for repayment. The funds are used to support large-scale electrification projects, including solar hybrid power systems, mini-grids, and infrastructure upgrades across educational institutions.

2.4 Project Benefits

The benefits of the proposed Project are as follows;

- The potential benefits of the proposed Project include but are not necessarily limited to, the following:
- Stimulation of academic and research activities within the University as a result of access to constant and reliable power supply, thereby promoting educational advancement.
- Reduction in fossil fuel consumption by the University, thereby leading to a reduction in carbon emissions and improvement in the eco-balance.
- Increase in social interactions within the University. There will be enhanced security in the University because of more streetlights for illumination, which would help prevent opportunistic crimes and gender-based violence.
- Enhancement of learning in renewable energy, leading to certification as a result of training centre to be provided as part of the Project.
- Improvement in livelihood-enhancing activities within the University.
- Direct and indirect employment opportunities during Project development and operation. The employment opportunities will lead to the acquisition of new skills and the introduction of all manner of income-generating spill-over effects.
- Increase in local and regional economy through the award of contracts and the purchase of supplies for Project development.
- Increase in financial and technical collaborations between the FGN, the University, REA, World Bank, and other relevant Ministries, Departments, and Agencies (MDAs).
- Contributing to Nigeria's NDC to cut carbon emissions by 20 % to 30 % by the year 2030, under the Paris Agreement.

2.5 Envisaged Sustainability

2.5.1 Technical Sustainability

The Project is an Energy-as-a-Service (EaaS) model, the same Energy Service Company (ESCO) responsible for the design and construction of the project will also manage its operations and maintenance (O&M) throughout the service period.

The design and construction phases will be supervised by qualified engineers from the REA and the University's Department of Works and Physical Planning to ensure compliance with technical specifications and quality standards. The EPC contractor will also develop standard operating manuals and relevant operational documentation for the Project.

In addition, adequate capacity-building and technical training will be provided to designated University personnel to support effective day-to-day operations and ensure the long-term technical sustainability of the project.

2.5.2 Environmental Sustainability

The project aligns with the Federal Government of Nigeria's commitment to reducing greenhouse gas (GHG) emissions and promoting climate-resilient development through the adoption of renewable energy

technologies. Although Nigeria's economic growth between 1990 and 2014 significantly outpaced the growth in GHG emissions, the country's emissions intensity remained relatively high compared to the global average (USAID, 2019). Consequently, the promotion of renewable energy for electricity generation has become a key national strategy for achieving sustainable development, improving energy access, and supporting climate change mitigation objectives.

Furthermore, the establishment of the Rural Electrification Agency Project Management Unit (REA-PMU), with experienced Environmental and Social Safeguards Specialists, provides the institutional framework necessary for effective environmental and social oversight during project implementation. The early conduct of the Environmental and Social Impact Assessment (ESIA), alongside the commitment to implement the recommended mitigation measures and Environmental and Social Management Plan (ESMP), demonstrates a proactive approach to minimizing potential environmental and social risks and ensuring the long-term sustainability of the project.

2.5.3 Economic Sustainability

The Proposed Nigeria Electrification Project (NEP) under DARES implemented by the Rural Electrification Agency (REA) with financing support from the World Bank (WB), is designed to be economically sustainable in both the short and long term through prudent project design, cost efficiency, and strong institutional arrangements.

At the project level, the deployment of solar-hybrid mini-grid systems significantly reduces dependence on diesel generators, which are characterized by high fuel, transportation, and maintenance costs. By substituting diesel-based generation with solar energy, the project delivers substantial savings in operational expenditure over its lifecycle. While initial capital investment in renewable energy infrastructure is relatively high, the long lifespan of solar PV systems and declining technology costs ensure lower levelized cost of electricity (LCOE) over time, making the systems economically competitive and financially viable.

The project also enhances institutional financial sustainability for beneficiary Federal Universities. Reliable and predictable electricity supply reduces recurrent spending on diesel procurement and generator maintenance, allowing institutions to reallocate limited financial resources toward core academic, research, and healthcare functions. Improved power availability also minimizes disruptions to academic calendars and research activities, indirectly strengthening institutional productivity and value for money.

From a macroeconomic perspective, the project supports Nigeria's broader economic sustainability objectives by reducing fossil fuel consumption, lowering foreign exchange expenditure on imported diesel, and contributing to energy security. Local content participation in system installation, operation, and maintenance further stimulates job creation and skills development, supporting local economies and reducing long-term reliance on external technical expertise.

2.5.4 Social Sustainability

Stakeholder consultation was undertaken as an integral part of the ESIA process to ensure that all relevant stakeholders were allowed to contribute to the Project at an early stage of development. This engagement process also helped to establish a strong foundation for building and maintaining positive relationships with

stakeholders. The initial stakeholder engagement activities conducted during the ESIA are documented and presented in this report.

To ensure sustained and structured engagement throughout the Project lifecycle, a Stakeholder Engagement Plan (SEP) will be developed and implemented. In addition, the Rural Electrification Agency (REA) has established a Grievance Redress Mechanism (GRM) for the Project. The GRM provides a clear and accessible communication channel through which stakeholders can submit complaints or concerns related to the Project, and it ensures that such grievances are addressed in a timely and effective manner.

2.6 Site/Project Selection

2.6.1 Alternatives

The selection of this site was guided by several key considerations, including: (i) the absence of rocky outcrops that could hinder the installation of solar panels; (ii) the lack of ecologically sensitive areas or cultural heritage resources within and around the site; (iii) good accessibility through the existing internal road network; (iv) the feasibility of achieving a direct connection to the existing switchyard; and (v) enhanced security within the proposed site.

Furthermore, the survey revealed the following key findings:

- The parcel of land is a polygonal parcel of land with clearly defined boundaries
- It covers a total area of 3.370 hectares
- The terrain appears generally accessible and suitable for development
- The site is bounded partly by an existing road, enhancing accessibility
- The survey was carried out by a geographic positioning system and plotting using auto-cad. It is also important to note that the terrain is a level of plain. The site is also accessible with good existing and proposed roads.

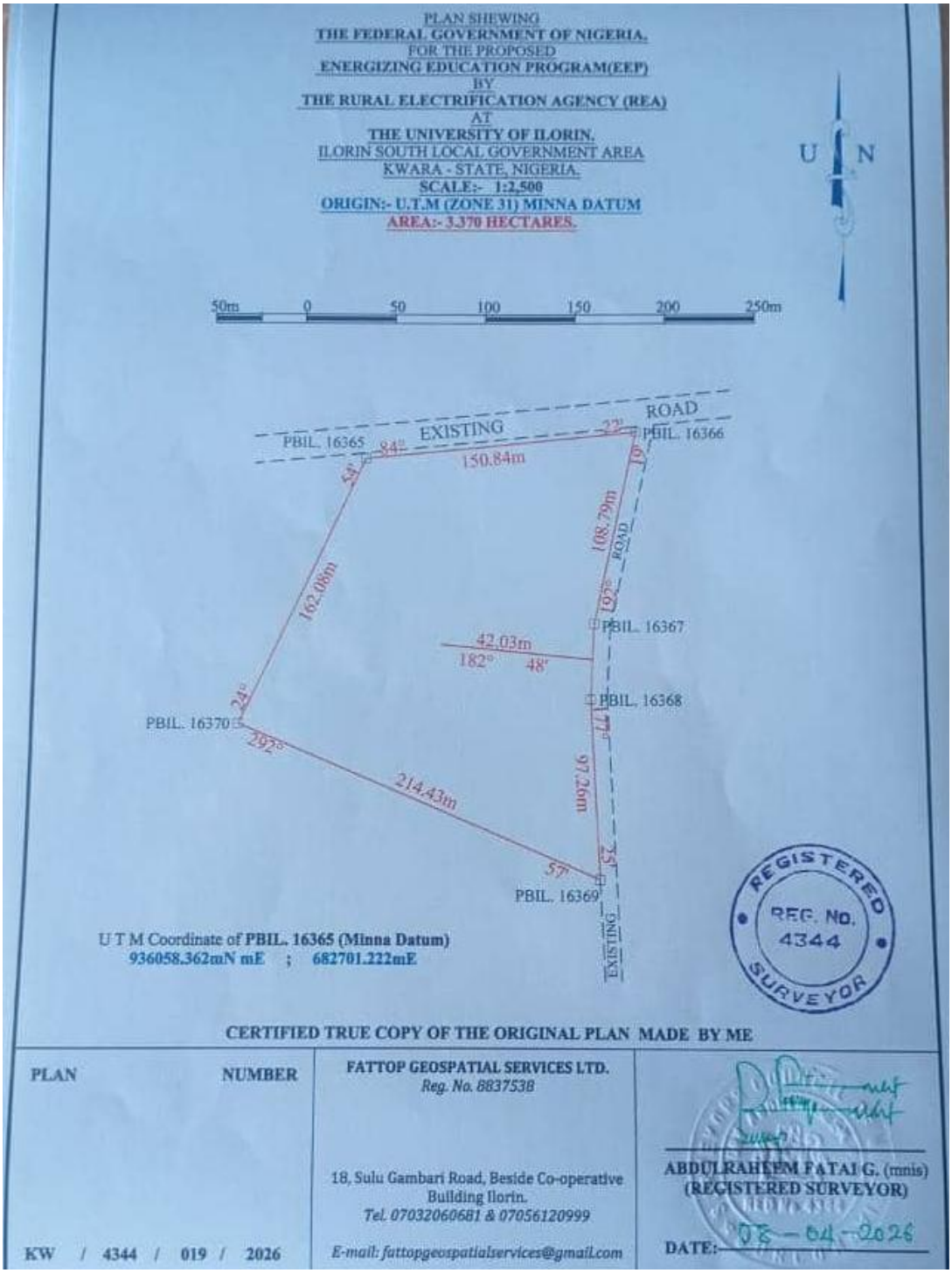

Figure 2.1: Approved Survey Map of the proposed Site

2.6.2 Alternatives Considered within the Context of the Proposed Solar-Hybrid Power Plant

The power plant to be provided as part of the proposed project in Ilorin has been conceptualized as a renewable energy source (solar technology) since that is part of the objectives of the EEP initiative (i.e. carbon emission reduction). Thus, this section specifically focuses on the alternatives considered within the proposed solar-hybrid power plant and eliminates discussion on other possible sources of power generation in Nigeria, such as the use of natural gas-fired power plants, coal-fired plant, oil-fuel plants, etc.

2.6.2.1 Overview

Solar power generation is currently one of the fastest-growing areas in renewable energy. Beyond panel production, it does not emit any significant GHGs. Compared to alternative renewable generation technologies such as wind turbines or biofuel generators, solar energy is produced by converting the sun's radiation – a process void of any smoke, gas, or other chemical by-product, which makes this technology meet the clean development mechanism of the Kyoto Protocol. This is the main driving force behind all green energy technology, as nations attempt to meet climate change obligations in curbing emissions.

The use of solar energy for the proposed power plant will significantly reduce the generation of GHG emissions associated with fossil-fuel power plants. Thus, the proposed Project will help contribute to Nigeria's NDC on climate change.

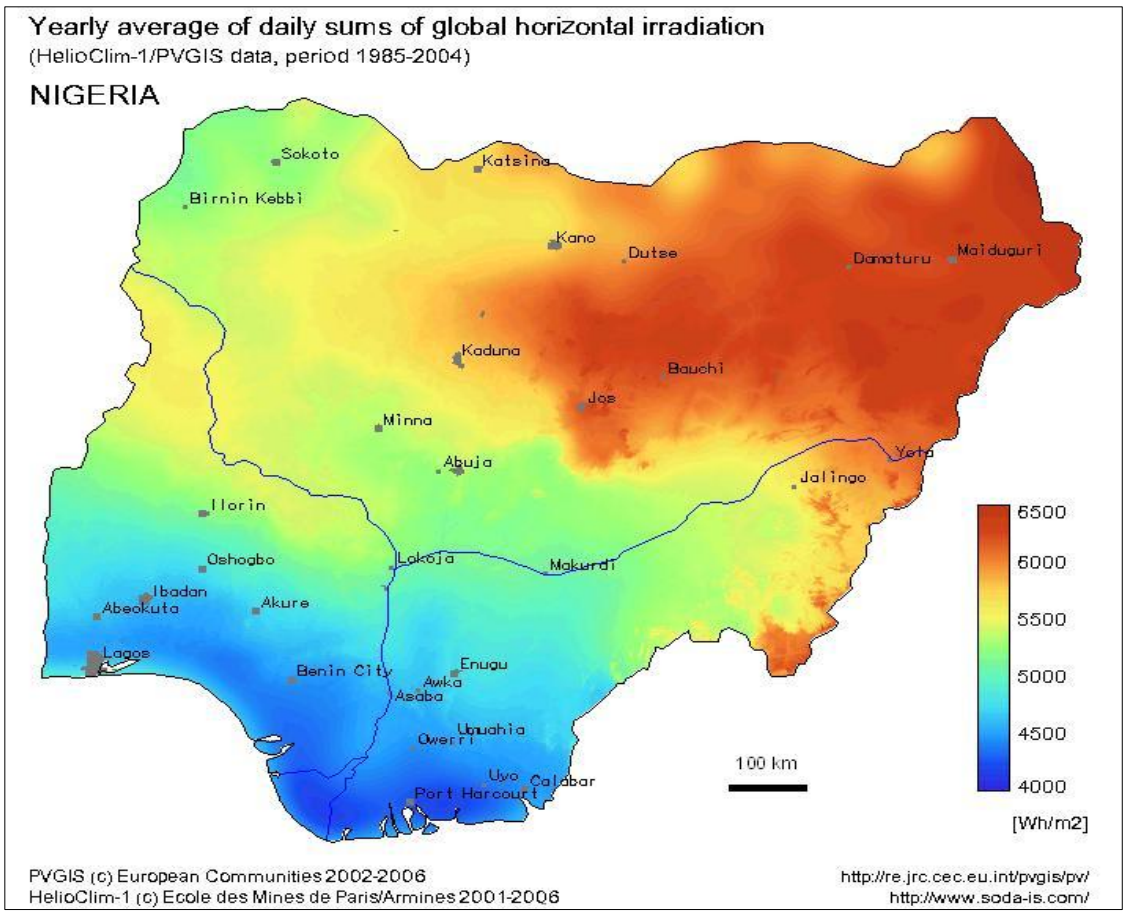

Figure 2.2: Photovoltaic power potential of Nigeria Source: © 2017 The World Bank, Solar resource data: Solargis

2.6.2.2 Solar Power Technology Alternatives

The solar technologies considered for the proposed power plant are:

For most modern solar projects, Monocrystalline PV panel design is generally considered the best option because it offers:
Higher efficiency (more power generation per square meter)
Better performance in low-light conditions
Longer lifespan (typically 25+ years)
Lower space requirement
Better aesthetic appearance

Table 2.1: Common PV Panel Types

Type	Efficiency	Cost	Performance	Best Use
Monocrystalline	High (18–24%)	Higher	Excellent	Commercial and institutional projects
Polycrystalline	Moderate (15–18%)	Moderate	Good	Budget-sensitive projects
Thin-Film	Lower (10–13%)	Lower	Fair	Large open areas with low structural load

Recommendation

For a university or institutional solar project with continuous electricity demand, a grid-connected monocrystalline PV system with battery backup is usually the most suitable because it provides:

- Reliable power supply
- Reduced dependence on generators
- Higher energy output
- Lower long-term operating costs

2.6.3 Battery Technology Alternatives

The proposed solar-hybrid power plant is an off-grid system, which will involve the storage of power. The batteries for the proposed power plant would be required to meet the demands of heavy cycling (charging and discharging) and irregular full recharging. Table 2.2 presents battery types and alternatives for the proposed project.

Table 2.2: Battery Types Alternative

Battery Type	Technology Description	Advantages	Disadvantages	Lifespan	Maintenance Requirement	Suitability for Solar Hybrid Station
Lithium-ion Battery	Rechargeable battery with high energy density	High efficiency, fast charging, compact size, long lifespan	High initial cost, requires BMS	10–15 years	Low	Excellent for commercial and institutional systems
Lithium Iron Phosphate Battery	Advanced lithium battery with improved safety and stability	Very safe, long cycle life, high efficiency, heat tolerant	Higher upfront investment	10–15 years	Low	Highly recommended solar hybrid stations
Lead-acid Battery	Traditional rechargeable battery technology	Low cost, widely available	Short lifespan, low efficiency, regular maintenance required	3–5 years	High	Suitable for small or low-budget systems
Gel Battery	Sealed lead-acid battery using gel electrolyte	Maintenance-free, spill-resistant	Lower charging speed, moderate lifespan	5–7 years	Low	Suitable for medium-scale installations
Absorbent Glass Mat Battery	Sealed battery using absorbent	Reliable, maintenance-free,	Shorter lifespan than lithium batteries	4–7 years	Low	Good for backup and moderate storage applications

Battery Type	Technology Description	Advantages	Disadvantages	Lifespan	Maintenance Requirement	Suitability for Solar Hybrid Station
	glass mat separator	moderate cost				

Lithium-ion Battery is recommended for the following reasons: High efficiency, fast charging, compact size, long lifespan

2.7 Project Options

2.7.1 No-Project Option

The proposed project is necessary because the current electricity demand within the University significantly exceeds available supply, while grid electricity remains unreliable and prone to frequent interruptions. Without the project, access to reliable, safe, and affordable electricity would remain limited, and the associated social, economic, and environmental benefits would not be realized. In addition, the University would continue to depend heavily on diesel-powered generators for electricity generation, resulting in high operational costs and increased greenhouse gas emissions, contrary to the Federal Government of Nigeria's carbon emission reduction objectives. Consequently, the "No Project" option is not considered a viable alternative.

2.7.2 Delayed Option

Delaying the implementation of the proposed project is considered impractical, as the prevailing political and economic conditions are favourable for its execution. Postponement would undermine the substantial time, resources, and financial investments already committed to project planning and feasibility studies, while also exposing the project to inflationary increases in the cost of materials, labour, and equipment. Such delays could negatively affect the overall economic viability and anticipated benefits of the project; therefore, the delayed implementation option is not considered suitable.

2.7.3 Go-Ahead Option

Allowing the Project to proceed as planned will deliver significant and far-reaching benefits, including improved quality of education, enhanced capacity for research and innovation, expanded training opportunities, and strengthened security across the University campus and teaching hospital facilities. The Project will also create employment opportunities for Nigerian professionals, as well as skilled and semi-skilled craftsmen, thereby contributing to local economic development.

To maximize these benefits, the recommended design is a grid-connected monocrystalline photovoltaic (PV) solar system with battery backup, which is particularly well suited for a university or institutional environment with continuous electricity demand. This solution provides a reliable and uninterrupted power supply, reduces dependence on diesel generators, delivers higher energy output due to the efficiency of monocrystalline panels, and lowers long-term operating and maintenance costs. By ensuring sustainable and dependable electricity, the proposed system will support the University's academic, research, healthcare, and administrative functions while advancing its energy sustainability objectives.

3.1 Background and Rationale of the Project

This chapter presents the description of the proposed project to be implemented.

3.2 Project Location

3.2.2 Description of the Project Area of Influence

The University of Ilorin is located within Ilorin East Local Government Area of Kwara State, North Central Nigeria, along the Old Jebba Road. The surrounding environment is predominantly urban and peri-urban in character, comprising a mix of educational institutions, healthcare facilities, residential neighbourhoods, commercial activities, and transportation infrastructure. The area experiences moderate to high human and vehicular traffic due to the presence of the University, the Teaching Hospital, nearby schools, markets, and adjoining communities. Major access roads within the area provide connectivity to other parts of Ilorin metropolis and neighbouring settlements, thereby enhancing accessibility to the project location.

The adjacent environment is characterized by relatively flat terrain with scattered vegetation, open spaces, and built-up developments typical of an expanding urban centre. Land use within the vicinity includes institutional, residential, commercial, and small-scale agricultural activities. Public utilities and social infrastructure such as electricity, water supply, telecommunications facilities, and healthcare services are available within the area. The presence of the University and UITH has also contributed significantly to socioeconomic activities in the surrounding communities through employment generation, commercial development, educational opportunities, and improved healthcare access. Overall, the adjoining environment is considered suitable for institutional and infrastructure development, subject to the implementation of appropriate environmental and social management measures.

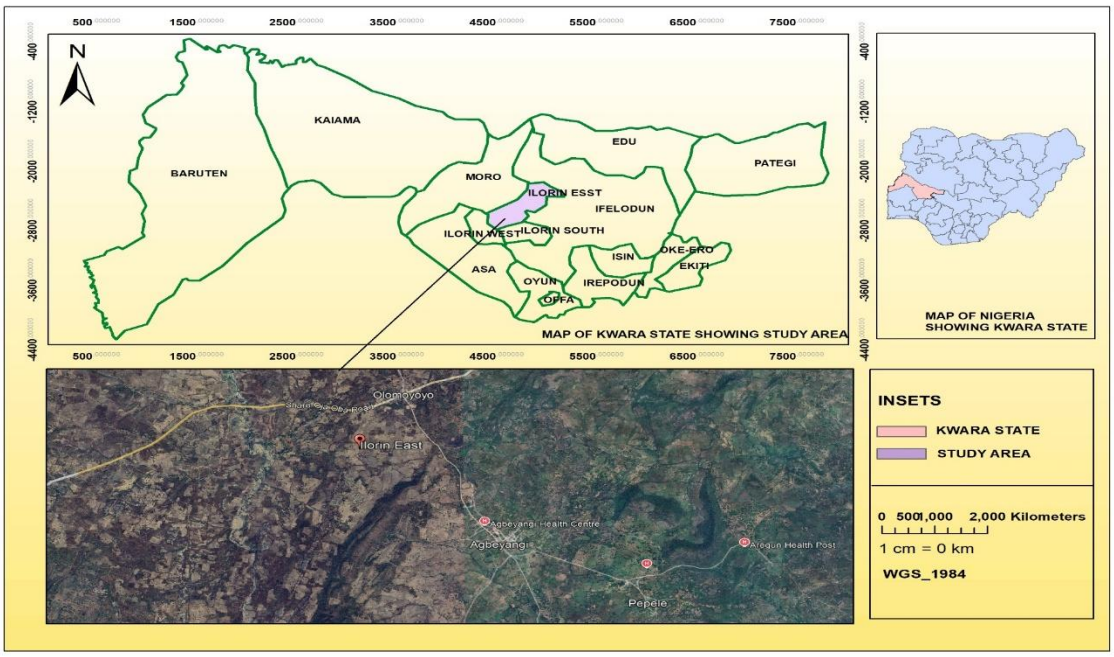

Figure 3.1: Administrative Map of Kwara State Showing the Project Area

Figure 3.2: Site Aerial Overview

3.3 Project Description

As previously stated, the scope of the EEP includes the provision of an independent power plant, rehabilitation of existing electricity distribution infrastructure, provision of street lighting as well as a renewable energy training centre. However, the Front-End Engineering Design (FEED) for the project is ongoing as at the time of this ESIA study. Therefore, the specifications and number of some of the components to be installed for the proposed project are yet to be finalized. Each of these components related to the solar hybrid power project are discussed below.

3.3.1 Proposed Solar-Hybrid Power Plant

Monocrystalline PV Panel Design

A monocrystalline PV panel design consists of several essential components that work together to convert solar energy into usable electricity efficiently and reliably. The primary component is the Photovoltaic Cell, made from high-purity monocrystalline silicon, which converts sunlight into direct current (DC) electricity through the photovoltaic effect. These cells are arranged in series and parallel configurations within the panel to achieve the required voltage and power output.

Tempered Glass Cover and Encapsulation

The solar cells are protected by a tempered glass cover, which shields the panel from environmental conditions such as rain, dust, wind, and physical impact while allowing maximum sunlight transmission. Beneath the glass is an encapsulant layer, commonly made of Ethylene Vinyl Acetate (EVA), which cushions and secures the cells in place. A protective backsheet is installed at the rear of the panel to provide electrical insulation and protect the internal components from moisture and environmental degradation.

Aluminum Frame and Junction Box

An aluminum frame surrounds the panel to provide structural strength and facilitate mounting onto support structures. At the back of the panel is a junction box containing electrical connections and bypass diodes, which help reduce power losses and prevent overheating during partial shading conditions. DC cables and connectors are used to transmit the generated electricity from the panels to other system components.

Mounting Structure and Inverter

The mounting or racking structure is another critical component of the PV system design. It supports the panels at the optimum tilt angle and orientation to maximize solar energy capture while ensuring stability against wind and other environmental loads. For hybrid solar systems, the design also includes an Inverter, which converts the DC electricity produced by the panels into alternating current (AC) suitable for use by electrical appliances and grid integration.

Battery Storage and Safety Components

Additional components include a battery storage system for storing excess energy, a charge controller to regulate battery charging and prevent overcharging or deep discharge, and combiner boxes that consolidate power from multiple PV strings. The system also incorporates earthing and lightning protection measures to ensure electrical safety, as well as monitoring systems that track energy generation, system performance, and operational efficiency.

Provision of Street Lighting
As part of the proposed project, Streetlights will be installed (where required) to ensure that different areas within the campus are well illuminated.

Renewable Energy Training Centre
Students from the campus will be allowed to access the Project site for learning and training purposes. The training center will also include a storage room, a workshop and toilet facilities.

3.4 Engineering Codes and Standards

The Project components shall be designed and installed in compliance with the relevant codes and standards of the British Standard-Europe Norms (BS–EN), the International Electrotechnical Commission (IEC), International Organization for Standardization (ISO), and the Standard Organization of Nigeria (SON). Examples of the relevant codes and standards include ISO 15673:2005 "Guidelines for the simplified design of structural reinforced concrete for buildings" and BS EN 60529:2013 "Degree of Protection by Enclosures (IP Code)", amongst others.

3.5 Project Implementation Phase

3.5.1 Pre-construction Phase Activities

Following the completion of engineering design for the Project and receipt of relevant approvals, the major activities during this phase include site clearing and preparation, and mobilization of equipment, materials and personnel to site. Clearing will involve removal of existing vegetation from the site and preparing a level working surface in readiness for construction activities.

3.5.2 Construction Phase Activities

The construction phase of the Project will include civil, mechanical and electrical works; installation of PV panels and associated plant facilities; construction of a training centre; installation of streetlights as well as underground armoured cable for power evacuation. Also, where required, an upgrade of some of the existing power distribution infrastructure within the University will be carried out.

It is envisaged that approximately 300 people would be required for construction activities. These are divided into low-skilled workers (e.g. construction labour who will make up the majority of workers), semi-skilled workers (drivers, technicians, etc.), and skilled personnel (e.g. engineers and expatriates). Most of the unskilled and semi-skilled workers would be drawn from the nearby local community (located outside the campus) to enhance the job opportunities associated with the proposed Project. A moderate level of migrant workers may also be associated with the construction phase activities (potential impacts associated with the migrant workers, as well as the proffered mitigation measures, are covered in Chapters 5 and 6). No workers' camp is planned to be established on-site during construction.

3.5.3 Commissioning Phase Activities

The commissioning phase of the proposed Project will include testing and checking individual equipment /system, as well as the associated infrastructure to ensure they have been installed correctly and can be handed over for use.

3.5.4 Operational Phase Activities

The operational phase of the Project will involve the generation and distribution of electricity to different sections of the University campus, alongside the operation of the renewable energy training centre to support learning and capacity development in clean energy technologies. To ensure efficient operation of the solar power plant, the EPC Contractor will develop Standard Operating Procedures (SOPs) for the maintenance and management of key components such as solar panels, inverters, batteries, and related infrastructure. These procedures may be reviewed and updated by the Operations and Maintenance (O&M) Contractor during the operational phase. Routine activities will include preventive and corrective maintenance aimed at maintaining optimal system performance throughout the plant's lifespan. Preventive maintenance will involve scheduled inspections and servicing activities such as panel cleaning, inverter maintenance, and structural checks, while corrective maintenance will address equipment faults, repairs, and replacement of damaged components when necessary. The solar photovoltaic (PV) power plant is expected to have an average operational lifespan of about 25 years, with the potential for extended service life through proper maintenance. Even after this period, the PV panels are expected to continue generating up to 90% of their original installed capacity.

3.6 Water Use and Supply

A major advantage of the proposed power plant is its reliance on solar energy, a clean and renewable resource that is naturally abundant and freely available. By generating electricity from solar power, the Project will reduce dependence on fossil fuel-based energy sources and contribute to lower greenhouse gas emissions and improved environmental sustainability. Water demand during the construction phase is expected to be relatively low, as only limited civil works involving concrete mixing will be carried out on-site. The primary use of water will occur during the operational phase, mainly for the periodic cleaning of photovoltaic (PV) panels to maintain their efficiency. Dust accumulation on solar panels, particularly during the dry season, can reduce the amount of sunlight reaching the solar cells and consequently lower energy output. The extent of dust build-up is influenced by factors such as soil characteristics, wind conditions, and the design of the mounting structures. To optimize water use, panel cleaning activities will be carefully managed and carried out only when necessary. During the rainy season, natural rainfall is expected to reduce the need for frequent cleaning, with manual washing likely limited to a few occasions. However, during the dry season, especially between November and April when dust levels are typically higher in Northern Nigeria, cleaning may be conducted more frequently depending on the level of dust accumulation observed on the panels. Experience from similar solar energy projects indicates that each PV panel may require approximately five litres of water per cleaning cycle. Based on the estimated number of panels, about 33,000 litres of water will be needed per cleaning operation. The required water supply will be sourced from a borehole to be installed within the Project site. Field assessments and estimated water demand indicate that the volume of water required for occasional panel cleaning is relatively small and is not expected to adversely affect groundwater resources or existing local water use within the area. In addition, groundwater recharge in the Project area is mainly sustained through natural rainfall infiltration, which supports the long-term availability of the resource.

3.7 Health and Safety Requirement

The EPC Contractor will appoint qualified and experienced personnel to oversee the Health, Safety, and Environment (HSE) aspects of the Project. These personnel will ensure compliance with all applicable HSE

regulations, standards, and project-specific environmental and social management measures by both the Contractor and subcontractors.

All contractors involved in the Project will be required to develop and implement Occupational Health and Safety (OHS) plans to guide safe working practices throughout the construction and operational phases. Regular HSE training programmes will be conducted to improve workers' awareness of workplace hazards, emergency response procedures, safe work methods, and the proper use of Personal Protective Equipment (PPE). Worker activities will also be controlled through established safety procedures such as Permit-to-Work systems, Job Hazard/Safety Analysis, and routine safety monitoring.

In addition, contractors will carry out regular safety inspections and implement measures aimed at preventing accidents, injuries, and occupational health risks. During construction, a risk assessment approach will be adopted to identify potential hazards associated with different work activities and educate workers on appropriate mitigation measures.

To enhance safety within and around the Project site, warning signs will be installed at strategic locations, while first aid facilities and adequate PPE will be provided for all personnel on-site. Workers, suppliers, and subcontractors will be continuously sensitized on the importance of maintaining safe working conditions and complying with all site safety requirements. Daily toolbox meetings and safety briefings led by onsite HSE officers will also be conducted to reinforce safety awareness. Furthermore, smoking, alcohol consumption, and the use of hard drugs within the Project site will be strictly prohibited to ensure a safe and healthy working environment.

3.8 Labour Requirement

A suitable labour structure for the DARES project would involve a total workforce of about 50 to 60 people, depending on the scale and pace of implementation. This workforce would be distributed across skilled, semi-skilled, and unskilled categories to support different phases of the project.

Skilled labour would make up about 30–40% (20-30 workers) and include engineers, project managers, and technical specialists responsible for design, supervision, and quality control. Semi-skilled labour would account for 25–30% (15 workers), mainly technicians and installers who handle system deployment. Unskilled labour would form the largest share, about 30–45% (30–35 workers), supporting construction and basic site activities, especially from local communities.

3.9 Power Supply Arrangements

3.9.1 Institutional Profile

The University of Ilorin, established in 1975 and one of Nigeria's foremost federal universities, is a large residential-academic campus spanning approximately 500 hectares in Ilorin, Kwara State. It is the largest of the five DARES project sites, with 374 surveyed buildings, 8.91 MW installed connected load, and a 33/11 kV primary distribution system. Grid supply is relatively more reliable than the other four sites (~80–94% availability during logging), though generator dependency remains structurally significant. Cooling and ventilation are the dominant load drivers.

3.9.2 Energy/Load Demand Estimates

The energy consumption analysis indicates a substantial and consistent electrical demand profile for the facility as provided by the FEED team. The recorded peak demand **is** 960 kW**,** representing the highest level of power required during operation. On average, the facility consumes approximately 12,630.91 kWh per day, corresponding to an average load of 526.29 kW**.** Over the course of a year, the total energy consumption is estimated at 4,610,281.32 kWh**.**

These figures provide a comprehensive overview of the facility's energy usage patterns and serve as a critical basis for evaluating energy efficiency, system sizing, operational performance, and potential renewable energy integration. Understanding the relationship between peak demand and average consumption is essential for optimizing energy costs, improving load management strategies, and supporting future planning and sustainability initiatives.

3.9.3 Land Requirement

Approximately 8–12 hectares are anticipated for the PV plant given the campus scale. The 500-hectare campus has ample available land within its boundary. The land acquired during the topographic survey is shown in Figure 2.1. The university management is willing to provide more land as the project progresses.

3.9.4 Energy Demand Profile

The Energy Demand Profile provides an assessment of the current and projected electricity requirements of the facility, serving as a critical basis for the design and sizing of the proposed solar photovoltaic (PV) system (Table 3.1). Understanding the energy consumption patterns of the University and its associated teaching hospital is essential to ensure that the proposed power solution can reliably meet operational needs while maintaining system efficiency and cost-effectiveness.

3.9.5 Appliance Audit Overview

The campus-wide electrical load assessment indicates a total connected load of 10.88 MW and an estimated daily energy consumption of approximately 44,923 kWh/day (44.92 MWh/day)**.** The analysis covers academic buildings, administrative facilities, residential areas, medical facilities, and other utility infrastructure across the University and teaching hospital.

The Administrative Buildings account for the largest share of electricity consumption, with a connected load of approximately 7.63 MW and daily energy demand of 30.90 MWh**,** representing nearly 69% of the campus's total energy consumption. This high demand is primarily driven by air-conditioning systems, office equipment, and other administrative support services.

Medical Facilities constitute the second-largest energy consumer, with a connected load of approximately 1.24 MW and daily energy consumption of 8.94 MWh**.** The significant energy requirements of these facilities reflect the continuous operation of medical equipment, cooling systems, lighting, and critical healthcare services.

Academic Buildings contribute a connected load of approximately 1.19 MW and daily energy demand of 3.80 MWh, supporting teaching, research, laboratory operations, and other academic activities. Residential facilities and other utility services account for the remaining portion of the campus load.

Across all building clusters, Cooling and Ventilation Systems represent the dominant electricity demand category, accounting for the majority of both installed capacity and daily energy consumption. This is followed by ICT and office equipment, lighting systems, and specialized equipment such as laboratory instruments, pumps, catering facilities, and medical devices.

The results from the FEED study conducted in 2026 suggest a substantial and continuous electricity requirement across the campus, underscoring the need for a reliable, scalable, and sustainable energy solution. The proposed solar photovoltaic system with battery energy storage is therefore intended to address a significant portion of this demand while reducing operating costs, improving energy security, and minimizing dependence on conventional power sources. Table 3.2 presents the full cluster-by-cluster appliance inventory for UNILORIN.

3.9.6 Proposed System Capacity

The proposed system capacity has been determined based on the University's current energy demand, projected load growth, operational requirements, and the need to ensure a reliable and sustainable power supply. The sizing of the solar photovoltaic (PV) system and associated battery energy storage infrastructure is intended to meet a substantial portion of the institution's electricity requirements while reducing dependence on the national grid and diesel-powered generators (See Table 3.1).

The capacity selection considers the results of the energy demand assessment, peak load requirements, daily energy consumption patterns, solar resource availability, and the projected increase in electricity demand over the next five years. Particular consideration has been given to critical facilities within the University and teaching hospital, including lecture halls, laboratories, administrative buildings, hostels, medical wards, diagnostic centres, operating theatres, and other essential services that require continuous power supply.

Table 3.1: Proposed System Capacity

System Component	Preliminary Estimate	Remarks
Solar PV Capacity	3.5 – 4.0 MWp	Monocrystalline, ground-mounted
Battery Energy Storage (BESS)	~7.5 MWh nominal	6-hr autonomy at 0.9 MW firm night load
Estimated Solar Fraction	70 – 85%	Pre-simulation estimate
Operating Mode	Islanded (primary); grid as contingency	Islanded design adopted for supply reliability assurance
Generator Role	Tertiary backup	Existing 2 MW main plant + distributed fleet; N-1 non-compliant

Soltech, 2026

3.10 Waste Management

This section discusses the waste streams associated with the proposed Project and the intended management plan.

3.10.1 Overview

It is the goal of REA that the proposed Project is designed, developed and operated in a sustainable manner. Thus, effective waste management practices that comply with the relevant local requirements and international best practices shall be implemented during all phases of the proposed Project. To achieve this, all contractors engaged during the lifecycle of the Project will put in place and comply with a site waste management plan.

Waste management principles shall be based on an integrated approach which involves a combination of techniques and programs to manage waste. Source reduction is at the top of the approach, followed by reuse and recycling as preferred options to disposal. Generally, wastes associated with the proposed Project shall be managed using the following prioritized program:

Reduction at Source – The elimination or minimization of waste generation through equipment modifications and installation of pollution abatement equipment.

Reuse – Using an item for its original purpose, or a similar purpose, in its original form. Wastes generated from one operation shall be put to use in other operations where they are found useful without compromising standards and safety.

Recycling – conversion of waste materials into reusable objects. This will involve using FMEnv/NESREA-approved companies involved in the recycling business using best available technology that meet international standards.

Residue Disposal – disposal of wastes in a government-approved dumpsite.

3.10.2 Associated Waste Streams

The waste streams associated with the proposed Project are discussed as follows:

Pre-construction Phase

The waste streams associated with the pre-construction phase of the Project include cleared vegetation (during site preparation), food waste, and general rubbish. The cleared vegetation (mostly grasses) will be removed from the site and allow to biodegrade at a portion of the site while wood from felled trees will be made available to the local community.

Construction Phase

The planned activities during the construction phase include civil, mechanical and electrical works and installation of PV panels and associated components which will be carried out by a number of construction

workers. The waste streams associated with the construction activities include excavated soil, general refuse, garbage, inert construction materials, metal scraps, concrete waste, food waste, and used packaging materials. In line with the NEP ESMF, the EPC Contractor shall put in place and comply with a site waste management plan. The plan shall be developed to address all waste streams associated with the construction activities and comply with relevant regulations. The contractor shall comply with the national requirements and building rules on storage of construction materials.

Furthermore, all concrete mixing will be undertaken on impermeable plastic lining to prevent contamination of the surrounding areas. Scrap metals generated during the construction phase will be collected for recycling in blue coloured waste receptacles for non-hazardous wastes. Excavated soil generated during the foundation work will be arranged according to the various soil layers for reuse as backfill during landscaping and site rehabilitation.

All electronic equipment shall be supplied by credible manufacturers to reduce the risk of generating wastes from faulty equipment. All damaged PV panels generated during the installation activities shall be collected in a dedicated container and returned to the manufacturer outside the country for proper recycling since there is currently no recycling facility in Nigeria that handles PV panels.

Litter collection facilities shall be provided and all solid waste materials that are not identified for reuse or recycling will be placed in appropriate on-site storage containers (black-coloured waste receptacles for food waste, blue-coded bins for paper, and yellow-coded bins for general rubbish) and periodically disposed of (at least once a week throughout the construction period or on the need basis depending on the volume of the waste) at a government-approved dumpsite through a third party waste contractor approved by the state environmental agency. It is estimated that approximately 0.225 m^3 of construction debris will be produced per week.

Hazardous wastes that could be generated during the construction activities include used oil rags, and spent filters from onsite diesel generator for power source during construction. Hazardous wastes shall be stored in a manner that prevents the commingling or contact between incompatible wastes, and stored in properly labelled, closed containers prior to evacuation by a third-party waste contractor approved by the state environmental agency for treatment and disposal.

Operational Phase

A major advantage of the proposed power plant is its reliance on solar energy, a clean and renewable resource that is naturally abundant and freely available. By generating electricity from solar power, the Project will reduce dependence on fossil fuel-based energy sources and contribute to lower greenhouse gas emissions and improved environmental sustainability.

Water demand during the construction phase is expected to be relatively low, as only limited civil works involving concrete mixing will be carried out on-site. The primary use of water will occur during the operational phase, mainly for the periodic cleaning of photovoltaic (PV) panels to maintain their efficiency. Dust accumulation on solar panels, particularly during the dry season, can reduce the amount of sunlight reaching the solar cells and consequently lower energy output. The extent of dust build-up is influenced by factors such as soil characteristics, wind conditions, and the design of the mounting structures.

To optimize water use, panel cleaning activities will be carefully managed and carried out only when necessary. During the rainy season, natural rainfall is expected to reduce the need for frequent cleaning, with manual washing likely limited to a few occasions. However, during the dry season, especially between November and April when dust levels are typically higher in Northern Nigeria, cleaning may be conducted more frequently depending on the level of dust accumulation observed on the panels. Experience from similar solar energy projects indicates that each PV panel may require approximately five litres of water per cleaning cycle. Based on the estimated number of panels, about 33,000 litres of water will be needed per cleaning operation. The required water supply will be sourced from a borehole to be installed within the Project site.

Field assessments and estimated water demand indicate that the volume of water required for occasional panel cleaning is relatively small and is not expected to adversely affect groundwater resources or existing local water use within the area. In addition, groundwater recharge in the Project area is mainly sustained through natural rainfall infiltration, which supports the long-term availability of the resource.

Decommissioning

The waste streams associated with the decommissioning phase of the Project would be similar to the construction waste. These will include refuse, e-waste, general rubbish, and demolition debris. The University should also be encouraged to prepare an e-waste management plan that accounts for safe end-of-life disposal of equipment from solar installations. Wastes will be segregated on-site, and non-reusable / recyclable wastes will be disposed of through an accredited third-party waste contractor. The summary of waste streams associated with the Project is provided in Table 3.2.

Table 3.2: Summary of Wastes Stream associated with the proposed Project and Handling Techniques

Waste Stream	Sources	Project Phase	Handling Techniques
		Construction (C), Operation (O), Decommissioning (D)	
General rubbish, refuse, and putrescible wastes (food wastes)	Wood splinter, domestic waste, food packs, used bottles	C, O, D	On-site waste segregation; disposal of non-reusable waste through a third-party waste contractor approved by the Bayelsa State Environmental Protection Agency.
Cleared vegetation	During site clearing and preparation	C	Composting, collection for biomass fuel
Scrap metals	Used tubular and casings, used iron rods	C, O, D	Scrap metals will be collected for recycling

Excavated materials	Foundation works	C, D	Excavated materials generated during foundation works will be used for backfilling. Excess excavated spoil will be stockpiled and reused as part of materials for the construction of plant buildings.
Damaged/expired PV panels	PV modules	C, O, D	Return to the manufacturer for recycling using the EPR model
Expired inverters	Electrical installation	O, D	Return to the manufacturer for recycling using the EPR model
Damaged/expired Batteries	Power generation	O, D	Return to the manufacturer for recycling using the EPR model
Sanitary waste	Training center	C, O, D	Periodic evacuation of content of the septic tank

3.11 Project Schedule

The proposed Project is planned to be operational by the fourth quarter (Q4) of 2028. The tentative Project schedule is provided in Table 3.3.

Table 3.3: Tentative Project Schedule

Project Schedule	Timeline											
	2026				2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Site allocation												
Energy demand audit												
Front-End Engineering Design												
ESIA study and Approval												
Selection of EPC Contractor and contract signing												
Civil, electrical, and mechanical design												
Procurement (manufacturing and transportation)												
Preconstruction and construction Phase Activities												
Commissioning												
Commencement of operation												

CHAPTER FOUR
ENVIRONMENTAL BASELINE DESCRIPTION

4.1 Preamble

This chapter presents the descriptions of the biophysical, socioeconomic, and health conditions of the environment, which will provide the basis for potential impact identification and appropriate mitigation measures associated with the development of the project.

4.2 Study Approach

The baseline status of the project area was obtained through consultations with the relevant stakeholders, a review of relevant literature as well as field studies. Environmental data acquisition involved a multidisciplinary approach and was conducted in line with regulatory requirements and best international practices. This approach includes literature desktop review, designing, and development of field sampling strategy; confirmation of the sampling design and locations, pre-mobilization activities (job hazard analysis, sampling equipment/materials calibrations and checks and mobilization to the field; community consultations, sample collection, handling, documentation, and storage protocols and, and demobilization from the field, transfer of sample custody to the laboratory for analysis. A summary of field sampling methods is discussed in the sub-sections below.

4.2.1 Daily Toolbox Meeting

A daily toolbox meeting was held before work to ensure that team members understood the work plan of the day and the security and safety tips. These are geared toward achieving a successful data-gathering exercise and zero incidents.

4.2.2 Baseline Data Collection and Desktop Review

Data gathering for the biophysical and social components of the project environment was undertaken from 12th to 19th January 2026 (dry season) and 22nd to 24th April 2024. The secondary sources of data include:

- Stakeholders, including government agencies, community chiefs, elders, women, and youths in various communities and community-based organizations (cooperative societies, development committees, etc).
- Local experts, research, and academic organizations

4.2.3 Sampling Design/Protocol

The sampling maps provide spatial distributions of the sampling points within the study area (See Figure 4.1).

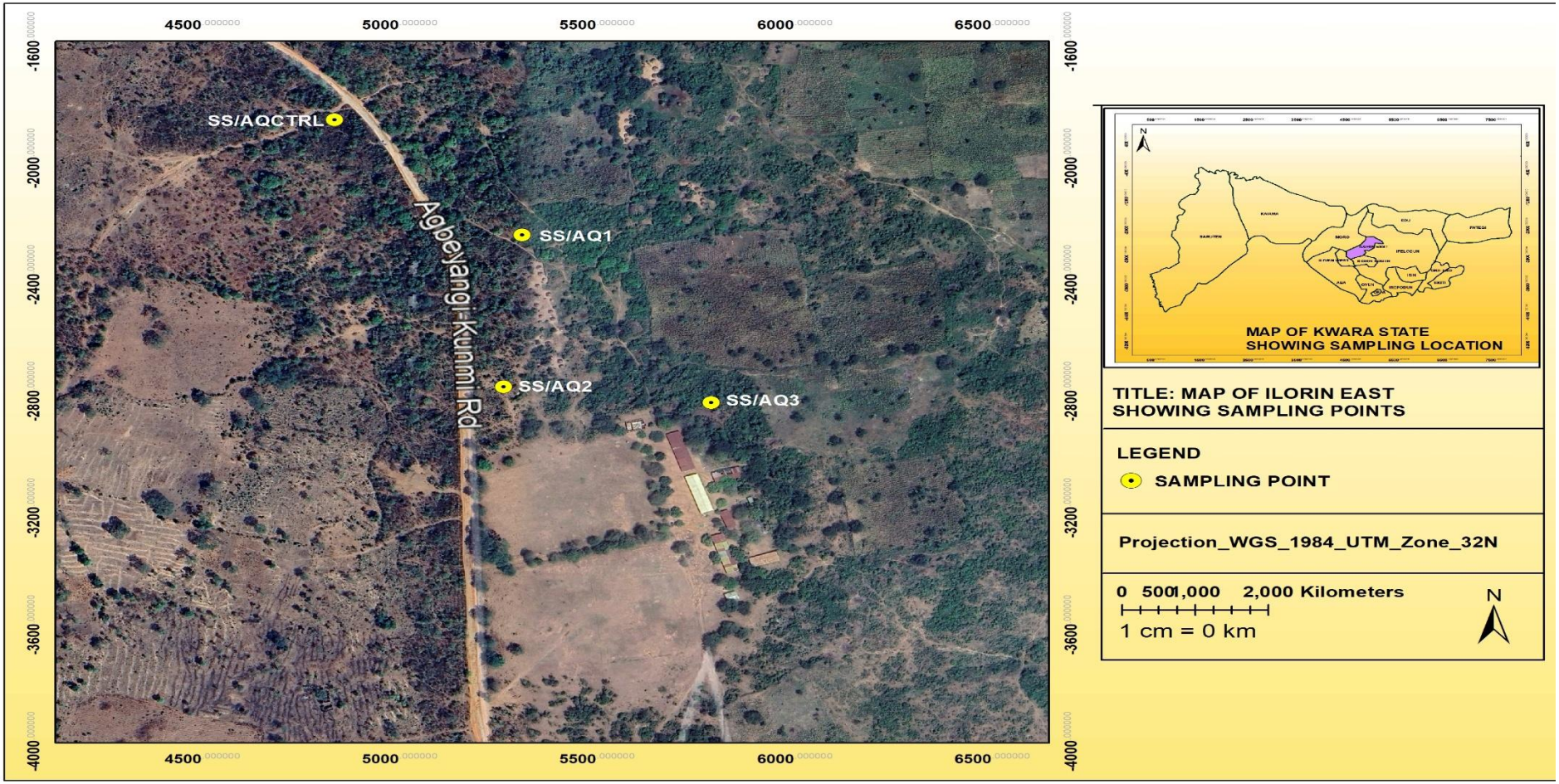

Plate 4.1: Sampling Map

Table 4.1 List of Geographical Coordinates

Federal University of Ilorin		
Sample ID	**Latitude**	**Longitude**
SS/AQ1	8°36'6.98"N	4°48'21.66"E
SS/AQ2	8°36'1.26"N	4°48'21.46"E
SS/AQ3	8°36'0.77"N	4°48'27.02"E
SS/AQCTRL	8°36'11.83"N	4°48'16.53"E

4.3 Field Sampling Equipment and Methods

4.3.1 Meteorology/Air Quality and Noise Measurements

Meteorological elements, namely wind, speed, wind direction, humidity, and temperature, were measured during the fieldwork from 4 predetermined locations (See Sampling Map – Figure 4.1). Each sampling location was adequately georeferenced with a GPS. Kanomax Gas Meter with Model No.2750 was used for the measurement of the following parameters: Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Dioxide (CO_2), and Hydrogen Sulphide (H_2S). Particulate Meter (PM) with Model No. DT-9880 was used to measure suspended particulate matter (SPM). The Noise levels at each point were measured with an Extech Noise Meter (Model No.407722). The sensor of the noise meter was directed toward the source of noise and the average reading over a period of three minutes was taken to be the Noise level at each point. Plate 4.2 shows air quality and noise measurements being taken during the studies.

4.3.2 Soil Sampling

Topsoil (0-15cm) and bottom soil (15-30cm) samples were collected from 3 points and 1 control using a hand auger. Two (2) auger bores were homogenized to form a composite sample. Samples for microbiology were taken in 25 ml sterilized vials. Samples for physico-chemical parameters were collected in pre-cleaned 250ml amber bottles. The samples were properly labeled and preserved in ice chests at 4°C.

4.3.3 Vegetation and Wildlife Studies

The vegetation survey was carried out along designated sampling transects/sub-transects. The location of each sampling point was confirmed using GPS. Vegetation was studied in sampling quadrats measuring 20 m x 20 m. For each sampling point, information on habitat, vegetation structure and species were recorded. Habitat data included vegetation description, latitude, longitude, and signs of wildlife. Plant species were categorized into trees (4m or more), shrubs (0.5m to 4m), and herbs (less than 0.5m). Dendrometric parameters recorded included height (m), diameter (cm) and number of trees. A pair of binoculars (Model: Helios Fieldmaster 8x40) was employed to aid in the field identification of trees. Plants were also observed for any disease symptoms/conditions.

Field observations were made at each sampling location for evidence of vertebrate wildlife. Hideouts such as crevices, leaf litter, logs etc. were probed with props to root out any hidden animals. Tree canopies were observed for birds and other arboreal animals such as squirrels and snakes. The indirect count method was employed, particularly for animals that do not readily offer themselves for observation.

4.4 Quality Assurance/Quality Control

Standard methods and procedures were strictly adhered to in the course of this study. The quality assurance program covers all aspects of the study, including sample collection, handling, laboratory analysis, data coding, statistical analysis, presenting and communicating results. Chain of custody procedures including sample handling, transportation, logging and cross-checking in the laboratory were also implemented. Trip blanks were used to assess the quality assurance/quality control of sample preservation, packaging, shipping, and storage.

The following precautions were also observed:

- Samples were collected in bottles that have been thoroughly washed with detergent (nutrient-free) and rinsed thoroughly;
- ✓ All sampling equipment is properly protected and maintained in accordance with manufacturers' manuals;
- ✓ Sampling bottles were adequately labeled with masking tapes and indelible markers to avoid mistaken identity;
- ✓ Only analytical grade (Analar) chemicals were used and where applicable, redistilled.
- ✓ Automated equipment is calibrated prior to field sampling.

Where samples were sent to another laboratory for analysis, a duplicate copy of the samples' information was sent along with the sample to the laboratory, independent of the sample. All movements of the samples were included in the sample record. Basic information was recorded together with the results of the analysis, in a sample registry. With proper, sustained calibration of the instrument and the use of standardized observational procedures, equipment errors were brought to an acceptable minimum.

4.4.1 Sample Handling and Preservation

All the samples collected during the fieldwork were labeled clearly and secured in easily identifiable containers. Each label contained the following Information:

- Date and/or time of sampling
- Sample name and number
- Type of sample
- Type of preservative used if any.

The sampling containers, preservatives used, and holding times for the different parameters of interest for water, benthos, and plankton samples are summarized in Table 4.2.

Table 4.2: Sample Handling and Preservation Methods used during Fieldworks

S/N	Parameters	Sample Vol.	Container	Preservative	Holding Time	Container pretreatment
1.	BTEX	15ml	20ml BTEX Vial	5ml of Methanol	10days	Methanol
2.	Metals, Mn, Fe, Cu, Zn, Ag, Ni, Pb, Cd, Cr, Co, Ca, Mg, K, Na	1L	Plastic	Add 2ml Conc HNO_3 & cool 4 °C ± 2◦C	6 months	Rinsed with 1+1 HNO_3
3.	Physico-Chemical, TSS, COD, O/G, Chloride	2L	Plastic	Cool 4 °C ± 2◦C	28 Days	Rinsed with Distilled water
4.	Hydrocarbons, phenols	1.L	Glass (wide mouth, calibrated)	H_2SO_4 to 2ml & cool 4 °C ± 2◦C	28 Days	Rinsed with Solvent

S/N	Parameters	Sample Vol.	Container	Preservative	Holding Time	Container pretreatment
5.	Zoo-/Phyto-plankton	500ml	Wide mouth plastic bottles	10% Formalin (with Rose Bengal)	-	Rinsed with Distilled water
6.	Microbiology, THB, HUB, Coliform, THF & HUF	200ml	Wide mouth plastic bottles	Cool 4 °C ± 2◦C	As soon as possible	Sterilized
7.	Macrobenthos	1.0L	Plastic	10% Formalin (with Rose Bengal)	-	Rinse with distilled water

4.5 Laboratory Analysis

After the fieldwork exercises, study samples were transported to Tudaka Analytical Nig Limited, Warri, Delta State, Nigeria (accredited by FMENV) for analyses (**Plate 4.6).** Samples brought to the laboratory were analyzed using standard analytical methods. The synoptic description of the laboratory methods and procedures employed for the various physical, chemical, and biological parameters, as well as the detection limits of these parameters in water and sediment samples. The summary of standard methods of environmental analysis is presented in Table 4.3.

Table 4.3: Summary of Laboratory analytical methods used for Water / Sediment Analysis

Parameters	Unit	Method
pH (H2O)		ASTM D 4972
Turbidity	(NTU)	APHA 214
Salinity	$^{0}/_{00}$	API-RP 45
Total Dissolved Solids	(mg/l)	APHA 209C
Total Solids	(mg/l)	APHA 209D
TSS	(mg/l)	APHA 209D
Electrical conductivity	(µS/cm)	APHA 209
Bicarbonate	(mg/l)	API-RP 45
Alkalinity	(mg/l)	APHA 2320-ALKALINITY-B
Acidity	(mg/L)	APHA 2310 B
Ammonia nitrogen	(mg/l)	EPA 350.2
THC	(mg/l)	APR – RP 45
Nitrite	(mg/l)	EPA 354.1
Chloride	(mg/l)	APHA 4500Cl- B
Sulphate	(mg/l)	EPA 375.4
Total Phosphorous	(mg/l) (mg/kg)	APHA 4500 P0 43-
Calcium	(mg/l) (mg/kg)	APHA 3111
Magnesium	(mg/l) (mg/kg)	APHA 3111/ASTM D 3561
Potassium	(mg/l) (mg/kg)	APHA 3111/ASTM D 3561
Cadmium	(mg/l) (mg/kg)	APHA3111
Chromium	(mg/l) (mg/kg)	APHA3111
Lead	(mg/l) (mg/kg)	APHA 3111
Manganese	(mg/l) (mg/kg)	APHA 3111
Iron	(mg/l) (mg/kg)	APHA 3111
Copper	(mg/l) (mg/kg)	APHA 3111
Zinc	(mg/l) (mg/kg)	APHA 3111
PCB	(mg/l) (mg/kg)	EPA method 625

4.6 Climate and Meteorology

Ilorin experiences a tropical wet-and-dry climate characterized by distinct rainy and dry seasons, typical of the Guinea Savannah ecological zone of North Central Nigeria. The climate is influenced mainly by the interaction between the moist south-westerly maritime mass from the Atlantic Ocean and the dry north-easterly continental air mass originating from the Sahara Desert. The rainy season usually extends from April to October, while the dry season occurs between November and March. Annual rainfall in Ilorin generally ranges between 1,000 mm and 1,500 mm, with peak rainfall commonly occurring between July and September.

Temperatures in Ilorin are relatively high throughout the year, with mean daily temperatures typically ranging from about 25°C to 35°C. The hottest period is usually between February and April, just before the onset of the rainy season, while relatively cooler conditions are experienced during the rainy months and the Harmattan period in December and January. Relative humidity is generally high during the wet season, often exceeding 70%, but decreases considerably during the dry season due to the influence of the Harmattan winds. Wind patterns in the area are moderate, with south-westerly winds dominating during the rainy season and dry north-easterly winds prevailing during the Harmattan season.

The climatic conditions of Ilorin are generally favourable for agriculture, vegetation growth, and human habitation. However, seasonal variations in rainfall and temperature may influence environmental conditions such as surface runoff, erosion, dust generation, and ambient air quality. These climatic characteristics are therefore important considerations in project planning, design, construction, and operational activities within the area.

Table 4.4: Measured Microclimatic Parameters in the Proposed Project Site

	Level	Air Temperature (°C)	Relative Humidity (%)	Atmospheric Pressure (mbar)	Wind	
					Speed (m/s)	Direction
Dry Season	Minimum	33.6	33.0	1004.4	1.6	NE
	Maximum	37.4	35.0	1017.2	3.6	SW
Wet Season	Minimum	36.9	34.8	1004.1	1.7	NE
	Maximum	38.7	37.4	1017.8	4.5	SW

Air Temperature

Air temperature in Ilorin is generally high throughout the year due to the area's tropical wet-and-dry climate. Mean annual temperatures typically range between 25°C and 35°C, with the hottest period occurring between February and April when daytime temperatures may exceed 35°C prior to the onset of the rainy season. Cooler conditions are usually experienced during the rainy season, particularly between July and September, as a result of increased cloud cover and rainfall, while the Harmattan season between December and January is characterized by relatively lower temperatures, especially during the early morning and nighttime periods due to the influence of dry north-easterly winds from the Sahara Desert.

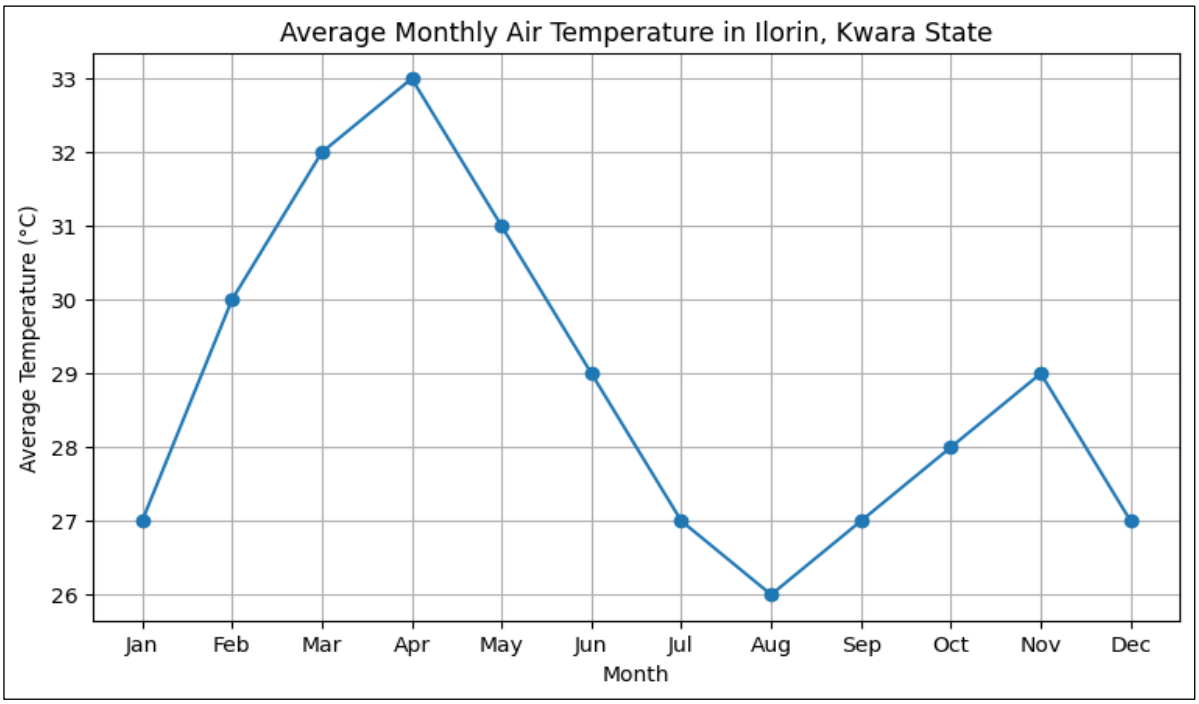

Figure 4.1: Monthly Temperature Distribution in the Proposed Area

(Source: NIMET, 2025)

Rainfall

The rainfall pattern in Ilorin is characterized by distinct wet and dry seasons typical of the tropical wet-and-dry climate of North Central Nigeria. The rainy season usually begins in April and ends in October, with peak rainfall occurring between July and September. Average annual rainfall ranges between 1,000 mm and 1,500 mm, supporting agriculture, vegetation growth, and groundwater recharge within the area. The dry season extends from November to March and is influenced by the Harmattan winds, resulting in significantly reduced rainfall and lower atmospheric moisture.

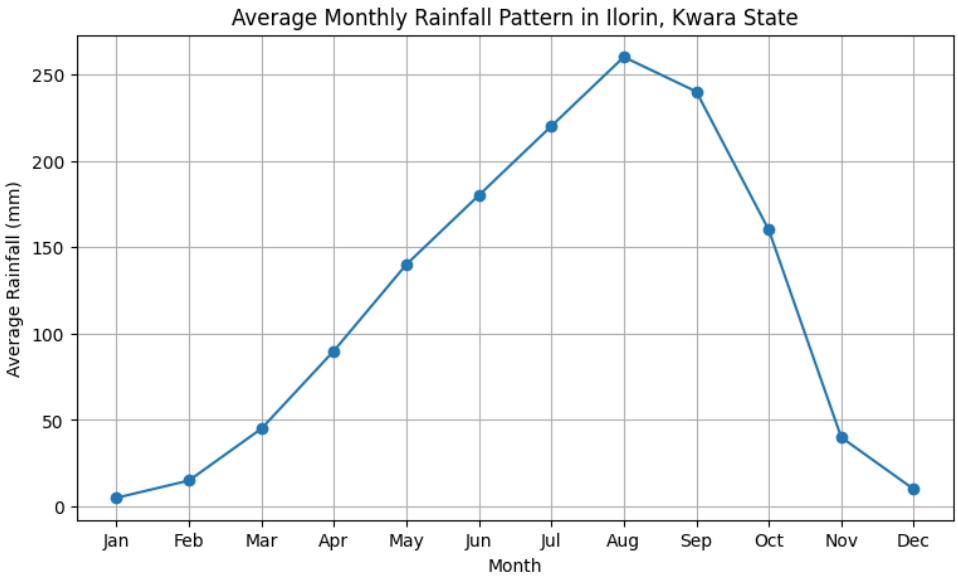

Figure 4.2: Monthly Rainfall in the Proposed Project Area

(Source: NIMET, 2025)

Relative Humility

The relative humidity pattern in Ilorin is strongly influenced by the seasonal movement of moist maritime air masses and dry continental winds. Relative humidity is generally high during the rainy season, typically ranging between 75% and 88% from May to September due to increased rainfall and atmospheric moisture. The highest humidity levels are usually recorded in July and August. During the dry season, particularly between November and February, relative humidity decreases significantly as a result of the dry Harmattan winds from the Sahara Desert, with values sometimes falling below 40%. These seasonal variations influence local weather conditions, thermal comfort, vegetation growth, and environmental processes within the area.

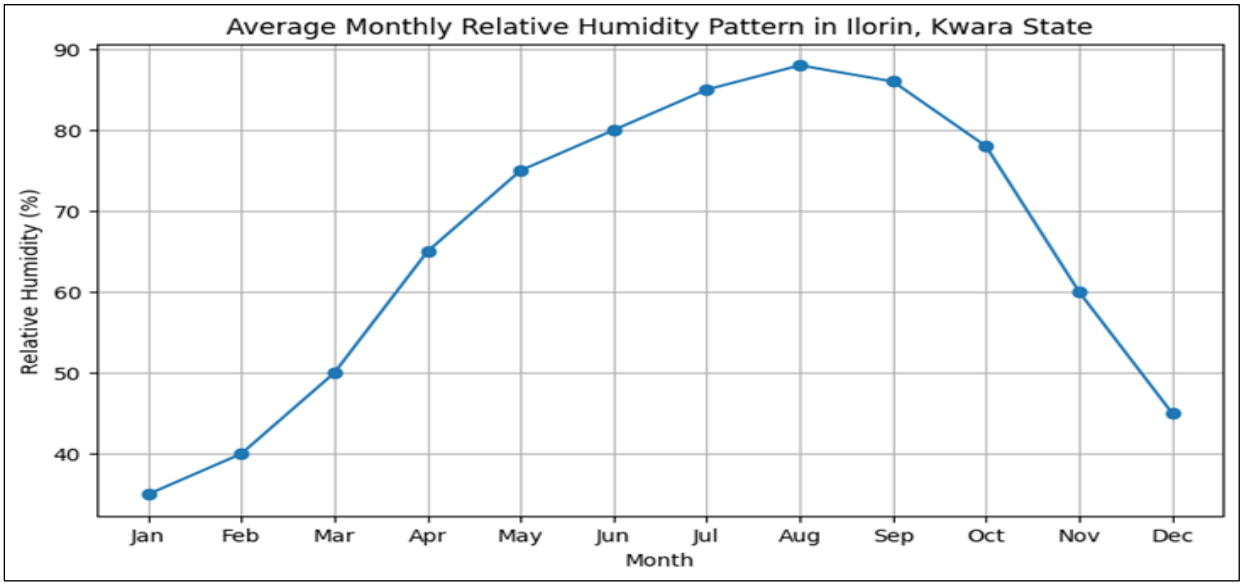

Figure 4.3: Relative Humidity in the Proposed Project Area

(Source: NIMET, 2025)

Wind Pattern

Wind conditions in the State are influenced by seasonal atmospheric circulation. During the dry season, the north-easterly Harmattan winds dominate, often carrying dust particles that reduce visibility and increase atmospheric dryness. In the rainy season, moist south-westerly winds prevail and contribute to precipitation.

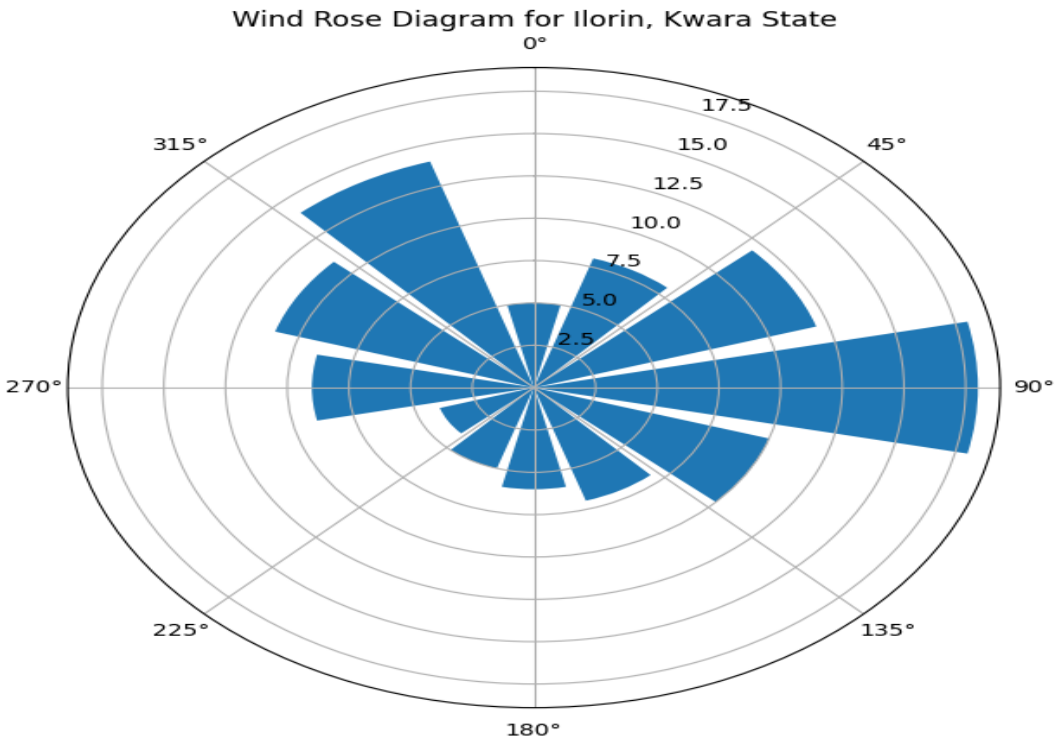

Figure 4.4: Surface Windrose of the Proposed Project Area
(Source: NIMET, 2025)

4.7 The Local Geology

The local geology of Ilorin is predominantly underlain by Precambrian Basement Complex rocks, which form part of the extensive Nigerian Basement Complex. The major rock types within the area include granite gneiss, migmatite, quartzite, schist, and granitic intrusions. These rocks are generally hard, crystalline, and structurally stable, providing suitable foundation conditions for infrastructure and institutional development. In some areas, weathering of the basement rocks has resulted in the formation of lateritic soils and sandy clay deposits that overlie the bedrock.

The geological characteristics of Ilorin influence the area's soil properties, drainage conditions, groundwater occurrence, and topographic features. The weathered overburden and fractured basement rocks serve as important groundwater reservoirs, supporting borehole development and water supply within the area. In addition, the presence of lateritic materials makes portions of the area suitable for construction purposes such as road development and building foundations. However, erosion and surface runoff may occur in areas with exposed or poorly managed soils, especially during the rainy season.

4.17.1 The Topography

The topography of Ilorin is generally characterized by gently undulating plains with elevations ranging between approximately 250 m and 350 m above mean sea level. The terrain is predominantly flat to moderately sloping, with isolated hills and ridges occurring in some parts of the city and surrounding areas. The area falls within the transitional zone between the forest and savannah regions of Nigeria, resulting in a landscape that supports both scattered vegetation and open grassland.

Surface drainage in Ilorin is influenced by the natural topography, with runoff flowing through seasonal streams, drainage channels, and minor rivers during the rainy season. The relatively gentle slopes within most parts of the area favour urban development, agriculture, transportation, and infrastructure projects. However, localized erosion and surface runoff may occur in areas with disturbed soil surfaces or inadequate drainage systems, particularly during periods of intense rainfall.

4.17.2 Project Location in Relation to Flood Level

The project location at the University of Ilorin is situated within an area of relatively gentle topography and moderate elevation, which generally reduces the susceptibility of the site to severe flooding. The area is characterized by well-drained terrain with natural surface runoff pathways that convey stormwater during the rainy season. Based on field observations and the surrounding landform characteristics, the project site is not located within a major floodplain or along the immediate banks of any large river system. Consequently, the overall flood risk within the immediate project area is considered low to moderate.

However, localized flooding and temporary water accumulation may occur during periods of intense rainfall, particularly in low-lying sections or areas with inadequate drainage infrastructure. Increased surface runoff resulting from urban development, soil compaction, and blocked drainage channels may also contribute to short-term flooding within parts of the University environment. Appropriate stormwater management measures, including proper site grading, drainage design, erosion control structures, and routine maintenance of drainage systems, should therefore be incorporated into the project design and operation to minimize flood-related risks and ensure long-term infrastructure resilience.

4.8 Air Quality and Noise Levels

Baseline ambient air quality monitoring carried out within the Project area indicates that the environmental conditions are generally within the permissible limits established by the Federal Ministry of Environment (FMENV). Variations observed between the dry and wet seasons are mainly influenced by climatic conditions, including Harmattan dust, rainfall intensity, temperature, humidity, and wind movement. The results are presented in Table 4.5.

Table 4.5: Air Quality Around the Project Area (Dry and Wet Seasons)

Parameters/Unit	Units	Dry Season Range	Dry Season Control	Wet Season Range	Wet Season Control	FMENV Limits (8 hr Avg.)
Noise Level	dB(A) Day	55.7 – 68.2	63.4	55.1 – 67.2	68.0	90
SOx	µg/m³	0.01	0.01	0.01	0.01	26
NOx	µg/m³	0.01	0.01	0.01	0.01	75 – 113
SPM	µg/m³	39 – 58	35.8	28 – 39	35.2	250

VOC	µg/m³	0.01	0.01	0.01	0.01	60
CO	µg/m³	0.5 – 2.3	1.9	0.3 – 1.8	1.4	11.4
O_3	µg/m³	10 – 18	7.0	1.8 – 3.2	0.9	NA
CO_2	µg/m³	130 – 270	102.6	108 – 109	90.82	NA
H_2S	µg/m³	0.01	0.01	0.01	0.01	0.01
Air Temperature	°C	35.5 – 38.8	34.6	34.5 – 37.8	33.7	NA
Wind Speed	m/s	0.1 – 1.0	0.21	0.6 – 1.6	1.2	NA
Humidity	%	30 – 48	41.5	62 – 84	73.2	NA

Field work 2026

Noise Level

Noise levels during the dry season ranged from 55.7–68.2 dB(A), while the wet season recorded 55.1–67.2 dB(A). The dry season control value (63.4 dB(A)) was slightly lower than the wet season control value (68.0 dB(A)). Seasonal differences were minimal, indicating that noise generation was mainly associated with anthropogenic activities rather than climatic conditions. All values remained below the FMENV limit of 90 dB(A), suggesting acceptable ambient noise conditions.

Sulphur Oxides (SOx)

SOx concentrations remained constant at 0.01 µg/m³ across both seasons and control sites. This indicates negligible sulphur-related emissions in the area and no observable seasonal influence. The values were significantly below the FMENV limit of 26 µg/m³, implying minimal contribution from combustion sources containing sulphur compounds.

Nitrogen Oxides (NOx)

NOx concentrations also remained uniform at 0.01 µg/m³ during both seasons. The absence of seasonal variation suggests limited industrial or vehicular combustion activities capable of generating nitrogen oxides. Concentrations were far below the FMENV permissible range of 75–113 µg/m³.

Suspended Particulate Matter (SPM)

SPM concentrations were noticeably higher during the dry season (39–58 µg/m³) compared to the wet season (28–39 µg/m³). This seasonal increase is expected because dry conditions promote dust suspension, soil particle resuspension, and reduced atmospheric washout. In contrast, rainfall during the wet season suppresses airborne particulates through wet deposition. Despite this variation, all values were below the FMENV limit of 250 µg/m³.

Volatile Organic Compounds (VOC)

VOC concentrations remained constant at 0.01 µg/m³ in both seasons and at control points, indicating very low organic pollutant emissions and no significant seasonal effect. The recorded concentrations were well below the FMENV limit of 60 µg/m³.

Carbon Monoxide (CO)

CO concentrations showed slightly elevated levels during the dry season (0.5–2.3 µg/m³) relative to the wet season (0.3–1.8 µg/m³). Reduced atmospheric dispersion and increased combustion activities during the dry season may explain this trend. Wet season rainfall and improved atmospheric mixing likely contributed to lower concentrations. All values remained substantially below the FMENV limit of 11.4 µg/m³.

Ozone (O_3)
Ozone concentrations were significantly higher in the dry season (10–18 µg/m³) compared to the wet season (1.8–3.2 µg/m³). Higher solar radiation and elevated temperatures during the dry season enhance photochemical reactions responsible for ozone formation. The wet season's cloud cover and reduced sunlight intensity likely limited ozone production. No FMENV standard was provided for comparison.

Carbon Dioxide (CO_2)
CO_2 concentrations were considerably higher during the dry season (130–270 µg/m³) than during the wet season (108–109 µg/m³). This variation may be linked to reduced atmospheric dilution, higher temperatures, and increased anthropogenic activities in the dry season. The wet season's enhanced vegetation activity and atmospheric mixing may contribute to lower concentrations. No FMENV limit was specified.

Hydrogen Sulphide (H_2S)
H_2S concentrations remained constant at 0.01 µg/m³ throughout both seasons and control sites. Since the values matched the FMENV limit (0.01 µg/m³), the area may require periodic monitoring to ensure concentrations do not exceed permissible thresholds, although no seasonal variation was observed.

Air Temperature
Air temperatures were generally higher during the dry season (35.5–38.8°C) than in the wet season (34.5–37.8°C). This reflects the expected climatic pattern, where dry season conditions are characterized by intense solar radiation and reduced cloud cover. Lower wet season temperatures are attributable to rainfall and increased atmospheric moisture.

Wind Speed
Wind speed was relatively low during the dry season (0.1–1.0 m/s) but increased during the wet season (0.6–1.6 m/s). Increased wind movement during the wet season may enhance pollutant dispersion and contribute to the lower concentrations of some air pollutants observed during this period.

Relative Humidity
Relative humidity showed a clear seasonal difference, with lower dry season values (30–48%) and substantially higher wet season values (62–84%). This trend reflects the increased atmospheric moisture associated with rainfall during the wet season. Elevated humidity may also aid in reducing particulate matter concentrations through moisture-induced particle settling.

4.9 Soil Quality

4.9.1 Physicochemical Parameters

Baseline ambient soil sampling carried out within the project area indicates that the environmental conditions are generally within the data obtained within the control area. The results are presented in Table 4.6. The soil physicochemical characteristics showed clear variations between the dry and wet seasons as well as between sampled locations and control sites. Seasonal changes were mainly influenced by rainfall, soil moisture dynamics, decomposition processes, and nutrient mobility within the soil profile.

Table 4.6: Physicochemical Characteristics of Soil Quality Around the Project Area (Wet and Dry Season)

Parameter	Unit	Dry Season (0–15 cm)	Dry Season (15–30 cm)	Control Mean (0–15 cm)	Control Mean (15–30 cm)	Wet Season (0–15 cm)	Wet Season (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
pH	-	6.2 – 6.9	5.4 – 6.5	5.7	5.4	6.5 – 6.7	6.4 – 6.9	6.8	6.5
Electrical Conductivity (EC)	µS/cm	95 – 128	140 – 166	109	106	126 – 208	170 – 262	147	187
Temperature	°C	33.0 – 36.5	32.8 – 34.9	34.7	33.9	32.5 – 32.8	32.9 – 34.7	32.4	32.8
Nitrate	mg/kg	0.25 – 0.68	0.10 – 0.51	0.21	0.31	0.15 – 1.24	0.10 – 1.40	0.92	0.81
Ammonia	mg/kg	0.41 – 1.12	0.12 – 1.97	1.25	1.16	1.40 – 2.20	1.20 – 2.15	1.95	1.76
Phosphate	mg/kg	1.2 – 3.4	2.8 – 5.7	3.2	2.6	3.6 – 6.4	5.6 – 4.15	2.2	3.8
Sulphate	mg/kg	7.5 – 11.3	6.3 – 12.4	8.5	11.8	10.6 – 16.5	8.9 – 14.1	11.5	10.8
Chloride	mg/kg	0.8 – 1.9	1.0 – 2.5	0.4	0.1	1.5 – 1.2	1.0 – 1.8	1.4	1.12
Total Organic Carbon (TOC)	%	0.25 – 0.74	0.18 – 0.37	1.2	0.06	0.75 – 1.25	0.12 – 1.30	1.01	0.16
Moisture Content	%	4.8 – 7.5	5.2 – 7.2	7.3	5.1	6.5 – 12.2	1.1 – 15.6	12.3	13.1

*Source Data**: Field work,2026***

Soil pH

Soil pH during the dry season ranged from 6.2–6.9 at the surface layer (0–15 cm) and 5.4–6.5 at the subsurface layer (15–30 cm), while the wet season recorded slightly higher values of 6.5–6.7 and 6.4–6.9, respectively. The control values were generally comparable, though slightly lower in some dry-season subsurface soils.The results indicate that soils were generally slightly acidic to near neutral, which is favorable for nutrient availability and microbial activities.

Electrical Conductivity (EC)

Electrical conductivity values increased from the dry season to the wet season. Dry season values ranged from 95–128 µS/cm (0–15 cm) and 140–166 µS/cm (15–30 cm), whereas wet season values increased to 126–208 µS/cm and 170–262 µS/cm, respectively. Compared with the control, wet season soils exhibited relatively higher EC values, especially at subsurface depth.

Soil Temperature

Soil temperature was higher during the dry season (33.0–36.5°C) compared to the wet season (32.5–32.8°C) at the surface layer. Similar trends occurred at the subsurface depth. The elevated dry season temperature reflects intense solar radiation and low soil moisture, whereas wet season temperatures were moderated by rainfall and increased moisture retention.

Nitrate

Nitrate concentrations were relatively low in both seasons but showed higher variability during the wet season. Dry season concentrations ranged from 0.25–0.68 mg/kg (surface) and 0.10–0.51 mg/kg (subsurface), while wet season values increased to 0.15–1.24 mg/kg and 0.10–1.40 mg/kg, respectively.

Ammonia

Ammonia concentrations were higher during the wet season than in the dry season. Dry season values ranged from 0.41–1.12 mg/kg and 0.12–1.97 mg/kg, while wet season concentrations increased to 1.40–2.20 mg/kg and 1.20–2.15 mg/kg.

Phosphate

Phosphate concentrations showed clear seasonal enrichment during the wet season. Dry season concentrations ranged from 1.2–3.4 mg/kg at the surface and 2.8–5.7 mg/kg at depth, while wet season values increased to 3.6–6.4 mg/kg and approximately 4.15–5.6 mg/kg.

Sulphate

Sulphate concentrations were moderately higher during the wet season. Dry season values ranged from 7.5–11.3 mg/kg and 6.3–12.4 mg/kg, while wet season values increased to 10.6–16.5 mg/kg and 8.9–14.1 mg/kg.

Chloride

Chloride concentrations were generally low but slightly higher during the wet season. Dry season values ranged from 0.8–1.9 mg/kg and 1.0–2.5 mg/kg, whereas wet season values ranged from approximately 1.2–1.5 mg/kg and 1.0–1.8 mg/kg.

Total Organic Carbon (TOC)

TOC values were generally higher during the wet season. Dry season concentrations ranged from 0.25–0.74% at the surface and 0.18–0.37% at depth, while wet season values increased to 0.75–1.25% and 0.12–1.30%. The wet season increase suggests enhanced accumulation and decomposition of organic residues under moist conditions. Surface soils generally contain higher TOC than subsurface soils

because organic matter accumulates primarily in the upper soil horizon. Compared with the control, some sampled locations showed reduced TOC values, possibly due to organic matter degradation or anthropogenic disturbances.

Moisture Content

Moisture content exhibited the most obvious seasonal variation. Dry season values ranged from 4.8–7.5% and 5.2–7.2%, while wet season values increased substantially to 6.5–12.2% and 1.1–15.6%. The significantly higher wet season moisture content reflects increased rainfall infiltration and water retention within the soil profile. Control soils also showed elevated moisture during the wet season, confirming the dominant influence of climatic conditions. Higher moisture availability during the wet season contributed to the observed increases in nutrient mobility and microbial activity.

Table 4.7: Major Cations

Parameter	Unit	Dry Season (0–15 cm)	Dry Season (15–30 cm)	Control Mean (0–15 cm)	Control Mean (15–30 cm)	Wet Season (0–15 cm)	Wet Season (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
Magnesium	mg/kg	1.2 – 9.1	5.5 – 8.2	3.3	32.1	24.1 – 39.6	28.4 – 42.5	33.8	36.4
Potassium	mg/kg	1.1 – 2.5	2.6 – 5.1	3.2	2.2	2.8 – 3.7	2.5 – 4.8	5.7	4.3
Sodium	mg/kg	5.7 – 10.9	5.2 – 7.5	4.8	5.6	11.4 – 14.7	12.9 – 18.7	14.9	15.9

Table 4.8: Heavy Metals

Parameter	Unit	Dry Season (0–15 cm)	Dry Season (15–30 cm)	Control Mean (0–15 cm)	Control Mean (15–30 cm)	Wet Season (0–15 cm)	Wet Season (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
Copper	mg/kg	1.1 – 2.3	1.2 – 2.4	3.9	4.8	2.4 – 4.6	3.0 – 5.2	3.6	4.1
Iron	mg/kg	105 – 152	112 – 145	133	120	140 – 215	175 – 208	118	110
Lead	mg/kg	0.05 – 0.42	0.10 – 0.55	0.13	0.11	0.30 – 0.82	0.45 – 0.96	0.78	0.91
Zinc	mg/kg	1.5 – 1.8	1.2 – 2.5	0.4	1.4	1.9 – 1.6	1.8 – 2.4	1.7	1.3
Manganese	mg/kg	0.4 – 1.5	0.7 – 1.8	1.3	1.0	1.2 – 2.7	1.6 – 3.1	2.4	2.8

Cations

The concentrations of exchangeable cations showed clear seasonal and depth-related variations across the study area. Magnesium concentrations during the dry season were relatively low, ranging from 1.2–9.1 mg/kg at the surface layer (0–15 cm) and 5.5–8.2 mg/kg at the subsurface layer (15–30 cm), compared with higher control values, especially at depth (32.1 mg/kg). During the wet season, magnesium concentrations increased substantially to 24.1–39.6 mg/kg and 28.4–42.5 mg/kg, closely matching the control values. The increase during the wet season may be attributed to enhanced mineral weathering, dissolution, and improved nutrient mobility due to rainfall infiltration.

Potassium concentrations were generally low in both seasons, with dry season values ranging from 1.1–2.5 mg/kg at the surface and 2.6–5.1 mg/kg at depth. Wet season concentrations showed slight improvement, ranging from 2.8–3.7 mg/kg and 2.5–4.8 mg/kg, respectively. However, the control soils recorded comparatively higher potassium levels, particularly in the surface soil during the wet season (5.7 mg/kg). The relatively lower potassium concentrations in sampled soils may indicate nutrient uptake by vegetation, leaching losses, or reduced potassium reserves within the soil matrix.

Sodium concentrations were higher during the wet season than in the dry season. Dry season values ranged from 5.7–10.9 mg/kg and 5.2–7.5 mg/kg, while wet season concentrations increased to 11.4–14.7 mg/kg and 12.9–18.7 mg/kg at the surface and subsurface layers, respectively. These wet season values were comparable to the control soils, which recorded 14.9 mg/kg and 15.9 mg/kg. The elevated sodium content during the wet season may be linked to increased dissolution and transport of soluble salts through rainfall and infiltration processes.

Heavy Metals

Heavy metal concentrations showed slight seasonal variations, with generally higher values during the wet season than the dry season. Copper concentrations increased from 1.1–2.4 mg/kg in the dry season to 2.4–5.2 mg/kg in the wet season, approaching the control values. Iron was the most abundant metal, rising from 105–152 mg/kg and 112–145 mg/kg in the dry season to 140–215 mg/kg and 175–208 mg/kg during the wet season, indicating enhanced mobilization under wetter conditions.

Lead concentrations remained low in both seasons, though slightly higher values were recorded during the wet season (0.30–0.96 mg/kg) compared to the dry season (0.05–0.55 mg/kg). Zinc showed only minor seasonal variation, while manganese increased noticeably from the dry season (0.4–1.8 mg/kg) to the wet season (1.2–3.1 mg/kg).

4.10 Vegetation Studies

The vegetation around the University of Ilorin is predominantly characteristic of the Guinea savanna ecological zone of Nigeria. The area is mainly composed of tall grasses interspersed with scattered trees and shrubs, reflecting a tropical savanna vegetation type. Common tree species identified on the university campus include *Daniellia oliveri*, *Gmelina arborea*, *Azadirachta indica* (Neem), and other indigenous and exotic species adapted to the savanna environment. Studies conducted within the university campus recorded considerable plant diversity, with about 54 tree species and 2,468 individual trees identified across different sections of the campus. *Daniellia oliveri* was reported as the dominant species, followed by *Gmelina arborea*. Vegetation serves important ecological functions such as erosion control, carbon

sequestration, microclimatic regulation, aesthetic enhancement, and biodiversity conservation within the campus environment.

In terms of conservation status, the vegetation of the university area can be described as moderately disturbed but relatively conserved due to ongoing landscaping and tree management practices. However, pressures from urban expansion, infrastructural development, deforestation, bush burning, and human activities pose threats to native plant diversity. Conservation efforts within the university include tree planting, landscaping programs, periodic vegetation inventory, and environmental awareness initiatives aimed at sustaining biodiversity. Researchers have recommended continuous monitoring, afforestation, and stakeholder participation to improve long-term conservation of the campus vegetation resources.

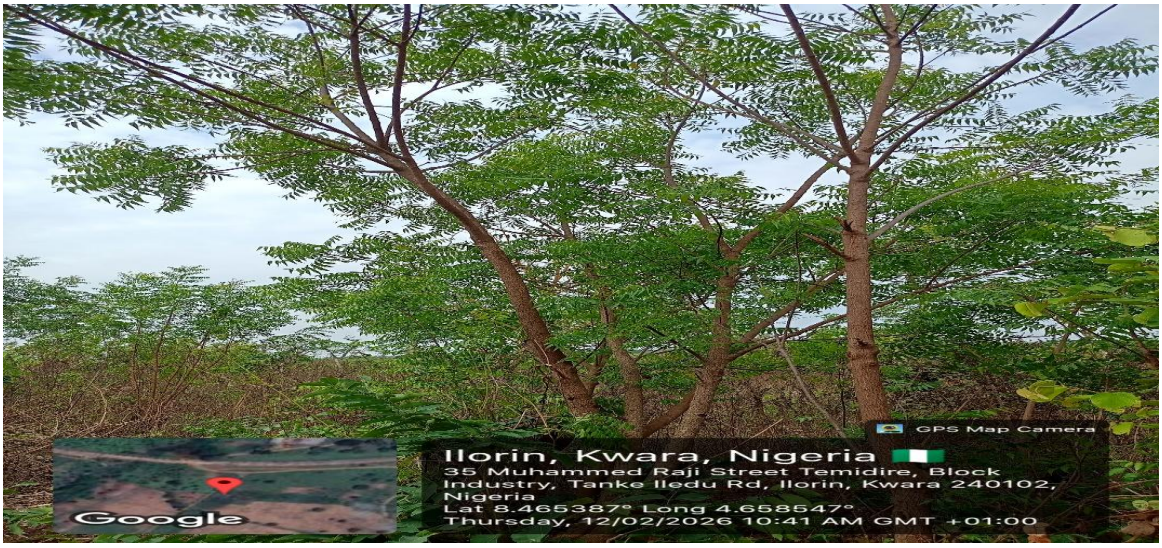

Plate 4.2: Azadirachta *indica*- Dogoyaro tree

The Dogoyaro tree is the common Nigerian name for Azadirachta indica, widely known as the Neem tree. It is a fast-growing evergreen tree commonly found across northern and southwestern Nigeria, including in Ilorin and around the University of Ilorin campus.

Table 4.9: Vegetation Type and Conservation Status

Vegetation / Plant Species	Vegetation Type	Conservation Status*
Daniellia oliveri	Indigenous savanna tree	Least Concern
Gmelina arborea	Exotic plantation tree	Least Concern
Azadirachta indica (Neem)	Exotic ornamental/shade tree	Least Concern
Parkia biglobosa	Indigenous savanna woodland tree	Vulnerable (locally threatened due to exploitation)
Vitellaria paradoxa (Shea tree)	Indigenous savanna tree	Vulnerable
Mangifera indica (Mango)	Cultivated fruit tree	Least Concern
Tectona grandis (Teak)	Plantation forest tree	Least Concern
Khaya senegalensis	Indigenous savanna woodland tree	Vulnerable
Acacia spp.	Savanna shrub/tree	Least Concern
Eucalyptus spp.	Exotic plantation tree	Least Concern
Tall savanna grasses (*Andropogon* spp., *Pennisetum* spp.)	Guinea savanna grassland	Not Evaluated
Shrub vegetation	Secondary regrowth vegetation	Not Evaluated

Ecological Observations

The study area exhibited typical Guinea savanna ecological characteristics, with the presence of grasses, shrubs, and scattered trees adapted to tropical climatic conditions. Vegetation growth was more pronounced during the wet season due to increased soil moisture and nutrient availability, while the dry season was characterized by reduced plant vigor and higher temperatures. Soil conditions were generally suitable for plant and microbial activities, supporting nutrient cycling and ecological productivity. Moderate human activities such as construction, farming, bush burning, and waste disposal were observed and may contribute to habitat disturbance, soil degradation, and biodiversity loss. However, the presence of birds, insects, and other small fauna indicates that the ecosystem still maintains some level of ecological balance. Tree planting and landscaping activities within the area also suggest ongoing efforts toward environmental conservation and sustainability.

Table 4.10: Common Plant Pathogens and Their Effects

Pathogen	Type	Disease Caused	Effects on Plants
Fusarium oxysporum	Fungus	Fusarium wilt	Wilting, yellowing, vascular blockage, plant death
Aspergillus flavus	Fungus	Aspergillus rot	Seed spoilage and aflatoxin contamination
Puccinia graminis	Fungus	Stem rust	Reduced photosynthesis and low crop yield
Rhizoctonia solani	Fungus	Root rot	Root decay and seedling death
Colletotrichum gloeosporioides	Fungus	Anthracnose	Leaf spots, fruit rot, stem lesions
Xanthomonas campestris	Bacterium	Black rot	Leaf yellowing and tissue necrosis
Ralstonia solanacearum	Bacterium	Bacterial wilt	Rapid wilting and crop collapse
Agrobacterium tumefaciens	Bacterium	Crown gall disease	Tumor-like swellings on roots and stems
Pseudomonas syringae	Bacterium	Leaf blight	Water-soaked lesions and leaf death
Tobacco mosaic virus	Virus	Mosaic disease	Leaf mottling and stunted growth

Cassava mosaic virus	Virus	Cassava mosaic disease	Distorted leaves and reduced tuber yield
Maize streak virus	Virus	Maize streak disease	Chlorotic streaks and poor grain production
Meloidogyne incognita	Nematode	Root-knot disease	Root galls and nutrient deficiency
Pratylenchus spp.	Nematode	Root lesion disease	Poor root growth and wilting
Phytophthora infestans	Oomycete	Late blight	Leaf decay and tuber rot
Pythium spp.	Oomycete	Damping-off	Seedling collapse and poor germination

Wildlife and Conservation Status

The wildlife around the University of Ilorin reflects the Guinea savanna ecosystem, supporting small mammals, reptiles, birds, and insects adapted to tropical savanna conditions. Most species are currently classified as Least Concern, indicating relatively stable populations. However, species such as the straw-colored fruit bat and African rock python face increasing pressure from habitat loss, urban expansion, hunting, and human disturbance. Continued habitat protection, tree planting, and reduction of bush burning and indiscriminate land clearing are important for maintaining biodiversity within the university environment.

Table 4.11: Wildlife and Conservation Status

Wildlife Species	Group	Conservation Status*
Grasscutter (*Thryonomys swinderianus*)	Mammal	Least Concern
African Giant Rat (*Cricetomys gambianus*)	Mammal	Least Concern
Mona Monkey (*Cercopithecus mona*)	Mammal	Least Concern
Straw-colored Fruit Bat (*Eidolon helvum*)	Mammal	Near Threatened
African Civet (*Civettictis civetta*)	Mammal	Least Concern
Monitor Lizard (*Varanus niloticus*)	Reptile	Least Concern
Agama Lizard (*Agama agama*)	Reptile	Least Concern
African Rock Python (*Python sebae*)	Reptile	Near Threatened
Tree Squirrel (*Heliosciurus* spp.)	Mammal	Least Concern
Weaver Bird (*Ploceus* spp.)	Bird	Least Concern
Cattle Egret (*Bubulcus ibis*)	Bird	Least Concern
Pied Crow (*Corvus albus*)	Bird	Least Concern
Village Quelea (*Quelea quelea*)	Bird	Least Concern
Termites (*Macrotermes* spp.)	Insect	Not Evaluated
Butterflies	Insect	Not Evaluated
Honeybee (*Apis mellifera*)	Insect	Least Concern

Flora and Fauna of the Project Area

Flora

The flora of the project area is characteristic of the Guinea savanna vegetation zone, consisting mainly of grasses, shrubs, and scattered trees adapted to tropical climatic conditions. Common plant species observed include Azadirachta indica (Dogoyaro/Neem), Daniellia oliveri, Gmelina arborea, Vitellaria paradoxa, Parkia biglobosa, *Acacia* species, and various savanna grasses such as *Andropogon* and *Pennisetum* species. These plants provide ecological benefits, including shade, erosion control, carbon sequestration, nutrient cycling, and habitat for wildlife. Most species are classified as Least Concern, although some indigenous economic trees, such as the Shea tree and African locust bean, are locally threatened by deforestation, bush burning, and land clearing activities.

Fauna

The fauna of the project area includes a variety of mammals, birds, reptiles, and insects commonly associated with the savanna ecosystem. Wildlife species observed or commonly found in the area include grasscutters (*Thryonomys swinderianus*), African giant rats (*Cricetomys gambianus*), squirrels, monkeys, monitor lizards, agama lizards, snakes, weaver birds, cattle egrets, butterflies, termites, and honeybees. Most of these species are classified as Least Concern according to the International Union for Conservation of Nature conservation categories. However, increasing urbanization, habitat disturbance, bush burning, and human activities may threaten some wildlife populations over time. The presence of diverse flora and fauna indicates moderate ecological stability within the project area despite ongoing anthropogenic pressures.

Ecological Significance and Conservation Considerations

The project area is ecologically significant because its Guinea savanna vegetation supports biodiversity, soil stability, nutrient cycling, and microclimatic regulation. The grasses, shrubs, and trees provide habitat and food for birds, reptiles, insects, and small mammals, while plant species such as Azadirachta indica, Vitellaria paradoxa, and Parkia biglobosa contribute to erosion control, carbon sequestration, and environmental sustainability. Soil microorganisms and vegetation interactions also help maintain soil fertility through nutrient recycling and organic matter decomposition.

However, the area is exposed to environmental pressures such as land clearing, construction activities, bush burning, farming, and improper waste disposal, which may result in habitat loss, biodiversity decline, and soil degradation. Conservation measures should therefore include protection of vegetation cover, tree planting, proper waste management, controlled land use, and continuous environmental monitoring. These measures are important for maintaining ecological balance and ensuring the long-term sustainability of the project environment.

Wildlife Migration Pathways

Wildlife migration pathways within the project area are generally limited due to the semi-urban nature of the environment and increasing human activities. However, the existing vegetation cover, open grasslands, drainage channels, and scattered tree stands provide temporary movement corridors for small mammals, birds, reptiles, and insects. Species such as squirrels, grasscutters, monkeys, reptiles, and migratory birds may move through these pathways in search of food, water, shelter, and breeding sites, particularly during seasonal changes between the dry and wet seasons.

During the wet season, increased vegetation growth and water availability enhance wildlife movement and habitat utilization, while the dry season may restrict movement due to reduced food and moisture availability. Human activities such as road construction, land clearing, bush burning, and infrastructural development can disrupt these natural movement routes and contribute to habitat fragmentation. Conservation efforts such as preserving green corridors, protecting vegetation cover, and minimizing habitat disturbance are therefore important for maintaining wildlife movement and ecological connectivity within the area.

Bird and Livestock Movement

Bird movement within the project area is influenced by seasonal changes, food availability, vegetation cover, and human activities. During the wet season, increased vegetation growth, insect abundance, and water availability attract a higher number of birds, including weaver birds, cattle egrets, pigeons, and other migratory or resident species. Birds commonly move between trees, grasslands, open fields, and nearby waterlogged areas for feeding, nesting, and shelter. In the dry season, movement may increase over longer distances as birds search for food and water sources. Human activities such as construction, vehicular movement, and noise may temporarily disturb bird movement and nesting behavior.

Livestock movement in the area mainly involves cattle, goats, and sheep grazing within open grasslands and nearby undeveloped lands. Movement patterns are usually controlled by herders and are influenced by pasture availability and water sources, especially during the dry season when forage becomes limited. During the wet season, livestock disperse more widely due to increased pasture growth. Continuous grazing, trampling, and unrestricted livestock movement may contribute to vegetation loss, soil compaction, and erosion if not properly managed. Proper grazing control and protection of sensitive vegetation areas are therefore important for maintaining ecological balance within the project environment.

4.11 Socioeconomic and Health Study

This chapter presents the results and analysis of the survey questionnaire conducted as part of the Environmental and Social Impact Assessment (ESIA) for the proposed hybrid solar power plant. A total of 40 respondents completed and submitted the questionnaire, providing comprehensive information on socioeconomic and demographic characteristics, health status, standard of living, gender-based violence concerns, environmental and cultural resources, project impact perceptions, and grievance redress mechanisms.

The data collected has been analyzed and presented using various visualization techniques including pie charts and bar charts to facilitate better understanding of the survey findings. The results are organized according to the survey sections: Household Data, Health Status, Standard of Living, Gender-Based Violence/Sexual Exploitation and Abuse, Resources/Cultural Property, Project Activities Impact Evaluation, Grievance Redress Mechanism, and World Bank Environmental and Social Standards (ESS).

4.11.1 Demographic Profile

Gender Distribution

The gender distribution in university admissions in Nigeria has historically varied, but at the University of Ilorin specifically, female students slightly outnumber their male counterparts with a female-to-male student ratio of 1.1:1. However, out of the 40 respondents sampled, 60% (24 respondents) were male while 40% (16 respondents) were female. The sampling population could have been influenced by the staffs and business operators within the university community. Figure 4.6 shows the gender distribution in the study area.

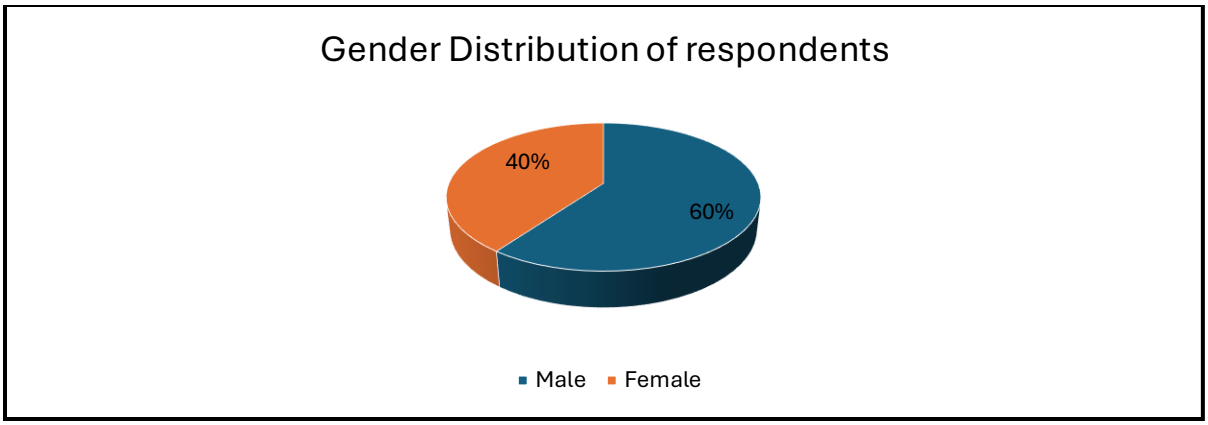

Figure 4.5: Gender Distribution in the Study Area

4.11.2 Age Distribution

The age distribution shows that the majority of respondents (65%) fall within the 18-45 years age bracket, representing 26 individuals. This is followed by 30% in the 46-65 years category (12 respondents), and 5% below 18 years (2 respondents). This distribution indicates a predominantly young to middle-aged population, which is typical for a university community.

4.11.3 Marital Status

The study population showed that 55% of the respondents were married, the single population represented 45% while no respondent indicated divorce or widowed as their marital status. A significant population of the students were single as expected of undergraduate, while the married population were predominantly staffs and business operators within the university community. Figure 4.7 depicts the marital status of respondents.

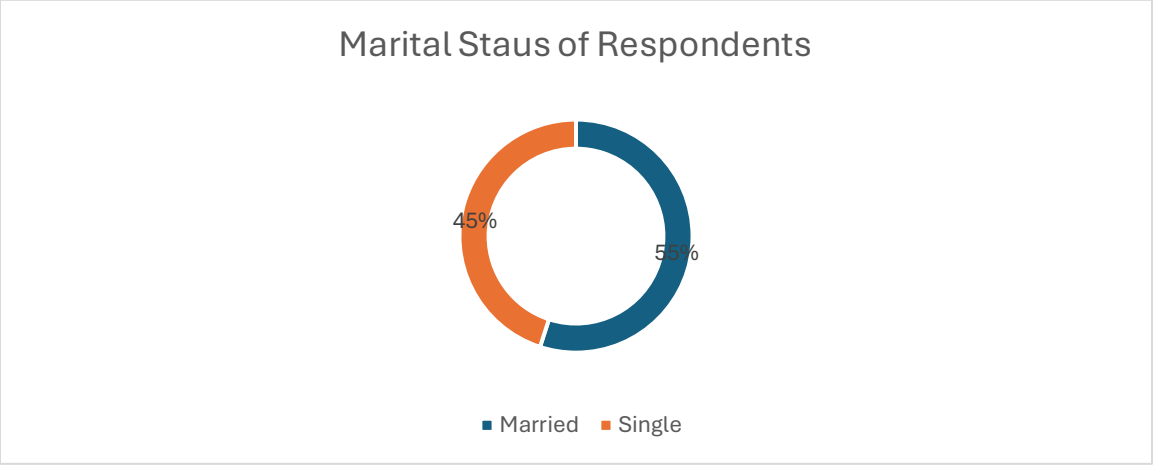

Figure 4.6: Depicts the Marital Status of Respondents

4.11.4 Occupation Distribution

The occupational distribution in a university community is highly specialized, dominated by professional, educational, and service-oriented roles, while also featuring a large, temporary, and often part-time student workforce. These communities typically consist of a high concentration of knowledge-based occupations, with a mix of academic, administrative, and support staff, as well as businesses serving the student population. The occupational distribution of the study population showed that the Civil servants constitute 45% (18 respondents), Students accounted for 35% (14 respondents), while trading and shopkeeping represents 20% (8 respondent). This occupational distribution indicated a mixed occupational distribution typical of a university system (Figure 4.8). The Civil Servants comprise both academic and none academic staff of the University, while the students were unemployed.

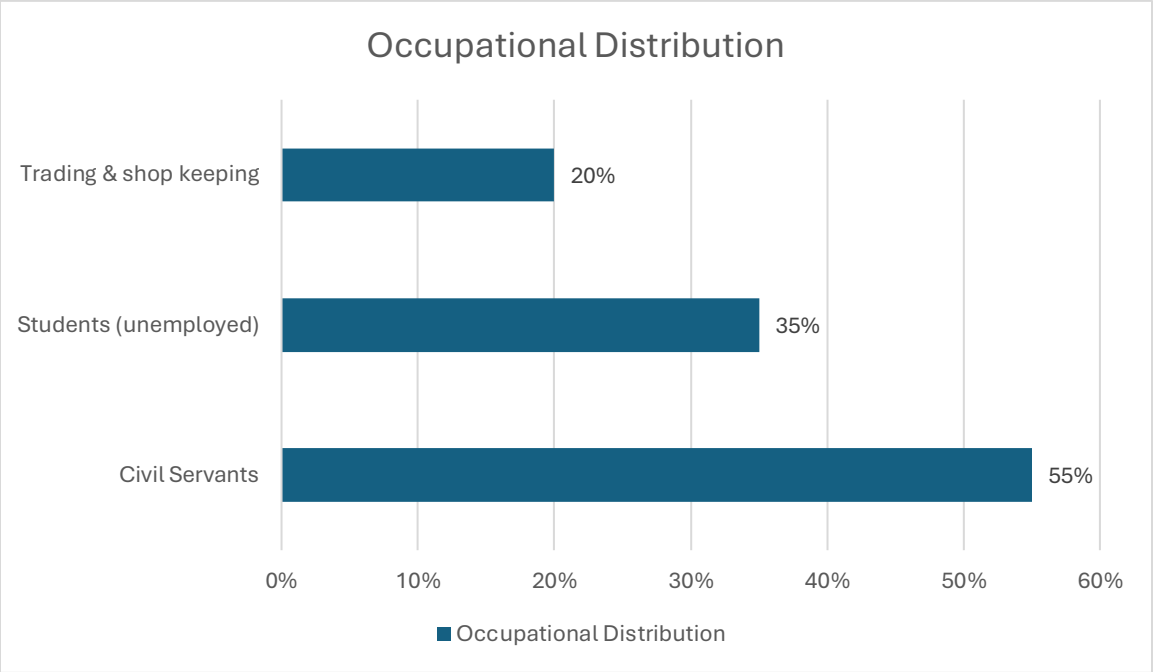

Figure. 4.7: Occupational Distribution of the study area.

4.11.5 Residential Status

The majority of respondents (55%) are permanent residents, indicating strong community ties and long-term investment in the area. Returnees constitute 35% of the population, while only 10% are non-residents. This residential pattern suggests a stable community with established roots in the area.

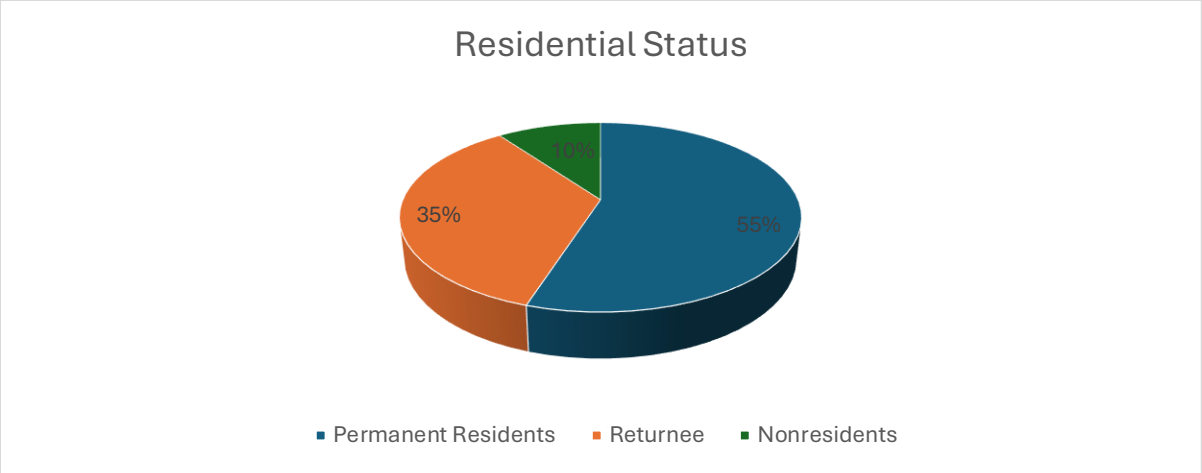

Figure 4.8: Residential Status of Respondents

4.11.6 Ethnic Group Distribution

The primary ethnic group in Ilorin and the surrounding Kwara State is Yoruba, making it the dominant local culture within the university community. The ethnic composition shows significant diversity, with Hausa Yoruba representing the largest group representing 70%, Hausa-Fulani represent 15% Ibos represent 10%, among others.

4.11.7 Religious Distribution

Ilorin is a predominantly Muslim, culturally rich city in Nigeria often described as *Ilu Alfa* (City of Scholars), characterized by a strong, deeply rooted Islamic heritage alongside a significant, minority Christian population. Islam is practiced by 65% of respondents (26 respondents), while Christianity is practiced by 35% (14 respondents). No respondents indicated adherence to traditional religion. This religious composition is reflective of the demographic patterns in Kwara State, which is predominantly Muslim.

4.11.8 Relationship to Household Head

Relationships to household head defines a person's familial or functional connection to the primary decision-maker/breadwinner in a household. The relationship with the head of household is such that 45% of the respondents were the actual household head, 20% are spouses of the household head, 35% are children of the Head of household. This distribution indicates that the survey captured responses from key decision-makers within households.

4.11.9 Household Size

The household size of a typical family is relative, depending on several factors such as income, level of education and religious belief. The household size of the respondents varies between 3 to 8 members, with

a mean household size of 6 persons. This household size is typical of Ilorin, Kwara State which has an average household size ranging between 6 and 7 persons.

4.11.10 Duration of Living/Working in the Area

The analysis showed that 45% of respondents have lived or worked in the area for 6-9 years, 30% have been there for 10 years or more. 25% of respondents are living and working 3-5 years or less. This data indicates a well-established community with significant institutional memory and long-term stakes in the area's development.

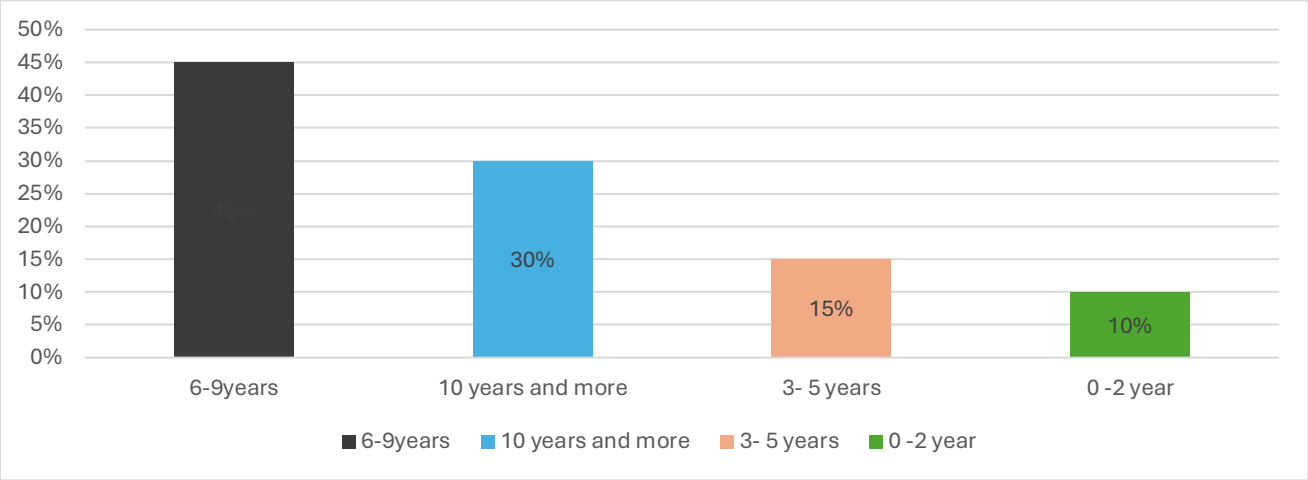

Figure 4.9: Duration of Living/Working in the Area

4.11.11 Educational Level

Educational attainment is notably high among respondents. University graduates represent 65%, university postgraduates 25%, while secondary school 10%. No respondents indicated having no formal education or only primary school education. This high educational level is consistent with the university community context and suggests good capacity for understanding and engaging with the proposed project.

4.12 Health Status

This section examines the health management practices, healthcare access patterns, common ailments, and perceptions about potential health impacts of the proposed infrastructure project.

4.12.1 Health Management Practices

An overwhelming majority of respondents (90%) indicated that they attend hospitals or clinics when sick, demonstrating good health-seeking behavior. Only 10% reported buying drugs from nearby chemists

without professional consultation. This pattern suggests adequate awareness of the importance of professional medical care and likely indicates reasonable access to healthcare facilities.

4.12.2 Hospital/Clinic Visit Frequency

The health care facilities that exist in the study area include the University of Ilorin Teaching Hospital and the University Health Services (Clinic) on campus, which provide medical, nursing, and dental services to the university community. The proximity and access to health facilities are major driver that influences the frequency of attendance to hospital/clinic. Among those who attend hospitals or clinics, 60% reported visiting within the last six months, while 30% last visited within the past year, while 10% of the respondents have not visited a hospital for 2 years stretch.

4.12.3 Common Ailments and Sicknesses

The most commonly reported ailments are Malaria (45%) and Typhoid fever (30%), which are endemic diseases in Nigeria. High Blood pressure/ Hypertension (10%), Diarrhea affected 10% and 5% of respondents had Eye pain. These disease patterns are typical of tropical regions and do not indicate any unusual health burden that would be exacerbated by the proposed solar power project. Figure 4.11 depicts the common ailments and sickness in the study area.

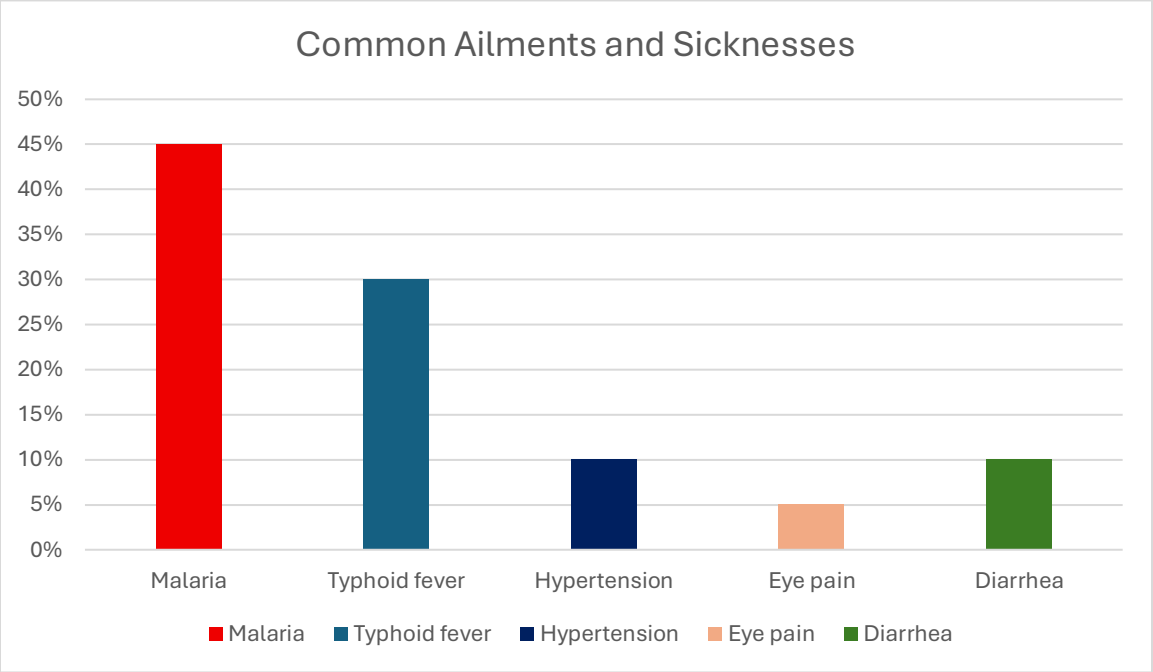

Figure 4.10: Depicts the Common Ailments and Sickness in the study area

4.12.4 Perceived Health Impact of Proposed Infrastructure

The perception of respondents on the perceived health implication of the proposed solar power plant project was positive. All the respondents indicated that they do not believe their health conditions will be affected by the proposed infrastructure intervention. This unanimous perception suggests strong confidence in the project's safety and minimal anticipated health risks from the solar power installation.

4.13 Standard of Living/Socioeconomic Activities

This section analyzes the living conditions, housing characteristics, utility services, income levels, and perceptions about changes in standard of living among respondents.

4.13.1 Housing Characteristics

The most common house types within Ilorin are bungalows (ranging from 2-bedroom to 4-bedroom), which are popular for being easier to build and maintain. Other prevalent residential building types include blocks of flats (apartments), duplexes (fully detached and semi-detached), and terraced houses. However, the predominant housing type in the study areas were constructed with cement, blocks and plastered walls, indicating good quality housing infrastructure. The interior compartments each household consist of an average of 3-4 rooms, which represent 55%, while 1-2 rooms households represent 35%. Majority of the students occupies single rooms hostel apartment on campus while others share 2-bedroom apartments usually off campus.

4.13.2 Sanitation Facilities

Sanitation facilities are systems and infrastructure designed to safely separate human excreta from human contact, preventing disease transmission and ensuring public health. Improved, safe options include flush/pour-flush toilets connected to sewers or septic tanks among others. Water closet toilet facilities are available in 90% of households, demonstrating good sanitation infrastructure. However, 10% use toilet facilities (pit latrine) located outside their dwellings while others engage in open defecation.

4.13.3 Housing and Land Tenure

Housing tenure shows that 65% of respondents rented their accommodation while 25% own their homes while 10% did not indicate their housing tenure. The land tenure distribution mirrors this pattern exactly, with 65% renting and 25% owning land. This split between ownership and rental suggests a mixed community of long-term residents and more transient university staff.

4.13.4 Refuse Disposal Methods

The study area had a mixed household solid waste disposal method, they range from disposal at Community refuse pit/dumpsite, burning, depositing at the backyard of residence, collection by waste contractors among others. The predominant solid waste disposal method was by burning which represent 40 %, this was

followed by deposition at the backyard which represent 25% and waste collection by registered waste contractors representing 25%. Dumping at community dumpsite represents 10%. However, within the university community, Solid wastes are collected and disposed off by waste contractors, unfortunately, students engage in indiscriminate dumping of waste behind their hostels. Therefore, it is pertinent that waste segregation at source, reuse and recycling be prioritized in the study areas.

Plate 4.3: Indiscriminate Disposal of Waste in the Study Area

4.13.5 Source of Lighting

All respondents (100%) indicated access to electricity from the national grid, through the Ibadan Electricity Distribution Company (IBEDC), although the duration and quality of supply vary due to the Band scheme of IBDC which specify the number of hours of electricity available to users per day. Alternative lighting sources include torchlight/battery (10%), standalone Solar system (35%) candles (10%), and generators (45%). The reliance on multiple backup sources suggests unreliable electricity supply from the national grid, hence the proposed solar power project will mitigate the power gap within the community. Plate 4.3 shows electricity facility on site.

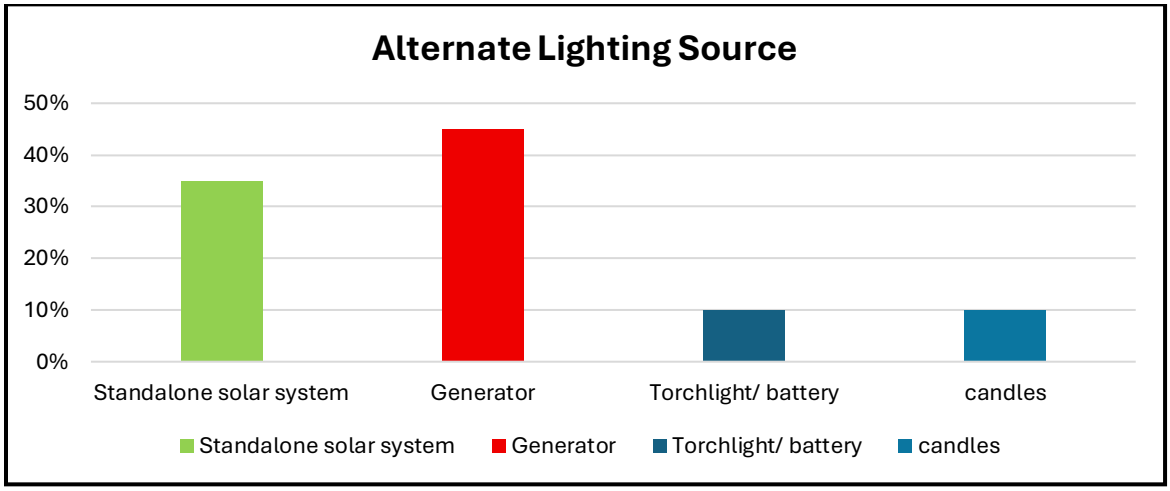

Figure 4.11 Alternative Lighting Source

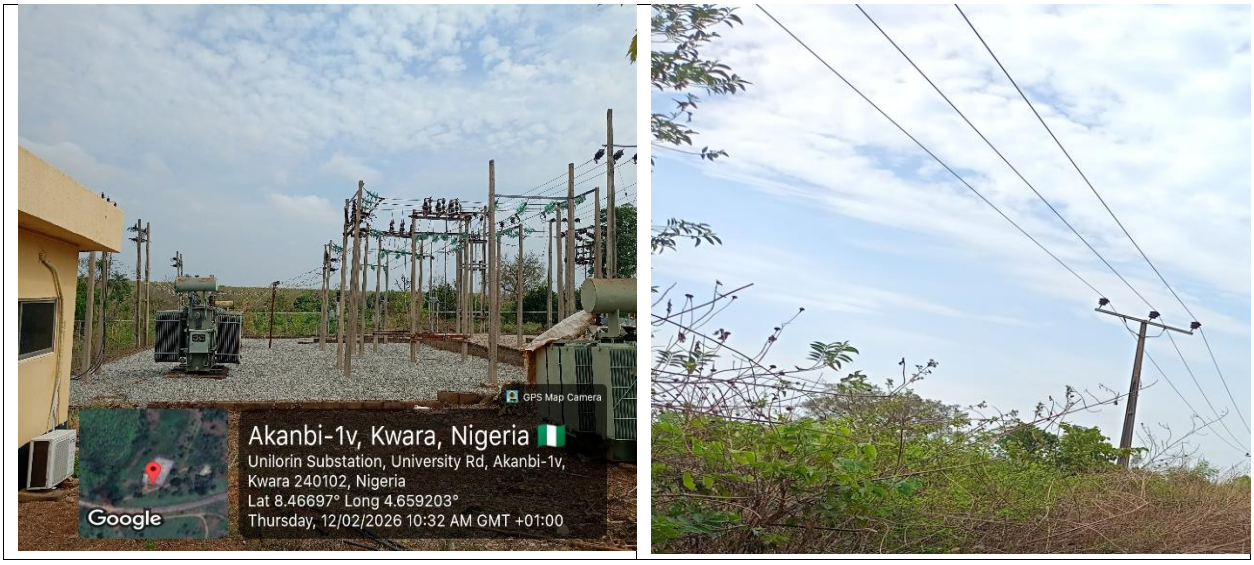

Plate 4.4: Existing Electricity Facilities in the Study Area.

4.13.6 Energy Sources for Cooking

The predominant energy for cooking is gas, which represent 45%, kerosene stove represents 25% and firewood represent 10%, Coal represents 15% while electricity users constitute 5%. This heavy reliance on biomass fuels (coal and firewood) indicates significant potential for environmental impact and suggests that improved electricity access could lead to cleaner cooking practices.

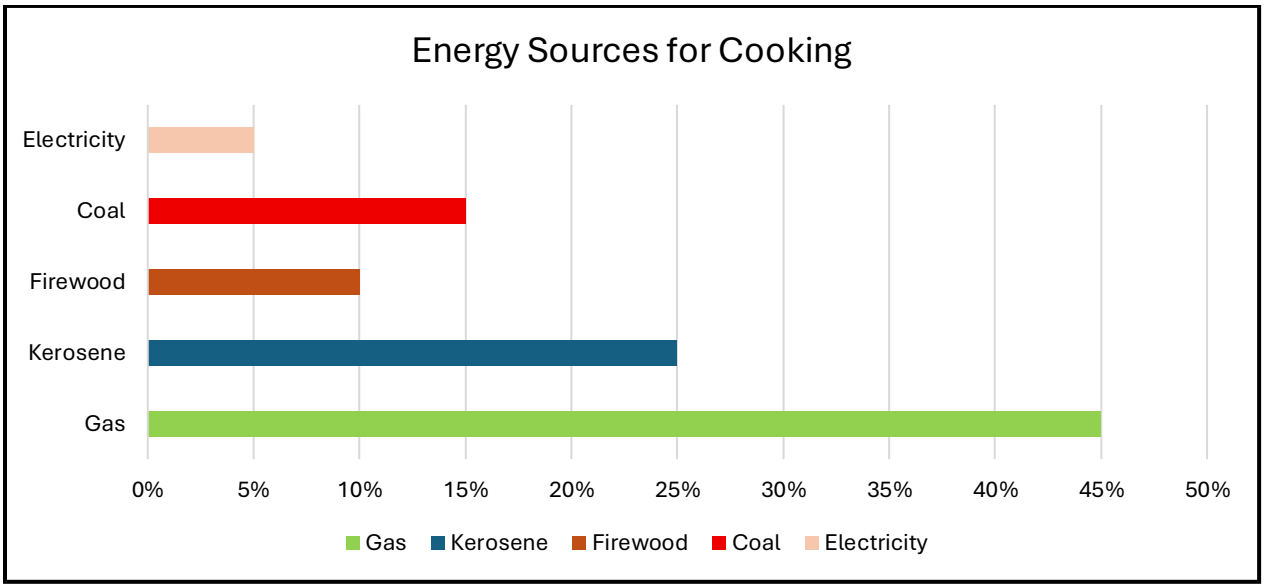

Figure 4.12: Energy Sources for Cooking

4.13.7 Income Distribution

Income distribution measures the spread of income across different groups (households, individuals, or income sources) within an economy, rather than just the average income. Unfortunately, 40% of the respondents refused to disclose their monthly income for personal reasons. However, 20% of the respondents earn a monthly income of 200,000 only, 25% earns less than 150,000 monthly while 15% earn 100,000 and below. Table 4.12 shows the income distribution of the study area.

Table 4.12: Income distribution of the study area

S/No	Monthly income	Percentage distribution
1	100,000 and below	15%
2	101,000 – 150,000	25%
3	200,000 and above	20%
4	Non-disclosure	40%

4.13.8 Remittances

Only 20% of respondents receive financial support from family members living elsewhere, with amounts ranging from N20,000-30,000 per month. The majority (80%) do not receive remittances, suggesting that most households are self-sufficient or primary income earners for their families.

4.13.9 Changes in Standard of Living

When asked about changes in standard of living over the previous three years, 50% indicated that it had nosedived tremendously, impacting their livelihood negatively. 35% of the respondents reported marginal improvement (better), while 15% indicated a similar situation (same). This mixed response suggests varying economic experiences within the community, which could be attributable to the earning opportunities peculiar to the different respondents. Figure 4.14 depicts the change in standard of living over a period of 3 years.

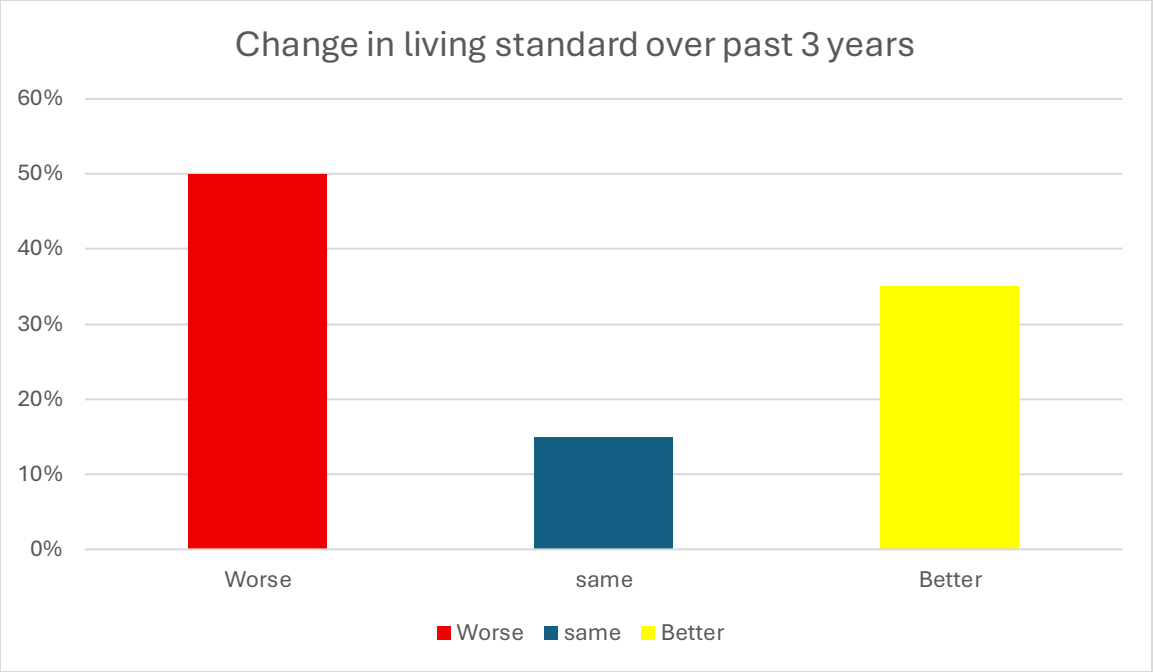

Figure 4.13: Change in living standards over the past 3 years

4.13.10 Electricity's Role in Living Standards

Access to reliable and affordable electricity has a multiplier effect in enhancing economic prosperity and improving the standard of living due to the lower cost of generating power individually and spurring small and medium-scale businesses. However, 35% of respondents reported that their standard of living changed positively due to improved electricity supply, while 65% attributed changes to other factors. This indicates that while electricity is important, it is not the sole determinant of living standards in the community.

4.14 Gender-Based Violence/Sexual Exploitation and Abuse

This section examines gender-related issues, including restrictions on women's access to services, criminalization of certain acts, safety measures, and gender equity practices in the community.

4.14.1 Provisions Restricting Women's Access to Health Services

The survey showed that there is no restriction on women's access to health and social services requiring male consent for medical treatment, 70% responded yes, 5% no, and 10% did not respond. Regarding parental consent for adolescents' access to contraceptives, 60% responded yes, 10% no, and 30% no response. For medical practitioners refusing services based on conscientious objection, 60% said yes, 10% no, and 25% did not respond. These responses indicate significant awareness of restrictive practices that may affect women's health access.

4.14.2 Criminalization of Acts

Both adultery and prostitution were identified as criminalized acts by 90% of respondents, with 10% not responding. Among those who acknowledged prostitution criminalization, opinions varied on who bears criminal responsibility: 30% said the sex worker, 30% said the procurer and/or customer, 20% said both, and 20% did not respond. This data reflects the legal and social framework regarding these issues in the community.

4.14.3 Measures for Women's Safety

Women in Ilorin face significant safety challenges in public spaces and transportation, driven by poorly maintained infrastructure, long wait times, and risks of harassment. Key issues include physical discomfort in crowded vehicles, verbal and physical abuse, and inadequate lighting at night, which particularly affect women. In the study area, he majority of respondents (60%) indicated there are measures or programs implemented to increase women's safety in public spaces or transportation, (solar street lighting, Gender policy among others) while 40% had no idea.

4.14.4 Training on Gender-Based Discrimination

The university community developed its gender policy in 2019 and recently revised in 2024. The policy is geared toward preventing and responding to gender-based violence, such as sexual harassment and assault among others. 80% of respondents indicated that there are specific training programs for medical and legal professionals on gender-based discrimination in health and safety. While 20% were unaware of such training programmes.

4.14.5 Gender Equity in the Community

The Nigerian Constitutional Provisions (Section 42): Nigeria's Constitution guarantees freedom from discrimination on the basis of sex, gender, or religion, providing a legal foundation for equality. Nigeria's primary framework for gender equality is the National Gender Policy (2021–2026), which aims to bridge gender gaps, promote women's empowerment, and achieve 35% affirmative action in political and decision-making roles. In the study areas, gender equality is being promoted in line with the University Gender Policy 2024.

When asked how gender equity is ensured, 30% of respondents indicated that Women are elected to public office, 25% indicated that quotas on genders are ensured in leadership of community-based organizations, while 45% of the respondents indicated that females are given equal opportunity and access to education and employment. This suggests that while educational and employment equity exists, political representation and leadership equity remain minimal, as seen in Figure 4.13.

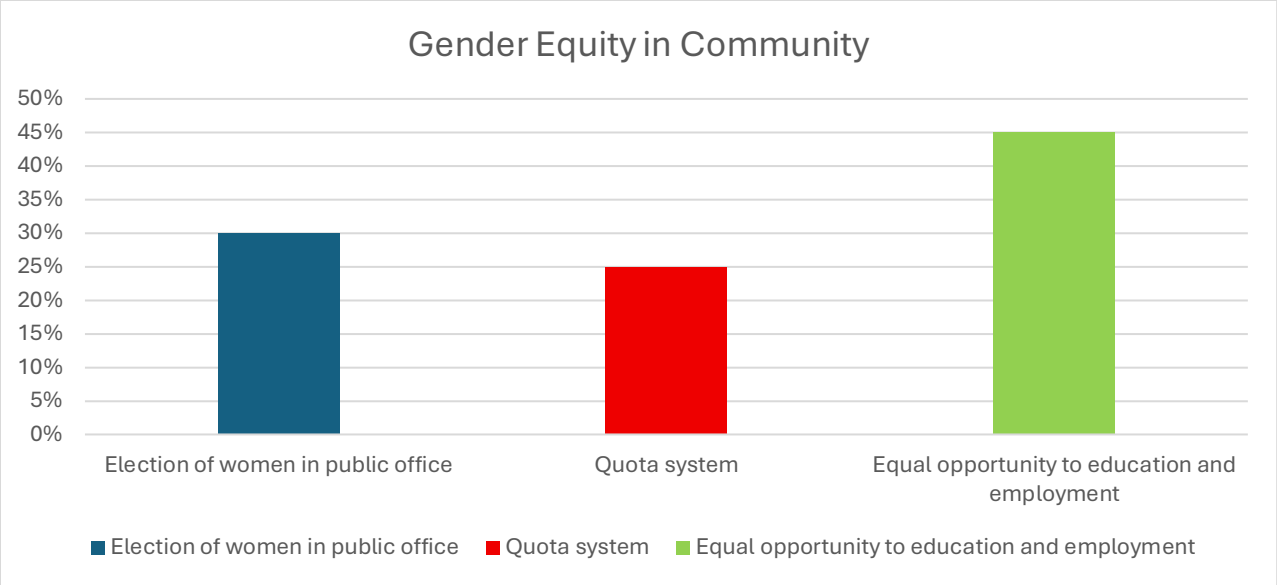

Figure 4.14: Gender Equity in Community

4.4.6 4.14.6 Vulnerable Groups

Vulnerable groups are individuals or populations who, due to certain conditions or circumstances, are at a higher risk of harm, discrimination, or exclusion from social, economic, educational, or health opportunities. They often need special protection, support, or attention in policies, institutions, and community programs to ensure fairness and inclusion. At a university level, vulnerable groups may include Students with disabilities, Students from extremely poor backgrounds, Female students facing gender-related challenges, international students or minorities, Students with mental health difficulties.

Support mechanisms at universities typically include Scholarship or bursary programs, Counseling and health services, Inclusive education accommodations (e.g., assistive technology, extended exam time), Protective policies against harassment or discrimination, among others. The Vulnerable groups within the University community primarily include students living with disabilities (PLWD) facing accessibility challenges and economically disadvantaged individuals (urban poor) within the surrounding Ilorin metropolis. These groups encounter significant barriers to education, infrastructure, and resources, requiring specialized support and intervention.

The University has a Counselling and Human Development Centre, where counsellors attend to vulnerable group. The center urge students to champion a culture whereby every individual feels physically safe and emotionally included in order to foster a truly thriving academic community.

The university has a network of help available to vulnerable students, including the University Security Unit, the University Health Centre, the Dean of Student Affairs' office, and the Counselling and Human Development Centre for psychological and emotional support.

The University developed and ratified its “Disability Policy, 2024” to help people with disabilities thrive within the university community, this policy seeks to guarantee that they have equal access to administrative, extracurricular, and educational opportunities as well as that the university complies with applicable local, national, and international disability rights laws. The policy is applicable to every visitor, employee, and student at the University of Ilorin.

4.15 Resources/Cultural Property

This section assesses environmental challenges in the community and potential impacts of the proposed project on natural and cultural resources.

4.15.1 Current Environmental Problems

Inadequate drainage systems, combined with improper waste disposal, have increased the risk of flooding, particularly in rapidly urbanizing areas around the University community. However, the respondents indicated that poor drainage system represented 40%, bad roads 35% were significant problems in the community. Environmental degradation and waste management were mentioned to represent 20% and 5% contribution respectively. These existing environmental issues provide context for assessing the proposed project's potential impacts.

4.15.2 Expected Environmental Problems from Project Construction

Remarkably, 100% of respondents indicated that they do not expect any of the listed environmental problems (soil infertility, poor drainage, bad roads, low visibility, erosion, flooding, environmental degradation, infrastructure destruction, land encroachment, or pollution) to result from the proposed solar power project during construction. This unanimous perception reflects strong confidence in the project's environmental safety and proper management.

4.15.3 Impact on Valued Cultural/Archaeological Property

All respondents (100%) indicated that the proposed Solar power plant infrastructure project will not affect any valued resource, cultural, or archaeological property in their area. Rather, it will enhance the appeal of the community and its valued resources. This is consistent with the project being located on a virgin land belonging to the university that is not currently in use and has no known cultural or archaeological significance.

4.16 Intervention Project Activities Impact Evaluation

This section evaluates awareness of the proposed solar power project, information sources, potential for community restiveness, expected impacts, and community expectations from the project.

4.16.1 Project Awareness

Project awareness involves educating stakeholders or the public about a project's goals, impact, or existence, crucial for fostering community support, compliance, and successful implementation. Unfortunately, the level of awareness of the proposed intervention was abysmally low, only a handful of persons are aware among the University management team. 10% of respondents indicated awareness of the proposed solar power project, while 90% were not aware. This low awareness level highlights the importance of enhanced stakeholder engagement and communication about the project to ensure community understanding and participation.

4.16.2 Information Sources

Among those aware of the project, 60% learned about it from colleagues in the Works Department, 30% obtained information through management meetings, while 10% got informed from stakeholders' engagement. This distribution suggests that informal workplace communication is currently the primary information channel, indicating potential for more systematic communication strategies.

4.16.3 Potential for Community Restiveness

All respondents (100%) indicated that the proposed infrastructure project will not cause restiveness in the community. This unanimous response reflects strong community acceptance and support for the project, as well as confidence in its implementation approach.

4.16.4 Positive Impacts of the Project

Respondents identified multiple positive impacts expected from the project, including constant power supply, increased productivity and efficiency, enhanced research and academic output for lecturers and students, promotion of economic development and prosperity, and reduction of noise and global warming. No negative impacts were identified by respondents, further demonstrating strong community support.

4.16.5 Community Expectations from the Project

The survey revealed several key expectations from the community. Employment of locals and contracting opportunities during construction was expected by 80% of respondents, capacity building for maintenance during implementation by 90%, and community input into final engineering design by 20%. Additionally, respondents emphasized the importance of durability, proper maintenance, and adequate security to protect against theft and robbery.

4.17 Grievance Redress Mechanism

Grievance Redress Mechanisms

A grievance refers to any complaint, dissatisfaction, or concern an individual (staff or student) has regarding: Academic issues (e.g., grading, supervision, examination results), Administrative matters (e.g., delays, misconduct). Workplace conditions (for staff) Harassment, discrimination, or unfair treatment. The Grievance Redress Mechanism (GRM) at the University of Ilorin provides a structured process for students and staff to seek resolution when they encounter unfair treatment, academic issues, or administrative problems. The University ensures that the GRM is guided by: Fairness and impartiality, Confidentiality, Timeliness, Non-retaliation (no punishment for filing a genuine complaint) and documentation of every step for accountability.

Step-by-Step Process of Grievance Redress at UNILORIN

Informal Resolution

The complainant (student or staff) is encouraged to first discuss the issue informally with the person(s) directly involved — such as a lecturer, supervisor, or department officer. Many issues can be resolved at this level through communication and clarification.

Departmental / Faculty Level

If the issue is not resolved informally, the complainant submits a written complaint to the Head of Department (HOD) or Dean of Faculty. The HOD/Dean investigates the matter, possibly holding a meeting with all parties involved. A decision or recommendation is then communicated to the complainant.

University Grievance Committee

If the complainant is unsatisfied with the departmental resolution, the case is escalated to the University Grievance Redress Committee. This committee reviews the complaint, conducts hearings if necessary, and ensures due process is followed. Both parties may be invited for clarification or presentation of evidence.

Appeal to the Vice Chancellor

If the complainant still feels dissatisfied with the outcome, they can appeal to the Vice-Chancellor (VC). The VC reviews the entire process and may make a final decision or direct further investigation.

External Resolution

If internal mechanisms fail, the complainant may seek redress through external bodies such as the National Universities Commission (NUC), the Federal Ministry of Education Or, in exceptional cases, the courts.

The university environment, like other community have had its fair share of grievances, emanating from theft of valuables, which were addressed by varying instruments in the past three years. Statistically, 75% of grievances were reported to the university authority for resolution, 15% were reported to the law enforcement agency (Police), while 10% were reported to the landlords/ CDA. Overall, 80% satisfactory grievance resolution rate was reported.

This section examines the community's experience with grievances, reporting mechanisms, and satisfaction with resolution processes.

4.17.1 Grievances in the Last Three Years

40% of respondents indicated that they have had grievance issues in the community in the last three years, while 50% reported not to have had any major grievance issues within the community. However, 10% of the respondent did not indicate because they could not remember and did not want to give a misleading view on the question.

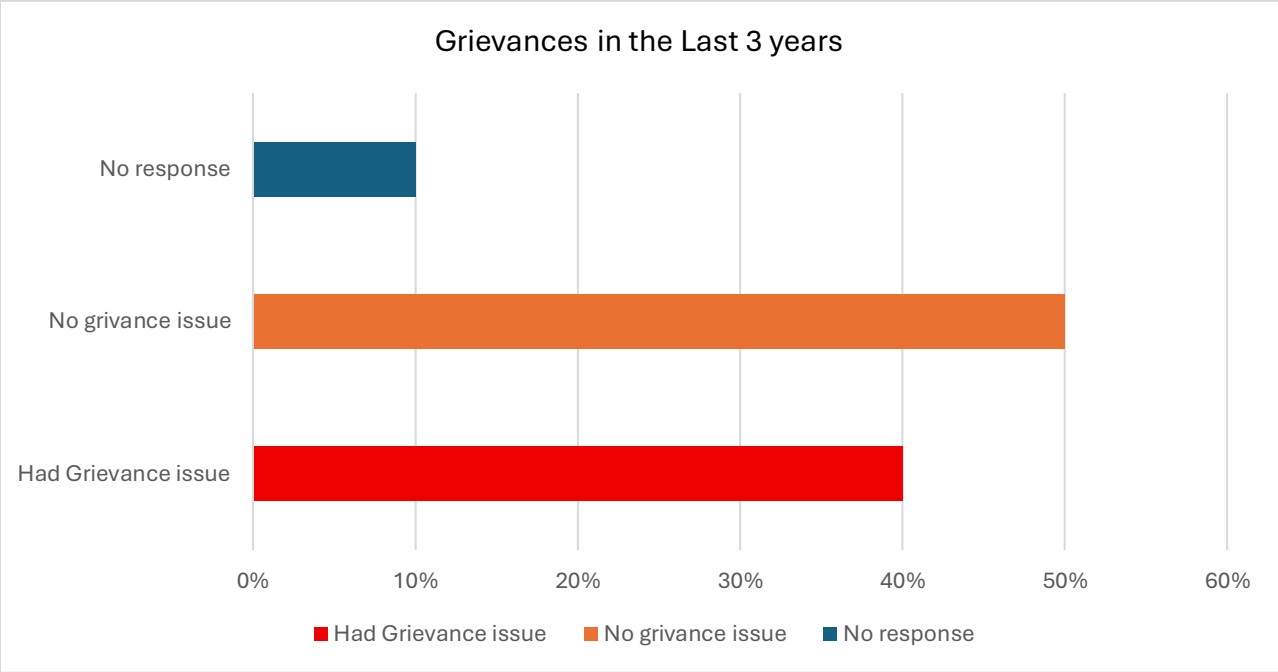

Figure 4.15: Grievances in the last 3 years

4.17.2 Grievance Reporting Channels

The University of Ilorin utilizes a structured grievance redress mechanism, primarily managed by the Dean of Student Affairs for student-related issues. Complaints are often settled informally, or through formal investigation involving necessary evidence, with results forwarded to the Vice-Chancellor, who may set up committees for resolution.

When asked where they would report grievances, 75% indicated they would approach the school authority/management, 10% would go to landlord/ CDA, and 15% would approach the law enforcement agency. This distribution shows that the university administration is seen as the primary authority for addressing concerns, which is appropriate given the institutional context.

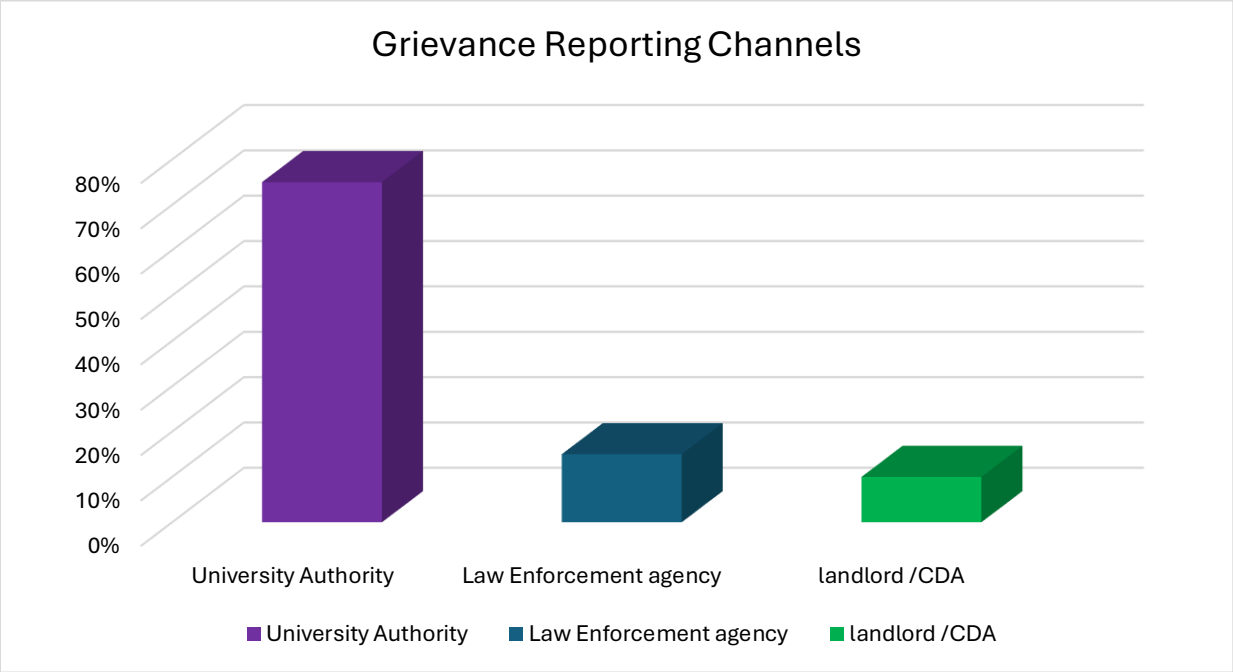

Figure 4.16: Grievances Reporting Channel

4.17.3 Satisfaction with Grievance Resolution

The level of satisfaction derived from grievance resolution mechanism varied in the study area, 80% of respondents indicated that grievances are satisfactorily addressed or resolved by the chosen reporting channels while 20% objected and were dissatisfied with the outcome of the grievance resolution. However, there are opportunities for improvement in the existing redress mechanism.

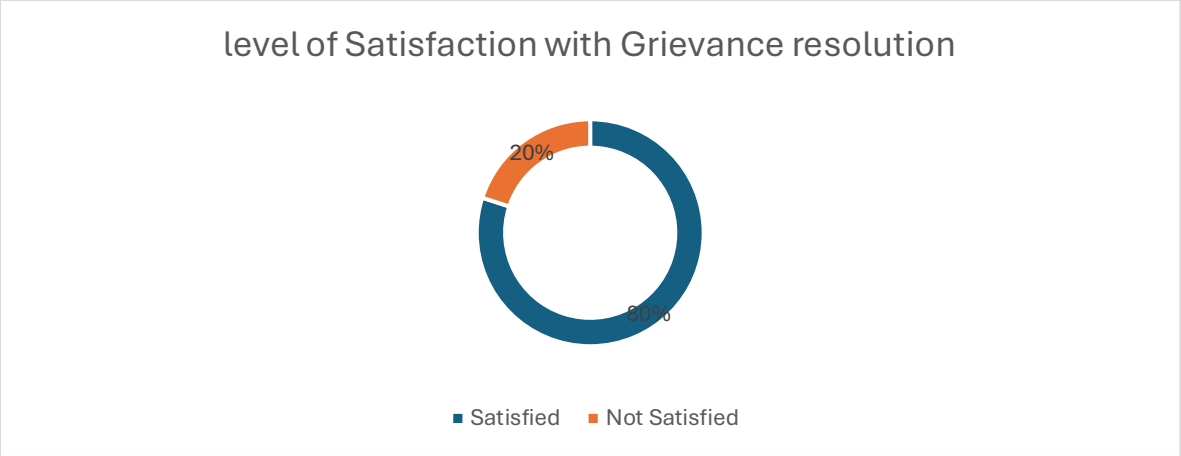

Figure 4.17: Level of Satisfaction with Grievance Resolution

4.17.4 Specific Concerns About the Project

Concerns and fears about developmental projects are part of every developmental process. Concerns and fear stem from little knowledge about the project design, its impacts and scope among others. However, the beneficiaries of the proposed projects and respondents expressed specific concerns regarding the proposed intervention project, primarily focusing on the durability and proper maintenance of the solar power plant. They emphasized the need for adequate security measures to protect against theft and vandalism. The age distribution shows that the majority of respondents (65%) fall within the 18-45 years age bracket, representing 26 individuals. This is followed by 30% in the 46-65 years category (12 respondents), and 5% below 18 years (2 respondents). This distribution indicates a predominantly young to middle-aged population, which is typical for a university community.

CHAPTER FIVE
ASSOCIATED AND POTENTIAL IMPACTS

5.1 Introduction

The project has overall positive impacts by providing a competitive, cost-effective, pollution-free, and reliable mode of solar power. It will certainly meet the ever-increasing demand for power and bridge the gap between demand and supply of power. However, the proposed project may have some negative impact on the environment during site preparation, construction & operation phases. During the construction phase, the impacts may be regarded as temporary or short-term; while long-term impacts may be observed during the operation stage.

5.2 Impact Assessment Overview

The potential for an Environmental and Social impact exists where an environmental and social aspect has been identified i.e. where a project activity has been determined to have the potential to interact with the biophysical and socio-economic environment.

The assessment process was as follows:

- Identification of the various potential impacts using an interaction matrix to show the relationship/ interaction between the project environmental components and planned project activities.
- A screening of potential impacts associated with each phase of the project is performed using a Risk Assessment Matrix, and
- A detailed evaluation of the individual impact-producing factors that comprise each aspect of the project phases is then performed. The significance of the potential impacts is quantified using the same rationale as for the screening.

The assessment of impact significance is both in qualitative and quantitative terms. Qualitatively, the impact significance is ranked on four (4) widely accepted levels: Major, Moderate, Minor and Negligible. The impact assessment covers the entire life cycle of the Project. i.e.: preconstruction, Construction, operation, and decommissioning.

5.3 Identification of Environmental and Socio-economic Aspects and Impacts

A number of project activities would be carried out in phases. These planned activities are what would impact on the environmental components positively or negatively. The PV-based power plant project activities are grouped into five phases as follows:

Pre-Construction phase: Involves activities such as award of contract, project design and planning, consultation, recruitment, site preparation and transportation of the utility scale PV based power plant components to site.

Construction phase: It involves activities such as mobilization of workforce and equipment to site, digging, trenching, bulldozing, grading, soil compaction; and installation of temporary camp and power plant components. This phase is usually a short term one. Commissioning phase: It involves the integrated application of a set of engineering techniques and procedures to check, inspect and test every operational component of the project, from individual functions, such as instruments and equipment, up to complex amalgamations such as modules, subsystems and systems. Operational phase: This is usually 'long term', involving activities from post construction to pre-decommissioning. It commences once the power plant has been commissioned for use. Activities include use of natural resources (water for domestic uses and cleaning of solar modules), plant and

equipment operations, and routine maintenance of equipment and plant. Decommissioning phase: It begins once the power plant use is discontinued or the project life span has come to an end. It should be noted that impacts can occur at any time; during these phases mentioned above i.e. pre-construction, construction and operational phases of the project. Some impacts may however, occur in some or all phases of the project. To identify environmental and social aspects of the Project, the proposed Project activities were considered in terms of their direct or indirect potential to:

- Interact with the existing natural environment including its physical and biological elements;
- Interact with the existing socio-economic environment; and
- Breach relevant policy, legal and administrative frameworks including national legislation, relevant international legislation/conventions, standards and guidelines, and corporate environmental policy and management systems.

The FMEnv EIA Procedural Guidelines and the World Bank Safeguard Systems and ISO 14001 approach among other references were used in the identification process.

The assessment approach generally involved matching the various activities of the different stages of the proposed project (as described in Chapter 3 of this report) with the components of the existing environment. Consequently, the possible changes (and extent of changes) in the environment as a result of the interactions have been identified/ evaluated, hence mitigation measures are proffered in order to reduce, offset or ameliorate such changes. The potential/ associated adverse and beneficial impacts of the proposed power plant project on the existing environment were identified at this stage of the ESIA.

The Risk Assessment Matrix (RAM) has been employed in determining risks posed by the identified potential/associated impacts of the project in order to proffer appropriate mitigation measures. In predicting impacts, the experiential/practical 'worst case scenario' approach has been applied to determine the extreme effects of project activities on environmental components, while 'consensus of opinions has been used to determine the importance of affected environmental components. The impact evaluation results make up the pedestal for developing the ESMP of the proposed project.

5.3.1 Potential Impact Characterization

The following characteristics were also used to define potential impacts that may be associated with the proposed Project:

- Negative: An impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor.
- Positive: An impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
- Direct: Impacts that result from the direct interaction between a planned project activity and the receiving bio-physical and socio-cultural environment.
- Indirect: Impacts that result from other activities that are encouraged to happen as a consequence of the project.
- Temporary: Temporary impacts are predicted to be of short duration, reversible and intermittent/occasional in nature

- Short-term: Short term impacts are predicted to last only for a limited period but will cease on completion of the activity, or as a result of mitigation measures and natural recovery
- Long-term: Impacts that will continue for the life of the project, but cease when the project stops operating.
- Permanent: Potential impacts that may occur during the development of the project and cause a permanent change in the affected receptor or resource that endures substantially beyond the project lifetime
- On-site: Impact that is limited to the project site.
- Local: Impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community.
- Regional: Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries.
- National: Impacts that affect nationally important environmental resources; affect an area that is nationally protected; or have macroeconomic consequences
- Reversible: An impact that the environment can return to its natural state.
- Irreversible: An impact that the environment cannot return to its original state, e.g. the extinction of an animal or plant species
- Cumulative: Potential impacts that may result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project. This also includes synergy with other projects/infrastructure in the project area
- Residual: Both environmental and social impacts that will remain after the application of mitigation measures to project impacts during each of the project phases.

5.3.2 Screening and Scoping for Potential Impacts

The first step in identifying impacts associated with the project is the development of an interaction matrix which shows the relationship/ interaction between the project's environmental and social components and planned project activities. A modified version of the Leopold Interaction-matrix technique was employed to screen and scope for the potential impacts of the proposed Project on the environment. The basis for the screening was derived from the following:

- Knowledge of Project activities.
- Detailed information on the environmental and socio-economic setting of the Project’s area of influence.
- Consultation with relevant stakeholders.
- Review of other ESIA reports on similar projects/environments.

Table 5.1: Project Activities – Leopold's Environmental and Social Interaction Matrix (Impact Significance Matrix)

Project Phase	Activity	Air Quality	Ambient Noise	Soil	Landscape Topography	Terrestrial Flora	Terrestrial Fauna	Land Use	Population	Utilities Infrastructure	Employment / Income	Gender Issues	Construction Workers (H&S)	Workplace Health & Safety	General Public
Pre-construction	Site selection	X													
	Site clearing and preparation	X	X	X	X	X	X	X	X		X	X	X	X	X
	Mobilization of equipment & materials	X	X	X	X						X	X	X	X	X
Construction	Civil works (excavation, trenching, cable laying, foundation, buildings)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Installation of power plant & infrastructure	X	X	X	X	X					X	X	X	X	X
	Waste generation and disposal	X	X	X	X	X					X	X	X	X	X
Commissioning	Testing of power plant & infrastructure	X	X	X							X	X	X	X	X
Operational	Power generation, distribution & training	X	X	X	X						X	X	X	X	X
	Routine maintenance; waste generation & disposal	X	X	X	X	X	X	X	X	X					

decommissioning	Land recovery							X	X	X	X	X	X	X	X
	Waste mgt	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 5.2: EEP III Solar Power Plant Impacts Categorization -Project Activities and Associated Potential Impacts Matrix

Project Phase / Activity	Associated & Potential Impacts	Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Short Term	Long Term
Pre-construction Phase	Employment opportunities from recruitment	X			X	X			X	
	Business opportunities for local contractors	X			X	X		X	X	
	Skill acquisition and workforce enhancement	X			X	X		X		X
	Improvement in quality of life (compensation)	X			X	X				X
	Conflicts over employment (quotas, methods)		X	X		X		X	X	
	Disputes over MoU with project proponents		X	X		X		X	X	
	Influx of migrant workers & pressure on infrastructure		X	X		X		X	X	X
	Increase in social vices (theft, prostitution)		X	X		X		X	X	X
	Agitations over land disputes & leadership tussles		X	X			X	X	X	X
	Loss of vegetation & forest resources	X		X			X	X		X
	Increased risk of accidents during mobilization	X		X		X			X	
	Risk of armed robbery / hostage situations		X	X			X	X	X	X
	Noise and vibration from heavy equipment	X		X		X		X	X	
	Dust and vehicular emissions	X		X		X		X	X	
	Waste generation (scrap, domestic waste, etc.)	X		X		X		X	X	X

Table 5.3: Commissioning and Operational Phases – Potential Impact Matrix

Project Phase / Activity	Associated & Potential Impacts	Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Short Term	Long Term
Commissioning Phase	Testing and commissioning of power supply	X			X	X			X	
Operational Phase	Improved quality of life due to enhanced power supply	X			X	X		X		X
	Improvement in air quality (reduced generator emissions)		X		X	X		X		X
	Reduced demand for petrol and diesel for power generation		X		X	X		X		X
	Injuries/fatalities from operational accidents	X		X			X	X	X	X
	Soil/groundwater contamination from oil/fuel spills	X		X		X		X	X	X
	Workplace accidents (cuts, trips, falls)	X		X		X		X	X	
	Skill acquisition for plant operation personnel	X			X	X		X		X

Table 5.4: Decommissioning Phase – Potential Impact Matrix

Project Phase / Activity	Associated & Potential Impacts	Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Short Term	Long Term
Decommissioning Phase	Loss of employment and business opportunities	X		X		X		X		X
	Reduced power supply to the University	X		X		X			X	X
	Risk of injuries from collision with abandoned structures	X		X		X			X	
	Risk of accidents during demolition activities	X		X		X		X	X	
	Increased dust and vehicular emissions	X		X		X		X	X	
	Traffic obstruction from movement of vehicles		X	X		X		X	X	
	Availability of land for alternative uses	X			X	X				X
	Loss of site aesthetic quality (abandoned/dilapidated structures)	X		X			X	X		X

5.4 Determination of Impact Significance

The significance of impacts that could occur due to the implementation of the project's activities was established based on three steps, which are:

- Impact Magnitude, which combines the extent, duration, scale, and frequency of an impact
- Value/ Sensitivity/ Fragility and importance of the relevant Receptor.
- Identification of the impact significance, which is the cumulative indicator of both of the above two key variables.

The magnitude of an effect requires quantifying the sources of potential environmental and socio-economic effects from routine and non-routine project activities, such as the extent of land take or predicted change in noise levels. On the other hand, the receptor sensitivity is derived from factors such as:

- Legislative controls.
- Designated status within the land use planning system;
- Number of affected individual receptors;
- Ability of the resource or receptor to absorb change; and
- Public perception about the criticality or sensitivity of the receptors.

The determination of impact significance also entails considering compliance with environmental policies, quality standards and set pollution limits.

5.4.1 Method for Determining Impact Magnitude

Potential negative impacts were assigned Negligible, Low, Medium, and High labels based on their magnitude while for positive impacts, it sufficed to indicate that the project is expected to result in a particular positive impact without assigning a magnitude to it.

5.4.1.1 Defining Magnitude Levels for Biophysical Impacts

A High Magnitude Impact is considered to affect an entire area, physical system or species at sufficient magnitude to cause a significant measurable numerical increase in measured concentrations or levels (when compared with national or international limits and standards specific to the receptors) or a decline in species abundance beyond which natural process would not return that population or species, to its former level within several generations.

A Medium Magnitude Impact occurs at a sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels and may bring about a change in species abundance but does not threaten the integrity of that population or any population dependent on it.

A Low Magnitude Impact affects a specific area, system, aspect (physical), group of localized individuals within a population (biological), and at sufficient magnitude to result in a small increase in measured concentrations or levels over a short time period but does not affect other trophic levels or the population itself, and a localized area.

A Negligible Magnitude Impact results in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation.

5.4.1.2 Defining Magnitude Levels for Socio-economic Impacts

For socio-economic impacts, the magnitude is based on the perspective of those who would be affected by the impact; this considers the likely perceived importance of the impact, the ability of people to manage and adapt to change caused by the impact and the extent to which a human receptor gains or loses access to, or control over socio-economic resources resulting in a positive or negative effect on their well-being. The event magnitude rankings are shown in Table 5.5.

Table 5.5: Event Magnitude Rankings

Importance Level	Description / Attributes
High	• Highly undesirable outcome (e.g., impairment of endangered or protected habitat/species) • Detrimental and prolonged changes to flora and fauna behavior (breeding, spawning, moulting) • Major reduction or disruption in value, function, or service of impacted resource • Occurs during environmentally sensitive periods • Continuous non-compliance with international best practices • Significant negative impact on livelihoods, income, or living conditions affecting a large population, leading to economic loss and possible protests • Reputational damage and/or revenue loss threatening business viability • Increased public health risk leading to injury or fatality • Damage to public infrastructure (e.g., sewer, water pipeline), causing wider environmental or socio-economic impacts
Medium	• Noticeable negative outcome • Measurable reduction or disruption in value, function, or service of impacted resource • Potential non-compliance with international best practices • Moderate negative impact on livelihoods, income, or living conditions • Temporary business disruption causing minor revenue loss • Increased public health risk is manageable with mitigation measures • Disruption to public infrastructure (e.g., road closures) causing inconvenience
Low	• Imperceptible or minimal outcome • Insignificant change in value, function, or service of impacted resource • Fully compliant; no controls required • Minor, localized, temporary, and reversible nuisance to livelihoods or living conditions • Temporary business disruption without revenue loss or reputational impact • No change in community health status • Minor inconvenience from temporary infrastructure disruption

5.4.2 Determining Receptor Sensitivity

Receptor sensitivity refers to the socio-economic and environmental importance of the receptor, including human dependence on the receptor for food and income. It basically considers the type of receptor (namely, biological/ecological, human, and physical receptors) and the impacts that directly affect people. Vital natural resources are considered more important than indirect impacts.

Where the receptor is physical (for example, soil environment) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered. Where the receptor is biological (for example, the aquatic environment), its local, regional, national or international importance and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. The receptors' sensitivity is categorized as Low, Medium and High and the criteria for ranking the receptor sensitivity are defined in Table 5.6.

Table 5. 6: Receptor Sensitivity Ranking

Sensitivity Level	Description / Attributes
Low	• Receptors have a moderate to high capacity to adapt to change and maintain or improve quality of life • Individuals who can quickly adapt to temporary disruptions in living conditions, livelihoods, or public infrastructure (e.g., road closures) • Businesses with robust economic models that can easily adjust to restrictions or even benefit from changes
Medium	• Receptors have limited capacity to adapt to change and maintain or improve quality of life • Individuals who depend heavily on their livelihood and have limited ability to adapt to changes • Businesses with limited flexibility that are sensitive to reductions in revenue or reputational impacts
High	• Receptors are vulnerable with little or no capacity to adapt to change or maintain quality of life • Includes vulnerable groups such as homeless individuals, internally displaced people, people without land titles, migrants, or seasonal herders • Individuals with marginal livelihoods, low income, or poor living conditions • Individuals vulnerable due to age, disability, or other factors requiring special assistance • Businesses with marginal economic viability that cannot easily adapt to change

5.4.3 Significance

Risk Assessment Matrix

Magnitude ↓ / Sensitivity →	**Low Sensitivity**	**Medium Sensitivity**	**High Sensitivity**
High Magnitude	Minor	Moderate	Major
Medium Magnitude	Minor	Moderate	Major
Low Magnitude	Negligible	Minor	Moderate

Negligible Significant impacts are where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations. An impact of minor significance is one where an effect will be experienced. Still, the impact severity is sufficiently low (with or without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. An impact of moderate significance is one within accepted limits and standards. Moderate impacts range from a threshold below which the impact is minor, up to a level that might be just short of breaching a permissible limit. Thus, impacts of Negligible, Minor, or Moderate significance are considered as being mitigated as far as practicable and necessary, and therefore, do not require further mitigation.

An impact of major significance is one in which acceptable limits or standards may be exceeded, or a high-magnitude impact occurs to highly valued/sensitive receptors/resources, and for such negative impacts, additional mitigation is required.

Table 5.7: Impact Magnitude Ranking												
Phase	**Activity**	**Air Quality**	**Noise**	**Soil**	**Groundwater / Aquifer**	**Flora**	**Fauna**	**Land Use**	**Infrastructure / Utilities**	**Employment / Income**	**Public Health & Safety**	**Workers Health & Safety**
Pre-construction	Site selection	2(2)	–	–	–	–	–	–	–	–	–	–
	Site clearing & preparation	2(2)	2(2)	2(2)	–	2(1)	–	3(1)	3(1)	+	2(2)	–
	Mobilization of equipment & materials	2(2)	2(2)	–	–	–	–	2(2)	+	–	–	–
Construction	Civil works (excavation, trenching, cable laying, buildings)	2(2)	2(2)	3(1)	2(2)	–	–	3(2)	++	–	2(2)	2(3)
	Installation of plant, batteries, infrastructure	2(2)	2(2)	3(1)	–	–	–	2(2)	–	–	–	–
	Waste generation & disposal	2(2)	–	2(2)	2(1)	–	–	+	–	–	2(2)	2(2)
Commissioning	Testing of plant & infrastructure	2(1)	–	–	–	1(1)	–	1(1)	–	–	–	–
Operational	Power generation & distribution	2(1)	–	–	–	–	–	++	–	–	–	–
	Routine maintenance & waste disposal	2(2)	–	2(2)	2(2)	–	–	2(2)	2(2)	–	2(1)	1(2)
Decommissioning	Land recovery	2(2)	–	-	-	–	–	-	-	–	2(1)	1(2)

	Waste mgt	2(2)	–	2(2)	2(2)	–	–	-	-	–	-	1(2)

Receptor sensitivity ranking: 1 = Low; 2 = Medium; 3 = High. Impact Magnitude Ranking: 1 = Negligible; 2 = Low; 3 = Medium; 4 = High

5.5 Impacts Discussion

5.5.1 Potential Positive Impacts

The proposed Project seeks to provide an independent and reliable power supply to the Academy through solar energy source and thus, improve the quality of education and other services within the institution as there will be longer hours available with better illumination for studying. Ultimately, the activities of the project will contribute to the achievement of Nigeria's carbon emission reduction targets (20% reduction by the year 2030) in fulfilment of the nation's Nationally Determined Contributions (NDC) to climate change. The positive impacts' significance is thus considered **high.**

Within the project area, there will be reduced noise and pollutants from generator sets, and natural habitats and human health will be protected from pollution arising from the use of fossil fuels. The renewable energy training centre constructed during the project implementation will provide capacity development through learning renewable energy technologies and practices in the University and consequently, the certification of trained individuals. The positive impacts' significance is thus considered **moderate.**

The installation of streetlights as part of the proposed Project will improve safety by reducing hazards associated with flammable fuels and candles and enhance security within the school. The positive impacts' significance is thus considered **moderate.**

In addition, the project will improve social cohesion and community development and generate new income as it would stimulate economic activities and offer new opportunities for small businesses in the University premises. The employment opportunities for skilled, semi-skilled, and unskilled labour associated with the project will multiply job creation, especially during construction to facilitate overall socioeconomic development. The positive impacts' significance is thus considered **moderate.**

5.5.2 Potential Negative Impacts

The potential adverse impacts from project activities are grouped into the following subjects and discussed further according to the different applicable phases – Preconstruction, Construction, Operation and Decommissioning phase:

- Land use
- Impacts from equipment, personnel and plant material movement;
- Impact on traffic;
- Impact on air;
- Impacts from noise and vibration;
- Impacts on terrestrial flora and fauna;
- Impact on water resources
- Impacts on waste generation;
- Impact on soil quality;
- Visual/ aesthetic impact;

- Social economic impacts;
- Health impacts; and
- Impacts from workplace hazards.

5.5.2.1 Pre-construction and Mobilization Phase

The pre-construction phase of the proposed Project includes the following activities:

- Site selection
- Site clearing and preparation
- Mobilization of equipment, materials and personnel to site

Site selection

No additional land either from private or public property outside the University campus will be expropriated for the Project. The Project site is characterized by farmlands (covering approximately 20% of the land) and vegetation which includes grass, shrubs, and a few trees. There are no physical structures on the site. The farmlands are cultivated by staff of school. It was gathered from the University management that the farms plots are usually allocated to staff for short periods or seasonal farming.

Though the management specifies that land is always available for farming for staff, and the land uptake will not pose a risk to the secondary income or food source for the staff, the land take for the project will however result in loss of access to land for the staff pending reallocation to other land areas. Thus, the impact significance of site selection for the proposed Project on the existing land use is rated moderate.

Site Clearing and Preparation

The project site will be cleared of vegetation prior to construction activities. The site clearing activities would involve the use of earth-moving equipment such as tractor. The potential impacts associated with the site clearing activities are discussed as follows:

Potential Impact on Terrestrial Flora and Fauna

Site clearing activities associated with the proposed Project will lead to loss of terrestrial flora on the Project site. The potential impact on the terrestrial flora is considered to be negative, direct, site specific and largely irreversible. The impact magnitude is considered to be medium considering that not all the land area will be cleared for the Project. However, the sensitivity /importance of the receptor is regarded as low since the Project site is a modified habitat, and none of the plant species identified within the Project site during the baseline survey was found to be endangered or threatened based on the International Union for Conservation of Nature (IUCN)-2018 classification scheme. Also, the local community has no direct or indirect ecosystem services that they benefit from the site. Furthermore, there are no protected/conservation areas within the site. The significance of the potential impact of site clearing on the existing terrestrial flora species of the Project site is therefore regarded as minor.

While the plant species are unable to avoid the point of impact, most fauna species may be able to migrate away from unfavourable areas. Animals are generally mobile and, in most cases, can move away from a

potential threat. The tolerance levels of some animal species are of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact.

About the clearing of the Project site prior to the construction phase, the potential impact on terrestrial fauna species may include loss of individual or localized population of fauna species or disturbance to avifauna species. This is unlikely to lead to a change in conservation status of the species since none of the fauna species (including avi-fauna) encountered or reported in the project site belongs to the IUCN classification of threatened animal species which include those classified as critically endangered, endangered or vulnerable. The sensitivity of the fauna species recorded on the Project site is thus regarded as **low**. The impact magnitude is considered to be **low** given that the site clearing activities would cover approximately 12.8 ha of land allocated for the Project. The potential impact is direct, irreversible, short term and localized. The impact significance is thus considered **minor**.

Potential Impact on Soil

The proposed site clearing and preparation activities could potentially impact on the soil environment of the Project site. The potential effects on soil include degradation due to site preparation e.g. compaction of soil as a result of the movement of earth moving equipment. Soil degradation is the removal, alteration, or damage to soil and associated soil forming processes, usually related to human activities. The stripping of vegetation or disturbance to the natural ground level over disturbance areas will negatively affect soil formation, moisture levels, soil density, soil chemistry, and biological activity. Uncontrolled site clearance of vegetation could lead to direct surface soil exposure and hence erosion of soil which could be significant.

The impact magnitude is considered as **medium** as the extent of soil erosion could be high, especially if the site clearing activities are carried out in the wet season. However, based on the results of laboratory analysis conducted on soil samples from the Project area, the Project site is not considered to be significantly prone to land-based erosion. Thus, the impact and significance of site clearing on soil environment of the study area is considered **minor**.

Potential Impact on Air Quality and Ambient Noise

The pollutants which could impair air quality during site clearing activities are particulate matter in form of dust, and NOx, CO, Total Suspended Particulates (TSP), SOx from combustion engines of the earth-moving equipment that will be used for clearing. Intermittent noise emissions could also occur from the operation of the machinery. The impact magnitude is considered to be low since the activities will be short-term, intermittent, localized and reversible. The site clearing activities will take less than 1 week. The sensitivity of the airshed of the Project area is also regarded as low based on the results of air quality measurements conducted in the area during the field data gathering. The impact significance of site clearing on the ambient air environment of the Project site is considered to be **minor**.

Potential Impact on Workers Safety

Site clearing and preparation are potentially hazardous activities. Accidents may occur especially when those involved are unskilled. Such accidents may result in loss of man-hours, which may ultimately affect the schedule date of completion of the Project development, especially if the man-hour losses are high. The

site clearing activities will take about 1 week and the number of workers required will be less than 10. The impact significance is considered to be **minor**.

Mobilization of equipment, materials and personnel to site

In executing the proposed project, a great deal of haulage/ movement would be undertaken all through the phases of the project. Movements would include transportation of equipment and personnel for construction and operational phases; and movement of plant components to project site for construction and installation. Anticipated impacts during the mobilization of equipment and personnel to site will include:

Potential Impact on Air Quality and Ambient Noise

Construction equipment and materials will be moved to the Project site prior to the commencement of main construction activities. The potential biophysical impacts associated with the mobilization activities include decrease in ambient air quality of the Project area as a result of emissions from vehicles that will convey materials and equipment to site.

It is anticipated that the potential impacts will be similar to those experienced during site clearing activities. The capacity for assimilation of vehicular emissions and dust associated with the mobilization activities in the Project's AoI is considered to be high. The overall impact significance of mobilization activities on the ambient air quality and noise of the Project area is rated **minor**.

Potential Impact on Infrastructure (Road) Regarding safety along the project route, the mobilization activities during the preconstruction phase of the Project could increase the traffic volume in the Project area (and potential for road accident) as a result of movement of vehicles in and out of the Project site. The social aspects of these activities could lead to accidents, traffic congestion and annoyance from other road users in the area. The magnitude of the impact is considered low since the mobilization activities would be within 1 week. The sensitivity of the receptors is judged as medium given that the existing vehicular movement in the University environment is high. The prominent means of transportation are cars, motorcycles/tricycles, and buses/trucks. The impact significance is considered to be **minor**.

Potential Impact on Workers Safety

Mobilization of construction materials will involve offloading of heavy consumables such as cement, gravel, etc. Injuries and accidents may occur especially when those involved are unskilled. It is expected that the potential impacts will be similar to those experienced during site clearing and preparation activities. The impact significance is **minor**. Table 5.8 summarizes the potential impacts associated with the pre-construction phase of the proposed Project.

Table 5. 8: Potential Negative Impacts Associated with the Pre- Construction Phase of the proposed Project

Activity	Receptor	Associated Impact	Significance
Site Selection/ land	Existing crop farming on site	• Loss of land for farming activities due to land Take for the Project	Moderate
Site clearing	Terrestrial flora	• Vegetation loss	Minor

and preparation	and fauna	• Direct impacts on vegetation and soil-dwelling organisms; indirect impacts on fauna species in the immediate surroundings of the Project site	
	Soil	• Loss of topsoil • Soil compaction and degradation • Increased erosion potential • Reduction in structural stability and percolative ability of soil	Minor
	Air Quality and Noise	• Air quality impacts due to emissions from site clearing equipment • Increase in ambient noise levels	Minor
	Workers Safety	• Injuries and accidents to workers during site clearing and preparation.	Minor
Mobilization of construction equipment and materials to site	Air Quality and Noise	• Air quality impacts from vehicular emissions (TSP, NOx, CO, SOx) • Increase in noise levels	Minor
	Infrastructure (road)	• Increase in vehicular movement and traffic including potential for road accident	Minor
	Workers Safety	• Injuries and accidents to workers during loading and offloading of construction materials.	Minor

5.5.2.2 Construction Phase

The construction phase of the proposed Project will include activities such as civil and electrical works (excavation, trenching, concrete mixing, etc.), installation of PV panels and associated components; construction of training centre; installation of streetlights, upgrade of existing electricity distribution infrastructure; and waste generation and disposal.

The potential environmental and social impacts associated with the construction phase of the proposed Project are assessed and discussed as follows:

Equipment, Personnel and Plant Material Movement

As part of the construction phase, personnel and materials would be transported to site on need basis. Transportation could be from workers or visitors to the site. Vehicles to be deployed for construction purposes would include saloon, SUVs and heavy-duty vehicles (such as trucks, excavators, etc).

Movement of vehicles during this phase is important and cannot be avoided as such would impact significantly on the environment as well as on people living within the area in the following ways:

- Vehicular emission of pollutant gases (such as CO, SO2 and NO2) from vehicle exhaust;
- Contribution to global gas warming and ozone layer depletion from pollutant gases emitted from vehicles;
- Increased traffic movement of heavy-duty truck en-route project site;
- Potential accident to personnel and asset from vehicle movement during construction; and
- Dust emission arising from construction activities at the project site.

The impact from equipment, personnel and plant material movement on surrounding receptors is therefore considered to be of moderate significance prior to mitigation and steps will be taken to minimize the effects.

Civil and Electrical Works, and Installation of Plant Facilities

Potential Impact on Air Quality

At installation and construction phases of the project, the potential sources of emissions would include dust, particulate matter (PM), emissions from heavy trucks and earthmoving equipment that will be operated on the project site. Exhaust emissions during material transportation, stockpiling and equipment transfer during construction activities. It is proposed that the construction phase of the Project would take up to 12 months. These emissions will be localized to the construction site area and will be short-term, the extent of impact would therefore be **medium** and its significance is rated **minor**

Potential Impact on Noise Levels

The primary short-term noise and vibration impacts are associated with construction and decommissioning activities. During construction activities, work equipment will result in increased noise level and vibration in the area, although noise would not cause a major disturbance to its surroundings. The potential source of noise during the construction phase of the Project includes civil work and installation activities, vehicular movement and operation of construction equipment may lead to elevated noise levels beyond the baseline concentration. Noise may cause a major disturbance to fauna species such as birds and mammals in the area.

These would move further into the forest to avoid the disturbance.

The noise levels from construction activities would be intermittent and localized and are not envisaged to result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location. The potential impact magnitude is regarded as low due to the envisaged low extent of its effect. The overall impact significance is considered minor.

Potential Impact on Soil

The proposed construction activities will include excavation, loosening of soil, stockpiling, mixing, filling, etc. These activities can directly impact soil environment negatively contributing to soil degradation and possibly accelerated erosion.

Soil environment of the Project site could be impacted in terms of removal of topsoil and soil compaction, reduction in structural stability and percolative ability of soil, loss of soil dwelling organisms resulting from

compaction during excavation activities, installation of PV panels, mounting structures, and 11kv underground cable. These activities also have the potential to increase siltation as a result of accelerated erosion. The impact magnitude is considered to be **medium** considering the number of PV panels to be installed and the distance for burial of the proposed underground cable from the Power Plant to the switchyard. The sensitivity of the soil environment in the Project area is regarded **medium** as the soil in the area is prone to erosion especially during the rainy season. Therefore, the impact significance is considered to be **moderate**.

Potential Impact on Terrestrial Flora and Fauna

The project would require the removal of clearing of vegetation to accommodate the power plant and ancillary structures. Increase in human activity, noise level, creation of areas of bare soil would create a resulting effect which would be the altering of the composition and diversity of flora species in the site as well as migration of fauna species that make use of the plants for food and shelter further away into the forest. Also, the disturbance associated with noise and movement of construction equipment and personnel at the Project site may deter bird species from the area and disrupt the breeding of avifauna. It may also lead to increased risk to species such as snakes, rodents and mammals. The sensitivity of the receptor is judged to be **low**. Based on desktop reviews and field observation, the project area is not known as a migratory route for avifauna species. The impact significance is regarded as **minor**.

Potential Impact on Groundwater

The construction activities for the Project could lead to potential impacts on Groundwater of the Project area. These include increased sediment load in the drainage channels as a result of erosion; increased stormwater runoff from a decrease in infiltration; increased runoff from hard standing areas which could result in creation of drainage lines. Groundwater may be impacted as a result of infiltration of contaminants associated with spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks.

There could also be decrease in amount of groundwater as a result of groundwater abstraction for project activities. It is planned that at least one borehole will be dug onsite to serve as source of water supply for the project activities. Currently, though there are boreholes within the University, there is no borehole on the project site. Also, the quality of the existing groundwater resources in the study area is considered to be good. It is not anticipated that construction activities will have any direct impacts on the underground aquifer in the project area. Therefore, the potential for groundwater contamination as result of construction activities is rated **minor.** The potential impact on the existing underground aquifer (water reserve) of the study area as a result of water abstraction for construction activities such as concrete mixing and washing of construction equipment is considered to be negligible because the activities are very minimal. There are several boreholes within the University campus as noted during the site visit. During the rainy season, the underground water aquifer increases; thus, boreholes yield improves significantly.

Potential impact on Gender

During construction activities, women may experience discrimination as most employment and training opportunities may be provided to men, while women will be left with menial jobs. This may result in marginalization thereby reinforcing gender stereotypes and gender pay gaps. In attempts to reduce the

gender knowledge gaps, select female students will undergo end-to-end onthe-job training and capacity building participating in the full construction activity.

Furthermore, there is the possibility that the proposed Project may increase the risk of GBV, as a result of shifting existing power dynamics and financial relationships. This is considered a minor risk as many women in the community are engaged in economic activities.

Potential Impact on Socio-economic and Health

Impacts associated with the construction phase of a project are usually of a short to medium term in nature but could have long term effects on the surrounding environment. During construction, the proposed Project has the potential to affect the University community and the nearby community.

With regard to the presence of construction workers on site, the manner in which the workers conduct themselves can affect the University environment and local community in terms of disruption of existing structures due to influx of people. The potential behaviour of workers, most especially male construction workers, may lead to an increase in levels of crime and drug and alcohol abuse, and an increase in incidence of casual sexual relations, which may result in increase in sexually transmitted disease (such as HIV/AIDS infections) and unwanted pregnancies.

Additional pressure may also be placed on existing social infrastructure. Considering that the proposed number of workers for the construction phase of the Project may be relatively high, the potential risk to social structures is regarded as high. However, given that the majority of the construction workers, especially unskilled labour force would be drawn from the local community, the impact significance is considered to be **moderate**.

Potential Impact on Infrastructure (Road)

It is envisaged that movement of personnel and equipment along the road leading to the University would increase once the project commences. The road is slightly busy during the day and as such may lead to intermittent traffic build up which may not last long with proper coordination. During the installation of street lights around the University campus, traffic flow might be obstructed along the road paths where the street lights will be installed if activities are improperly managed. Construction activities may result in a significant increase in movement of vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents. The impact magnitude is considered as **low** due to the minimal number of Project vehicles and trucks to be used during the construction phase. Therefore, the impact significance is considered **minor**.

Potential Impact on Construction Workers Safety

Construction sites are potentially hazardous place. Occupational accidents may occur especially when those involved are unskilled. Such occupational accidents may result in loss of man-hours which may ultimately affect the schedule date of completion of the Project development especially if the man-hour losses are high. Potential impacts to construction workers include increase in noise level and air emissions from construction activities, injuries, electrical shocks, accident, and denial of rights. The impact significance is considered **moderate**.

Waste Generation and Disposal

Wastes from the project are grouped into solid wastes, liquid (wastewater) and air emissions. Solid wastes would include; wood, metals, food remains, glass, and refuse etc. Liquid wastes include sewage, while gaseous air pollutants (NO_x, SO_x and CO) would be from exhaust of vehicles. It should be noted however that during their normal operation PV systems emit no gaseous or liquid pollutants, and no radioactive substances.

Potential Impact on Soil

The proposed construction activities will lead to the generation of wastes. Improper handling of these wastes or their discharge into the surrounding environment without proper treatment would increase the level of micro-organisms (bacteria, viruses and fungi) that could be pathogenic to staff working in the area. The potential construction waste to be generated include scrap metals, electrical cables, spent oils, wood/planks, paper waste, leftover sand and gravel, etc. The impact magnitude of the waste on the soil is considered to be **low**. Thus, the impact significance is considered to be **minor**.

Potential Impact on Groundwater

Groundwater may be impacted as a result of infiltration of contaminants associated with liquid wastes especially from spent oils. The impact magnitude is considered low. The impact sensitivity is **medium** because groundwater is a major source of potable water within the Project AoI. The potential for groundwater contamination as result of waste disposal is rated **minor**. Table 5.9 summarizes the potential negative impacts associated with the construction phase of the proposed Project.

Table 5.9: Potential Negative Impacts Associated with the Construction Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance
Movement of Equipment, Personnel and Plant Materials	Air Quality	• Vehicular emissions (CO, SO_2, NO_2) from exhaust • Contribution to global warming and ozone layer depletion • Dust emissions from construction activities	Minor
	Social System (Road)	• Increased traffic from heavy-duty trucks en route to project site	Minor
	Health & Safety	• Risk of accidents involving personnel and assets due to vehicle movement	Minor
Civil and Electrical Works / Installation Activities	Air Quality	• Emissions from construction equipment (SPM, NOx, CO, SOx) • Dust from land clearing and stockpiles	Minor
	Ambient Noise	• Increased noise levels from construction activities	Minor
	Soil	• Increased erosion from excavation	Moderate

Activity	Receptor	Associated Impact	Significance
		• Reduced soil stability and permeability due to compaction	
	Terrestrial Flora and Fauna	• Loss of plant species due to invasive species • Loss of fauna due to human activity and noise	Minor
	Groundwater	• Depletion of groundwater from abstraction (e.g., concrete mixing, washing) • Increased sediment load from erosion • Increased runoff and drainage formation from hard surfaces	Minor
	Gender	• Potential discrimination against women and GBV risks	Moderate
	Socio-economic & Health	• Influx of people leading to increased risk of sexually transmitted diseases	Moderate
	Infrastructure (Road)	• Road damage, traffic congestion, and safety concerns	Minor
	Construction Workers Safety	• Risk of injury during construction activities	Moderate
	Soil	• Soil contamination from construction waste (solid and liquid)	Minor
Waste Generation and Disposal	Groundwater	• Contamination from liquid construction waste streams	Minor
	Infrastructure (Waste Management Facility)	• Disposal of waste at existing facilities in project area	Negligible

5.5.2.3 Commissioning Phase

Once the construction phase of the Solar Power Plant is completed, the Plant will be tested to ensure that it has been installed according to the pre-design and operational requirements.

Potential Impact on Noise

During the Plant commissioning, there could be increase in noise level due to humming noise emission from the Plant components (inverters and batteries), vehicular movement (transportation of commissioning officials), public address system, crowd noise, and other ceremonial activities. The impact significance is however rated **minor**.

Potential Impact on Safety

Also, there is potential for occupational hazards during Plant testing as a result of any wrong electrical connection. The impact significance is considered to be **moderate** on the workers' health and safety.

However, the potential hazard to the public during the commissioning activities could be electrical shocks from exposure to wrong electrical connections. This is considered to have a **minor** impact on the general public.

Potential Impact on infrastructure (road)

The commissioning phase will lead to an influx of guests and officials which will have an impact on the population and infrastructure (road). Due to the short duration of the commissioning phase (1 day), the impacts are considered to be **negligible**. Table 5.10 summarizes the potential negative impacts associated with the commissioning phase of the proposed Project.

Table 5. 10: Potential Impact Associated with the Commissioning Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance
Plant Testing	Ambient Noise	• Increase in ambient noise levels during testing activities	Minor
	Workers	• Occupational health and safety hazards (e.g., injuries, electrocution) due to incorrect electrical connections	Moderate
	Campus Occupants' Safety	• Risk of electrocution from wrong electrical connections	Minor
	Population Influx	• Temporary increase in population during commissioning phase	Negligible
	Infrastructure (Road)	• Increased traffic and risk of road accidents	Negligible

5.5.2.4 Operational Phase

Power Generation and Distribution

Potential Impact on Noise

The potential sources of noise during the Power Plant operations are inverters and batteries. Typically, the designed noise level from an inverter is approximately 30- 35 dB(A) while that of a battery is 15-20 dB(A). The associated noise levels from the inverters and batteries are not envisaged to result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location offsite. The impact significance is considered to be **negligible**.

Potential Impact on Gender

Women have conventionally been under-represented in the energy sector; they are often marginalized from many power sector employment and training opportunities. There is a potential that this situation may come to play during the operations phase of the Project as women experience discrimination may be denied training and employment opportunities. Male and female staff will be trained on the management and maintenance of the facility.

Although the number of personnel working at the Project site would reduce, the likelihood of impacts predicted during the construction phase may exist. Therefore, the impact significance is regarded as **minor.**

Potential Impact on Socio-economic and Health

The potential negative impacts on the socio-economic environment (community health and safety) during the operational phase of the Project are related to visual impact and the generation of electromagnetic field (EMF) radiation.

For visual impact, the Project site is not known to be a tourist route or to have any special scenic characteristics, hence it has a limited potential for visual impacts on the receiving environment. However, the facility (primarily the PV panels) will be visible during operation.
The impact significance is considered **negligible.**

Regarding EMF radiation, Solar PV panels, inverters, batteries, and other components that make up solar PV arrays produce extremely low frequency EMF when generating and transmitting electricity. Thus, the potential impact of EMF radiation from the proposed Solar
Power Plant on community health and safety is considered to be **negligible**.

Potential Impact on Occupational Health, Safety and Welfare of Workers
During the Plant operation, workers may be exposed to occupational health and safety issues (e.g. electrical and field exposure, shock hazards and mechanical injuries) including work related issues such as discrimination, denial of rights, unfair treatment, poor working conditions etc. The impact significance is considered to be **moderate** primarily due to the low number of staff (approximately 10) required for operation.

Routine Maintenance, Waste Generation and Disposal

Potential Impact on Soil

Routine maintenance of the Plant will lead to the generation of wastes which can contaminate the soil within the Project site and AoI. The major waste stream will be e-waste generated from spent/damaged components of the Project such as batteries, inverters and PV panels. These wastes will be stored within the Project site according to the manufacturer's instructions. All components to be used for the Project will have buy back agreements with the manufacturers as specified in the Extended Producer Responsibility Program (EPRP). The impact significance is considered to be **minor**.

Potential Impact on Groundwater

Potential impacts may include decrease in amount of groundwater reservoir as a result of water abstraction for cleaning of the PV panels. Cleaning of the PV panels is envisaged to be carried more during the dry season than in the rainy season.

Based on previous experience, each MW of panels would require approximately 5 litres of water per cleaning cycle. The water required for cleaning purposes would be obtained from the boreholes proposed to be dug at the project site. Based on observations noted during the field survey and the estimated quantity of water required for occasional cleaning of the PV

panels, water abstraction for the Project is not envisaged to have serious effect on the existing groundwater aquifer of the Project area as well as the local water use. Thus, the impact significance is considered **minor**.

Potential Impact on Occupational Health, and Safety of Workers

During routine maintenance, workers may be exposed to occupational health and safety issues (e.g. electrical and field exposure, shock hazards and mechanical injuries). The impact significance is considered to be **minor** primarily due to the low number of staff (approximately) required for maintenance activities and low frequency of maintenance. Table 5.11 summarizes the potential negative impacts associated with the operational phase of the proposed Project.

Table 5. 11: Potential Negative Impacts Associated with the Operational Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance
Power Generation and Distribution	Noise	• Noise from batteries and inverters during power generation and evacuation	Negligible
	Gender	• Discrimination of women during employment • GBV (sexual harassment, assault, poor working conditions)	Minor
	Socio-economic (Visual)	• Landscape alterations causing unpleasant visual changes in the area	Negligible
	Socio-economic (Health Issues)	• Community health and safety concerns due to electromagnetic field (EMF) radiation	Negligible
	Health, Safety and Welfare of Staff (Plant Operation)	• Electric shock and injuries during plant operation • Work-related issues (discrimination, denial of rights, unfair treatment, poor working conditions)	Moderate
Routine Maintenance	Soil	• Soil contamination from spent batteries and inverters	Minor
	Groundwater	• Groundwater abstraction from cleaning of PV panels	Minor
Waste Generation and Disposal	Soil & Groundwater	• Soil and groundwater contamination from waste streams	Negligible
	Health, Safety and Welfare of Staff (Maintenance)	• Electric shock and injuries during maintenance activities	Minor

5.5.2.5 Potential Cumulative Impacts

Cumulative impacts are those impacts resulting from the combined effects of past, present or reasonably foreseeable actions owing to the project aspects and activities outside the project (GSI, 2003). The concept of cumulative effects is an important one. It holds that, while impacts may be small individually, the overall impact of all environmental changes affecting the receptors taken together can be significant. When a resource is nearing its tolerance threshold, a small change can push it over.

The major existing activities around the Project area are seasonal farmlands. The nature of the activities associated with the proposed Project and the existing activities around the project area, the potential cumulative impacts of the Project on road traffic, ambient noise levels and groundwater availability is considered **low**.

5.6 Risk and Hazard Assessment

5.6.1 Project Specific Risks and Hazards

The potential risks and hazards associated with the proposed project are:

5.6.1.1 Fire and Explosion

The major risk associated with the operation of the plant is fire and explosion because PV systems are subject to electrical faults like other electrical installations such as short circuits, ground faults and reverse currents. Failures within the plant system could cause hotspots that can ignite nearby combustible materials. Faulty installations or failure with DC/AC inverters can also cause photovoltaic fires. Overcharging, high temperatures and physical stress to Lithium-ion battery cells can cause thermal escape, which commonly leads to the destruction of the battery, fire and even explosions. In addition, deep discharge can also cause battery fires. Any outbreak of uncontrolled fire in the area can escalate to dangerous dimensions which could be critical. Thus, this hazard is classified as high risk.

5.6.1.2 Electrocution

Electrocution from direct contact with high-voltage electricity or tools, vehicles, ladders, and other devices that are in contact with high-voltage electricity could occur during the plant operation. This hazard is hardly likely to occur, and it is of minimally severe consequence and is thus classified as moderate risk.

5.6.1.3 Occupational Hazards

During construction, workers carrying out activities at heights could be exposed to occupational hazards. Electrical accidents may also result in shocks and/or burns, muscle contractions, and traumatic injuries associated with falls after the shock. This hazard is fairly probable although its severity is considered minimal thus it is classified as moderate risk.

CHAPTER SIX
MITIGATION MEASURES

6.1 Introduction

This chapter presents the mitigation measures proffered for the associated and potential impacts of the proposed solar-based power plant project. A comprehensive risk assessment matrix, as indicated in Figure 6.1, was used to determine the mitigation requirements for each of the impacts identified. The frequency, severity, sensitivity, scale, longevity, political, economic, legal, reputation/ image, and communication/complaints were factors taken into consideration during these assessments.

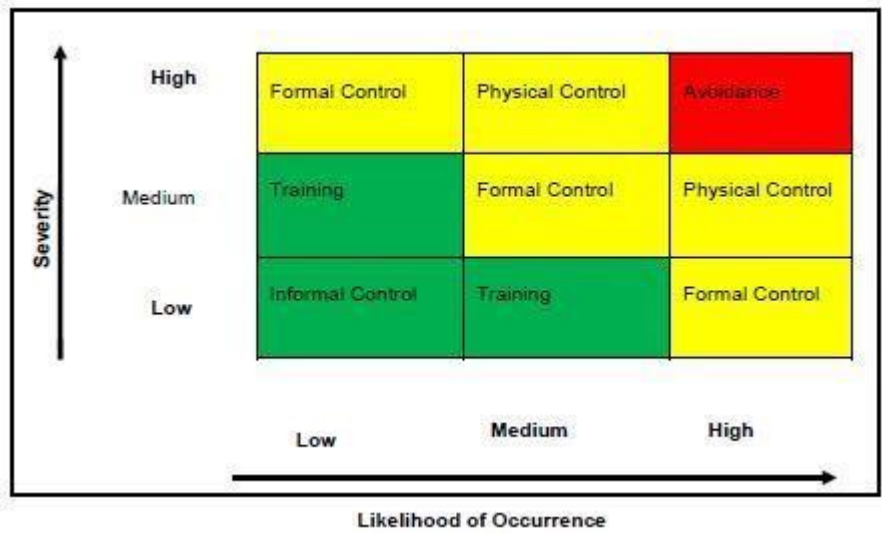

Figure 6. 1: Matrix for Determination of Mitigation Measures

(Source: www.researchgate.net/risk assessment matrix)

Mitigation measures designed to prevent, reduce or control the adverse impacts of the environmental and social aspects of the proposed project to as low as reasonably practicable were considered and documented in this chapter of the report. Subsequently, the specific mitigation measures satisfying the mitigation requirement were established, putting the following into consideration:

- Available resources and competencies.
- On-site conditions; and
- Public concerns and technology.

6.2 Mitigation Measures and Approach

Mitigation refers to measures or interventions necessary to avoid, minimize, reduce, or offset adverse impacts. The approach, as indicated in Table 6.1 for selecting appropriate mitigation measures, includes:

- Anticipate and avoid risks and impacts.
- Where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels.
- Once risks and impacts have been minimized or reduced, mitigate.

- Where significant residual impacts remain, compensate or offset them, where technically and financially feasible.

In proffering mitigation measures for the various negative impacts identified in the previous chapter, preference was given to avoidance or prevention of adverse impacts, which were not feasible. Measures that are practicable and cost-effective using best available technology were suggested to reduce and/or minimize the impacts, while rehabilitation, restoration or compensation was considered as the last resort. The implementation of the proffered mitigation measures highlighted in Table 6.2 are of negligible to minor significance. There are no potential long-term impacts associated with the Project that cannot be mitigated to acceptable levels of residual impact. Table 6. 1 presents the Mitigation Measures for the Potential Negative Impacts of the Proposed Project

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Table 6. 1: Mitigation Measures for the Pre-construction phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Site Selection / Land Take	Existing Crop Farming	• Loss of land for farming activities	Moderate	REA shall; • Avoid high-value agricultural land where possible (site optimization) • Provide fair and prompt compensation in line with World Bank ESS5 standards • Implement Livelihood Restoration Plan (LRP) • Engage affected communities through consultation and participation	Minor
Site Clearing & Preparation	Terrestrial Flora & Fauna	• Vegetation loss • Direct and indirect impacts on fauna	Minor	REA shall: • Minimize clearing footprint to only required areas • Pre-clearance ecological surveys and species relocation where necessary • Avoid clearing during breeding seasons • Implement biodiversity management plan	Negligible
	Soil	• Loss of topsoil • Soil compaction and erosion • Reduced soil stability and permeability	Minor	REA shall: • Strip and store topsoil for later reuse (rehabilitation) Restrict movement of heavy machinery to designated routes • Implement erosion control measures (mulching, silt fences) • Progressive site restoration	Negligible
	Air Quality & Noise	• Emissions from equipment • Increased noise levels	Minor	REA shall: • Regular maintenance of machinery to reduce emissions • Use dust suppression methods (water spraying) • Limit work to daytime hours • Provide noise control measures and PPE (ear protection)	Negligible
	Workers Safety	• Injuries and accidents during site clearing	Minor	REA shall:	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
				• Implement Occupational Health & Safety procedures aligned with International Labour Organization standards • Provide PPE (helmets, gloves, boots) • Conduct safety training and toolbox talks • Supervision and enforcement of safety protocols	
Mobilization of Construction Equipment & Materials	Air Quality & Noise	• Vehicular emissions (TSP, NOx, CO, SOx) • Increased noise levels	Minor	REA shall: • Maintain vehicles regularly to meet emission standards • Optimize logistics to reduce trips • Enforce speed limits and idle-time reduction • Use low-sulfur fuels where possible	Negligible

Table 6.2: Mitigation Measures for the Construction Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Movement of Equipment, Personnel & Materials	Air Quality	• Vehicular emissions (CO, SO_2, NO_2) • Dust emissions	Minor	REA shall: • Regular vehicle maintenance and emission checks • Use of low-sulfur fuels and efficient engines • Dust suppression (water spraying, covering trucks) • Limit vehicle idling and enforce speed limits	Negligible
	Social System (Road)	• Increased traffic from heavy-duty trucks	Minor	REA shall: • Implement Traffic Management Plan • Schedule deliveries during off-peak hours • Use designated haulage routes • Community awareness and signage	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
	Health & Safety	• Risk of accidents due to vehicle movement	Minor	REA shall: • Driver training and certification • Speed control and enforcement • Vehicle inspection and maintenance • Use of warning signs and traffic marshals	Negligible
Civil & Electrical Works / Installation	Air Quality	• Emissions from equipment • Dust from land clearing and stockpiles	Minor	REA shall: • Maintain construction equipment regularly • Dust suppression measures (watering, covering materials) • Limit activities during high winds • Provide PPE (respirators where necessary)	Negligible
	Ambient Noise	• Increased noise levels	Minor	REA shall: • Restrict noisy activities to daytime hours • Use well-maintained equipment with silencers • Provide hearing protection to workers • Establish buffer zones near sensitive receptors	Negligible
	Soil	• Erosion from excavation • Soil compaction and reduced permeability	Moderate	REA shall: • Implement erosion and sediment control measures (silt fences, drainage control) • Limit heavy machinery movement to designated areas • Progressive rehabilitation and re-vegetation • Proper site grading and drainage design	Minor
	Terrestrial Flora & Fauna	• Loss of plant species (invasive species risk) • Disturbance to fauna	Minor	REA shall: • Control and monitor invasive species • Minimize vegetation clearing • Restrict worker movement to designated areas • Implement biodiversity management plan	Negligible
	Groundwater	• Depletion from abstraction	Minor	REA shall: • Use water-efficient construction practices	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
		• Increased sediment load and runoff		• Obtain abstraction permits and monitor usage • Install sediment traps and proper drainage systems • Avoid contamination of water sources	
	Gender	• Discrimination and GBV risks	Moderate	REA shall: • Develop and implement Gender Action Plan and GBV Action Plan aligned with World Bank guidelines • Code of conduct for workers • Awareness training and strict sanctions • Confidential grievance redress mechanism	Minor
	Socio-economic & Health	• Spread of STDs due to influx of workers	Moderate	REA shall: • Community health awareness programs • Provide access to healthcare services and testing • Enforce worker codes of conduct • Collaborate with local health authorities and NGOs	Minor
	Infrastructure (Road)	• Road damage, congestion, safety issues	Minor	REA shall: • Traffic and logistics management plan • Routine road maintenance and repairs • Use appropriate vehicle sizes and loads • Coordination with local authorities	Negligible
	Construction Workers Safety	• Risk of injury during construction	Moderate	REA shall: • Implement Occupational Health & Safety system (aligned with International Labour Organization standards) • PPE provision and enforcement • Safety training, supervision, and emergency preparedness • Regular audits and incident reporting	Minor
	Soil	• Soil contamination from construction waste	Minor	REA shall: • Proper waste segregation and storage	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
				• Use lined containment areas for hazardous waste • Spill prevention and response plan • Disposal through licensed contractors	
Waste Generation & Disposal	Groundwater	• Contamination from liquid waste streams	Minor	REA shall: • Treat wastewater before discharge • Use impermeable liners for storage areas • Regular inspection of waste systems • Compliance with environmental standards	Negligible

Table 6.3: Mitigation Measures for the Installation Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Plant Testing	Ambient Noise	• Increase in ambient noise levels during testing activities	Minor	REA shall: • Restrict testing to daytime hours • Use well-maintained equipment with noise suppression features • Notify nearby occupants in advance • Provide hearing protection (PPE) to workers	Negligible
	Workers	• Occupational health and safety hazards (injuries, electrocution due to incorrect connections)	Moderate	REA shall: • Implement strict electrical safety procedures (lockout/tagout systems) • Ensure only certified personnel handle electrical connections • Provide appropriate PPE (insulated gloves, boots) • Conduct pre-commissioning safety checks and supervision • Emergency response and first aid readiness	Minor
	Campus Occupants' Safety	• Risk of electrocution from wrong electrical connections	Minor	REA shall: • Secure and restrict access to testing areas • Install warning signage and physical barriers • Ensure proper grounding and insulation of systems	Negligible

				• Supervise all testing activities closely	

Table 6.4: Mitigation Measures for the Operational Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Power Generation & Distribution	Gender	• Discrimination of women during employment • GBV (sexual harassment, assault, poor working conditions)	Minor	REA shall: • Implement Gender Action Plan and GBV prevention measures aligned with World Bank guidelines • Enforce equal opportunity employment policy • Worker code of conduct and regular training • Establish confidential grievance redress mechanism	Negligible
	Health, Safety & Welfare of Staff (Plant Operation)	• Electric shock and injuries • Workplace discrimination and unfair treatment	Moderate	REA shall: • Implement Occupational Health & Safety (OHS) system in line with International Labour Organization standards • Install lockout/tagout (LOTO) systems and safety signage • Provide appropriate PPE (insulated gloves, boots, etc.) • Conduct routine safety training and audits • Enforce fair labor practices and worker rights policies	Minor
Routine Maintenance	Soil	• Soil contamination from spent batteries and inverters	Minor	REA shall: • Store hazardous materials in sealed, labeled containers • Implement hazardous waste management plan	Negligible

				• Use certified waste handlers for disposal/recycling • Install secondary containment and spill response systems	
	Groundwater	• Groundwater abstraction from cleaning PV panels	Minor	REA shall: • Use water-efficient or dry-cleaning technologies • Harvest and reuse rainwater where feasible • Monitor abstraction rates and comply with permits • Adopt water conservation measures	Negligible
Waste Generation & Disposal	Health, Safety & Welfare of Staff (Maintenance)	• Electric shock and injuries during maintenance	Minor	REA shall: • Enforce electrical isolation procedures (LOTO) • Provide PPE and insulated tools • Conduct competency-based training • Routine inspection and supervision of maintenance work	Negligible

Table 6.5: Mitigation Measures for the Decommissioning Phase

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Dismantling of Plant & Equipment	Air Quality	• Dust emissions from dismantling activities • Emissions from machinery and vehicles	Minor	REA shall: • Apply dust suppression measures (water spraying) • Use well-maintained, low-emission equipment • Cover trucks transporting materials • Limit unnecessary idling of machinery	Negligible
	Ambient Noise	• Increased noise from dismantling activities	Minor	REA shall: • Restrict activities to daytime hours • Use equipment fitted with silencers • Provide hearing protection (PPE) to workers	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
				• Notify nearby communities in advance	
	Workers Safety	• Injuries from equipment dismantling • Risk of electrocution	Moderate	REA shall: • Implement Occupational Health & Safety procedures aligned with International Labour Organization standards • Apply lockout/tagout (LOTO) systems before dismantling • Provide appropriate PPE (helmets, gloves, insulated gear) • Ensure only trained personnel handle electrical components • Emergency preparedness and supervision	Minor
Removal of Foundations & Civil Works	Soil	• Soil disturbance, erosion, and compaction	Minor	REA shall: • Minimize excavation footprint • Implement erosion and sediment control measures • Reuse and reinstate topsoil • Progressive rehabilitation of disturbed areas	Negligible
	Groundwater	• Potential contamination from spills and exposed materials	Minor	REA shall: • Proper storage and handling of fuels and chemicals REA shall: • Spill prevention and response plans • Avoid discharge of contaminants into soil and water • Regular inspection of work areas	Negligible
Waste Generation & Disposal	Soil & Groundwater	• Contamination from hazardous and non-hazardous waste	Moderate	REA shall: • Implement comprehensive waste management plan (segregation, recycling, disposal) • Use licensed waste contractors • Store hazardous waste in secure, labeled containers with secondary containment	Minor

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
				• Comply with national and international waste regulations	
	Infrastructure (Waste Facilities)	• Increased burden on existing waste management systems	Minor	REA shall: • Coordinate with approved waste facilities • Schedule waste transport efficiently • Promote recycling and material recovery (e.g., metals, panels)	Negligible
Transportation of Decommissioned Materials	Air Quality & Noise	• Emissions and noise from haulage vehicles	Minor	REA shall: • Maintain vehicles to reduce emissions • Optimize transport logistics • Enforce speed limits and reduce idling • Use designated transport routes	Negligible
	Infrastructure (Road)	• Traffic congestion and road safety risks	Minor	REA shall: • Implement Traffic Management Plan • Use trained drivers and road signage • Schedule transport during off-peak hours • Repair any road damage caused	Negligible
	Community Health & Safety	• Risk of accidents involving local communities	Minor	REA shall: • Community awareness programs • Install warning signs and barriers • Escort oversized loads where necessary • Enforce strict safety protocols	Negligible
Site Restoration & Rehabilitation	Terrestrial Flora & Fauna	• Loss of habitat prior to restoration	Minor	REA shall: • Re-vegetate using native species • Restore natural habitat conditions • Monitor ecological recovery • Prevent introduction of invasive species	Negligible
	Socio-economic	• Temporary loss of employment after project closure	Moderate	REA shall: • Develop worker transition and livelihood restoration programs • Provide skills training and job placement support • Engage stakeholders early on closure plans	Minor

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Introduction

This section deals with the set of mitigation management measures to be taken to avoid, reduce, mitigate or compensate for adverse environmental, occupational and social impacts with the institutional arrangement, monitoring schedule, parameters to be monitored and soon including tentative monitoring budget. It includes the following aspects:

- Types of Impacts and their Mitigations
- Mitigation Measures
- Environmental Code of Conduct/ Practices (to be attached to bidding documents and/ or contracts)
- Monitoring Plan
- Communication and Documentation
- Cost of ESMP
- Integration with Project (contract clauses, others)
- Grievance Resolution Process
- Plan for stakeholder/ community engagement during pre-construction, construction, and operation phases; the plan should include a community mobilization approach from both social and commercial perspectives.

Further to the impacts assessed in the previous chapter, this section presents more detailed mitigation measures and monitoring requirements that correspond to the impacts examined in the previous section, thus exploring them in more detail. Mitigation measures aim to offset any negative impacts that may result from the project, and monitoring is the process of measuring the success of mitigation measures to assess their effectiveness.

7.2 Objectives of the ESMP

The purpose of the Environmental and Social Management Plan (ESMP) is to ensure that Environmental and Social impacts identified during the ESIA process are effectively addressed during the construction, operation and closure of the project. The ESMP specifies the mitigation and management measures to which the Proponent is committed and shows how the Project will mobilize organizational capacity and resources to implement these measures.

The ESMP will be a living document and will continue to develop during the design and construction phases to enable continuous improvement of the Project's environmental performance.

The specific objectives of the ESMP are to:

- Promote Environmental and social management and communicate the aims and goals of the ESMP;
- Ensure that all workers, subcontractors, and others involved in the Project meet legal and regulatory requirements concerning environmental management, including financial implications

- Incorporate environmental and social management into Project design and operating procedures;
- Serve as an action plan for environmental and social management for the Project;
- Provide a framework for implementing Project environmental and social commitments (i.e. mitigation measures identified in the ESIA).

7.3 Environmental and Social Management Measures

The recommended environmental and social management measures required to mitigate the identified impacts of the proposed project activities during pre-construction, construction, commissioning, and operation phases are presented in Tables 7.1 to 7.8.

Table 7. 1: Environmental Management Plan for Pre-Construction Phase of the Proposed Project

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Site Selection / Land Take	• Loss of land for farming activities	REA shall: • Engage affected communities through consultation and participation	Minor	Inspection	Before Mobilization	Evidence of consultations; grievances resolved	EPC Contractor	PMU	1,400
Site Clearing & Preparation	• Vegetation loss • Direct and indirect impacts on fauna	REA shall: • Minimize clearing footprint • Conduct pre-clearance ecological surveys • Avoid clearing during breeding seasons • Implement biodiversity management plan	Negligible	Inspection	Monthly	Compliance with clearing limits; no unnecessary vegetation loss	EPC Contractor	PMU / POE	2,000
	• Loss of topsoil • Soil compaction and erosion • Reduced soil stability	REA shall: • Strip and store topsoil • Restrict heavy machinery movement • Implement erosion control (mulching, silt fences) • Progressive restoration	Negligible	Inspection	Quarterly	Evidence of topsoil stockpiling; reduced erosion signs	EPC Contractor	PMU	1,800

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
	• Air emissions from equipment • Increased noise levels	REA shall: • Maintain machinery regularly • Apply dust suppression (water spraying) • Limit work to daytime • Provide PPE for noise protection	Negligible	Inspection	Quarterly	Reduced dust levels; acceptable noise levels	EPC Contractor	PMU	1,500
	• Injuries and accidents	REA shall: • Implement OHS procedures (ILO standards) • Provide PPE • Conduct safety training/toolbox talks • Enforce supervision	Nelgiigble	Inspection	Daily	Number of incidents recorded; PPE compliance rate	EPC Contractor	PMU / HSE Officer	2,200
Mobilization of Construction Equipment & Materials	• Vehicular emissions (TSP, NOx, CO, SOx) • Increased noise levels	REA shall: • Maintain vehicles to emission standards • Optimize logistics • Enforce speed limits and reduce idling • Use low-sulfur fuels	Negligible	Inspection	Weekly	Reduced emissions; compliance with transport procedures	EPC Contractor	PMU	1,600

Table 7.2: Environmental Management Plan for Construction Phase of the proposed Project

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Movement of Equipment, Personnel & Materials	• Vehicular emissions (CO, SO_2, NO_2) • Dust emissions	REA shall: • Maintain vehicles regularly • Use low-sulfur fuels • Apply dust suppression (water spraying, covering trucks) • Limit idling and enforce speed limits	Negligible	Inspection	Daily	Reduced dust levels; emission compliance	EPC Contractor	PMU	1,500
	• Increased traffic and congestion	REA shall: • Implement Traffic Management Plan • Schedule deliveries off-peak • Use designated routes • Community awareness and signage	Negligible	Inspection	Daily	Traffic incidents minimized; complaints resolved	EPC Contractor	PMU	1,200
	• Risk of accidents	REA shall: • Train drivers • Enforce speed limits • Conduct vehicle inspections	Negligible	Inspection	Daily	Number of accidents/incidents recorded	EPC Contractor	HSE Officer / PMU	1,300

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
		• Use traffic marshals and signage							
Civil & Electrical Works / Installation	• Air emissions and dust generation	REA shall: • Maintain equipment • Apply dust suppression • Limit work during high winds • Provide PPE	Negligible	Inspection	Daily	Visible dust reduction; PPE compliance	EPC Contractor	PMU	1,600
	• Increased noise levels	REA shall: • Restrict work to daytime • Use silencers • Provide hearing protection • Establish buffer zones	Negligible	Inspection	Daily	Noise complaints minimized	EPC Contractor	PMU	1,200
	• Soil erosion and compaction	REA shall: • Install silt fences and drainage • Restrict machinery movement • Rehabilitate progressively • Proper grading	Minor	Inspection	Weekly	Evidence of erosion control measures	EPC Contractor	PMU	1,800
	• Loss of flora and fauna	REA shall: • Minimize clearing	Negligible	Inspection	Weekly	Vegetation condition maintained	EPC Contractor	PMU	1,500

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
		• Control invasive species • Restrict worker movement • Implement biodiversity plan							
	• Groundwater depletion and contamination	REA shall: • Use water efficiently • Monitor abstraction • Install sediment traps • Prevent contamination	Negligible	Inspection	Monthly	Water usage records; no contamination	EPC Contractor	PMU	1,400
	• GBV and discrimination risks	REA shall: • Implement Gender & GBV Action Plans • Enforce code of conduct • Awareness training • Grievance mechanism	Minor	Monitoring	Monthly	Number of GBV cases resolved	EPC Contractor	PMU	2,000
	• Spread of STDs	REA shall: • Health awareness programs • Provide testing access	Minor	Monitoring	Monthly	Participation rates; reported cases	EPC Contractor	PMU	1,800

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
		• Enforce worker conduct • Collaborate with health agencies							
	• Road damage and congestion	REA shall: • Traffic management plan • Maintain roads • Control vehicle loads • Coordinate with authorities	Negligible	Inspection	Weekly	Road condition maintained	EPC Contractor	PMU	1,500
	• Worker injuries and accidents	REA shall: • Implement OHS system (ILO aligned) • Provide PPE • Conduct training • Emergency preparedness	Minor	Inspection	Daily	Incident rate; PPE compliance	EPC Contr		

Table 7.3: Environmental Management Plan for with the Commissioning Phase

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Plant Testing	• Increase in ambient noise levels during testing activities	REA shall: • Restrict testing to daytime hours	Negligible	Inspection	Daily (during testing)	Noise complaints minimized; PPE usage compliance	EPC Contractor	PMU	1,200

		• Use well-maintained equipment with noise suppression features • Notify nearby occupants in advance • Provide hearing protection (PPE) to workers							
	• Occupational health and safety hazards (injuries, electrocution due to incorrect connections)	REA shall: • Implement electrical safety procedures (lockout/tagout) • Use certified personnel only • Provide PPE (insulated gloves, boots) • Conduct safety checks and supervision • Ensure emergency response readiness	Minor	Inspection	Daily (during testing)	Zero fatal incidents; reduced injury rates	EPC Contractor	HSE Officer / PMU	2,000
	• Risk of electrocution to campus occupants	REA shall: • Restrict access to testing areas • Install warning signage and barriers • Ensure proper grounding and insulation • Supervise all testing activities	Negligible	Inspection	Daily (during testing)	No unauthorized access; zero electrocution incidents	EPC Contractor	PMU	1,000

Table 7.4: Environmental Management Plan for Operational Phase of the proposed Project

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Power Generation & Distribution	• Discrimination of women in employment• GBV (sexual harassment, assault, poor working conditions)	REA shall: • Implement Gender Action Plan & GBV prevention (World Bank aligned) • Enforce equal opportunity employment • Worker code of conduct & training • Confidential grievance mechanism	Negligible	Monitoring	Monthly	Number of grievances reported/resolved; gender balance in workforce	Plant Operator / EPC	PMU	2,000
	• Electric shock and injuries• Workplace discrimination	REA shall: Implement OHS system (ILO aligned) • Install LOTO systems & signage • Provide PPE (insulated gloves, boots) • Conduct training & audits • Enforce fair labor practices	Minor	Inspection	Daily	Incident/accident rate; PPE compliance	Plant Operator	HSE Officer / PMU	2,500
Routine Maintenance	• Soil contamination from batteries and inverters	REA shall: Store hazardous materials in	Negligible	Inspection	Weekly	No contamination incidents; proper storage observed	Plant Operator	PMU	1,800

		sealed/labeled containers • Implement hazardous waste plan • Use certified waste handlers • Install secondary containment & spill response							
	• Groundwater use for panel cleaning	REA shall: Use water-efficient/dry-cleaning methods • Harvest/reuse rainwater • Monitor abstraction & comply with permits • Apply water conservation measures	Negligible	Monitoring	Monthly	Water usage records; compliance with limits	Plant Operator	PMU	1,500
Waste Generation & Disposal	• Electric shock and injuries during maintenance	REA shall: • Enforce LOTO procedures • Provide PPE & Insulated tools • Conduct competency-based training • Routine inspection & supervision	Negligible	Inspection	Weekly	Zero fatal incidents; reduced injury rates	Plant Operator	HSE Officer / PMU	1,600

Table 7.5: Environmental Management Plan for Decommissioning Phase

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Dismantling of Plant & Equipment	• Dust emissions• Emissions from machinery and vehicles	REA shall: • Apply dust suppression (water spraying) Use low-emission equipment • Cover haulage trucks • Limit idling	Negligible	Inspection	Daily	Reduced dust levels; emission compliance	EPC Contractor	PMU	1,800
	• Increased noise levels	REA shall: Restrict to daytime hours • Use silencers • Provide hearing PPE • Notify nearby communities	Negligible	Inspection	Daily	Noise complaints minimized	EPC Contractor	PMU	1,400
	• Injuries and electrocution risks	REA shall: • Implement OHS procedures (ILO aligned) • Apply LOTO systems • Provide PPE • Use trained personnel • Emergency preparedness	Minor	Inspection	Daily	Incident rates; PPE compliance	EPC Contractor	HSE Officer / PMU	2,500
Removal of Foundations & Civil Works	• Soil disturbance, erosion, compaction	REA shall: • Minimize excavation footprint • Implement erosion controls • Reinstate topsoil • Progressive rehabilitation	Negligible	Inspection	Weekly	Evidence of rehabilitation; no erosion	EPC Contractor	PMU	1,700

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
	• Groundwater contamination risks	REA shall: • Proper storage of fuels/chemicals • Spill prevention & response plan • Prevent contaminant discharge • Regular inspections	Negligible	Inspection	Weekly	No contamination incidents	EPC Contractor	PMU	1,600
Waste Generation & Disposal	• Soil & groundwater contamination from waste	REA shall: • Implement a waste management plan • Use licensed contractors • Secure hazardous waste storage • Comply with regulations	Minor	Inspection	Weekly	Proper waste handling; no contamination	EPC Contractor	PMU	2,000
	• Pressure on waste infrastructure	REA shall: • Coordinate with approved facilities • Schedule transport efficiently • Promote recycling and recovery	Negligible	Monitoring	Monthly	Volume of waste recycled; facility compliance	EPC Contractor	PMU	1,300
Transportation of Decommissioned Materials	• Emissions and noise from vehicles	REA shall: • Maintain vehicles • Optimize logistics • Enforce speed limits • Use designated routes	Negligible	Inspection	Weekly	Reduced emissions; compliance with routes	EPC Contractor	PMU	1,500
	• Traffic congestion and	REA shall: • Traffic Management Plan • Trained drivers & signage	Negligible	Inspection	Weekly	Traffic incidents minimized	EPC Contractor	PMU	1,400

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
	road safety risks	• Off-peak scheduling • Repair road damage							
	• Community accident risks	REA shall :• Community awareness programs • Warning signs and barriers • Escort oversized loads • Enforce safety protocols	Negligible	Inspection	Weekly	Zero community incidents	EPC Contractor	PMU	1,600
Site Restoration & Rehabilitation	• Habitat loss before restoration	REA shall: • Re-vegetate with native species • Restore habitat conditions • Monitor ecological recovery • Prevent invasive species	Negligible	Inspection	Monthly	Vegetation regrowth; biodiversity recovery	EPC Contractor	PMU	2,200
	• Loss of employment post-closure	REA shall: • Worker transition programs • Skills training • Job placement support • Stakeholder engagement	Minor	Monitoring	Monthly	Number of workers transitioned	EPC Contractor	PMU	2,000

7.4 Roles, Responsibilities and Accountabilities

The Rural Electrification Agency Project Management Unit (REA-PMU) supervises the implementation of ESMP throughout the project life span while conformance with the mitigation measures will be ensured by the Engineering, Procurement and Construction (EPC) contractor during the construction phase and by the operations and maintenance (O&M) contractor during the operational phase of the project. Table 7.8 indicates the Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring and Review of the ESMP.

Table 7. 6: The Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring, and Review of the ESMP					
Stakeholder	**Pre-Construction Phase**	**Construction Phase**	**Commissioning Phase**	**Operational Phase**	**Decommissioning Phase**
Director of Works / Physical Planning	• Approve site and land use • Review ESMP and ensure institutional commitment • Appoint & train Site Engineer • Ensure livelihood restoration before mobilization	• Supervise ESMP implementation • Ensure contractor compliance • Address grievances and enforce corrective actions	• Oversee safe plant testing • Ensure stakeholder communication • Confirm readiness for operation	• Review ESMP reports • Recommend improvements to PMU/O&M • Ensure safeguards (OHS, GBV, environment)	• Oversee decommissioning activities • Ensure site restoration • Support livelihood transition
REA – PMU	• Approve ESMP and integrate into contracts • Coordinate stakeholders and regulators • Allocate ESMP budget	• Monitor compliance and conduct audits • Report to regulators • Enforce corrective actions	• Ensure compliance during testing • Approve transition to operation	• Oversee ESMP implementation• Ensure monitoring, audits, reporting• Address non-compliance	• Supervise dismantling compliance • Ensure waste management • Prepare closure reports
Site Engineer	• Support ESMP planning • Participate in training	• Implement ESMP daily on-site • Monitor EHS compliance • Maintain records and reports	• Supervise testing • Ensure safety procedures (LOTO, PPE) • Report incidents	• Monitor operations & maintenance • Ensure ESMP compliance • Report environmental & safety issues	• Supervise dismantling • Monitor waste handling • Support site rehabilitation

NESREA / FMEnv Representatives	• Review and approve ESIA/ESMP• Issue environmental permits	• Monitor ESMP implementation (environmental compliance) • Conduct inspections and enforce regulations • Engage stakeholders on compliance issues	• Monitor compliance during commissioning • Verify environmental and safety readiness	• Monitor ESMP implementation (environmental compliance) • Conduct periodic audits and inspections • Discuss ESMP improvements with PMU, Director, and O&M Contractor to address non-compliance and emerging risks	• Monitor decommissioning activities • Verify environmental restoration • Approve closure compliance • Recommend corrective actions where necessary
State Ministry of Women's Affairs & Social Development (GBV/SEA Service Provider)	• Review Gender/GBV Action Plans• Support stakeholder engagement on GBV risks	• Monitor implementation of gender and GBV mitigation measures • Provide GBV/SEA support services • Conduct awareness programs	• Monitor GBV risk during commissioning activities • Ensure reporting and response mechanisms are active	• Monitor Gender Action Plan implementation • Handle GBV/SEA cases confidentially • Provide survivor support services • Engage with PMU, Director, and Gender Officer on improvements	• Monitor GBV risks during workforce demobilization • Support vulnerable groups and affected persons • Ensure proper closure of GBV cases and services

7.5 Additional Management Plans

During the progression of the project, management plans will be expanded to include specific procedures to guide implementation by the relevant project personnel and institutions including contractors and subcontractors. Such documents will be prepared strictly in line with the requirements set out in the relevant international standards and guidelines and other applicable national and local regulations and guidelines. These additional management plans include the following:

- Stakeholder Engagement Plan
- Emergency Preparedness and Response Plan
- Traffic Management Plan
- Waste Management Plan
- Occupational Health and Safety Plank,
- Livelihood Restoration Plan

7.6 Environmental Monitoring Programme

Monitoring shall be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. The key components of the environmental monitoring program that will be developed for this project include:

- Comprehensive identification of high-level issues, risks, opportunities, and gaps in system and operating practices that can impact the ability to achieve the required level of performance.
- Establishment of clear metrics to measure statistically significant performance improvement areas towards goals and targets;
- Establishment of processes to ensure documents and records that are critical to operational excellence are current, controlled, and accessible.
- Establishment and maintenance of appropriate processes for regular monitoring of HSE performance as well as conducting regular environmental audits and evaluations to ensure that the system is implemented and maintained and remains effective.

7.7 Training, Awareness and Capacity Building for Zonal Officers

REA shall identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environmental or social conditions. It is important that employees at each relevant phase of the project are aware of the potential environmental impacts of their activities and the occupational hazards associated with the work; as well as their roles and responsibilities in achieving conformance with the management documented in this report. Thus, a formal training process will be organized for employees on environmental management programs, plans and procedures associated with the project.

All staff employed will be trained in the following:
General operation of the plant.

- Environmental management.
- Specific job roles and procedures.

- Occupational health and safety; and
- Contingency plans and emergency procedures. Training will include:
- Induction training on appointments.
- Specialist training (as required for specific job roles); and
- Refresher training as required.

Training for the local community on general environmental awareness and ESMP mitigation measures on community health, safety, and security should also be provided.

7.7.1 ESMP Capacity-Building Plan

The various actors involved in the ESMP implementation will need capacity enhancement to ensure adequate understanding of ESMP/ OHS/ Waste Management/ Code of Conduct requirements amongst other areas identified. Proposed topics and target audience is outlined in Table 7.11.

Table 7.7: ESMP Capacity Building Plan

S/N	Training Content	Participants	Delivery Responsibility	Revised Cost (USD)
1	Specialized Training on Environmental & Social Management (ESM) (ESIA, safeguards, monitoring, reporting)	PMU, Environmental & Social Safeguard Officers	Consultant / PMU	4,500
2	ESMP Implementation Training (mitigation measures, roles & responsibilities, monitoring procedures)	Project Team (PMU, Site Engineer, Supervisors)	Consultant / PMU	1,500
3	Contractor Training on ESMP Compliance (mitigation measures, Code of Conduct, OHS requirements)	Contractor's management, workers, HSE Officers	Consultant / PMU	1,500
4	Driver & Traffic Management Training (fleet management, road safety, traffic control within the project area)	Drivers, Transport Officers, HSE Officers, Security Personnel	Transport/Traffic Specialist / PMU	1,200
5	GBV/SEA/SH Prevention & Response Training (Code of Conduct, reporting channels, survivor-centered approach)	Project Team, Safeguard Officers, Contractors	GBV Specialist / Consultant / PMU	2,500
6	Grievance Redress Mechanism (GRM) Training (complaint handling, documentation, resolution process)	GRC Members (project & management levels), PMU	Consultant / PMU	2,000

Total Estimated Cost: $13,200

7.8 Record Keeping

The contractor should keep records providing evidence of ongoing mitigation activities. These documents should be made available upon request. The Safeguard Unit should keep records to provide evidence of monitoring activities and effectiveness of the monitoring plan to include monitoring Plan, identified problems/corrective actions and monitoring Reports.

7.9 ESMP Costing

Table 7.8 provides the summary of the cost estimate required to effectively and efficiently implement the recommended mitigation measures and management plans required to address the potential and associated impacts of the proposed project. The total cost of implementing the ESMP is estimated at US$ **57,300** with the current Naira value of 135,00.32 to 1 dollar.

Table 7. 8: Cost of ESMP

S/N	ESMP Activity	Cost (USD)	Key Cost Components	Justification
1	Pre-Construction Phase	8,000	Stakeholder engagement, ESMP disclosure, livelihood restoration planning, training of safeguards staff	Required to address social risks early, prevent conflicts, and ensure readiness before project mobilization
2	Construction Phase	13,000	Daily monitoring, mitigation measures (dust, erosion, OHS), PPE, inspections, reporting	Most impact-intensive phase requiring continuous supervision and high resource allocation
3	Commissioning Phase	800	Testing supervision, safety monitoring, stakeholder notification	Short-term phase with limited activities but critical safety requirements
4	Operational Phase	13,500	Routine monitoring, OHS audits, waste management, GBV/SEA implementation, reporting	Long-term phase requiring sustained compliance, monitoring, and system maintenance
5	Decommissioning Phase	4,000	Dismantling supervision, waste disposal, site restoration, livelihood transition	Ensures safe closure, environmental restoration, and social safeguards at project end
6	Mitigation & Monitoring	7,000	Environmental sampling, inspections, compliance audits, documentation	Dedicated funding ensures effective tracking of impacts and regulatory compliance
7	Capacity Building	11,000	ESMP training, OHS training, GBV/SEA awareness, GRM training	Builds stakeholder capacity for effective ESMP implementation and sustainability
	TOTAL	57,300		Cost reflects full lifecycle ESMP implementation aligned with international standards

7.10 Remediation Plan after Decommissioning/Closure

Upon the completion of useful life cycle of a project, there is a need to abandon and/or decommission such project if it no longer becomes economically viable either as a result of depleted feed stock or competing technology. The proposed solar project is expected to have a life span of 25 years. It is envisaged that technology and environmental policies could have changed so drastically by then, hence a definite decommissioning plan cannot be put in place for now. However, it is of importance that abandonment activities be planned in accordance with the Nigerian regulatory requirements.

7.10.1 Decommissioning Activities

Decommissioning refers to the process of removing all the operating assets of a project after completion of its life cycle. The average life span of the solar Photovoltaic (PV) power plant to be provided as part of the proposed Project is 25years (which can be extended through regular maintenance), while the training center can last for 40 years or more. Even after 25 years, the PV panels can still generate up to 90% of the design capacity.

During decommissioning, REA shall ensure that the project sites are returned to a safe and environmentally acceptable condition. The decommissioning activities will typically include the following:
Dismantling and removal of PV panels and associated infrastructure (mounting structure, power evacuation cable, inverters, transformers, batteries, etc.);

- Removal of any sub-surface installations (e.g. underground cables);
- Waste generation and management.
- Restore the environment to allowable baseline conditions and monitor the process in line with legislative and regulatory requirements and best industry standards; and
- Assess the residual impacts, if any, that the project has on the environment; and specifically, if there are any future restrictions for other activities.

7.10.2 Management of Decommissioning Activities

In the event of decommissioning, REA, in conjunction with the leadership of the Academy, shall ensure that the Project site is left in a safe and environmentally acceptable condition. A standard decommissioning, abandonment and closure programme shall be invoked. The tasks will include, amongst others:

- Evacuation of the dismantled PV panels and other related items (such as inverters, and control devices) to the manufacturers for recycling.
- Transportation of spent batteries to recycling facilities.
- Monitoring the abandoned project environment as necessary.

Decommissioning activities will only begin after due consultation with the relevant stakeholders, including the regulatory authorities. The decommissioning activities shall be carried out in line with the relevant provisions of the National Guidelines for Decommissioning of Facilities in Nigeria (2017) issued by the FMEnv.

Typically, the following actions shall be undertaken for decommissioning:
An updated plan that takes into account the most cost-effective and best practicable methods, legal requirements and industry practices at that time for the facility decommissioning shall be developed and submitted to the FMEnv and other relevant regulatory authorities for approval. The plan shall include but not limited to the following: Description of the site and components to be decommissioned.

Description of the decommissioning scope, objectives, end state and strategy;

- Activities to be performed during the decommissioning;
- Schedule of decommissioning activities; o Estimate of the decommissioning cost;

- Estimated inventory of waste streams to be generated during the decommissioning and handling techniques;
- Decommissioning team (qualifications, roles and responsibilities)

- To ensure that due consideration is given to all options a detailed evaluation of facility decommissioning options shall be carried out.
- The options will include facility mothballing, partial facility decommissioning or complete site decommissioning. The evaluation will consider environmental issues in conjunction with technical, safety and cost implications to establish the best practicable environment-friendly options for the Project decommissioning.

- A risk assessment shall be conducted to ensure that nothing which could be constituted as a hazard for other users of the site or for the environment in general will be left at the site.
- The Project site shall be left in a safe and environmentally acceptable condition.

- Hazard identification and analysis shall be conducted to determine special safety concerns to be addressed.
- An appropriate Health, Safety and Environment (HSE) plan shall be implemented to ensure that the decommissioning activities are carried out in an environmentally sound manner and in conformity with relevant laws and regulations guiding such operations

- Third party notifications should be carried out before any demolition and should be conducted in a phased sequence.

- Socio-economic considerations of facility decommissioning shall be carried out. These will include assessment of potential effects associated with termination of employment (at the end of the operational phase) and measures to minimize the effects by:

- Ensuring that employees are fully informed about the decommissioning and how it will affect them before the project finally closes.

- Building community capacity to manage opportunities and impacts arising from the decommissioning and post-decommissioning phase of the Project.

- Providing training to build local skills tailored to project decommissioning and post-decommissioning activities (e.g. equipment dismantling, rehabilitation activities, monitoring, etc.).

- Providing training to transfer project-learned skills to alternative and secondary industries tailored to respond to the market economy.

- An effective waste management plan shall be developed for the decommissioning activities. The decommissioning options for redundant structures and equipment will include: the complete

dismantling of structures and equipment and the return of all components to the equipment manufacturer for recycling. A detailed record of all suitable recycling materials shall be maintained.

7.10.3 Vegetation Control Plan

Objectives

The overall objective of the Vegetation Control and Management Plan is to maintain vegetation within acceptable limits to ensure reliable operation of the solar mini-grid while conserving environmental resources. The plan seeks to prevent vegetation from shading solar panels, maintain safe access to project infrastructure, reduce the accumulation of combustible materials, protect electrical equipment from vegetation-related damage, and preserve native vegetation where practicable. The plan also aims to control invasive species, minimize soil erosion, support ecological restoration in disturbed areas, and promote sustainable land management practices throughout the project lifecycle.

Implementation Strategy

Vegetation management shall be implemented using an integrated approach that prioritizes mechanical and manual control methods over chemical treatments. Grass cutting, brush clearing, pruning, and manual weeding shall be conducted routinely to maintain vegetation at heights that do not interfere with solar generation or operational safety. Herbicides shall only be used where alternative methods are ineffective and shall be applied by trained personnel in accordance with manufacturer specifications and environmental protection requirements.

Monitoring and Performance Standards

The project operator shall conduct regular inspections to assess vegetation conditions within the solar array, around electrical equipment, along access roads, and at perimeter security fences. Vegetation-related performance indicators shall include the absence of panel shading, maintenance of required equipment clearances, prevention of vegetation-related outages, effective control of invasive species, and the absence of fire incidents attributable to vegetation. Inspection findings shall be documented and corrective actions implemented within specified timeframes.

Roles and Responsibilities

The Project Manager shall have overall responsibility for the implementation of this plan and for ensuring adequate resources are available for vegetation management activities. The Operations and Maintenance Manager shall coordinate routine vegetation control works and ensure that maintenance schedules are adhered to. The Environmental Officer shall monitor environmental compliance, maintain records, and oversee implementation of biodiversity protection measures. The Health, Safety and Environment Officer shall ensure that all vegetation management activities are conducted safely and that fire prevention measures are effectively implemented.

7.10.4 Biodiversity Management Plan

Biodiversity Management Measures

Prior to construction, a biodiversity assessment shall be conducted to identify important habitats, plant species, wildlife populations, and any species of conservation concern. Project infrastructure shall be located,

where possible, to avoid sensitive ecological areas. Vegetation clearing shall be restricted to the minimum area required for project development, and native vegetation outside operational areas shall be retained wherever feasible. Construction activities shall be confined to designated work areas to reduce habitat disturbance. Workers shall be prohibited from hunting, trapping, or disturbing wildlife. Speed limits shall be enforced on access roads to minimize wildlife collisions, and any wildlife encountered during construction shall be protected and relocated where necessary by qualified personnel.

Habitat Restoration and Invasive Species Control

Areas disturbed during construction shall be rehabilitated as soon as practicable through regrading, replacement of topsoil, and revegetation using native plant species. The project shall monitor disturbed areas and implement corrective measures where vegetation establishment is unsuccessful. To prevent the spread of invasive species, equipment entering the site shall be cleaned of soil and plant material.

Monitoring and Reporting

Biodiversity monitoring shall be conducted periodically throughout the construction and operational phases. Monitoring activities shall include vegetation inspections, wildlife observations, invasive species surveys, and assessments of rehabilitated areas. Monitoring results shall be documented and used to evaluate the effectiveness of mitigation measures and identify any corrective actions required. Records of biodiversity-related incidents, monitoring findings, rehabilitation activities, and invasive species management shall be maintained by the project operator and included in environmental performance reports.

Roles and Responsibilities

The Project Manager shall be responsible for the overall implementation of this Biodiversity Management Plan. The Environmental Officer shall oversee biodiversity monitoring, maintain records, and ensure compliance with biodiversity commitments. Contractors and site personnel shall comply with all biodiversity protection measures and report any environmental incidents or wildlife observations during project activities.

Review and Continuous Improvement

This Biodiversity Management Plan shall be reviewed annually and updated as necessary to reflect changes in project activities, environmental conditions, monitoring results, and regulatory requirements. The project shall continually improve biodiversity management practices to ensure effective protection of ecological resources and sustainable operation of the solar mini-grid facility.

7.10.5 Abandonment Plan

Before site abandonment, REA shall establish a standard procedure for incorporating the following practices:

- Identification of the components of the power plant that will be abandoned and/or removed;
- The proposed methods for abandonment or re-use of the plant equipment/material are applicable;
- Processes put in place to mitigate potential environmental impacts associated with the abandonment process; and
- Appropriate site rehabilitation programs (including re-vegetation of the site with native plant species) to return the Project site to its original status (as much as possible).

In the event of the project being abandoned, this shall be done in accordance with strict compliance with legislative requirements and international best practices. The decommissioning, abandonment and/or closure programme shall generally be managed by a team of competent personnel from REA-Project Management Unit, the Department of Works and the Physical Planning Department of the Academy. The abandonment process shall be carried out as follows:

- Relevant stakeholders shall be duly informed;
- Physical Asset Verification (PAV) of the facilities shall be carried out;
- National Sectoral Regulations, as they affect the abandonment of the project, shall be strictly complied with to ensure:
- Restoration and rehabilitation of the environment.
- Management of residual impacts of the project in strict compliance with extant
- National/ FMEnv sectoral regulations.
- In addition, a site close-out permit shall be obtained as appropriate, and a close-out report shall be prepared and archived for future reference.

CHAPTER EIGHT
STAKEHOLDER ENGAGEMENT AND GRIEVANCE REDRESS MECHANISM

8.1 Preamble

Consultations play a crucial role in identifying the key environmental and social issues that are central to the preparation of this ESIA. A Stakeholder Engagement Plan (SEP) was developed to support the effective and sustainable implementation of all phases of the Project lifecycle, including pre-construction, construction, operation, and decommissioning.

The SEP outlines the methods used to identify stakeholders, the approaches adopted for engaging them, and the outcomes of consultations conducted to date. It also details the measures taken by the Project to ensure that relevant information was appropriately disclosed to stakeholders.

8.2 Stakeholder Engagement

A Stakeholder Engagement Plan (SEP) is the process of managing stakeholder expectations, which influences project decisions throughout the life cycle of the project. This process provides a plan to interact effectively with stakeholders and support the project's interests. It is very important to plan these activities well so that they appraise the contribution of stakeholders on projects, manage their expectations, and achieve project objectives. The stakeholder engagement process emphasized free, prior, and informed consultation (FPIC) with affected communities and other relevant stakeholders, while considering appropriate approaches for involving vulnerable and marginalized groups. Consultations included early disclosure of information in formats that are accessible and easily understood, as well as key informant interviews, focus group discussions (segmented by men, women, and youth), and broader public meetings.

Table 8.1: Stakeholder Engagement Plan (SEP)

Groups and individuals	Date	Type of Engagement	Discussion
Management of the University	11/02/2026	Consultation /homage	Overview of the ESIA, benefits of the proposed REA Solar project
University Community	12/02/2026	Focal Group Discussion,	An overview of the ESIA and the benefits of the proposed REA solar project.

All consultation activities were properly documented, including relevant data, supporting evidence, participant lists with contact information, and photographic records. Information disclosure complied with the provisions of national regulations, including the EIA Act No. 86 of 1992 (as amended under Cap E12 LFN 2004), as well as the World Bank's Environmental and Social Safeguards Standards (ESSS).

8.3 Objectives of Stakeholder Engagement

The purpose of public participation in an ESIA is to ensure that potentially affected and interested stakeholders are provided with adequate, clear, and accessible information in an objective manner. This enables them to identify key concerns, contribute meaningful input, and propose options for improving project benefits and considering alternatives.

The stakeholder engagement process has been structured in line with the requirements of the Nigerian EIA Act as well as applicable international standards. For this Project, the main objectives of stakeholder engagement are as follows:

- Identify key stakeholders that can influence the Project and its activities;
- Inform and educate stakeholders about the proposed Project;
- Gather local knowledge to improve the understanding of the environmental and social context;
- Better understand the locally-important issues;
- Identify the most effective methods and structures through which to disseminate project information, and to ensure regular, accessible, transparent and appropriate consultation;
- Provide a means for stakeholders to have input into the Project planning Process;
- Take into account the views of stakeholders in the development of effective mitigation measures and management plans; and
- Lay the foundation for future stakeholder engagement.

8.4 Disclosure and Participation Plan

Information disclosure is a critical activity, not only as a means of engagement but also as a foundation for enabling other engagement processes to be carried out in an informed and participatory manner. This section outlines the procedures to be followed for information disclosure and stakeholder participation as part of the implementation of the EEP. In accordance with the World Bank Safeguards requirements, the REA is expected to disclose the environmental and social assessment, along with a documented record of stakeholder engagement. This record should include details of the stakeholders consulted, a summary of the feedback received, and a clear explanation of how the feedback was incorporated into the Project, or the reasons why it was not adopted.

8.4.1 Disclosure Mechanism

The process of information disclosure can be undertaken in two ways: either voluntary disclosure or disclosure as part of the regulatory requirements (EIA requirements, public hearing). While regulatory disclosure involves the provisioning of information as required by the authorities and agencies involved in the project, voluntary disclosure refers to the process of disclosing information to the various stakeholders in a voluntary manner. This disclosure not only allows for trust to be built amongst the stakeholders through the sharing of information, but it also allows for more constructive participation in the other processes of consultation and resolution of grievances due to the availability of accurate and timely information.

8.4.2 Process for Disclosure of Information

As a standard practice, this ESIA will be released for public review according to the WB disclosure procedures and for a period of 21 days in accordance with Nigerian Regulatory Frameworks. Distribution of the disclosure material will be done by making it available at venues and locations convenient for the stakeholders and places to which the public has unhindered access. The language of the ESIA is in English. The report will be made accessible to the general public at the following locations:

- The EA Department of the Federal Ministry of Environment;
- The Kwara State Ministry of Environment,
- The Federal University of Ilorin
- Other designated public locations to ensure wide dissemination of the materials.

Electronic copies of the ESIA report will be made available on the websites of the World Bank and FMEnv, enabling stakeholders with internet access to information on the proposed development and participate in the public consultation process. Stakeholder input will be facilitated through various mechanisms, including press releases and media announcements, as well as notifications to local, regional, and national NGOs, relevant professional bodies, and other interested parties regarding the disclosed materials.

8.5 Stakeholder Identification/Mapping and Analysis

The stakeholders were identified based on the direct project beneficiaries, adversely impacted groups, project supporters /proponents, regulatory/ planning,

However, the stakeholders covered are;

- Rural Electrification Agency (REA)
- Federal Ministry of Environment (FMEnv)
- Kwara State Ministry of Environment
- Ilorin South Local Government Area

Major Points of Initial Consultation

Key points included:

- Introduction of Stakeholders
- Opening Remarks
- Description of the Proposed Project by REA/Consultant
- Overview of The ESIA and Public Consultation by Consultant
- Questions, Comments, and Remarks by other stakeholders
- Closing Remark

Key feedback received during Stakeholder Consultations is presented below;

Table 8.2: Engagement with the Management of the University

S/N	Comments / Questions Raised	Responses / Clarifications

1	Prof. M.A. Alfanla (Registrar) requested clarification on the expected timeline and schedule for the implementation of the proposed Solar Power Plant Project. He expressed interest in understanding when the University should expect the commencement of physical activities on site.	Dr. Charles Ebojei (Charlton Consult Limited) explained that the implementation process would commence immediately after the completion of the preliminary studies, Environmental and Social Impact Assessment (ESIA), and other regulatory procedures. He assured the management that the project sponsors were committed to ensuring timely delivery of the project.
2	Mr. Emmanuel Osamiewenfan (Charlton Consult Limited) sought confirmation from the University management on whether the proposed project site was free from encumbrances, ownership disputes, compensation claims, or any form of land-related conflict that could hinder project implementation.	Prof. Omopupa K. Tunde, speaking on behalf of the Vice Chancellor, confirmed that the University possesses adequate land for the proposed project and that there were no existing disputes, compensation claims, or encumbrances associated with the proposed project location. He assured the consulting team that the land was suitable and available for the project.
3	Mr. Emmanuel Osamiewenfan further enquired whether the University management had responded to the requests for documents and relevant information contained in the introductory letter issued by the Rural Electrification Agency (REA).	Prof. Omopupa K. Tunde responded that the requested information would likely have been forwarded to the REA already. However, he noted that the University management would obtain the necessary internal clearance before officially sharing the documents and information directly with the consulting team from Charlton Consult Limited.
4	Members of the University management acknowledged the importance of uninterrupted electricity supply to the institution, particularly in supporting teaching, research activities, water supply systems, security lighting, and the operation of equipment and machinery across the campus.	The consulting team appreciated the University's concerns and reiterated that the proposed Solar Power Plant Project was designed to provide reliable, affordable, and sustainable electricity supply in line with the objectives of the REA, the Federal Government, and the World Bank-supported DARES programme.
5	The University management expressed appreciation to the Federal Government, the Rural Electrification Agency (REA), the World Bank, and Charlton Consult Limited for initiating the project and engaging stakeholders through consultation.	The consulting team thanked the University management for their cooperation, warm reception, and willingness to collaborate throughout the ESIA process and subsequent implementation stages of the project.

Plate 8.1: Stakeholder Engagement with the Management of Unilorin

Plate 8.2: Questionnaire Administration

8.6 Grievance Redress Mechanism

A Grievance Redress Mechanism (GRM) shall be established for the proposed Solar Power Plant Project, to provide an accessible, transparent, and effective process for receiving and resolving complaints or concerns arising from project activities. The GRM is designed to strengthen stakeholder confidence, promote accountability, and ensure that issues affecting students, staff, contractors, and host communities are addressed in a timely and fair manner. The mechanism will serve as an important tool for preventing conflicts and enhancing cooperation among all parties involved in the project implementation.

The primary objective of the GRM is to provide affected persons and stakeholders with a formal platform through which grievances can be lodged and resolved amicably. The mechanism will ensure that complaints relating to environmental impacts, social concerns, labor issues, security matters, or operational disturbances are properly documented, investigated, and addressed. It will also help to improve communication between the project proponents, the University management, the Rural Electrification Agency (REA), contractors, and surrounding communities.

The scope of grievances to be handled under the mechanism includes concerns relating to land use, noise and dust generation, occupational health and safety, damage to infrastructure, employment and labor disputes, community health and security concerns, theft or vandalism of project facilities, and any dissatisfaction associated with project activities. Sensitive issues such as harassment, discrimination, and gender-based violence should also be handled confidentially and in accordance with established safeguarding procedures.

To ensure effective implementation, a Grievance Redress Committee (GRC) shall be constituted. The committee may comprise representatives of the University management, the Rural Electrification Agency, Charlton Consult Limited, contractors, community representatives, student representatives, security personnel, and environmental and social safeguard officers. The committee will be responsible for receiving complaints, conducting investigations, facilitating dialogue among parties, and ensuring that corrective measures are implemented where necessary.

Stakeholders shall be able to submit grievances through multiple channels to ensure accessibility and inclusiveness. Complaints may be lodged verbally or in writing through complaint boxes placed within the University premises, dedicated telephone lines, email addresses, community liaison officers, or directly through the University's Works and Maintenance Department. Anonymous complaints shall also be accepted and treated with confidentiality to encourage openness and protect complainants from fear of retaliation.

Upon receipt of the grievance, the complaint shall be formally registered and acknowledged within a reasonable timeframe. The Grievance Redress Committee will then assess and investigate the matter to determine appropriate corrective actions. Resolution outcomes shall be communicated clearly to the complainant, and where necessary, follow-up actions shall be monitored to ensure satisfactory implementation. In situations where the complainant is dissatisfied with the decision reached, an appeal process shall be provided to allow for further review of the grievance.

All grievances and their resolutions shall be documented in a grievance register containing details such as the nature of the complaint, date received, actions taken, resolution status, and date of closure. Periodic monitoring and reporting of grievances will help improve transparency, accountability, and overall project performance. Continuous awareness creation and stakeholder engagement will also be carried out to ensure that all affected people understand the grievance process and can access it without difficulty.

8.6.1 Grievance Redress Mechanism Process

The key steps in the GRM process are as follows

1. Grievance Submission – Complaint is lodged through available channels.
2. Acknowledgment & Registration – Complaint is recorded and acknowledged.
3. Screening & Assessment – Issue is reviewed and categorized.
4. Investigation – Facts and evidence are collected.
5. Resolution – Appropriate corrective action or solution is provided.
6. Appeal/Escalation – Unresolved complaints may be reviewed at a higher level.
7. Closure & Documentation – Case is closed and documented for future improvement.

8.6.2 Publicizing and Disclosure of the GRM

The GRM will be disclosed to the stakeholders through written and verbal communication. The mediums to be used for this purpose are public meetings, group discussions The GRM disclosure will be done along with the disclosure of other management plans.

8.6.3 Receiving and Recording Grievances

As part of the GRM, the grievances from the stakeholder or their representatives may be communicated verbally (in person or over a telephonic conversation) or in written form to the project representatives or to the designated Grievance Officer (GO) directly. If the grievance is received directly by the GO or other project representatives, it will be recorded directly into the Grievance Form as soon as the personnel return to site.

8.6.4 Maintaining a Grievance Register

Each grievance received shall be recorded in a grievance register. This grievance register shall be updated at each stage of the grievance resolution. Once the grievance is recorded in the register, a preliminary analysis shall be undertaken by the social standard officer/ manager to ensure that the grievance is within the scope of the GRM.

8.6.5 Acknowledgment of Grievance

Once the grievance has been recorded, the stakeholder will receive an acknowledgment of receipt along with a summary of the complaint.

8.6.6 Resolution, Escalation, and Closure

Based on the understanding developed, the Social Safeguard Officer, in consultation with relevant departments, shall determine an appropriate resolution to the issue. This may include providing information to clarify the situation, implementing corrective actions to address identified problems, offering compensation; either financial or in kind for any damage caused, and introducing mitigation measures to prevent recurrence. The agreed resolution shall be communicated to the complainant within 10 working days after completion of the site investigation.

Where the issue falls outside the mandate of the Social Safeguard Officer, it shall be escalated to the Head of the PMU under the NEP, and the complainant shall be duly informed of the escalation. The Head of the PMU shall make efforts to resolve the grievance within 10 working days of receiving it.

If grievance remains unresolved and no adequate solution can be identified by the Head of the PMU, a formal response shall be provided to the complainant, along with guidance on alternative avenues for redress. This may include referral to a citizens' rights mediation centre for resolution before pursuing legal action. At any stage, if the complainant is dissatisfied with the proposed resolution, they may request that the grievance be escalated to the next level. In cases where a grievance is determined to be unfounded, a clear and reasoned explanation shall be provided to the complainant.

8.6.7 Update of Records

The grievance register shall be updated on a weekly basis to reflect the current status of each complaint. Once a grievance has been resolved and the outcome communicated to the complainant, it shall be formally closed in the register. The register should also document how each grievance was addressed, providing a clear record of the resolution process. These records will serve as useful references for handling similar grievances in the future. Where there is evidence of recurring issues or repeated grievances, such matters should be escalated to the Head of the PMU under the NEP for assessment to determine whether modifications to the project design are necessary.

CHAPTER NINE

CONCLUSION AND RECOMMENDATIONS

9.1. Conclusion

The Environmental and Social Impact Assessment (ESIA) for the proposed solar power plant at the Federal University of Ilorin Kwara State, was conducted in compliance with the Nigerian EIA Act Cap E12 LFN 2004 and World Bank Environmental and Social Standards. The assessment supports informed decision-making by integrating environmental and social considerations into project planning and implementation.

Stakeholder consultations were undertaken to identify and address project-related concerns, with ongoing engagement planned throughout the project lifecycle. Baseline environmental and socio-economic conditions were established through field surveys, sampling, literature review, and secondary data to support future monitoring and evaluation.

Potential environmental and social impacts were assessed, and mitigation measures were developed in line with industry's best practices and HSE standards. An Environmental and Social Management Plan (ESMP) was prepared to guide impact management, monitoring, and regulatory compliance during construction and operation. The Rural Electrification Agency (REA) will oversee monitoring of key parameters, including air quality, noise, and groundwater, in accordance with FMEnv and World Bank requirements.

9.2 Recommendations

The ESIA study recommends the following:

- Ensure full implementation of the Environmental and Social Management Plan (ESMP) throughout the project lifecycle.
- Conduct regular environmental monitoring for air quality, noise, groundwater, and waste management.
- Maintain continuous stakeholder engagement and effective community communication.
- Prioritize local employment, capacity building, and renewable energy training opportunities.
- Implement strong occupational health and safety measures, including emergency response systems.
- Establish and maintain an efficient Grievance Redress Mechanism (GRM) for timely resolution of complaints.
- Promote proper waste management, including safe disposal of hazardous and electronic waste.
- Ensure compliance with regulatory requirements through continuous oversight by the Rural Electrification Agency and relevant authorities.

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Appendix – Laboratory Report -Soil Ilorin

TUDAKA ANALYTICAL NIG. LIMITED

OFFICE ADDRESS:
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15th April 2026

Parameter	Unit	Season	Depth	SP1	SP2	SP3	Control
pH	-	Dry	0–15 cm	6.2	6.5	6.9	5.7
	-	Dry	15–30 cm	5.4	5.9	6.5	5.4
	-	Wet	0–15 cm	6.5	6.6	6.7	6.8
	-	Wet	15–30 cm	6.4	6.6	6.9	6.5
Electrical Conductivity (EC)	µS/cm	Dry	0–15 cm	95	112	128	109
	µS/cm	Dry	15–30 cm	140	153	166	106
	µS/cm	Wet	0–15 cm	126	165	208	147
	µS/cm	Wet	15–30 cm	170	216	262	187
Temperature	°C	Dry	0–15 cm	33.0	34.8	36.5	34.7
	°C	Dry	15–30 cm	32.8	33.7	34.9	33.9
	°C	Wet	0–15 cm	32.5	32.6	32.8	32.4
	°C	Wet	15–30 cm	32.9	33.8	34.7	32.8
Nitrate	mg/kg	Dry	0–15 cm	0.25	0.46	0.68	0.21
	mg/kg	Dry	15–30 cm	0.10	0.30	0.51	0.31
	mg/kg	Wet	0–15 cm	0.15	0.70	1.24	0.92
	mg/kg	Wet	15–30 cm	0.10	0.82	1.40	0.81
Ammonia	mg/kg	Dry	0–15 cm	0.41	0.76	1.12	1.25
	mg/kg	Dry	15–30 cm	0.12	1.05	1.97	1.16
	mg/kg	Wet	0–15 cm	1.40	1.85	2.20	1.95
	mg/kg	Wet	15–30 cm	1.20	1.68	2.15	1.76
Phosphate	mg/kg	Dry	0–15 cm	1.2	2.3	3.4	3.2
	mg/kg	Dry	15–30 cm	2.8	4.1	5.7	2.6
	mg/kg	Wet	0–15 cm	3.6	5.0	6.4	2.2
	mg/kg	Wet	15–30 cm	4.15	4.90	5.60	3.8
Sulphate	mg/kg	Dry	0–15 cm	7.5	9.4	11.3	8.5
	mg/kg	Dry	15–30 cm	6.3	9.2	12.4	11.8
	mg/kg	Wet	0–15 cm	10.6	13.2	16.5	11.5
	mg/kg	Wet	15–30 cm	8.9	11.5	14.1	10.8
Chloride	mg/kg	Dry	0–15 cm	0.8	1.3	1.9	0.4
	mg/kg	Dry	15–30 cm	1.0	1.7	2.5	0.1
	mg/kg	Wet	0–15 cm	1.5	1.3	1.2	1.4
	mg/kg	Wet	15–30 cm	1.0	1.4	1.8	1.12
Total Organic Carbon (TOC)	%	Dry	0–15 cm	0.25	0.48	0.74	1.2
	%	Dry	15–30 cm	0.18	0.28	0.37	0.06
	%	Wet	0–15 cm	0.75	1.00	1.25	1.01
	%	Wet	15–30 cm	0.12	0.71	1.30	0.16
Moisture Content	%	Dry	0–15 cm	4.8	6.1	7.5	7.3
	%	Dry	15–30 cm	5.2	6.0	7.2	5.1
	%	Wet	0–15 cm	6.5	9.4	12.2	12.3
	%	Wet	15–30 cm	1.1	8.3	15.6	13.1

QUESTIONNAIRES

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PLAN (ESIA) PHASE III: ENERGIZING EDUCATION PROGRAM (EEP) PROJECT

NOTE:

Please read each question carefully. Your answers are completely confidential and will be included only in summaries where individual answers cannot be identified. Unless otherwise instructed, please tick appropriate answer category that best describes your opinion. It will take approximately 20 minutes to complete this questionnaire.

SECTION A: Household data

Location/Name of School.....

1. Gender of Respondent: (a) Male (b) Female
2. Age: (a) Below 18 yrs (b) 18-45 yrs (c) 46-65 yrs (d) Above 66 yrs
3. Marital Status: (a) Single (b) Married (d) Divorced/Separated (e) Widowed
4. Occupation: (a) Civil Servant (b) Daily Labourer (c) Trading & Shop Keeping (d) Artisans (e) Employed (salary)(f) Retired (g) Famer (h) Unemployed (i) Others specify.....
5. Residential Status: (a) Permanent Resident (b) Back Home (Returnee) (c) Nonresidents, Visiting
6. Ethnic Group: (a) Ebira (b) Igala (c) Hausa-Fulani (d) Igbo (e) Hausa Yoruba (f) others.....
7. Religion: (a) Islam (b) Christianity (c) Traditional
8. Relationship to Houshold Head (HH): (a) Self (b) Spouse (c) Child (d) Parent (e) Other, specify.....
9. Size of the HH .....
10. How long have you been living/working in this area? (a) 0-2 yrs (b) 3-5 yrs (c) 6-9 yrs (d) 10 yrs and Above
11. Education: (a) NO formal education (b) Primary School (c) Secondary School (d) Tertiary (Excluding University) (e) University Graduate (f) University Postgraduate

SECTION B: Health Status

1. How do you manage your health conditions when sick? (a) Attend hospital/clinic (b) Buys drugs from nearby chemist (c) Traditional medicine (d) None (e) Others Specify.....
2. If you do attend a hospital/clinic, when last did you visit one? (a) last six months (b) last one year (c) last five years (d) more than five years ago (e) Never visited one.

3. Please tick one or more of the under-mentioned ailments/sicknesses that you suffer from most, accordingly?

4.

5.

Ailment	**√**	**Ailment**	**√**
Whooping Cough		Rheumatism	
Tuberculosis		Rashes	
Asthma		Eczema	
Dysentery		Ringworm	
Diarrhoea		Eye pains	
Cholera		Cataract	
Pile		Glaucoma	
Hypertension		Typhoid fever	
Congestive health problem		Malaria	
Pneumonia		Sickle cell anemia	
Sexually transmitted diseases		Epilepsy	

7. Do you think your health condition will be affected by the proposed Infrastructure intervention? (a) Yes (b) No

8. If yes, how? ……

9. Please suggest how this can be averted during construction and implementation……

SECTION C. Standard of Living /Socioeconomic Activities

1.0 Assets

1.1 What sort of housing does your household live in?					
a. Construction material - Walls		Plastered mud	c. Number of rooms		1-2
		Cement blocks			3-4
		Other (specify)			Other (specify)
b. Construction material - roofing		Corrugated roofing	d. Other structures on plot		Animal Pen
		Aluminium			Granary
		Asbestos			Shops
		Tile			Kiosks

		Other (specify)			Other (specify)
e. Construction material - floor		Earthen			
		Concretes			
		Tiles			
		Other (specify)			
f. Toilet Facility		Pit latrine			
		Water closet			
		Toilet facility outside dwelling			
		Pier latrine			
		Other (specify)			
		None			
g. Tenure of housing		Owned			
		Rented			
		Occupied rent free			
		Other			
h. Tenure of land		Owned			
		Rented			
		Occupied rent free			
		Lease hold			
		Others specify			

1.2 Indicate household refuse disposal for solid waste? (Multiple options) (a) Depositing refuse at backyard of the house (b) Dumping in water body (c) Dumping in community refuse/garbage pit/dumpsite (d) Burning after gathering together (e) Waste collector (f) Other specify.....

2.0 Household Services

2.1 Rank in order of availability and usability the source(s) of lighting for the household? (Please use 1, 2,in hierarchical order with 1 indicating the most available and used source)

(a) PHCN	(b) Generator	(c) Lantern	(d) Candle	(e) Palm Oil Lamp	(f) Torchlight Battery	(g) Wood	(h) Kerosene	(i) Gas

2.2 Using the method in 2.1, indicate major source of energy for cooking?

(a) Fire Wood	(b) Coal	(c) Kerosene	(d) Electricity	(e) Animal dropping	(f) Gas	(g) Crop Residue/saw dust	Others

3.0 Sources of Water

Sources	for drinking	for cooking	for bathing and washing
a.Well			
b. Borehole/Water pump			
c. Community tap			
d. Piped water outside dwelling			
e. River			
f. Rain harvesting			
g. Water vendor			
h. Tanked water			
i. Other (specify)			

4.0 **Income and source livelihood**

Please, state your main income per month and source livelihood	₦

4.1 Remittances

1. Does anyone in the family who lives elsewhere send money to you?	1	YES	2	NO
2. If yes, how much (per month)	₦			

5. In your opinion, how has the standard of living of your household changed over the previous three years? (a) Same (b) Better (c) Worse
6. Is the option in 5 propelled by the state of the electricity provision/availability? (a) Yes (b) No
7. If 6 is YES, do you think the proposed infrastructure intervention will improve the situation? (a) Yes (b) No
8. If 7 is YES specify how the project will improve the situation .....

SECTION D: Gender-Based Violence/Sexual Exploitation and Abuse

1. Are there any provisions which restrict women's access to health and other social services? In particular which:

(Please specify in the space provided for this purpose "yes" or "no")

( ) require the consent of a male relative/husband for a married woman's medical examination or treatment or access to contraceptives or abortion,

( ) require parental consent in case of adolescents' access to contraceptives abortion;

( ) allow medical practitioners to refuse provision of a legal medical service on grounds of conscientious objection

( ) prohibit certain medical services, or require that they be authorized by a physician, even where no medical procedure is required; in particular:

( ) IUDs (intrauterine devices) or hormonal contraceptives

( ) Emergency contraceptives, including the morning-after pill, ( ) Sterilization on request;

( ) Early abortion (in first trimester of pregnancy) at the pregnant woman's request

( ) Medically assisted reproduction (e.g., in vitro fertilization) 2. Are the following acts criminalized?

(Please specify in the space provided for this purpose "yes" or "no")

( ) adultery

( ) prostitution

(If yes, who is criminally responsible? (a) the sex worker (b) the procurer and/or the customer) (c) both

3. Are there any measures and programs put in place in order to increase women's participation safety e.g. in public urban spaces, in public transportation, etc.? (a) Yes (b) No (c) No idea

4. Are there specific training programs for medical and legal professionals on the issue of gender-based discrimination in the area of health and safety? (a) Yes (b) No (c) No idea

5. How do you ensure gender equity in the community? (a) Women are elected in public office (b) Females are given equal opportunity and access to education and employment (c) Quotas on genders are ensures in leadership of community-based organizations (d) Others specify.....

SECTION E: Resources/ Cultural Property

1. Please indicate the environmental problems which your community experiences? (a) Soil infertility (b) Poor drainage system (c) Bad road (d) Bad lands (e) environmental degradation (f) Degraded land (i) Destruction of infrastructures (j) Others

(specify) .....

2. Please indicate the environmental problems which your community would likely experience and whose cause can be linked to the proposed Infrastructure intervention project during construction?

(a) Soil infertility (b) Poor drainage system (c) Bad road (d) Low visibility

(e) Erosion Problems (f) Flooding (g) Environmental degradation

(h) Destruction of infrastructures (i) encroachment of land properties (j) Pollution (air, surface water, ground water, noise) (k) others (specify)

……..

3. Do you think the proposed Infrastructure intervention project will affect any valued resource/cultural/archaeological property in your area? (a) YES (b) NO
4. If yes mention the name(s) of the valued resource/cultural/archaeological property

……

5. How will valued resource/cultural/archaeological property be affected? (a) Displacement of such valued cultural properties (b) Vandalization of sacred items/locations (c) Possible theft of sacred/archaeological items (d) Others,

specify:……

SECTION F: Intervention Project Activities Impact Evaluation

1. Are you aware of the proposed Solar Power Project? (a) Yes (b) No
2. If yes, from which source (a) Community meetings (b) Media (TV, Radio, Newspaper, Internet) (c) Others specify……
3. Do you think the proposed Infrastructure intervention project can cause restiveness in your community? (a) YES (b) NO
4. If 3 is yes, how will the proposed Infrastructure intervention result in restiveness? (a) Disrespect of norms and culture by contractors (b) loss of farmland / Property (c) Possible theft of sacred/archaeological items (d) local people not employed during

construction (e) Others, specify: ……

5. How will the proposed Infrastructure intervention project impact on your livelihood and environment?

Positive impacts	Negative impacts
(a)	
(b)	
(c)	

6. Can you name some of the animals and other habitat that may be affected by the proposed Infrastructure intervention project?

……

7. What do you expect from the activities of solar power Infrastructure intervention? (a) employment of Locals during construction (b) compensation for those whose properties will be affected (c) capacity building for maintenance during implementation (d) community input into final engineering design (e) Others please specify……

Section G: Grievance Redress Mechanism

1. Have you had grievances issue in this community in the last three years? (a) Yes (b) No

2. If 1 is yes, what was the cause of the grievance? (a) Land issue (b) theft of valuables (c) vandalization of property (d) Others, please specify.....

3. Who do you report your grievances in this community to? (a) School authority/management (b) Law enforcement (c) My landlord/CDA (d) traditional/community leader (e) Others, please specify.....

4. Are grievances satisfactorily addressed or resolved by option(s) chosen in question 3 above? (a) Yes (b) No

5. Are there any other issue(s) of concerned as regards the proposed intervention project in your area, please state clearly?.....

Section H: World bank ESS

	World Bank ESS	Question	Yes	No
1	ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Will the project activities impact or lead to the disruption of the ecosystem?		
2	ESS2: Labour and Working Conditions	Are labour rights and safe working conditions ensured?		
	ESS3: Resource Efficiency and Pollution Prevention	Will waste be generated from this project		
	ESS4: Community Health and Safety	are community health and safety nearby affected by this project?		
	ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	A will farmer within the university by displaced		
	ESS6: Biodiversity Conservation and Sustainable	How is biodiversity protected?		

	Management of Living Natural Resources			

MINUTE OF MEETING HELD AT THE UNIVERSITY OF ILORIN, KWARA STATE WITH THE MANAGEMENT OF THE UNIVERSITY.

Title	Stakeholder's Consultation meeting for the Environmental and Social Impact Assessment for the Deployment of the Proposed Solar Power Plant Project in the University of Ilorin, kwara State, Nigeria.
Date	Thursday 12th February, 2026
Language	English language
Location	Vice Chancelor's Conference Hall, University of Ilorin, kwara State
Participants	Prof. Omopupa k. Tunde (University librarian), Prof. M.A., Alfanla (Registrar); R.K. Amoo (Director, Works), Tosin Obafemi (Deputy Director, Works), Azeezzat Ibrahim (Deputy Director), Dauda A.; Emmanuel Osamiewenfan (Charlton Consult Limited); Dr. Charles Ebojei (Charlton Consult Limited).
Introduction	The Director of Works, Engr. Amoo introduced the management team of the University of Ilorin, he stated that the Vice Chancellor and the Deputy Vice Chancellors were unavoidably absent due to prior engagement out of the University Community. However, the Vice Chancellor was ably represented by the Registrar. Engr. Amoo affirmed that the University was in receipt of a letter dated 15th of January, 2026 from the Rural Electrification Agency (REA) introducing the Charlton Consult limited as one of its consultants to undertake the preliminary studies and design for the proposed Solar Power Plant project, however, the letter did not specify the precise date for the engagement.
Presentation by Charlton Consult Limited	The team lead, Emmanual Osamiewenfan, congratulated the University for been selected to benefit from the Distributed Access through Renewable Electricity Scale-up (DARES) programme of the REA in collaboration with the World bank. He stated that access to uninterrupted, reliable and affordable electricity was germane to industrialization and in particular, a must for universities to strive as centers of excellence for research and academic purposes. He mentioned that the proposed project was in line with the Energy Transition Programme and aligns with the SDG 7. He posited that stakeholder's engagement is a mandatory aspect of the Environmental and Social Impact Assessment (ESIA) process, aimed at informing the stakeholders of the Federal Government intention in regard to the deployment of the Solar power plant, securing stakeholders support and buy-in and to share ideas on how best to implement the proposed project among others. Furthermore, he mentioned that the project sponsors were critical about the land administration, ensuring that the proposed project location is free from all forms of dispute.
Address by the Representative of the Vice Chancellor	Prof. Omopupa welcomed the Consulting team from Charlton Consult Limited on behalf of the Vice Chancellors Prof. Wahab Olasupo Egbewole, SAN and his management team. He appreciated the Federal Government and the REA for the laudable initiative. He mentioned that the University had series of electricity challenges in 2025, ranging from inadequate supply to humongous electricity bills which had eaten deep into the institution's finances. He posited that access to uninterrupted electricity supply was critical in keeping to the mandate of the institution which are teaching, learning and other engagement. They have tried to mitigate some of the cost, unfortunately the challenges persist. He mentioned that the project is a blessing to the institution and they are pleased having a robust stakeholder's engagement in that regard. He commented that all the critical aspect of human lives revolves around access to adequate electricity supply, especially in the face of insecurity, where the institution needs electricity for street lightening at night; pump water, power equipment and machines among other. Finally, he appreciated the project conceiver, the REA and World Bank for the project which promises to address pending electricity challenges in the University. He assured the team that they are ready to partner collaboratively with the REA for a seamless implementation of the project.
Comments and Questions	Prof. M.A., Alfanla, enquired about the schedule for the project implementation. Mr. Emmanual, enquired if the proposed project location is from encumbrances and land dispute, also if the requested document and information contained in the letter from the REA had been responded to.

Responses by Stakeholders	Prof Omopupa responded that the information would have been sent to the REA, however, they will get clearance from the school management to share them with the consulting team. Also, he posited that the university has adequate land for the project, and that there were no pending compensation issues or dispute related to the ownership of the proposed project location. Dr. Charles posited that the project will be implemented in the shortest time possible, once the preliminary studies are concluded.
Closing	The meeting came to a close by 2.30 pm.

ATTENDANCE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PLAN (ESIA) PHASE III:
ENERGIZING EDUCATION PROGRAM (EEP) PROJECT

Name of University UNIVERSITY OF ILORIN
Location ILORIN, KWARA STATE
Date 12/02/2026

Stakeholder Engagement – General

n	Name	Designation	Contact	Signature
.	Prof Omoyiya K. Tunde	University Librarian	Unilorin	
.	M. A. Afonla	Registrar	Unilorin 08035783125	12/02/2026
3	R.K AMOO	Director	dow@Unilor.edu.ng	
4	Tosin Obafemi	Deputy Director	08063337356	
5	Azeezat A. Ibrahim	Deputy Registrar	08028876502	
6	Dawda Ab Ly Fabai	Officer Kwara	07037386015	
7	Emmanuel Osamuwanta	Consultant	07062392434	
8.	Dr. Charles Ebojei	"	08058456185	

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PLAN (ESIA) PHASE III: ENERGIZING EDUCATION PROGRAM (EEP) PROJECT

Name of University ILorin
Location Uni-Ilorin VC
Date 12/2/2026

Stakeholder Engagement – General

s/n	Name	Designation	Contact	Signature
1	Engr. J.S. Adebayo, FNSE	Deputy Director	Works Dept. Unilorin	[signature]
2	Mrs. C.O Balogun	B/woman	Shop 1 squash	[signature]
3	Mr. Abubakar Kayode A.	B/man	Shop 2 squash	[signature]
4	Olayiwola Al-Ameen O	Human Kinetics Stu.	08117692031	[signature]
5.	OLANIYI ESTHER	H.K.E	09046470334	[signature]
6	OLUPAYIMO OKIKI	H.K.E	09069131966	[signature]
7.	Mrs M. Z. Aderogba	B/woman	08023574939	[signature]
8	MR Adegbola SA	Tanke Ilorin	08037204770	[signature]
9	ADEBOLAJE SAMAD	AES Student	07038168080	[signature]
10	Tosin Obafemi	Deputy Director	08063337356	[signature]
11	Engr. Dr. Jenyo M.B	Director	08035640079	[signature]
12	Engr. Olatunbosun F.O	Assistant Director	08034114418	[signature]
13	Prof Mohammed B. Abdulkadir	Acting CMD	08065754333	[signature]
14	DR. B. B. OLAFIMIHAN	DCMAC (T&E)	08033607286	[signature]