ESIA

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

for the proposed

AGRO-INDUSTRIAL HUB (AIH)

AT ADIABO, ODUKPANI LGA, CROSS RIVER STATE

by

CR-SAPZ

CROSS RIVER-SPECIAL AGRO-INDUSTRIAL PROCESSING ZONE PROGRAM

Submitted to

FEDERAL MINISTRY OF ENVIRONMENT, ABUJA

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ABBREVIATIONS & ACRONYMS

Acronym	Full Meaning
%	Percent
<	Less than
>	Greater than
≤	Lesser than or equal to
≥	Greater than or equal to
≥	Greater than or equal to
ºC	Degree Celsius
ºF	Fahrenheit
AfDB	African Development Bank
AIH	Agro-Industrial Hub
AKSU	Akwa Ibom State University
AQ	Air Quality
CE	Critically Endangered
Cl_2	Chlorine gas
CO	Carbon monoxide
CBO	Community-Based Organization
CRS	Cross River State
CRSMEnv	Cross River State Ministry of Environment
CRS-SAPZ	Cross River -Special Agricultural Processing Zone Program
CSO	Civil Society Organisation
D	Dominant
DLP	Damage Liability Period
Rmt	Running Meter
RCC	RCC – Reinforced Cement Concrete
MVA	MVA – Mega Volt Ampere
KVA	KVA – Kilo Volt Ampere
KLD	KLD – Kilolitre per Day
MBBR	MBBR – Moving Bed Biofilm Reactor
STP	STP – Sewage Treatment Plant
HDPE	HDPE – High-Density Polyethylene
GI	GI – Galvanised Iron
DD	Data Deficient
dB(A)	Decibel
E	East
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan

Acronym	Full Meaning
FBO	Farmer-Based Organization
FGD	Focus Group Discussion
FMAFS	Federal Ministry of Agriculture and Food Security
FMEnv	Federal Ministry of Environment
FMoHSW	Federal Ministry of Health and Social Welfare
GBV	Gender-Based Violence
GI	Galvanized Iron
GPS	Geographic positioning unit
GRM	Grievance Redress Mechanism
H_2S	Hydrogen sulphide
HCN	Hydrogen Cyanide
HDPE	High-Density Polyethylene
IFAD	International Fund for Agricultural Development
IPP	Indigenous Peoples Plan
ISDB	Islamic Development Bank
IUCN	International Union for Conservation of Nature
KII	Key Informant Interview
KLD	Kilolitre per Day
LC	Least concern
LGA	Local Government Area
LGBTQ	Lesbian, Gay, Bisexual, Transgender, and Queer
LREP	Livelihood Restoration and Enhancement Plan
M	Meter
m/s	meters per second
m^3	Meter Cube
mg/m^3	Milligram per cubic meter
Max	Maximum
M&E	Monitoring and Evaluation
MBBR	Moving Bed Biofilm Reactor
Min	Minimum
MVA	Mega Volt Ampere
N	North
NE	North East
NGO	Non-Governmental Organization
NH_3	Ammonia
NIOSH	National Institute of Occupational Safety and Health
NMA	Nigerian Meteorological Agency
NO_2	Nitrogen dioxide
NPC	National Population Commission
NT	Near Threatened
NW	North-West
O&M	Operation & Maintenance

Acronym	Full Meaning
PAPs	Project-Affected Persons
PEL	Permissible Exposure Limit
PM	Particulate matter
ppm	Part per million
PPP	Public-Private Partnership
RAP	Resettlement Action Plan
REA	Rural Electrification Agency
RCC	Reinforced Cement Concrete
Rmt	Running Meter
S	South
SE	South East
SAPZ	Special Agro-Industrial Processing Zones
SEA	Sexual Exploitation and Abuse
SGBV	Sexual and Gender-Based Violence
SIA	Social Impact Assessment
SMEs	Small and Medium Enterprises
SO_2	Sulphur dioxide
STEL	Short-term Exposure Limit
STP	Sewage Treatment Plant
SW	South West
Th	Threatened
ToR	Terms of Reference
TVOCs	Total Volatile Organic Compounds
TWA	Time Weighted Average
VCD	Value Chain Development
VGP	Vulnerable Groups Plan
Vu	Vulnerable
W	West
WHO	World Health Organization
Zn	Zinc

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EXECUTIVE SUMMARY

ES 1: Introduction

The Cross River State Agro-Processing Zone (CR-SAPZ) is part of the Federal Government of Nigeria's Special Agro-Industrial Processing Zones (SAPZ) programme, designed to enhance agricultural productivity and promote value addition in key agro-commodity chains. Located on a 130-hectare site in Adiabo Community, Odukpani LGA, Cross River State, the CR-SAPZ aims to catalyze rural industrialization through modern infrastructure, reduce post-harvest losses, and create jobs. The project is sponsored by the Federal Ministry of Agriculture and Food Security (FMAFS) and supported by the African Development Bank (AfDB), with implementation led by the Cross River State Government under a Public-Private Partnership (PPP) model.

The proposed Agro-Industrial Hub (AIH) in Adiabo in Odukpani Local Government Area of Cross River State is a 130 ha of land, located along Tinapa-Adiabo Road, off the Calabar - Ikom Highway, at latitude 5° 4'2.88"N: longitude 8°19'17.76"E, belonging to, and donated by, two Adiabo communities of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot, through the Adiabo Clan Council, to the Government of Cross River State for the AIH project. The land was previously used by PAMOL for rubber plantation, and recently restored to the community, on expiration of their tenor. About 80 ha are currently used by farmers for cultivation of cash crops like cassava, maize, rice, and melon while 14 ha are light fallow bush and 36 ha occupied by riparian forest. Other communities, Ikot Okon Archibong, and Ikot Okon are within 3 km radius of the proposed site, and they belong to the Adiabo Clan.

The ESIA was commissioned to comply with the Environmental Impact Assessment Act Cap E12 LFN 2004 and the AfDB's Integrated Safeguards System (ISS) 2024. Its core objectives are to identify potential environmental and social impacts of the CR-SAPZ, evaluate their significance, and propose mitigation and enhancement measures to ensure environmental sustainability, social inclusion, and compliance with national and international standards.

The scope of the study includes an assessment of biophysical and socio-economic conditions, stakeholder engagement, and the development of a comprehensive Environmental and Social Management Plan (ESMP). Methodologies used include desk research, field sampling, socio-economic surveys, stakeholder consultations, GIS mapping, and impact analysis using standardized risk ranking matrices. A separate RAP with an LRP has been prepared for implementation.

A comprehensive framework of environmental and social governance under which the CR-SAPZ project is being executed. It brings together the national, state, and international legal instruments, institutional arrangements, and policy frameworks that guide the planning, implementation, and monitoring of the Environmental and Social Impact Assessment (ESIA).

At the national level, emphasis is on the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, which mandates environmental evaluations for projects with significant environmental implications. The Federal Ministry of Environment (FMEnv) and the National Environmental Standards and Regulations Enforcement Agency (NESREA) are identified as the primary regulatory authorities. Other referenced legislation includes the Land Use Act of 1978, which governs land tenure and acquisition, and various sectoral environmental regulations.

In addition to Nigerian regulations, the project complies with international best practices and development partner guidelines, particularly those of the African Development Bank (AfDB). The AfDB's Integrated Safeguards System (ISS) outlines operational safeguards related to environmental sustainability, pollution prevention, resettlement, labor, and stakeholder engagement. The project's ESIA process aligns with these requirements through risk screening, stakeholder consultations, and the development of an Environmental and Social Management Plan (ESMP).

On the institutional front, the framework defines the roles and responsibilities of federal, state, and local government bodies, with provisions for oversight, enforcement, and collaboration. The Cross River State Ministry of Environment, the State Environmental Protection Agency, and relevant MDAs are key actors in this structure. Their engagement ensures that implementation aligns with environmental sustainability, community welfare, and statutory compliance.

The structure of the report is laid out in nine chapters, beginning with this introduction and followed by chapters covering project justification, legal frameworks, project description, environmental baseline, potential impacts, and mitigation planning, environmental and social management plans and a conclusion.

ES 2: Project Justification

The initiative is a response to persistent constraints in crop value chains within Cross River State—challenges spanning low yields, poor market access, inadequate processing technologies, unreliable infrastructure, and limited access to credit and extension services. These constraints have hindered agricultural productivity, especially among smallholder farmers who dominate the rural landscape.

The CR-SAPZ project aims to revitalize the agricultural sector by addressing these systemic issues through targeted investments in infrastructure, value addition, and market systems. Expected benefits include enhanced food security, poverty reduction, employment creation, improved livelihoods, and stimulation of both rural and national economies. Socioeconomic benefits are far-reaching: training in Good Agricultural Practices, creation of out-grower schemes, post-harvest loss reduction, and expanded access to domestic and international markets.

The benefits of the proposed project are detailed across three key stakeholder categories:

- **Government**: improved business environment, stronger investor confidence, and enhanced revenue generation;
- **Communities**: employment, market access, improved road networks, capacity building, and CSR-driven development;
- **Investors**: reduced operational costs, tax incentives, access to shared infrastructure, and compliance-ready facilities meeting international food safety standards.

Revenue streams for the AIH include land and facility leasing, energy and water supply fees, infrastructure maintenance, auxiliary services, and commercial ventures such as food courts, advertisements, and weighbridge operations. The project also demonstrates strong potential for profitable cassava and rice value chains, highlighting job creation opportunities across logistics, processing, and export sectors, with high gender inclusiveness.

Sustainability was evaluated through environmental, social, economic, and technical lenses. The ESIA has embedded conservation strategies, climate-sensitive infrastructure designs, and stakeholder engagement mechanisms. Social sustainability is supported through inclusion of vulnerable groups, community hiring preferences, and livelihood restoration efforts. Economically, the AIH promises improved return on investment, labor absorption, and expanded markets. Technically, the project is deemed feasible due to its use of Best Available Technologies (BAT) and support from an experienced international contractor.

Three development options were considered: no-project (rejected due to food insecurity risks), delayed implementation (rejected due to inflation concerns and opportunity loss), and immediate implementation (preferred for immediate and long-term benefits). For site selection, a GIS-based Multi-Criteria Analysis (MCA) was conducted comparing four potential sites. **Adiabo** emerged as the most suitable based on topography, access to markets, drainage, and land use, outperforming alternatives like Mbarakom, Ikot Mbakara, and Ekpri Ikang.

ES 3: Project Description

The AIH, designed to host a wide range of facilities including processing zones, vocational centres, warehouses, residential areas, and commercial spaces, totaling 130 hectares. will operate under a Design, Build, and Operate (DBO) model, offering common-use infrastructure for agro-industrial tenants. Its key features include a boundary fencing and perimeter security post, office buildings, admin blocks, training and R&D centres, roads, drainage, water, sewage, electricity, solid waste systems, cold storage, fuel stations, veterinary clinics, recreational areas

The internal setup includes flexible pavement roads (2,902m), stormwater drains (5,804m), power substations (13 MVA demand), borewells, HDPE water networks, sewage treatment plants (STP, 500 KLD), and solar-powered street lighting. Roads are categorized into major (2-lane) and minor (1-lane) with asphalt surfacing. Rehabilitation of Tinapa Road and construction of a flyover at the Calabar-Ikom Highway intersection are recommended to improve access and transport efficiency.

Water demand is projected at 6,900 m^3/day (max 12,420 m^3/day), sourced 50% from boreholes and 50% from surface water. A dual storage system and fire-fighting infrastructure are planned. The estimated power load is 10.98 MW, with 1.098 MW reserved for solar hybrid systems. There will be an additional telecommunication infrastructure for reliable connectivity.

Stormwater will be discharged via a dedicated channel into Calabar River. A combination of roadside and main drains, culverts, and gravity-fed sewer pipes is planned. Domestic and industrial wastewater will be treated via a packaged plant.

Waste types include construction debris, process waste, sludge, and recyclables. A color-coded segregation system will be adopted. Waste not recovered by the contractor will be handled by Cross River Waste Management Agency.

The project will use large volumes of cement, aggregates, pipes, and steel sections, and employ about 400 personnel of different categories, drawn from the local catchment areas, nationally and a few expatriates. Equipment includes excavators, rollers, water tankers, cranes, and concrete pumps.

A detailed construction scope flowchart and schedule are presented, covering road works, utilities, and building structures which will span 24 months. Maintenance plans are included in the DBO contractor's Facility Management Plan.

ES 4: The Existing Environment

The study was conducted using a structured, multidisciplinary methodology that combined field sampling, stakeholder engagement, and desktop research. Data collection spanned both wet and dry seasons, with fresh fieldwork in June 2025 and validation through secondary sources.

Environmental baseline assessments covered air, water, soil, vegetation, and sediment quality, alongside geophysical investigations and community health surveys. All sampling and laboratory analyses adhered to national and international standards (FMEnv, APHA, EPA, ASTM), with strict QA/QC protocols ensuring data integrity.

The field sampling campaign was designed to generate accurate baseline data across key environmental and social indicators. Its core objective was to assess the prevailing ecological and community health conditions in the project area, forming a scientifically grounded reference for impact prediction and mitigation planning.

The scope of sampling extended across multiple domains, including air quality and noise levels (10 measurement points plus 1 control), soil characteristics (5 samples plus 1 control), surface and groundwater quality (four each plus 1 control), hydrobiology, fisheries resources, wildlife diversity, vegetation structure, geology, hydrogeology, and community health and socioeconomic conditions. This comprehensive coverage ensured that both natural ecosystems and human populations were fully represented in the environmental baseline.

Laboratory analyses were conducted at the Ministry of Science and Technology Laboratories in Uyo, Akwa Ibom State, applying methodologies approved by Nigeria's Federal Ministry of Environment (FMEnv) and international standards such as APHA, EPA, and ASTM. To safeguard data reliability, key parameters like pH, conductivity, temperature, and total dissolved solids (TDS) were measured in-situ, using calibrated instruments, reducing error associated with sample transportation and delay.

Air Quality and Noise

Ambient air quality analysis revealed that most pollutant concentrations were within permissible limits. However, exceedances of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) were recorded near biomass combustion areas, primarily linked to local cooking and fish-smoking activities. Noise levels were slightly above NESREA daytime thresholds in market areas but remained within limits in residential zones.

Meteorology and Climate

The project area experiences a humid tropical climate with average temperatures around 27°C, annual rainfall exceeding 3,000 mm, and high relative humidity. Prevailing winds are weak to moderate, predominantly from the northwest and southwest. These conditions favor agricultural productivity but require climate-resilient infrastructure to mitigate flooding and humidity-related risks to industrial operations.

Water and Sediment Quality

Groundwater samples were generally potable and met WHO standards, while surface water samples showed microbial contamination and elevated iron concentrations, necessitating treatment before use. Sediment samples exhibited stable chemical composition, low trace metal content, and minimal organic contamination, classifying them as unpolluted under USEPA guidelines.

Soil and Geology

Soils are mainly sandy loams of the Benin Formation, slightly acidic, and moderately drained. They are suitable for agricultural use but require nutrient enrichment for intensive cropping. The area is geotechnically stable with low risk of erosion when managed properly.

Ecology

The vegetation is a mosaic of farmlands, fallow lands, and regenerating secondary forest. Biodiversity studies recorded moderate floral and faunal diversity with some species of conservation interest such as the hooded vulture and chimpanzee. Aquatic biodiversity in the Calabar River was diverse, with healthy plankton and fish populations and no significant pollution effects observed.

Socioeconomic and Health Conditions

Adiabo communities are agrarian, relying primarily on farming, fishing, and petty trading. Infrastructure is limited, with poor access roads, inadequate water supply, and non-functional healthcare facilities. Common health issues include malaria, diarrheal diseases, and hypertension. Despite awareness of health risks, access to medical services remains low. The communities expressed strong support for the project, anticipating employment, improved infrastructure, and social amenities, while requesting fair compensation and environmental safeguards.

Stakeholder Engagement

Stakeholder consultations were central to the process, involving host communities and regulatory bodies to foster transparency, secure consent, and integrate local perspectives. This inclusive approach enhanced community ownership and minimized resistance.

Stakeholder mapping identified three categories: primary stakeholders – directly affected communities (Adiabo Ikot Mbo Otu and Adiabo Esine Ufot), secondary stakeholders – regulatory agencies (FMEnv, NESREA, etc) and other relevant MDAs, development partners, Odukpani local government council, and private sector actors, and tertiary stakeholders – NGOs, civil society, academic institutions, and media organisations.

Preliminary consultations during the ESIA preparation stage (May–July 2025) included stakeholder engagement / scoping workshop for all the categories of stakeholders on 17 June 2025 at Hogis Hotel, Calabar. Also, town hall meetings, focus group discussions, key informant interviews, and socio-economic surveys were held in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot, the two communities within the 3 km area of influence. Stakeholders, especially the PAPs and the Adiabo communities welcomed the proposed AIH but raised fears of project abandonment like a few other projects in the area that were not completed and operational. They expressed their expectations for project completion, and for local employment and inclusivity, fair compensation, market access, skills training, improved road and water infrastructure, and environmental protection measures.

The engagement strategy is designed for each phase of the project. A mix of engagement tools like community meetings, focus groups, local media, printed materials, social media, and liaison offices will ensure inclusivity and reach.

The FMEnv shall disclose the ESIA for 21 official days and place paid announcements in two national dailies and local radio station while AfDB shall disclose the cleared ESIA and other ancillary instruments on its website. Communication channels will be adapted for different audiences, including local languages and accessible formats for vulnerable groups. Monitoring disclosure effectiveness will involve surveys, meeting attendance records, and third-party reviews.

Grievance Redress Mechanism

A structured Grievance Redress Mechanism has been designed to provide multiple accessible channels for lodging complaints, establish a structured process for receiving, recording, and addressing grievances, ensure PAPs and vulnerable groups have equal access to resolution mechanisms, promote timely and transparent resolution of issues, and strengthen accountability of the CR-SAPZ, DBOC, and relevant public institutions.

The GRM will operate at multiple levels - starting with the Community Liaison Officer (CLO) as the first point of contact, escalation to the Grievance Redress Committee (GRC) at the project level, and further referral to state or national authorities, when necessary.

ES 5: Associated and Potential Impacts

The ESIA identified and evaluated potential environmental and social impacts across all project phases using qualitative and quantitative risk analysis. Impacts were categorized as low, medium, or high based on significance, duration, reversibility, and mitigation feasibility.

Pre-Construction Phase: Key concerns include land acquisition, displacement of about 145 farming households, and potential community conflicts. Social risks such as population influx, sanitation challenges, and increased demand for local resources were also identified.

Construction Phase: Adverse impacts include vegetation loss, erosion, sedimentation, noise, dust, water pollution, and occupational safety risks. Construction waste and poor site management could further degrade the environment if not properly controlled. On the positive side, local employment and economic stimulation are expected to improve household incomes.

Operational Phase: During operation, potential impacts include emissions from industrial activities, solid waste generation, increased traffic, and social vices associated with population growth. Nevertheless, significant positive outcomes are anticipated, including long-term employment, enhanced trade, and improved local infrastructure.

Decommissioning Phase: At the end of the project's life cycle, demolition and dismantling activities may generate dust, waste, and noise. However, site restoration and vegetation re-establishment will help return the area to stable ecological conditions.

ES 6: Mitigation Measures

Mitigation measures are designed to minimize negative impacts and enhance positive outcomes throughout the project's life cycle. These include implementing a comprehensive Resettlement Action Plan (RAP) and Livelihood Restoration Program (LRP) for affected farmers, enforcing erosion and dust control measures, ensuring proper waste management, conducting periodic air and water monitoring, and establishing robust occupational health and safety systems. Social mitigation includes local hiring, gender-sensitive employment, community engagement, and continuous awareness campaigns. The measures are fully integrated into the Environmental and Social Management Plan.

ES 7: Environmental and Social Management Plan (ESMP)

The ESMP translates the ESIA's recommendations into implementable actions, specifying monitoring indicators, institutional responsibilities, and budgetary provisions. Implementation will be led by the CR-SAPZ State Project Implementation Unit (SPIU) with support from the Design–Build–Operate Contractor, Cross River State Ministry of Environment, FMEnv, AfDB, and independent auditors.

Capacity-building programs will enhance the knowledge of project officers, contractors, and community representatives on environmental management, emergency response, and stakeholder relations. Periodic environmental audits and performance monitoring will ensure compliance. The plan also integrates a Stakeholder Engagement Plan (SEP) for continuous dialogue and a Grievance Redress Mechanism (GRM) to resolve community concerns promptly.

ES 8: Decommissioning and Abandonment

The decommissioning plan provides for environmentally responsible closure of the project. Activities include dismantling of equipment, removal of temporary structures, safe disposal of waste, soil remediation, and re-vegetation. Health and safety protocols will be observed, and local communities will be engaged to ensure smooth transition and possible reuse of the site for compatible purposes.

ES 9: Conclusion and Recommendations

The ESIA concludes that the proposed Agro-Industrial Hub at Adiabo is environmentally feasible, socially beneficial, and economically viable. The project will contribute significantly to food security, poverty reduction, and rural development in Cross River State. Potential adverse impacts are site-specific, mostly reversible, and can be effectively managed through diligent implementation of the ESMP, RAP, SEP, and GRM.

The report recommends strict adherence to environmental and social safeguard requirements of FMEnv and AfDB, regular monitoring and reporting, continued stakeholder engagement, and institutional capacity strengthening. By implementing these measures, the AIH project will advance sustainable agricultural industrialization in Cross River State while preserving the ecological integrity and wellbeing of its host communities.

ACKNOWLEDGEMENT

The Proponent, Cross River Special Agro-Industrial Processing Zone Program (CR-SAPZ), on behalf of the Government of Cross River State, wishes to express her appreciation and acknowledge the invaluable contributions, cooperation and support of the Federal Ministry of Environment, the Cross River State Ministry of Environment, African Development Bank (AfDB), the National Program Coordination Office for the Special Agro-Industrial Processing Zone Program (SAPZ), the Project Implementation Unit (PIU) team of the CR-SAPZ, Community Based Organizations, leaders and members of host communities, the environmental consultants, PGM Nigeria Limited, and other interested and affected parties for the successful preparation of this ESIA document.

1. INTRODUCTION

1.1 Background to the Study

The proposed Agro-industrial Hub located in Adiabo, Odukpani Local Government Area of Cross River state is part of the Special G Zones (SAPZs, a Federal Government of Nigeria's initiative driven by the Federal Ministry of Agriculture and Food Security (FMAFS) in collaboration with state governments, development partners, relevant federal ministries, departments and agencies (MDAs), and private investors and funded by the African Development Bank (AfDB), Islamic Development Bank (IsDB), International Fund for Agricultural Development (IFAD), and contributions from the Federal and State Governments.

This program aims to achieve greater economic diversification and promote long-term sustainable development. The Special Agro-Industrial Processing Zones program is a five-year program that is designed to develop multiple clusters of Agricultural Transformation Centres (ATCs) and Agro-Industrial Hubs (AIHs) within major clusters of high agricultural production, where functional infrastructures like roads, power, water, communication are provided to attract private investment into modern Agro-industrial processing and value addition to locally produced crops, livestock and related agribusiness activities.

The establishment of SAPZs in Nigeria will boost the structural transformation of the economy by providing opportunities for public and private sector investment in agriculture, and when fully operational, the SAPZs will enhance national food and nutritional security, optimize the export of value-added agricultural commodities and improve the quality of livelihoods through wealth creation for rural farming communities.

The first phase of the SAPZ Program will be implemented in seven (7) states - Cross River, Imo, Kaduna, Kano, Kwara, Ogun, and Oyo, and the Federal Capital Territory (FCT). The Program is valued at USD 538.05 million (net taxes).

The SAPZ will consist of two key components: Agricultural Transformation Centres (ATCs) and Agro-Industrial Hubs (AIHs) across the participating states and the FCT. Each AIH, depending on the land area, may require Environmental Impact Assessments (ESIAs) and Resettlement Action Plans (RAPs), or Livelihood Restoration Plans and other relevant environmental and social safeguards instruments, depending on the requirements of the funding partner.

1.2 Proposed Project Location

The proposed Agro-Industrial Hub (AIH) in Adiabo in Odukpani Local Government Area of Cross River State (Figure 1.1 to 1.2) is a 130 ha of land, located along Tinapa-Adiabo Road, off the Calabar - Ikom Highway, at latitude 5° 4'2.88''N: longitude 8°19'17.76''E (Figure 1.3), belonging to and donated by two Adiabo communities of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot, through the Adiabo Clan Council, to the Government of Cross River State for the AIH project. The land was previously used by PAMOL for rubber plantation, and recently restored to the community, on expiration of their tenor. About 80 ha are currently used by farmers for cultivation of cash crops like cassava, maize, rice, and melon while 14 ha are light fallow bush and 36 ha occupied by riparian forest.

As part of compliance with the Environmental Impact Assessment Act (Cap E12 LFN 2004) and AfDB Operational Safeguard 2 (Involuntary Resettlement), a comprehensive Resettlement Action Plan (RAP) accompanied by a Livelihood Restoration Plan (LRP) has been prepared for project-affected households who will experience loss of farmland or livelihood. These plans provide for fair compensation at full replacement cost, provision of alternative livelihood opportunities, and priority employment during construction and operations.

No physical displacement or relocation of residential structures is anticipated since the project site comprises farmlands rather than settlement areas. Economic displacement impacts have been assessed and mitigation will be implemented before commencement of construction. The RAP/LRP implementation will be monitored by the CR-SAPZ State Project Implementation Unit (SPIU) in collaboration with the Federal Ministry of Environment (FMEnv), Cross River State Ministry of Environment (CRSMEnv), and the African Development Bank (AfDB) to ensure that all affected persons are adequately supported and their livelihoods fully restored.

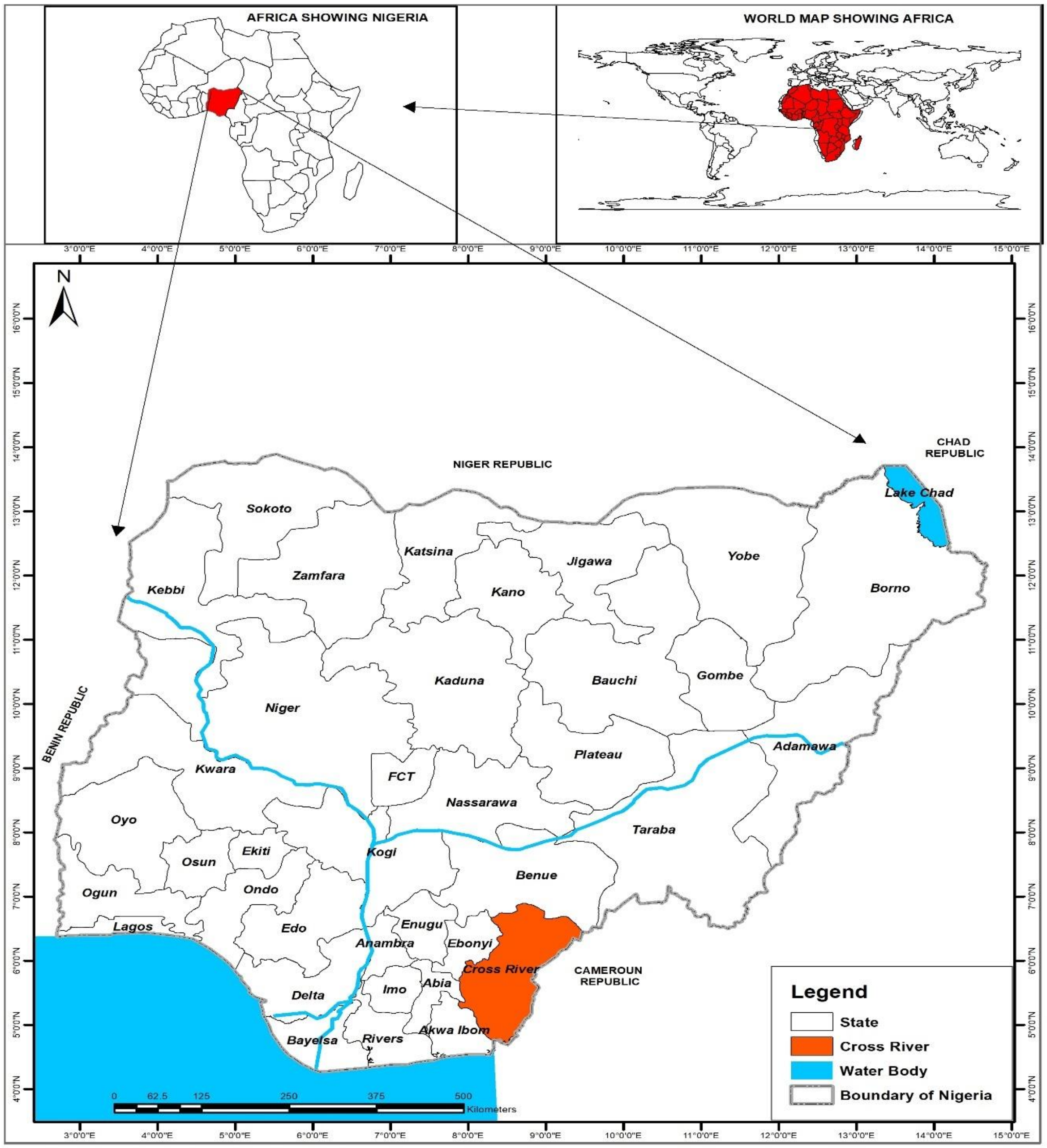
The project site bordered southward at latitude 5° 3'52.81''N; longitude 8°19'25.05''E, a distance of 200m from government secondary school Adiabo while northward, the project area border at latitude 5° 4'4.07''N; longitude 8°19'33.06''E adjacent Banga Camp. At extreme north-western end, the project site bordered at latitude 5° 4'38.92''N; longitude 8°19'5.11''E close to stationaries materials while at the extreme south-western end, the proposed site bordered at latitude 5° 4'6.10''N; longitude 8°18'41.25''E (Figure 1.). A tributary of the Cross River traverses the project site before joining the Cross River at latitude 5° 3'29.64"N; longitude 8°18'20.14"E. Major landmarks near the project site include: Government Secondary School Adiabo located 200m southward, Adiabo townhall located 600m south of the project site, Tinapa water park at 1,700m southward, Banga Camp located 250m northward, Marygold International boarding school located 880m northward, Adiabo power sub-station located 1500m northward. The distance from Tinapa junction to the project site is approximately 3,000 metres.

1.3 Proponent's Intent & ESIA Objective

The proposed project is expected to have both negative and positive impacts on the environment and people of the area and it is recognized that comprehensive planning and management of environmental and socioeconomic issues are essential to the execution of any successful project. As such, the ESIA process seeks to fully integrate environmental and socioeconomic considerations into the life cycle of the proposed project.

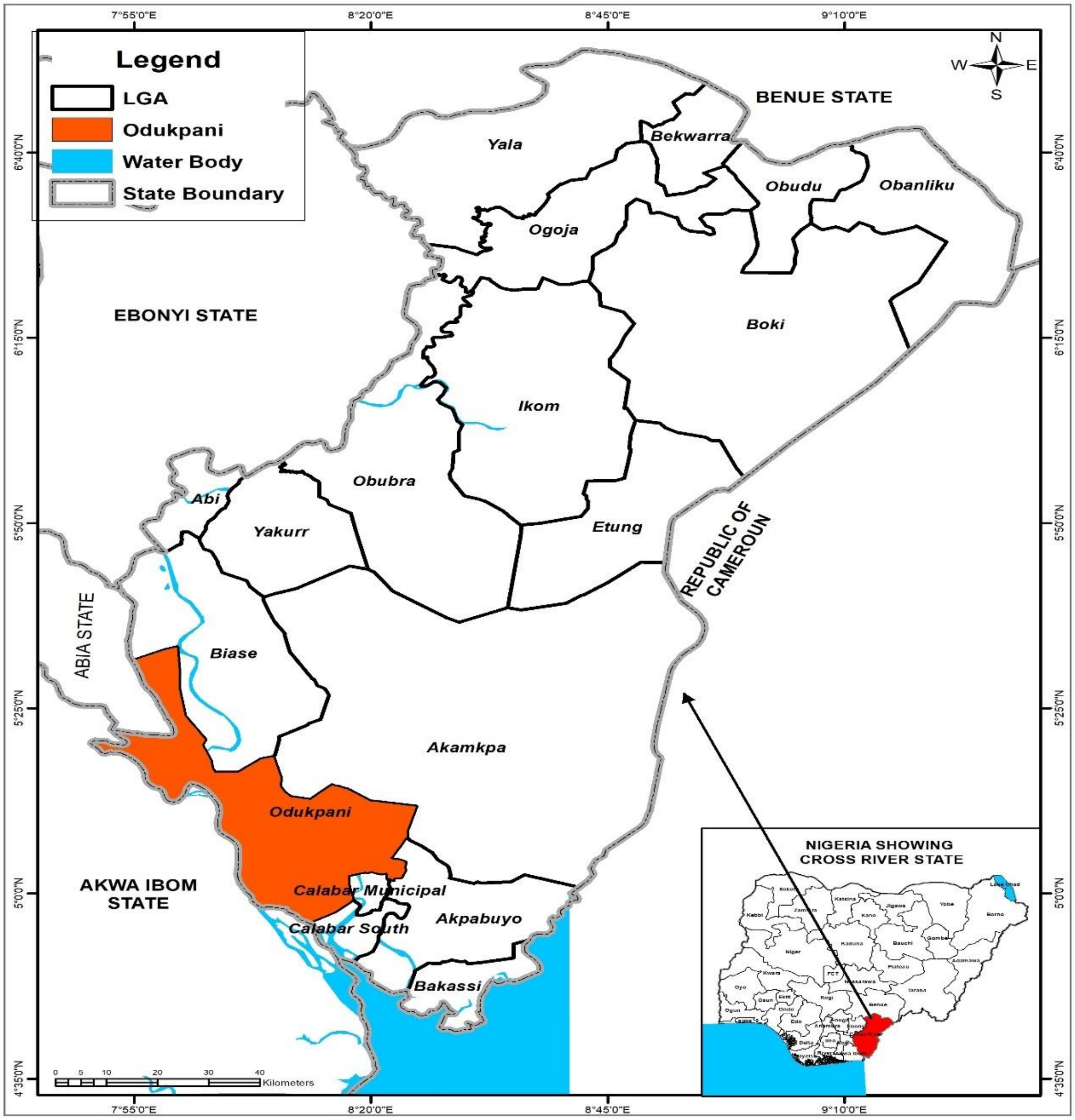
CR-SAPZ, the proponent, therefore, has undertaken this Environmental and Social Impact Assessment (ESIA), in parallel with the conceptual design of the project, to ensure that any identified adverse impacts are addressed in the detailed design and mitigated during the development stages which involves site preparation, construction, commissioning, operation, decommissioning and abandonment.

The purpose of this ESIA is to assess the potential and associated impacts of the project and project-related activities on the environment (including biophysical, and socioeconomic resources), and where applicable to proffer measures to enhance positive impacts and to avoid, reduce or mitigate (compensate) negative impacts to the environment; and develop cost-effective environmental and social management plans to make the proposed project sustainable.



NIGERIA SHOWING CROSS RIVER STATE

Figure 1.1: Map of Nigeria showing Cross River State.



Cross River State Showing Odukpani LGA

Figure 1.2: Map of Cross River State showing Odukpani LGA (The project LGA)

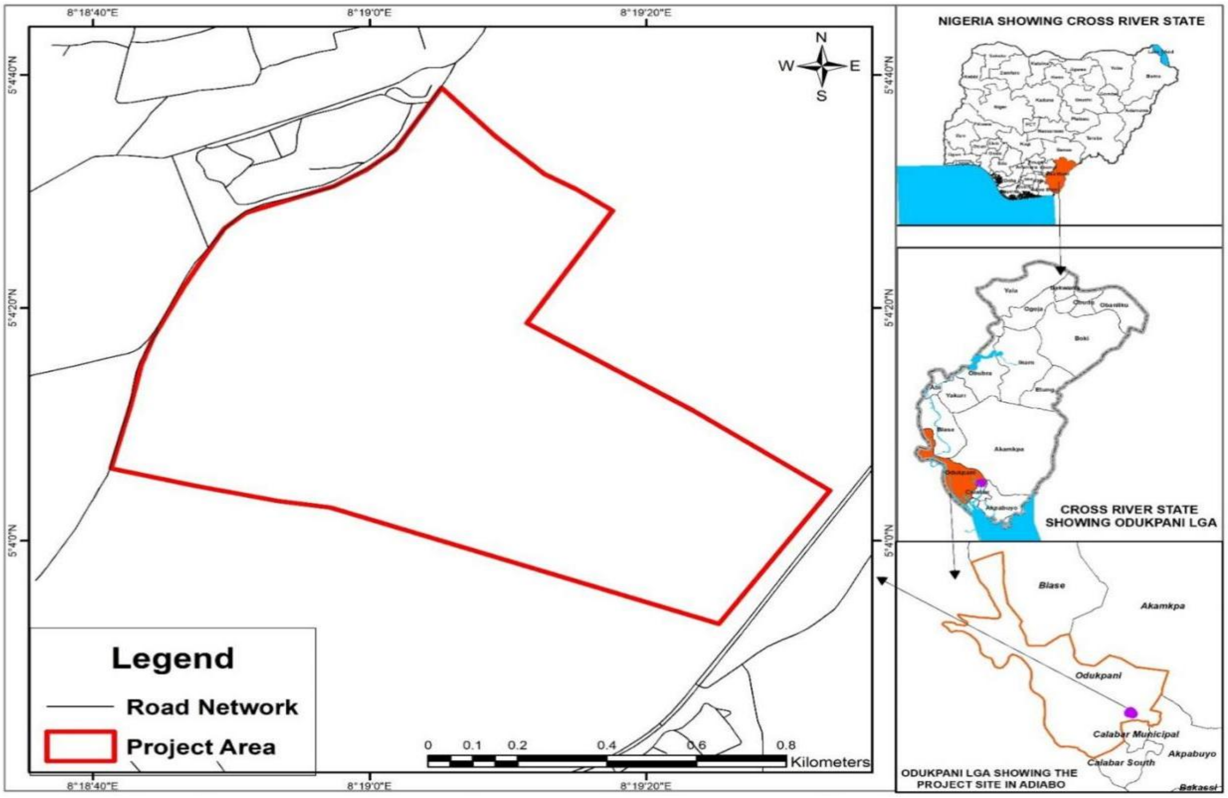


Figure 1.3: Location Map of the Proposed Agro-Industrial Hub in Adiabo, Odukpani LGA.

Figure 1.4: Satellite Imagery of the proposed AIH at Adiabo Showing Major Landmarks

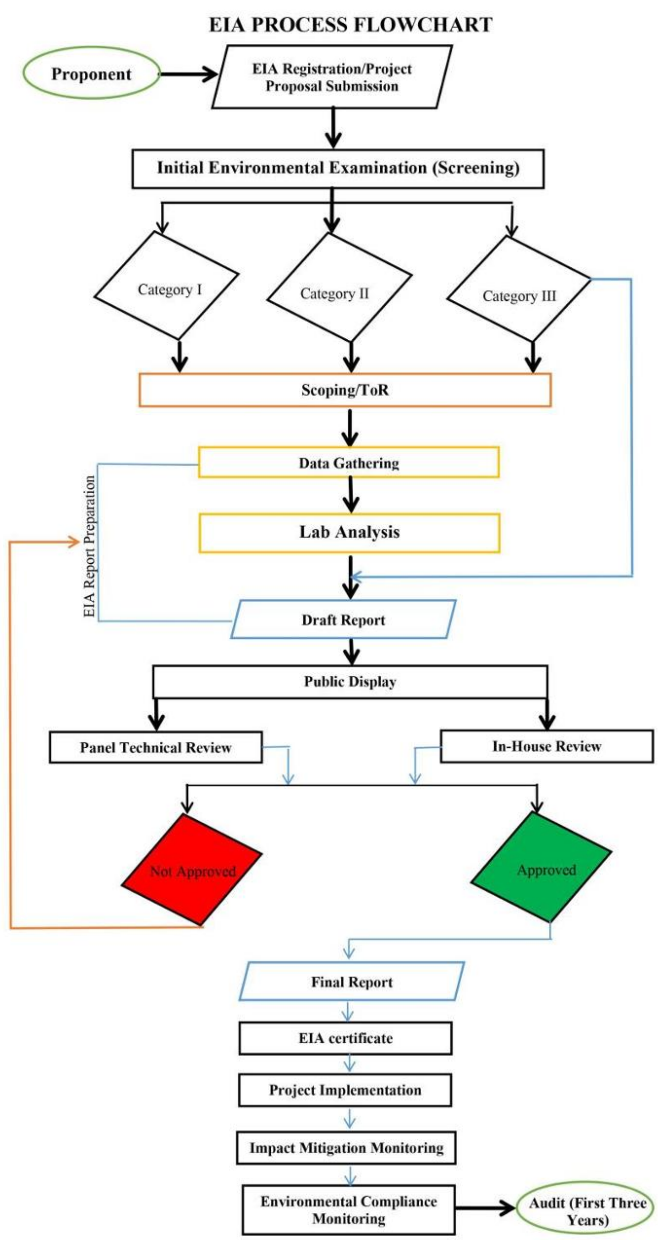


Figure 1.1: The ESIA Process

Figure 1.1 depicts the Nigeria's country (FMEnv) ESIA process that has been adopted for the preparation and implementation of the ESIA of the proposed AIH project.

1.4 Terms of Reference of the EIA

The Terms of Reference (ToR) for the ESIA was prepared and submitted to the Federal Ministry of Environment (FMEnv) after the scoping exercise for approval in line with the requirements of the National EIA Procedural Guidelines. The ToR defined the objectives, and outlined the scope, approach, methodology and reporting format for the ESIA. The FMEnv ‘s letter conveying approval for ESIA ToR for the project is attached as Appendix 1.1 to this report.

1.5 Statutory (Legal and Administrative) Framework

The legal, regulatory and policy framework for carrying out the ESIA of the proposed project is contained in the applicable acts and regulations of the Federal and State Government, statutes and international conventions to which the Nigerian Government is a signatory. Various environmental studies and related strategic initiatives would meet or surpass the relevant Nigerian and international environmental legislative requirements and guidelines. These include but not limited to:

1.5.1 Federal Ministry of Environment

Act 58 of 1988 established the Federal Environmental Protection Agency (FEPA) as the chief regulatory body for environmental protection in Nigeria. The Act establishing FEPA placed on it the responsibility of ensuring that all industries meet the limits prescribed in the national guidelines and standards and the associated various regulations of environmental pollution management in Nigeria (e.g. effluent limitation, management of solid hazardous waste, etc.). FMEnv may update the National Guidelines and Standards from time to time.

The Federal Government released the Environmental Impact assessment (EIA) Act CAP E12 LFN 2004. The Act makes the ESIA process mandatory for any major development project and prescribes the procedures for conducting and reporting EIAs.

1.5.2 FMEnv’s Guidelines on ESIA

Federal Ministry of the Environment developed National ESIA procedures following the enablement of the EIA Act CAP E12 LFN 2004. The procedure indicates the steps to be followed from project conception to commissioning to ensure that the project is implemented with maximum consideration for the environment.

1.5.3 ESIA Sectoral Guidelines of the Federal Ministry of Environment

Federal Environmental Protection Agency (FEPA) was established by Act 58 of 1988 to monitor and prevent the pollution of the environment following the Koko toxic waste dump incident. This status empowered the then FEPA to prepare Environmental Guidelines and Standards as instruments for prevention of environmental pollution. This Act also gives specific powers to FMEnv to facilitate environmental assessment of projects. In addition, FMEnv regulations S.I.8, S.I.9 and S.I.15 of 1991 provides guidelines and standards for the following:

- Solid and Hazardous waste management
- Effluent limitations
- Pollution abatement in industries generating waste.

In September 1995, EIA Sectoral Guidelines for proposed projects in Nigeria were published. The guidelines are intended to assist the proponent to conduct proper and detailed ESIA in compliance with the EIA Act of 1992. The procedure for EIA involves the project proposal stage where the project proponent officially notifies FMEnv of the proposed project. This proposal is to contain concise information of the project including a land use map. The legal and regulatory framework for carrying out ESIA of the proposed project are contained in relevant national statutes and international environmental conventions to which Nigeria is a signatory.

This stage is followed by the screening phase, whereby an Initial Environmental Examination (IEE) is executed by the FMEnv then the projects are assigned into categories based on the following criteria:

- Magnitude
- Extent or Scope
- Duration and Frequency
- Risks
- Potential Environmental Impacts

Another stage of FMEnv's ESIA procedure is the scoping stage, the main feature of which the proponent is required to submit the Terms of Reference (TOR) for the proposed ESIA. In some cases, the FMEnv may demand a Preliminary Assessment Report from the proponent to assist in vetting the scope and the TOR of the proposed ESIA.

This stage is followed by:

- Actual Implementation of the ESIA
- Preparation of Draft Report
- Final ESIA Report
- Review Process and Approval/Certification.
- Apart from the general EIA Guidelines, the Ministry has issued sectoral guidelines for ESIA in different infrastructural sectors.

1.6 Institutional Framework

A summary of other authorities with the mandate to implement aspects of Nigerian legislation over aspects relating to the Project are provided in this Section.

1.6.1 Federal Ministry of Environment (FMEnv)

FMEnv is the principal authority for the regulation and enforcement of environmental laws in Nigeria. The EIA Act, established by the Ministry, which ensures that all development and industrial activities, operations and emissions are within the limits prescribed in the national guidelines and standards and comply with relevant regulations for environmental pollution management in Nigeria as and when these are released by the Ministry. Further to the Mandate, FMEnv developed laws/ guidelines on various sectors of the national economy including the Environmental Impact Assessment (EIA Act CAP E12, LFN 2004) Act and procedures for evaluating EIA reports. Furthermore, in September 2021, through Official Gazette No. 105, Vol 108, the Federal Republic of Nigeria published S.I. No. 109, Environment Impact Assessment Procedures and Charges Regulations. This ESIA will consider these regulations, which outlines the EIA procedure from project conception to commissioning and describes the requisite follow up activities. FMEnv consults with State Ministries of Environment and their Environmental Protection Agencies during the EIA permitting process. In addition, other regulatory agencies/authorities with oversight over specific industries have also issued guidelines to regulate the impact of such industries on the environment.

1.6.2 National Environmental Standards and Regulation Enforcement Agency (NESREA)

The National Environmental Standards and Regulations Enforcement Agency (NESREA) were established in 2007 by the Federal Government of Nigeria as an Agency of FMEnv. The Agency is charged with the responsibility of enforcing the environmental laws, guidelines, standards, and regulations in Nigeria, specifically during the operational phase of development projects.

1.6.3 National Regulatory Framework

The national policies and regulations included in Table 1 have E&S implications that pertain to the Project and associated ESIA in

Table 1.1 National Policies and Regulations and the Applicability thereof.

Table 1.1: National policies and regulations and the application

Governing Documents	Description	Applicability
National Policies		
National Policy on the Environment, 1989	The National Policy on the Environment, 1989 (revised 1999 and 2017), provides a national mechanism for routine coordination and consultation among various tiers of local, state, and federal government to improve the development and implementation of environmental policy as well as establish effective relationships. In doing so, this Policy aims to achieve sustainable development through conserving the environment and natural resources, raising public awareness between environmental resources development, maintaining, and enhancing ecosystem processes, and co-operating with other countries, organisations, and agencies to reduce transboundary environmental degradation.	In line with the aims of the policy, this ESIA includes an assessment of impacts to the physical, biological and Socioeconomical environments related with the different phases of the Project. Moreover, this ESIA includes mitigation measures and an associated Environmental and Social Management and Monitoring Plan (ESMMP) that aim to avoid /minimise/manage the severity of identified impacts. Once the ESIA is approved by the FMEnv, CR-SAPZ will need to implement the commitments included and conduct periodic audits to ensure continuous improvement.
The National Gender Policy, 2021	The National Gender Policy, 2021 presents a set of minimum standards to meet the mandate for gender equality, good governance, accountability, and being socially responsive to the needs of	This ESIA process has (and continues) to be undertaken to ensure effective, transparent, and timely stakeholder engagement. Moreover, it will be structured such that all stakeholder engagement activities will take

Governing Documents	Description	Applicability
	vulnerable groups. The policy builds on the revision of the NGP, 2007 to respond to emerging issues across the sectors since 2006 and to incorporate current gender gaps to fulfil Nigeria's commitment to such global agenda as the SDGs. The strategic policy objectives are to bridge gender/social inclusion gaps, achieve parity in all spheres, to protect women's human rights, and mitigate sexual and gender-based violence through appropriate buffers and related services.	into consideration in gender sensitivities, particularly when engaging with local communities. Moreover, the ESIA considers gender equality in recruitment and that no employee or job applicant discriminated against on the basis of his or her gender, marital status, nationality, ethnicity, age, religion or sexual orientation.
National Policy on Occupational Safety and Health, 2021	The Occupational Safety and Health policy strengthens the National Labour Policy and extant labour legislations, provisions Cap 126, the workmen's Compensation Act Cap 470, Trade Union Act Cap 126, Trade Dispute Act Cap 432, wages Board and Industrial Councils Act 466 and the Labour Act Cap 198, and other relevant Laws of the Federation of Nigeria. The goal of the policy is to facilitate improvement of occupational safety and health performance by providing the framework for participative occupational safety and health protection of workers including the most vulnerable groups in all sectors of economic activities.	The safety, health and welfare of all the workers associated with the Project will need to be addressed in line with all the provisions of this Policy throughout the Project lifecycle (construction, operational and decommissioning phases).
National Policy on Solid Waste Management, 2022	The National Policy on Waste Management 2022 provides a guidance for efficient and sustainable solid waste management in Nigeria. The policy objective is to provide a national direction on solid waste management for the Federal, States, Local governments, private sector, and all stakeholders. In doing so, the policy aims to promote a healthy and aesthetically satisfactory environment by ensuring effective, sustainable, safe, and sanitary solid waste management.	The Project, during the construction, operational and decommissioning phases, will generate wastes, which will need to be disposed of as per the guidelines in this Policy. The ESMMP will consider these regulations and includes a section on solid waste management.
National Environmental Sanitation	This Policy serves as the instrument for securing sustainable quality environment for good health and social wellbeing of present and future generations.	This ESIA process will be undertaken to cover events that could impinge on sanitation, hygiene, and health.

Governing Documents	Description	Applicability
Policy, 2005 (revised 2018)		
The Agriculture Promotion Policy, 2016	The Agriculture Promotion policy builds on achievement of Agriculture Transformation Agenda (ATA), 2011-2015 and was readjusted to solve challenges faced by implementation of ATA and highlight Federal government (in partnership with State Government) priorities in the agricultural sector.	In line with this policy, CR-SAPZ is required to abide to climate change and environmental sustainability in its operation and participation in agricultural promotion.
General Environmental		
Environmental Impact Assessment Act 86 of 1992 (amended by EIA Act CAP E12 LFN 2004) and regulation 2021	This is the primary governing Act for EIA in Nigeria. The Act establishes a procedure and methodology to be followed to undertake an EIA. Section 2 (2) of the Act requires that an EIA must be undertaken in accordance with the Act when the extent, nature, or location of the proposed project or activities is likely to affect the environment significantly.	As the proposed Project will entail an EIA in line with the provisions of the EIA Act is therefore required prior to the project commencing. Accordingly, an ESIA is proposed to be carried out in line with the requirements of this Act and has further considered the Environment Impact Assessment Procedures and Charges Regulation, 2021, CR-SAPZ shall be required to commit to implementing the commitments included in the ESMMP which will be laid out in the proposed ESIA Report and any other conditions as laid out by FMEnv, should an ESIA licence be issued for the Project.
National Environmental Impact Assessment Procedural and Sectoral Guidelines, 1994	FMEnv developed the National EIA Procedural Guidelines in response to the establishment of the EIA Act. The Procedural Guidelines assists proponents in conducting detailed E&S assessments by providing an overview of the baseline information, key issues, impacts, mitigation, and management plans to be considered as part of the EIA.	This ESIA will be undertaken to comply with the requirements of these Guidelines. CR-SAPZ shall be required to commit to implementing the resultant ESMMP and any other conditions stipulated by FMEnv.
The National Environmental (permitting & Licensing System) Regulation, 2009	The purpose of this regulation is to enable consistent application of Environmental Laws, Regulations and Standards in all sectors of the economy and geographical regions.	In line with these regulations, the ESIA will consider the Environmental Laws, guidelines, standards, and regulations in Nigeria during all Project phases.
Waste and Pollution		

Governing Documents	Description	Applicability
National Environmental (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991, S.I.9	These Regulations impose restrictions on the release of toxic substances into the environment and stipulate requirements for pollution monitoring units, machinery for combating pollution, and contingency plans to be implemented by industries.	The Project, during the construction, operational and decommissioning phases, will generate wastes, which will need to be disposed of as per the guidelines in these Regulations. The ESMMP will consider these regulations and includes a section on the management of both non-hazardous and hazardous wastes.
National Environmental Protection (Effluent Limitation) Regulation 1991, S.I.8	The National Effluent Limitation Regulation, S.I.8 of 1991 (No. 42, Vol. 78, August 1991) makes it mandatory for industries such as waste generating facilities (including research institutes, clinics, hotels etc.) to install pollution prevention and pollution abatement equipment on site. The regulation is specific for each category of a waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the ecosystem. Appropriate penalties for contraventions are also specified in the regulation.	The Project, during the construction, operational and decommissioning phases, will generate waste effluent, which will need to be managed per the guidelines in these Regulations. This regulation requires the Project to install anti-pollution equipment for the detoxification of effluent and chemical discharges emanating from its activities and specify selected wastewater parameters for the industries in the First Schedule to the Regulations.
National Environmental (Management of Solid and Hazardous Wastes) Regulations, 1991, S.I.15	This instrument regulates the collection, treatment, and disposal of solid and hazardous waste streams from municipal and industrial sources. It gives a comprehensive list of chemicals and chemical waste by toxicity categories. The regulation requires the project proponent to practice waste segregation (at source) and engage the services of a government-approved waste management agents for appropriate waste disposal throughout the project's life cycle.	The Project, during the construction, operational and decommissioning phases, will generate wastes, which will need to be managed and disposed of as per the guidelines in these Regulations. The ESMMP will consider these regulations and includes a section on the management of both non-hazardous and hazardous wastes.
National Environmental (Sanitation and Wastes Control) Regulations, 2009, S.I.28	This Regulation aims to adopt sustainable and environment-friendly practices in environmental sanitation and waste management to minimise pollution.	The provisions included in this Regulation have been considered as part of the Project ESMMP.
Soils and Water		

Governing Documents	Description	Applicability
National Environmental (Soil Erosion and Flood Control) Regulations, 2011, S.I.12	The overall objective of this Regulation is to ensure that projects developed on sites that are vulnerable to flooding, including facilities that serve such projects, are protected against flooding by appropriate design at the time of initial construction.	The provisions included in these Regulations will need to be considered by CR-SAPZ as part of Project Engineering designs.
National Environmental (Surface and Groundwater Quality Control) Regulations, 2011, S.I.22	The purpose of these Regulations is to enhance and preserve the physical, chemical and biological integrity and to maintain existing use of groundwater and surface water resources. The standards contained herein provide for the protection of surface and ground water from pollutants so that the waters shall be protected, used, developed, conserved, managed, and controlled in ways that take into account: ▪ Citizens right of access to clean water and sanitation; ▪ Protection of aquatic ecosystems and long-term sustainability of water resources; and ▪ Reduction and prevention of pollution and degradation of surface water resources and recognition of preventive, precautionary, and polluter-pays-principles.	The Project will be associated with waste generation, more specifically solid and effluent wastes, which should be managed and disposed of in an environmentally friendly manner to avoid any form of pollution, including water pollution. This ESIA and associated ESMMP will consider these regulations.
Water Resources Act, CAP W2 LFN, 2004	This Act is aimed at promoting the optimum planning, development, and use of Nigeria's water resources; ensuring the coordination of activities that are likely to influence the quality, quantity; distribution, use, and management of water; providing the application of appropriate standards and techniques for the investigation, use, control, protection, and management of water resources; and facilitating technical assistance and rehabilitation for water supplies.	In line with the requirements of this Act, CR-SAPZ will need to safeguard the integrity water systems within and surrounding the Project area throughout the implementation of the Project. This includes implementing proper waste management to prevent water pollution during the construction, operational and decommissioning phases.
Climate Change		
Climate Change Act, 2021	The Climate Change Act provides a legal and institutional framework for reducing GHG emissions in Nigeria. The objective of the law is to establish a framework for	In line with the requirements of this Act, this ESIA will consider the climate change adaptation requirements for the Project and

Governing Documents	Description	Applicability
	reducing GHG emissions and to embed climate change actions into national plans and programmes. The Act establishes the National Council on Climate Change (NCCC), which will be delegated the authority to make policies and decisions on all matters relating to climate change in Nigeria. The NCCC is directed to collaborate with the Federal Inland Revenue Service (FIRS) to develop a carbon tax in Nigeria. The proceeds from the carbon tax will go to the Climate Change Fund established under the Act. The Fund is to be used for the administration and general operation of the NCCC, the funding of innovative climate change mitigation and adaptation projects, conducting assessments of climate change impacts on vulnerable communities, and incentivizing the transition to clean energy.	management relating to GHG emissions during all Project phases.
Air Quality		
National Environmental (Air Quality and Control) Regulations, 2021, S.I.88	The objective of the Regulations is for the prevention, control, and reduction of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g., vessels, motor vehicles) and stationary sources (e.g., industries). Emission limits for different areas and facilities have been set. The regulations make provision for designating controlled areas and the setting of objectives of air quality management plans for these areas.	The Project, during the construction, operational and decommissioning phases, will generate air emissions. As part of this ESIA process, an air quality study will be undertaken. The primary objective of the air quality study is to consider and assess the potential impacts which the Project may have upon existing air quality, during both construction and operational phases. The assessment of construction impacts focuses on the potential effect of construction dust and construction-related combustion emissions (including vehicles) at existing sensitive receptor locations immediately adjacent to the Project. The assessment of operational impacts focuses on the potential negative effects of pollutants from a variety of sources. Impacts of emissions on air quality have been quantified by comparison of the predicted maximum concentrations with the Project applicable air quality standards (which have considered these

Governing Documents	Description	Applicability
		Regulations). Moreover, the ESMMP includes specific controls to mitigate air quality emissions.
Noise		
National Environmental (Noise Standards and Control) Regulations, 2009, S.I.35	The Regulation highlights the permissible noise levels to which a person may be exposed, control and mitigate noise, permits for noise emissions above acceptable levels and enforcement maximum permissible noise levels a facility or activity to which a person may be exposed to.	The Project, during the construction, operational and decommissioning phases, will generate noise. As part of this ESIA process, a noise study will be undertaken. The study will consider noise emissions at the potentially most affected noise sensitive receiver (NSR) locations in proximity to the Project. The Project will be required to comply with these Regulations to promote a healthy and safe working environment throughout all Project phases. Noise impacts have been quantified by comparison of the predicted maximum concentrations with the Project applicable noise standards (which have considered these Regulations). Moreover, the ESMMP includes specific controls to mitigate noise emissions.
Biodiversity		
National Environmental (Control of Alien and Invasive Species) Regulations, 2013, S.I.32	This regulation seeks to prevent the decline and minimise the modification and destruction of the ecosystem and human health caused by alien and invasive species.	This ESIA and associated ESMMP will consider a range of potential ecological impacts associated with the Project, including the control of invasive alien plants in the immediate Project area and surrounds.
Endangered Species Act CAP E9 LFN, 2004 as amended 2016	This Act prohibits, except under a valid license, the hunting, capture, or trade-in animal species, either presently or likely being in danger of extinction, and defines the liability of any offender under this Act. It also provides for regulations to be made necessary for environmental prevention and control regarding the purposes of this Act.	These regulations have been considered in the biodiversity study for the ESIA and associated ESMMP.
Health and Safety and Labour		
Employment Laws and Regulations Nigeria 2023	The Employment Laws and Regulation 2023 strengthen employment laws as stated in the constitution of the Federal Republic 1999, the Labour Act 2004, Federal and State laws that relate to labour and	CR-SAPZ will be bound to abide to Nigeria labour and employment laws and regulation during its Project lifecycle.

Governing Documents	Description	Applicability
	employment, and international conventions, treaties and protocols relating to labour and employment, industrial relations or matters connected therewith that have been ratified by Nigeria.	
Factories Act, CAP F1 LFN 2004	The Factories Act 1990 (amended in 2004) is the primary law regulating the health, safety and welfare of workers in the country's factories. The Law holds management and staff personally responsible for violations of the provisions in the Act.	The safety, health, and welfare of all the workers associated with the Project will need to be addressed in line with all the provisions of this Act throughout the Project lifecycle.
Labour Act, CAP L1 LFN 2004	Nigeria has ratified all core International Labour Organisation Conventions. The Labour Act 1990 (amended in 2004) is the primary law protecting the employment rights of individual workers. The Act covers protection of wages, contracts, employment terms and conditions, and recruitment; and classifies types of workers and special workers.	CR-SAPZ will be bound by this Act to abide to its stipulation on employee management and remuneration during its construction and operational phases.
Trade Unions Act, 2005	This Act contains provisions with respect to the formation, registration, and organization of trade unions. It includes stipulation of 'equal pay for equal workers without discrimination on account of sex, or any other ground whatsoever'.	The Proponent will respect workers' rights to join (or not join) unions of their choice and to engage with those unions which workers are members of in relation to collective bargaining, disciplinary proceedings, and retrenchment of workers.
National Minimum Wage Act, 2019	The Act prescribes the national minimum wage and provides for a legal framework for a seamless review of the stated national wage.	CR-SAPZ will abide to the stipulation of this Act on employee remuneration during the Project lifecycle.
Employee Compensation Act, 2010	This Act repeals the Workmen's Compensation Act W6 LFN 2004 and makes comprehensive provisions for payment of compensation to employees that suffer from occupational diseases or suffer injuries from accident at workplace or in the course of the employment.	The safety, health, and welfare of all the workers associated with the Project will need to be addressed in line with all the provisions of this Act throughout the Project lifecycle.
Pension Reform Act, 2014	This Act makes provision for the contributory pension scheme for public and private sectors in Nigeria.	CR-SAPZ will be bound by this Act to abide to its stipulation on employee remuneration during all Project phases.
Violence against Persons	The Violence against Persons (Prohibition) Act (VAPP) was passed into law in May	The safety, health, and welfare of all the workers and communities associate with the

Governing Documents	Description	Applicability
(Prohibition) Act, 2005	2015. The Act was necessitated as a result of agitations for the protection of persons against different forms of violence. The Act has strengthened advocacy against rape, female genital mutilation, partner battery, stalking, harmful widowhood practices while prohibiting all forms of violence, including physical, sexual, psychological, domestic, harmful traditional practices and discrimination against persons. It also provides maximum protection and effective remedies for victims and punishment of offenders.	Project will need to be addressed in line with all the provisions of this Act throughout the Project lifecycle.
Land		
Land Use Act CAP L5 LFN, 2004	Land Use Act No. 6 was enacted in 1978 (revised in 1990 and 2004). The Act vests all land in the territory of each State (except land vested in the Federal Government or its agencies) solely in the Governor of the State, who holds such land in trust for the people and is solely responsible for the allocation of land in all areas, to individual resident in the State and to organizations for residential, agricultural, and commercial purposes.	CR-SAPZ will have to legally secure rights to the land associated with development of the Project.
Other		
National Environmental (Ozone Layer Protection) Regulations, 2009, S.I.32	This regulation prohibits the use, emission, storage, and disposal of stratospheric ozone-depleting substances (ODS) and articles which contain those substances.	CR-SAPZ will need to ensure that equipment containing ODS's will either not be used on site or, if currently being used, will need to be phased out.
National Environmental (Construction Sector) Regulations (S.I No. 19), 2011	The purpose of these Regulations is to prevent and minimize pollution from construction, decommissioning and demolition activities applicable to Nigerian projects. It stipulates that new projects in the construction sector shall apply cost-effective, up-to-date, efficient, use best available technology, to minimize pollution to the barest degree practicable.	This ESIA considers a variety of potential impacts that may result in pollution to the environment during the construction and decommissioning phases of the Project. CR-SAPZ shall be required to commit to implementing the ESMMP laid out in this ESIA and any other conditions stipulated by FMEnv.
Harmful Waste (Special	The Harmful Waste (Special Criminal Provisions) Act CAP H1 LFN, 2004	The Project is not anticipated to generate any harmful waste, ESMMP will consider

Governing Documents	Description	Applicability
Criminal Provisions) Act CAP H1 LFN, 2004	prohibits and declares unlawful activities relating to the purchase, sale, importation, transit, transportation, deposit, and storage of harmful wastes. Appropriate penalties for infringement are prescribed.	these regulations and includes a section on the management of both non-hazardous and hazardous wastes.
The Standards Organization of Nigeria (SON) ACT NO. 14, 2015	The Standards Organisation of Nigeria was established by Act. No.56 of 1971 which vested it with the authority for: Standards elaboration, Specifications, Quality assurance system of commodities, manufactured industrial and imported products and services generally. The Act No. 14 of 2015 amended the previous SON Act, 2004, and was enacted for the purpose of providing additional functions for the Standards Organisation of Nigeria, increasing penalty for violations; and for related matters.	CR-SAPZ shall be required to commit the quality standards as certified by SON throughout its operation.
Criminal Code of 1990 (now CAP 38 LFN, 2004)	The Act contains the primary criminal law offences related to environmental damage, public health, and natural resources. Some environmental crimes include causing a public nuisance, fouling the water of any spring, stream, well, or reservoir of a place, and violating the atmosphere in any position to make it harmful to the health of persons.	CR-SAPZ shall be required to commit to implementing the ESMMP laid out in this ESIA and any other conditions stipulated by FMEnv and Cross River State environmental legislations (CRMEnv, town planning, water resources permit) relevant to stormwater, waste, traffic, and cultural heritage permitting.

1.7 Other applicable national laws and regulations:

1.7.1 Inland Fisheries Act, Cap I10, LFN 2004

The Inland Fisheries focused on the protection of the water habitat and its species, the following sections 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 the solar hybrid systems is the 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.

1.7.2 Conventions, Protocols and Agreements

Nigeria is a signatory to several international conventions and agreements targeted toward the conservation and protection of the environment to ensure sustainable development. The relevant international conventions and regulations most applicable to the project are highlighted below in Table 1.2.

Table 1.2: List of Relevant International Conventions and Regulations

Conventions	Year Adopted
The Paris Agreement	2015
International Health Regulations (IHR)	2005
International Labour Organization (ILO): ILO-OSH, 2001 - Guidelines on Occupational Safety and Health (OSH) Management	2001
The United Nations Convention on Biological Diversity	1994
The Rio Declaration on Environment and Development	1992
The United Nations Framework Convention on Climate Change	1992
International Convention on Oil Pollution Preparedness, Response, and Co-operation (OPRC)	1990
The Montreal Protocol on Substances that deplete the Ozone Layer. Adopted on September 16, 1987.	1987
Vienna Convention for the Protection of the Ozone Layer.	1985
Protocol Concerning Cooperation in Combating Pollution in Cases of Emergency in the West and Central African Region	1981
Convention on the Conservation of Migratory Species of Wild Animals, 1979	1979
African Convention on the Conservation of Nature and Natural Resources	1968

1.8 International Best Practice Standards and Guidelines

African Development Bank's Integrated Safeguards System: The AfDB provides a set of 10 Operational Safeguards standards that present a credit risk management framework for determining, assessing and managing social and environmental risk in project financing.

The AfDB's ISS establishes a unified framework of operational safeguards (OS) designed to promote environmental sustainability, social inclusion, and resilience in all Bank-financed projects. Based on the project's characteristics, scale, and identified environmental and social risks, the CR-SAPZ Adiabo project has been classified as a Category 1 project — requiring a full ESIA, Environmental and Social Management Plan (ESMP), and Resettlement Action Plan (RAP). The AfDB Operational Safeguards (OS) applicable to the AIH Adiabo project are presented in Table 1.3.

Table 1.3: AfDB Operational Safeguards (OS) applicable to the AIH Adiabo

Operational Safeguard	**Objective / Key Requirements**	**Relevance to the Project**
Environmental and Social Operational Safeguard 1: Assessment and Management of Environmental and Social Risk and Impact	This OS, together with OS10 (*Stakeholder Engagement and Information Disclosure*), provide the overall process framework for the ESA and management of Bank-financed operations at the level of the project, activities or other undertakings supported through Bank financing. The objectives of OS1 include: • Identify and assess the E&S risks and impacts including those related to gender inequalities, climate change, and vulnerability of Bank lending, investment, and grant-supported operations, in their areas of influence in a manner consistent with the Oss; provide opportunity for stakeholder engagement and consultation in assessing and managing the E&S risks and impacts; and utilize national E&S institutions, systems, laws, regulations, and procedures in the assessment.	Fully applicable. The Agro-Industrial Hub is a Category 1 project with potential biophysical and socio-economic impacts. A comprehensive ESIA and ESMP have been prepared to identify, assess, and manage these impacts in compliance with AfDB's ISS.
Environmental and Social Operational Safeguard 2: Labour and Working Conditions	creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions.	Fully applicable. A Labour Management Plan (LMP) and Occupational Health and Safety Plan (OHS) are embedded in the ESMP. These address local employment, PPE provision, safe work conditions, grievance redress, and emergency preparedness.
Environmental and Social Operational Safeguard 3: Resources Efficiency and	This Operational Safeguard (OS) recognizes that economic activities often cause air, water, and land pollution, and consume finite resources that may threaten people, ecosystem services, and the environment at the local, regional, and global levels. The current and projected	Applicable. The project includes processing and construction activities with potential emissions and effluents. The ESMP incorporates air quality

Operational Safeguard	Objective / Key Requirements	Relevance to the Project
Pollution Prevention and Management	atmospheric concentration of greenhouse gases (GHGs) threatens the welfare of current and future generations.	management, waste segregation, stormwater control, and energy-efficient systems (including 1.098 MW solar hybrid installation)..
Environmental and Social Operational Safeguard 4: Community Health, Safety and Security	This Operational Safeguard (OS) recognizes that projects, activities, equipment, and infrastructure can increase community exposure to risks and impacts. OS4 addresses the health, safety, and security risks to and impacts on project-affected communities and the corresponding responsibility of the Borrower to avoid or minimize them, with particular attention to people who, due to their particular circumstances, may be vulnerable.	Implementation of the Project will need to ensure that the health, safety and security of all Project affected communities are not compromised.
Environmental and Social Operational Safeguard 5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	Environmental and Social Operational Safeguard (OS) 5 recognizes that project-related land acquisition, restrictions on land access or land use, and loss of property/assets can have adverse impacts on communities and persons. Project-related land acquisition and restrictions on land use may cause physical displacement (relocation, loss of residential land or loss of shelter), economic displacement (loss of land, assets or access to assets, leading to loss of income sources or other means of livelihood), or both.	Fully applicable. Approximately 94.6 ha of farmland cultivated by 145 households will be affected. A Resettlement Action Plan (RAP) with a Livelihood Restoration Plan (LRP) has been prepared to ensure equitable compensation and livelihood improvement
Environmental and Social Operational Safeguard 6: Habitat and Biodiversity Conservation, and Sustainable Management of Living Natural Resources	This Environmental and Social Operational Safeguard (OS 6) outlines the requirements for the Borrower to (i) identify and implement opportunities to conserve and sustainably use biodiversity and natural habitats; and (ii) observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services.	Applicable. The site includes 14 ha of fallow vegetation and 36 ha of riparian forest. The ESMP provides mitigation through vegetation conservation, buffer zones, erosion control, and reforestation to maintain ecosystem integrity.
Environmental and Social Operational Safeguard 7: Vulnerable Groups	Some individuals and/or groups may be less resilient to risks and adverse impacts than others. Within the context of the Bank's operations, individuals and/or groups who are at a higher risk of being unable to anticipate, cope with, resist, and recover from project-related risks and/or adverse impacts are considered vulnerable.	Vulnerable persons and/or groups have been identified and considered in the project

Operational Safeguard	Objective / Key Requirements	Relevance to the Project
Environmental and Social Operational Safeguard 8: Cultural Heritage	he Bank recognizes that cultural heritage is an inherent and essential part of self-identification, and that it provides continuity in tangible and intangible forms between the past, present, and future. People identify with cultural heritage as a reflection and expression of their constantly evolving values, beliefs, knowledge, and traditions.	As part of this ESIA process a cultural heritage impact assessment (considering both tangible and intangible forms of cultural heritage) has been undertaken.
Environmental and Social Operational Safeguard 9: Financial Intermediaries	Environmental and Social Operational Safeguard 9 (OS9) recognizes that strong domestic capital and financial markets, and access to finance are important for economic development, growth, and poverty reduction. The Bank is committed to supporting sustainable financial sector development and enhancing the role of domestic capital and financial markets.	The OS 9 is not triggered by the proposed project
Environmental and Social Operational Safeguard 10: Stakeholder Engagement and Information Disclosure	The objectives of OS10 are as follows: • To establish a systematic approach to stakeholder engagement that will help Borrowers identify stakeholders, and build and maintain a constructive relationship and channels of communication with them, in particular project-affected parties. • To assess the level of stakeholder interest and support for the project and to enable stakeholders' views to be taken into account in project design and E&S performance, among others.	

Harmonization of Nigeria ESIA Guidelines and African Development Bank Integrated Safeguards System

The Nigeria's ESIA requirements and African Development Bank Integrated Safeguards System have been harmonized as far as possible in order to make the ESIA responsive to the objectives of good practice (Table 1.4).

It should be noted that the principles inherent in the environmental and social standards of the AfDB are in tandem with the FMEnv ESIA procedures and processes.

However, in the event of divergence between the two, FMEnv, on one hand, and AfDB ISS on the other hand, the most beneficial, environmentally and socially speaking, shall take precedence in the execution of the project and utilization of the ESIA instrument for project implementation.

Before commencement of an ESIA, the FMEnv issues a letter of intent on notification by the proponent, calls for public participation, review and mediation. The proposed study shall take into consideration this process and/or procedure produces a report that is acceptable to both FMEnv. The report shall also ensure compliance with State Legislations and International conventions ratified by the Federal Government of Nigeria on environmental conservation and protection.

Table 1.4: A Summary of the Procedure of Nigeria ESIA & AfDB ISS

Safeguard / Thematic Area	Relevant Nigerian Legal / Regulatory Framework	AfDB ISS Operational Safeguard / Requirement	Identified Gaps / Discrepancies	Proposed Mitigation Measures / Harmonization Actions	Preferred Framework in Case of Conflict
Environmental & Social Assessment	Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004; FMEnv Procedural Guidelines (1995); NESREA (Act 2007).	OS 1: Environmental and Social Assessment — requires early, integrated, participatory ESIA including ESMP, disclosure, and monitoring.	National framework largely aligned but less emphasis on social inclusion, gender, and participatory monitoring.	Apply AfDB's ISS provisions on inclusive stakeholder engagement and continuous monitoring to strengthen local EIA practice.	AfDB ISS (OS1) — broader and more comprehensive in social coverage.
Labour Conditions, Health & Safety	Labour Act (2004); Factories Act (1990); Employee Compensation Act (2010); National Policy on Occupational Safety & Health (2016).	OS 2: Labour Conditions, Health and Safety — enforces fair labour practices, safe workplaces, and prohibition of child/forced labour.	Nigerian framework ensures worker safety but lacks structured grievance redress and contractor monitoring protocols.	Implement project-level Labour Management Plan (LMP) and OHS Plan per AfDB OS5 to ensure compliance across contractors.	AfDB ISS (OS5) — ensures consistent standards with international labour norms.
Pollution Prevention & Resource Efficiency	NESREA Environmental (Noise Control, Effluent, Air Quality, Waste Management) Regulations; FMEnv Guidelines (2011).	OS 3: Pollution Prevention and Control, GHGs, Hazardous Materials, Resource Efficiency — requires efficient use of energy, water, and safe	National regulations specify pollutant limits but lack provisions on GHG quantification and energy efficiency.	Integrate GHG monitoring, energy efficiency, and resource optimization measures as per AfDB OS4.	AfDB ISS (OS4) — broader environmental scope.

Safeguard / Thematic Area	Relevant Nigerian Legal / Regulatory Framework	AfDB ISS Operational Safeguard / Requirement	Identified Gaps / Discrepancies	Proposed Mitigation Measures / Harmonization Actions	Preferred Framework in Case of Conflict
		waste management.			
Involuntary Resettlement & Livelihood Restoration	Land Use Act (1978); FMEnv RAP Guidelines (2018); Constitution of Nigeria (Section 44).	OS 5: Involuntary Resettlement, Land Acquisition, and Compensation — requires full replacement cost compensation, livelihood restoration, and pre-displacement consultation.	Nigerian laws emphasize compensation for land but lack explicit livelihood restoration and vulnerability consideration.	Implement RAP and LRP consistent with AfDB OS2; adopt AfDB's replacement-cost principle and livelihood improvement measures.	AfDB ISS (OS2) — offers higher social protection standards.
		OS 4: Community Health, Safety and Security			
Biodiversity Conservation & Ecosystem Services	National Environmental (Regulations on Biodiversity Conservation) 2011; Endangered Species Act Cap E9 LFN 2016.	OS 6: Biodiversity, Renewable Natural Resources, and Ecosystem Services — mandates mitigation hierarchy and conservation offsets.	Nigeria's law lacks explicit ecosystem services valuation and offset mechanisms.	Adopt AfDB OS3 hierarchy: avoid–minimize–restore–offset; integrate biodiversity monitoring indicators in ESMP.	AfDB ISS (OS3) — internationally recognized conservation approach.
		OS 7: Vulnerable Groups			
		OS 8: Cultural Heritage			
Stakeholder Engagement & Grievance Redress	FMEnv EIA Procedural Guidelines (1995); Public Hearing	Embedded across OS1–OS10 and explicitly guided under AfDB's	National framework limited to one-time consultations	Apply AfDB SEP and GRM procedures; establish continuous	AfDB ISS — provides ongoing engagement and

Safeguard / Thematic Area	Relevant Nigerian Legal / Regulatory Framework	AfDB ISS Operational Safeguard / Requirement	Identified Gaps / Discrepancies	Proposed Mitigation Measures / Harmonization Actions	Preferred Framework in Case of Conflict
	Guidelines (2009).	Stakeholder Engagement Framework (2024).	during EIA scoping; no requirement for ongoing engagement or structured GRM.	engagement through CLOs and quarterly disclosure.	accountability requirements.
Climate Change & Green Growth	National Climate Change Act (2021); National Renewable Energy Policy (2015).	AfDB Supplementary Guidance: Climate Change and Green Growth — emphasizes resilience, low-carbon design, and GHG tracking.	Nigeria's framework lacks operational GHG accounting standards for projects.	Integrate AfDB climate resilience tools; monitor GHG emissions and implement adaptation strategies (solar hybrid, drainage, green buffers).	AfDB ISS — more operationalized for climate risk management.

1.9 Structure of EIA Report

An outline of the proposed contents of the main volume of the ESIA report is provided in Table 1.5. The proposed structure follows the guidance provided by FMEnv.

The content may be altered during the evolution of the project or based on the outcomes of on-going consultations. However, it is anticipated that the contents of the ESIA report will accord broadly within the suggested framework.

Table 1.5: Structure of the ESIA Report.

Chapter Number	Contents Reading	Explanatory Note
Front Piece		Title page, acknowledgments, authors and contributors, table of contents (including lists of figures, tables and maps)
0	Non-technical summary	Summary of the entire ESIA report.

Chapter Number	Contents Reading	Explanatory Note
1	Introduction	This Chapter will outline the development and structure of the ESIA report including the background, terms of reference and declaration. The policy, legal and institutional framework within which the ESIA will be conducted will be discussed. National regulations will be summarized along with relevant international agreements and conventions to which Nigeria is party as well as applicable international best practice guidelines and project standards.
2	Project Justification	This chapter will include discussion of the project background, objectives, need for the project, value of the project, envisioned sustainability, alternatives considered (including no project alternative), developed options considered and site selection.
3	Project Description	This Chapter will provide a concise description of the project and its geographical and temporal context. It will include a site description and overview of the facility project design and details of project inputs and outputs.
4	Description of the environment	This chapter will summarize the available baseline data on the environmental and social resources and receptors within the project AoI. It will be based on both primary and secondary data resources and will consider changes in the baseline condition without the development in place.
	Stakeholders Engagement	This Chapter will present the results of consultation undertaken as part of the ESIA, plus plans for future consultation. It will identify key project stakeholders and present their feedback on the project
5	Potential and Associated Impacts	This Chapter will summarize the predicted positive and negative impacts of the project. Cumulative impacts of the project. Cumulative impacts will be assessed as appropriate.
6	Impact Mitigation Measures	This Chapter outlines general and specific mitigation measures to avoid, reduce, or mitigate (compensate) negative impacts to environmental and social receptors. Enhancement measures for all positive impacts are also presented here.
7	Environmental and Social Management Plan (ESMP)	The ESMP will draw together the possible mitigation measures; group them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation and estimate the costs of the measures.
8	Decommissioning & Abandonment	This chapter presents the process of restoring the environment to 'as close to its original state as possible' at the end of its lifespan.
9	Conclusion	This Chapter will summarize conclusions that are made based on the assessment as well as outline any further recommendations.
References		All references made in the report and documents drawn upon during the course of the assessment.

Chapter Number	Contents Reading	Explanatory Note
Annexes		These will include technical annexes with details of specific technical surveys.

2. PROJECT JUSTIFICATION

This Chapter discusses the need and rationale for the project and enumerates the benefits to be derived from project implementation. It also discusses the envisaged sustainability of the project as well as the project alternatives and development options considered.

2.1 The Need for the Project

The need for the proposed AIH stems from the existence of constraints on crop value chains in Cross River State as summarized in Table 2.1

Table 2.1: Crop value chain constraints in Cross River State

Production Constraints	Marketing Constraints	Processing Constraints
Low yield	Inadequate access to appropriate packaging material	Inappropriate processing technologies particularly among small-scale millers
Pest and diseases which limit optimum yield in most of the production areas of state;	Price fluctuation	Poor equipment maintenance support by dealers, shortages and high cost of equipment and spares
Limited access to information from extension service.	Inadequate sources of finance	Erratic power supply and increased cost of fuel
Inadequate certified inputs such as seeds, fertilizer and herbicides etc	Small traders have limited storage capacity and thus are committed to a continuous cycle of buying and selling.	Unreliable supply of produce

A large percentage of households in rural areas of Nigeria are dependent on subsistent farming for survival, with majority of them being smallholder farmers. While they have the landmass as compared to the cities, such factors as youth migration, limited access to funding, infrastructure and technology among others are causing an increasing decline in food security. A solution to these food security challenges will increase agricultural output, create jobs and improve livelihoods for its citizens. Another benefit of this strategy is the creation of job opportunities, reduced cost of living, diversification of the Nation's economy and generally enhancing sustainable development.

The agricultural sector of Nigeria remains largely untapped and poses bright prospects for the her to tap into for the country's general development. The establishment of SAPZs in Nigeria (Cross River State) will boost the structural transformation of the economy by providing opportunities for public and private sector investment in agriculture, and when fully operational, the SAPZs will enhance national food and nutritional security, optimize the export of value-added agricultural commodities and improve the quality of livelihoods through wealth creation for rural farming communities.

2.2 Benefits of the Project

The Special Agro-Processing Zone (SAPZ) is designed to diversify Nigeria's economy by positioning agriculture as a major and sustainable source of revenue. It will enhance food security, strengthen inter-state and international trade, reduce rural-urban migration, and create mass employment across the agricultural value chain. By promoting agro-industrial processing, market access, and modern farming practices, the project will reduce post-harvest losses, raise productivity, and improve livelihoods, while also aligning with federal efforts to grow non-oil exports and achieve broader development goals

The project brings multiple layers of benefits. For government, it improves the business environment, boosts investor confidence, and generates new revenue streams. For communities, it enhances security, infrastructure, financial inclusion, and market accessibility while offering training for youth and women and driving local economic growth through CSR. For investors, it lowers costs through affordable leases, tax incentives, and shared facilities, while world-class infrastructure ensures compliance with global food safety and quality standards. Finally, the Agro-Industrial Hub (AIH) will generate diverse revenue from land and space leases, facility management, agricultural services, energy and water supply, auxiliary services, advertising, truck parking, and weighbridge operations ensuring long-term financial sustainability.

2.3 Value of the Project

The monetary value of the proposed AIH is expected to be capital intensive considering that the project cost covers components such as including site preparation, infrastructure development, utility systems (power, water, and wastewater), internal and access roads, administrative and processing buildings, equipment procurement, environmental mitigation measures, and initial operational support under the Design–Build–Operate (DBO) model.

The investment is jointly funded by the African Development Bank (AfDB) and the Federal Ministry of Agriculture and Food Security (FMAFS), with counterpart contributions from the Cross River State Government under the Cross River Special Agro-Industrial Processing Zone (CR-SAPZ) Program. The financial structure follows the Public–Private Partnership (PPP) model, combining concessional loans, grants, and private equity.

Beyond its financial worth, the project's value lies in its capacity to stimulate the regional economy, create over 3,000 direct and indirect jobs, expand market access for agricultural producers, and strengthen Cross River State's position as a hub for agro-industrial transformation. The anticipated multiplier effect through agricultural value chains, logistics, housing, and services is estimated to exceed ₦100 billion (USD 65 million) over a ten-year period, thereby significantly contributing to both state and national GDP growth. Table 2.2 and Table 2.3 summarize the potential value chains for the three major crops for the CR-SAPZ, cassava, cocoa and rice, respectively.

Table 2.2: Potential Cassava Value Chain

Potential value	Details
Potentials for value addition	✓ Increase yields from 9 ton to 30 mt / ha ✓ Availability of improved varieties ✓ Production/processing of industrial products such as ethanol, starch, etc. ✓ Import substitution potentials ✓ Availability of improved processing techniques
Market potentials	✓ There is an opportunity for grouped sales by organized smallholder producers or cooperatives upon meeting the off-taker requirement, ✓ Stable price ✓ High industrial demand ✓ Export potential of cassava by-products
Potential for pro-poor growth Gender relevance	✓ Women farmers are actively involved in cassava production ✓ Marketing of cassava related products are dominated by women ✓ Retail selling is mainly female business ✓ Small scale processing is dominated by women ✓ Industrial processing is dominated by men

Potential value	Details
Job creation in downstream sectors	✓ High potential in small-scale processing ✓ Export ✓ High potential to attract FDI ✓ Transportation/logistics ✓ Artisanal and industrial processing will generate significant number of jobs

Table 2.3: Potential Cocoa & Rice Value Chains

Potential value	Details
Potentials for value addition	✓ Improved quality of processed cocoa beans & milled rice, especially reduction of impurities and stones by better harvesting and processing techniques ✓ Innovations for farm machinery/extension services ✓ Soil testing for optimum fertilizer application ✓ Training on GAP (including fertilizers, herbicides, etc.) ✓ Promotion of agro machinery service providers ✓ Capacity building for machinery and equipment operators (power tiller, mills, etc.) ✓ Linkages to effective financial services/literacy trainings/management ✓ Improved quality of certified seeds ✓ Strengthened linkages among the value chain actors ✓ Availability of credible market information
Market potentials	✓ Huge deficit demand and supply of rice in Nigeria ✓ Availability of off-takers all over the country ✓ Import substitution potentials
Potential for pro-poor growth Gender relevance	✓ Women are actively involved in processing and production ✓ Marketing of rice paddy and cocoa beans is predominantly carried out by men and youth ✓ Retail selling is mainly female business ✓ Small scale processing is dominated by women
Job creation in downstream sectors	✓ High potential to attract FDI ✓ Transportation/logistics ✓ Seed breeders and multipliers ✓ Small and large-scale production, marketing and processing will generate significant number of jobs
Natural endowments	✓ Favorable climatic condition such as low temperature and optimum relative humidity during large part of the year
Profitability	✓ Highly profitable upon meeting the requirement of the buyers and off-takers

2.4 Envisaged Sustainability

Sustainability is the ability of a development project to maintain or expand a flow of benefits at a specified level for a long period after project inputs have ceased. The concept of sustainability means different things to different activities, organizations and developments. Specifically, for the project, sustainability means, ensuring the project continues to maintain its operations, provide its services and deliver its long-term benefits during implementation and projected life span. The sustainability of the proposed project is evaluated and described below using the following dimensions/ factors, namely: environmental, social, economic and technical considerations.

2.4.1 Environmental friendliness

An environmentally sustainable project is one that will meet the needs of the present without compromising the ability of future generations to meet their own environmental needs. Based on the above definition, the proposed Agro-industrial Hub (AIH) will be constructed to reduce environmental impacts and designed to consider such factors as climate change, judicious use of resources, protection of natural ecosystems among others. Potential impacts that are likely to arise as a result of the project in the different phases have been identified and their mitigation measures proffered, starting from the design-level, and documented for reference throughout the project lifespan to ensure that the environment quality is not compromised for future generations.

The proposed project is considered to be environmentally friendly, as environmental protection initiatives have been embedded in the project implementation process. And as such, the potential environmental risks and impacts of the project have been assessed as part of this ESIA and discussed in detail in Chapter Five (5). Environmental conservation and management measures have also been proffered not only to reduce ecological footprints of the project; measures have also been proffered to ensure that the AIH is constructed and maintained using energy and resource efficient materials and methodologies to the extent possible. These measures address the potential environmental risks impacts identified during the different phases of the project and are well articulated in the ESMP developed as part of the ESIA Report. The ESMP is presented in Chapter Seven.

2.4.2 Social Desirability

The AIH project prioritizes her stakeholders' perception, especially the acceptance of the hosts communities. Stakeholders' Engagement and Grievance Redress Mechanisms have been established throughout the project life cycle to address the needs of stakeholders. The engagement process already commenced from the scoping stage all through the field data gathering exercise to the public consultation held with stakeholders on the outcome of the ESIA. It is envisaged that the effective implementation of the E&S safeguards instruments, including the Livelihood Restoration Plan, will ensure social desirability of the project. Additional measures to ensure social sustainability of the project, will include the following:

- Inclusion of vulnerable groups such as elderly people, female heads of household, children and youth, racial and ethnic minorities, displaced persons, women and girls etc.
- Implementation of Corporate Social Responsibility (CSR) programmes targeted at improving Socioeconomic and health status in project affected communities will be embarked upon.
- Employment of as many local inhabitants of the host communities as possible during all phases of the project. Contractor's employment policy shall give preference to indigenes of these communities in a bid to ensure that they benefit directly from the project.
- Promote training, mentorship and development opportunities to prepare talented employees for successful succession.

2.4.3 Economic Viability

The economic viability of the proposed AIH project is based on the fact that it will eliminate agricultural and agro-industrial constrains, improve productivity, and therefore Return on Investment (ROI), improving exports to other states and outside the country as well. Additionally, the expansion of local markets is imminent with the inception of the project. The AIH project is designed to create both direct and indirect labour, skilled and unskilled workers for both indigenes and non-indigenes, which will in turn improve livelihood of the people and bring economic development to the state and the country at large.

2.4.4 Technical Feasibility

The construction and implementation of the proposed AIH project design is will be based on Best Available Technologies (BAT). The project team includes Arise Network, the DBO Contractor, a world-class firm with experience and expertise in the building and operations similar complex projects in and outside Africa.

2.5 Development Options

2.5.1 No Project Option

This is a do-nothing option. This option implies that the AIH project will not be implemented and the status quo will be maintained with the attendant challenges of food shortages and insecurity in the state and the country at large. This option is considered if there is economic, technical or human capacity deficiencies or that the proponents are unwilling to commence the project or that the regulatory authorities are unwilling to approve the project thus leading to a “no project option”. This option if adopted will represent a major setback for the initiatives and efforts of the Federal Government of Nigeria strategy to alleviate poverty by improving the agricultural sector. In addition, the inherent socioeconomic benefits of the project including stimulation of economic activities, job creation, improved livelihood, poverty reduction among others This option was neither socially desirable nor economically viable and was therefore rejected.

2.5.2 Delayed Project Option

The delayed project option implies that the project will be suspended and implemented in the future. This option may prolong the realization of the Federal Government of Nigeria strategy to alleviate poverty by improving the agricultural sector. In addition, the agricultural shortfalls of the state and the Nation will remain the same with grave implication for the economic development of the state and the nation in general.

Such option is usually taken when conditions are unfavourable for project implementation, such as in a situation where there is war, or host community is deeply resentful of the project. Also, if the economics of the project are unacceptable or unattractive at the time, then a delay may be feasible. But none of these conditions are applicable. In fact, on the contrary, both the economics and the political environment are most favourably disposed towards the project.

Furthermore, this option is not economically sustainable as huge amount of money will continue to be spent on importation of food products which provides only temporary solutions to the inherent problems. The project cost may also increase significantly given the unstable currency and exchange rate around the world. This option is therefore rejected because it is socially and economically unsustainable.

2.5.3 Immediate Project Implementation

This option implies that the project will go ahead as planned. Adoption of this option will ensure the realization of the numerous benefits of the project, especially the enormous associated socioeconomic benefits to the state, region and nation as a whole, e.g., increased agricultural productivity and employment, leading to reduced hunger, improved standard of living for the PAPs and other persons who will be directly or indirectly involved in the project. This option is therefore the preferred option.

2.6 Project Site Alternatives

Land suitability assessment is a critical process in determining the best use of land resources, particularly for agriculture. Geographic Information Systems (GIS) combined with Multi-Criteria Analysis (MCA) techniques provide a powerful framework for integrating various biophysical, environmental, and Socioeconomic factors to assess the optimal locations for agricultural development. In this research, the GIS and MCA technique was adopted in selecting suitable site for the Special Agro-Industrial Processing Zone (SAPZ) in Cross River State. Four different locations were assessed and they include: Mbarakom in Akamkpa LGA, Adiabo in Odukpani LGA, Ekpri Ikang in Bakassi LGA and Ikot Mbakara in Akpabuyo LGA.

The major relevant factors that influence crop growth and agricultural productivity considered in the analysis include biophysical factors (land-use and elevation/relief, drainage, etc.), Socioeconomic factors (proximity to roads/markets), environmental factor (drainage and flood risk). The parameters were assessed and reclassified based on their suitability status. For instance, in the land-use map, built-up areas were reclassified as ‘not suitable’ while fallowed/cultivated farmlands were reclassified as ‘highly suitable areas. Similarly, site that are closer to access road and market were classified as highly suitable and vice versa.

In assigning weight to the identified parameters, Analytical Hierarchical Process (AHP) and expert knowledge was used to assign importance to each factor. The AHP involves pairwise comparisons between criteria and consistency ratio (CR) to check judgment reliability. The reclassified parameters were integrated to form a suitability map using the formula in the raster calculator (ArcGIS 10.8). the result was classified into four suitability classes: highly suitable, moderately suitable, marginally suitable and not suitable.

Consequently, GIS-based MCA offers a systematic, reproducible, and spatially explicit approach to agricultural land suitability assessment. When well-executed, it provides robust decision-support for policymakers, planners, and farmers aiming for sustainable agricultural development. From the result in this analysis, among all the sites selected, the proposed site at Adiabo was observed to be highly suitable for the project as it meets all the criteria. For instance, location like Ekpri Ikang in Bakassi and Ikot Mbakara in Akpabuyo were observed to be highly susceptible to flooding due to its low topography while Mbarakom, apart from low level of accessibility due to bad roads and far distance from market, it is also threatened by gully and difficult terrain. Adiabo was observed to be highly connected to the major roads and market, with moderate topography to support the intention of the project as well as agricultural land-use type. Hence, Adiabo was accepted as the suitable site for the project (Figure 2.1 and Table 2.4).

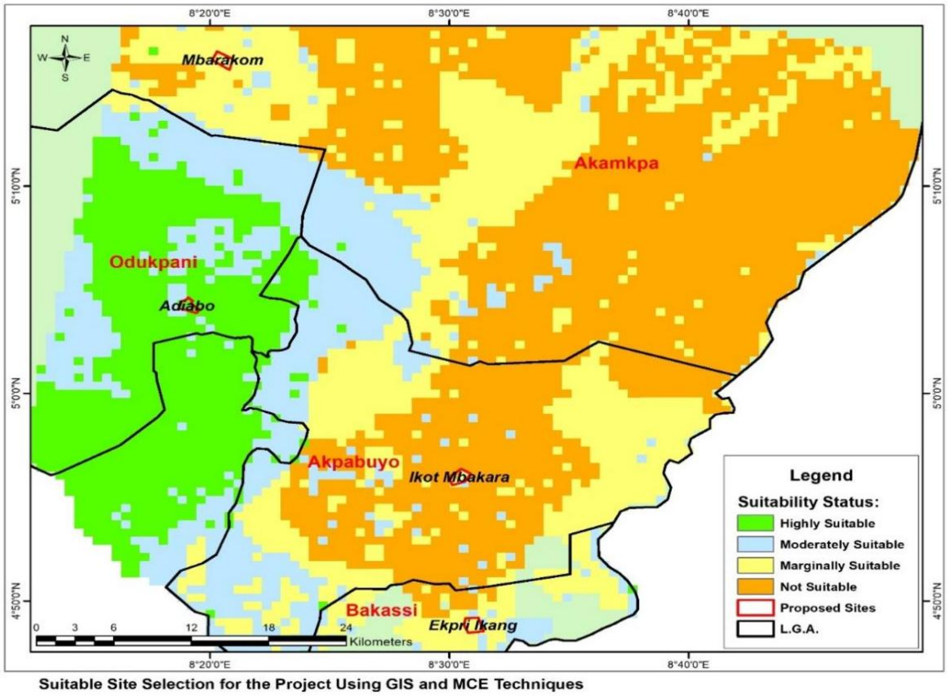


Figure 2.1: Suitable Site Selection for the Project Using GIS and MCE Techniques

Table 2.4: MCA for site selection

	Location	Land Availability	Relief	Inter-modal Accessibility	Security	Proximity to farmers	Proximity to markets	Score (%)	D
1	Ekpri Ikang, Bakassi	5	8	4	3	4	4	38.33	R
2	Ikot Mbakara, Akpabuyo	4	8	6	4	4	5	51.67	R
3	Adiabo, Odukpani	5	7	9	9	6	8	78.33	S
4	Mbarakom, Akamkpa	7	6	3	6	6	5	45.00	R

Weights: 0 = Not suitable; 1-3 = Marginally suitable; 4-6 = Moderately suitable; 7-10 = Highly suitable. D = Decision; R = Rejected; S = Selected.

3. PROJECT DESCRIPTION

3.1 Project Description

This chapter presents and overview of the project, describes the project design and the planned activities throughout the project life cycle. The proposed Agro-Industrial Hub (AIH) is being developed through a Design, Build and Operate (DBO) / site and services model. It is planned to sit on a 130 ha of land (Figure 3.1). The proposed AIH is planned to provide common infrastructure and facilities to the expected agro-industries of various scales, ranging from small to medium and large which will be established, owned and operated by prospective investors. This ESIA covers only the common infrastructure and facilities of the project as detailed in subsequent sections of this chapter. The prospective agro-industries will take advantage of this ESIA when approved, to carry out their individual E&S assessments as will be required of them prior to establishment.

3.2 AIH Layout

Based on the value chain needs of the AIH, the site layout is developed. The required facilities are as shown in Table 3.2. The site layout is shown in Figure 3.1.

3.3 Components of the Agro-industrial Hub (AIH) at Adiabo

The proposed Agro-Industrial Hub (AIH) infrastructure will include office buildings, training centres, general services fencing, internal access roads/parking, drainage, power supply, water, and sewerage, effluent management, health, and safety) specialized services will include quarantine, quality control, lab. and certification centres. breeding centres, business support services (administrative knowledge/ ICT/procurement /employment centres, and activities to implement the ESMP.

The proposed AIH will have common on-site and off-site infrastructures and facilities for the use of all tenants and operators. These will include access and internal roads and drainage, power and water supplies, solid and liquid waste management facilities, warehousing, market, etc. The industries will be built, owned and operated by prospective investors. They will therefore be required to subject their respective industries to the ESIA process for permitting prior to establishment. The details of the of the proposed infrastructure are presented in sections following.

3.4 On-Site Infrastructure and Facilities Planning

On the basis of function and facilities required for the AIH, on-site infrastructure is planned as described in Table 3.2, Table 3.3 & Table 3.4 while Table 3.5 shows the Bank + ATM, small, medium and large-scale industries are not part of this ESIA as their details are not available now and therefore their full impacts cannot be identified and assessed presently.

Table 3.1: AIH Site provisions

SN	Description	Remarks
1	Land Development	Site grading works will only be for the road and general infrastructure area, to enhance economy and environmental considerations. The vegetation along the water courses, accounting for about 12.5 ha of the proposed site (Figure 3.2: The AIH site showing the area (in yellow) of vegetation to be cleared and conserved (ingreen)) shall be conserved green to retain the carbon sequestration capacity of the site. The total area that would be cleared of vegetation is 37.94 ha. The remaining 80 ha of the available 117.5 ha has crops that would be harvested before construction. The trees in this portion of the land will be left, as much as possible, standing.
2	Boundary wall and fencing	A wall fence to surround the zone is planned. This will enhance the security of the project. The total approximated length of the fence is 4.6 km. Trees shall be planted at 10 m interval along the internal fence line to enhance the carbon sequestration capacity of the facility and compensate for the 164,720.23.55 m3 of biomass that will be removed during site clearing. Approximately, 170,000 pieces of concrete blocks will be used to erect the perimeter fence.

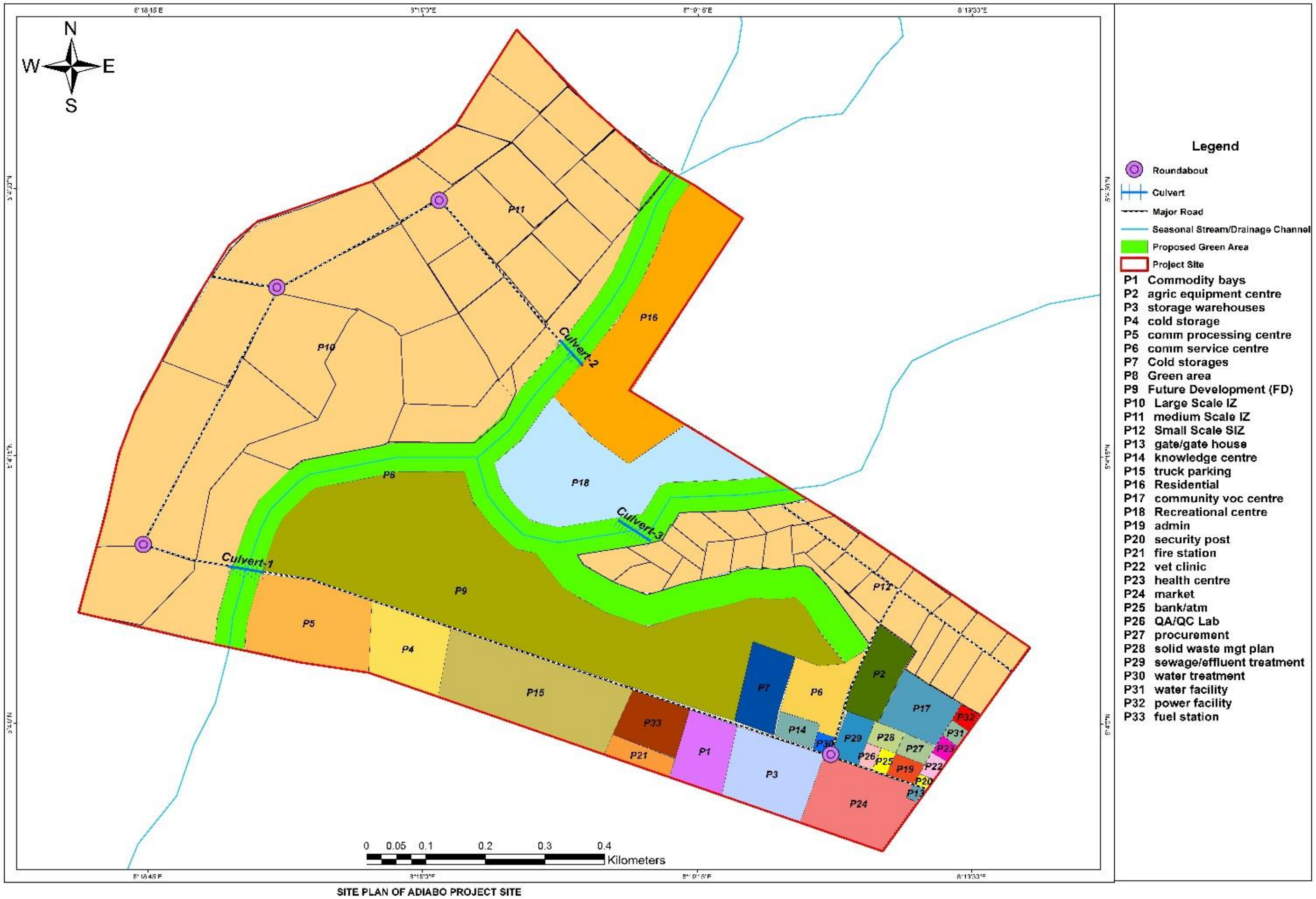


Figure 3.1: Proposed AIH Layout

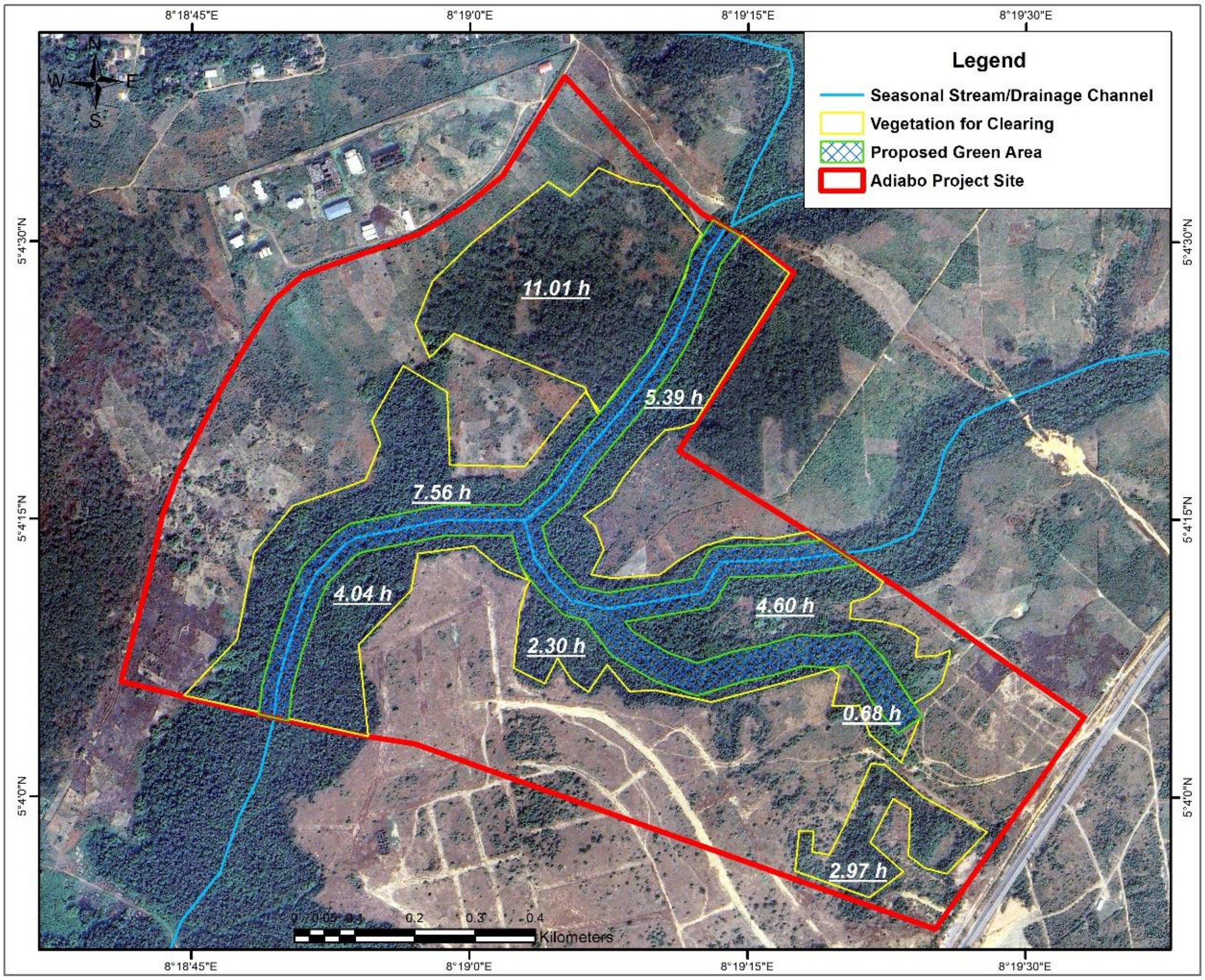


Figure 3.2: The AIH site showing the area (in yellow) of vegetation to be cleared and conserved (ingreen)

Table 3.2: Facilities and components in the proposed AIH

Description	Area (SqM)
Perimeter Fence	1,150
Gate /gate house	500
Security outpost	500
Commodity service Centre	10,000
Commodity processing Centre	20,000
Industrial / Employment zone	100,000
Truck Park	30,000
Community vocational Centre	10,000
Residential area	50,000
Water facility (boreholes, overhead tanks/steel towers & reticulation)	1,000
Water treatment plant	1,000
Power facility	1,000
Storage warehouses	20,000
Cold storages (meat etc.)	10,000
Fuel station	5,000
Solid waste management plant	2,000
Sewage and effluent treatment plant	4,000
Fire station	1,000
Admin. Block	2,000
Commodity loading and uploading bays	10,000
Veterinary clinics	1,000
Health centre	1,000
Market	20,000
Recreational	10,000
QA&QC lab	1,000
Knowledge centre	3,000
Procurement centre	2,000
Agric equipment centre	10,000
Bank + ATM services	2,000
Small scale industrial zone	200,000
Medium scale industrial zone	200,000
Large scale industrial zone	200,000
Future development area	175,000
Green area	125,000
	1,328,000

Table 3.3: AIH component capacity and lifespan details

AIH Project Components		
Component	Capacity / Specification	Design Life (Years)
Internal Roads	5500 Rmt, Flexible pavement, 18m ROW with solar street lights	20
Drains	12804 Rmt, RCC rectangular, 600 mm wide	30
Power Demand	Peak Load 23 MVA (Installed capacity 500 KVA x 2)	N/A
Substation	Compact substation (1000 KVA)	20
Electrical Distribution	13.8 km	20
Borewells	2 Nos, Depth 200 m, Yield 65 m^3/hr	20
Storage Tanks	500 KLD, Ground-level RCC tanks	35
HDPE Distribution Pipes	13.8 km, PN 10, 225–280 mm diameter	25–50
Wastewater Generation	1750 KLD, Domestic + Industrial mix	N/A
STP Type	MBBR technology	
STP Capacity	500 KLD	
STP Lifespan (Civil)		35
STP Lifespan (Mechanical)		15
Sewer Network	9.8 km, HDPE 225–280 mm diameter	25–50
Admin / R&D / Other Buildings	RCC framed, GI roofing	50–60
Public Toilets	60 sqm, 16 WCs	30–40
Fire Station	75 sqm, RCC, 24x7 manned	40–50
Gate & Gatehouse	RCC structure	40–50
Chain Link Fencing	4600 Rmt, 2m height, steel posts with concrete foundation	15–20

Table 3.4: Facility Design Details

Design Details of AIH		
A	Area in Ha	130 ha
B	Time period (AIH+ATC)	
	Design	4 Months
	Construction	18 Months
	Operations & Maintenance (Including Defect Liability Period (DLP)	60 Months
C	Internal Road	Length: 5500 Rmt ROW: 18m wide, with solar street lights and channel kerbs.
D	Drain	Length: 3804 Rmt - ranging from 500mm x 500mm to 1000mm x 1000mm
E	Electrical	

	Design Details of AIH	
	Power Source	0.2 km to the substation, 33 kV line along the plot boundary
	Power Demand	13MVA
	Distribution length	3.8 km
	Sub-station	Compact substation of 1000 kVA
F	Water	
	Source	Ground Water (Unless state brings surface water to the site)
	Demand	1500 KLD
	borewell	2 Nos
	Storage	1000 KLD Capacity
	Distribution	3.8 Km of HDPE pipe ranging from 225 mm to 280 mm
G	Wastewater	
	Generation	1550 KLD
	STP	1000 KLD
	Conveyance	3.8 Km of HDPE pipe ranging from 225 mm to 280 mm
H	Buildings	1. Administrative Block + Research and Development + Disaster Management - 400 Sqm
	Fire station	75 Sqm - with Shed for fire tender (Does not include cost of fire tender)
	Public Toilet	60 Sqm - 8 WCs x 2
I	Gate & Gatehouse	1 Nos
J	Boundary wall	4600 Rmt - Chain Link Fencing
K	Access Roads	Since the Plot is next to the Highway, Access Road has not been considered

The facilities presented in Table 3.5 will be developed, owned and operated by private investors. The would be subjected to both FMEnv's and AfDB's E&S requirements, to prepare and implement specific ESMPs for their individual operations, leveraging on this ESIA, when it is approved and implemented.

Table 3.5: Facilities to be developed by Investors in the AIH

SN	Description
1	Fuel station
2	Small scale industrial zone
3	Medium scale industrial zone
4	Large scale industrial zone
5	Bank + ATM Services

3.5 Internal Roads

To attain smooth daily traffic flow inside the AIH, internal road network was designed according to the classification of major and minor roads. Major roads will enhance mobility while minor roads will maximize accessibility to each factory. Access road to the AIH is directly connected to the Tinapa Road.

The major is road is two lanes for vehicular traffic with drainage and sidewalks on both sides while the minor roads are single lane with side drainage on both sides. In anticipation of high level of activities in the AIH, a traffic management plan has been developed (in Appendix 7), the surfacing will be asphalt over a lateritic base and sub-base courses. These surfacing will reduce cost of maintenance and rehabilitation. Based on the AIH layout, the internal road details are presented in the Table 3.6.

Table 3.6: Internal roads specifications

SN	Description	Length (m)	Number of Lane	Width of Lane	Materials
1	Major Road	2830	2	10m + 10m	Asphalt
2	Minor Road	2670	1	10m	Asphalt

The layout and cross sections of the proposed major and minor internal roads are presented in Figure 3.3, Figure 3.4 and Figure 3.5.

3.6 Off-Site Road Requirement

There is a need to improve some sections of the Tinapa Road that is susceptible to flooding, and the intersection of the same road with the Calabar-Ikom Highway, (Figure 3.3) to enhance the AIH. These interventions will facilitate transportation of inbound and outbound raw materials and products, access to the site and commuting of employees from the community. The provision for the roads is shown in

Table 3.7: Off-site roads details.

Plate 3.1: Flooded Tinapa Road on a rainy day (left); Tinapa Junction along Calabar-Ikom Highway (right)

Table 3.7: Off-site roads details

SN	Description	Length (km)	Cross-section	Material
1	Rehabilitation of Tinapa Road leading to the AIH	4	Dual - 7.3m carriage +1.5m Shoulder	Asphalt
2	Provision of a flyover at the Calabar-Ikom Highway/Tinapa Road intersection	Recommended	Recommended	

3.7 Construction Materials

Table 3.8 and Table 3.9 present the basic construction materials and product output.

Table 3.8: Schedule of Construction Materials

Material	Approximate Quantity
Steel Reinforcement Rods (Rebars)	~ 1000 MT
Cement	~ 32000 bags
River Sand (Concrete Grade)	~ 75000 m^3
Sand (Masonry / Plastering)	~ 3000 m^3
Stone Aggregates (Crushed)	~ 120000 m^3
Gravel / Fine Aggregates	~ 24000 m^3
HDPE Pipes (PN 10, 225-280mm)	~15.5 km
PVC Pipes and Fittings	~3 km (various diameters)
Bitumen	~7,500 tonnes
Concrete Blocks / Bricks	~3.5 million units
Steel Sections (Beams, Channels, Angles)	~200 tonnes

Material	Approximate Quantity
Formwork Materials (Plywood, Props)	~75,000 m^2 plywood + props
Reinforcement Accessories (Ties, Chairs, Wire)	Various quantities (e.g., 3-5% of rebar weight)
Electrical Cables and Accessories	Lump sum based on design (~20 km cables)
Solar Street Lights and Fixtures	~240 sets (estimate based on 18m ROW length)
Waterproofing Materials	~3,000 m^2
Paints and Coatings	~15,000 liters
Chain Link Fencing	6,000 Rmt

Table 3.9: Product Output

Product Output	
Product	Quantity
Concrete for drainage, median, manholes etc.	105290 m^3
Fill material	703223 m^3
Asphalt wearing course	15061 m^3
Asphalt binder course	22292 m^3
Base course	425400 m^3

3.8 Major Project Equipment

The major equipment to be deployed for the construction are listed in Table 3.10. During decommissioning, plies and deck concrete will be dismantled and removed from site.

Table 3.10: Schedule of Equipment

Construction Equipment			
Equipment/Plant	Quantity	Capacity / Size	Duration of Use
Excavators	2	20-ton class	12–18 months
Dump Trucks / Tippers	8	15–20-ton payload	12–18 months
Concrete Mixer Trucks	2	6–8 cubic meters per batch	10–12 months
Vibratory Rollers	2	10-ton	6–9 months
Water Tanker Trucks	4	10,000 liters	12–18 months
Mobile Crane	1	20-ton lifting capacity	6 months
Welding Machines	5	Standard portable units	12–18 months
Generators	3	250 kVA	12–18 months
Concrete Pumps	1	30 m^3/hr	6–9 months
Transit Mixture	2	7 m^3	12-18 months
Operation Equipment			

Construction Equipment			
Equipment/Plant	Quantity	Capacity / Size	Duration of Use
Maintenance Vehicles	2	Medium duty trucks	5 years (ongoing)
Fire Tender (fire truck)	1	4,000 liters water tank	5 years (ongoing)
Water Pumps	3	10–15 HP pumps	5 years
Generators	2	100 kVA	Backup power for critical systems
Landscaping Equipment	3 set	Standard lawn mowers, trimmers	Seasonal/periodic use

3.9 Construction Material Transportation

The transportation of construction materials for the proposed project will be managed efficiently to minimize environmental impact and ensure timely delivery. Materials such as crushed stone, sand, and aggregate will be sourced from quarries and suppliers located within a 50-kilometer radius of the project site, thereby reducing transportation costs and emissions. These materials (as highlighted in Table 3.8) will be transported using 10-ton dump trucks, adhering to safety and load regulations.

Asphalt and cement will be procured from regional production facilities with the capacity to meet the project's quality and quantity requirements. Delivery will be scheduled to align with construction phases to optimize storage and usage. Excavated soil and other spoil materials will be promptly removed from the site to avoid clutter and potential environmental hazards. These materials will be transported to designated and approved dump sites, ensuring compliance with environmental regulations and minimizing disruption to Adiabo and surrounding communities.

Additionally, the excavated soil spoil will be efficiently removed from the site and transported to designated dump sites, ensuring a streamlined and organized construction process while maintaining the integrity of the surrounding environment.

3.10 Project Personnel

Approximately 200 staff members will be brought on board for the construction phase of the project, and expert subcontractors will be enlisted as required by the DBOC. The subcontractors will be selected from firms and individuals residing in the communities surrounding the construction site of the road. To facilitate the transportation of employees to and from the work location, shuttle buses will be furnished at designated spots within the town and its surroundings. These buses will depart prior to 7 am and return at the conclusion of the workday. Of the entire workforce, 70% will be sourced locally, comprising 40% unskilled labor, 20% semi-skilled labor, and 10% skilled workers, while the remaining 30% will be recruited from areas outside of the local vicinity. Of the 200 expected staff members, 50 will be engaged during the preconstruction phase, additional 150 will be added for construction while the number will drop to 30 during the operations. These figures are for the DBOC and their subcontractors. When the investors come on board, these figures will change accordingly.

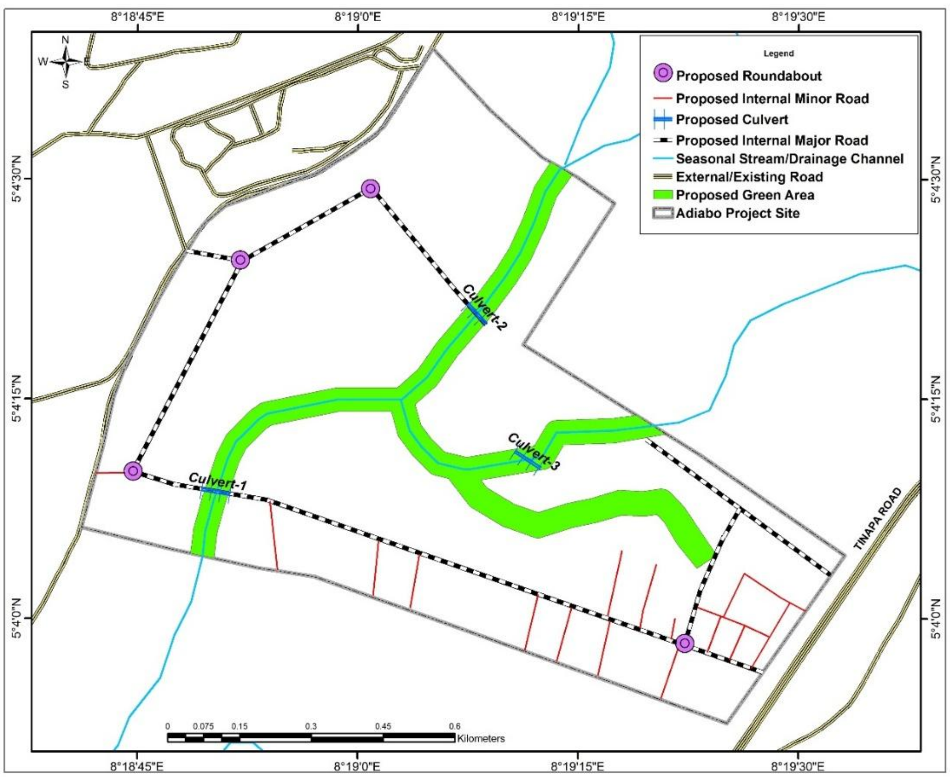


Figure 3.3: Layout of the proposed internal roads in the AIH

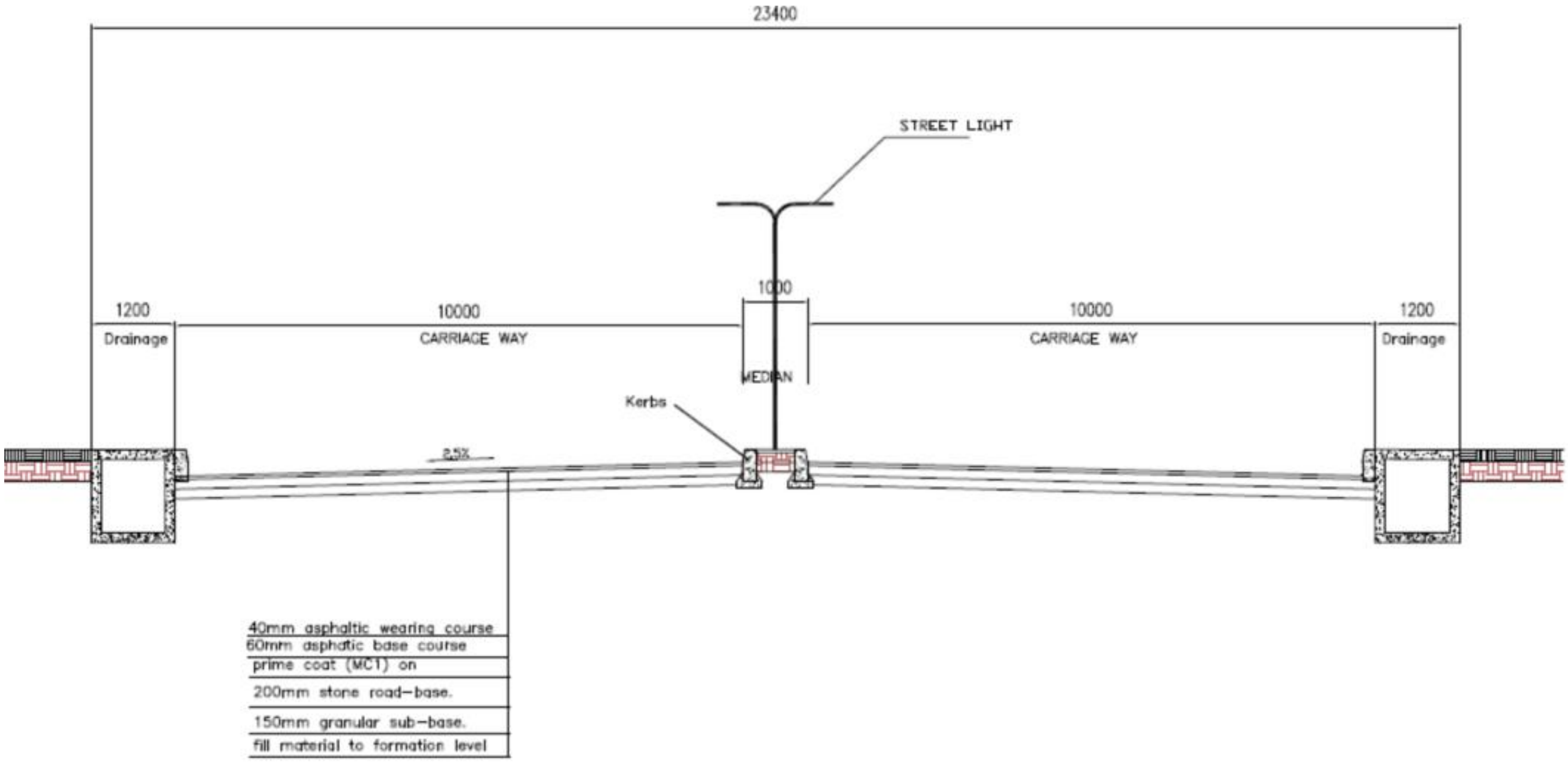


Figure 3.4: AIH’s Typical Major Road Cross Section

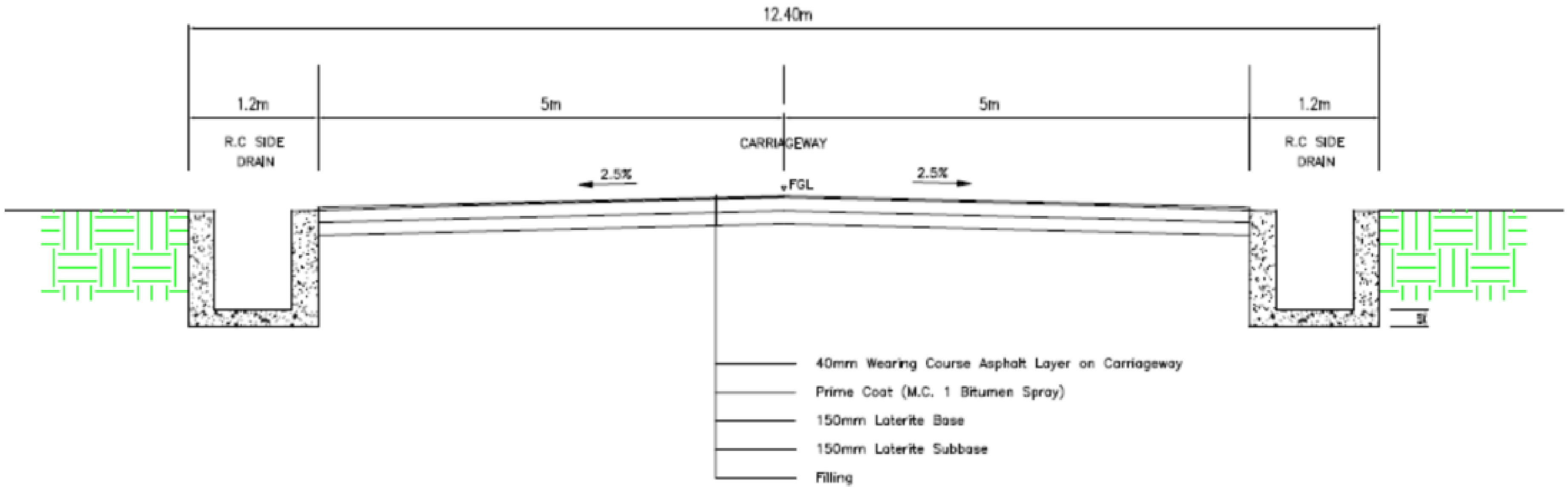


Figure 3.5: AIH's Typical Minor Road Cross Section

3.11 Storm Water Drainage Channel

Storm water drainage channel is planned to discharge stormwater from the AIH to the Calabar River, about 1.3 km from the site. Storm water inside the AIH is planned to be collected into roadside drains along the internal road and then released into the river. Cross culverts are located at appropriate locations. Based on the AIH layout the storm water drainage details are presented in Table 3.11

Table 3.11: Storm water drainage specifications

SN	Description	Length (m)	Number	Dimension
1	Road Side drains	4286.4	2	1.2m x 1.2m
2	Main drain for discharge to the rivers	1381.5	1	2.0m x 1.5m
3	Cross culverts	221.6	25	1.2m x 1.2m

The drains material will be reinforced concrete to reduce cost of maintenance and rehabilitation. The design of drainage system is based on established design criteria. The expected storm water runoff from rainfall is estimated using the Rational Method as recommended in the Federal Highway Manual Part 1 Design, and of the form.

$$Q = 0.278\,CIA$$

Where:

Q = Quantity of run–off in cubic metre per second (m^3/sec)

C = Coefficient of run-off expressed as a percentage of imperviousness of the water shed surface.

I = Rainfall intensity in millimeter per hour (mm/hr.)

A = Catchment area in square kilometre.

The above formula is true for catchment areas of 12 square kilometres maximum. An area reduction factor is then applied for areas above 12 square kilometres, this factor is derived from the work done by Balasha-Jalon Consultants (1977) on the Benin City Master Plan for Drainage Scheme and can be applied for catchment areas in the sub-Sahara region of Africa.

$$Factor = \frac{1}{e^{(1\frac{12}{A})}}$$

Where, A=area of catchment in square kilometres

The sizing of the drains using Manning's formula for uniform flow calculations:

$$Q = \frac{AR^{\frac{2}{3}}S^{\frac{1}{2}}}{n}$$

Q = Flow Rate (Discharge) m^3/sec

A = Area of Section in m^2

R = Hydraulic radius in meter

n = Manning's roughness coefficient

S = Slope of channel in m/m

The designed channel is such that the minimum velocity is 0.6m/s for self-cleansing and the maximum should be such that scouring will be prevent.

3.12 Water Sources and Demand

The main water sources will be both boreholes and surface water, a network of industrial boreholes will be utilized.

The AIH shall have constant water supply to cater for the following:

- For use by the industries in the AIH;
- For people in the facility for drinking, bathing, cooking, etc.;
- For the livestock in the facility; and
- Other uses such as gardening, cleaning, toilet flushing etc.

The basis used in estimation of the water demand are shown in Table 3.12, losses of up to 10% will be taken into account.

Table 3.12: Average day unit demand figures

Consumer Type	Average Day Unit Water Demand
Domestic	
Standpipe	20 litres/person/day
Yard tap	40 litres/person/day
House connection	200 litres/person/day; High Income Consumers (with multiple fixtures and a garden tap; includes car washing and garden watering) 100 litres/person/day; Medium Income Consumers (with a kitchen sink, one or two WCs, showers and bathtubs and hand wash basins).

Consumer Type	Average Day Unit Water Demand
	50 litres/person/day; Low Income Consumers (with limited fixtures, a WC and one or two taps).
Institutional Schools – Day (students and staff) – Boarders (students and staff) Hospitals – Outpatients and non-resident staff – In-patients and resident staff Mosques Churches	 5 litres/person/day 50 litres/person/day 10 litres/person/day 100 litres/person/day 15 litres/person/day 5 litres/person/day
Commercial Hotels Lodges Shops Bars/Restaurants Offices Petrol stations/washing bays Abattoirs/butcheries	 100 litres/bed/day 50 litres/bed/day 25 litres/shop/day 200 litres/day 5 litres/person/day 200 litres/day 50 litres/day
Industrial Milk cooling Dry processing mills Unspecified industrial areas	 200 litres/day 30 litres/day 10,000 litres/hectare/day
Livestock Livestock Unit	 50 litres/head/day

3.12.1 Fluctuations in Rate of Demand for Water

Average Daily Per Capita Demand

= Quantity Required in 12 Months/ (365 x Population)

If this average demand is supplied at all the times, it will not be sufficient to meet the fluctuations.

Seasonal variation: The demand peaks during the dry season. Fire breakouts are generally more in dry season, increasing demand. So, there is seasonal variation.

Daily variation depends on the activity. People draw out more water on weekends and festival days, thus increasing demand on these days.

Hourly variations are very important as they have a wide range. During active household working hours i.e., from six to ten in the morning and four to eight in the evening, the bulk of the daily requirement is taken. During other hours the requirement is negligible. Moreover, if a fire breaks out, a huge quantity of water is required to be supplied during short duration, necessitating the need for a maximum rate of hourly supply.

So, an adequate quantity of water is available to meet the peak demand. To meet all the fluctuations, the supply pipes, service reservoirs and distribution pipes properly proportioned. The water is supplied by pumping directly and the pumps and distribution are system is designed to meet the peak demand. The effect of monthly variation influences the design of storage reservoirs and the hourly variations influences the design of pumps and service reservoirs. As the population decreases, the fluctuation rate increases.

$$Maximum\ daily\ demand = 1.8\ x\ average\ daily\ demand$$

Maximum hourly demand of maximum day, i.e., Peak demand

= 1.5 x average hourly demand

= 1.5 x Maximum daily demand/24

= 1.5 x (1.8 x average daily demand)/24

= 2.7 x average daily demand/24

= 2.7 x annual average hourly demand

3.12.2 Water Demand

Table 3.13shows the water demand for the AIH, which is estimated based on the basics presented in

Table 3.13Table 3.12.

The Average Daily Demand of the AIH is estimated to be 6900 m^3/day.

While the Maximum daily demand = 12,420 m^3/day.

Peak demand = 776m^3/hour.

It is expected that 50% of this demand will be sourced from boreholes which require little treatment, while the remaining 50% will be sourced from surface water which requires more elaborate treatment.

Table 3.13: AIH Projected water demand

SN	Land Use Description	Estimated Water Demand (m^3/Day)	10% Loss	Total Demand (m^3/Day)
1	Offices	337.5	33.75	371.25
2	Residential	90	9	99
3	Commercial	1352.3916	135.23916	1487.63076
4	Small scale Industries	1698.75	169.875	1868.625
5	Medium scale Industries	1653.75	165.375	1819.125
6	Large scale Industries	1071.168	107.1168	1178.2848
				6,823.91556

3.12.3 Fire Fighting Demands:

Provision for firefighting demand to be met through hydrants (Figure 3.7) is governed by the mathematical formula $100\sqrt{P}$ where P is population in thousands and quantity is in kilolitres subject to minimum provision of 5% of total water demand.

3.12.4 Water Storage Tank

Storage tanks serve to store the water needs of the population. They are sized so as to meet one of two values:

(1) 25% of daily peak demand, and

(2) 50% of average daily demand.

Selection of volume followed the following criteria: a surface storage tank sized close to 25% of daily peak demand and overhead water tank for 50% of daily average, by considering extension problems and marginal price difference on execution. Another factor is due to pumping by generator that requires ensuring a more comfortable storage for compensating more extended pump stopping. Reservoir capacity required specifically for firefighting is 1% of daily demand.

3.12.5 Water Distribution Lines

Water distribution facilities consist of water supply tank and distribution pipelines. (Figure 3.6and Figure 3.7) Storage capacity of water tank was designed, taking into account the hourly water demand fluctuation, necessary water amount for firefighting and emergency (cut-off of water supply) situations. Diameter of water distribution pipes are to accommodate the required hourly maximum water consumption.

The pipeline networks are classified in three categories:

(1) **Conveyance pipes**: this type of pipeline links up supply points treatment plant and pumping stations

(2) Transmission pipes link up pumping stations with water storage tanks, and

(3) **Distribution pipes**: starting from water storage tanks or connection points in case of gravitational network up to distribution points.

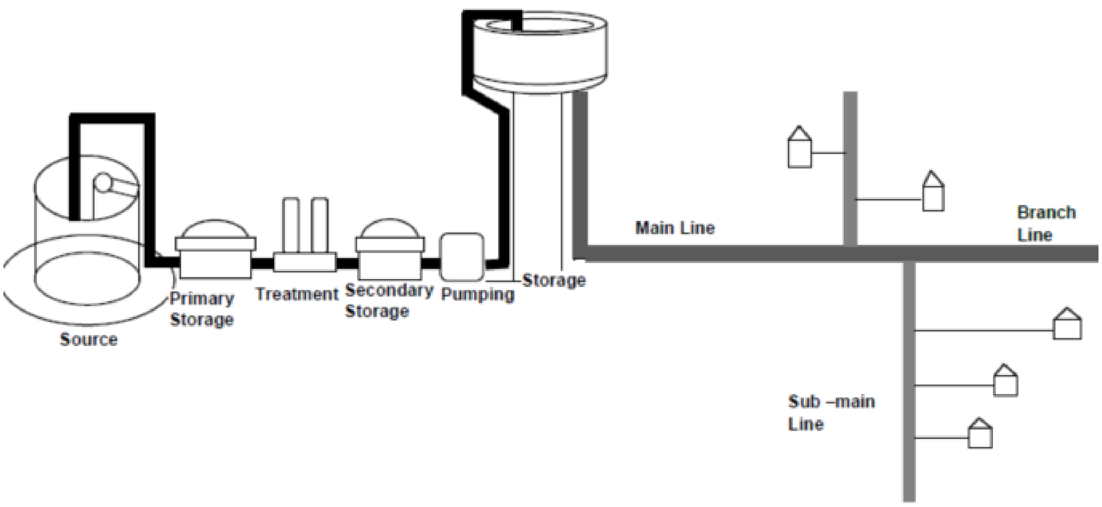


Figure 3.6: Water supply schematic diagram

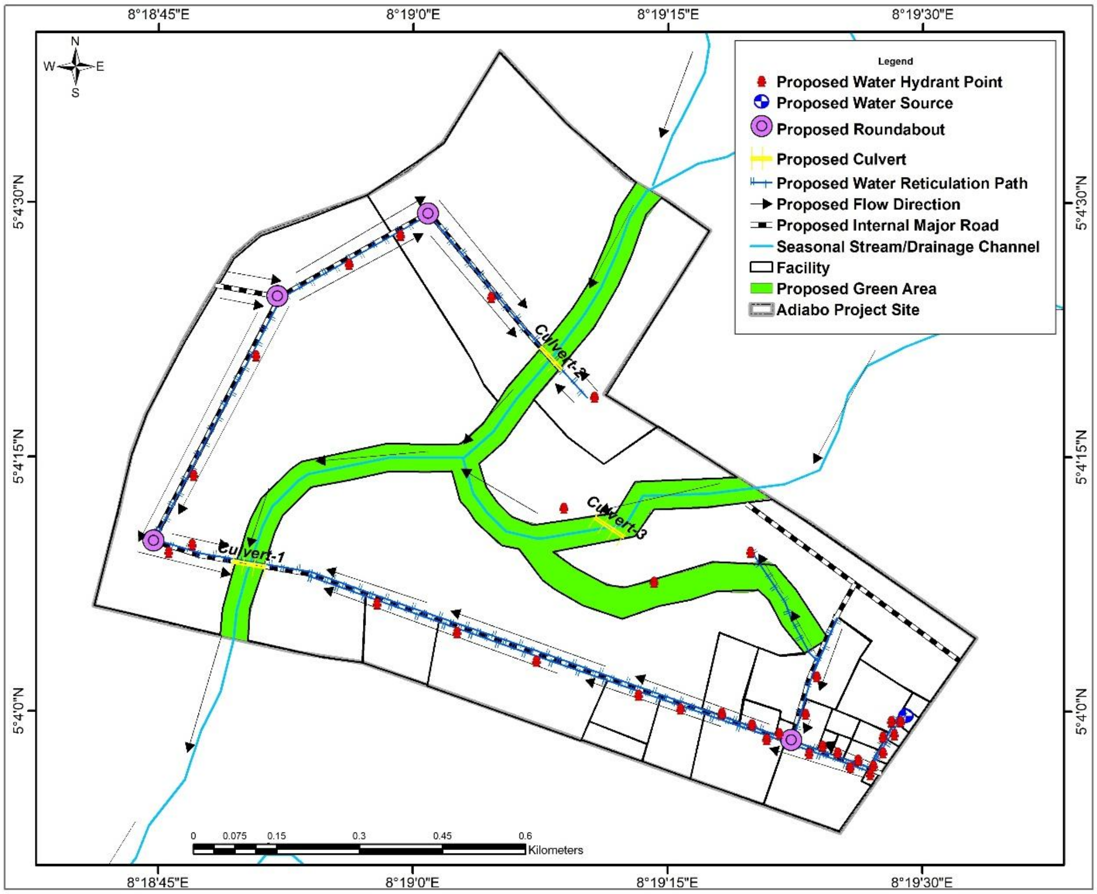


Figure 3.7: AIH site plan showing proposed water, waste water reticulation layout with hydrant stations

3.12.6 Power Demands

Overhead power distribution lines (33 kV) from the national grid would be extended to each tenant enterprise inside the AIH. Installation of step-down transformers is planned for small and medium power consumers, while 33 kV line will be directly extended to big power consumers.

Provision for the use of renewable energy to complement the power needs, will be made. Table 3.14 indicates a load estimation.

Table 3.14: Energy load estimation

SN	Description	Remarks	Estimated Power Load (kW)	Cumulative Estimated Power Load (kW)
1	Commodity Service Center 1-90 W; 2-150 W	- lighting load - small power load for meat storage	9 +15	24
2	Residential Areas 1-90 W 2-150 W	- lighting load - small power load for ventilation and cooling.	30.06+50.1	80.16
3	Market and Banks areas 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	18+30	48
4	Health center 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	7.83+13.050	20.88
5	Processing Centre 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	47.6+79.35	126
6	Community vocational Centre 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	79.35+47.61	126.96
7	Fire station (1-90 W)	- lighting load	74.520	75
8	Vet clinic (1-90 W)	- lighting load	7.65	7.65
9	Admin block 1-90w 2-150w	- lighting load small power load for ventilation and cooling	53.82+89.7	143
10	Agric Equipment Centre 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	39.33+65.55	104
11	Recreational Centre 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	315,09+525.150	840.24
12	Cold storage 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	13.5+22.5	36
13	Trucks parking 1-90w	- lighting load	13.5	13.5
14	Medium scale industrial zone	- lighting load	330.75+551.25+661.5	1543

SN	Description	Remarks	Estimated Power Load (kW)	Cumulative Estimated Power Load (kW)
	1-90 W 2-150 W 3-180 W	- small power load consumption machines. - medium power consumption machines.		
15	Large-scale Industrial Zone (D) 1-90 W 2-150 W 3-180 W 4-200 W	- lighting load - small power load consumption - medium power consumption machines - high consumption machines	206.28kw+343.8kw+412.56+458.4	1421
16	Small scale Industrial Zone 1-90 W; 2-150 W 3-180 W	- lighting load - small power load consumption machines	45+75+90	210
17	QA & QC LAB 1-90 W 2-150 W	- lighting load small power load for testing machines and test sample cold storage.	9+15	24
18	Commodity processing Centre 1-90 W 2-150 W	- lighting load small power load for water & fuel pumping machines	6.93+11.55	18.48
19	Solid waste management.	- lighting load small power load for sewage pumps	3.6+6	9.6
20	Power facilities 1-90 W 2-150 W	- lighting load small power load for water & fuel pumping machines	6.93+11.55	18.48
21	Sewage effluent treatment plant. 1-90 W; 2-150 W	- lighting load small power load for sewage pumps	4.5+7.5	12
22	Security street lighting 1-90 W	- lighting load	270	270
23	Total estimated load for the whole district			5,171.95

3.12.7 Load Mapping / Distribution for the AIH

Since the total load requirement/estimated based on the above-named estimating method, the proposed arrangement and load survey for the whole hub is proposed in Table 3.15, with underground distribution network layout presented in Figure 3.8

Table 3.15: Load Mapping

SN	Location	Estimated Load (MW)	Distribution Transformer Sizing/Selection	Remarks
1	The whole district under study/observation	5.17195	2-Number 15mVA 33/11 kV, with all necessary connecting accessories	Power other power transformers using 11 kV overhead or underground ring supply or radial
2	Large scale industrial zone (A)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
3	Large scale industrial zone (B)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
4	Large scale industrial zone (C)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
5	Large scale industrial zone (D)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
6	Medium scale industrial zone (A)	1543	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
7	Medium scale industrial zone (A)	1543	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
	SUM TOTAL	9MW		
		10.989 MW=1.089 MW		

NOTE all other load to be on the balance load of 1.089

Proposed solar power estimation of the AIH

The total estimated power load of this AIH was estimated at 10.98 Megawatt, based on thumb power estimation rule. To enable utilization of green energy for the proposed project 10% of this estimated load is set aside for the solar energy provision.

10% of 10.98MW=1.098MW.

So, 1.098MW was set aside for solar installation for the proposed project, and the proposal to compose of the following: -

- Solar power hybrid
- With a capacity of 1.098MW.
- With 3137 solar PV panels
- With PV combiners
- Connecting control breakers
- Ring main unit
- Step up transformer – (1mVa) 415V / 11kV.
- Earthing
- Armoured cablings
- Aluminium conductors
- Hybrid sensors power source

3.12.8 Street Lighting

All roads will be provided with solar streetlights.

Wastewater Treatment System

The wastewater collection facilities are planned to collect pre-treated effluent from each factory, and sewage from other facilities, in accordance with the following basic concepts:

- **Separate system**: which is a system for transporting wastewater and storm water separately, while stormwater drainage is planned to utilize drain ditch beside the internal road network (Figure 3.8),
- Industrial wastewater and sewage from toilet are collected into the same pipe to avoid duplication of facilities, and
- Wastewater is transported as free flowing basically by gravity to avoid the possibility of choking in pipes as well as to reduce the cost of construction and maintenance of the pumping system.
- **Oil**: Oil and grease from the maintenance of vehicles and equipment on-site will be collected and stored in sealed drums and evacuated under contract by the CRWMA

The domestic sewage to be generated has been assumed to be 80% of the domestic water consumption.

Based on the domestic sewage demand of 80% of water demand which is 5600m^3/day, a packaged wastewater treatment plant is designed to provide this volume.

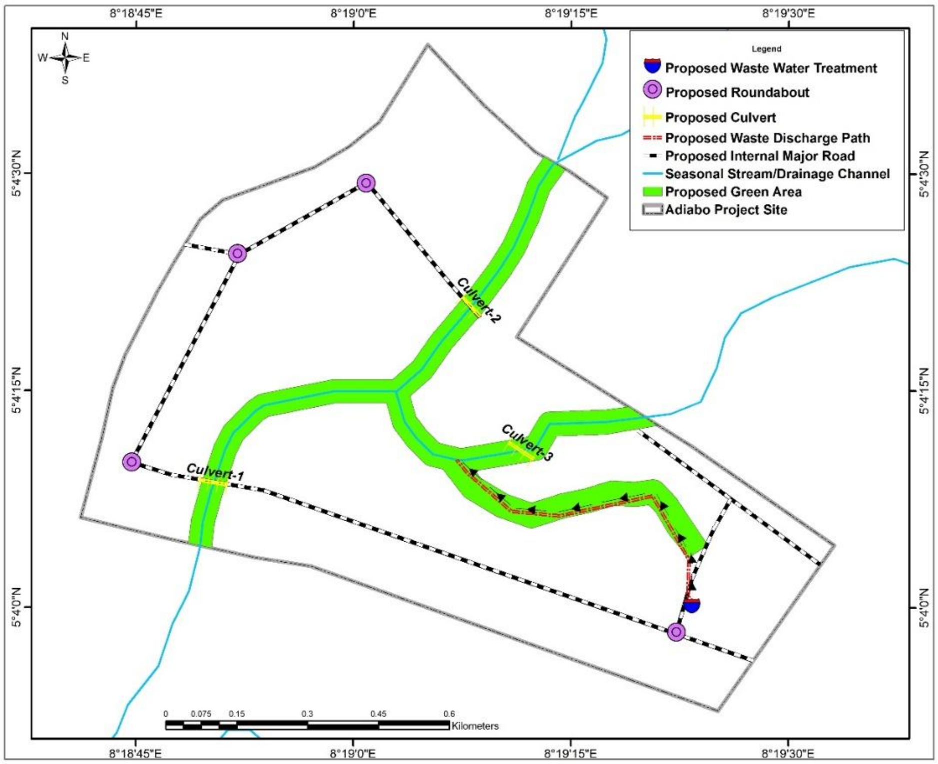


Figure 3.8: Proposed underground power distribution & Storm Water Drainage Network

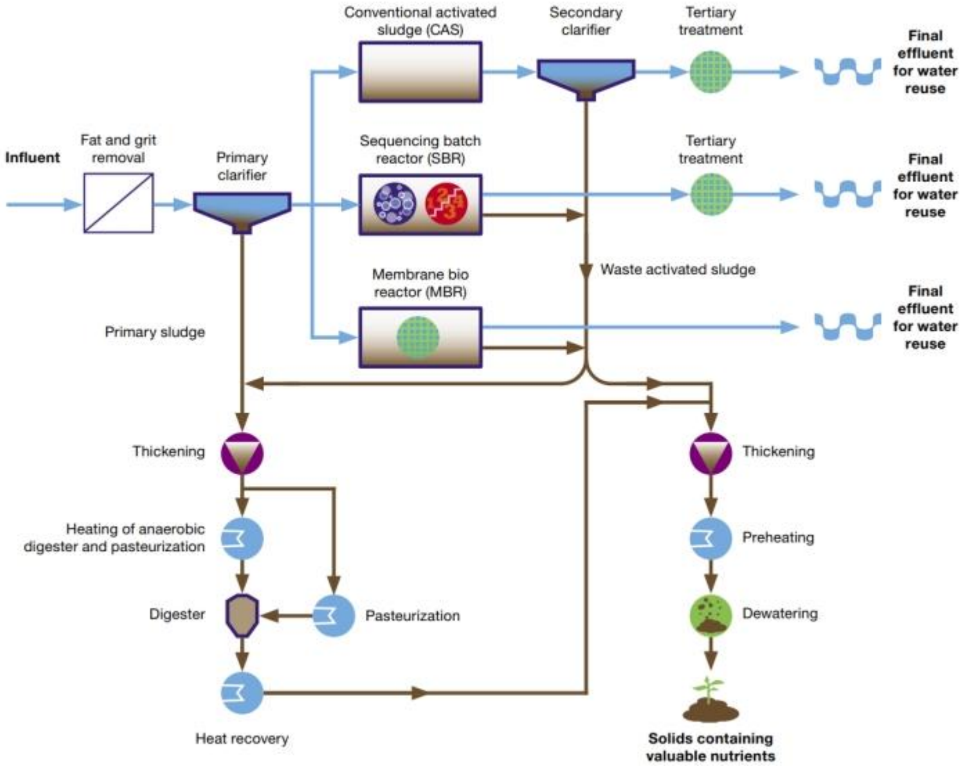


Figure 3.9: Flow diagram of the propose waste water treatment plant

Solid Waste Handling Facilities

The Design, Build & Operate (DBO) contractor and prospective investors will adapt the WMP prepared for this project, focusing on these five components:

- Generation
- Storage
- Collection
- Transportation
- Disposal

. The waste management plan for the proposed project has been carefully prepared based on a thorough understanding of potential waste characteristics. The project waste considered here include:

- **Construction waste**: vegetative (100,047 m3).

- **Excavated soil**: the expected 306,397 m3 of soil from excavation will be stocked and reused as back filling material for road and building foundations, and for landscaping. The cut-and-fill portion is not regarded here.
- **Oil**: oil and grease from malfunctioning vehicles and equipment on-site.
- Recyclables such as paper, glass, metal and plastics.
- Industrial process solid waste.
- Wood from pallets for transport products,
- Concrete from batching plant
- Dewatered sludge generated in the wastewater treatment facility.

Scrap metals, paper, glass, and plastics will undergo sorting and be sold for recycling or reuse. At the source, solid waste will be segregated. The Cross River State Waste Management Agency will be engaged to collect and dispose of waste not recovered by the DBO contractor for reuse. The waste will be carefully tracked and dumped at approved sites. The CRSWMA currently operates two officially designated dumpsites serving Calabar and environs: the Lemna Dumpsite, located approximately 12 km northwest of Calabar city, and the Esuk Utan Dumpsite, located within the Calabar Municipality. Waste from the Adiabo project site will be transferred to the Lemna Dumpsite, which is the approved regional facility with sufficient capacity and access for large-scale industrial waste disposal. All transport will comply with environmental guidelines and traffic safety regulations.

Each type of waste shall be segregated and put in respective colour-coded containers (Figure 3.10). each colour is distinct for a particular purpose. Yellow for plastics and metals, red (or black) for general waste, green for organic waste (food and garden waste) and blue for paper and cardboard.

Especially, food processing waste is diverted to compost through several processes. Outside the AIH, recyclables will be sold, while sludge and other wastes will be transported to a designated landfill site. Dedicated refuse collection bins will be provided in the AIH at the appropriate locations. (Figure 3.10).

Figure 3.10: Sample of colour-coded containers for waste collection

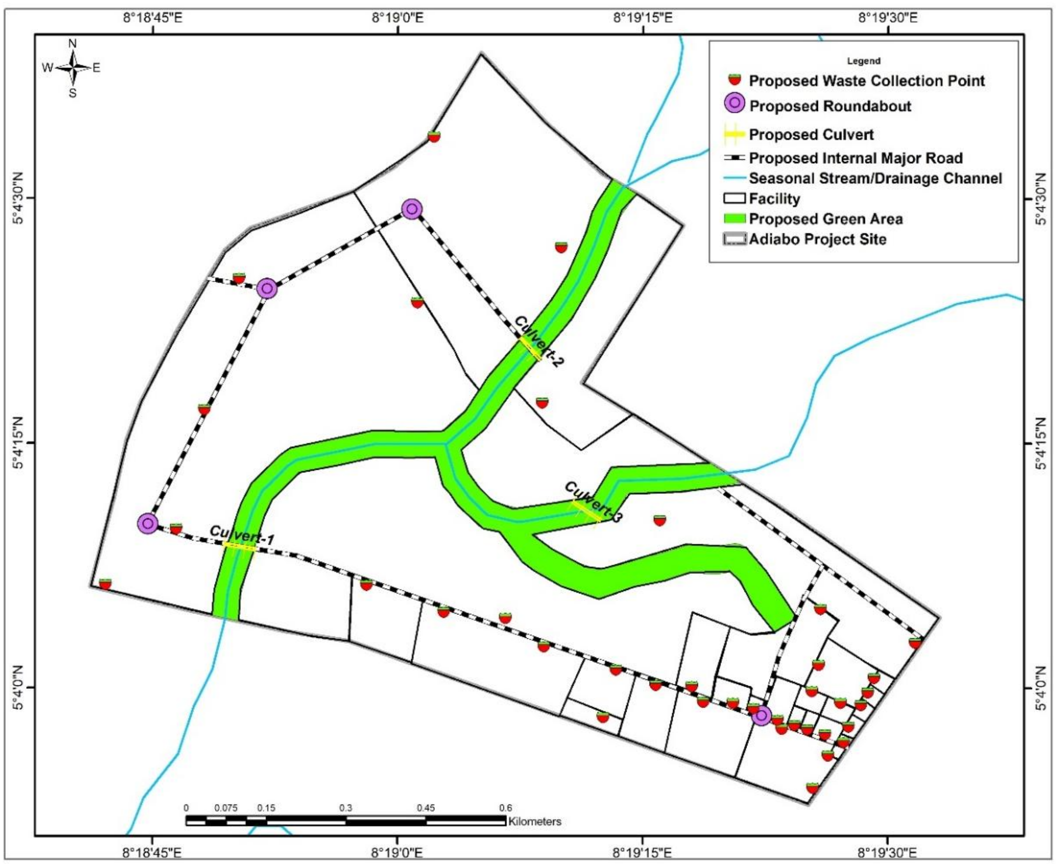


Figure 3.11: Location Map of Solid Waste Collection Points within the AIH

Upon completion of construction, the DBO contractor will decommission the construction site, and clear all debris, including remnants of temporary structures erected by food and other vendors for site workers, preparatory to AIH's commissioning for operations. The DBO contractor's waste disposal subcontractor will handle the collection and disposal of these materials. This meticulous waste management strategy ensures a responsible and environmentally conscious approach throughout construction. Figure 3.12 presents a simplified flowchart for proposed waste management strategy for the proposed AIH project while **Error! Reference source not found.** shows major waste generation and dumpsite locations in Calabar metropolis.

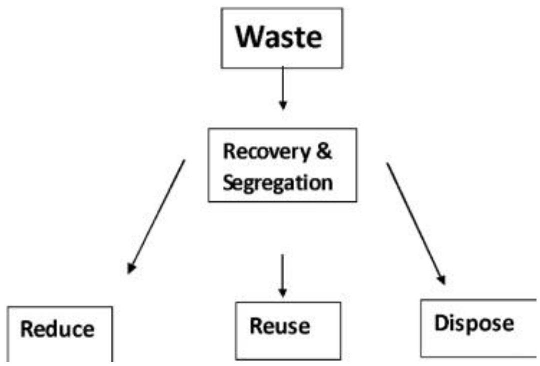


Figure 3.12: Waste Management flowchart for the proposed project.

Telecommunication

Although there may be telecommunication masts in the area, provision will be made for additional base station. This will take care of both the telephone and internet requirements of the site.

3.12.9 Operational Phase of the Project

During the operational phase, the Agro-Industrial Hub will host multiple agro-processing and service enterprises. Operations will include raw material intake, processing of crops such as cassava, rice, and cocoa, packaging, storage, and logistics. The AIH will also support administrative offices, training and research centres, and small business incubators. Operations will be powered by a hybrid energy system combining solar and grid power, with a wastewater treatment facility ensuring compliance with FMEnv discharge standards.

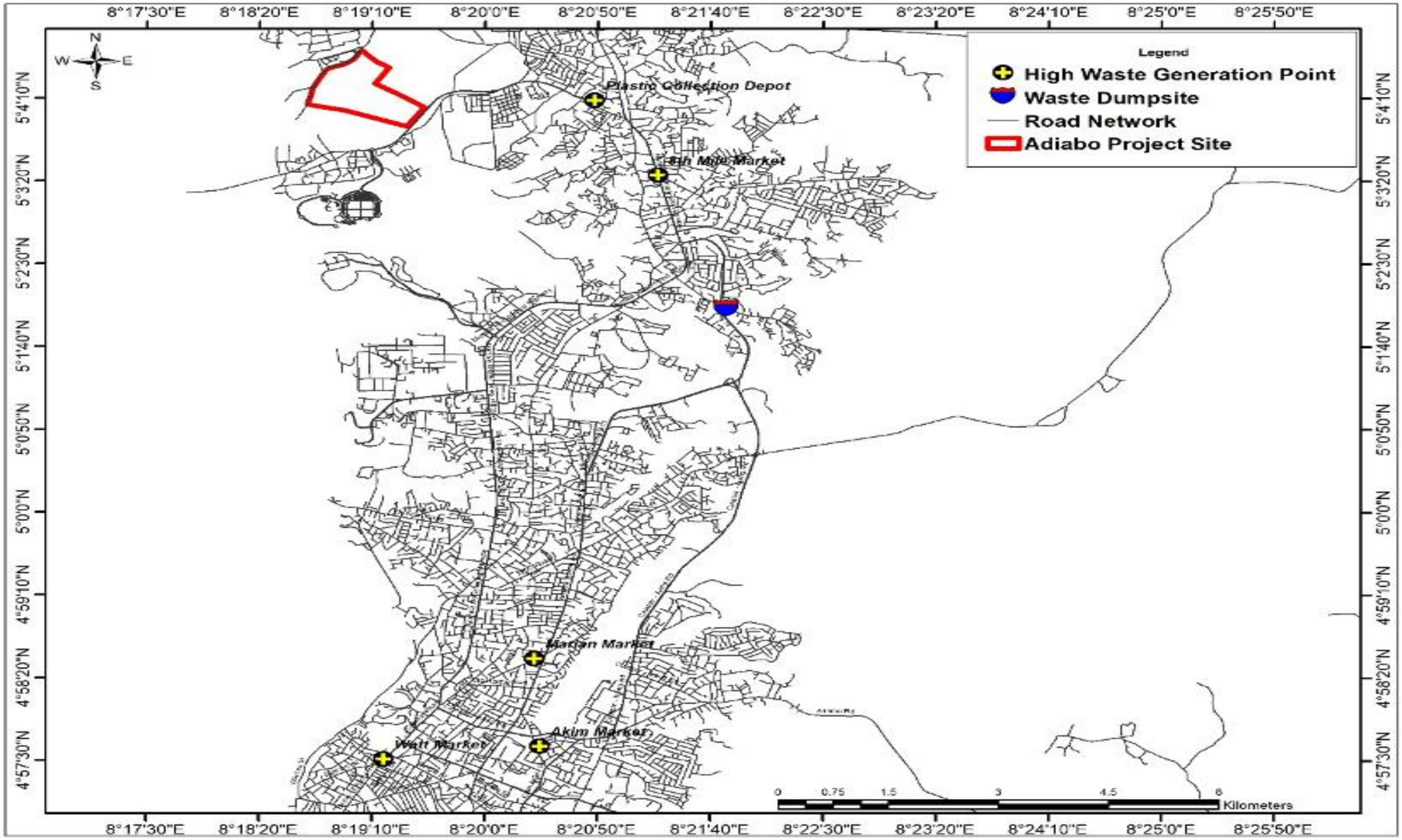


Figure 3.13: Major waste generation and dumpsite locations in Calabar Metropolis

Routine maintenance will include road cleaning, drainage desilting, landscaping, and equipment servicing. The operational workforce will consist of approximately 300 permanent and 700 temporary staff, with a strong emphasis on local employment and gender inclusion.

3.14 Project Lifespan and Decommissioning

The Agro-Industrial Hub has an anticipated lifespan of 40 years, depending on maintenance and economic viability. Decommissioning may involve the removal of structures, dismantling of industrial equipment, and restoration of affected areas. A Decommissioning and Site Restoration Plan (DSRP) will be implemented at that stage, ensuring environmental protection, waste recycling, and re-vegetation of the area where appropriate. The plan will comply with FMEnv and AfDB standards for closure and transition.

3.15 General Construction Work scope

Error! Reference source not found. presents flow chart of the work scope and the principal sequence of activities for the infrastructure development. These activities, from pre-construction through construction and operational and decommissioning phases of the proposed project are the sources of impacts, as presented in chapter five with proffered mitigation / enhancement measures in chapter six, and generic and specific plans developed to manage the environmental and social impacts identified as presented in chapter seven and annexes.

3.16 Maintenance Plan

CR-SAPZ through the DBO Contractor is unwavering in its commitment to guaranteeing the safety and efficiency of the AIH for all operators. The maintenance strategy is provided in the DBO Contractor's Facility Management Plan.

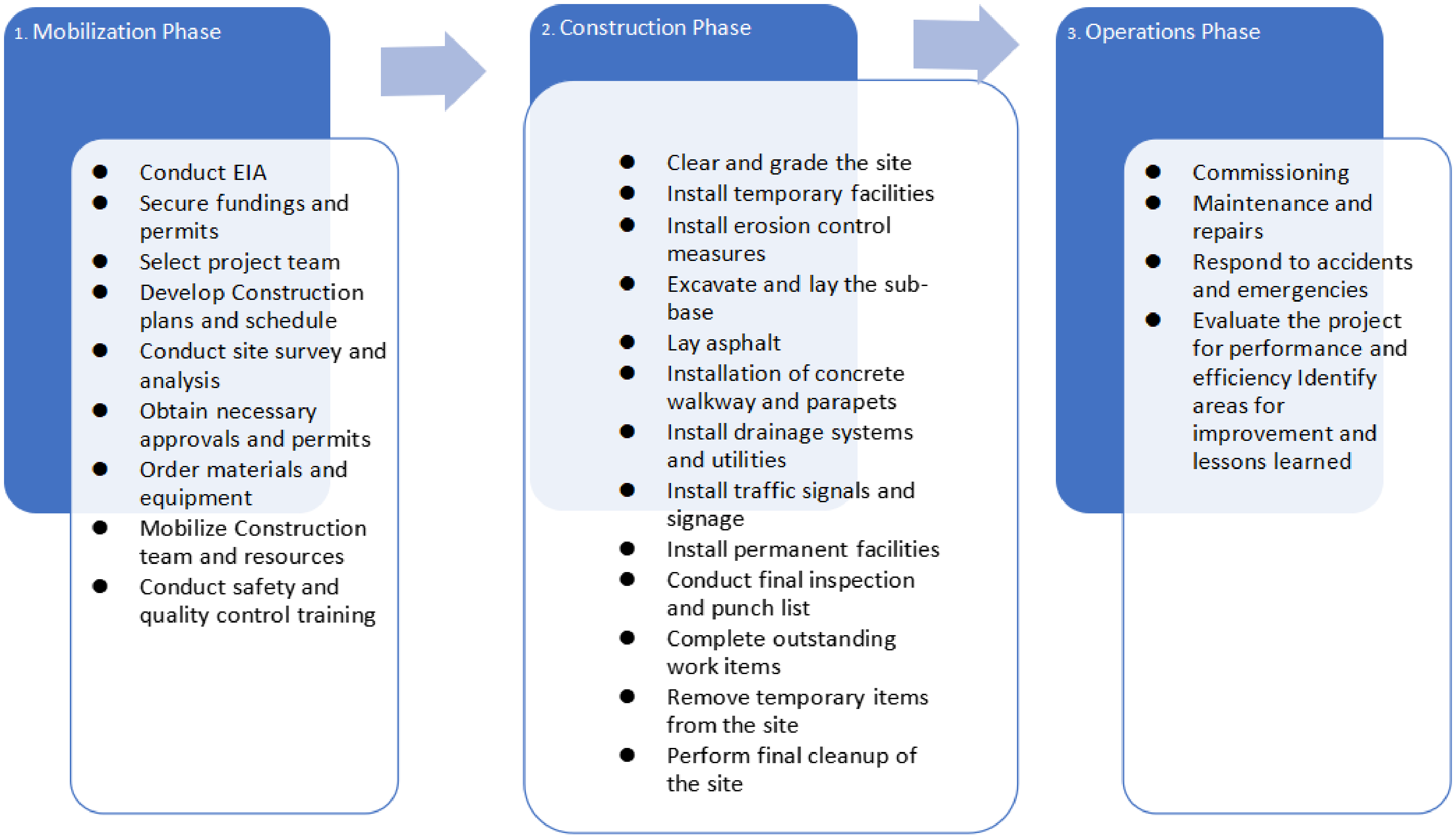
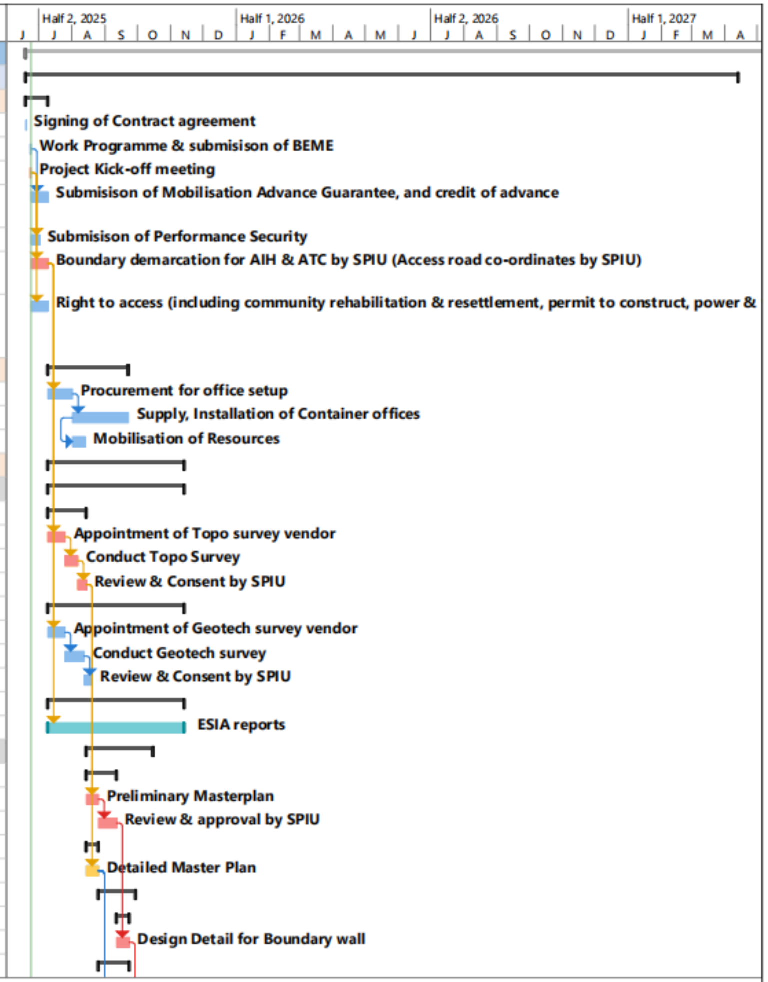


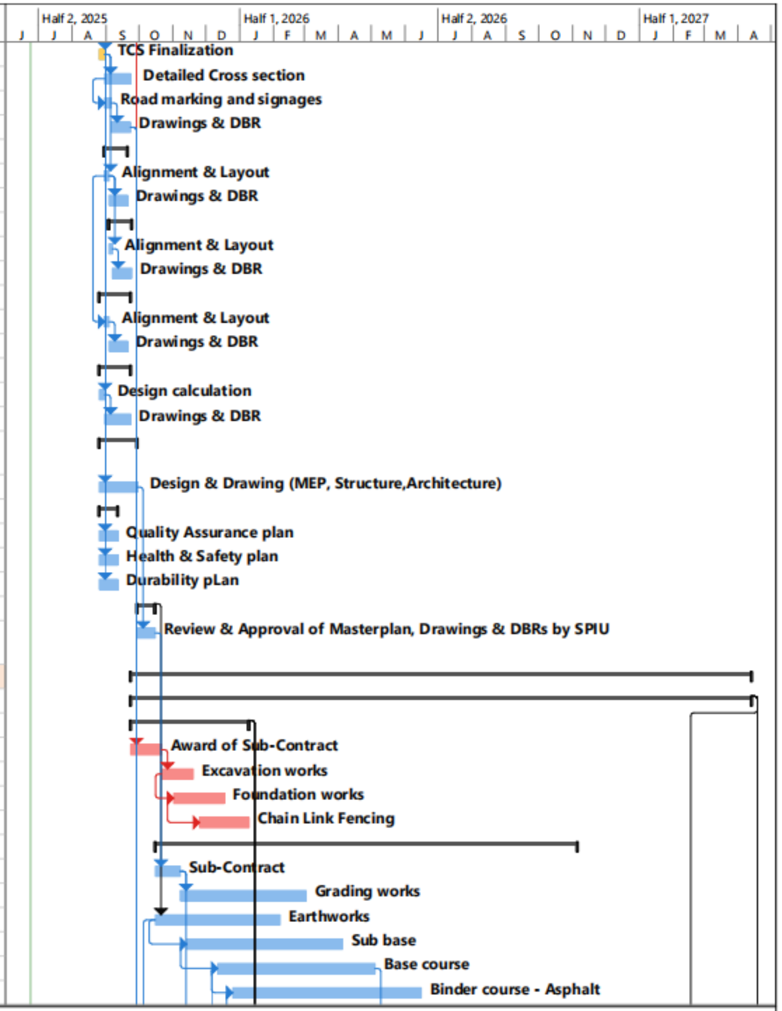
Figure 3.14: Flowchart of general construction work.

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
0		**CROSS RIVER AIH & ATC (DBO)**	**2139.25 days**	**19-06-2025**	**27-02-2032**	
1		**SAPZ (Design & Construction)**	**580.13 days**	**19-06-2025**	**13-04-2027**	
2		**Project Kick-off**	**18.13 days**	**19-06-2025**	**09-07-2025**	
3		Signing of Contract agreement	1 day	19-06-2025	19-06-2025	
4		Work Programme & submisison of BEME	1 day	23-06-2025	23-06-2025	
5		Project Kick-off meeting	1 day	23-06-2025	23-06-2025	
6		Submisison of Mobilisation Advance Guarantee, and credit of advance	14 days	24-06-2025	09-07-2025	4
7		Submisison of Performance Security	7 days	24-06-2025	01-07-2025	5
8		Boundary demarcation for AIH & ATC by SPIU (Access road co-ordinates by SPIU)	14 days	24-06-2025	09-07-2025	5
9		Right to access (including community rehabilitation & resettlement, permit to construct, power & water connection	14 days	24-06-2025	09-07-2025	5
10		**Site Infra structure**	**65 days**	**09-07-2025**	**22-09-2025**	
11		Procurement for office setup	20 days	09-07-2025	01-08-2025	8
12		Supply, Installation of Container offices	45 days	01-08-2025	22-09-2025	11
13		Mobilisation of Resources	10 days	01-08-2025	13-08-2025	12SS
14		**Design Phase**	**111.38 days**	**09-07-2025**	**13-11-2025**	
15		**Surveys**	**111.38 days**	**09-07-2025**	**13-11-2025**	
16		**Topographic Survey**	**31 days**	**09-07-2025**	**14-08-2025**	
17		Appointment of Topo survey vendor	14 days	09-07-2025	25-07-2025	8
18		Conduct Topo Survey	10 days	25-07-2025	06-08-2025	17
19		Review & Consent by SPIU	7 days	06-08-2025	14-08-2025	18
20		**Geotech & Hydrological Surveys**	**111.38 days**	**09-07-2025**	**13-11-2025**	
21		Appointment of Geotech survey vendor	14 days	09-07-2025	25-07-2025	8
22		Conduct Geotech survey	15 days	25-07-2025	12-08-2025	21
23		Review & Consent by SPIU	7 days	12-08-2025	19-08-2025	22
24		**ESIA by SPIU**	**111.38 days**	**09-07-2025**	**13-11-2025**	
25		ESIA reports	111.38 days	09-07-2025	13-11-2025	8
26		**Master Planning & Engineering**	**55 days**	**14-08-2025**	**15-10-2025**	
27		**Preliminary Master Planning & Design**	**25 days**	**14-08-2025**	**11-09-2025**	
28		Preliminary Masterplan	10 days	14-08-2025	25-08-2025	19
29		Review & approval by SPIU	15 days	25-08-2025	11-09-2025	28
30		**Detailed Master Planning**	**10 days**	**14-08-2025**	**25-08-2025**	
31		Detailed Master Plan	10 days	14-08-2025	25-08-2025	19
32		**Detailed Design & Building Architecture**	**30 days**	**25-08-2025**	**29-09-2025**	
33		**Boundary Wall**	**10 days**	**11-09-2025**	**23-09-2025**	
34		Design Detail for Boundary wall	10 days	11-09-2025	23-09-2025	29
35		**Road work**	**25 days**	**25-08-2025**	**23-09-2025**	



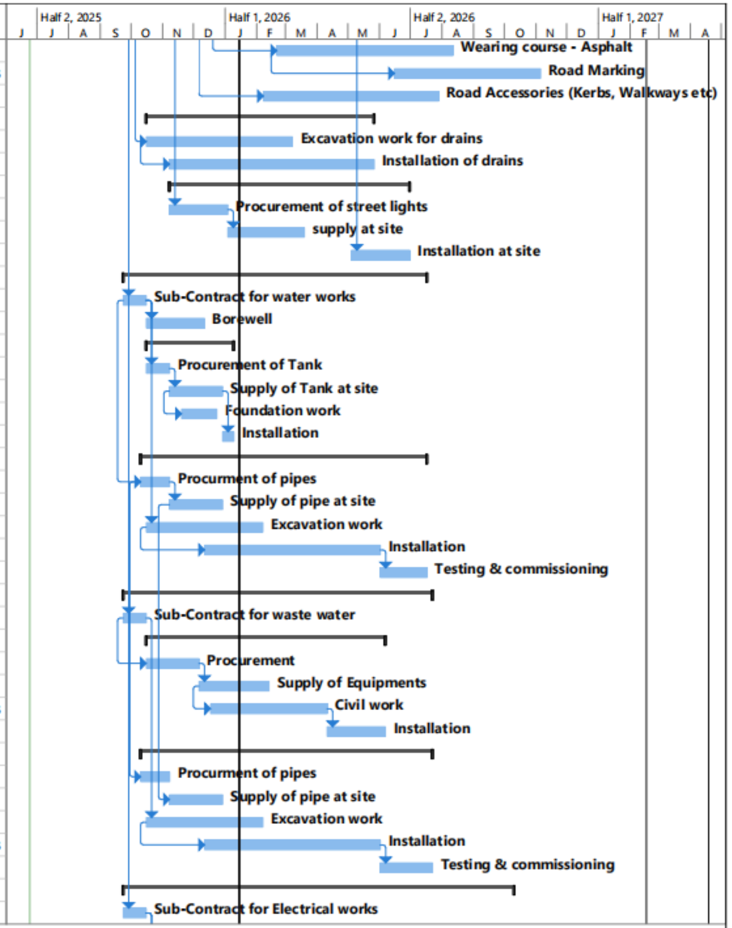
Task | Inactive Milestone | Start-only | Path Predecessor Summary Task

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
36		TCS Finalization	5 days	25-08-2025	30-08-2025	31
37		Detailed Cross section	20 days	30-08-2025	23-09-2025	36
38		Road marking and signages	5 days	30-08-2025	05-09-2025	37SS
39		Drawings & DBR	15 days	05-09-2025	23-09-2025	38
40		**Storm water work**	**18 days**	**30-08-2025**	**20-09-2025**	
41		Alignment & Layout	3 days	30-08-2025	03-09-2025	36
42		Drawings & DBR	15 days	03-09-2025	20-09-2025	41
43		**Sewer water work**	**18 days**	**03-09-2025**	**24-09-2025**	
44		Alignment & Layout	3 days	03-09-2025	06-09-2025	41
45		Drawings & DBR	15 days	06-09-2025	24-09-2025	44
46		**Water supply work**	**25 days**	**25-08-2025**	**23-09-2025**	
47		Alignment & Layout	3 days	30-08-2025	03-09-2025	41SS
48		Drawings & DBR	15 days	03-09-2025	20-09-2025	47
49		**Electrical network detailed design**	**25 days**	**25-08-2025**	**23-09-2025**	
50		Design calculation	5 days	25-08-2025	30-08-2025	31
51		Drawings & DBR	20 days	30-08-2025	23-09-2025	50
52		**Design of Admin office, Fire station, Boundary wall & Gate Complex**	**30 days**	**25-08-2025**	**29-09-2025**	
53		Design & Drawing (MEP, Structure, Architectur	30 days	25-08-2025	29-09-2025	31
54		**Technical compliance & standards**	**15 days**	**25-08-2025**	**11-09-2025**	
55		Quality Assurance plan	15 days	25-08-2025	11-09-2025	31
56		Health & Safety plan	15 days	25-08-2025	11-09-2025	31
57		Durability pLan	15 days	25-08-2025	11-09-2025	31
58		**Approval**	**15 days**	**29-09-2025**	**15-10-2025**	
59		Review & Approval of Masterplan, Drawings & DBRs by SPIU	15 days	29-09-2025	15-10-2025	53
60		**Construction Phase**	**496 days**	**23-09-2025**	**13-04-2027**	
61		**Infrastructure Construction Works**	**496 days**	**23-09-2025**	**13-04-2027**	
62		Boundary wall	**95 days**	**23-09-2025**	**09-01-2026**	
63		Award of Sub-Contract	25 days	23-09-2025	21-10-2025	34
64		Excavation works	25 days	21-10-2025	19-11-2025	63
65		Foundation works	40 days	01-11-2025	17-12-2025	64SS+10 days
66		Chain Link Fencing	40 days	25-11-2025	09-01-2026	65SS+20 days
67		**Roads, drains & streetlights**	**337 days**	**16-10-2025**	**05-11-2026**	
68		Sub-Contract	20 days	16-10-2025	07-11-2025	59
69		Grading works	100 days	07-11-2025	02-03-2026	68
70		Earthworks	100 days	16-10-2025	06-02-2026	58
71		Sub base	125 days	13-11-2025	04-04-2026	70SS+25 days
72		Base course	125 days	12-12-2025	04-05-2026	71SS+25 days
73		Binder course - Asphalt	150 days	25-12-2025	15-06-2026	72SS+12 days



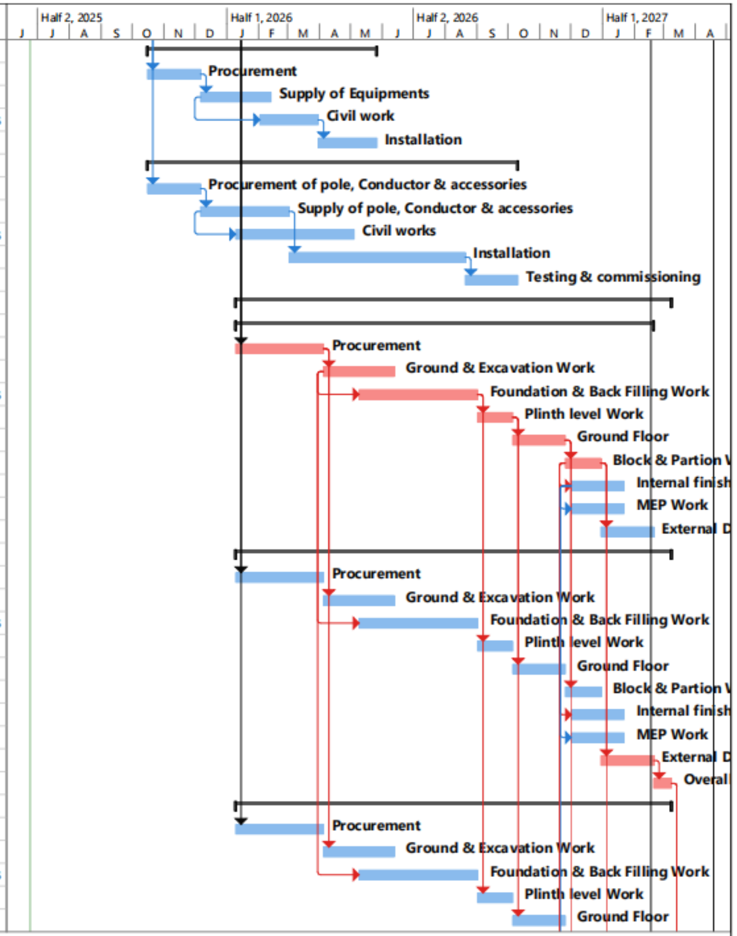
Task	Inactive Milestone	Start-only	Path Predecessor Summary Task

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
74		Wearing course - Asphalt	150 days	20-02-2026	11-08-2026	73SS+50 days
75		Road Marking	125 days	15-06-2026	05-11-2026	74SS+100 days
76		Road Accessories (Kerbs, Walkways etc)	150 days	07-02-2026	28-07-2026	72SS+50 days
77		**Drainage**	**195 days**	**16-10-2025**	**26-05-2026**	
78		Excavation work for drains	125 days	16-10-2025	07-03-2026	70SS
79		Installation of drains	175 days	07-11-2025	26-05-2026	78SS+20 days
80		**Street Lights**	**205 days**	**07-11-2025**	**30-06-2026**	
81		Procurement of street lights	50 days	07-11-2025	03-01-2026	68
82		supply at site	65 days	03-01-2026	19-03-2026	81
83		Installation at site	50 days	04-05-2026	30-06-2026	72
84		**Water Supply**	**260 days**	**23-09-2025**	**17-07-2026**	
85		Sub-Contract for water works	20 days	23-09-2025	15-10-2025	39
86		Borewell	50 days	16-10-2025	11-12-2025	85
87		**Storage Reservoisr**	**75 days**	**16-10-2025**	**09-01-2026**	
88		Procurement of Tank	20 days	16-10-2025	07-11-2025	85
89		Supply of Tank at site	45 days	07-11-2025	29-12-2025	88
90		Foundation work	30 days	19-11-2025	23-12-2025	89SS+10 days
91		Installation	10 days	29-12-2025	09-01-2026	89
92		**Distribution Network**	**245 days**	**10-10-2025**	**17-07-2026**	
93		Procurment of pipes	25 days	10-10-2025	07-11-2025	85SS+15 days
94		Supply of pipe at site	45 days	07-11-2025	29-12-2025	93
95		Excavation work	100 days	16-10-2025	06-02-2026	85
96		Installation	150 days	12-12-2025	01-06-2026	95SS+50 days
97		Testing & commissioning	40 days	01-06-2026	17-07-2026	96
98		**Waste water**	**265 days**	**23-09-2025**	**22-07-2026**	
99		Sub-Contract for waste water	20 days	23-09-2025	15-10-2025	39
100		**STP**	**205 days**	**16-10-2025**	**06-06-2026**	
101		Procurement	45 days	16-10-2025	06-12-2025	99SS+20 days
102		Supply of Equipments	60 days	06-12-2025	12-02-2026	101
103		Civil work	100 days	17-12-2025	10-04-2026	102SS+10 days
104		Installation	50 days	10-04-2026	06-06-2026	103
105		**Conveyance**	**250 days**	**10-10-2025**	**22-07-2026**	
106		Procurment of pipes	25 days	10-10-2025	07-11-2025	93SS
107		Supply of pipe at site	45 days	07-11-2025	29-12-2025	94SS
108		Excavation work	100 days	16-10-2025	06-02-2026	99
109		Installation	150 days	12-12-2025	01-06-2026	108SS+50 days
110		Testing & commissioning	45 days	01-06-2026	22-07-2026	109
111		**Electrical**	**335 days**	**23-09-2025**	**10-10-2026**	
112		Sub-Contract for Electrical works	20 days	23-09-2025	15-10-2025	39



Task | Inactive Milestone | Start-only | Path Predecessor Summary Task

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
113		**Isolators & other accesoris for tapping**	**195 days**	**16-10-2025**	**26-05-2026**	
114		Procurement	45 days	16-10-2025	06-12-2025	112
115		Supply of Equipments	60 days	06-12-2025	12-02-2026	114
116		Civil work	50 days	02-02-2026	30-03-2026	115SS+50 days
117		Installation	50 days	31-03-2026	26-05-2026	116
118		**Distribution**	**315 days**	**16-10-2025**	**10-10-2026**	
119		Procurement of pole, Conductor & accessories	45 days	16-10-2025	06-12-2025	112
120		Supply of pole, Conductor & accessories	75 days	06-12-2025	02-03-2026	119
121		Civil works	100 days	09-01-2026	04-05-2026	120SS+30 days
122		Installation	150 days	02-03-2026	20-08-2026	120
123		Testing & commissioning	45 days	20-08-2026	10-10-2026	122
124		**Buildings & Utility Works**	**370 days**	**09-01-2026**	**08-03-2027**	
125		**Admin office & gate house**	**355 days**	**09-01-2026**	**19-02-2027**	
126		Procurement	75 days	09-01-2026	04-04-2026	62
127		Ground & Excavation Work	60 days	04-04-2026	12-06-2026	126
128		Foundation & Back Filling Work	100 days	09-05-2026	01-09-2026	127SS+30 days
129		Plinth level Work	30 days	01-09-2026	05-10-2026	128
130		Ground Floor	45 days	05-10-2026	25-11-2026	129
131		Block & Partion Work	30 days	25-11-2026	30-12-2026	130
132		Internal finishing work	45 days	01-12-2026	21-01-2027	131SS+5 days
133		MEP Work	45 days	01-12-2026	21-01-2027	132SS
134		External Development	45 days	30-12-2026	19-02-2027	131
135		**Fire station**	**370 days**	**09-01-2026**	**08-03-2027**	
136		Procurement	75 days	09-01-2026	04-04-2026	62
137		Ground & Excavation Work	60 days	04-04-2026	12-06-2026	126
138		Foundation & Back Filling Work	100 days	09-05-2026	01-09-2026	127SS+30 days
139		Plinth level Work	30 days	01-09-2026	05-10-2026	128
140		Ground Floor	45 days	05-10-2026	25-11-2026	129
141		Block & Partion Work	30 days	25-11-2026	30-12-2026	130
142		Internal finishing work	45 days	01-12-2026	21-01-2027	131SS+5 days
143		MEP Work	45 days	01-12-2026	21-01-2027	132SS
144		External Development	45 days	30-12-2026	19-02-2027	131
145		Overall Finishing works	15 days	19-02-2027	08-03-2027	144
146		**Warehouse**	**370 days**	**09-01-2026**	**08-03-2027**	
147		Procurement	75 days	09-01-2026	04-04-2026	62
148		Ground & Excavation Work	60 days	04-04-2026	12-06-2026	126
149		Foundation & Back Filling Work	100 days	09-05-2026	01-09-2026	127SS+30 days
150		Plinth level Work	30 days	01-09-2026	05-10-2026	128
151		Ground Floor	45 days	05-10-2026	25-11-2026	129



Task | Inactive Milestone | Start-only | Path Predecessor Summary Task

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
152		Block & Partion Work	30 days	25-11-2026	30-12-2026	130
153		Internal finishing work	45 days	01-12-2026	21-01-2027	131SS+5 days
154		MEP Work	45 days	01-12-2026	21-01-2027	132SS
155		External Development	45 days	30-12-2026	19-02-2027	131
156		Overall Finishing works	15 days	19-02-2027	08-03-2027	155
157		**Handing Over**	**31 days**	**08-03-2027**	**13-04-2027**	
158		Quality Check by SPIU	30 days	08-03-2027	12-04-2027	145,156
159		As built drawings	30 days	**08-03-2027**	12-04-2027	145,156
160		Start of DLP	1 day	12-04-2027	13-04-2027	159
161		**Operation & Maintenance**	**1598 days**	**27-02-2027**	**27-02-2032**	
162		O&M manuals	7 days	13-04-2027	21-04-2027	61
163		Emergency resonse plan	15 days	13-04-2027	29-04-2027	61
164		Waste management plan	15 days	13-04-2027	29-04-2027	61
165		Health & safety Management plan	15 days	13-04-2027	29-04-2027	61
166		Quality Assurance management plan	15 days	13-04-2027	29-04-2027	61
167		Operation & maintenace	1598 days	27-02-2027	27-02-2032	61

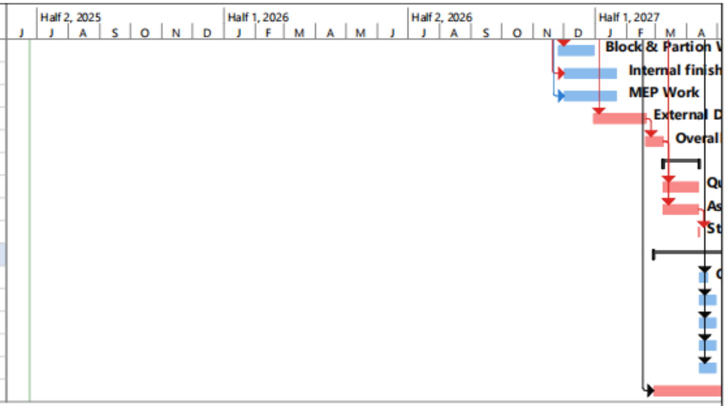


Figure 3.15: Proposed Project Execution Schedule

4. DESCRIPTION OF THE EXISTING ENVIRONMENT

This chapter captures all the baseline information of the study area of the proposed Agro-Industrial Hub (AIH) and its ancillary facilities of. This includes the physico-chemical environment (meteorology, geology, sediment / soil type and distribution, surface/groundwater characteristics), biological environment (location and distribution of benthos, plankton, fisheries, flora and fauna characteristics), as well as Socioeconomic and health conditions of the project affected communities.

4.1 Study Approach

The baseline environmental and social conditions were established based on data obtained over one (1) climatic season sampling carried out in the study area. Primary data was obtained from wet season field sampling exercise which commenced on Thursday 17th through Monday 21st June, 2025. Figure 4.1 shows the generalized sampling points for all environmental samples. The dry season biophysical data was adapted from FMEnv approved

Environmental Impact Assessment (EIA) carried out in the study area as listed below.

- EIA for the Proposed Calabar Independent Power Plant Project in Calabar, Cross River State.
- ESIA (2025) for the Proposed Lagos - Calabar Coastal Highway by the Federal Ministry of Works.

The baseline status of the project area was obtained through consultations with the relevant stakeholders as well as from field studies covering the following:

Reconnaissance survey.

- Field studies including air, surface water, sediment, soil and vegetation sampling;
- Geophysical investigation and groundwater sampling;
- Field analysis and sample preservation;
- Laboratory analysis of samples;
- Socioeconomic and health studies;
- Data processing, analysis and interpretation; and
- Reporting

4.1.1 Baseline Data Acquisition Methods

Basically, measurements, field data collection and sample collection of representative populations were utilized in the data acquisition process to determine the environmental parameters of the study area. This exercise involved a multi-disciplinary approach and was executed within the framework of a quality, health, safety and environment (QHSE) management system approach. Using the best available equipment, resources, and personnel, this method guarantees that the necessary data and samples were collected in accordance with established (scientific and regulatory) requirements. Elements of this approach include:

Review of existing reports that contain environmental information on the study area;

- Designing and development of field sampling strategies to meet work scope and regulatory requirements;
- Pre-mobilization activities (assembling of field team, sampling equipment / materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);
- Mobilization to field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- Demobilization from field; transfer of sample custody to the laboratory for analyses.

The methodology/procedures for collecting field data are described in the succeeding sub-sections. Also, baseline environmental conditions of the proposed AIH project's area as recorded during field study are described in succeeding sections below. The detailed documentation of the fieldwork execution including descriptions of the laboratory analytical methods and procedures, the detection limits for the various parameters analysed as well as an overview of the general QHSE plan adopted for field data gathering and laboratory analysis is presented.

4.1.2 Consultation with Regulators and Stakeholders

Prior to field sampling, meetings were held with the relevant stakeholders to provide detailed information about the project and to obtain their consent for conducting field data gathering. Consultation is an important element of Socioeconomic assessment and an integral component of the entire ESIA process. This is because appropriate and adequate consultations will ensure smooth project implementation and guarantee economic and commercial sustainability of the proposed project. It involves information dissemination and interaction/dialogues with the host communities and other stakeholders on the ESIA of the proposed project. The key objectives of consultation on the ESIA for the proposed AIH project are to:

- Ensure that the communities and all stakeholders are given early and adequate information on the ESIA and the proposed AIH project activities;
- Provide a framework for improving the understanding of the potential impacts of the proposed project on the Socioeconomics and biophysical environment;
- Include stakeholders' views and concerns as part of the ESIA execution especially as it concerns the potential impacts;
- Identify contentious issues in the proposed project execution;
- Establish transparent procedures for carrying out the proposed projects; and
- Create accountability and a sense of local ownership during project implementation, thus minimizing communities' conflicts and project delays that may result thereof.

4.1.3 Desktop Studies

Desktop studies involved the acquisition of relevant background information on the environment of the study area. Approved reports from earlier environmental studies conducted in the region, as well as books, articles, maps, and other materials about the proposed AIH project area and environs similar to it, were among the materials studied.

4.2 Objectives of Field Sampling/Measurement

The specific objectives of the ecological field sampling were to determine:

- Ambient air quality and noise level of the study area;
- Physico-chemical and microbiological characteristics of the soil within the study area;
- Physico-chemical and biological characterization of ground and surface water and sediment samples within the study area;
- Hydrobiology and fisheries resources of the study area;
- Wildlife abundance and diversity of the study area and environs;
- Vegetation characteristics of the area; and
- Establish the Socioeconomic and health status of the project affected communities.
- Geology and hydrogeology conditions of the project area

Plate 4.1: Sampling Equipment Materials

4.3 Analytical Methods

Samples collected from the field were analysed using various methods in the Ministry of Science and Technology laboratories in Uyo, Akwa Ibom, Nigeria. This study employed analysis techniques approved by the Federal Ministry of Environment. Some international analytical procedures were also adopted for this study. Those of APHA, EPA, and ASTM analytical procedures for soil, sediment, and water quality were among analytical procedures adopted and used in the course of this study. To ensure the reliability and integrity of some unstable physico-chemical parameters, in-situ measurement of pH, conductivity, Total Dissolved Solids (TDS), and temperature were carried out in the field. All field instruments were regularly cleaned and recalibrated after each use, some of which are shown in Plate 4.1.

The Quality Assurance and Quality Control (QA & QC) for laboratory analyses is in accordance with FMEnv. recommended method, and include blank analyses to establish analyte level, duplicate analyses to establish analytical precision, spiked and blank sample analyses to determine analytical accuracy.

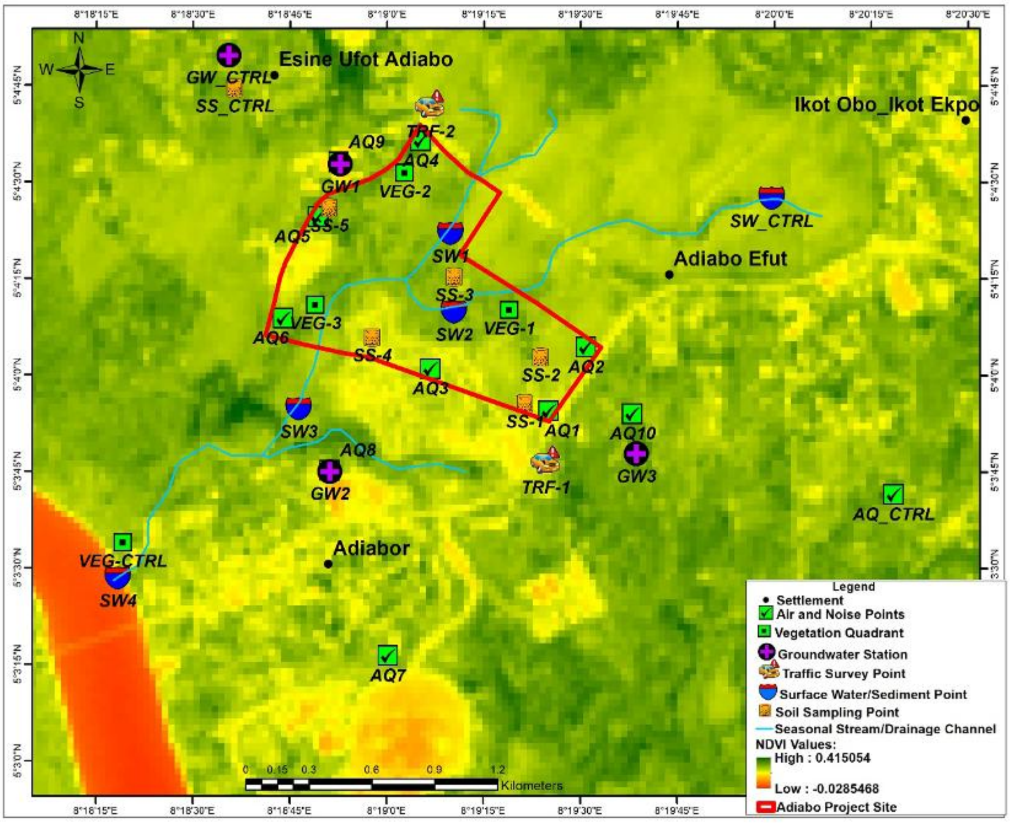


Figure 4.1: Generalised sampling map for all Environmental Components Studied at the proposed AIH Project Area. *Source: Field Fieldwork 2025*

4.4 Air Quality, Noise and Meteorological Studies

4.4.1 Study Sites

The study area is situated within latitudes 05º03'16.43" and 05º04'36.40" N, and longitude 008º18'23.38" and 008º19'30.02" E, with the highest elevation of 43.9m. Adiabo Community in Odukpani Local Government Area (LGA) of Cross River State, Nigeria, experiences a tropical monsoon climate characterized by high temperatures, heavy rainfall, and high humidity for most of the year. The average annual temperature ranges between 25°C and 30°C, with the hottest months being February and March, when temperatures can reach up to 32°C. The coolest months are July and August, due to increased cloud cover and rainfall. Rainfall in Adiabo is abundant, with the rainy season lasting from March to October and peaking between June and September. The community receives an annual rainfall of about 2,500mm to 3,000mm, making it one of the wettest areas in Nigeria. The dry season runs from November to February, with little to no rainfall, particularly in December and January. Humidity levels remain high throughout the year, often exceeding 80%, especially during the rainy season, due to the community's proximity to the Atlantic Ocean and its dense rainforest vegetation. The southwest monsoon winds bring heavy rains, while the Harmattan, a dry and dusty wind from the Sahara, occasionally affects the area between December and February, though its impact is milder compared to northern Nigeria. The lush tropical rainforest in Adiabo supports rich biodiversity and agricultural activities, including the cultivation of cassava, plantains, and oil palm. However, the heavy rainfall can sometimes lead to flooding in low-lying areas. Overall, Adiabo's climate is hot, wet, and humid, with a long rainy season and a short, relatively mild dry season.

4.4.2 Air Sampling

Concentrations of air pollutants were measured with highly sensitive digital portable meters comprising NO_2, SO_2, H_2S, HCN, NH_3, Cl_2, CO_2, CO, CH_4, $PM_{2.5}$ and PM_{10} at 10 sampling locations and a control point The portable meters used to detect gaseous pollution are listed in Table 4.1 while the methods employed are captured in Table 4.2

Table 4.1: Gaseous Emissions and Noise Measuring Instruments

Parameter	Equipment	Range	Alarm levels
Sulphur dioxide (SO_2)	SO_2 Crowcon Gasman S/N: 19648H	0-10ppm	2.0ppm
Nitrogen dioxide (NO_2)	NO_2 Crowcon Gasman S/N: 19831N	0-10ppm	3.0ppm
Hydrogen sulphide (H_2S)	H_2S Crowcon Gasman S/N: 19502H	0-50ppm	10ppm
Carbon monoxide (CO)	CO Crowcon Gasman S/N: 19252H	0-500ppm	50ppm
Carbon dioxide (CO_2)	KANGWF Air Quality Detector JSM – 131SC	0-5000ppm	2001-5000ppm
Ammonia (NH_3)	NH_3 Crowcon Gasman S/N: 19730H	0-50ppm	25ppm
Chlorine (Cl_2)	Cl_2 Crowcon Gasman S/N: 19812H	0-5ppm	0.5ppm
Hydrogen Cyanide (HCN)	HCN Crowcon Gasman S/N: 19773H	0-25ppm	5ppm
Methane (CH_4)	XP-3160	0-5,000 ppm	250 or 500 ppm
Suspended particulate monitor (SPM)	Haz-Dust TM 10µg/m^3 particulate monitor	0.1-200 10µg/m^3	+1- 0.0210µg/m^3
Noise Level Meter	NM 102	Auto Ranging (30-130dB)	-

Table 4.2: Methods for sampling of air pollutants

Method No.	Parameter measured	Method
TM-4	Sulfur dioxide (SO_2)	USEPA (2000) Method 6 or 6A or 6B or USEPA (1996) Method 6C or ISO (1989) Method 7934 or ISO (1992) Method 7935 or ISO (1993) Method 10396 or ISO (1998) Method 11632 (as appropriate)

Method No.	Parameter measured	Method
TM-5	Hydrogen sulfide (H_2S)	USEPA (2000) Method 11 or USEPA (2000) Method 15 or USEPA (2000) Method 16 or Environment Canada (1992) Reference Method EPS1/RM/6 (as appropriate)
TM-7	Chlorine (Cl_2)	USEPA (2000) 26A
TM-11	Nitrogen dioxide (NO_2)	USEPA (2000) Method 7 or 7A or 7B or 7C or 7D or USEPA (1990) Method 7E or USEPA (1996) Method 20 or ISO (1993) Method 10396 (as appropriate). NOx analyzers may be substituted in Method 7E provided the performance specifications of the method are met.
TM-32	Carbon monoxide (CO)	USEPA (1996) Method 10
TM-34	Volatile organic compounds (VOC)	USEPA (2000) Method 18 or USEPA (2000) Method 25 or 25A or 25B or 25C or 25D or 25E (as appropriate)
OM-5	'Fine' particulates ($PM_{2.5}$)	USEPA (1997) Method 201 or 201A (as appropriate)
AM-22	Particulate matter – PM_{10} – TEOM	AS 3580.9.8-2001
OTM-29	Hydrogen cyanide (HCN)	US EPA, Method OTM-29
Method 323	Formaldehyde	US EPA, 40 CFR Part 63, Method 323

4.4.3 Meteorological Data Acquisition

The existing meteorological and climatic data from Nigeria meteorological stations was used for the write-up. However, additional field data will be collected for atmospheric pressure, relative humidity, temperature, and wind speed and wind direction. The measurements were taken at 8 stations AAIH/AQ/01-AAIH/AQ/10 with a control point. The measurements of the meteorological parameters were carried out using *in situ* portable pieces of equipment as given in Table 4.3. and Plate 4.2.

Table 4.3: Meteorological Instruments

Parameter	Equipment
Relative humidity, Temperature	MAX-MIN THERMOMETER, HYGROMETER MODEL: KTJ TA318
Wind speed	MASTECH MS6252A Digital Anemometer
Wind direction, Atmospheric Pressure	Sun Road Digital compass (Altimeter) Model: CR2032
$PM_{2.5}$, PM_{10}, TVOC and CH_2O	Air Ae Steward Air Quality Monitor

4.4.4 Precaution/Quality Assurance/Quality Control (QA/QC)

In marking sampling location, special preference was given to the following:

- Accessibility
- Availability of open space with good configuration free from shed
- Meteorological consideration of upward and downward directions
- Areas with minimal local influence from vehicular moment.
- In sampling, consideration was given to:
- Sensitivity and stability of equipment used
- Re-calibration of equipment
- Reproducibility of results.

4.4.5 Data Analysis

The Dispersion Modelling of Air Quality using ARC-GIS Version 10.8 was described by Gulliver and Briggs (2011).

Plate 4.2: Air Quality, Noise level and field meteorological measurements

4.4.6 Baseline Findings for Air Quality, Noise Level and Meteorological Conditions

The baseline results demonstrate that the ambient air quality within the project area is generally good, with most parameters falling below national and international guideline limits. However, localized elevations of particulate matter (PM_{10}) and noise were recorded in specific areas influenced by existing community activities.

Particulate Matter ($PM_{2.5}$ and PM_{10})

i. $PM_{2.5}$: Ranged between 22–45 µg/m³, below the FMEnv limit of 75 µg/m³ and WHO limit of 60 µg/m³, indicating clean fine-particulate air with minimal combustion sources.
ii. PM_{10}: Ranged between 110–185 µg/m³, with slight exceedances above the FMEnv permissible limit of 150 µg/m³ recorded near the Adiabo Ikot Mbo Otu access road and land-clearing areas.

These exceedances were attributed to re-suspended dust from unpaved roads, dry weather, and vegetation clearing activities in the vicinity.

Gaseous Pollutants

The concentration of the air pollutant around the project area is presented in 4.3. The dispersion model of the pollutants is presented in Figure 4.4a and Figure 4.4b to reveal their spatial patterns and variations. Among the pollutants;

i. SO_2: Measured concentrations (0.002–0.006 ppm) were far below the 0.01 ppm FMEnv limit, showing no industrial combustion influence.
ii. NO_2: Ranged between 0.004–0.009 ppm, also below the 0.04 ppm threshold, suggesting limited vehicular or biomass burning emissions.
iii. CO: Concentrations ranged 1.1–2.5 ppm, below both FMEnv (10 ppm) and WHO (9 ppm, 8-hour mean) limits, indicating good ventilation and absence of major traffic congestion.
iv. H_2S and NH_3: Both gases were below detection limits (<0.001 ppm) at all locations, reflecting the absence of waste decomposition, sewage release, or industrial discharge sources.
v. VOCs: Detected in trace levels (<0.02 ppm) near residential areas, likely from domestic waste burning or cooking emissions, but well below concern thresholds.

Noise Levels

The noise level concentration across the 10 points and one controls sampled is presented in Figure 4.5. The spatial dispersion model for noise around the study area is presented in Figure 4.6.

i. Ambient noise ranged from 63 to 78.3 dB(A) across the sampling locations.
ii. Quiet agricultural zones and undeveloped lands recorded average values of 63–70 dB(A), well within the FMEnv limit of 75 dB(A) for mixed land-use areas.
iii. Roadside settlements and market vicinities near the main Adiabo–Calabar road recorded higher levels (88–93 dB(A)), exceeding guideline values due to vehicular traffic, community trading, and occasional machinery operations.

Meteorological Condition

Meteorological data collected during field measurements (Figure 4.7) showed that the project area experiences tropical humid conditions, characterized by alternating wet and dry seasons. The recorded data at the time of monitoring are summarized below:

i. Temperature: 29.2–31.6 °C (mean 30.4 °C), typical of daytime dry-season conditions (presented in Figure 4.8).
ii. Relative Humidity: 65–79%, indicating moderate atmospheric moisture conducive to natural pollutant dispersion (Figure 4.9).
iii. Wind Speed: 1.2–2.4 m/s, with predominant southwesterly winds (210°–240°) reflecting coastal influence from the Atlantic Ocean (details presented in Table 4.4 and Figure 4.10).
iv. Rainfall: The rainfall data (1994–2024) for Adiabo, Cross River State, Nigeria, with annual totals ranging from 2,371.8 mm (2004) to 4,168.7 mm (2012) and an average of 3,134 mm, reveals a tropical monsoon climate critical to planning the proposed Adiabo Agro-Industrial Hub.
v. Atmospheric Pressure: Averaged 1008–1012 hPa, indicating stable atmospheric conditions with limited vertical mixing.

The combination of low rainfall, moderate humidity, and light winds supports short-distance pollutant transport and temporary accumulation of dust, explaining localized variations in PM_{10} levels observed during the study.

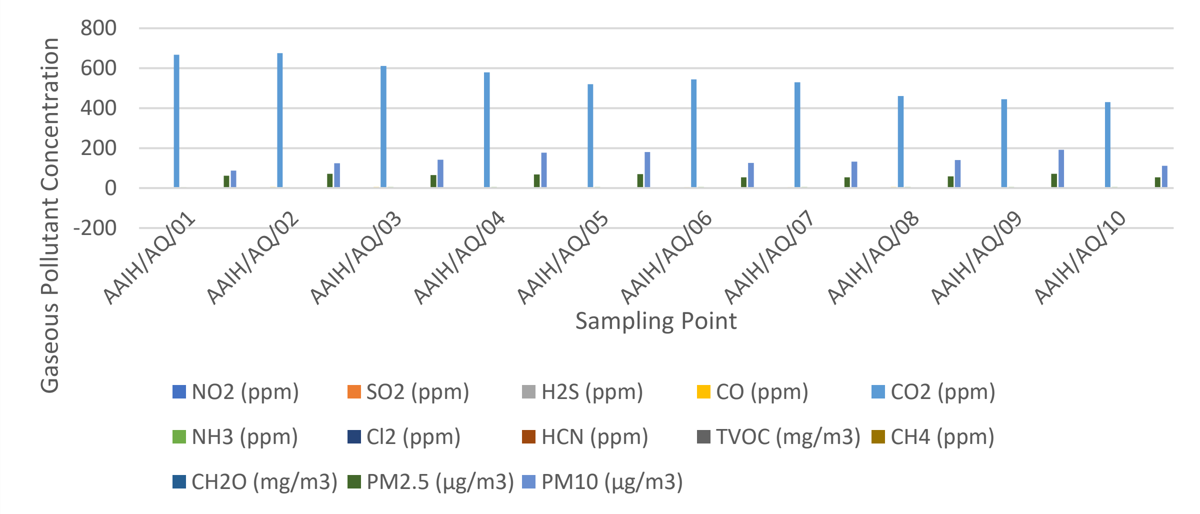


Figure 4.2: Air Pollutant Concentrations in the Study areas

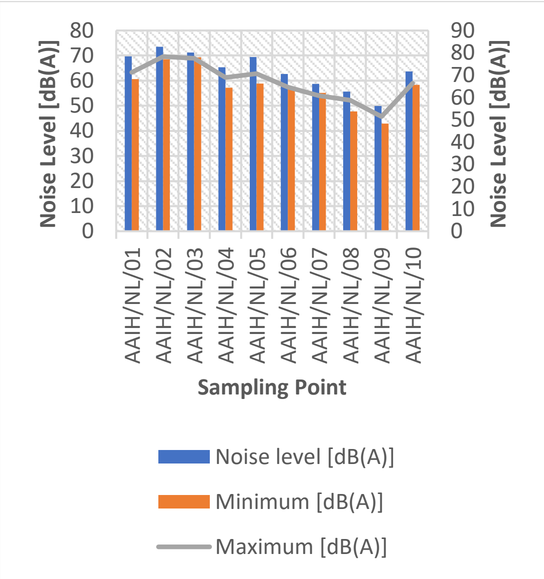


Figure 4.5: Noise Level of the Study area

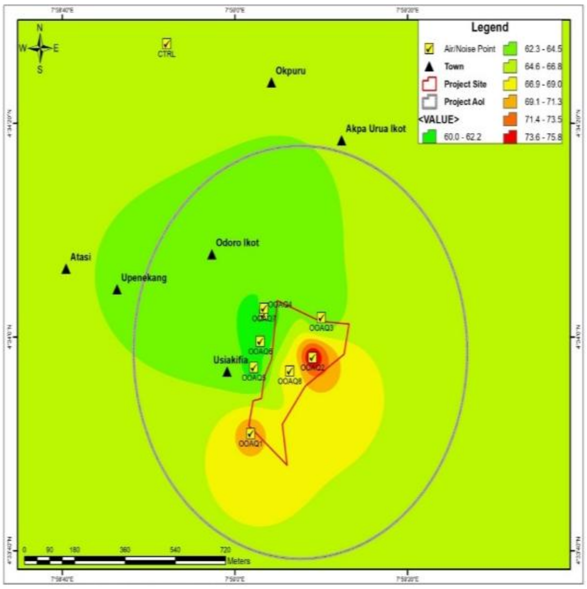
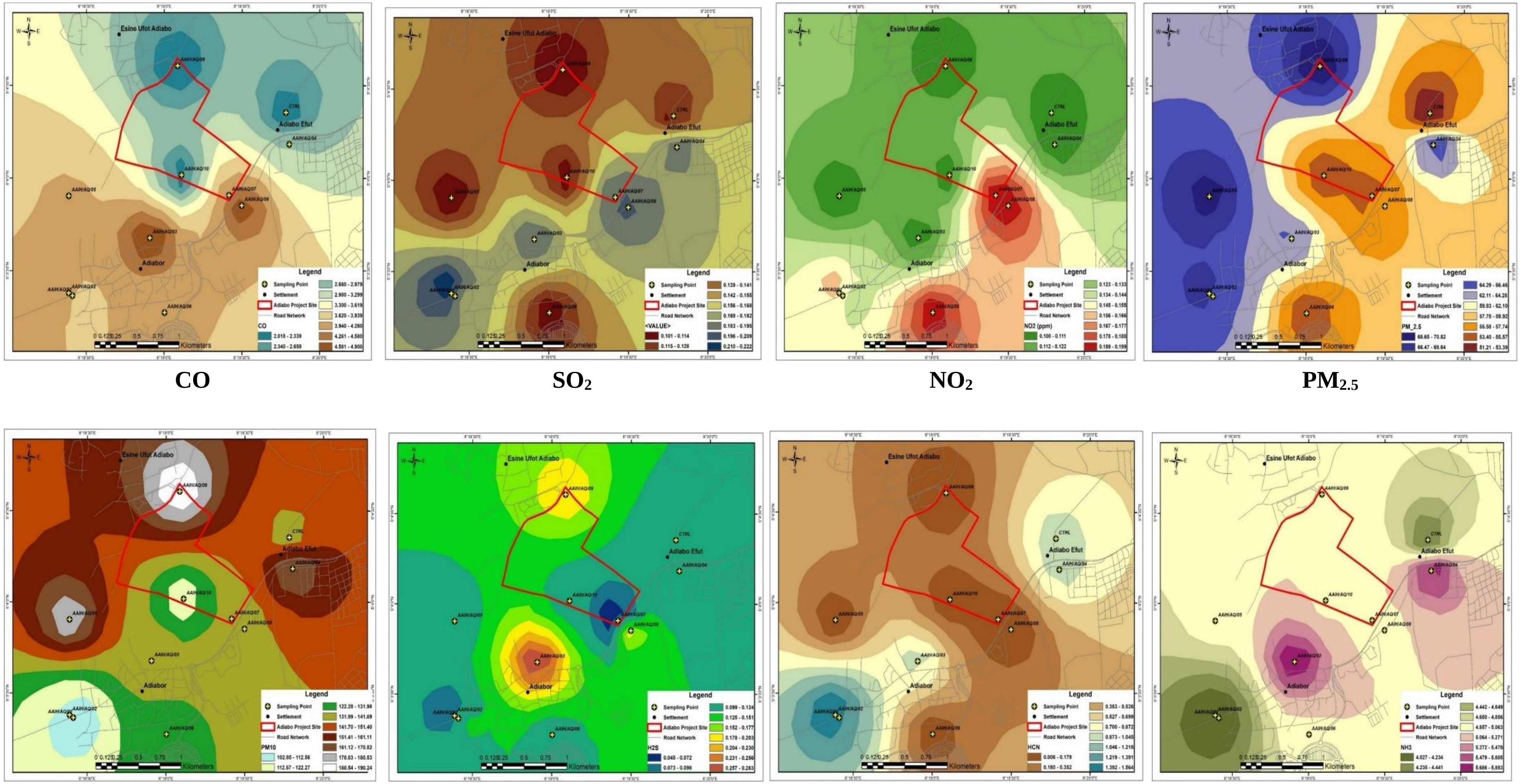


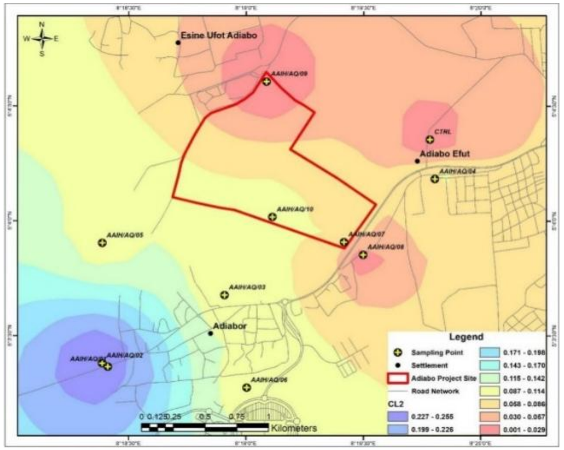
Figure 4.6: Map Indicating Spatial Dispersion of Noise Level



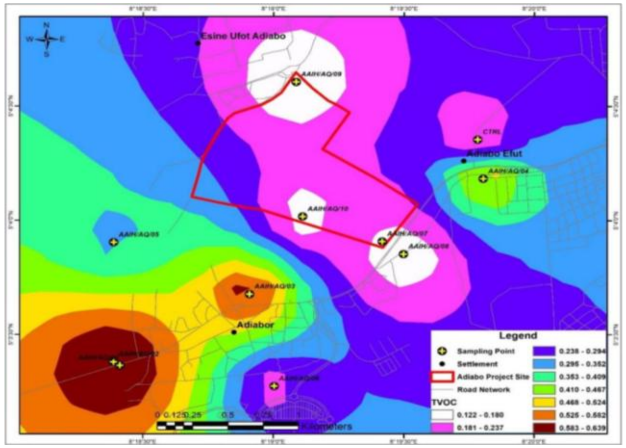
CO SO$_2$ NO$_2$ PM$_{2.5}$

PM$_{10}$ H$_2$S HCN NH$_3$

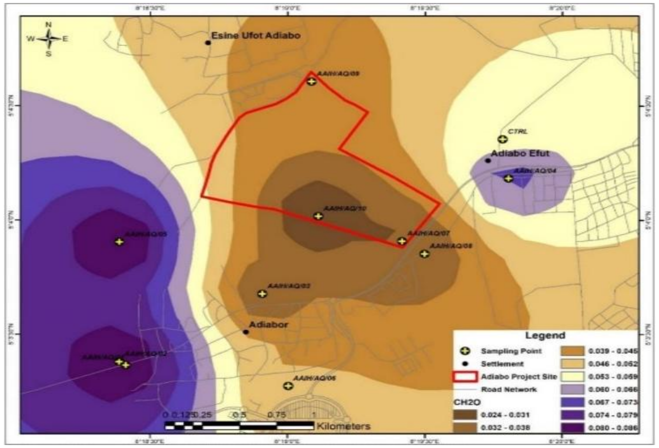
Figure 4.4a: Map Indicating Spatial Dispersion of Gaseous Pollutants



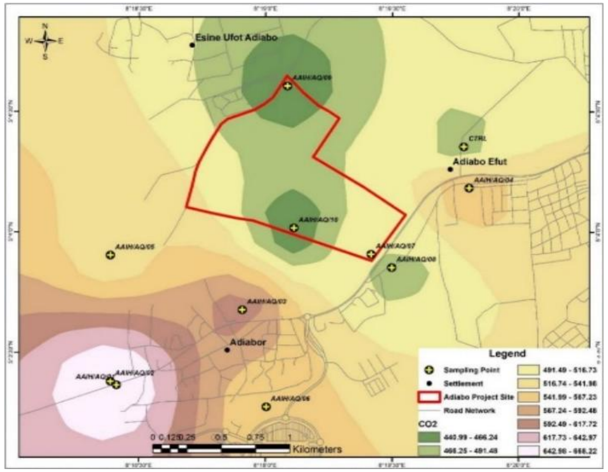
Cl_2



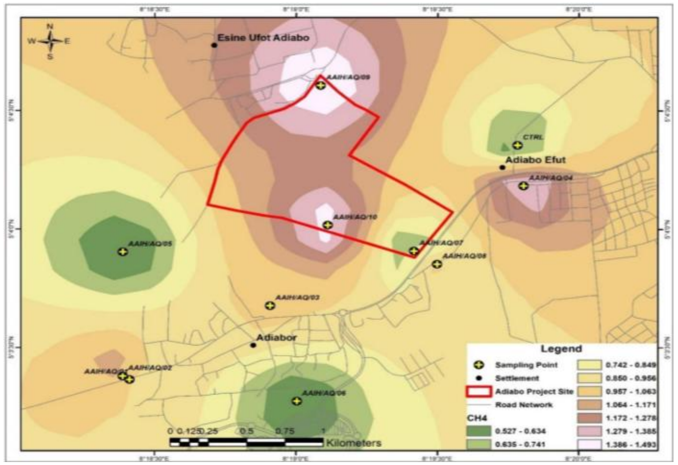
TVOCs



CH_2O



CO_2



CH_4

Figure 4.4b: Map Indicating Spatial Dispersion of Gaseous Pollutants

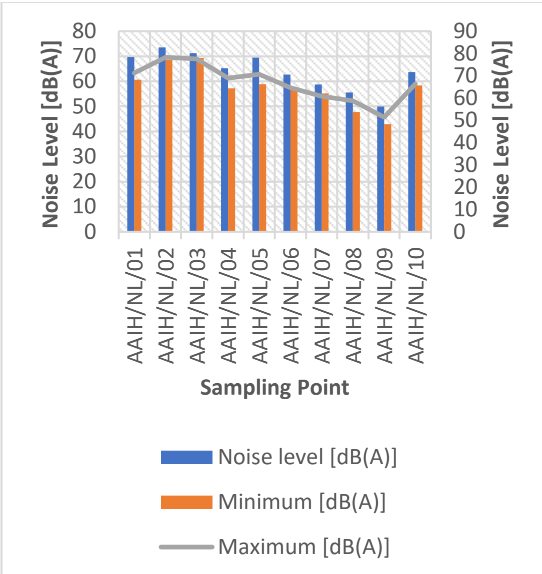


Figure 4.5: Noise Level of the Study area

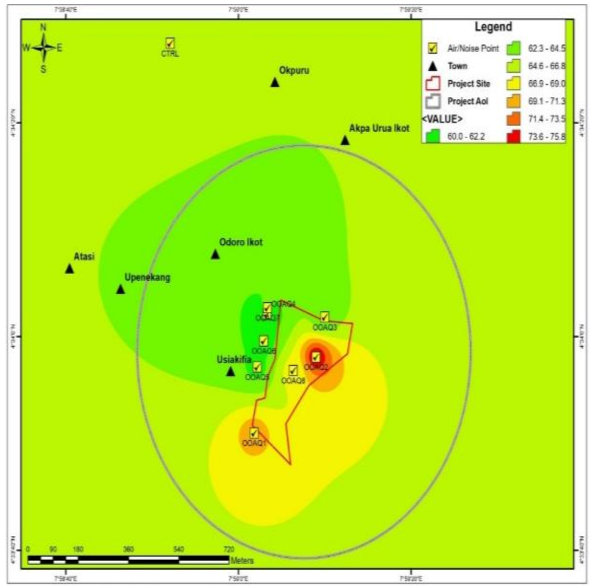


Figure 4.6: Map Indicating Spatial Dispersion of Noise Level

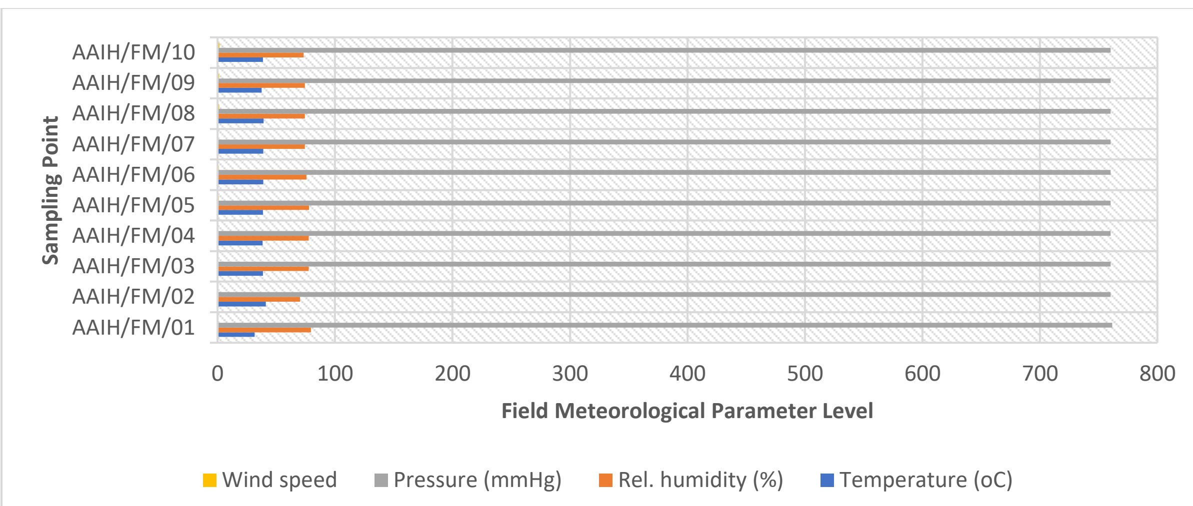


Figure 4.7: Field Meteorological Parameters

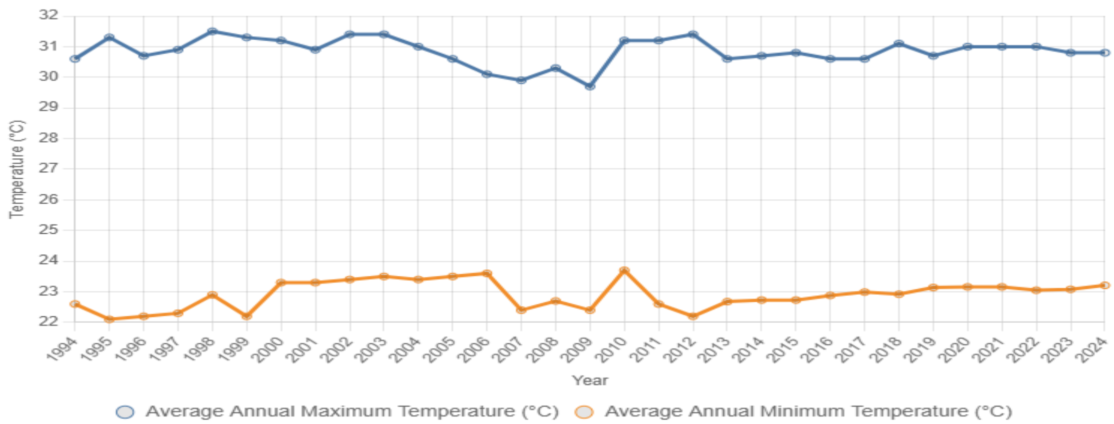


Figure 4.8: Average Annual Maximum and Minimum Temperature of the Study Area

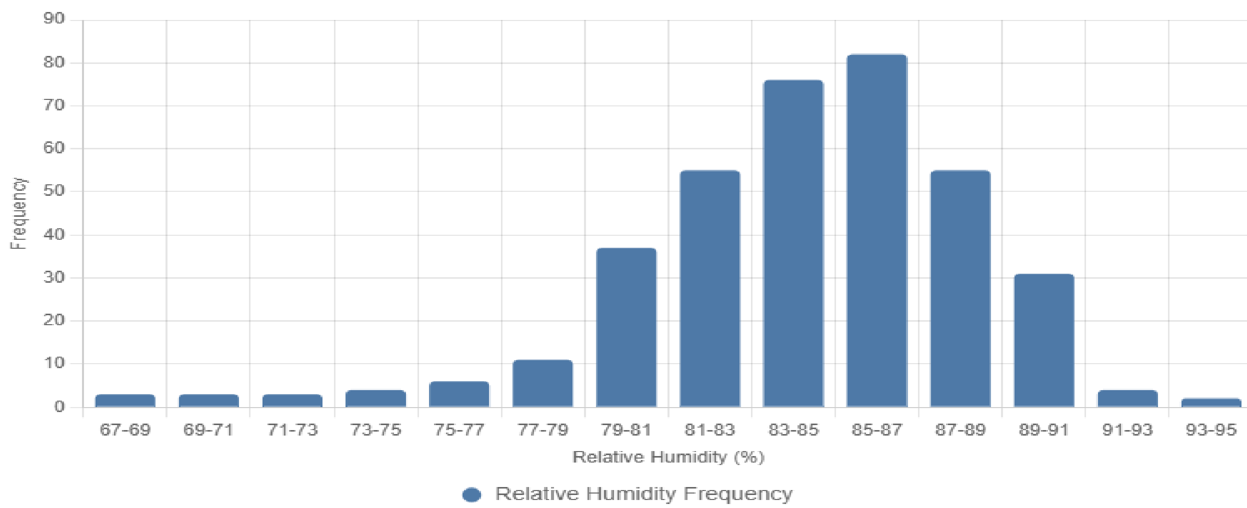


Figure 4.9: Relative Humidity Distribution (1994-2024) of the Study Area

Table 4.4: Wind Pattern

WD	**Wind Sped (m/s)**		
	0 – 1.50	**1.51-2.50**	**2.51 – 3.50**
N	1.18 = 14.6%	0 = 0 %	0 = 0 %
NE	1.22 = 15.1%	0 = 0 %	0 = 0 %
NNE	1.50 = 18.5%	0 = 0 %	0 = 0 %

Figure 4.10: Wind Rose for Proposed Area Based on Microclimatic Data

E	0.5 = 6.2%	0 = 0%	0 = 0 %
SE	0 = 0 %	0 = 0 %	0 = 0 %
SSE	0 = 0 %	0 = 0 %	0 = 0 %
S	0 = 0%	0 = 0%	0 = 0 %
SW	1.04 = 12.8%	0 = 0 %	0 = 0 %
WSW	0.93 = 11.5%	0 = 0 %	0 = 0 %
W	0 = 0 %	0 = 0 %	0 = 0 %
NW	0.87 = 10.7%	0 = 0%	0 = 0 %
NNW	0.86 = 10.6%	0 = 0%	0 = 0 %

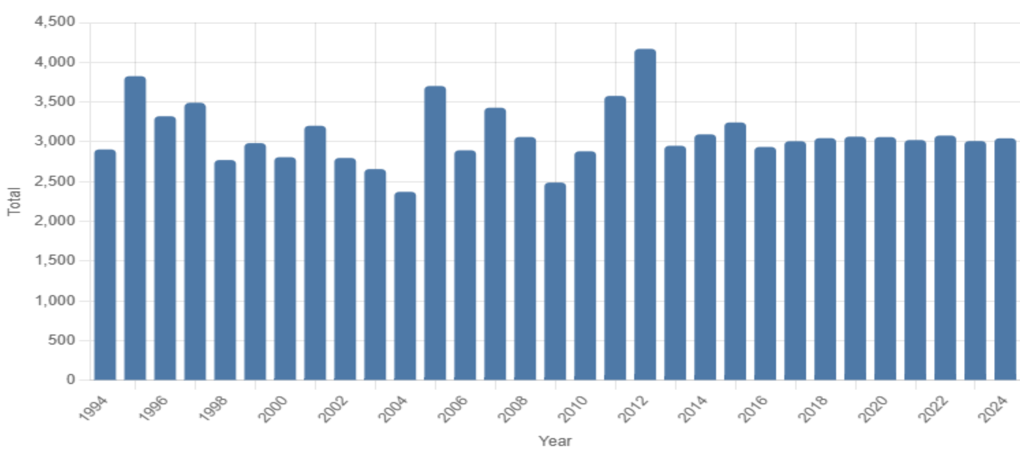


Figure 4.11: Average and Total Annual Rainfall Distribution in the Study Area

The results indicate that the ambient environment is generally clean, characterized by low concentrations of pollutants and minimal anthropogenic stressors.

However, PM_{10} and noise represent localized exceedances that reflect typical semi-rural community activities rather than industrial emissions. The meteorological data show that low rainfall, warm temperatures, and light winds during the monitoring period contributed to the limited dispersion of coarse particles (PM_{10}) and the accumulation of dust in roadside locations. The dominant sources of airborne particulates are windblown dust, soil disturbance, and vehicular movement on untarred access roads. Noise peaks are primarily due to transportation and market interactions, which are intermittent and not continuous exceedances. Overall, the area presents a moderate baseline condition that can easily accommodate short-term construction emissions, provided effective mitigation and monitoring measures are implemented.

4.4.6 Hydrogeology and Hydrology

Geology controls the occurrence of groundwater beneath the surface area. Existing hydrogeological and geophysical data suggests that the coastal plain sands of the Benin Formation (aquifer) exist under unconfined and confined conditions in most places and constitutes the major regional aquifer in southern part of Cross River State. However, the occurrence of clayey layers within the saturated zone creates in places, semi-confined conditions. Perched water tables also occur frequently due to a number of isolated clay lenses.

The first aquifer which is unconfined extends to depths of 60m – 70m below the ground level while the second and more prolific aquifer reaches up to 150m or more. The total thickness of the aquifers is reported to be up to 1500m in the coastal area with clayey inter-beddings covering only 4 – 15% of the whole unit, and on average having a thickness of 6m.

Available data on aquifer characteristics for the Benin Formation in Calabar also shows a discharge value of 543 – 4325m3/d, transmissivity value of 433 – 23570m3/d, Hydraulic conductivity value of 23.80 – 236m/d and storativity value of 0.015 – 0.30.

Recent hydrogeological data covering Calabar (including the study area) shows that the depth to water level varies from a low of 2.6m to a high of 70.2m with low static water level (<2m) recorded towards the Calabar River at Adiabo (EIA of CFTZ, 2002).

This study recorded low SWL (15m) with respect to the ground surface towards the Calabar River on the west and corresponding higher values (20m and 24m) further upland (northeastwards) indicating that the direction of groundwater flow in this part of the study area is basically southwestwards towards the Calabar River .The occurrence of differential relief over the entire proposed project area however, strongly suggest the existence of ground water divide within the study area as groundwater table often mimics topography to a large extent, especially where aquifers are generally unconfined as in the case here. The depression observed towards the northern fringe of the project area is a stream course, Banga stream which together with other tributaries of the Calabar River flow northwestwards and empties into the Calabar River. This confirms the existence of the groundwater divide as the groundwater flow direction in this part of the study area is basically to the northwest where it apparently meets the tributaries of the Calabar River. The overall groundwater flow direction in the proposed project area is therefore, southwestwards and northwestwards.

Based on available information on the lithologic sequence and logs from the study area and environs, it is obvious that the lateritic/clayey overburden does not provide adequate seal for the groundwater as recharge is basically by surface percolations. Communication exist also between aquiferous units in multiple/multi-storey aquifer system as most intervening layers are aquitards. It is therefore clear that groundwater quality could be readily affected by the quality of infiltration from the surface which is dependent on the air quality and the nature of materials introduced into the surface sediments.

The overall flow patterns (subsurface and surface) from the study area also show that the Calabar River stands to be affected by constituents of surface drainage as well as the quality of groundwater that discharges into it as the flow in this case is effectively topography driven. Similarly, waste water and effluents from the study area will likely follow the same flow patterns. Available information on the Calabar river at Adiabo shows an average width of 323m, average depth of 20.4m, average current velocity of 0.24m/s and an average volume discharge of 435.7m^3/s respectively.

4.5 Groundwater and Surface Water Quality and Chemistry

Results of the field and laboratory measurements/analyses of groundwater and surface water samples (3 samples and one control each) are presented in Table 4.5 and Table 4.6 respectively, Plate 4.4 shows the sample collection. The Federal Ministry of Environment (FMEnv) and World Health Organization (WHO) standards for water potability are also included for comparison.

Table 4.5: Results of the Physicochemical & Microbial Characteristics of Groundwater

Parameter	Range	WHO Limit	FMEnv Limit
Color (Pt Co Units NCASI)	2.68-3.22	5.0-15	-
pH	5.56-6.67	6.5-8.5	6.5-9.0
Temperature (°C)	25.8-28.9	-	-
Turbidity (NTU)	0.41-0.55	5	5
Salinity as Cl^- (mg/l)	20.8-28.7	-	-
Total Hardness (mg/l)	20.6-25.1	250	250
Conductivity (µS/cm)	45.1-58.8	1000	400
Dissolved Oxygen (mg/l)	0.15-0.21	5	>4.0
Biological Oxygen Demand (mg/l)	0.25-0.33	-	-
Chemical Oxygen Demand (mg/l)	<0.01	-	150
Total Hydrocarbon Content (mg/l)	<0.01	-	-
Phosphate (mg/l)	0.18-0.24	-	-
Sulphate (mg/l)	3.58-4.28	250	250
Nitrate (mg/l)	0.55-0.68	10	10
Total Dissolved Solids (mg/l)	22.55-29.4	1000	1000
Total Suspended Solids (mg/l)	0.17-0.23	-	-
Copper (mg/l)	0.26-0.34	1	0.01

Parameter	Range	WHO Limit	FMEnv Limit
Iron (mg/l)	0.28-0.35	0.36	0.36
Lead (mg/l)	0.025-0.033	0.05	<1.0
Zinc (mg/l)	0.77-0.81	3	<1.0
Cadmium (mg/l)	0.038-0.045	0.003	<1.0
Chromium (mg/l)	0.039-0.041	0.05	0.05
Potassium (mg/l)	0.46-0.52	-	-
Barium (mg/l)	0.16-0.21	-	-
Faecal Coliform (cfu/100ml)	0	0	0
Total Coliform (cfu/100ml)	0	0	0
Total Heterotrophic Bacteria (cfu/ml)	15-20	0	0

Source: Fieldwork/Laboratory Analysis (2025)

Table 4.6: Results of the Physicochemical & Microbial Characteristics of Surface Water

Parameter	Range	WHO limit	FME Limit
Color (Pt Co Units NCASI)	14.4-14.7	5.0-15.0	-
pH	6.51-6.77	6.5-8.5	6.5-9.0
Temperature (ºC)	27.3-30.5	-	-
Turbidity (NTU)	24.56-25.67	5	5
Salinity as Cl^-(mg/l)	23.1-74.3	-	-
Hardness (mg/l)	56.2-57.4	250	250
Conductivity (µS/cm)	31.1-139.8	1000	400
Dissolved Oxygen (mg/l)	6.55-7.25	5	>4.0
BOD (mg/l)	2.74-3.05	-	-
COD (mg /l)	2.53-2.75	-	150
THC (mg/l)	<0.01	-	-
Phosphate (mg/l)	0.47-0.58	-	-
Sulphate (mg/l)	0.40-0.53	250	250
Nitrate (mg/l)	2.43-2.82	10	10
TDS (mg/l)	22.8-99.7	1000	1000
TSS (mg/l)	10.23-10.7	-	-
Copper (mg/l)	0.03-0.10	1	0.01
Iron (mg/l)	4.35-4.66	0.36	0.36
Lead (mg/l)	<0.001	0.05	<1.0
Zinc (mg/l)	4.27-4.48	3	<1.0
Cadmium (mg/l)	0.037-0.051	0.003	<1.0
Chromium (mg/l)	0.027-0.038	0.05	0.05
Potassium (mg/l)	1.27-1.58	-	-
Barium (mg/l)	0.47-0.65	-	-

Parameter	Range	WHO limit	FME Limit
Faecal Streptococci (cfu/100ml)	8.0-14.0	0	0
Total Coliform (cfu/100ml)	10.0-13.0	0	0
Total Heterotrophic Bacteria (cfu/ml)	1.0×10^5-1.4×10^5	0	0

Source: Fieldwork/Laboratory Analysis (2025)

Baseline Findings

Groundwater in the CR-SAPZ Adiabo area was found to be clear, mildly acidic, and of low mineral content, with most parameters within the FMEnv and WHO permissible limits. The detailed parameter ranges from Table 4.5 are summarized below:

i. pH: Ranged from 5.56 to 6.67, slightly below the WHO lower limit (6.5) at two locations, indicating mild acidity typical of lateritic tropical soils influenced by carbonic acid from organic matter decomposition.
ii. Temperature: 25.8–28.9 °C, reflecting stable tropical aquifer conditions.
iii. Turbidity: 0.41–0.55 NTU, well below the 5 NTU guideline, indicating excellent clarity.
iv. Electrical Conductivity: 45.1–58.8 µS/cm, and TDS: 22.55–29.4 mg/L — both signify very low mineralization, confirming freshwater origin with minimal saline intrusion.
v. Total Hardness: 20.6–25.1 mg/L, far below the 250 mg/L limit, classifying the water as soft.
vi. Dissolved Oxygen (DO): 0.15–0.21 mg/L, indicating low oxygen levels due to the reducing nature of the aquifer.
vii. BOD_5 / COD: Averaged 0.25–0.33 mg/L and <0.01 mg/L, respectively — both extremely low, confirming negligible organic load.
viii. Chloride and Sulphate: 20.8–28.7 mg/L (Cl^-) and 3.58–4.28 mg/L (SO_4^{2-}), both well below the 250 mg/L permissible limit.
ix. Nitrate: 0.55–0.68 mg/L — far below the 10 mg/L threshold, indicating no leaching of agricultural fertilizers or sewage infiltration.
x. Phosphate: 0.18–0.24 mg/L — trace concentration, environmentally insignificant.
xi. Iron (Fe): 0.28–0.35 mg/L, within the 0.36 mg/L limit.
xii. Copper (Cu): 0.26–0.34 mg/L — marginally above the FMEnv guideline (0.01 mg/L) but well below the WHO limit (1.0 mg/L).
The slight elevation likely reflects natural mineral dissolution from copper-bearing soils.
xiii. Lead (Pb): 0.025–0.033 mg/L, well below the 0.05 mg/L limit.
xiv. Zinc (Zn): 0.77–0.81 mg/L, below the 3.0 mg/L WHO limit.
xv. Total Hydrocarbon Content (THC): <0.01 mg/L — no detectable hydrocarbon contamination.

Microbiological analysis results (Table 4.5) show:

xvi. Total Coliforms: 0 cfu/100 mL (Not Detected)
xvii. Faecal Streptococci: 0 cfu/100 mL (Not Detected)
xviii. Total Heterotrophic Bacteria (THB): 15–20 cfu/mL (mean = 17.67 ± 2.5)

These results confirm absence of faecal pollution and excellent bacteriological quality, implying that groundwater abstraction points are well protected from surface contamination.

The baseline results indicate a clean, fresh, and potable aquifer system. Given the proposed CR-SAPZ activities (construction, utilities, and limited process water abstraction), potential impacts are minimal but must be managed to avoid sediment infiltration, oil spillage, or seepage from waste disposal areas during construction. Baseline data from Table 4.5 will serve as a benchmark for future monitoring and comparison during ESMP implementation.

Baseline Findings for Surface Water

Overall, surface water quality in the Adiabo project area is moderately good, reflecting a semi-rural environment with limited industrial influence. However, isolated exceedances in certain parameters were observed, primarily in areas influenced by local agricultural and domestic activities.

i. pH and Temperature: Values ranged between 6.4 and 7.3 and 27.5–29.2°C, respectively—within acceptable limits for freshwater ecosystems and indicative of stable, near-neutral aquatic conditions.
ii. TDS and Conductivity: Measured between 82–130 mg/L and 145–265 µS/cm, both below the NESREA limit of 1000 mg/L (TDS) and 1000 µS/cm (EC), showing low mineralization and limited anthropogenic salinity input.
iii. TSS: Slightly elevated levels (45–60 mg/L) were recorded at downstream locations, exceeding the FMEnv limit of 30 mg/L. These values suggest surface runoff from agricultural plots and unpaved roads, particularly following rainfall events during the sampling period.
iv. BOD_5 and COD: Average BOD_5 ranged 8–10 mg/L, while COD averaged 18–25 mg/L, slightly above guideline values ($BOD_5 \leq 6$ mg/L). These elevated organic loads likely originate from domestic effluents, decomposing vegetation, and small-scale washing activities observed along the riverbanks.
v. Oil and Grease: Trace concentrations (1.2–1.4 mg/L) were detected at points close to fishing jetties and canoe landing sites, marginally exceeding the FMEnv limit of 1.0 mg/L. This is attributed to minor fuel spills and lubricant residues from local boat operations.
vi. Heavy Metals (Fe, Pb, Zn, Cu): All measured concentrations were below regulatory thresholds, indicating no evidence of industrial metal pollution. Iron concentrations ranged 0.15–0.28 mg/L, well within the 1.0 mg/L limit.
vii. Microbiological Quality: Total coliform counts were recorded at 20–45 CFU/100 mL, slightly above the NESREA limit of 10 CFU/100 mL, suggesting domestic waste and runoff influence near residential sections of Adiabo Ikot Mbo Otu.

The slight deviations observed in TSS, BOD_5, COD, oil and grease, and coliform counts are not indicative of severe contamination but rather reflect localized human influence on natural water bodies.

Given that the CR-SAPZ project involves land preparation, construction, and potential effluent discharge during operational phases, maintaining water quality integrity is critical. The current baseline indicates a slightly stressed but recoverable aquatic environment, and project activities, if unmanaged, could worsen suspended solids and organic load. However, with appropriate erosion control, drainage design, and wastewater management, impacts can be effectively mitigated.

4.5.1.1 Methodologies for Microbiological Analyses

Soil samples were collected using a sterile auger (as shown in Plate 4.3), stored in polyethylene bags, and homogenized. Groundwater was obtained from borehole standpipes. For microbial analysis, samples were mixed with 0.35% NaCl, agitated for 30 minutes to extract microorganisms, then serially diluted to determine microbial densities.



Plate 4.3: Collection of soil sample using soil auger (left)
Plate 4.4: Surface water (middle) and groundwater (right) samples collections points at Adiabo

Heterotrophic bacteria and fungi were quantified using the surface-spread technique on nutrient agar and Sabouraud dextrose agar, respectively (Harrigan & McCance, 1990). Total coliforms were enumerated on MacConkey agar, while hydrocarbon-utilizing microbes were assessed on oil agar. To selectively isolate bacteria, cycloheximide (100 µg/mL) and benomyl (50 mg/mL) were added to suppress fungal growth; streptomycin (0.5 µg/mL) was used for fungal isolation.

Sulfate-reducing bacteria (SRB) were cultured on modified Bacto Sulfate API agar, containing yeast extract, sodium lactate, and ferrous ammonium sulfate. Serial dilutions were anaerobically incubated at 28°C for 48 hours. Bacterial plates were incubated at 37°C (24 hours), fungal plates at 28±2°C (4 days), and hydrocarbon-utilizing microbes at 28±2°C (7 days). Colonies were counted (Quebec colony counter) and identified using taxonomic keys (Cowan, 1985; Barnett & Hunter, 1987).

4.5.1.2 Enumeration of Bacteria

Total heterotrophic bacteria were enumerated using standard plating techniques (SPT) as described by Collins and Lyne (1976).

- The samples were diluted using 10-fold serial dilution
- 1ml of appropriate dilutions (10^{-7} for soil and 10^{-5} for water) was transferred with sterile pipette into sterile Petri dish.

- Prepared molten nutrient agar (Biotec) at 40 – 45^{0}C was poured over the inoculums. Each Petri dish was gently rocked to ensure uniform distribution or homogeneity of the water sample.
- When the agar had solidified, the plates were inverted and incubated as follows: Duplicate plates were incubated at 3 different temperatures for each sample at 37^{o}C – 44^{o}C for 24 hours and 28 ± 2^{0}C (room temperature) for 48 hours.
- At the end of the incubation period, the total number of colonies were counted and multiplied by the dilution factor and the result expressed as colony forming units/ml (cfu/ml) for water or cfu/g for soil.

4.5.1.3 Enumeration of Fungi

Total fungal counts (TFC) were determined using 0.1ml of the supernatant from 10^{-3} to do surface plating on Potato Dextrose Agar (PDA) [Oxoid]. The inoculums were spread on PDA surface using a sterile bent glass rod. The samples were plated in duplicate and incubated at 28 +_2^{0}C (room temperature) for 3 – 5 days. Fungal colonies were counted at the end of the incubation period and expressed as cfu/ml or cfu/g for water and soil respectively.

4.5.1.4 Coliform counts

Membrane filtration method was used for the enumeration of coli form bacteria in water. Millipore type filter (147mm in diameter and 0.45µm pore size) was used to determine the total and thermo tolerant (faecal) coli forms in water (Harrigan and McCance, 1976). The membrane filtration apparatus was sterilized using 70% alcohol. The sterile filter was placed in the filtration unit and 100ml of water was passed through the filter by suction. After filtration, the filter was removed and placed in a Petri-dish on a pad previously soaked with membrane lauryl sulphate broth. Two sets of filters were used for each sample. One set was incubated at 37^{o}C for total coli forms and the second set at 44^{o}C for 24 hours for thermo tolerant (faecal) coli forms.

4.5.1.5 Confirmatory Tests for Coliforms

To confirm the membrane filter results for total coli forms, a representative number of colonies were sub-cultured to tubes of lactose peptone water and incubated at 37^{o}C for 48 hours. Gas production within this period confirms the presence of total coli forms. To confirm the presence of thermo tolerant (faecal) coli forms and *Escherichia coli* on membranes, a representative number colony was sub-cultured to a tube of lactose peptone water and a tube of tryptone water. The tubes were incubated at 44^{o}C for 24 hours. Growth with the production of gas in the lactose peptone water confirms the presence of thermo tolerant coli forms. Confirmation of E. coli requires the addition of 0.2-0.3ml of Kovac's reagent to each tryptone water culture. Production of red color indicates the synthesis of indole from tryptophan and confirms the presence of *E. coli*.

4.5.1.6 Enumeration of Hydrocarbon Degraders

The presence and number of crude oil degrading microorganisms in water and soil were determined using the method of Jackson *et al*., (1994). Surface plating method earlier described for total fungal count was used. This was by streaking 0.1ml of 10^{-3} and 10^{-4} dilutions in duplicate on crude oil agar.

Crude oil agar was prepared by addition of 0.2% Qua Iboe light (QIL) crude oil and 2% agar to mineral salt medium of Zajic and Supplison (1972). Plates were incubated at 28 ± 2^oC (room temperature) for 5-7 days. Discrete colonies were counted at the end of the incubation period and recorded as $cfug^{-1}$. To isolate crude oil utilizing fungi, the same medium as that of bacteria was used except that the medium was acidified with 10% lactic acid.

4.5.1.7 Characterization and Identification of Microbial Isolates

Pure cultures of bacteria isolated were characterized and identified on the basis of their cultural, morphological and biochemical properties and by reference to Bergey's Manual of Determinative Bacteriology (Holt *et al*, 1994) and Cowan and Steel's Manual for the identification of Medical Bacteria (Barrow and Feltham, 1993). The fungal isolates were characterized based on their macroscopic appearance on culture medium, microscopic morphology and types of asexual spores produced and were identified by reference to illustrated Genera of Imperfecti Fungi (Barnett and Hunter, 1972) and Fungi in Agricultural Soil (Domsch *et al*, 1980).

4.5.1.8 Detection and Estimation of Faecal Streptococci

The detection and enumeration of faecal streptococci in water samples was carried out using sodium azide medium and incubation at 37^oC (Fawole and Oso 1988). Confirmation is by growth and production of acid on glucose azide broth after incubation at 44.5^oC for 48 hours.

4.5.1.9 Detection and Estimation of Clostridium perfringens

Differential reinforced clostridium medium (DRCM) and litmus milk medium were used. Different 10ml and 5ml quantities of water were inoculated into double strength and single strength media in screw-capped bottles and incubated at 37^oC in anaerobic jar for 48 hours. The bottles showing blackening were regarded as positive and the most probable number of Clostridium sp. in each water sample was determined by MacCrady Table (Itah *et al*, 1996).

To confirm the presence of *Clostridium perfringens* inoculums from positive tubes were inoculated into freshly prepared litmus milk media and incubated at 37^oC for 48 hours in an anaerobic jar. The tubes with "Stormy Clot" were read as positive.

4.5.1.10Coliform Count

Total coliform counts and Fecal coliform counts in the ground water samples for the study area were zero. Counts of total heterotrophic bacteria in the groundwater of the study area were within the range of 15 - 20 cfu/ml (17.67±2.5) (Table 4.5). The presence of total coliform as well as other suspended particles might be objectionable to consumers.

4.6 Sediment

4.6.1 Sediment Geochemistry

The overall mean, range and standard deviation of physical and chemical parameters of the sediments for the two seasons are given in Table 4.12. The texture of the sediment samples was mostly silty-clay. The pH of the sediment shows slight alkalinity (6.86 < pH <8.42) with an average pH value of 7.6 ± 0.22 while the sediment temperature varied between from 24.8 to 27.5 oC (mean value = 26.5 ± 0.45oC).

Trace elements in sediments

The seasonal mean concentrations, ranges and standard deviations of heavy metals (cadmium, zinc, iron, copper, lead, chromium, vanadium, nickel, manganese, mercury and arsenic) and major elements are presented in Table 4.12. Most of the heavy metal values represent background levels. The mean concentration of cadmium (2.06 ± 0.42 mg/kg) ranged from a minimum value of1.45 mg/kg during dry season to a maximum value of 2.60 mg/kg obtained in the wet season. The concentrations of zinc varied between 10.20^{D} and 24.50^{W} mg/kg (overall mean = 16.71 ± 5.10mg/kg). iron concentrations varied between 180.5^{D} and 332.90^{W} mg/kg (overall mean = 295.26 ± 80.22 mg/kg). The concentrations of copper varied between 4.64^{W} and 9.40^{D} mg/kg (overall mean = 6.71 ± 1.37 mg/kg). lead concentrations ranged from 13.430^{W} mg/kg to 18.42^{D} mg/kg (mean = 15.75 ± 1.75 mg/kg) while values for chromium ranged between 1.20^{W} and 2.86^{D} mg/kg (overall mean = 1.78 ± 0.59 mg/kg. The concentrations of vanadium varied between 1.12^{D} and 2.42^{W} mg/kg (overall mean = 1.69 ± 0.59 mg/kg) while those of nickel showed fluctuation from 0.83^{D} mg/kg to 1.94^{W} mg/kg with a mean concentration of 1.51 ± 0.38mg/kg. The concentrations of mercury varied between 0.01^{D} and 0.12^{W} mg/kg (mean = 0.04 ± 0.03 mg/kg) while the concentrations of Arsenic varied between 0.08^{D} and 1.82^{W} mg/kg (mean = 1.01 ± 0.31 mg/kg). The mean concentration of manganese (43.17 ± 505.93 mg/kg) ranged from a minimum value of 10.00^{W} mg/kg to a maximum value of 78.0^{D} mg/kg.

A quantitative measure of metal pollution in aquatic sediments was made by using the index of geo-accumulation (I-geo): I-geo = $\log_2 \{C_n/(1.5 \times B_n)\}$, where C_n is the measured concentration of element n in the pelitic fraction of sediment (< 2 μm) and B_n is the geochemical background for the element n (Muller (1969). B_n was directly measured from the literature (average deep sea sediment value and shale value). The factor 1.5 was introduced to include possible variations of the background values that are due to lithologic variations. The I-geo was classified into seven grades: I-geo ≤ 0 (grade 0), unpolluted; 0< I-geo ≤1 (grade 1), slightly polluted; 1 < I-geo ≤ 2 (grade 2), moderately polluted; 2< I-geo ≤3 (grade 3), moderately severely polluted; 3< I-geo ≤4 (grade 4), severely polluted; 4< I-geo ≤5 (grade 5), severely extremely polluted; I-geo > 5 (grade 6), extremely polluted. Table 4.13 presents the geo-accumulation index for the quantification of heavy metal accumulation in the study area. The I-geo grades for the sediments of the study area varied from metal to metal and site to site (across metals and sites). The results show that the entire sediments are not polluted with I-geo ≤ 0 (grade 0) indicating background concentrations of these elements. Further assessment of sediment pollution was made by comparison of the mean metal concentration (Table 4.13) with effect-based sediment quality guideline (SQG) to identify contaminants of concern in aquatic ecosystem (MacDonald et al., 2000). On the basis of SQG of USEPA (Perin et al., 1997), sediments of the study area were classified as non-polluted with respect to the metals.

4.6.1.1 Organic Contaminants in sediments

Total Petroleum Hydrocarbon and, PAHs

The TPH concentrations varied between 5.89 in the dry season and 33.80 mg/kg in the wet season (overall mean = 16.23 ± 5.05 mg/kg). ∑PAHs in the sediments were low with concentrations ranging from 0.00 during dry season to 0.25 mg/kg in the wet season (overall mean = 0.04 ± 0.05 mg/kg).

In order to assess whether sediments in the study area will cause toxic effects, the ∑PAH levels in sediments were compared against effects-based guideline values such as the effects range-low (ERL), effects range-median (ERM), and apparent effects threshold values developed by the US National Oceanic and Atmospheric Administration (Kim et al., 1999). In the study area, the maximum ∑PAH concentration (0.25 mg/kg) detected in the sediment was lower than the ER-L value (4.0 mg/kg) and lower than 2.0–4.0 mg/kg in sediment quality guidelines proposed by Ontario Ministry of the Environment (Long et al., 1995). According to Baumard et al. (1998, Ekpo et al., 2011), ∑PAHs <0.100 mg/kg are indicative of low pollution, whereas values >4.0 mg/kg correspond to chronically polluted industrialized areas. And on the basis of the Threshold Effect Level (TEL) of 0.87mg/kg (Allen Burton, 2002), the level of pollution by ∑ PAHs in the surface sediments of the study area is low.

4.6.2 Sediment Microbiology

Sediments share some properties with soils and yet are distinct from soil environments for a variety of reasons, many of which are of great importance to the populations of microbes that reside there. Sediments are, in general, overlain by a permanent water body, be it an ocean, fjord, lake, river, or reservoir. Thus, although the chemistry of the water may vary substantially, as may the level of primary productivity (autochthonous input) and contribution from runoff or rivers (allochthonous input), sediments share the property of being continuously wet. Microbes in sediment ecosystems are known to play important roles in the transformation of organic matter and in biogeochemical cycling of primary elements such as nitrogen, sulfur, phosphorus, and iron (Zhang *et al*., 2014).

Bacterial and fungal isolates identified in sediments are captured in figures 4.26 and 4.27. The summary of microbial organisms of the sediment samples is presented in Table 4.7**.** In sediment samples, total heterotrophic bacteria (cfu/g) ranged between 2.1 × 10^5 and 3.5 × 10^5; total heterotrophic fungi (cfu/g) ranged between 2.6×10^5 and 3.6×10^5; hydrocarbon utilizing bacteria (cfu/g) ranged between 1.0×10^3 and 1.7×10^3, and hydrocarbon utilizing fungi (cfu/g) ranged between 1.1×10^3 and 2.3×10^3. A total of 12 bacterial species were isolated and 9 fungal species. This sums up to 21 species isolated from the sediment samples.

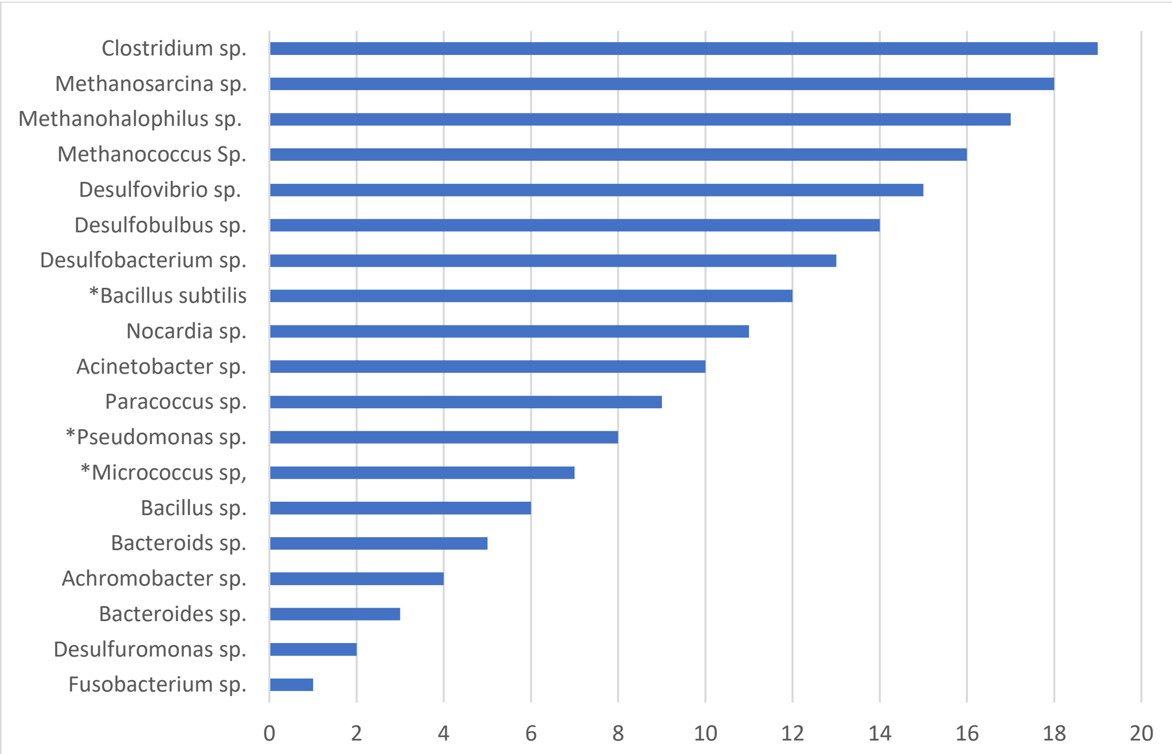


Figure 4.3: No. of Bacterial Isolates Identified in Sediment Samples

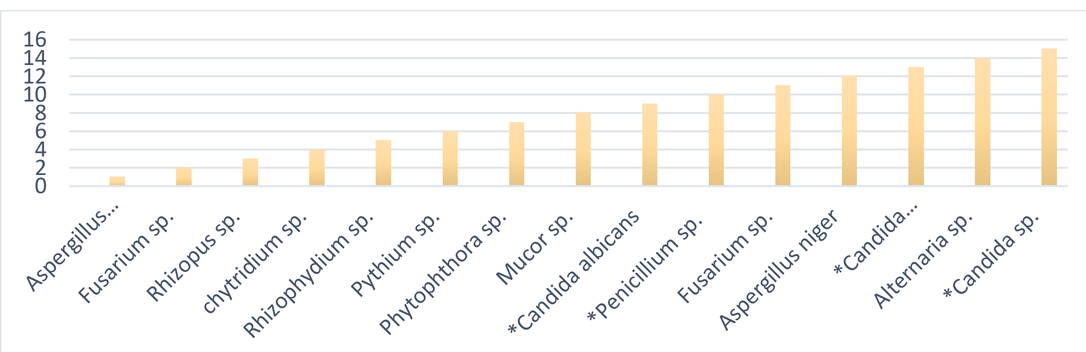


Figure 4.4: No. of Fungal Isolates Identified in Sediment Samples

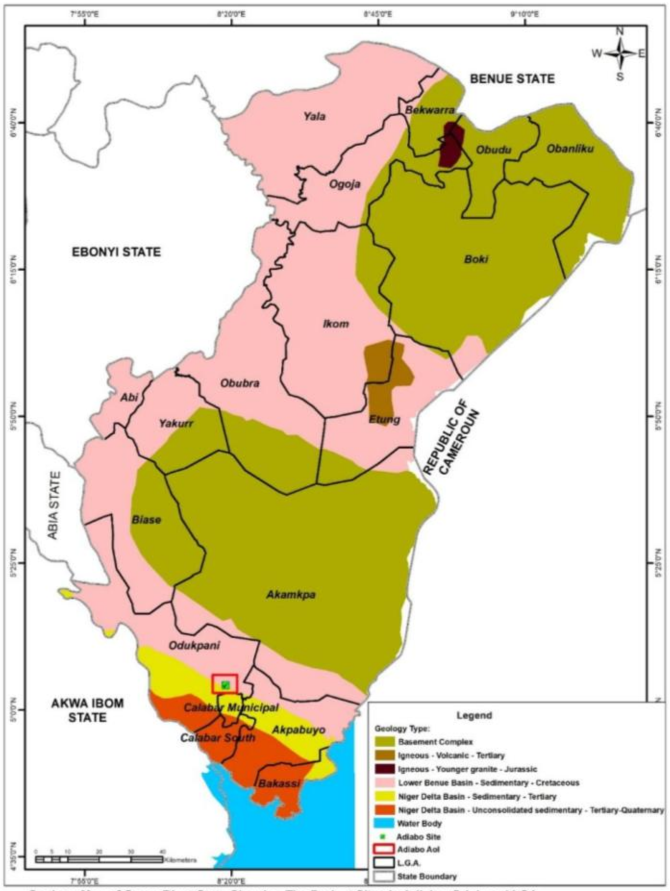
Table 4.7: Microbiological Characteristics of Sediment Samples

Parameter	SED1			CTRL		Microorganisms identified	
	US	MS	DS	US	DS	Bacteria	Fungi
THB (CFU/g)× 10^5	3.1	2.1	3.5	2.3	2.9	*Fusobacterium* sp., *Desulfuromonas* sp., *Bacteroides* sp., *Achromobacter* sp, *Bacteroids* sp, *Bacillus* sp., **Micrococcus* sp,. **Pseudomonas* sp., *Paracoccus* sp, *Acinetobacter* sp, *Nocardia* sp.**Bacillus subtilis*, *Desulfobacterium* sp., *Desulfobulbus* sp., *Desulfovibrio* sp., *Methanococcus* Sp., *Methanohalophilus* sp., *Methanosarcina* sp., *Clostridium* sp.	*Aspergillus fumigatus*, *Fusarium* sp, *Rhizopus* sp., *chytridium* sp., *Rhizophydium* sp., *Pythium* sp., *Phytophthora* sp., *Mucor* sp., **Candida albicans*, **Penicillium* sp. *Fusarium* sp, *Aspergillus niger*, **Candida tropicalis*, *Alternaria* sp, **Candida* sp.
THF (CFU/g)×10^5	3.2	2.6	3.6	2.5	3.1		
HUB (CFU/g) x 10^3	1.2	1.0	1.7	1.3	1.5		
HUF (CFU/g) ×10^3	1.3	1.1	2.3	1.8	2.5		

Source: Laboratory Analysis (2025) US = Upstream MS = Midstream DS = Downstream

4.7 Geology

The Geological survey map of Nigeria, 1:250,000 Geological series, Umuahia sheet 79 (GSNA) together with other reports and available data indicate that the study area is underlain by coastal plain sands of the Benin Formation which is the uppermost lithostratigraphic unit in the present-day Niger Delta. This formation is a continental deposit of oligocene to pleistocene (tertiary/quaternary) age consisting of mostly fine to coarse poorly consolidated sands and gravels with clay lenses. These sands are generally aquiferous, as they are mostly coarse to medium grained. Cretaceous sediments of the Calabar Flank (the Awi Formation, the Mfamosing, the Ekenkpon Shale, the New Netim Marl) underlie the Benin Formation in the study area. These cretaceous sediments of the Calabar Flank in turn lie unconformably on the Precambrian Basement Complex (figure 4.28).



Geology Map of Cross River State Showing The Project Sites in Adiabo, Odukpani LGA.

Figure 4.5: Geology map of Cross River showing the proposed AIH site

4.7.1 Site Description and Soils

The Adiabo soils lie within the Coastal Plain Sands formation of Southern Nigeria and are derived from shale-influenced sedimentary deposits. The project zone lies at latitude 5° 3'–5° 4'N and longitude 8° 18'–8° 19'E with elevations ranging from 43 to 132 feet above sea level. Vegetation is characteristically mixed secondary forest, dominated by palms, shrubs, and food crops. Topography is nearly level (0–2% slope), and soils are moderately deep, porous, well-drained to poorly drained, fragile, moderate in most essential plant nutrients and weakly-structured. Such soils lack diagnostic horizons and are mostly classified as *Entisols* and *Ultisols* depending on the stage of *pedogenic* development based on the USDA *Soil Taxonomy* and the FAO/UNESCO soil legend of the world map (Soil Survey Staff, 1992, 1998; FAO/UNESCO, 1988). (Figure 4.6).

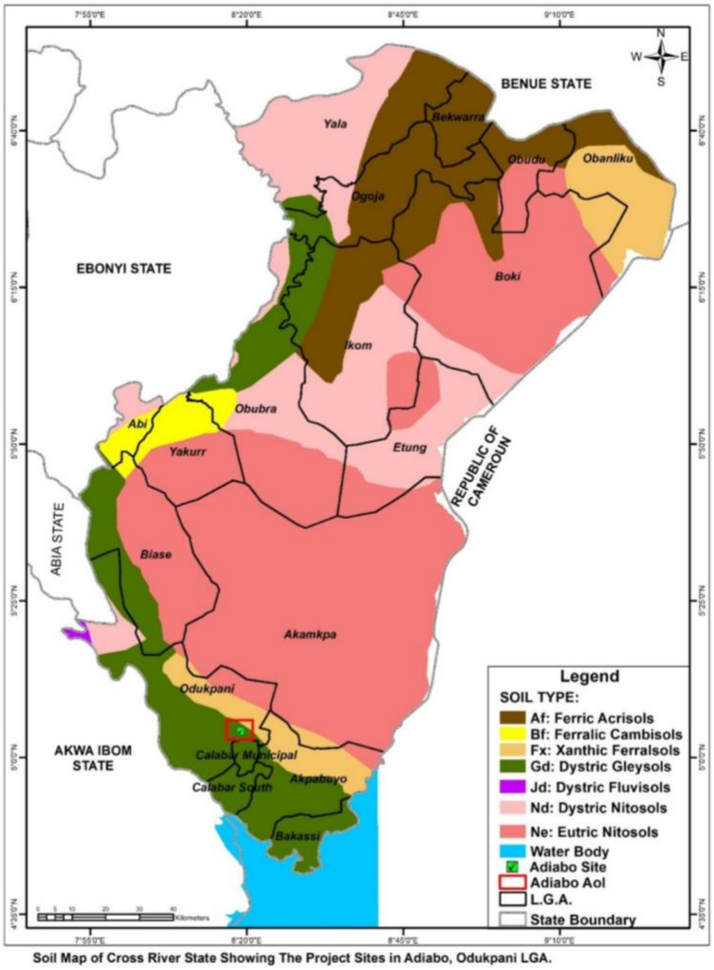


Figure 4.6: Soil map of Cross River showing the AIH site

These soils exhibit weak profile development, high sand content (>65%), and acidic pH values between 4.76 and 5.52. Morphologically, the soils lack diagnostic horizons but show moderate porosity (36–41%) and bulk densities (1.28–1.48 mg/m³) suitable for rooting. The soils support some forest vegetation (trees, shrubs and herbs in varying degrees) alongside *Raphia* palms, timber and economic crops such as coconuts, oil palms, cassava, plantain, citrus, Banana, etc around the project area.

4.7.2 Field Soil Sampling

6 composite soil samples (including 1 control) were collected at the depth sequence of 0 - 15cm and 15 - 15cm representing surface and subsurface soils respectively. The GPS coordinates of the sampling points are shown in Table 4.8 . The soil samples collected were air-dried (room temperature), ground with wooden roller and sieved via 2mm mesh. Samples for bulk density were also collected and placed in an oven at $105^{0}C$ until constant weight was reached (Tel and Hagarty, 1984; Obi, 2000). A total of 6

soil samples (inclusive of the control) were collected representing 5 stations (exclusive of the control) within the proposed project site. The percent total pore space was computed from the bulk density assuming a particle density of 2.65g/cm^3.

The samples collected were processed, sieved through a 2mm mesh prior to physico-chemical analyses. The parameters of interest for the soil section include:

- pH (H_2O)
- Available phosphorus (MgKg-1)
- Organic Carbon (%)
- Total Nitrogen (%)
- Electrical conductivity (dSm-1)
- Exchangeable bases (Ca, Na, K, Mg) (Cmolkg-1) (Nutrients) and their anions
- Exchange Acidity (Cmolkg-1)
- Bulk density (MgM-3)
- Particle size distribution (sand, silt and clay) (%)
- Micronutrients (MgKg-1): (Fe, Pb, Ni, V, Pb, Cu and Zn)
- Total Hydrocarbon (THC) (MgKg-1)
- Microbiological analyses (THB, THF, HUB, HUF).

Table 4.8: GPS Coordinates for soil sample locations

Soil Sample	Site Description	Latitudes	Longitudes	Altitude (ft)
SS_1	SAPZ Proposed project site	5º 3’ 57.39588’’	8º 19’ 29.03412’’	108
SS_2	SAPZ Proposed project site	5º 4’ 6.37212’’	8º 19’ 17.60412’’	79
SS_3	SAPZ Proposed project site	5º 3’ 54.342’’	8º 19’ 21.27612’’	99
SS_4	SAPZ Proposed project site	5º 3’ 53.74188’’	8º 19’ 22.23588’’	132
SS_5	SAPZ Proposed project site	5º 3’ 54.072’’	8º 19’ 26.706’’	99
SS_6 (Control)	Adiabo bridge by Calabar River, (1km away from project site)	5º 3’ 18.63’’	8º 18’ 24.624’’	43

Source: Field Survey (2025)

4.7.3 Laboratory Analysis

The weight of the oven-dry samples was later taken and recorded accordingly. The bulk densities of the samples were evaluated using the equation (Eq. 1):

$$BD = \frac{\text{Wt.of oven dry sample (gm)}}{\text{Volume of sample (Cm3)}} \quad \text{.................. (Eq.1)}$$

Particle size distribution was determined by Bouyoucos hydrometer method (Gee and Bauder, 1986) using sodium hexa-metaphosphate as a dispersant and the textural classes determined using the textural triangle chart.

Soil pH was determined using the routine method of IITA (1979). The method of Walkley and Black (1934) as outlined by Juo (1979) were used in the determination of organic carbon (Table 4.9). Available phosphorus was determined by Bray and Kurtz (1945) No. 1 method. Total nitrogen was determined by the micro-Kjeldahl digestion method (Jackson, 1962). Exchangeable bases (Ca, Mg K and Na) were extracted with neutral IM NH4OAc, pH 7.0; the potassium and sodium in the extract was by flame photometry while calcium and magnesium were by Versenate EDTA titration method (Jackson, 1962; IITA, 1979). Cation exchange capacity (CEC) was obtained by the summation of exchangeable bases.

Heavy metals contents of the soils were extracted by digestion of the samples with a mixture of concentrated $HN0_3$ and HCl and their concentrations determined by Atomic Absorption Spectrophotometry (AAS) using "Buck Scientific 200A" by flame atomization (Barnhisel and Bertsch, 1982).

Table 4.9: Summary of analytical methods and equipment used in laboratory analysis of soil samples

S/N	Parameters Determined	Equipment/Technique
1	pH	Jenco UC meter 6100
2	Particle size distribution (PSD) (%)	Bouyoucos hydrometer method (Gee and Bauder, 1986)
3	Hardness	EDTA Titration kit, AAS
4	Permeability	Metal ring (15-30cm diameter) driven into the soil to form a test area
5	Porosity	Core sampler or metal cylinder used to collect undisturbed soil sample
6	THC mg/Kg	GC-FID, UV-Vis
7	TN%	Graphite furnace and gravity
8	Organic Carbon (%)	Walkley and Black (1934) as outlined by Juo (1979)
9	Available Phosphorus (mg/Kg)	Bray-1 Method
10	Heavy Metal mg/l or ppm	AAS, UNICAM 939, after digestion
11	Soil Moisture Content %	Gravimetry after drying to constant weight
12	Soil permeability	Falling heed permeability test
13	Exchangeable cations (cmol/kg)	AAS, after digestion

4.7.3.1 Results and Discussion

This report presents the results of a detailed physicochemical and fertility analysis of soils sampled from the AIH site. The study aims to assess the suitability of the soils for sustainable agricultural and agro-industrial activities, with specific emphasis on parameters that influence soil fertility, solidity, and crop productivity.

4.7.3.2 Field Observations

Mild variability exists in soils of the study area and its environs. This variability was in terms of texture, moisture regime, drainage conditions, colour (light grey, dark, light brown, etc. depending on location and local *edaphic* factors) and other inclusions (charcoal, waste/litter materials). The texture of the soils varied from sand, sandy loam, loamy and sandy clay loam fractions for both surface and subsurface soils of the area. Some of the stations sampled were of coastal plain sands. Some of the terrain have poor internal drainage, fragile soils and high-water table and are liable to erosion/flood menace owing to the nature of the soil parent material plus the visible absence of internal drainage within some of the stations in the proposed study area. Besides, some of the soils are porous, fragile, with high degree of sand fraction exceeding 70% and weakly structured with poor morphological development.

Baseline Findings

Laboratory analyses followed FMEnv (2011) and WHO (2017) standards, with results detailed in Tables 4.10 and Table 4.1. The key baseline results for soil quality within the CR-SAPZ Adiabo project area are summarized below:

i. Soil Texture and Type: The soils are predominantly sandy and well-drained, characteristic of the Benin Formation. They are structurally friable, non-clayey, and suitable for both agricultural and construction purposes.
ii. pH (Acidity/Alkalinity): The soils exhibit a slightly acidic pH range of 5.28–6.41, typical of tropical rainforest soils. This mild acidity supports the growth of most crops and vegetation.
iii. Electrical Conductivity (EC): Recorded values ranged from 68 to 105 µS/cm, well below the FMEnv limit of 1000 µS/cm, confirming that the soils are non-saline and free from ionic contamination.
iv. Moisture Content and Organic Matter: Moisture content values ranged between 6.4% and 9.2%, while organic matter content was 0.95–1.45%, indicating moderate fertility and adequate microbial activity for organic decomposition.
v. Total Organic Carbon (TOC): Values ranged between 0.55% and 0.87%, reflecting a healthy balance of organic inputs and microbial turnover, consistent with natural rainforest soils.
vi. Macronutrients (Nitrogen and Phosphorus): The nitrogen (0.02–0.05%) and phosphorus (0.25–0.38 mg/kg) indicate low nutrient content, a natural outcome of leaching and high rainfall in tropical environments.
vii. Cation Exchange Capacity (CEC): Ranged from 5.4 to 6.7 meq/100g, suggesting moderate nutrient retention capacity and relatively stable soil structure.

viii. Exchangeable Bases: Calcium, magnesium, potassium, and sodium concentrations were low to moderate, maintaining a balanced exchange complex and confirming the absence of soil sodicity.

ix. Heavy Metals: All detected metal Iron (0.36–0.55 mg/kg), Manganese (0.12–0.22 mg/kg), Copper (Cu 0.05–0.09 mg/kg), Zinc (0.11–0.18 mg/kg) and Lead (0.03–0.06 mg/kg) concentrations were well below FMEnv and WHO permissible limits, confirming no contamination.

x. Total Hydrocarbon Content (THC): All samples recorded below detection limits (<0.01 mg/kg), confirming absence of hydrocarbon or petroleum-related contamination in the project area.

The baseline results indicate that the soils in the Adiabo project area are chemically stable, slightly acidic, and free from contamination. Their physical and nutrient characteristics reflect natural tropical conditions rather than anthropogenic impacts. The low nutrient and organic carbon values are due to intense leaching and organic decomposition, while trace metal concentrations represent natural background levels. Overall, the soils provide a clean, geochemically stable foundation for project development, with no indications of salinity, hydrocarbon pollution, or heavy-metal accumulation.

Table 4.10: Summary of physico-chemical status of soils

Parameter	**Unit**	**Surface Soils**		**Subsurface Soils**		**Maximum Tolerable Limit**
		Range	Mean	Range	Mean	
Sand	%	65.00 – 73.00	69.17	71.00 – 75.00	73.00	NL
Silt	%	8.00 – 18.00	10.83	3.00 – 10.00	5.33	NL
Clay	%	10.00 – 27.00	20.00	16.00 – 26.00	21.67	NL
Textural Class (USDA)	-	s; sl; ls	-	s; sl; ls		-
Permeability	%	32.40 – 39.80	36.52	29.90 – 34.80	32.13	8 - 52% (2-13cm/hr)+++
Porosity	%	36.60 – 40.60	38.32	32.20 – 36.20	33.88	
Bulk density	MgM^{-3}	1.28 – 1.48	1.37	1.33 – 1.57	1.44	
II) Chemical Characteristics:						
pH (H_20)	-	4.8 – 5.5	5.2	6.4 – 6.6	6.4	5.1 – 6.5
EC	dSm^{-1}	0.060 – 0.080	0.070	0.050 – 0.640	0.160	2 – 4 dSm^{-1+}
Org. C	%	1.08 – 2.91	1.92	1.01 – 2.13	1.56	2.0%++
Total N.	%	0.01 – 0.65	0.22	0.02 – 0.53	0.17	0.20%++
Available P	$Mgkg^{-1}$	14 – 31	20	11 – 30	19	20$Mgkg^{-1+++}$
Exch. Ca	$cmolkg^{-1}$	1.30 – 4.80	3.34	1.25 – 4.20	3.15	10 - 20 $cmolkg^{-1}$
Exch. Mg	$cmolkg^{-1}$	0.60 – 1.10	0.87	0.50 – 1.05	0.80	3 - 8 $cmolkg^{-1+++}$

Parameter	Unit	Surface Soils		Subsurface Soils		Maximum Tolerable Limit
		Range	Mean	Range	Mean	
Exch. K	cmolkg^{-1}	0.08 – 1.57	0.37	0.10 – 0.84	0.24	0.6 – 1.2 cmolkg^{-1}[+++]
Exch. Na	cmolkg^{-1}	0.06 – 0.15	0.09	0.04 – 0.80	0.06	0.7 – 1.2 cmolkg^{-1}[+++]
CEC	cmolkg^{-1}	2.15 – 6.11	4.69	2.08 – 5.44	4.26	4.1 cmolkg^{-1}[+++]
EA	cmolkg^{-1}	0.52 – 1.34	0.85	0.52 – 1.62	0.97	>20cmol/kg[+]
ECEC	cmolkg^{-1}	3.49 – 6.64	5.54	3.61 – 6.08	5.23	>30cmol/kg[+]
SAR	-	3.08 – 10.15	5.64	3.14 – 9.53	5.47	0 - 10[+]
Base Saturation	%	62 – 95	82	57 – 95	80	60 – 80[+++]
III) Fertility Indices:						
C : N	-	3.25 –58.67	14.47	16.83 – 56.67	23.02	25 :1[++]
Ca : Mg	-	2.94 – 6.86	3.96	3.52 – 7.20	4.26	3:1 – 7:1[+]
Mg : K	-	3.50 – 12.38	6.11	2.60 – 7.65	4.77	1:5 – 3:1[+]

* **Legends**: + = Miller and Donahue, 1995; s = sand, sl = sandy loam; ls = loamy sand; ++ = FPDD, 1990; +++ = Paul and Clark, 1989; NL = No Limit; Surface soils (0 – 15cm depth); Subsurface soils (15 – 30cm depth); CEC: Cation Exchange Capacity; + = Landon (1991); Paul and Clare (1989); +++ = FAO/USDA Classification

Table 4.11: Summary Results Showing Micronutrients and THC status of soils sampled

Heavy Metal (mg/kg)	Surface Soils		Subsurface Soils		Maximum permissible Limit
	Range	Mean	Range	Mean	
Iron (Fe)	25.50 – 49.10	41.45	23.40 – 41.80	34.83	20,000 - 100,000 mg/kg*
Zinc (Zn)	3.27 – 4.51	3.87	3.05 – 4.08	3.48	10 – 300 mg/kg^{-1}**
Copper (Cu)	2.05 – 2.76	2.43	2.11 – 2.52	2.27	2 - 100 mg/kg^{-1}**
Vanadium (V)	0.01	0.01	0.00 – 0.01	0.01	10 - 150 mg/kg^{-1}**
Nickel (Ni)	0.01 – 0.03	0.02	0.01 – 0.03	0.02	5 – 50 mg/kg^{-1}**
Lead (Pb)	1.11 – 1.30	1.21	1.09 – 1.25	1.16	10 - 70 mg/kg*
THC	<0.01	<0.01	<0.01	<0.01	50 - 100 Mg/kg*

Legends: *= Brady and Weil, 1996; ** = Bohn *et al.*, 1985; Surface soils (0 – 15cm depth); Subsurface soils (15 – 30cm depth)

4.7.3.3 Some Fertility Indices (Ca: Mg ratios; Mg: K ratios)

The mean Ca: Mg ratios (mean 3.96) for surface soils; 3.52–7.20 (mean 4.26) for subsurface soils — within the agronomic window of 3:1–7:1 (Landon, 1991), indicating no Ca–Mg antagonism risk; yet, absolute Ca and Mg levels remain low, so balanced liming and Mg fertiliser may still be necessary. For Mg: K ratios (mean 6.11) for surface soil; 2.60–7.65 (mean 4.77) for subsurface soils —above the desirable 1:5–3:1 range, signalling relative K deficiency and potential Mg dominance in cation uptake. Targeted K fertilisation (e.g., KCl, K_2SO_4) and split applications are recommended to correct this imbalance and improve crop response efficiency . Calcium is absorbed by plants as Ca^{2+}. It is thus essential for root growth and as a constituent of cell wall materials. Replenishing Ca contents in the soils require the application of liming, which in turn reduces acidity of the soils.

Low calcium and magnesium as well as potassium deficiency, therefore indicate a deficient/ infertile soil, requiring a fertiliser to boost crop yield.

The Mg: K ratios indicates that Mg is available to the crops in soils relative to that of K. Magnesium is essential to crops and is absorbed as Mg^{2+}. Thus, it is an ingredient of chlorophyll, aids in the translocation of starch within plant, and is vital in the formation of oils and fats. Potassium (K) is usually absorbed by plants in ionic (K^+) form. It improves plant's ability to resist disease and cold, aids in the production of carbohydrates and proteins alongside an active part of enzymatic action.

4.7.3.4 Carbon – Nitrogen Ratio (C: N)

Carbon-nitrogen ratio is the amount of nitrogen content to carbon content in either organic materials or microorganisms for decomposition of organic matter (Donahue *et al.,* 1990). Carbon-nitrogen ratio varied from 3.25–58.67 (mean 14.47) for surface soils; 16.83–56.67 (mean 23.02) for subsurface soils—both >25:1 threshold, implying net mineralisation predominates, rapid organic matter turnover and potentially faster nutrient cycling. This supports short-term nutrient release to continually replenish organic matter to maintain soil quality (Table 4.10, Table 4.11, and Table 4.12). In all the stations, the range of C:N ratios were small or narrow as some of the values exceeded 25 (Paul and Clark, 1989) being the separating index for mineralization and immobilization of nitrogen in the soils. The implications of the narrow C:N ratios in the soils reflect high levels of microbial activity and rapid decomposition of organic matter with a concomitant release of nutrient elements into soil solution for crop uptake. Thus, C:N ratio less than 25:1 indicates net mineralization. Some of the results obtained agree with the work of Edem (1998) who had a range of C:N ratio of 11 to 14 in Mangrove soils of Akwa Ibom State. With the low values of organic carbon coupled with the loamy sand, sandy loam and sand texture, the soils have weak surface aggregation, possess adsorptive capacity for nutrients though rated medium in fertility status.

4.7.5 Soil Microbiology

The abundance and distribution of microorganisms in soil within the project environment are presented in Table 4.12; Figure 4.7 and Figure 4.8. The densities of bacteria and fungi in the study area varied between sample locations. The heterotrophic bacterial densities obtained ranged from 1.8 x 10^5cfu/g to 3.2 x 10^5cfu/g while 1.9 x 10^5 cfu/g to 3.4 x 10^5 cfu/g was recorded for fungi. The present status of heterotrophic microbial densities indicates a fertile soil environment. Oil degrading microbes were also detected in the soil samples. The low counts of oil degrading bacteria (1.1 x 10^3 cfu/g to 1.8 x 10^3 cfu/g) and fungi (1.0 x 10^3 cfu/g to 1.8 x 10^3 cfu/g) indicates a remarkable slightly high hydrocarbon load of the soil (Essien and Antai, 2005, Odu 1972). Their presence implies that the project environment may undergo natural remediation process in event of contamination with hydrocarbons during construction. The diverse species of microorganisms encountered in the project environment are listed on Table 4.13.

Table 4.12: Microbial characteristics of soil samples

Parameter	**SS_1**		**SS_2**		**SS_3**		**SS_4**		**SS_5**		**CTRL**	
	TS	**SS**	**TS**	**SS**	**TS**	**SS**	**TS**	**SS**	**TS**	**SS**	**TS**	**SS**
THB (CFU/g) x 10^5	2.8	2.0	3.1	2.5	3.2	2.9	2.5	1.8	2.2	1.5	2.7	2.1
THF (CFU/g) x 10^5	3.4	2.9	3.3	2.8	2.7	2.3	2.7	2.1	2.4	1.9	3.0	2.6
HUB (CFU/g) x 10^3	1.5	1.0	1.6	1.2	1.5	1.1	1.8	1.5	1.8	1.3	1.7	1.4
HUF (CFU/g) x 10^3	1.6	1.1	1.7	1.2	1.5	1.0	1.4	1.2	1.8	1.2	1.6	1.3

THB = Total heterotrophic bacteria
THF = Total heterotrophic fungi
HUB = Hydrocarbon utilizing bacteria
HUF = Hydrocarbon utilizing fungi

Table 4.13: Microorganisms Identified

Isolate	SS_1		SS_2		SS_3		SS_4		SS_5		CTRL		%Occurrence
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	
Bacteria													
Geobacter sp	+	-	-	-	-	-	+	-	-	-	-	-	20
**Nitrobacter* sp	-	-	+	+	-	-	+	-	+	-	+	-	40
**Bacillus brevis*	+	+	+	-	-	-	+	-	+	+	+	+	60
Clostridium titanii	+	+	+	+	-	-	+	-	+	+	+	-	70
Clostridium perfrigens	+	-	+	-	+	+	+	-	+	+	+	-	70
Sulfolobus sp	-	-	-	-	+	+	-	-	+	-	-	-	30
Staphylococcus sp.	+	+	-	-	+	-	+	-	+	-	+	-	50
Escherichia coli	+	-	-	-	+	-	+	-	+	-	+	-	40
**Pseudomonas aeruginosa*	-	+	+	+	+	-	-	-	+	+	+	-	60
**Bacillus* sp.	+	-	+	-	+	-	+	+	-	-	+	+	50

Isolate	SS_1		SS_2		SS_3		SS_4		SS_5		CTRL		%Occurrence
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	
**Clostridium* sp	+	+	+	+	-	-	+	-	+	-	+	-	60
Citrobacter sp	-	-	-	-	+	-	-	-	-	-	-	-	10
Thiobacillus sp	-	-	+	-	+	-	+	-	+	-	+	-	40
Fungi													
Russula sp.	-	-	-	-	+	-	+	+	-	-	-	-	30
Tomentella sp	+	-	-	-	+	-	+	-	-	-	+	-	30
Tricholoma sp	-	-	+	+	-	-	-	-	-	-	-	-	20
Tylospora sp.	+	-	-	+	+	-	-	-	-	-	-	+	30
Acrmonium sp.	-	-	-	-	+	-	-	-	-	-	+	-	10
Metarhizium sp.	+	-	-	-	-	-	+	-	-	-	-	-	20
Lecanicillium sp.	+	-	-	-	-	-	-	-	-	-	-	-	10
Aspergillus fumigatus	-	-	-	-	+	-	-	-	+	-	-	+	20
Aspergillus niger	+	+	+	-	+	+	+	+	-	+	+	+	80
Trichoderma sp.	+	-	-	-	-	-	-	-	-	-	-	-	10
Fusarium sp	+	-	+	-	+	-	+	+	+	+	+	-	70
Coniothyrium sp.	-	-	-	-	-	-	+	+	-	-	-	+	20
Pyrenochaeta sp.	-	-	-	-	-	-	+	-	+	-	-	-	20
Pleotrichocladium sp	+	-	-	-	-	-	-	-	-	-	-	-	10
**Candida tropicalis*	+	+	-	+	+	+	+	-	-	+	+	+	70
Cadophora sp.	-	-	-	-	+	+	-	-	-	-	-	-	20

*Hydrocarbon degrader TS = Top Soil, SS = Sub Soil

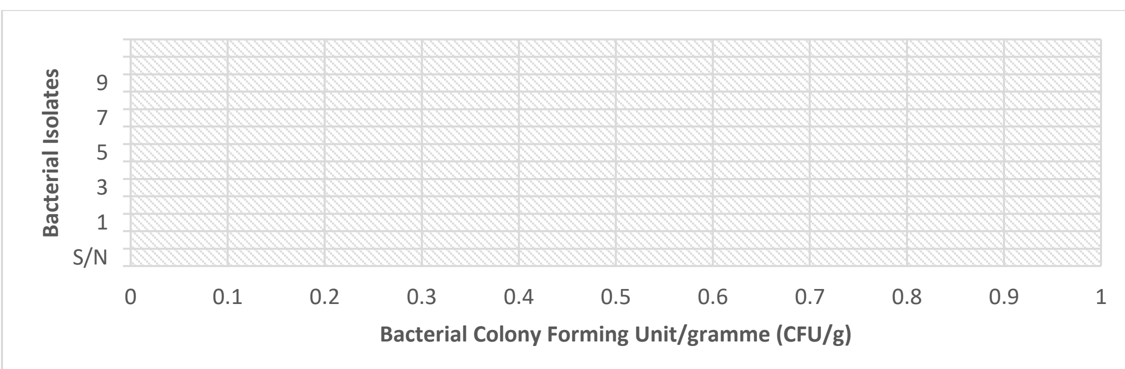


Figure 4.7: Bacterial Isolates Showing % Occurrence in Soil Samples

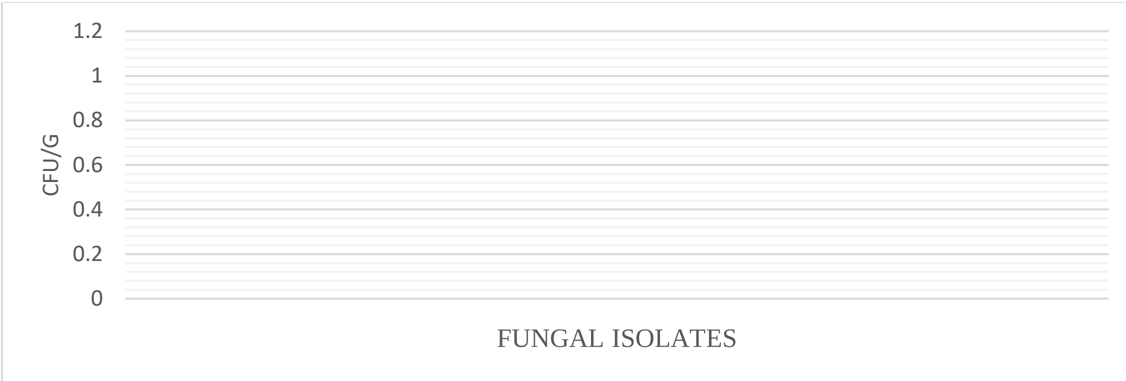


Figure 4.8: Fungal Isolates Showing % Occurrence in Soil Samples

4.8 Ecology

4.8.1 Methodology

4.8.1.1 Vegetation

Vegetation studies were carried out to determine the baseline status of the study area vis-à-vis the species composition, diversity, and population of the plant species as well as their medicinal and economical uses. The density and percentage of the key tree species and the herbaceous layers were determined while rare and endangered plant species and all those of special significance to the ecosystem and the local economy were categorized. The species diversity of the plants was calculated as the ratio between the number of species and importance value which for the purpose of this study was taken as numbers of individual per quadrat. Both the generic and specific characteristics of the vegetation were assessed by determining their floristic composition, life form and biological spectra.

Four (4) stations point of the study area was established (120m x 240m). Each sampling station was further divided into sampling points. A sampling point was established as a five-line transect of 200m apart over a 300m length. Three (3) stations were within the proposed site while fourth station was at the bank of the Calabar River, about 1.3 km from the proposed site, serving as control.

An average of 5000 m^2 was adopted as sampling size per sampling point. This resulted in a total sampled area of 4 hectares.

4.8.1.2 Wildlife

The wildlife study cuts across the entire ecosystem. Methodologies of sample collection and identification include:

- Visual observations and documentation of droppings.
- Oral discussion with natives of the study area.

- Tree beating, shaking, purpose mark, feathers, shells, sounds, foot prints, information on the available species and relative abundance was obtained through oral interviews and discussions with artisanal hunters and indigenes.

4.8.2 Data Analysis

Species Richness/Composition

The number of species present in each plot was evaluated using several multivariate data analysis packages that treated multivariate data summarizing the data and revealing the structure. It further gave detailed information about each plot and made it possible for plots to be weighed against each other. Plots were compared for the number of species in relation to the number of individuals.

Species Abundance

Abundance of species was evaluated by counting the number of individuals of a species in the area census.

Relative abundance (Pi) of species was evaluated using the following formula:

$$Pi = Ni\ x\ 100$$

Sum of all individuals recorded.

Where Ni is the sum or proportion of each individual species in the sample

Species Diversity

In order not to miss an important aspect of the numerical structure of the community, diversity index (Table 4.15) was calculated for the different plots. Despite the several diversity indices available, Shannon's index was preferred as it is independent of area hence result can be compared with other sites. It was calculated by determining for each species the proportion of individuals that it contributed to the total in the sample. The following formula was used:

$$H = -\sum PilnPi$$

Where H = Shannon's index, ln = log.

Equitability or evenness, which is the maximum possible value diversity, assumed that since individuals were completely evenly distributed (Begon, et al 1986) was also calculated using the following formula;

$$EQ = \frac{-\sum PilnPi}{lnS}$$

Where EQ = equitability, S = total number of species.

Family Abundance

Family abundance was evaluated by counting the number of individuals of species belonging to a family. Relative abundance of family was evaluated by:

$$\frac{\text{The number of individuals in a family}}{\text{Sum of all individuals recorded.}}\ x\ 100$$

Species Frequency

Frequency is a simple measure calculated as the percentage of the plots set up, in which the species is present (Sutherland et al 1996).

$$\frac{\text{Number of plots in which species is recorded}}{\text{Total number of plots census}}\ x\ 100$$

Relative frequency of species was evaluated by dividing the frequency of individual species by the sum of all frequencies.

$$\frac{\text{Frequency of a species}}{\text{Sum of all frequencies}}\ x\ 100$$

Frequency analysis of families followed the same procedure.

Species Dominance

For each plant species recorded, diameter at breast height (DBH) was also recorded. DBH was also used to calculate the basal area of each species and also for the total study area. Species dominance was then evaluated by summing for each species, the basal area. Relative dominance of each species was evaluated by dividing the sum of basal area of a species by the total basal area of all species, expressed in percentage.

$$\frac{\text{Combined basal area of a single species}}{Total\ basal\ area\ of\ all\ species}\ x\ 100$$

Family Dominance

For each plant family that was recorded, dominance was evaluated by summing the basal area of all species belonging to the family. Relative dominance of each family was evaluated by dividing the sum of basal area of all species in a family by the total basal area of all species, expressed in percentage

$$\frac{\text{Combined basal area of species in a family}}{Total\ basal\ area\ of\ all\ species}\ x\ 100$$

Forest Structure

Forest structure was evaluated in terms of stem densities, tree diameter and size class distribution and basal area.

Density

Tree density was evaluated by dividing the total number of trees recorded by the total area sampled. Relative densities were also evaluated where the following formula was used:

$$\frac{\text{Number of individuals of a species}}{Total\ area\ sampled}\ x\ 100$$

Size class Distribution

Tree diameter recorded was arranged in diameter classes. The range of tree diameter found in the area was represented in a graphic way by displaying tree diameter in an orderly manner of 10m interval difference. Tree diameter recorded was arranged in diameter classes. The range of tree diameter found in the area was represented in a graphic way by displaying tree diameter in an orderly manner of 10 interval difference.

Basal Area

The basal area was calculated using Edward method, where tree diameter was divided by 2 to get the radius, secondly the radius was squared and thirdly, the number was multiplied by π, where π = 3.14.

Floral description of study area

The existing vegetation consists of forest (rainforest, cultivated farmlands and freshwater swamp) which contain trees of 3-15 meters namely: oil palms, rubber trees, Indian bamboo etc. It is a regenerating forest, as it was part of the rubber plantation project that has been decommissioned and cleared after 99 years tenement. The distribution of these vegetation types in the study area is presented in Figure 4.9.

The existing vegetation is composed of mix of habitats namely:

- Regenerating rain forest
- Cultivated farmlands
- Freshwater swamp forest

4.8.3 Regenerating Rainforest

This is the most dominant forest formation of the study area. To some extent human activities have greatly transformed the structure as well as the species richness of this vegetation type. This is seen in the number cultivated farmlands. Trees of the uppermost layer include; *Klainedosa gabonensis, Hevea brasilensis, Triplochiton scleroxylon, Symphonia globufera, Alstoria booneii, Terminalia superba, Invingia gabonensis, chlorophora excelsa, Ceiba. Pentandra, Piptademiastrum africanum, Cynometra megalophylla, Cola spp, Lophire alata*. Their crown merges to form a continuous canopy. They are associated with various shrub-like species especially climbers and epiphytic species. They include

Chloromolaena odorata, *Clappertonic ficifolia*, *Psychortinia Vogelina*, *Anthoratha macrophylla*, *Xylopia ethiopica*, *Alchanea cordifolia*. *Tetrapleura tetraptera*, *ficus veogeliana*, *Baphia* spp.

The forest is reasonably penetrable and the canopies formed by the crown of the trees species makes the forest floor gloomy with isolated sunlight rays penetrating through gaps in the canopy (Figure 4.9). Species occurring here includes*; Diplarium sammanti*, *Acanthus monotamus*, *Maranthocloa congensis*, *Costus afer*, *sellogenella* spp. The density distribution of trees in this forest type shows that *Bambusa vulgaris*, *Elaeis guineensis* and *Hevea brasiliensis* are the most dominant tree species.

4.8.4 Cultivated areas

The cultivated area is primarily used for agriculture and is devoid of "natural trees" which have been felled either for fuel or other purposes, as well as shrubs, due to continuous clearing of the land, filling and cultivation of agricultural crops. Species diversity in this area is quite low. Plants occurring here are mainly foods crop such cassava (*Manihot esculenta)*, maize (*zea mays)*, cocoyam (*Coloccosia esculenta)*, yam (*Discorea rotundata*), sugar cane (*Saccharum officinale*), and melon (Figure 4.10).

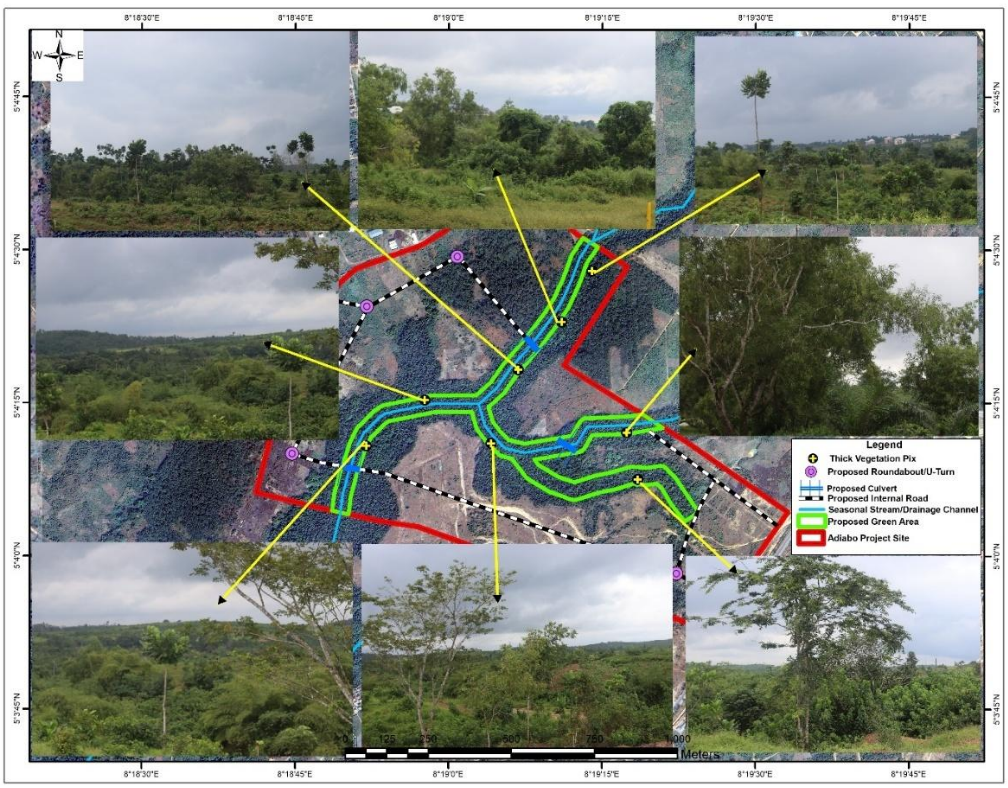


Figure 4.9: Map Showing vegetation within the AIH Site in Adiabo

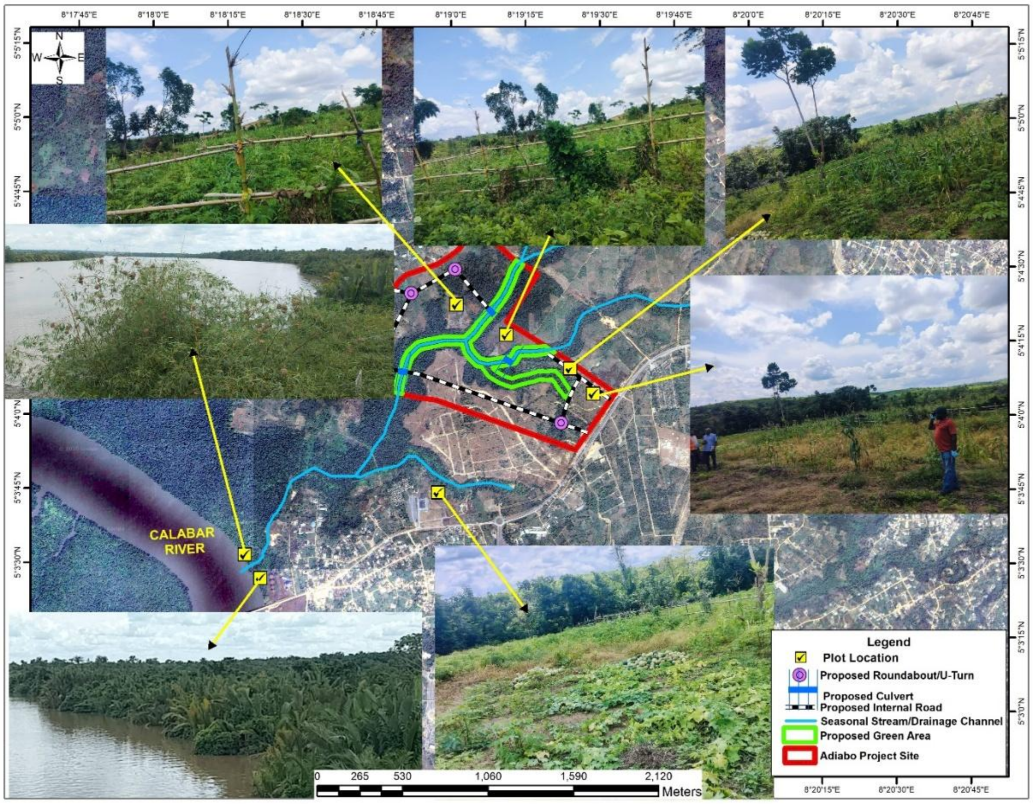


Figure 4.10: Cultivated crops – cassava, maize, melon *(Field fieldwork, 2025)*

A total of 48 species were censored yielding 1,880 individuals (Abundance). About 5% were trees, 55.6% shrubs, 22.4% were herbs and about 17% were grasses.

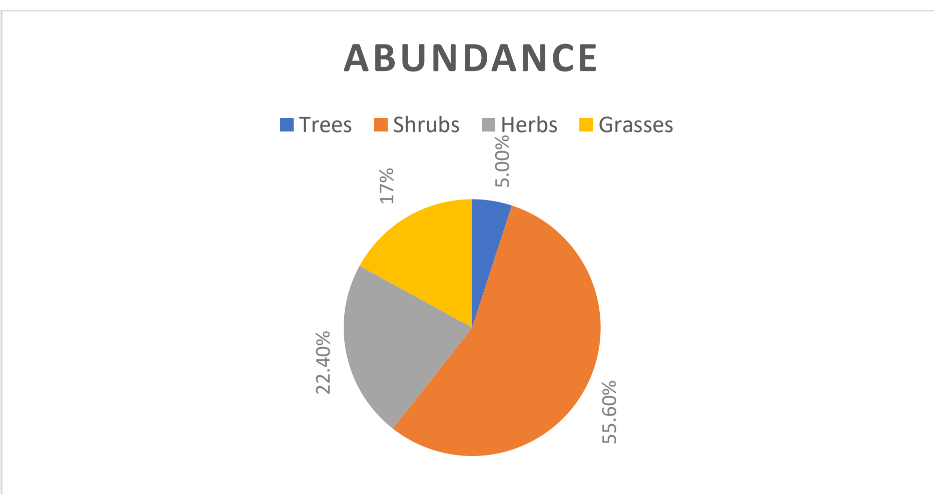


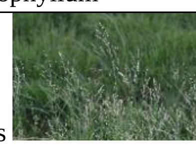
Figure 4.11: Showing percentage abundance of flora

Some of the tree species censored in the study areas include; *Hevea brasiliensis, Elaeis guineensis, Triplochiton scleroxylon, Magnifera Indica, Citrus sinensis, Carica papaya, Anacardium occidentale, Psidium guajava, Azadirachta indica, Gmelina arborea, Butyrospermum parkii and Parkia bioglobosa, Klainedosa gabonensis, Symphonia globufera, Alstoria booneii,Terminalia superba, Invingia gabonensis, chlorophora excelsa, Ceiba Pentandra, Piptademiastrum africanum, Cynometra megalophylla,Cola spp, Lophire alata, Raphia hookerii, Adansonia digitata and Terminalia glaucescens*,. Figure 4.11 shows the percentage abundance of flora around the area. The Shannon index for the study area was 2.15. Of the twenty-four (24) species listed in the IUCN database as alien and invasive to Nigeria, only *Panicum lax and Mimosa pudica*were the invasive species captured in this study while *Etandrophragma angolense* was the only alien species (as shown in Table 4.14: List of alien plant species in Nigeria. Table 4.15 presents the plant diversity index and occurrence while Table 4.16 presents the floral occurrence in the area.

With respect to the ecosystem services provided by the plant species, some of the species were reviewed to provide food/energy and medicinal services, while some species were used as raw materials. The indigenous uses of each plant inventoried were assessed. Some of the indigenous uses include fuel wood, medicinal purposes, as fruits and seeds, as sundry products, as beverages and drinks, as fodder, as wattles, as nuts, as spice, as flavours and thickeners as chewing stick, as gum and adhesives, and some for prevention of soil erosion. Some species with numerous indigenous uses include *Elaeis guineensis, Magnifera indica, Carica papaya, Raffia hookeri, Azadirachta indica, Acacia senegalensis and Khaya ivorensis*. The IUCN version of 2023 criteria were used to evaluate the conservation status of the species. The result indicated that some of the species were threatened or vulnerable.

Table 4.14: List of alien plant species in Nigeria

Alien Species	**Invasive Species**
Acalypha indica	Bidens Pilosa
Adeniacissampeloides	Chromolaena odorata
Ageratum conyzoides	Cyperan rotundas
Alternetherabrasicus	Dalbergia sissoo
Alternetherasessils	Elchhhornia crasipies
Antigoniumleptolus	Imperata cylindrical
Chromolaena odorata	Leucaena leucocephala
Cissus argute	Mimosa diplotrichia
Commenlina benghalensis	Momomorium destractor
Dissotis rotundifolia	Momomorium floricola
Euphorbia grammea	Nypa fruticans
Euphorbia heterophylla	Psidum guajava
Lantana camara	Prosopis sp
Leucaena leucocephala	Adenanthera pavonine
Merremia kentrocaulos	Althermanthera sessilus

Alien Species	Invasive Species
Mucuna pruriens	Mimosa pudica 
Passoflora foetida	Oxycaryam cubense 
Plastosoma africanum	Bacopa momieri 
Ruthalaciae glandulosa	Cardiospermun grandiflorum 
Schriankia leptocarpa	Cenchrus ciliaris 
Setaria barbata	Commelina bengualensis
Tithonia diversifolia	Discorea bulbifera
Truimfetta rhombusa	Lygodium microphyllum
Typha australis	Panicum repens 
	Paspalum scrobiculatum
	Rhizophora mangle
	Rottbiellia cocchinchnesis 
	Ricinus cumunis
	Ziziphus Mauritania

Source: Borokini (2011)

Table 4.15: Showing Plant Diversity Index

Species	**n_1**	**p_1**	**Lnpi**	**$-(P_1.\ln p_1)$**	**Distribution %**
Elaeis guineensis	280	0.1489	1.9045	0.2084	14.9
Klainedosa gabonensis	58	0.0309	3.4770	0.1074	3.1
Azadiractha indica	152	0.0809	2.5145	0.2034	8.1
Magnifera Indica	400	0.2128	1.5474	0.0329	21.3
Citrus sinensis	108	0.0574	2.8577	0.1640	5.7
Carica papaya	87	0.0462	3.0748	0.1421	4.6
Anacardium occidentale	68	0.0361	3.3215	0.1199	3.6
Psidium guajava	50	0.0266	3.6268	0.0965	2.6
Gmelina arborea	175	0.0931	2.3740	0.2210	9.3
Butyrospermum parkii	135	0.0718	2.6339	0.18911	7.2
Parkia bioglobosa	40	0.0213	3.8490	0.0473	2.1
Acanthus monotamus	24	0.0128	4.3583	0.0558	1.3
Raffia hookeri	38	0.0202	3.9020	0.0788	2.02
Mamillaria spp	35	0.0186	3.9846	0.07411	1.9
Adansonia digitata	55	0.0292	3.5336	0.1031	2.9
Acacia raddianna	70	0.0372	3.2914	0.1224	1.9
Lonchocarpus griffonianus	35	0.0186	3.9845	0.0741	1.9
Isoberlinia doka	64	0.0340	3.3814	0.1150	3.4
Total	**1880**			**2.15**	**100**

Source: Field Fieldwork, 2025

Table 4.16: Flora species occurrence in the study area

Serial.	Species	English/ Common Names	Local Names	Life Form/ecosystem services	IUCN STATUS (2023)
1.	*A. laxiflora*	Three-veined bead string	Ububo	Shrub	Th
2.	*Acacia raddianna*	Umbrella thorn	Aila	Tree	Th
3.	*Acanthus monotamus*	White ginger	Ogwu_agha	Tree	Th
4.	*Adansonia digitata*	Baobab Tree	Otiti	Tree	Th
5.	*Alchanea cordifolia*	Christmas bush	Obubo	Shrubs	Th
6.	*Allophyllus africanus*	African false currant	Eekan-ehoro	Herb	Th
7.	*Alstoria booneii*	Patten wood	Ebo	Tree	Th
8.	*Anacardium occidentale*	Cashew		Tree, F&E	D
9.	*Anthoratha macrophylla*			Shrubs	Th
10.	*Baphia* spp	Camwood		Shrubs	Th
11.	*Butyrospermum parkii*	Shea tree		Tree/ RM	D
12.	*Calamus derratus*	Rattan palm		Shrub/RM	Th
13.	*Carica papaya*	Pawpaw		Tree, F&E, M	D
14.	*Carpolobia lutea*	Cattle stick	Agba	Shrub	Th
15.	*Chloromolaena dorata*	Siam weed	Abani di egwu	Shrubs	Th
16.	*Cissus polyantha*		Okoho	Shrub	Th
17.	*Citrus sinensis*	Sweet orange		Tree, F&E, M	D
18.	*Clappertonic ficifolia*	Bolo-bolo		Shrubs	Th
19.	*Cleistopholis pattens*	Salt and Oil Tree	Apako	Tree	Th
20.	*Commelina benghalensis*	wandering Jew		Herb/M	Th
21.	*Costuss afer*	ginger lily	Okpete	Herb/M	R
22.	*Digitaria debilis*	Finger Grass		Herb/M	Th
23.	*Dimorphochlamys mannii*	Ahara		Herb	Th
24.	*Diplazium sammanti*	Edible fern	Nyama Idim	Tree	Th
25.	*Dossotis rotundifolia*	Pinklady		Herb	Th
26.	*Elaeis guineensis*	Oil palm	Isip eyop	Tree/ RM, F&E	D
27.	*Ficus veogeliana*	African Fig	Oba-Odan.	Shrubs	Th
28.	*Gmelina arborea*	White teak		Tree/ RM	D
29.	*Hevea brasiliensis*	Rubber Tree	Roba	Tree/ RM	D

Serial.	Species	English/ Common Names	Local Names	Life Form/ecosystem services	IUCN STATUS (2023)
30.	*Isoberlinia doka*		Afang/ Ukazi	Tree	Th
31.	*Leptadenia pyrotechnica*	Broom bush		Shrubs/ F&E	Th
32.	*Lonchocarpus griffonianus*	Lancepod	Ududu	Tree/ RM	Th
33.	*Lophire alata*	Red Ironwood	Akufo	Tree/ RM	Th
34.	*Magnifera indica*	Mango		Tree/ F&E	D
35.	*Mamillaria spp*	Finger cactus		Tree	D
36.	*Opilia celtidifolia*	Ironwood	Nembossi	Climbers	Th
37.	*Parkia bioglobosa*	African locust bean tree		Tree	D
38.	*Psidium guajava*	Guava		Tree, F&E, M	D
39.	*Psychortinia Vogeliqna,*	Bofuasokuwa		Shrubs	Th
40.	*Raffia hookeri*	Raffia palm	Ukot	Tree/ F&E	Th
41.	*Salvadora persica*	Toothbrush tree		Shrubs	R
42.	*Symphonia globufera*	Gum Tree		Tree	Th
43.	*Terminalia superba*	White Afara	Afara	Tree	Th
44.	*Tetrapleura tetraptera*	Aidan fruit	Obogolo	Shrubs	Th
45.	*Uvaria chamae*	Bush banana	Afuru-agu	Climbers	Th
46.	*Xylopia ethiopica,*	Guinea pepper	Uda	Shrubs	Th

Source: Field fieldwork, 2025

Keys
Th - Threatened
R - Rare
D - Dominant

4.8.5 Protected Areas

Generally, there are no protected areas to be affected by the project in all the states. The closest protected area is the Ekinta Forest Reserve, about 18 km from the proposed AIH (Table 4.17).

Nigeria's protected area management system falls into 3 categories. Game Reserves and Forest Reserves are by statute managed by State Governments. The Federal Government of Nigeria oversees the management of the National Parks. Protected areas such as Forest Reserves were mostly creation of the colonial government in Nigeria. Most protected areas were thus established between the 1930s and 1960. For a variety of reasons mostly related to inadequate resources such as funding, skilled manpower and conflicting government policies, most protected areas at both state and federal levels exist only on paper. Table 4.16 shows flora species occurrence in the study area and plant species and their ecosystem services.

Cross River State preserves over 50% of Nigeria's remaining tropical high forest, making it a vital ecological hotspot. These areas support critically endangered species such as the Cross River gorilla and drills, and are managed under federal (national park), state (forest reserves), and community-based (Mbe, Afi sanctuary) stewardship. The Oban Hills Division (3,000 km²) and Okwangwo Division (640 km²) are among Nigeria's largest remaining blocks of intact lowland rainforest. The Afi River Forest Reserve covers 312 km² and serves as a corridor linking Afi Mountain Wildlife Sanctuary and Mbe Mountains Community Forest. Similarly, Afi Mountain Wildlife Sanctuary covers 100 km² and was established in 2000 to protect the critically endangered Cross River gorilla. Mbe Mountains Community Forest covers~86 km² which is community-managed and home to endangered primates. Other Forest Reserves include Afi River FR, Cross River North (Cross River National Park) and South (Oban Forest reserve), Ekinta FR, Ukpon River FR, and others. The sizes and summary of the protected areas are presented in Table 4.17.

Figure 4.12 shows the proximity of all the forest reserves from the project site in Adiabo. The distances are further summarized in Table 4.17which shows that the closest reserve is Ekinta FR located 18.4km (as the crow flies) from the project site. This is followed by Kwa Fall in Akamkpa (21.4km), Uwet Odot FR (30.6km), Umon Ndealichi FR (39.9km) respectively while the farthest reserves from the proposed AIH site are Mbe community FR and Mfi River FR which cover 154.7km and 143.7km respectively.

Table 4.17: Forest Reserve/Protected Area and their Distances from the proposed AIH Site

SN	Name of forest reserve/protected area	Size	Feature	Distance from AIH project site (km)
1	Afi River Forest reserves	312 km²	Corridor forest connecting Afi Sanctuary and Mbe Mountains	143.7
	Afi Mountain Wildlife Sanctuary	100 km²	Protects gorillas, chimpanzees, and gray-necked rockfowl	
2	Oban Forest Reserves			45.6
3	Cross River NP – Oban Division	3,000 km²	Largest intact rainforest, wildlife-rich	76.6
	Cross River NP – Okwangwo Division	640 km²	High biodiversity; former Boshi reserves	
4	Kwa Fall Akamkpa			21.4
5	Ukpon River/FR			100.6
6	Mbe Community FR	86 km²	Community-managed; biodiversity stronghold	154.7
7	Esa Iko Community/Agoi FR			64.7
8	Umon Ndealichi FR			39.9
9	Uwet Odot FR			30.6
10	Ekinta FR			18.4

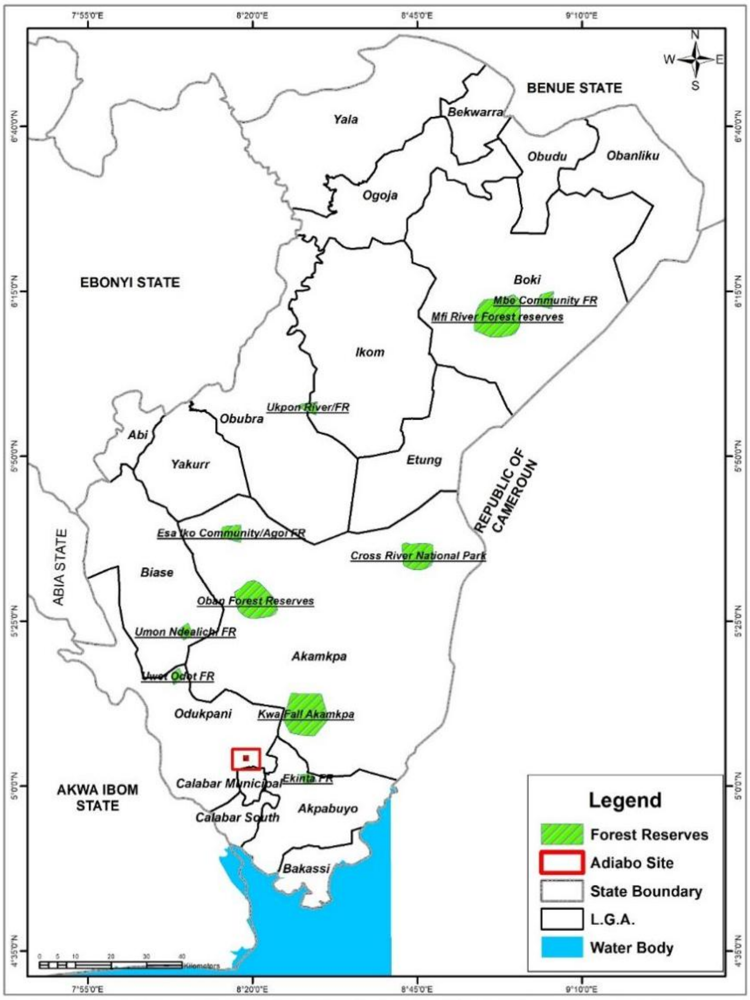


Figure 4.12: Map showing Forest Reserves / Protected Areas in Cross River State relative to the proposed AIH

4.8.6 Fauna Wildlife

Sampling Method

A combination of sampling techniques was used which included identifications of major ecosystem types to identify associated fauna, collecting, preserving and representing fauna species such as foot prints analysis, faecal samples, nest type, feeding site, sounds, shell types and interviews with the indigenes.

Two main methods of fauna sampling were adopted: Direct evidence (sighting, sounds) and indirect evidences.

Direct observations: Visual encounter survey during nocturnal and diurnal expeditions and recognizing evidence of wildlife species presence through vocalization was undertaken. The Capture-recapture method was used for small mammals and some invertebrate fauna.

Indirect Observations: Indirect signs such as footprints, scats/faeces, feeding activity, nests, tracks, holes/diggings or scratching, carcass. The recorded evidence was represented both by direct (collections and observations) and indirect (tracks, footprints, scats/faeces, feeding activity, nests, tracks, holes/diggings or scratching, carcass and identification by local residents).

Examination of road kills and meat markets*:* Interview of hunters, fishermen, farmers, etc to gain better insight into the habitat history, faunal distribution pattern, seasonal migration, local names, conservation status, economic importance and threats to biodiversity.
The fauna diversity in the study area is very rich. A total of 17 species of birds, 34 of mammals and 8 species of reptiles were encountered. Some predominant invertebrate species recorded around the study area include termites, snails, worms and ants. The termites and ants dominate especially the grasslands of the study area. Of all these, mammals found in the study area include deer, antelope, grasscutter. The fauna species play an important role in traditional worship of gods and deities in some part of the study areas, as they are sacrificed for appeasements during festivals and occasions such as; commencement of new farming season, harvest season, marriages, burials and coronations.

Hunting of these animals is done in local and crude methods. Sometimes the animals are trapped or directly clubbed or macheted to death. Hunting is mostly done at night especially during the hunting seasons mostly by ensnarement at water holes. Also found in the northern region of the study areas are cattle herded by the Fulani herdsmen. These cattle are reared and fed in the grasslands which hold a definite seasonal cattle route. They cattle herds are made up of the Muturu, Zebu and N'dama breeds.

Further in the lower food chain are the Isopteran termites which dominate the soil fauna forming heaps occasionally. The lady beetle and the spiders are part of the invertebrate fauna. There is a wide range of species habitats as some live on tree tops such as the eagle (which is seen maybe once in a year), kites, hawks and vultures which are mostly scavengers feeding on dead and decomposing carcasses. The lower canopies of the trees are habitats for monkeys, bats (a delicacy in the study area), snakes and squirrels.

The soil fauna also recorded black ants *(Monosium minium)* which are the major invertebrate fauna in the study area forming huge colonies found in most quadrats in the study area.

The avian species recorded are of high economic importance as they feed on grains and seeds of crop plants in the fields.

Like flora, the study was also conducted on the fauna resources of the study area. The habitats were also classified based on the vegetation habitats - forests habitat. Appendix 4.1 (Table A4.5) shows fauna species in the study areas

Mammalia fauna
The mammalian fauna existing in the natural forest habitat of the project area was studied. The result as shown in Table 4.18 indicates that a total of thirty-four (34) mammalian species cutting across nine (9) families were recorded. The breakdown of this number comprises sixteen (16) species of Rodentia,

nine (9) species of Artiodactyla, six (6) species each of Primata and Viverridae, two (2) species each of Manidae and Molossidae and one (1) species each of Pongidae, Canidae and Bovidae**.**

Table 4.18: Results of mammalian Fauna Species Recorded in the Study Area

SN	Family/ Order	Common Names	Zoological Names	Abundance	2023 IUCN Status
1	Rodentia	Red-legged sun squirrel	*Helioscius rufobrachium*	1	LC
2		Pygmy striped squirrel	*Myosciurus pumilio*	*	LC
3		Crested porcupine	*Hystrix cristata*	*	LC
4		Grass-cutter	*Thryonomys swinderianus*	1	LC
5		Giant rat	*Cricetomys gambiannus*	2	DD
6		Bush tailed porcupine	*Atherurus africanus*	*	LC
7		Marsh cane-rat	*Thryonomis spp*	*	LC
8		Green squirrel	*Paraxerus poensis*	*	LC
9		Bush rat	*Rattu rattus*	3	LC
10		common rat	*Rattus norvegicus*	6	LC
11		Bush rat	*Rattus fuscipes*	3	LC
12	Pongidae	Robust chimpanzee	*Pan troglodytes*	*	EN
13	Manidae	Giant pangolin	*Manis gigantea*	*	VU
14		Ground pangolin	*Smutsia gigantea*	*	EN
15	Canidae	Pale fox	*Vulpes pallid*	*	NE
16	Bovidae	Congo forest buffalo	*Syncerus caffer nanus*	*	LC
17	Molossidae	*Nigerian free-tailed bat*	*Chaerephon nigeriae*	3	LC
18		Little Free-tailed Bat	*Chaerephon pumilus*	1	VU
19	Primata	white throated monkey	*Cercopithecus erythrogaster*	*	EN
20		black throated colored monkey	*Cercopithecus roloway*	*	EN
21		Blue Monkey	*Cercopithecus mitis*	*	LC
22		Old world monkey	*Mandrillus leucophaeus*	*	NE
23		Mona monkey	*Cercopithecus mona*	*	NT
24	Viverridae	Blotched genet	*Genetta tigrine*	*	LC
25		African civet	*Civettictis civetta*	*	LC
26		African palm civet	*Nandinia binotata*	*	LC
27		Cape clawless otter	*Aonyx capensis*	*	NT
28		Small Indian *Mongoose*	*Herpestes auropunctatus*	*	NA
29	Artiodactyla	Bush pig	*Potamochoerus porcus*	*	LC

SN	Family/ Order	Common Names	Zoological Names	Abundance	2023 IUCN Status
30		Sitatunga or marshbuck	*Tragelaphus spekii*	*	LC
31		Water chevrotain	*Hyemoschus aquaticus*	-	LC
32		Blue duiker	*Cephalophus monticola*	2	LC
33		Red-flanked duiker	*Cephalophus rufilatus*	*	LC
34		Deer	Odocoilus virgianus	3	LC

Source: Field Survey, 2025

Asterisk (*) indicate species recorded indirectly, **LC**=Least Concern, **Vu**=Vulnerable, **CE**=Critically Endangered, **EN**= Endangered**, NT**=Near Threatened, **DD**=Data deficient, NA=Not Assessed, NE= Not Evaluated

Species Abundance

A total of thirty-four (34) individuals of the ten (10) mammalian species were censored directly in this habitat. *Rattus norvegicus* (common rat) represented by six (6) individuals was the most abundant mammalian species sighted. This was followed by *Rattu rattus* (Bush rat) and *Chaerephon nigeriae (Nigerian free-tailed bat)* with three (3) individuals each. *Cricetomys gambiannus* (Giant rat), and *Rattus fuscipes* (Bush rat) were represented by two (2) individuals each while *Helioscius rufobrachium* (Red-legged sun squirrel), *Thryonomys* swinderianus (Grass-cutter), *Chaerephon pumilus* (Little Free-tailed Bat), *Cephalophus monticola* (Blue duiker) and *Tragelaphus scriptus* (bush buck) were each represented by an individual.

Twenty three (23) species including *Myosciurus pumilio, Hystrix cristata*, *Atherurus africanus*, *Thryonomis spp*, *Paraxerus poensis, Pan troglodytes, Manis gigantean, Smutsia gigantean, Vulpes pallid, Syncerus caffer nanus, Cercopithecus erythrogaster*, *Cercopithecus roloway*, *Cercopithecus mitis*, *Mandrillus leucophaeus*, *Cercopithecus mona*,*Genetta tigrina*, *Civettictis civetta*, *Nandinia binotata*, *Aonyx capensis*, *Herpestes auropunctatus*, *Potamochoerus porcus*, *Tragelaphus spekii* and *Cephalophus rufilatus* were censored by indirect indicators.

2023 IUCN Status

A total of 5 species censored in this habitat were classified in any one of the three threatened categories. *Pan troglodytes*, *Cercopithecus roloway*, *Smutsia gigantean* and *Mandrillus leucophaeus*were classed as Endangered (EN) while *Manis gigantean* and *Chaerephon pumilus* were classed as Vulnerable. *Aonyx capensis* and *Cercopithecus mona* was categorized as Near Threatened (NT). All others were either classed as Data Deficient, Not Evaluated (NE) or Least Concern (LC).

Avi fauna Species

The Avi fauna existing in the Natural Forest Habitat of the project area was studied. The result as shown in Table 4.19 indicated that a total of seventeen (17) Avi fauna species cutting across nine (9) taxonomic families were recorded. The breakdown comprises three (3) species each of Accipitridae and Columbidae, two (2) species each of Anatidae, Apodidae, Muscicapidae and Tytonidae and one (1) species of Rallidae, *Phasianidae* and Numididae. Plate 4.5 shows bird nests on a bamboo tree.

Plate 4.5: Bird nests on bamboo tree by bank of Calabar River

Table 4.19: Results of Avi Fauna species Recorded in the study area

S/N	Family/ Order	Common Names	Zoological Names	Abund ance	2023 IUCN Status
1	Accipitridae	Back kite	*Milvus migrans*	2	LC
2		Hooded vulture	*Necrosyrtes monachus*	1	CR
3		African harrier hawk	*Polyboroides typus*	2	LC
4	Rallidae	African rail	*Rallus caerulescens*	*	LC
5	*Phasianidae*	Double-spurred Francolin	*Francolinus bicalcaratus*	1	NE
6	Apodidae	African palm swift	*Cypsiurus parvus*	1	LC
7		Little swift	*Apus affinis*	2	LC
8	Tytonidae	**Barn owl**	*Tyto alba*	3	LC
9		Owl	*Strix alba*	2	NE
10	Muscicapidae	Cassins flycatcher	*Muscicapa cassini*	*	LC
11		Rusty-tailed Flycatcher	*Muscicaparuficauda*	1	LC
12	Columbidae:	Red eyed dove	*Streptopelia semitorquata*	*	LC
13		Blue headed wood dove	*Turtur brehmeri*	2	LC
14		African green fruit pigeon	*Treron calvus*	1	LC
15	Numididae	Guinea fowl	*Numida meleagris*	3	LC
16	Anatidae	Bush duck fowl	*Nettapus auratus*	1	LC
17		*Nigerian free-tailed bat*	*Chaerephon nigeriae*	3	LC

Source: Field Survey, 2025

*Asterisk (*) indicate species sighted indirectly, **LC**=Least Concern, **Vu**=Vulnerable, **CR**= Critically Endangered*

Species Diversity

A total of seventeen (17) Avi fauna species were censored in this habitat. Of this, fourteen (14) species which include [*Milvus migrans* (Back kite), *Necrosyrtes monachus* (Hooded vulture), *Polyboroides typus*(African harrier hawk), *Francolinus bicalcaratus* (Double-spurred Francolin) *Cypsiurus parvus* (African palm swift), *Apus affinis* (Little swift), *Tyto alba* (**Barn owl), ***Strix alba*(owl), *Muscicapa* ruficauda (Rusty-tailed Flycatcher), *Turtur brehmeri (*Blue headed wood dove), *Treron calvus* (African green fruit pigeon), *Numida meleagris* (Guinea fowl), *Nettapus* *auratus* (bush duck fowl) and *Anas sparsa* (African black duck)] were censored directly while three (3) species including *Rallus caerulescens* (African rail), *Muscicapa cassini* (Cassins flycatcher), and *Streptopelia semitorquata (*Red eyed dove) were censored by indirect evidences (Table 4.19).

Family Diversity

Accipitridae, Rallidae, ***Phasianidae,*** Apodidae, **Tytonidae,** Muscicapidae, Columbidae, Numididae, and Anatidae were the nine (9) fauna families for which the seventeen (17) censored avi fauna species are grouped. Breakdown showed that Accipitridae and Columbidae which accounted for three (3) species each were the most abundant families in terms of species richness, this was followed by Apodidae, **Tytonidae,** Muscicapidae and Anatidae accounting for by two (2) species each while Rallidae, ***Phasianidae*** and Numididae were represented by a species each.

Species Abundance

A total of seventeen (17) individuals from fourteen species were censored directly in this habitat. The Breakdown showed that *Tyto alba* and *Numida meleagris* has the highest abundance of three (3) individuals each, followed by *Milvus migrans, Polyboroides typus, Apus affinis, Strix alba*, and *Turtur brehmeri with two (2) individuals each. Necrosyrtes monachus, Francolinus bicalcaratus, Cypsiurus parvus, Muscicaparuficauda, Treron calvus, Nettapus auratus* and *Anas sparsa* had one individual each. On the other hand, *Rallus caerulescens, Muscicapa cassini* and *Streptopelia semitorquata* were the three (3) avi fauna species censored indirectly.

2023 IUCN status

One species, *Necrosyrtes monachus* censored in this habitat was categorized as **Critically Endangered** in the 2023 Red List. All others were classified as Least Concern (LC) and Not Evaluated (NE)**.**

Reptilian Fauna species

The reptilian fauna in the Natural Forest Habitat was studied. The result as shown in table 4.18 indicated that a total of nine (9) reptilian fauna species cutting across three (3) taxonomic families were recorded. The breakdown comprises five (5) scinidae species, One (1) Agamidae species, and one (1) Bovidae species. This finding is shown in Table 4.20.

Table 4.20: Results of Reptilian Fauna Species Recorded in the Natural Forest

S/N	Family/ Order	Common Names	Zoological Names	Abundance	2023 IUCN Status
1	Agamidae	Common rainbow lizard	*Agama agama*	*	LC
2	Bovidae	Boa	*Boa constrictor*	*	LC
3	Scinidae	Skink	*Mabuya cochonaev*	4	NE
4		West African dwarf crocodile	*Osteolaemus tetraspis*	*	Vu
5		Rock python	*Python bivittatus*	*	Vu
6		Spitting cobra	*Naja nigricollis*	1	LC

Source: Field Fieldwork 2025

Asterisk (*) indicate species sighted indirectly, LC = Least Concern, Vu = Vulnerable, CR= Critically Endangered, (-) = Indicate species absent in the study area

Species Diversity

A total of nine (9) reptilian fauna species were censored in this habitat. Of this number, three (3) species which include *Mabuya cochonaev* (Skink), *Naja nigricollis* (Spitting cobra were censored directly while four (4) species including *Agama agama* (Common rainbow lizard), *Osteolaemus tetraspis* (West African dwarf crocodile), and *Python bivittatus* (Rock python), were censored by indirect evidences.

Family Diversity

Agamidae, Bovidae and Scinidaeare the three (3) fauna families for which the nine (9) reptilian fauna species are grouped. Breakdown showed that Scinidae had seven (7) species while Bovidae and Agamidae were represented by a species each.

Species Abundance

A total of three (3) individuals from two (2) species were recorded in this habitat. *Mabuya cochonaev* was represented by four (4) individuals while *Naja nigricollis* and *Varanus niloticus* were represented by one individual each.

4.8.6.1 Soil Fauna Diversity

Five species of termites were found in the grasslands. Their estimated total abundance and biomass were 485m^2 and 1.0gm^{-2} respectively. The dominant trophic group was the soil feeders (460 m^2 and 0.4gm^{-2}) although the wood feeders (8 m^2 and 0.01gm^2) were underestimated due to exclusions of their arboreal nesting. Only two of the five species of the soil feeders constructed epigeal nests (mounds).

The presence of Tsetse fly in the grasslands indicates the reason for the neglect of the derived savannah area in livestock rearing and development. These biting flies are vectors of the disease *Trypanosomiasis* which is fatal to both man and grazing herds. The Tsetse flies live in trees and shrubs covers. Also abound in the study area are soldier ants which help in disposing of ground litter and debris and in soil aeration by
their burrowing activities.

4.8.6.2 Land Use

The study area is a typical dominated majorly by forest, fallow land and or agricultural land, followed by rivers and clusters of settlements scattered along the project area. Table 4.21 shows the percentage distribution of the major land uses in the study area and its immediate environs and Figure 4.13shows the land use & land cover of the proposed AIH site.

Table 4.21: Major Land Use Distribution in the proposed AIH site

S/N	Major Land Use	Coverage Area (%)
1.	Forest	30
4.	Fallow/Cultivated Land	62
5.	Rivers/streams	6
6.	Residential	0
7.	Education/Infrastructure	0
8.	Others	2
	Total	**100**

Source: Field Survey, 2025

LAND-USE/LAND-COVER (LULC) MAP OF THE PROJECT AREA

Figure 4.13: Land Use & Land Cover map of the proposed AIH site

4.9 Hydrobiology

4.9.1 Overview

The productivity of any aquatic water body depends on the number of plankton present in the said water body (Davies *et al* 2009). Four groups of hydrobiology parameters were evaluated. They are phytoplankton, zooplankton benthos and fishes.

Ecosystem stability is a critical factor for aquatic lives. Since preconstruction and construction activities are likely to impact negatively on the water bodies, expected change in water quality would result in growth and count of opportunistic species. Therefore, a baseline study of the plankton population is imperative. Also, sediment deposition is also predicted to affect benthonic lives.

Sampling Methods

Plankton Sampling

Sample for plankton analyses were collected by means of a 55 µm mesh tow net with diameter of 30 cm. The net was used to filter water scooped in a bucket (the content of the tube attached to the end of the plankton net was emptied into plastic bottles and made up to 100 ml mark) and preserved in buffered 10 % formalin.

4.9.1.1 Sediment

Sediment samples were collected from sampling stations where surface water samples were taken. Bottom sediments were sampled using the Eckman Grab. Samples for macrobenthic fauna were sieved through a 0.5 mm mesh and transferred into 500 ml wide-mouthed plastic containers. Benthic organisms were preserved in 500 ml plastic containers using 40 ml of 10 % formalin. The organisms were identified and enumerated in the laboratory using identification tools and keys.

4.9.1.2 Plankton

Plankton could be affected by pollutants and other human activity in aquatic systems, but they are not suitable indicator organisms for aquatic pollution monitoring/impact assessment programmes for the following reasons:

They are easily drifted away by wind and water currents.

Their distribution is highly influenced by availability and the depth of light penetration which is a function of the water turbidity.

They are patchy in their natural distribution, being very concentrated in one area of the sea and less or completely absent in another within a short span of distance.

They are influenced by nutrient concentration in the water and by season

Phytoplankton

A total of 18 phytoplankton species during the wet and 24 during the dry seasons representing 4 taxonomic groups were obtained in the study area during the survey. Bacillariophyceae constituted 44.4% (8 species) followed by Chlorophyceae 22.2% (4 species), Cyanophyceae and Euglenophyceae 16.7% each (3 species) during the wet season. During the dry season Bacillariophyceae constituted 41.7% (10 species) followed by Chlorophyceae 25% (6 species), Cyanophyceae and Euglenophyceae 16.7% each (4 species) The density of phytoplankton ranged from 62 cells per litre at station WS-5 to 130 cells per litre at WS-2 during the wet season. These numbers increased significantly during the dry season. It varied from 201 cells L^{-1} at station WS-4 to 367 cells L^{-1} at WS-3 (Appendix 4.1: Table A4.6 and A4.7). The numbers of species also varied with site. Within the wet season, the diatoms (Bacillariophyceae) were the dominant group (40-63%) followed by Chlorophyceae (14-35%), Cyanophyceae (0-24%) and Euglenophyceae (0-14%). The same trend was noticed during the dry season, Bacillariophyceae dominance (44-58%) was followed by Chlorophyceae (17-38%). However, Euglenophyceae (7-16%) were more abundant than Cyanophyceae (0-12%). Increases in the number of species were also noticed during the dry season. The dominance of the diatoms is vividly shown in Figure 4.14 and Figure 4.15. During the wet season the numbers of phytoplankton was expectedly low because of the high turbidity that resulted in low light penetration in Calabar River.

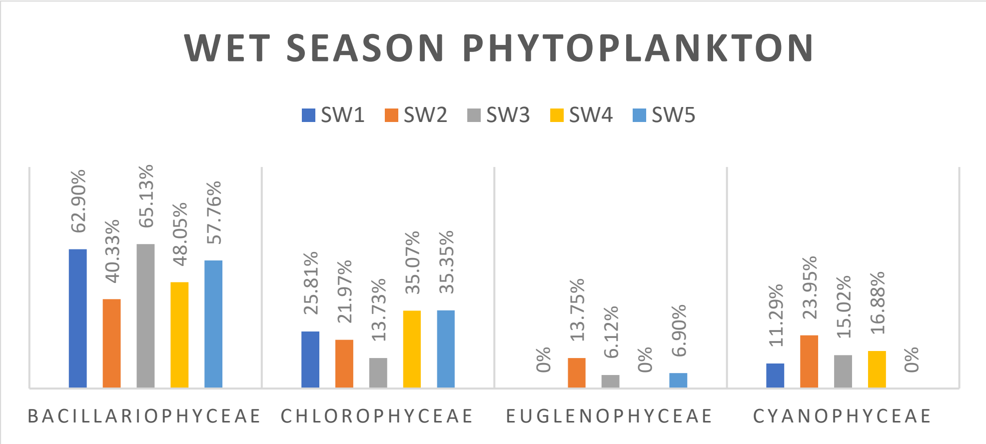


Figure 4.14: Distribution of Phytoplankton species in various sampling stations along Calabar River during Wet season

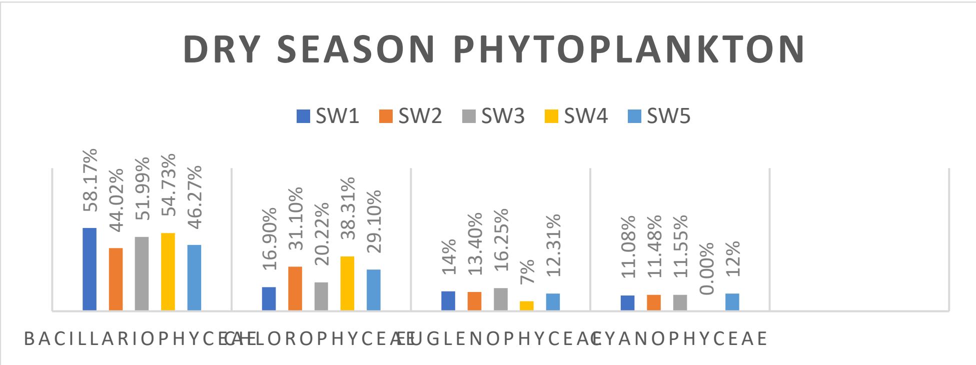


Figure 4.15: Distribution of Phytoplankton species in various sampling stations along Calabar River during dry season

Zooplankton

The zooplanktonic fauna of project area are represented by Copepoda, Rotifera, Cladocera and Gastropoda (Appendix 4.1: Tables A4.8 and A4.9). The distributions of these taxonomic groups at the sampling locations during wet and dry seasons are presented in Figure 4.16 and Figure 4.17**.** The Order Copepoda dominated the zooplankton with 62 individuals (50-67%) in all stations sampled and was represented by 4 species during the wet season. This was followed by the Rotifera with 21 individuals (17-30%) made up of 3 species, Cladocera with 12 individual organisms (12.1%) made up of 3 species and Gastropoda with 1 species has 4 individuals which constituted only 4.0% of the total abundance. During the dry season a significant increase in zooplankton abundance was observed. The dominant taxonomic group were also the Copepods with 232 individuals (42.1%) represented by 6 species. This was followed Cladocera with 158 individual organisms (28.7%) made up of 5 species, Rotifera with 142 individuals (25.8%) had 4 species and Gastropods with 19 individual organisms (3.4%) was represented by 1 species.

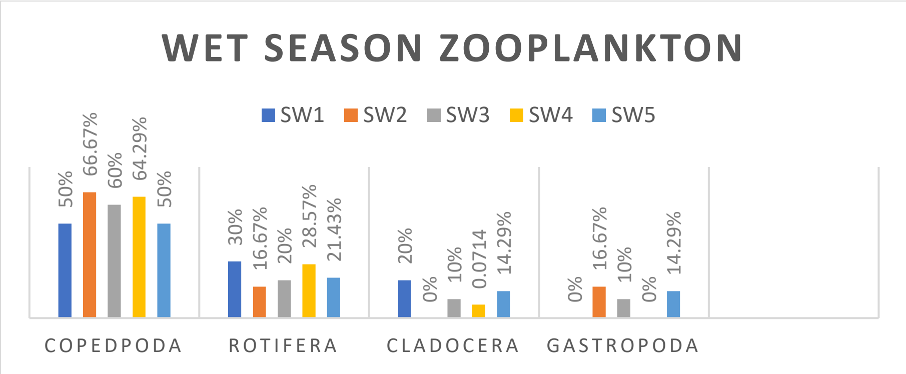


Figure 4.16: Composition and abundance of Zooplankton species in Calabar River (per litre) during Wet season

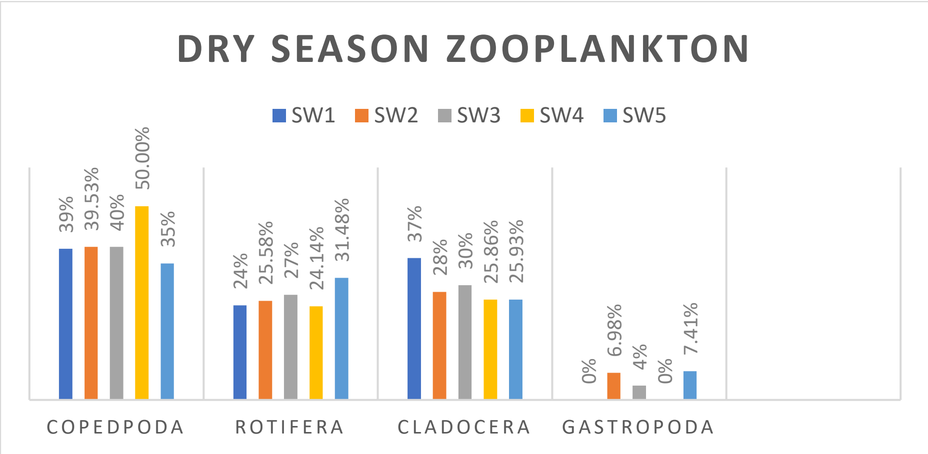


Figure 4.17: Composition and abundance of Zooplankton species in Calabar River (per litre) during Dry season

The low number of zooplankters during the wet season could be ascribed to

(a) the very low concentrations of nutrients (PO_3, NO_3 SiO_2) in the water which directly affect phytoplankton number, and which are in turn fed upon by zooplankton.

(d) the flushing effect of the estuary tends to drift most of them out of the estuary into the wildness of the marine coastal water.

The most important hydrographic factor affecting plankton promotion in the Calabar River was flood water, initiated by the rainfall of the wet season. Flood water increased the rate of water flow, introduced allochthonous materials from adjoining wetlands and diluted the water considerably. These also increased river turbidity which affected phytoplankton photosynthesis and limited primary production that the zooplankters depend on for growth.

4.9.2 Benthic Studies

A total of 14 species of macro-zoobenthic forms were collected in the survey. The family Capitellidae and Nereidae dominated the fauna by number of species, comprising (21.4%) (3 spp) of the macro benthos in the area; Glyceridae constituted 14.3% (2 spp); others were represented by 1 species constituting 7.1%. (Tables 4.22 and 4.23).

A total of 569 and 579 organisms were collected from 10 sampling stations during the wet and dry season respectively. During the wet season, the family Glyceridae dominated the fauna by number of individuals comprising 26.0% (150 individuals), followed by the Capitellidae – 23.1% (133 individuals); Nereidae constituted 14.7% representing 85 and Nephthyidae – 13.7% with 79 individuals. The families Chironmidae, Potamidae, Tellidae Arenicolida and Gammaridae had 38, 34, 23, 19 and 16 individuals respectively collected during this season. During the dry season there were no changes in terms of faunal composition and the family Capitellidae dominated the faunal abundance comprising 147 individuals (25.4%). This was followed by Glyceridae – 121 individuals (20.9%) and Nereidae – 98 individual (16.9%). The other families Chironmidae, Nephthyidae, Arenicolidae, Gammaridae, Tellidae and Potamidae had 52, 50, 32, 32, 27 and 20 individuals respectively. Faunal densities showed spatial variations. Higher densities were observed in stations downstream (WS-1 to WS-6) with densities ranging from 147 at WS-4 to 252 individuals/m^2 at WS-5 during the wet season (Table 4.22). Faunal densities also showed the downstream abundant trend with values ranging from 135 at WS-4 to 255 individuals/m^2 at WS-1 during the dry season (Table 4.23). The species *Glycera capitata* were found in almost all the sampling locations indicating their ability to adapt readily to various benthic locations especially sandy sediments which were prevalent within the study area.

Table 4.22: Distribution and relative abundance of Benthic Macro invertebrates in Calabar River during Wet season

S/N	Family	Species	Stations				
			SW-1	SW-2	SW-3	SW-4	SW-5
1	**Arenicolidae**	*Arenicola marina*	4(20.1)	1(5.3)	-	9(47.4)	-
2	**Capitellidae**	*Capitella capitata*	10(12.2)	16(19.5)	9(11.0)	7(8.5)	11(13.4)
3		*Notomastus latrella*	-	3(12.5)	1(4.2)	-	4(16.7)
4		*Notomastus tenuis*	4(14.8)	-	3(11.1)	-	8(29.6)
5	**Chironomidae**	*Chironomus ablabiesmia*	-	5(13.2)	1(2.6)	7(18.40)	8(21.0)
6	**Glyceridae**	*Glycera capitata*	14(15.1)	12(12.9)	10(10.8)	12(12.9)	10(10.7)
7		*Glycera convolute*	-	11(20.7)	7(13.2)	8(15.1)	-
8	**Gammaridae**	*Nototropis swimidami*	5(13.3)	-	-	-	-
9	**Nereidae**	*Nereis pelagic*	8(25.8)	6(19.4)	3(9.7)	6(19.4)	1(3.2)
10		*Nereis virens*	3(11.1)	8(29.6)	-	-	5(18.5)
11		*Nereis diversicolor*	8(29.6)	-	2(7.4)	7(25.9)	5(18.5)
12	**Nephthyidae**	*Nephthys hombergi*	-	13(16.5)	-	15(19.0)	5(6.3)
13	**Potamidae**	*Tympanotonus fuscatus*	-	7(20.6)	4(11.8)	5(14.7)	-
14	**Tellidae**	*Tellina nymphalis*	-	2(8.7)	1(4.3)	4(17.4)	-

S/ N	Family	Species	Stations				
			SW-1	SW-2	SW-3	SW-4	SW-5
Total Number of Species			8	11			10
Total Number of Individuals			56	84			41
Density (Individuals/m^2)			168	252			123

Table 4.23: Distribution and relative abundance of Benthic Macro invertebrates in Calabar River during Dry season

			Stations				
S/N	**Family**	**Species**	SW-1	SW-2	SW-3	SW-4	SW-5
1	**Arenicolidae**	*Arenicola marina*	-	-	-	9(28.1)	8(25.0)
2	**Capitellidae**	*Capitella capitata*	12(20.0)	9(15.0)	6(10.0)	10(16.7)	-
3		*Notomastus latrella*	13(23.6)	5(9.1)	2(2.6)	-	-
4		*Notomastus tenuis*	-	-	-	3(9.4)	10(31.3)
5	**Chironomidae**	*Chironomus ablabiesmia*	8(15.4)	4(7.7)	-	7(13.5)	12(23.0)
6	**Glyceridae**	*Glycera capitata*	-	10(12.2)	9(11.0)	15(18.3)	12(14.6)
7		*Glycera convolute*	8(20.5)	7(17.9)		-	-
8	**Gammaridae**	*Nototropis swimidami*	-	-	-	5(15.6)	14(43.8)
9	**Nereidae**	*Nereis pelagic*	8(21.0)	8(21.0)	-	8(21.0)	-
10		*Nereis virens*	9(27.2)	-	5(15.2)	-	7(21.2)
11		*Nereis diversicolor*	12(44.4)	4(14.8)	-	7(25.9)	-
12	**Nephthyidae**	*Nephthys hombergi*	-	-	4(8.0)	12(24.0)	8(16.0)
13	**Potamidae**	*Tympanotonus fuscatus*	-	-	-	4(20.0)	6(30.0)
14	**Tellidae**	*Tellina nymphalis*	3(11.1)	5(18.5)	5(18.5)	5(18.5)	-
Total Number of Species			8	8		6	11
Total Number of Individuals			73	52		31	85
Density (Individuals/m^2)			219	156		93	255

4.9.3 Fisheries

With the riverine areas of the proposed project, apart from farming, fishing is the next major occupation of the people. The common fishing craft is the traditional dug – out canoe or half plank-constructed canoe (pirogue). Fishing gears commonly used in fish exploitation include traps, hook and lines, set gill net, cast nets and beach seine nets.

The traps are used mainly in the flood plains, shallow Creeks and the fringes of the Calabar river and are made from raffia palms or reeds. Valved aperture range of between 40mm and 110mm are used mainly by subsistence fishers. This is complemented with hooks whose size ranged between 5mm and 15mm. The set gill net with mesh size ranging between 30 and 120mm are bottom set and used in the open water. However, some of the fishers use selective and non-selective gears, which indiscriminately catch juveniles and could deplete the stock and reduce the sustainable yield.

Data on fisheries were collected primarily from the local fishermen and unpublished data kept by the Department of Fisheries, Cross River State Ministry of Agriculture and Irrigation. Information was also obtained from the use of identification pictorials administered on experienced local fishermen in Adiabo. Fish specimens for morphometric analysis were obtained from fishermen at the different sampling locations usually during the fishing activity and on landing.

The fishes for tissue analysis were parked in ice chest and transported in frozen condition to the laboratory.

4.9.3.1 Body Condition

The sampled specimens were dissected and examined for a number of biological features such as body cavity, opacular cavity, gill and the occurrence of any form of physical deformity.

4.9.3.2 Tissue analysis

About 5g of fish tissue were taken from the muscle (Bernherd 1976, Cossa et al 1992). The muscles were dissected using clean plastic instrument and the piece of the muscle weighed 1 – 2g of fish tissue was homogenised and wet digested with nitric acid perchloric acids (Bernherd 1976). Clear digest was diluted with deionised water to 70 ml and the concentration of the specific metals determined using atomic absorption spectrophotometry (PYE unicam Model 919, Solar System; Pye Unicam England).

4.9.3.3 Results - Fisheries

Fish species known to exist in the study area as gathered from local fishermen (as shown in Plate 4.6) and the Fisheries Department of Cross River State Ministry of Agriculture and Irrigation, are presented in

Table 4.24. The table indicates that at least 30 fish species in 20 genera and 15 families are caught in the area. During the field data gathering exercise for the proposed project a total of 60 fish specimens were collected and studied. These specimens were identified to belong to 8 families, 11 genera and 12 species, as presented in

Table 4.24. The mean lengths and weights of the different species are also presented in the Table 4.25.

Table 4.23 shows that the family Cichlidae was the most abundant accounting for 31.2% of the total catch. This was followed by Mugilidae (15.7%), Bagiridae and Clariidae (13.3%) each, Osteoglossidae and Mochokidae (9.4%) each, Cynoglossidae (4.7%) and Channidae (3.1%).

Table 4.24: Fish Species assemblage in the Calabar River

Family	Species
Anabantidae	*Ctenpponia imgslayae*
Bagridae	*Chrysichthys nigrodigitatus, C. Auratus longifilis, Auchenoglanis occidentalis*
Mormyridae	*Mormyrus rume, Mormyrops delicious*
Cichlidae	*Tilapia zilii, T. Gunieensis, Hermichromis fasciatus, Sarotherodon galilee*
Channidae	*Parachanna Africana, P. obscura*
Cynoglosidae	*Cynoglossus senegalensis, C. Monodi*
Elopidae	*Elops lacerta*
Mugilidae	*Liza falicipinnis, Liza hoefleri*
Osteoglossidae	*Heterotis niloticus*
Polynemidae	*Polynemus quadrifilis, Galeoidesde decadactylus, Pentanemus quinquarius*
Clariidae	*Clarius lazera, C. anguillaris, C. gariepinis, Heterobranchus longifilis*
Sciaenidae	*Pseudotolitus elongates, Pseudotolitus epipercus*
Clupeidae	*Ethmalosa fimbrata, Sardinella maderensis*

A greater number of the fish species identified in this study are pelagics, which moved within the upper strata of the water column and are more likely to move away from environmental pertubation such as oil pollution. The demersals occupy the lower stratum and could be more susceptible to habitat perturbation.

Fish abundance and the biotic integrity are likely to be influenced by any habitat degradation such as discharge of effluents. These would lead to fish mortality including the fish adults, juveniles and egg/larvae mainly through degradation in water quality, contact-oiling alteration of the food resources. Eventually, the recruitment pattern will be altered and drastically reduced resulting in lower fish abundance.

Plate 4.6: Fishery resources encountered during the study. From left to right, *Claridea angularis* (Catfish), *Penaeous notialis* (Brown Shrimp), *Heterobranchus Longifilis* (Catfish)

4.9.4 Physical Deformities

Examination of the 54 fish samples collected showed most of the fishes were healthy with no physical deformities. However, few of the fishes had part of their fins chopped off possibly due to the activities of piscine predator. Examination of gut contents revealed traces of planktons and fish in the diet. The abnormality status of the fish samples is presented in

Table 4.26. The table shows the number of occurrences of each disease type and the percentage prevalence in relation to the total fish samples studied.

Table 4.25: Mean Length, Weight, Abundance and Relative Abundance of Fish Specimen collected from the study Area

Family	Species	Mean Length (cm)	Mean Weight (g)	Abundance	Relative Abundance (%)
Bagiridae	*C. nigrodigitatus*	57.2	928.2	15	26.3
Mugilidae	*Liza falicipinnis*	17.4	69.9	4	7.0
	L. grandisquami	16.3	67.5	6	10.5
Osteoglossidae	*H. niloticus*	23.6	136.6	8	14.0
Cichlidae	*Tilapia zilii*	24.5	195.3	3	5.3
	S. galilee	22.4	191.0	1	1.8
	H. fasciatus	29.7	269.4	4	7.0
Sciaenidae	*P. elongatus*	48.4	389.8	4	7.0
Clariidae	*C. macromystax*	29.3	259.4	4	7.0
	Cl. buthupogon	31.7	262.2	1	1.8
Polynemidae	*P. quadrifilis*	36.6	314.3	7	12.3

Table 4.26: Abnormality Status of Fish Samples from the Study Area

Disease	No. of Occurrence	Prevalence (%)
Ulceration	4	6.6
Epithelial hypereplatia	1	1.7
Fused gill lamellae	2	3.3
Excessive mucus secretion	1	1.7
Fin rot/erosion	5	8.3
Chilodonelosis	1	1.7
Total	**14**	**23.3**

The fish disease occurrence and prevalence values in
Table 4.26 above shows that the general occurrence of fish deformities and/or abnormalities was considerably low when compared with the total number of fish samples studied. The most commonly occurring abnormalities were fin rot/erosion and ulceration.

4.9.5 Tissue Analysis

The profiles of tissue analysis conducted on fish species *(Chrysichthys nigrodigitatus)* is presented in Table 4.27. The result shows that all the parameters analysed for were within the World Health Organisation (WHO) maximum permissible limit for inland waters. This suggests that the aquatic environment at the time of this survey was devoid of heavy metals pollution.

Table 4.27: Tissue Analysis of Chrysichthys nigrodigitatus from the Study Area

Parameter	Fish Sample	WHO Limit
Fe	0.09	0.3
Zn	0.08	5.0
Cu	<0.03	1.0
Mn	0.052	0.1
Pd	<0.02	0.05
Ni	0.02	-
Cd	<0.001	0.005
Cr	<0.01	0.05
As	<0.01	0.05
Hg	<0.01	0.001

4.10 Socioeconomic Impact Assessment

4.10.1 Objectives of the Socioeconomic Impact Assessment

Objectives of the socioeconomic study include the following;

- The socioeconomic assessment aimed to establish baseline conditions in the Adiabo Ikot Mbo Otu and Adiabo Esine Ufot communities, the direct hosts of the proposed AIH project. The study evaluated demographics, livelihoods, land tenure, infrastructure, cultural heritage, and community perceptions. It identified vulnerable groups and assessed potential project impacts—both positive and negative—on social and economic structures.
- A mixed-method approach was used, combining household surveys, FGDs, KIIs, and observational assessments. Data collection involved 100 households and was supported by trained field teams. Stratified random sampling was used for surveys, while purposive sampling guided FGDs and KIIs. Community entry was facilitated through meetings with traditional leaders, and stakeholder workshops were held to gather feedback and promote inclusive planning.
- The social area of influence extends beyond the immediate project footprint, recognizing broader community linkages and downstream users. Data analysis integrated both primary and secondary sources to inform project design, impact mitigation, and long-term monitoring strategies.
- The socioeconomic baseline data collection exercise was conducted between 10th and 20th June 2025. Data were collected using structured questionnaires, key informant interviews (KIIs), and focus group discussions (FGDs) targeting household heads, women, youth, and community leaders.

4.10.2 Social Area of Influence (SAI)

A 'social area of influence' consists of the people potentially impacted by the project within 3km radius of the project site. Affected peoples include both 'communities of place' and 'communities of interest'.

Two communities, Adiabo Ikot Mbo Otu and Adiabo Esine Ufot, the direct host communities to the project have been identified as being directly affected by the proposed project**.** The average distance of human settlements to the perimeter fence of the proposed project site is 4600 metres, while the project site covers 130 hectares of land. Land use within 3 km^2 radius of the AIH project site is within Adiabo communities. These communities, together with the physical footprint of the project will hereafter be referred to as the **"Area of Influence" or ''Host Communities''** for the AIH project.

4.10.3 Scope of the Study

The scope of the study covered demographic conditions, land ownership and tenure, employment situation in households, livelihood activities of residents and their exploitation of natural resources for sustenance, income levels and expenditure patterns. It also delved into the socio-cultural, historical, cultural heritage, archaeological resources and traditional administrative institutions of the communities. Social vices, security and conflict resolution dynamics in the communities were also assessed. The study also analysed the quality of life of residents determined by quality of housing, availability of facilities and utilities, and the infrastructural framework. Potential negative and positive impacts of the project were identified and the impact history, perceptions, concerns and expectations of residents and their suggestions of enhancement and mitigation measures for potential impacts were also obtained. Based on the above, appropriate mitigation and enhancement measures were recommended for the project design, construction and operations to address the identified potential impacts of the project on the people and communities.

4.10.4 Study Design and Strategy

The study was designed to obtain relevant Socioeconomic data from primary and secondary sources using a mixed-method approach combining quantitative and qualitative data collection methods. The exercise was conducted by a team of trained enumerators, supervisors, a gender specialist and a social safeguard specialist. A desktop study of the literature, EIA report of the Lagos- Calabar Highway project etc. provided secondary data for the study. Primary data were obtained through field studies in the Project Affected Communities (PAC). This involved consultations and discussions with stakeholders, structured questionnaire administration to Household Heads (HH), Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and Participatory Rural Appraisal (PRA). Primary data were also obtained from observations made during ground truthing the project area and study community. The field study activities were as outlined below.

4.10.4.1 Survey Design

A structured household questionnaire was developed using KoboToolbox, a mobile-based data entry software and pre-tested. Focus Group Discussion (FGD) and Key Informant Interview (KII) guides were also prepared to triangulate quantitative findings.

4.10.4.2 Development of a Sampling Framework

The sampling framework involving identification of the target population, sampling method, and sample size was developed as outlined.

4.10.4.3 Target Population

The target population for the study were residents and stakeholders of the communities directly affected by the AIH project namely Adiabo Ikot Mbo Otu and Adiabo Esine Ufot in Adiabo clan, Odukpani LGA, Cross River State.

4.10.4.4 Sampling Method:

Minimal Rapid Assessment (MRA) method of sampling was used to achieve this, employing purposive sampling strategy.

MRA is a fast, low-cost, small sample survey method used to generate basic socio-economic or health data when time, resources, or access is limited. Instead of aiming for statistically representative large samples, MRA uses a smaller but purposively or systematically selected sample to quickly capture key characteristics, trends, and risks of community or the Project-Affected population.

Sample Size: A total of 200 questionnaires were administered across the two project communities (Adiabo Ikot Mbo Otu and Adiabo Esine Ufot. Of these, 100 questionnaires (each) were distributed in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot. A total of 200 completed questionnaires were retrieved and analysed, representing a 100% response rate.

4.10.4.5 Community Entry and Mobilization

Initial consultation and sensitization meetings were held with the village heads and traditional leaders of the two communities at the palace of the clan head of Adiabo clan**.**

4.10.4.6 Household Surveys and Data Collection Tool

A structured questionnaire was administered to a representative sample of 100 Heads of Households (HH) across the target communities, using KoboToolbox. 10 of which were woman and the rest of the 20 were youths. The respondents were heads of households or their representatives and adults above 18 years of age. Information gathered included household composition, income sources, education, health, housing, food security, land use, access to services, concerns and expectations from the proposed project.

4.10.4.7 Focus Group Discussions (FGDs)

FGDs were held with elders, women, and youth leaders and fisherfolks (Plate 4.7) in the communities. Discussions explored perceptions of the AIH, socio-cultural norms, impact history, conflict resolution mechanisms, concerns and expectations from the project.

4.10.4.8 Key Informant Interviews (KIIs)

KIIs were conducted with individuals including community leaders, women leaders, youth representatives, school heads, fisherfolks and farmers. Focus areas for the KII included community development priorities, historical grievances, land tenure systems, gender relations, impact history, concerns and expectations from the project etc.

4.10.4.9 Observational Assessments

Field teams carried out community walk with representatives of the communities to assess and record infrastructure conditions (roads, schools, health centres), water sources, waste disposal methods, and community layout. Photographs of these facilities were also taken and recorded.

4.10.4.10 Scoping and Stakeholder Engagement Workshop

A scoping and stakeholder workshop involving relevant stakeholders was convened to present the project to relevant stakeholders and to receive their inputs into the design and implementation of the project to ensure a win-win outcome for all

4.10.4.11 Data Collation and Analysis

Data obtained from all the sources above were analysed and interpreted for the report writing. Data analysis combined quantitative (descriptive statistics) and qualitative (thematic) methods to provide a holistic understanding of demographic characteristics, livelihood activities, income levels, social infrastructure, health conditions, and community perceptions of the proposed Agro-Industrial Hub.

4.10.4.12 Data Analytical Techniques and Data Presentation

Summary statistics including percentages, averages and ratios were used in the report and data presentation was done in tables and charts. Labour force population covers all persons aged 15-64years who are willing and able to work regardless of whether they have a job or not (Annual Abstract of Statistics, Vol. 1, 2016). Population sizes and relevant distributions were determined using the following formulae:

I. Population projection using the exponential model

$$Pn = Po\ (1 + r)^n$$

where P_o is population in the base year, r is estimated annual growth rate of population, and n is time lapse in years.

II. $Sex\ Ratio = \frac{Number\ of\ Males}{Number\ of\ Females}\ x\ 100$

III. $\text{Dependency Ratio} = \frac{\text{Population aged } 0{-}14\text{years} + 65\text{years and above}}{Population\ aged\ 15{-}64\ years}$ x 100

4.10.5 Stakeholder Consultations and Integration in the Study

Major development projects proposals have the potential to impact the Socioeconomic environment in several ways within and outside the project's immediate environment. Impacts could arise from perceptions of benefits, loss of assets, changes in income levels, among others. The proposed AIH project would potentially impact individuals, families and communities in the project area. Impacts would vary with different phases of the project from mobilization through construction, commissioning, operations and decommissioning. The impacts could be beneficial, adverse, negligible, significant, short term or permanent. In consideration of these impacts, it was necessary to ensure participation and integration of various stakeholders including the local populace (community residents), non-governmental organizations, public agencies, security agencies, professional bodies, government regulators and the academia in the environmental and social studies. The integration and participation were aimed at public consultation and disclosure, data gathering and involvement of stakeholders in identifying associated and potential impacts and developing acceptable mitigation and enhancement measures. This process helped to secure a **Social License to Operate** in the communities and ensure sustainability in the proposed AIH project.

The stakeholder engagement and consultation exercises involved:
Consultation with Adiabo Clan Council on the 16th of June, 2025 (Plate 4.8).

Participatory data gathering using household questionnaire administration, FGDs, and KIIs. The consultation meetings were useful in eliciting stakeholders' perceptions, concerns and expectations from the proposed project. Consultation and engagement activities are continuous to provide useful feedback to ensure community integration and sustainable development during all phases of the project. Field consultations and engagements were also carried out with community groups, owners of assets on and around the proposed project site. The engagements provided information about stakeholders' perceptions, concerns and expectations, and preferred mitigation measures to the identified potential impacts.

A Scoping and Stakeholders' Engagement Workshop was held on the 17th of June, 2025 at HOGIS Hotel, State Housing Estate, Calabar, Cross River State. The workshop was attended by the communities' leaders, residents, members of the public, the project proponent (CR-SAPZ), security agencies (including the Nigeria Army, Department of State Security (DSS), Nigeria Security and Civil Defence Corps (NSCDC), Nigeria Police Force (NPF), Nigeria Customs Service (NCS), regulators (Federal Ministry of Environment, NESREA) etc and the academia (Plate 4.9)

At the workshop an overview of the proposed project and its potential impacts was presented, and stakeholders' perceptions, concerns and suggested mitigation measures were discussed.
Focused Group Discussion FGD), Key Informant Interviews (KII), Questionnaire surveys, Community Walk and Participatory Rural Appraisal (PRA) for ground truthing with community leaders, youth, women leaders and fisherfolks on June 18, 2025 by the SIA team. Minutes of the different engagements are provided below, while attendance lists for the meetings are attached as in Appendix 4.3.


Plate 4.7 (Right): Focused Group Meeting with Elders of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot Communities at Adiabo Town Hall On 18.06.2025

Plate 4.8 (Left): Consultation Meeting with Leaders of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot at Adiabo Town Hall on 18.06.2025

Plate 4.9: Cross sections of participants at the stakeholders engagement/scoping workshop: FMEnv. Rep. addressing the workshop (left); NESREA Rep. making his contribution (middle left); CR-SAPZ Rep. fielding questions from participants (middle right; and a cross section of Adiabo contingent (right).

4.10.6 Background of the Study Area - Odukpani LGA

4.10.6.1 Historical and Geographical Background

Odukpani is a large Local Government Area in Southern Senatorial District of Cross River State, Nigeria. Odukpani was established in 1976 as "Western Calabar," Odukpani originally encompassed present-day Odukpani and Akpabuyo' however, in 1991, Akpabuyo was separated, and Eburutu community was added to Odukpani. It spans approximately 2,624.7 km², bordered by Calabar Municipality to the southeast, Biase LGA to the northeast, Akwa Ibom State to the west, Akamkpa to the east, and Abia State to the northwest. The area sits around 126 meters (413 ft) above sea level, featuring lush forests and undulating terrain. Both the Cross River and Calabar River traverse its landscape.

4.10.6.2 Political and Governance Structure

The political system in Odukpani LGA follows the Nigerian local government framework, which is democratic and tiered under the 1999 Constitution (as amended). It consists of elected and appointed officials responsible for lawmaking, executive functions, and community representation. Local governments in Nigeria have the executive and legislative arms. The Executive arm is headed by the Executive Chairman supported by Supervisory Councillors appointed by the Executive Chairman. The legislative arm is made up of elected councilors from all the wards in the LGA. Odukpani LGA is made up of 11 wards. The tenure of the elected officers is 3 years.

4.10.6.3 History, Governance and Administrative Structures In Adiabo Ikot Mbo Otu and Adiabo Esine Ufot Communities

History of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot

The elders of the community led by their Highnesses Chief Ukpabio Okon–Abasi Otu of Adiabo Ikot Mbo Otu and Chief Okon Otu Inok of Adiabo Esine Ufot said that Adiabo Clan is an ancient kingdom founded by their great grandfathers 100-200 years ago. It consists of about 20 villages inherited from our grandfathers. Adiabo Ikot Mbo Otu and Adiabo Esine Ufot are part of these 20 villages of Adiabo clan. They indicated and emphasized that the traditions, rules and norms of the community are still intact. There are rules governing the hierarchy of leadership and governance in the clan.

Administrative structure of the communities

There are senior and junior chiefs that work together in the governance and administration of the clan. There are ruling houses in Adiabo clan and villages. Senior chiefs are selected from the ruling houses based on birth right and the persons qualification, while Junior chiefs are selected by appointment based on hard work and service to the community.

Administrative and Governance Organs in Adiabo Clan.

The following are the administrative and governance organs in Adiabo clan:

1. **The clan council**: This is the highest policy and decision-making body in the clan and made up of senior chiefs who form the cabinet. It is headed by the Clan Head. Junior chiefs are not part of the clan council.

2. **The Council of Chiefs**: This is where the junior chiefs belong. It is the implementation organ of the policies, decisions and directives of the clan council.

3. **The Adiabo Youth Council**: As the name implies, this is the umbrella governing body for all the youths in the clan. It is in charge of the security and sanitation in the clan and adjudication in youth issues. They work under the guidance and direction of the council of chiefs and the clan council

4. Iban Adiabo Council This is the umbrella organisation for all the women in Adiabo clan. They also work under the guidance and direction of the council of chiefs and the clan council.

Administrative and Governance Hierarchy in Adiabo Clan.

1. The Clan Head; 2. The Most Senior Chief; 3. The Senior Chiefs; 4**.** The Council of Chiefs comprising of (a) The Junior Chiefs' (b) Youth leaders, and (c) Women leaders

Cultural Groups and Cultural Festivals in Adiabo Adiabo Ikot Mbo Otu and Adiabo Esine Ufot. There are many cultural socities and groups with their various functions and cultural activities in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot viz: 1. Ekpe, 2. Obon, 3. Akita, 4. Abang (for women), 5. Ekombi (for men & women); 6. Ekong Ikong Ukom; and 7. Iban Isong

Ekpe society:

This is only for men and you must be initiated into the group to participate in their activities When the Ekpe cultural group is operating, no stranger or non-initiate is permitted to come out or work around the community. To prevent contravention of this rule by strangers and non-initiates, the leaves or branch of Aboti tree is usually pinned to the ground around the community to alert strangers and non-initiates in the community. Another way of alerting strangers and non-initiates that ekpe masquarade is operating is by the beating of the ekpe drums which has a distinct sound. The ekpe masqurade is displayed during the elevation of a member, burial of a member or during important occasions

Obon/ Akata:

Only initiated members can come out when they are displaying. If a non- initiate is caught moving about during their display, he will be fined and initiated.

Functions of the Cultural Groups

They help in maintaining security in the communities especially Obon/Akata, and settling of problems between individuals and groups etc.

Social organisations in the communities: There are many social organizations in the communities such as Ikpo Mkparawa, Mkparawa, Beloved sisters, Iyakidiekeunyam, Adiabo Likeminds, etc. These serve as community development catalysts, member support and social safety net organizations.

Role of the Youth in the Communities

There are two categories of youths in these communities namely – Ikpo Mkparawa (senior or matured youths) and Mkparawa (junior youth or younger youth). The ikpo mkparawa are seen as matured and responsible age group and qualified to take responsibilities. They are assigned leadership responsibilities in the communities. The Mkparawa age grade have graduate into the Ikpo Mkparawa age grade before taking on leadership responsibilities in the communities. The youth is made up of males and females in their 20s and 30s and they are traditionally responsible for ensuring internal and external security, enforcing and maintaining law and order, and mobilization for community sanitation. They exert their influence and play their roles through their youth organization – **Adiabo Youth Council**

Role of Women in the Communities

Traditionally, the communities recognize important roles played by women in the family and society, including supportive roles in traditional administration, social mobilization, and initiation and ownership of developmental projects and programmes. They are also important in attending to welfare needs and conflict management, especially as this concern their members. The women contribute to household income as they work and invest in livelihood activities. They are key in the upbringing of children and community development. They exert their influence and play their roles through the apex women organization – **Iban Adiabo Council** and other women groups in the community.

4.10.7 Demographic Characteristics of the Study Area

4.10.7.1 Population Size of the Study Area

Nigeria has conducted five national censuses between 1952/53 and 2006. The results from four of the censuses including 2006 were accepted and published. Following 2006 national census, the National Population Commission (NPC), published population figures at national, state and local government levels and did not publish figures of individual communities in the LGAs.

4.10.7.2 Population Growth

Demographic processes of fertility, mortality and migration determine population growth, and following their interplay the NPC had estimated the annual population growth rate across Nigeria at 2.5% (NPC 2022).

4.10.7.3 Fertility Rate:

Total Fertility Rate (TFR) refers to the average number of children that would be born alive to a woman (or a group of women) during her lifetime if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year. The average number of children a woman would have by the end of her childbearing years if she bore children at the current age-specific fertility rates. If fertility were to remain constant at current levels, a woman in Nigeria would bear an average of 4.8 children in her lifetime. Fertility is much higher in rural areas than in urban areas. On average, women in rural areas give birth to 5.6 children over their lifetime, while urban women give birth to 3.9 children in their lifetime. The TFR in Nigeria has declined consistently over time, from 6.3 children per woman in the 2008 NDHS to 4.8 children per woman in the 2023–24 NDHS. (FMoHSW, NPC, IFC et.al, 2024). The Total Fertility Rate (TFR) for Cross River State was 3.26 in 2022 (**(NBS Demographic Statistics Bulletin 2022).** This shows a steady decline from 4.74 in 2015 to 3.26 in 2022.

4.10.7.4 Migration

Migration is induced by socioeconomics, environmental and political factors, and it impacts various development areas at the macro and micro levels (Annual Abstract of Statistics Vol. 1, 2016). The general migration pattern in Nigeria is a rural to urban movement of the population. The study area, Adiabo Ikot Mbo Otu and Adiabo Esine Ufot being the host communities to the AIH will attract many migrants seeking work in the AIH. It has been a receptor for private sector workers, itinerant workers and job seekers from rural settlements and even other urban centres to the PAMOL rubber plantation and the Tinapa Business and Leisure Resort.

4.10.7.5 Population Projection for Odukpani LGA, 2025-2028

Based on the 2006 population figure for Odukpani LGA, population projections for Odukpani LGA for 2025 - 2028 are shown on Table 4.28. These projections were made using average annual growth rate for Cross River rural areas (2.4–2.8%), and midline growth of 2.6% over 19 years for 2025.

Table 4.28: Projected Populations of Odukpani LGA, 2025 - 2028.

Community/LGA	Year/Population (Census Figures and Projections)				
	2006 census	2025	2026	2027	2028
Odukpani LGA	192,884	315,201	323,282	331,531	339,951

Source: NPC Priority Table Vol. IV, 2010.

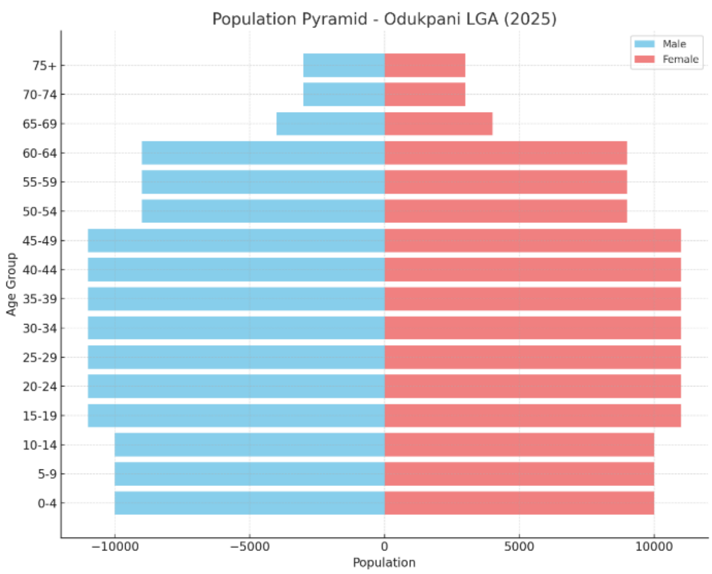


Figure 4.18: Population Pyramid for Odukpani LGA (2025 projection).
Source: Survey Projection **(2025)**

Figure 4.18 showing the population pyramid for Odukpani LGA (2025 projection). It shows a broad base with a high concentration in the 0–24 age range. This reflects high birth rates, a young, rapidly growing population and a future increase in demand for education, jobs, and youth services

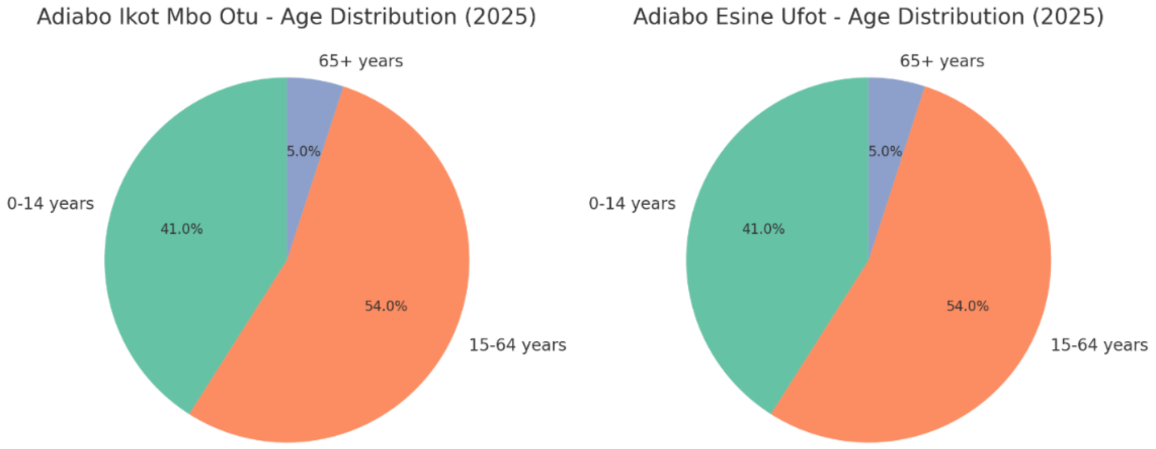


Figure 4.19: Age Distribution in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot.
(Source: Survey Projetion (2025))

Figure 4.19 shows that both communities have significant numbers of school-aged children (0-14) and working adults (15-64). **Both villages have youth-heavy populations**, with 4 in 10 residents under age 15. This indicates that demand for schools, primary healthcare, food security services will remain high and youth-focused programs and job creation are critical. Agriculture and vocational training for the 15–35 age bracket will have a significant impact. It is expected that a sustainable and inclusive AIH will help meet these needs.

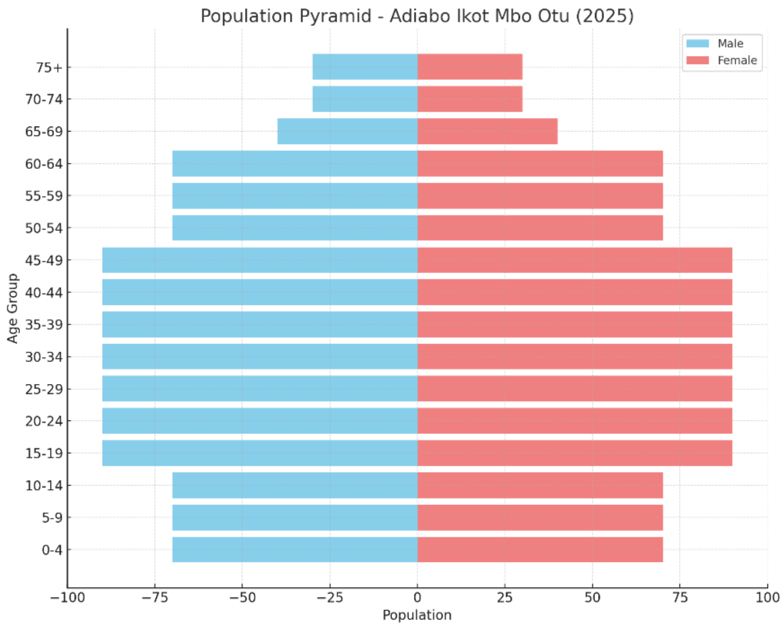


Figure 4.20: Population Pyramid for Adiabo Ikot Mbo Otu (2025)
Source: Survey Projection (2025)

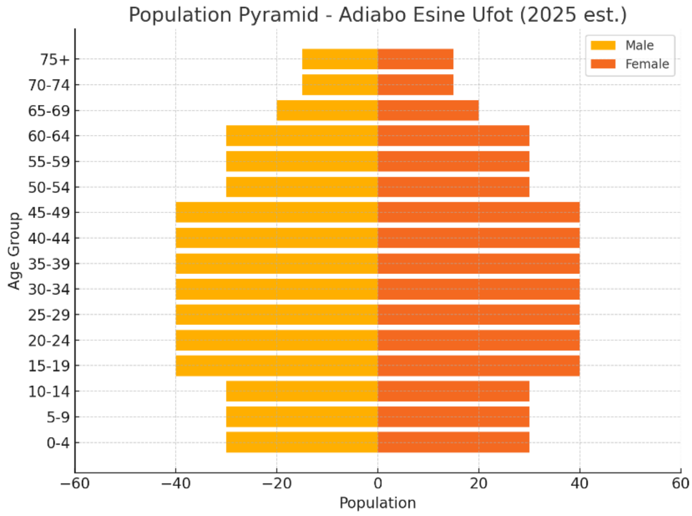


Figure 4.21: Population Pyramid for Adiabo Esine Ufot (2025 projection)
Source: Field Work 2025

Figure 4.21 reveals a youthful structure with a broad base, showing a high proportion of children and young adults, and a tapering older population, typical of rural Nigerian communities.

4.10.7.6 Dependency Ratio

The **dependency ratio** is a measure of the pressure or economic burden on the productive population (ages 15–64) to support those who are typically economically dependent—children (0–14) and the elderly (65+).

Table 4.29: 2025 Projected Dependency Ratio for Odukpani LGA, Adiabo Ikot Mbo Otu and Adiabo Esine Ufot

Area	Working-age Pop.	Dependent Pop.	Dependency Ratio
Odukpani LGA	174,400	148,600	85.2%
Adiabo Ikot Mbo Otu	2,700	2,300	85.2%
Adiabo Esine Ufot	1,215	1,034	85.2%

Source: Survey Projetion (2025)

Table 4.29 shows the dependency ratio for Odukpani LGA, Adiabo Ikot Mbo Otu and Adiabo Esine Ufot. The table shows a dependency ratio of 85% across the LGA and the two project communities. This means that for every 100 working-age people, there are about **85 dependents**. Adiabo Ikot Mbo Otu and Adiabo Esine Ufot mirror the LGA-wide ratio with **85 dependents per 100 working-age adults**. This means every household with 2 working adults is likely supporting **nearly 2 dependents**. This indicates a **moderately high burden** typical of rural Nigerian LGAs. The higher ratios imply that more resources are committed to the care of children and the elderly in households in the LGA and communities. Youthful populations have reduced labour input and income per capita and high dependency ratios. These are characteristic of underdeveloped economies (UNDP, 2006).

Implications of the high dependency Ratio

High youth dependency: Indicates a strong need for:

- Expanded education services (teachers, facilities, materials)
- Primary healthcare access (especially maternal and child)
- Food and nutrition programs

Modest elderly population:

- Elder support systems should be **proactive but not yet burdensome**
- Future planning for health insurance, elderly support, and pensions is wise

Labour force support:

- High ratio suggests adult workforce must be **economically productive**
- Need for job creation in agriculture, informal trade, apprenticeships

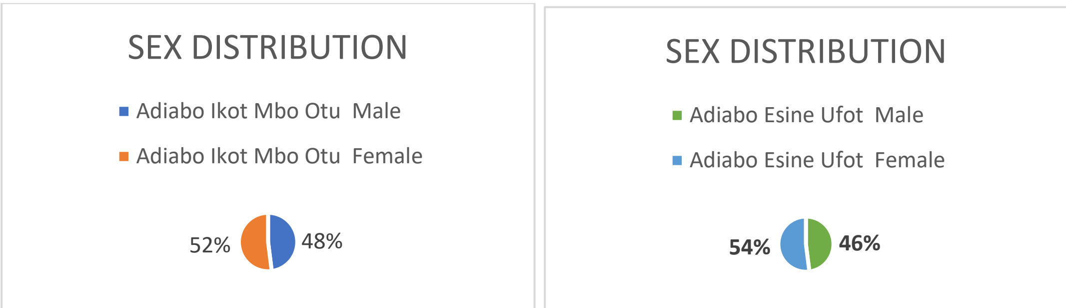


Figure 4.22: Sex Distribution of Respondents in the Study Communities

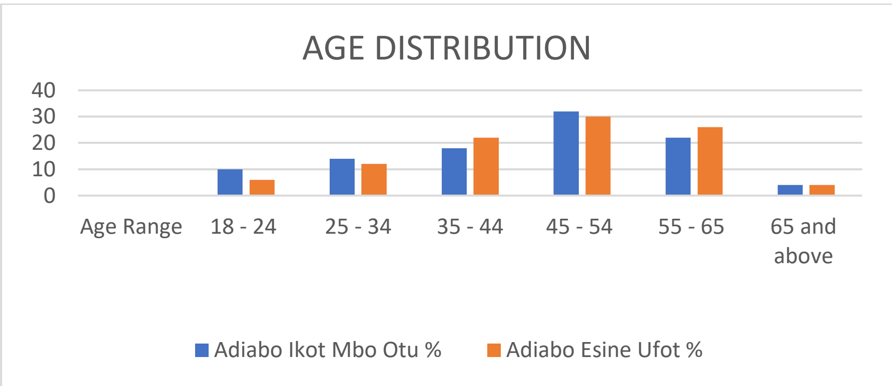


Figure 4.23: Age Distribution of Respondents in the Study Communities
Source: Field Work 2025.

The result of the survey shows that 48.0% and 46.0% of the respondents were males and 52.0% and 54.0% were females respectively in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot as shown in (Figure 4.22). This indicates that the number of the females in the population is higher than the number of males. This result is corroborated by the submissions of the communities' leaders during focused group discussions that there were more females than males (males – 40% and females – 60%) in the communities.

The survey shows that 10% of the respondents were between the 18-24 age bracket, 14 % between 25 – 34, 18% between 35–44, 32% between 45–54, 22% between 55 – 64, while 4% were in the 65 and above age brackets (Figure 4.24). The preponderance of the 45-64 age bracket in the survey result may be due to the agrarian nature of the communities which encourages out migration of the youths to urban areas in search of white-collar jobs. It is expected that a sustainable job creating, inclusive and profitable AIH business environment will stem the tide of rural – urban migration of the youths of the are

4.10.7.7 Marital Status

Marriage is a revered institution among residents across the study area. It has been noted that the marital status of an individual is a very important indicator of social responsibility, trust and achievement in Nigeria (Akpogomeh O. S. and Atemie J. D., 2002). Many couples would rather endure their marriages than be separated or divorced because of the importance attached to marital status. Marriages are usually celebrated with merry making and exchange of gifts between families of the bride and groom. They involve family members and friends of the couple and processes including negotiation of a bride price by elders from both families. Marriages in the two communities are monogamous.

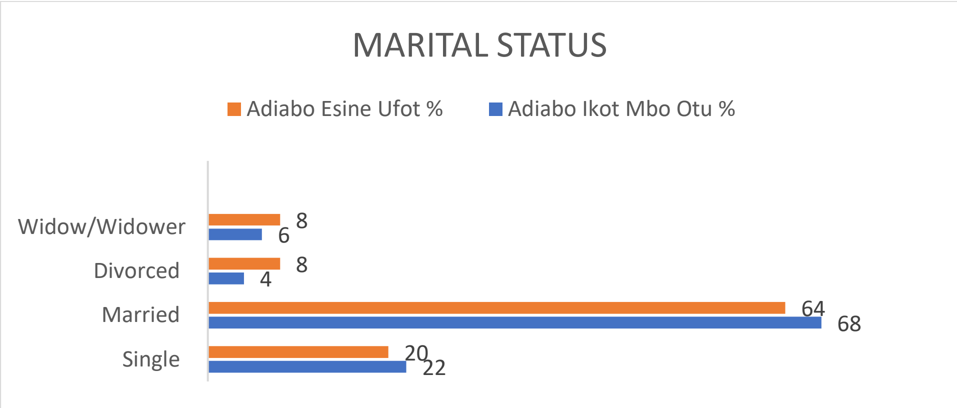


Figure 4.24: Marital Status of the Respondents in the Study Community
Source: Field Work 2025

Marriages in the community are mostly contracted under Customary Law and Ordinance. It is usually between adult males and adult females. There are no known communal restrictions on marriage on the basis of religion, culture, social status or ethnicity. The proposed project is not expected to impact the marriage institution in the study communities.

From Figure 4.24, 64% and 68% of the respondents are married, 20% and 22% are singles, 8% and 6% are divorced, while 8% and 4% are widows/widowers in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively.

4.10.7.8 Household Composition, Structure and Size

Households live together, share same source of food and recognize themselves as a social unit under the authority of a head. Although visitors are excluded, members are not necessarily related biologically. Household size refers to the number of persons in a household which in Nigeria ranges from one to 25, (NPC Priority Table Vol. IX, 2010). The average household in the study area headed by the father and members include his wife, children and wards. The wards include domestic staff (house helps).

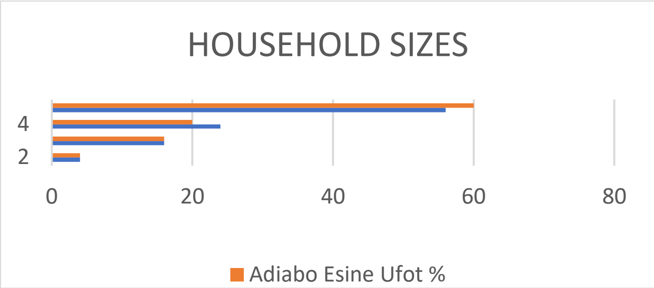


Figure 4.25: Household sizes in the project communities
Source: Field Work 2025

As can be seen from Figure 4.25, 4%, 15%, 25% and 56% have household sizes of 2, 3, 4, and 5 and above persons respectively in both communities. Analysis of the data gives an average family size of 5 persons per household in the project communities.

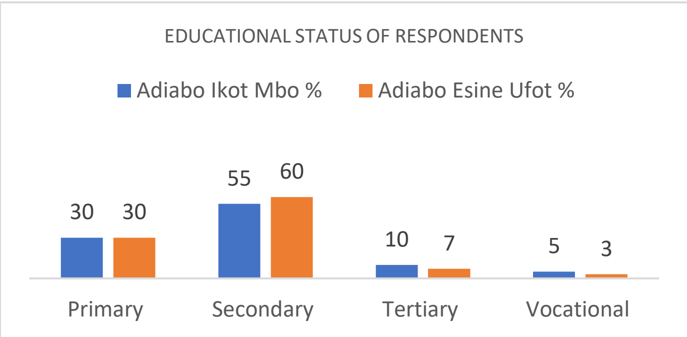
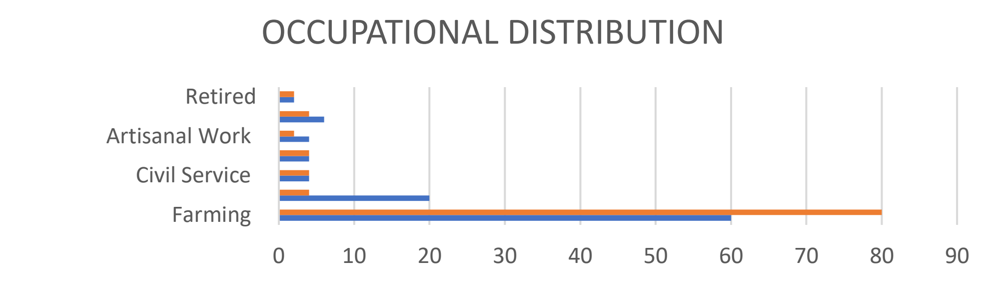


Figure 4.26: Educational Characteristics of the Study Community
Source: Field Work 2025

From Figure 4.26, 60% and 55% of the population have attained secondary level of education, 30% each have attained primary level of education, while 10% and 7% have attained tertiary level of education, while 5% and 3% have vocation education in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively. The high level of educational attainment (over 50% secondary and tertiary) indicates availability of labour force in the communities



	Farming	Fishing	Civil Service	Trading	Artisanal Work	Other (Sand mining, hunting)	Retired
Adiabo Esine Ufot %	80	4	4	4	2	4	2
Adiabo Ikot Mbo Otu %	60	20	4	4	4	6	2

Figure 4.27: Occupational Distribution of respondents

The analysis in Figure 4.27 shows that 60% and 80% of the respondents are engaged in farming, 20% and 4% are engaged in fishing which is mostly done by men, while 6% and 4 % % are engaged in sand mining and sales respectively for Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively. 4% each are engaged in civil service and trading in both communities, while, 4% and 2% are artisans in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively. This shows that majority of the population (80%) are engaged in agriculture and therefore any activity that will impact the agricultural resources/ activities of this sector negatively or positively will affect the community and people negatively or positively respectively. This indicates the need for sustainable, inclusive and comprehensive planning and implementation of the AIH project to enhance the incomes and livelihood of the people to prevent negative fall outs on the people and communities.

From the Figure 4.28, 36.0% earn between N10,000 and N30,000 monthly, 28.0% earn between N30,000 and N50,000, 14% each earn N50,000 - N80,000 and N120,000 and above, while 8% N80,000-N120,000 monthly in the two communities. It is expected that the proposed project will boost the income of the people in the area through their employment and contracting opportunities.

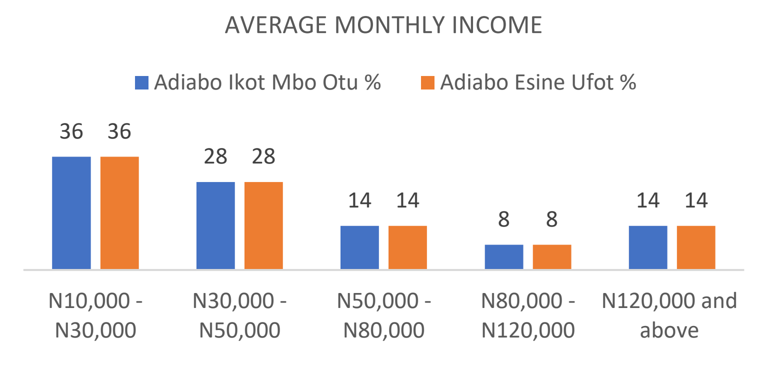


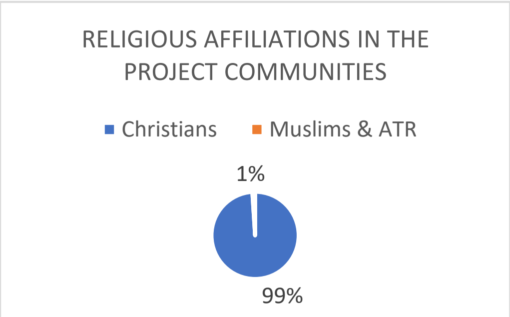
Figure 4.28: Income Distribution of Respondents
Source: Field Work 2025

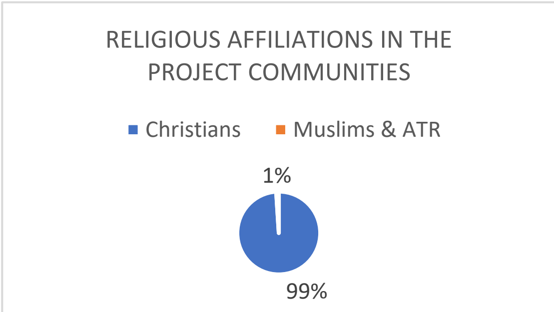
Table 4.30: Household Expenditure Pattern

	Adiabo Ikot Mbo Otu	Adiabo Esine Ufot
Items of expenditure	**% of income spent**	**% of income spent**
Food	45	40
Education	15	20
Health	5	3
Clothing	9	9
Transport	8	8
Fuel	14	14
Others	4	6

Source: Field Work 2025

The analysis in Table 4.30 shows that majority of the households (45% and 40%) spend a large proportion of their income in purchasing food for their families. 15% and 20% of the income goes to provide education for their children, while fuel for energy and lighting and cost of transportation take 14% and 8% of their income for Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively. This can be attributed to the high cost of food items and increased energy and transport costs currently being experienced in the country.





ADIABO IKOT MBO OTU **ADIABO ESINE UFOT**

Figure 4.29: Religious Affiliations in the Study Communities

From Figure 4.29, 100% of the respondents surveyed claimed to be Christians. This result was corroborated by elders and leaders of the communities who informed during the FGD that 99% of the residents were Christians, while 1% were a mixture of Muslims and African Traditional Religious (ATR) worshipers.

4.10.8 Available Means of Commercial Transport in the Project Community

Available means of commercial transport in the two project communities include motorcycle, bicycle, tricycle (keke) and minibus, cars and boats in Adiabo Ikot Mbo Otu, while motorcycle, tricycle and bicycle are the available means of transport in Adiabo Esine Ufot. Motorcycle was identified as the major means of transportation in the two communities.

4.10.9 Transportation cost

The respondents indicated that a drop with a motorcycle (bike) cost between N400-N500 within the communities because of bad roads, while keke (Tricycle) costs N250-N300 a drop.

4.10.10 Housing

Table 4.31 indicates that majority of the respondents 60% and 50% live in their own houses, 20% and 10% live in their family houses, while 20% and 40% live in rented houses in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively.

Table 4.31: Housing Ownership Status of Residents of the Communities

	No	%	No	%
Owner		60		50
Renter		20		40
Family House		20		10

Source: Field Work 2025

4.10.11 Building Materials Used in Housing Construction in the Project Communities

Table 4.32: Building Materials Used in the Project Communities

Type	Adiabo Ikot Mbo Otu %	Adiabo Esine Ufot %
Cement block wall	80	80
Brick walls	10	5
Mud walls	10	15

Source: Field Work 2025

The survey shows that 80% each of the households live in cement block houses, 10% and 5% live in houses made with brick walls, while 10% and 15% live in houses made with mud walls in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively (Table 4.32, Plate 4.10).

Plate 4.10: Showing Building Materials Used in the Study Area

Table 4.33: Materials Used for Roofing in the Study Community

Materials	Adiabo Ikot Mbo Otu %	Adiabo Esine Ufot %
Zinc	80	80
Aluminium	10	10
Thatch	10	10

Source: Field Survey (2025)

Table 4.33 and Plate 4.11 present the types of roofing material prevalent in the project communities. This shows that majority of the people, 80% each use zinc for roofing, 10% each use aluminium for roofing, while 10% each use thatch as their roofing material in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively.

Plate 4.11: Showing Materials used for Roofing in the Project Communities

4.10.12 Cost of House Rent in the Project Community

From Table 4.34, the cost of rent depends on the size and quality of the house. While a single room costs between N36000 and N600000 per year, a self-contained costs N80,000-N120,000, a 1-bedroom flat goes for N150,000-N200,000, while a 2-bedroom flat is reported to cost between N400,000- N500,000 per year. House rent in the communities may be expected to increase with the coming of the project as it will cause influx of workers to the area, exacerbating the need for rental accommodation. It will also boost the incomes and livelihood of landlords in the area.

Table 4.34: Showing the Current Cost of Rent for Different Types of Houses in the Project Community

HOUSE SIZE	COST OF RENT (N)
One room	N36,000 – N60,000/year
Self – contain	N80,000 – N120,000/year
One bedroom flat	N150,000 – N200,000/year
Two-bedroom flat	N400,000 – N500,000/year
Three-bedroom flat	N600,000 – N750,000/year

Source: Field Survey (2025)

4.9.13 Community Needs and Priority Ranking of the Community Needs (with 1 as the highest and 6 as the lowest priority)

The ranking of the communities' needs is based on survey results, input from focused group meetings with the elders, youth and women leaders from communities. From the Table 4.35, the first priority need of the communities is employment for their people, second, roads and secondary school, third, skills acquisition and potable water supply, fourth, health facilities and skills acquisition centre, while potable water supply and construction of modern market ranked fifth for Adiabo Ikot Mbo Otu and Adiabo Esine Ufot respectively.

Table 4.35: Showing the Priority Needs Ranking by the Community

NEEDS	COMMUNITY	
	Adiabo Ikot Mbo Otu	Adiabo Esine Ufot
	Priority Ranking Level	
Potable water supply	5	3
Provision of Educational Facilities	6	2 (secondary sch.)
Provision of Health Facilities	4	5
Provision of Skills Acquisition Facilities	3	4
Employment of the teeming population	1	1
Provision of Roads to link the communities	2	6

Source: Field Survey (2025)

4.10.13 Socio-Economic and Livelihood Activities of the Project Affected Communities

The two project communities of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot are basically agrarian communities depending mostly on farming as their major occupation, source of income and livelihood.

4.10.13.1 Crop Farming

Majority of the members of the communities are engaged in crop farming and the major crops grown are cassava, yams, vegetables, maize, plantain and bananas. They produce for both home consumption and for sales

4.10.13.2 Challenges to Crop Farming in the area

Majority of the respondents (80%) identified pests/diseases attack on crops, lack of credit facility and lack of knowledge and information as the major challenges to crop farming in the two communities. This indicates the need to integrate training in integrated pest management, climate smart farming and provision of credit facilities to farmers as deliberate policies of the AIH to improve and enhance the operations of the farmers in the area in order to sustainably provide raw materials to the AIH. This will help boost the profitability, incomes and livelihoods of the farmers. As part of the SIA recommendations to strategically and specifically address the pests' problems.

4.10.13.3 Livestock Farming

Many of the respondents in the two communities are also engaged in livestock farming such as poultry, goats, pigs, etc. production. They produce for both home consumption and for sales. The major challenge to livestock production is high cost of feeds, poor quality of feeds and diseases especially in poultry production. These challenges can be addressed through the inclusion of quality feed milling facilities as component of the AIH to provide quality feeds at affordable prices to farmers. Majority of the livestock farmers reported not having access to veterinary services. This gap, however, has already been taken into consideration and addressed in the planning and development of the AIH by the provision of a veterinary clinic in the AIH.

4.10.13.4 Fishing

Adiabo Ikot Mbo Otu is blessed with the presence and passage of the Calabar River in Adiabo through the community. On account of this, fishing is a major Socioeconomic and livelihood activity in Adiabo Ikot Mbo Otu. Fisherfolks reported that the major commercial fishes found in the area are catfish, tilapia, ekwe, edeng, crayfish, periwinkle, crabs etc. The respondents indicated that fishing is done every night and that two out of the six nights that they go on fishing expeditions, they could come back with nothing. They could not provide information on the weight of catch or landings in kg per expedition as they do not measure the weight of their catch. However, they estimated their sales per trip or landing to be between N12,000 and N20,000. This puts their income at between N48,000 – N80,000 per week and N192,000 – N320,000 per month assuming fruitful four days expedition per week. Fishing is done mainly by men, while fish processing is done mainly by women. Very few of the respondents were engaged in fish farming(aquaculture) and farm catfish and tilapia using concrete ponds.

4.10.13.5 Sand Mining

By virtue of the availability of the Calabar River in Adiabo Ikot Mbo Otu, sand mining and sales are also major economic activities and sources of income and livelihood in this community as can be seen in Plate 4.12. Sand mining is mainly carried out by men.

Plate 4.12: Showing Livelihood Sources
(Sand Mining and Boat Making) in the Study Area

4.10.13.6 Artisanship practices

Artisanship practices in the study communities include welding, electrical and electronic installations and repairs, auto mechanics, electrical works, panel beating, fashion design, hair dressing, pedicure and manicure, food service, carpentry and furniture making, among others.

Other livelihood activities in the area include petty trading, transportation services, boat (canoe) building for fishing and sand mining and employment in the public and organized private sectors. Most livelihoods including farming, trading, artisanship practices, transportation services are operated in the informal sector.

4.10.14 Experience of External Shocks and Coping Measures

Respondents indicated having experienced external shocks in the last year ranging from floods, late rains, agricultural pests/ diseases, insecurity/violence to theft of crops etc. In the face of these shocks the people reported employing many coping strategies ranging from reduced expenses on agricultural inputs, borrowing more money than usual, reducing household expenditures on health and education, selling more animals than usual to withdrawing children from school.

4.10.15 Natural Resources and their Exploitation for Sustenance

Generations of members of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot communities have depended on the natural resource endowment of their area namely land, forests and water bodies for their sustenance over the years. This has led to encroachment and levels of forest degradation. Land provides space for housing, other physical developments, and farming. Forests in the community provide wood and timber for housing construction, boat building, furniture making and firewood for cooking, fish drying and packaging. Forests also support hunting livelihood in Adiabo Esine Ufot. Adiabo Ikot Mbo Otu is blessed with water bodies rich in fisheries resources. These water bodies support fishing and sand mining which are some of the major livelihood activities for members of the community.

Housing, agricultural, infrastructural and industrial developments have encroached significantly on the lands, forests and water bodies that were traditionally exploited for livelihood.

4.10.16 Natural Resource Conservation Practices

Traditional conservation practices in the communities try to control and limit resource exploitation in order to allow for rejuvenation through regrowth. They mostly involve temporary or permanent prohibitions on entry and exploitation of resources in some locations like shrines and the forests around them, ban on cutting economic trees for use as firewood, ban on hunting in Adiabo Ikot Mbo Otu and encouragement of the practice of shifting cultivation. The use of lands, forests and wetlands for housing, infrastructural and industrial development has hampered most of these traditional practices. Shifting cultivation and its attendant bush fallow system operates by leaving farmlands fallow for a number of years after cultivation. Farmlands are left fallow for between three and seven years, depending on availability of farmlands. The fallow period allows for natural regeneration.

4.10.17 Land Ownership and Tenure

The legal framework for land ownership, acquisition and resettlement in Nigeria is provided by the Constitution of the Federal Republic of Nigeria (1999) and the Land Use Act CAP 202 LFN 2004. The Act recognizes the State Government's ownership of all lands and it provides the framework for payment of compensation for land acquisition for development purposes. Land has a great Socioeconomic and socio-cultural significance as it serves as a major livelihood and development asset, and generational inheritance. Therefore, in spite of the law, the communities still practice their traditional land ownership systems which vests ownership of lands in extended families. The families allocate, sell or lease parts of their lands to individuals and corporate organizations as they wish. Such lands can be put to any use including housing, infrastructural and industrial development. Family lands are managed by males in the family.

The major land uses in the communities include agriculture, housing, industrial and infrastructural development. These account for more than 90% of land use in the communities.

4.10.18 Employment Situation in Households

Employment and unemployment are considered among the population aged 15-64years. The labour force in Nigeria has been defined as covering all persons aged 15-64years who are willing and able to work regardless of whether they have a job or not (NBS Annual Abstract of Statistics, Vol. 1, 2016). Some residents of the communities within this age bracket are employed in livelihood activities at micro, small and large scale in the informal, public and organized private sectors, and there are also residents who are unemployed and underemployed. The unemployed are those that have actively been looking for work but have not been able to secure any in six months preceding this study, while the underemployed are those doing jobs that are less than their qualifications and desire.

Nigeria has had high unemployment and underemployment rates in the last decade. In the third quarter of 2017, the National Bureau of Statistics (2018) reported unemployment rate of 18.8%, underemployment of 21.2% and combined unemployment and underemployment rate 40.0%. It also reported an increase in unemployment rate from 27.1% in the second quarter of 2020 to 33.3% in the last quarter of 2021, (https//www.nigerianstat.gov.ng). Residents of the community have reported high level of unemployment of over 50% of the working age in the community, despite the availability of many skilled workers in the community. It is expected that the proposed project will provide employment for some residents of the community.

4.10.19 Socio-Cultural Resources and Values of the Study Area

4.10.19.1 Ethnic Composition of the Study Area

The communities have a combination of indigenous and non-indigenous residents. Indigenous residents are the Efiks who form the dominant population of the area. There are other residents from various ethnic groups residing in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot including Annangs, Ibibios, Oros, Igbos, Yorubas, Hausas among others. The communities do not have any known socio-cultural practices that limit or forbid interactions between residents of different ethnic backgrounds and religious orientations. Ethnic and religious tensions between community members and workers on the proposed project are therefore not expected.

4.10.19.2 Cultural Heritage

Cultural heritage and resources encompass the tangible and intangible assets of a society or culture that are preserved and passed down through generations. These include physical artifacts like cemetery (Adiabo Vaults), buildings and monuments, as well as intangible elements like traditions, knowledge, and languages. They represent a society's history, identity, and values, and are important for understanding and preserving cultural continuity.

The cultural heritage of the study communities is linked to language, dress and food, festivals and dances. The communities have various similarities in the way they dress, foods they eat and ways they conduct their marriages. Indigenous languages spoken in the communities are some of their cultural heritages. Among all the communities, land is considered a major socio-cultural asset and a heritage that must be bequeathed to succeeding generations. The communities have deities, shrines and sacred places which they have maintained example the Efe Ekpe. These deities, shrines, sacred places and traditional worship are important aspects of the people's cultural heritage.

The proposed project is not expected to impact any cultural heritage sites in the community including shrines, grooves, graves and community play grounds where cultural activities are staged as the project site is currently used for farming.

4.10.19.3 Language and Communication

Efik is the dominant native language spoken in both villages. It is also one of Nigeria's historically documented and widely broadcasted local languages. Other indigenous languages spoken in area are Ibibio, Annang, Oron etc. Apart from the indigenous languages, more than 70% of residents are able to communicate in English language and Pidgin English.

4.10.20 Social Organizations and Support Systems in the Study Community

4.10.20.1 Social Structure and Organization

Social institutions across the communities comprise families (nuclear and extended) and Community Based Organizations (CBOs). Nuclear and extended families are very basic and important in each of the communities; they confer social identity. Traditionally, nuclear families are single units with a father as the head while each extended family comprises several nuclear families that identify with a common ancestor who would have lived several generations in the past. The extended family is always headed by a male. Every indigenous resident would traditionally identify with a nuclear and an extended family in the community of residence. The CBOs play specific roles and while membership of some is exclusive, membership of some others is not. For instance, the Women's Groups are exclusive to women either born or married into the community while the Youth Groups are unisex. There are unisex social groups with membership from indigenous and non-indigenous residents.

4.10.20.2 Gender and Vulnerability Analysis

1. Purpose and scope

To identify how the AIH project will differentially affect people according to gender, age, income and livelihood, to surface hidden vulnerabilities, and to design targeted measures so benefits are equitable and risks reduced — across Project-Affected Household (PAH) Vulnerable Persons (VPs) already identified.

2. Definitions and vulnerability categories

- Gender groups: Men, Women, Non-binary (if applicable locally).
- Age bands: Children (0–14), Youth (15–24), Working-age adults (25–59), Older adults (60+).
- Income strata (household): Low (bottom 40% — subsistence), Lower-middle (next 35% — smallholders), Higher-middle (next 20% — commercial smallholders), High (top 5% — larger landholders/agribusiness).
- Livelihood types: Smallholder crop farming, Livestock/poultry, Trading/market vending, Artisans/crafts, Wage labour (casual), Formal employment, Informal service (food, transport), Non-agricultural microenterprise, Remittance-dependent, Unemployed.

Vulnerable Persons (VPs) for LREP: widows, elderly with no productive assets, persons with disabilities (PWDs), landless tenants, chronically ill, and single-parent households.

3. Disaggregated vulnerability profile

By sex

- Male: 45% (103 persons)
- Female: 55% (127 persons)

By age

- 0–14: 18% (children in PAP households) — not direct beneficiaries but dependents
- 15–24 (Youth): 22% (51 persons)
- 25–59 (Working-age adults): 54% (124 persons)
- 60+ (Elderly): 6% (14 persons)

By income strata (household head classification)

- Low: 45% (104 households)
- Lower-middle: 35% (81)
- Higher middle: 15% (35)
- High: 5% (10)

By primary livelihood (household head)

- Smallholder crop farming: 58% (134)
- Livestock/poultry: 8% (19)
- Trading/market vending: 10% (23)
- Artisans/crafts: 7% (16)
- Wage labour (casual): 9% (21)
- Microenterprise/service: 6% (13)

VPs are concentrated in the Low-income and smallholder farming categories, and include a higher female ratio (estimated 65% female of VPs), more elderly and PWDs.

4. Key gender-differentiated vulnerabilities and barriers (findings and implications)

A. Land and resource access

- Women typically lack formal land titles; compensation and land-based livelihood restoration may bypass them if only titled owners are compensated.
- Tenants and land-poor households (often younger or female-headed) will be at risk of losing livelihoods without adequate alternative land access.

B. Income and employment

- Women and youth face structural barriers to skilled, formal employment (training access, mobility, domestic responsibilities).
- Low-income smallholders risk increased dependence on wage labor if crop land is lost or reduced.

C. Social norms and decision-making

- Women's limited participation in community decision-making risks them being excluded from benefit-sharing and training opportunities.
- Elderly and PWDs have limited voice in consultations and struggle to access retraining or credit.

D. Time poverty and care burden

- Women carry disproportionate unpaid care duties (childcare, eldercare) which limits their participation in time-intensive trainings or business activities unless support is provided.

E. GBV/SEA risk

- Construction phase labour influx and increased cash flows can raise risks of sexual exploitation, harassment and transactional sex, disproportionately affecting women and girls.

F. Market access & productive assets

- Women often lack capital, extension services and market linkages, limiting ability to scale from subsistence to commercial production or value-addition activities

5. Vulnerability implications during project phases

- Pre-construction/Land acquisition: Highest risk for women, tenants, land-poor — loss of informal tenure rights, exclusion from compensation.
- Construction: Increased household income opportunities (men more likely to secure unskilled labour; women low uptake unless quotas or targeted roles exist). Increased GBV risks.
- Operation: Opportunity for female-targeted value-chain roles (processing, packaging, marketing) but risk of exclusion without proactive measures.
- Decommissioning: Vulnerable groups risk being left without support; productive assets may disappear if not formally transferred.

4.10.20.3 Taboos/Norms

Social norms are generally considered as a socio-cultural phenomenon affiliated with beliefs, values, custom, and hierarchical power. The culture of the project area like a typical African society prohibits stealing, incest, adultery, homosexuality, killing, illegal possession of firearm, farmland and other properties, etc.

4.10.20.4 Dispute Resolution

Family disputes are resolved by the family head which is the father of the house; youth disputes are settled by the youth leader, and women disputes by the women leader. In instances where these disputes cannot be settled by these various leaders, the case is always forwarded to the community head, who will then sit with his cabinet members to resolve the case. In situations where the family heads are unable to resolve the dispute, they forward the case to the village Head. Where the matter is not still resolved at his level, it is taken to the council of chiefs and finally to the clan council if the council of chiefs cannot handle the case satisfactorily.

4.10.20.5 Marriage and Family

The marriage institution is revered. Marriages are contracted between adult males and adult females. There are no known instances of same sex marriages within the area. Monogamy is mainly practiced. The family is a very important social unit in the community, and the concepts of nuclear and extended families exist. The typical nuclear family is headed by a father with other members including the mother and the children. The extended family includes members who share common ancestors. Marriage before the age of 20 is common especially for the female gender. Marriage payments/dowries are made to the prospective bride's parents. The marriage payment is shared among the bride's kin, with the father keeping the largest share. The marriage payment traditionally had to be completed before the marriage could be consummated.

4.10.20.6 Inclusion Strategies of Vulnerable Persons

To safeguard the rights and dignity of all vulnerable persons, including those identifying as LGBTQ and people with Disabilities (PWD), the following strategies are recommended:

- **Non-Discrimination Policies:** The project should incorporate a non-discrimination clause in all Human Resources policies for contractors and partners. This should explicitly prohibit discrimination based on sexual orientation, gender identity, or expression, in line with **AfDB's ISS** and **UN Guiding Principles on Business and Human Rights**.

- **Confidential and Safe Grievance Mechanism**: The grievance redress mechanism (GRM) should allow anonymous reporting and ensure privacy to protect LGBTQ persons and others at risk of social reprisal.
- **Inclusive Communication and Training**: Training for project staff, security personnel, and contractors should include modules on human rights, respect for diversity, and prevention of workplace harassment and abuse.
- **Access to Services Without Discrimination**: Any community benefits such as health services, microenterprise support, or social investments should be accessible to all residents, regardless of perceived identity.
- **Monitoring and Safeguards**: The project's monitoring and evaluation (M&E) framework should track inclusion indicators and flag any reports of exclusion or abuse, including against hidden or vulnerable groups.
- **Limitations and Ethical Considerations**: Given the socio-legal context in Nigeria, it is neither ethical nor safe to require the identification or public participation of LGBTQ persons in SIA consultations. Instead, the approach relies on general principles of human rights, anonymity, and safe inclusion practices based on global standards.

The law in Nigeria does not recognize LGBTQ and for this reason there are no provisions for such persons. Homosexuality is illegal by the laws of Nigeria and is punishable by up to 14 years imprisonment (Same Sex Marriage Prohibition Act 2013). Culturally, the communities do not accommodate any sexual orientation and marriage practice other than that of an adult male and female. None were identified as LGBTQ during stakeholder engagements. It is doubtful if any would want to identify as LGBTQ because of the social stigma associated with it.

4.10.20.7 Religious Practices and Belief Systems

Among residents of the study community are those who identify as Christians, worshippers of traditional deities and Muslims. Christianity is the major religious belief of 99% of the people in the community and there are many Christian worship centres of various denominations in the community viz: Qua Iboe church, Assemblies of God, Sure Foundation, Faith Tabernacle, Mount Zion Lighthouse, Mount Horeb, Faith and Works etc. There are no known communal restrictions on religious beliefs and practice. Residents are at liberty to pursue their religious interests.

4.10.20.8 Social Vices

The major social vices in the study area are abuse of alcohol and drugs. Prevalent is the smoking of marijuana/cannabis and other locally sourced stimulants/suppressants. Consumption of spirits and alcoholic beverages including beers, local gin and palm wine, at cultural and social functions and in private entertainment is common among male and female adult residents. The communities have shops and drinking bars that sell alcoholic beverages without age restrictions. In addition, some residents take concoctions of roots, barks and leaves of plants and trees soaked in local gin (kaikai, ogogoro) for their perceived medicinal value. Alcoholism and drug abuse indulged in by youths particularly were reported by the elders of the communities to be existent in the communities, but to a negligible extent as there are strong rules against vices in the communities. Other vices include cultism, banditry, robbery, and kidnapping. These only take place in pockets. Cultism and banditry only come to play when there is a major fracas or issue between rival groups.

4.10.21 Infrastructural Facilities and Amenities Situation of the Communities

4.10.21.1 Available Infrastructure and their Functional Statuses

Infrastructural facilities comprise physical amenities including access roads, streets, bus stops, telecommunication facilities and meeting halls and social amenities which include water, education, health and electrification facilities. Others are markets, hospitality and security facilities.

4.10.21.2 Roads

Adiabo Ikot Mbo Otu has a few tarred roads, while Adiabo Esine Ufot has none. However, at the time of this study, a road construction project was ongoing to provide a road to the community and her neighbours.

4.10.21.3 Telecommunications facility

Residents of the community have access to mobile telecommunication services provided on the GSM networks of MTN, Glo, and Airtel and reported of occasional fluctuations in service.

4.10.21.4 Health Facilities

Adiabo Ikot Mbo Otu community has a functional health Centre, while Adiabo Esine Ufot has a health post.

4.10.21.5 Educational Facilities:

Adiabo Ikot Mbo Otu and Adiabo Esine Ufot communities both have public primary schools, St. Patrick’s Primary School, Adiabo Ikot Mbo Otu and St. Mary’s primary school, Adiabo Esine Ufot respectively, which provide primary education to children from these communities. There are also private nursery schools in these communities (Plate 4.13). There is a public secondary school and a private secondary school in Adiabo Ikot Mbo Otu. The government secondary school is called Community Secondary School, Adiabo Ikot Mbo Otu. Adiabo Esine Ufot, has no secondary school. Secondary students have to travel many 2-5 kilometres to attend secondary schools outside their community.

Plate 4.13: Educational Facilities in Adiabo Ikot Mbo Otu and Adiabo Esine Ufot communities (left); and 132/33 kV power substation in Adiabo (right)

4.10.21.6 Potable Water supply:

Majority of Adiabo Ikot Mbo Otu residents’ source their water from private and commercial boreholes, while others source from the available streams and river in the community. In Adiabo Esine Ufot, the main source of water supply to majority of the households is the community stream – Idim Ukong, and some private and commercial boreholes. They reported that the 2 water boreholes and hand pumps provided by the Cross River Basin Authority had broken down.

4.10.21.7 Electricity

Adiabo Ikot Mbo Otu community is connected to the national grid; however, they reported suffering frequent power outages which sometimes lasts for days, weeks and even months, if there is a breakdown in the major distribution facilities. In Adiabo Esine Ufot, the people reported that though electric poles had been planted in the community, the community had not been connected to the national grid, as a result, there is no power supply to the community from the national grid. This is surprising as the Adiabo community hosts a 132/33 kV power substation (Plate 4.13)

4.10.21.8 Markets

There are no daily and periodic markets within the study communities.

4.10.21.9 Hospitality Centres:

The communities are host to Tinapa Business and Leisure Resort.

4.10.21.10 Security in the Study Area

There is a Police Station in the community, and it provides public security to the residents. Its presence has helped to reduce security concerns in the study area and to check the prevalence of cultism, banditry, and robbery.

4.10.22 Impact History

Impact history refers to the experience of past projects and other historical events. The elders of the communities during focused group meetings and discussions lamented that the communities have had a long history and experience of failed and abandoned government projects in the communities and that these had negative impacts on the psyche, morale, hope and confidence of the people in government development projects. These failed or abandoned projects have taken and occupied lands that the people could have used for their farming and improvement of their livelihoods. They gave a list of the existing failed and abandoned projects in the communities to include:

Tinapa Business and Leisure Resort, Retrostat Tank farm, DSS training school, Adiabo bridge. The construction of the road passing in front of His Eminence's house. Given the litany of the failed and abandoned projects in the communities (Plate 4.14), the people are worried and hoping that this AIH project will not go the way of past projects.

Plate 4.14: Showing Abandoned Tank Farm Project in Adiabo

4.10.23 Problems Confronting the Community

Members of the community indicated the following as some of the problems confronting the community.

4.10.23.1 Socioeconomic Problems

- Lack of employment/ empowerment to the youth and women in the communities
- Lack of potable drinking water
- Lack of educational facilities - secondary school in Adiabo Esine Ufot
- Lack of skills acquisition centre
- Lack of improved health facilities in in Adiabo Esine Ufot which currently has a health post that does not adequately meet their health needs.
- Declining fish catch
- Flooding

4.10.23.2 Socioeconomic Sensitivities and Vulnerable Groups

The proposed AIH is a significant project that will cover 130 hectares of land and its development process will potentially impact public and private assets, livelihoods and incomes. The socioeconomic environment will be sensitive to changes that will arise as a result of the project. Sensitivities associated with it will include safeguarding livelihoods and household income levels, and protecting residents and workers from diseases and accidents, Table 4.36.

Table 4.36: Socioeconomic Sensitivities.

Socioeconomic Component	Sensitivity and Benefits
Maintaining household income flows through employment and contracting opportunities.	During construction phase the project would provide opportunities for employment and contracting which will enhance household incomes. However, it will also lead to the loss of farmlands, livelihoods and unemployment. The AIH project will provide training to enhance farmers productivity, process and add value to farmers' produce and provide ready market to producers. This will help prevent produce spoilage and wastage, increase incomes, enhance the livelihoods of the people and reduce poverty. Household income levels will be impacted positively for the employed and adversely for the displaced and unemployed. Household income flows need to be maintained and indeed enhanced.

Source: Field Work, 2025.

4.10.23.3 Vulnerable Groups

Project activities will potentially impact differently on different groups and individuals. Some of these will be traditionally vulnerable households which include those headed by women, minors, persons with disabilities and chronically ill persons and the aged. Vulnerability will arise as a means of livelihood such as family farms and crops will be lost in the course of the proposed project implementation.

It is envisaged that movement of equipment and vehicles will increase with project construction phase. Residents and frequent users of the roads would be vulnerable to disruptions of traffic and complete closure of portions of the road during the project construction phase. Potentially vulnerable groups include physically challenged residents, children and the elderly.

Unemployed community youths will be another vulnerable group. There could be agitations and restiveness if desire for employment is not met due to limited opportunities in the project. The youth are also very energetic and impressionable which could lead to several other vulnerabilities associated with social vices. If drug abuse and commercial sex activities increase in communities in the area due to project activities, the youth would be most vulnerable to the influence of these activities. These vices could have long lasting impacts on morals and life of the youth.

4.10.23.4 Stakeholder Perceptions, Concerns and Expectations

The proposed project is expected to facilitate economic activities and boost employment in the area. Several stakeholders were identified and engaged. They generally perceived the project is developmental and will benefit residents, businesses and the community, LGA and the state. However, some concerns and expectations were expressed as follows.

The Communities' concerns include:

- Loss of land - the proposed project will take 130 hectares of land from the community.
- Fear of inadequate compensation and delay in payment
- Neglect of our people in employment opportunities in the AIH
- Insecurity that may be occasioned by the influx of job seekers into the communities.
- Population explosion and congestion in the communities
- Waste disposal problems as there is no waste management facility in the communities
- Project non-completion and abandonment as happened with many projects in the past.
- Loss of dwelling and commercial buildings around the proposed project site
- Increased flooding of parts of the community during the wet season if provision is not made for adequate drains along the road.
- Movement in the community will be impaired for pedestrians during construction.
- Distribution of benefits like employment during construction phase could cause problems and agitations in the community if not properly managed.
- Inadequate compensation and delays in payment.
- Movement of construction vehicles and equipment would cause dust and air pollution, road blocks, traffic congestion and accidents.
- Construction activities will cause vibrations that would affect foundations and walls of buildings.

Concerns of the National Union of Road Transport Workers and the Federal Road Safety Commission (FRSC)

- Project construction will lead to blockage of sections of the road, traffic congestion and diversion. This will make movement within the communities cumbersome for residents.
- Provision of adequate and safe diversions along the roads to take care of vehicular movements during proposed project construction phase.
- Rehabilitation of roads intended to be used as diversions prior to commencement of the proposed project.
- On completion there will be increased vehicular traffic which would be potentially hazardous for persons with disabilities, children and other community residents. There is a need to protect them from fast moving vehicles while they carry out their normal activities in the communities.

Expectations of the National Union of Road Transport Workers and the Federal Road Safety Commission (FRSC)

- Provision of adequate road diversions during project construction phase.
- Rehabilitation of roads intended for use as diversions so that vehicles will have minimal damage plying the routes.
- Provision of speed breaks and road signage on portions of external and internal road networks.

Expectations and Requests of the Project Host communities

- Employment of members of the communities especially youth and women in skilled and unskilled positions during construction and operational phases of the project.
- Signing of Memorandum of Understanding (MOU) or Community Development Agreement (CDA) with the Communities by the project proponents.
- Appointment of liaison officers from the project impacted communities.
- Prompt payment of adequate compensation to residents whose properties example crops and other assets will be affected by the proposed project.
- Provision of infrastructural amenities to the community viz: potable water supply, educational facilities (secondary school in Adiabo Esine Ufot), improved healthcare facilities, skills acquisition centre,
- Provision of tarred roads in the community to link and open up the communities
- Provision of low interest loans and grants to indigent members of the community for business start-up and expansion
- Award of contracts to indigenes of the community,
- Local sourcing of available raw materials from the community etc.
- Introduction of pedestrian bridges, zebra crossings and speed breaks along the road, especially where the road passes through built up areas in the communities.
- Construction of deep drains along the roads to prevent flooding in the communities.

4.11 Health Impact Assessment

4.11.1 Study Objectives

The overall objective of the community health study for the proposed Agro-industrial hub in Adiabo was to determine the current health status of the community within the project area, and evaluate the possible impact of the project on community and environmental health.

The specific objectives of the study were to:

a. Identify and document the available indices of environmental health significance in the project communities.
b. Identify and document the types and pattern of common diseases prevalent in the project communities.
c. Identify and enumerate available health facilities, and assess the quality and access to healthcare, including child and maternal health, in the project communities.
d. Identify peculiar health problems, hazards and potential health hazards within the project area.
e. Identify knowledge, attitude, practice and behavior on health in the communities.
f. Assess the indices expected to be vulnerable to the presumed impact of the project.
g. Develop appropriate and necessary recommendations.

4.11.2 Methodology

The study methodology comprised a variety of methods involving literature review and community health status survey, including epidemiological and environmental health data collection and analysis, using the following standard procedures:

- Questionnaire / Key Informant Interviews
- Document Review
- Focus Group Discussions
- Direct observation / assessment of the physical environment for general hygiene and sanitation; settlement pattern / style and housing; socioeconomic, health and health-related facilities; hazardous and potentially hazardous agents.
- Health facility survey
- Anthropometric examinations

4.11.3 Health Status of Project Area

4.11.3.1 Natality, Mortality and Morbidity Indices

There are no formal records of births, deaths and illnesses in the community; hence the rate of these indices could not be determined. However, information gathered from focus group discussions (FGD) and key informant interviews (KII), based on the discussants' knowledge of their communities, provided limited and qualitative data on the profile of birth, death and common ailments in the area. Birth cases were not considered alarming; however, the largely youthful population that characterizes the communities might seemingly suggest high birth rate. Child mortality was adjudged low, with less than 3 deaths within the last year of the study period in Adiabo Ikot Mbo Otu and none in Adiabo Esine Ufot. Few death cases (less than 5) were also recorded in each of the communities within the period.

Comparison with national figures would be unrealistic since these values were not derived from formal records. According to 2023 statistics, Nigeria's Crude Death Rate (number of deaths in a given period divided by the population exposed to risk of death in that period) was 12 (World Bank, 2025).

Community members named probable causes of death amongst children as poor nutrition and poor healthcare; and hypertension/stroke and diabetes amongst the adult population on poverty. Current data by the World Health Organisation (WHO) record Malaria and lower respiratory infections as the leading causes of death in Nigeria (WHO, 2024).

The communities have an aged population, including individuals around 80 years old, both male and female. While actual estimates on life expectancy in the area are not available, national figures for 2023 show Nigerians' life expectancy at birth as 54 years (male) and 55 years (female) (World Bank, 2025).

4.11.3.2 Maternal Health

Maternal health refers to the health of women during pregnancy, childbirth, and the postnatal period (WHO, 2023). Access to maternal health, therefore, entails access to antenatal care, skilled birth attendance, postnatal care, emergency obstetric care and family planning. There is poor access to maternal healthcare in the community. Maternal healthcare is limited by the capacity of available healthcare facilities in the area. The health center in Adiabo Ikot Mbo Otu can barely attend to skilled birth delivery, while in Adiabo Esine Ufot, the primary healthcare services are lacking due the non-functional health center; the women seek attention in health facilities at 8 Miles, about 10 kilometres away. In the absence of fully-functional healthcare system, traditional birth attendants (TBAs) fill the gap for maternal healthcare within the communities. Although the TBAs are not formally trained, community women rely on them for deliveries during childbirth. Nationally, maternal healthcare is plagued by various factors, especially limited access to quality healthcare, inadequate prenatal care, late initiation of antenatal care, and a shortage of skilled healthcare professionals (Abiola, 2024). These factors may be impacting on maternal mortality in the country. In 2020, Nigeria's maternal mortality rate stood at 1,047 per 100,000 live births (World Bank, 2024).

4.11.3.3 Child Health

Child health refers to the health of children from birth to adolescence. Being foundational to healthy adulthood, it is critical to community and public health. Child healthcare at the community level is expected to be covered by the services of the primary healthcare institutions, where such exist. In Adiabo Ikot Mbo Otu, the available health center can respond to minor cases in children, including malaria treatment and immunization. Their periodic outreach also is an opportunity to campaign on good hygiene and nutrition. In Adiabo Esine Ufot, these services are lacking.

The common health condition in children recorded at the available health centre was malaria. Key Informant Interview (KII) confirmed zero child deaths at the health center in any distant past that could be recalled. Given the availability and number of patent medicine stores in the area, their role in child healthcare in the community would not be trivialized as parents address some child illnesses by obtaining medications from them.

Although child deaths were not a feature in the communities, malaria was noted as a significant threat to child health. Recent estimates show that 64% of Nigeria's under-five mortality rate, put at 128 per 1000 live births, are caused by malaria, pneumonia or diarrhea (UNICEF 2024).

4.11.3.4 Nutrition

Nutrition refers to the intake of food, considered in relation to the body's dietary needs. While this can be influenced by choices, food availability, etc., it is significant because, among other aspects, dietary patterns can impact health outcomes. The communities have access to a variety of food types obtained from the farm and aquatic environment, owing to their geographic location and the dominant occupations of farming and fishing, which engage 60% and 30% of the working population, respectively. Their diet comprises chiefly of starchy staple derived from cassava-based products. Their major food types include garri, *fufu*, rice, cocoyam, plantain, *ekpang nkukwo*; with a variety of local vegetables and common fruits. Fish and other forms of sea food, snails are abundant and relished in the area; and these constitute the major source of animal protein. There are no food taboos in the two communities.

The nutritional condition of children assessed through body mass index (BMI) might be a reflection of the community's status. Anthropometric measurements provided evidence of malnutrition among children under five years of age. The Body Mass Index (BMI) values for a cross section of under-fives in Adiabo Ikot Mbo Otu ranged from 7.38 to 11.21 kg/m², with an average of 12.59 kg/m². This indicates severe underweight; falling below the standard of 17.5, it also signifies anorexia nervosa, an eating disorder that can lead to serious health conditions.

Malnutrition may impact child growth and development in the communities. Malnutrition is a direct or underlying cause of 45% of all deaths of children under five years of age. About 2 million Nigerian children are affected by severe acute malnutrition (SAM) (UNICEF 2023).

4.11.4 Community Healthcare System

4.11.4.1 Health Facilities and Healthcare Infrastructure

There are primary healthcare facilities in the communities. In Adiabo Ikot Mbo Otu, there is a 3-bed health center (Plate 4.15), headed by a community health officer, with 4 health staff; 3 community health extension workers (CHEW) and a junior CHEW. There is no support staff. Although not adequately equipped, the facility is able to provide services such as treatment of minor ailments, family planning, immunization and fortnightly outreach programmes.

The catchment communities to the health center include Koffi, Obufa Efak, Esoh, James Scott, Ama Otu, B Camp, Banga Camp, which are all settlements within Adiabo. The major cases handled by the facility are malaria and delivery services. Figure 4.31 shows a 6-month record of confirmed malaria cases, where 37 cases were reported and treated in the health center, from December 2024 to May 2025. Malaria was confirmed using rapid diagnostic test (RDT). Other health conditions reported sometimes at the center include pneumonia, cough and high blood pressure. The health center makes referrals to General Hospital, Calabar.

The facility groans under infrastructural and manpower needs; there is no laboratory and staffing is inadequate. The provision of these needs would enhance the capacity of the health center to live up to its mandates.

Plate 4.15: Health Centre in Adiabo.

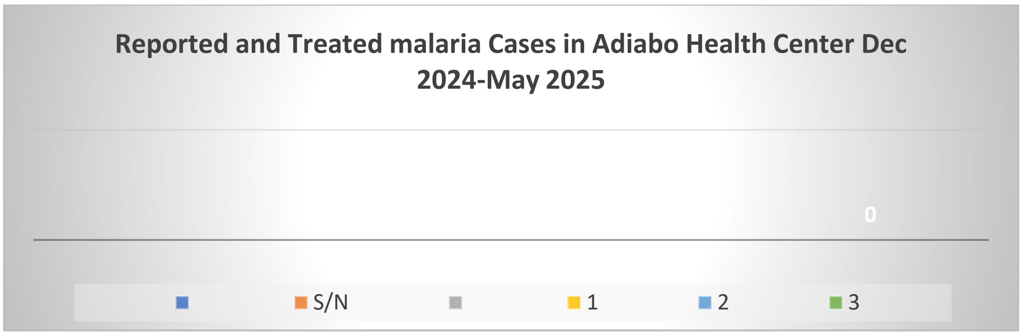


Figure 4.30: Six-month malaria record in Health Center, Adiabo Ikot Out

The health center in Adiabo Esine Ufot (Plate 4.15) operates from a property donated by the community. There is one nurse, yet the facility is operationally non-functional. Patent medicine stores, the Traditional Birth Attendants also form a part of the healthcare infrastructure in the area.

4.11.4.2 Access to Healthcare

Access to healthcare refers to the ease with which an individual can obtain needed medical services (Rand, 2016). It is influenced by various factors, including availability of functional healthcare infrastructure, affordability of available services, delivery of quality services and healthcare-seeking behavior or attitude and practice of healthcare. Within these contexts, it is deducible that the communities are in need of healthcare. Adiabo Ikot Mbo Otu has limited access to healthcare, because the available health infrastructure, the primary health center, does not have the functional capacity to render needed healthcare services to the people. This also promotes informal healthcare-seeking behaviour. Conversely, in Adiabo Esine Ufot, where the existing health center is not functional, the people seek medical attention at its closest location in 8th miles, a suburb of Calabar, about 9 kilometres away. The community lacks access to healthcare.

It is obvious that the difficulty and inconveniences involved in terms of logistics, time, money and safety in moving from the village to the urban/township definitely influence health choices in the community and negatively affect health and welfare of the people. Community members rather have access to patent medicine stores, where they could buy medicines on self-medication; and to traditional birth attendants who handle delivery services.

4.11.4.3 Disease Trend

The common health problems in the communities were identified through medical record, key informant interviews (KII), focus group discussions and field studies. From medical record and KII at the health center, malaria was identified as the most common disease in the area. Others include pneumonia, cough and high blood pressure. Ailments and health conditions identified by the people as common in their community include malaria, typhoid fever, arthritis, waste pain, high blood pressure and diabetes. These health conditions are experienced throughout the seasons. Malnutrition was identified amongst the children through BMI assessment. Malaria is the most common amongst these and one which poses the greatest threat to the communities. Figure 4.53 shows a trend in malaria in the study area. Reported cases spanned across both rainy and dry months. Like other parts of the country, malaria is endemic in the area, with steady transmission through the seasons. Malaria is one of the leading causes of death in Nigeria (WHO, 2024). Table 4.37 shows common illnesses in the area and their predisposing factors.

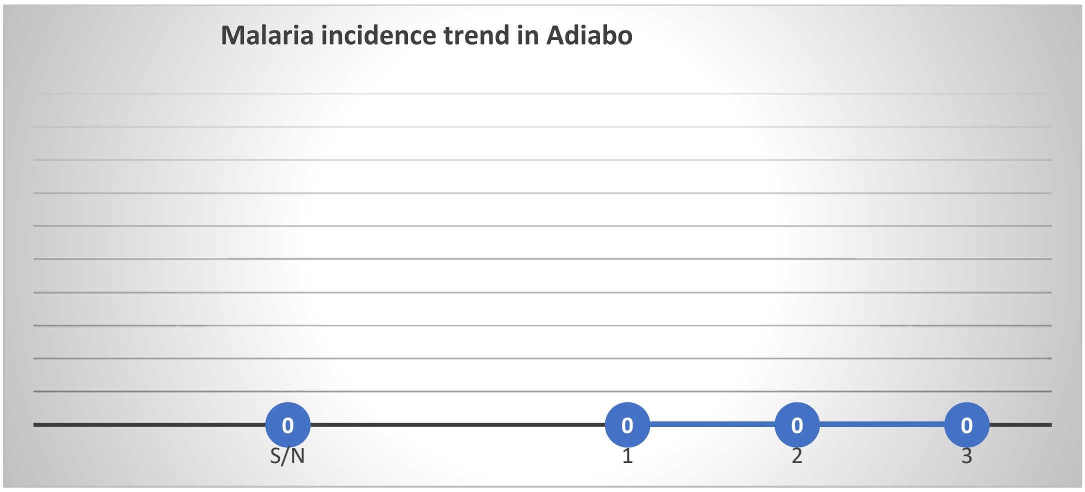


Figure 4.31: Trend of malaria incidence in Adiabo
(Reported cases Dec 2024-May 2025)

Table 4.37: Common illnesses/health conditions and their predisposing factors in Adiabo

S/N	Illness	Predisposing/Risk Factor
1	Malaria	- Water logs due to poor drainage, microenvironment conducive for vector breeding
2	Typhoid fever	- Unsafe source of drinking water - Poor sanitation
3	High Blood Pressure	- Stress, age - Excessive alcohol consumption
4	Diabetes	- Age, Genetics
5	Coughs	- Air pollution
6	Malnutrition	- Diet/food choices
7	Arthritis	- Work stress, age
8	Waist pain	- Work stress, age

Source: Field data, FGD/KII, 2025

4.11.5 Environmental Health Factors

4.11.5.1 Water Supply

There are two major sources of water supply in the communities, namely; borehole and stream/river. The dominant source of drinking water is borehole. Borehole facilities are owned by individual households (Plate 4.4). There are also two community boreholes from where water is reticulated for public use. Hence, borehole water supply is available to 90% of the population in Adiabo Ikot Mbo Otu. This is not the case in Adiabo Esine Ufot, where 10% has access to the resource. Water from this source is not treated before use. The microbiological profiles of groundwater in the area revealed neither faecal streptococcal bacteria nor total coliforms, but total heterotrophic bacteria with mean of 1.8 x 10^3±2.6 cfu/ml. This is within permissible limit by the WHO and the Federal Ministry of Environment, suggesting a level of safety of the water (Adiabo ESIA Laboratory work 2025). Although this might pose little or no significant risk to drinking, contamination of drinking water during storage and transit cannot be ruled out. Also, high heterotrophic plate count indicates ideal conditions for the growth of pathogenic bacteria.

About 10% of the population in Adiabo Ikot Mbo Otu use the supply from public taps, which are reticulated from 2 community boreholes, powered by solar energy. This is not available in Adiabo Esine Ufot. Safe handling and storage of borehole and pipe-borne water are strongly advised.

The local stream/river (Plate 4.16) is mostly used in Adiabo Esine Ufot, where about 90% of the population depend on it, in the absence of a better source of water supply. Microbial analysis of surface water in the area indicated faecal contamination of the resource; with recorded means of 10.7±3 cfu/100ml, 11.3±2 cfu/100ml and $1.2 \times 10^5 \pm 0$ cfu/ml for faecal Streptococci, Total Coliforms and Heterotrophic bacteria, respectively. These values are above permissible limits by the WHO and the Federal Ministry of Environment in this regard, and signifies that the water is not safe for drinking and domestic purposes. The Some community people also use drinking water in sachet (packaged water or "pure water") or bottles, from commercial sources.

Rainfall is another source of water for the people, accessible to 100% of the population, but not readily available as it is seasonal. It is prone to contamination by particulate matter and gaseous pollutants that cause acid rain; and also exposed to contamination during collection and storage.

Access to safe drinking water is defined as the percentage of the population having access to and using improved drinking water sources (CDC, 2022). Going by what is available to them and how it is managed, it is obvious that Adiabo Esine Ufot community lacks access to basic drinking water, which refers to water from an improved source, provided collection time is not more than 30 minutes for a round trip. Improved water sources include piped water, boreholes (Plate 4.16) or tube wells, protected dug wells, protected springs, and packaged or delivered water (World Bank, 2023).

The lack of safe water is a major public health issue. National statistics show that 70% of the population has access to basic water services, but more than 50% of these water sources are contaminated (UNICEF, 2021).

Plate 4.16: Sources of water supply in Adiabo. Left: Borehole facility in Adiabo, middle: Borehole fetching point, right: Idim Banga (stream)

4.11.5.2 Sanitation

Sanitation refers to the provision and availability of facilities and services for maintaining personal and public hygiene. Hence access to sanitation is measured by the percentage of the population which has access and are using improved sanitation facilities, such as flush or pour-flush toilet/latrine (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine (Plate 4.17) with slab or composting toilet (CDC, 2022).

The common sewage disposal methods in the communities are the use of water closet (WC) (water system) in buildings and the pit latrine. The former is dominant in Adiabo Ikot Mbo Otu, while the latter is dominant in Adiabo Esine Ufot. About 64% of the household use the WC in Adiabo Ikot Mbo Otu, while about 36% use the pit toilet. In Adiabo Esine Ufot, the WC is available to about 10% of households, while about 90% use the pit toilet. Open defeacation is not a common practice in the communities.

Plate 4.17: A pit toilet in Adiabo

4.11.5.3 Housing

Housing is significant in the assessment of health and wellbeing of communities; and this involves the building structure and the indoor and outdoor dwelling conditions associated with it. The dominant housing structures in the community are those of block wall with zinc roof (70%). Others are mud wall/Zinc roof (10%), block wall/aluminum roof (10%), Mud wall/thatch roof (10%) (Plate 4.18). The settlement pattern in the area is linear, nucleated; and a reflection of communal habitation.

Housing condition is fair in block-walled houses; most of such structures have ample ventilation, with mosquito net-screened windows. Mud-walled/thatch houses lack good ventilation and ample comfort; rather they have open eaves, which give access to disease vectors such as mosquitoes and other pests.

The status of house occupancy is fair in Adiabo Ikot Mbo Otu, with 3 persons sleeping in a room in a typical household; but poor in Adiabo Esine Ufot where with more than 3 persons sleeping in a room, especially in the low housing structure accommodations. This is indicative of inadequate housing, which is the sole cause of congestion in living houses. Housing deficiency is a major source of concern for the government. Recent statistics show that there is a national deficit of 28 million houses, with a budget requirement of 21 trillion Naira to meet (Gulloma, 2023). Congestion can enhance communal transmission and spread of contagious and airborne infections.

Plate 4.18: Housing. Left: Typical block wall/zinc roof house in the study area, right: typical mud wall/zinc roof houses in the study area.

4.11.5.4 Waste Management and Environmental Hygiene

i. General Waste Management

Wastes generated in the communities comprise mostly solid waste, which includes domestic and household wastes such as food waste, cellophane materials, empty cans, and waste from farm produce. Waste generation is low, and the waste stream is light, typical of a rural area.

The common practice of waste disposal is open dumping principally in surrounding bush patches in the neighbourhoods and in the river. Some of the wastes dumped around living surroundings are dispersed and littered by domestic animals and wind action. Open dumping of waste creates breeding sites for disease vectors and agents such as mosquitoes and other insects, and rodents. This has grave impact on environmental hygiene, with serious public health implications. Dumping of solid waste is a major source of pollution in the waterways. Waste burning is also a common practice of waste disposal in the communities. During FGD, community members expressed concerns about the rising wave of waste generation due to gradual increase in population in the area, and called for urban waste disposal services to be extended to their communities.

ii. Environmental Hygiene

At study time, most of the household surroundings in the community were largely tidy, having been well-swept. However, litters of household waste and fallen/dried leaves were observed in some areas. Most households are flanked by bush patches and overgrown vegetation comprising cultivated crops such as banana, plantain, pineapple, vegetables and grasses (Plate 4.19). Some of these plants have axils that hold water and create microenvironments conducive for the proliferation of arthropod vectors of common diseases, especially malaria. Overgrown vegetation around the homes also poses the risk of bites and discomfort by various animal species, ranging from insects and reptiles to lower mammals that would find the natural vegetation cover habitable.

Plate 4.19: Environmental hygiene. Left: typical living surroundings flanked by vegetation, right: Typical community surrounding in the study area

4.11.5.5 Pollution

The significant issues of pollution in the area are surface water pollution and indoor air pollution. The Calabar River course traversing their borders is prone to pollution from anthropogenic sources, especially waste dumping, both upstream and midstream around the community areas. Apart from solid waste, sand extraction activities by local sand miners cause turbidity and ecosystem disturbance, which could affect fisheries and livelihoods.

Another issue of concern is indoor air pollution through cooking and fish drying. About 50% of the population in both communities use firewood as source of energy for cooking and fish drying.

Cooking areas / fireplaces are located near living houses; hence household members are exposed to high risk of pollution by smoke. Children, especially the under-fives are potentially vulnerable to the effects of indoor air pollution (WHO, 2008). Indoor air pollution could promote health effects such as headaches, respiratory problems, frequent colds and sore throat, chronic cough, skin rashes, eye irritation, lethargy and dizziness and memory lapses (Vincoli, 1995).

4.11.5.6 Disease Vectors and Pests

The rural riverine ecology sustains various animal species, some of which are disease vectors and pests. The dominant disease vectors occurring in the area are insects, notably mosquitoes; and this corroborates the seeming high prevalence of malaria in the area. Other common insect pests reported to occur around the homes are houseflies, sand flies and cockroaches. Vertebrate animals that pose health risks include reptiles e.g., snakes; and rodents such as rats. Domestic animals are also kept in free range. These include goats, sheep, dogs and fowls. Most community people are conscious of the risk of zoonosis; whereby animal diseases could be transmitted to humans.

4.11.5.7 Occupational Health Risks

The community people are engaged in various livelihood activities including farming, fishing, trading, artisanal work, sand mining and hunting; but farming (80% and 60%) and fishing (4% and 20%) and are the major occupations in Adiabo Esine Ufot and Adiabo Ikot Mbo Otu, respectively. Sand mining also engages about 2-4% of the population. The major occupational health risks are the inherent risks associated with farming, fishing and sand mining (
Table 4.38).

Table 4.38: Major occupational health risks in the study area

S/N	Health risk	Ranking (1-10)	Predisposing Factor
1	Insect bite	10	Fishing, farm work
2	Snake bite	7	Farm work
3	Drowning	9	Fishing, Sand mining
4	Pneumonia	8	Cold/fishing, Sand mining
5	Rheumatism	7	Work fatigue

Ranking: 1 (very low) – 10 (very high), based on degree of risk.

4.11.5.8 Knowledge, Attitude and Practice on Health Issues

Knowledge, attitude and practice of the people on issues of health were assessed using information corroborated from questionnaire survey, focus group discussion (FGD), and key informants' interview (KII).

4.11.5.9 Knowledge of Common health issues

A qualitative assessment of the knowledge of community people on contemporary health issues taken at the FGD and KII sessions is presented in Table 4.39. Responses were rated qualitatively on a scale of 4: 0 (No knowledge), 1 (Uncertain), 2 (Fair Knowledge) and 3 (Good knowledge). Fair knowledge of the cause and prevention of common health conditions such as malaria, tuberculosis, HIV/AIDS and Zoonosis was recorded.

Survey results indicated the knowledge gap amongst the people on some contemporary health issues. For example, about 14% of community survey respondents were unaware of HIV/AIDS, while 36% were ignorant of its mode of transmission. Community health education / enlightenment is necessary in these communities.

Table 4.39: Qualitative rating of knowledge of common health issues in Adiabo

HEALTH INDEX	INDICATOR 0=No knowledge 1=Uncertain 2=Fair Knowledge 3=Good knowledge	
	Cause	Prevention
Malaria	3	3
Tuberculosis	2	2
HIV/AIDS	2	2
Zoonosis	3	3

Source: FGD/KII

4.11.5.10 Healthcare-seeking behaviour

Individual's reaction to ill health constitutes a major indicator to healthcare. Healthcare-seeking behaviour (HSB) is defined as "any action or inaction undertaken by individuals who perceive themselves to have a health problem or to be ill, for the purpose of finding an appropriate remedy" (Olenja, 2003). It refers to one's choices in dealing with health problems. There are three basic categories of HSB, namely, Appropriate; which involves formal medical care, Inappropriate, which involves informal options such as patent medicine vendors, traditional healers, self-treatment, and Inaction, which refers to no action. At Focus group discussions, HSB was considered at the community level as attitude and practice of seeking and obtaining treatment for illnesses by the people, and defined in context by the proportion of people taking the respective actions/inaction. Healthcare options available to the people in the communities are primary healthcare center, patent medicine stores, traditional medicine, and the church. Healthcare-seeking behaviour was identified as formal (appropriate); most people desire to seek medical attention at health centres or hospitals for their health problems. About 57% of respondents in the community survey would go to the health center/hospital, while 36% prefer the patent medicine store as a first line of action towards addressing their health problem. However, in practice, owing to limited or no access to healthcare, the need to patronize the patent medicine shop or other alternatives as a first line of action becomes unavoidable. Appropriate HSB can be influenced by the availability of healthcare infrastructure, good service delivery, proximity, affordability, prompt attention, and readily available drugs in the healthcare facility (Latunji & Akinyemi, 2018).

4.11.5.11 Lifestyle and Habits / Psychosocial Health Indicators

Common habits and lifestyle were examined to determine the inclinations of the people. These include alcohol consumption, tobacco smoking, sexual behaviour and personal hygiene. At the community level, the extent of indulgence or habitual practice of these was qualitatively rated from FGDs on a 5-point scale as 1 (Very low), 2 (Low), 3 (High) and 4 (Very high) or 0 (Inexistent); and these were determined by the people's knowledge of their environment. Illicit sexual behavior was defined in context as the level of casual/extra-marital affairs by individuals, and determined by the keeping of sexual partners not married to one. Hand-washing before meals and after defecating was used as key indicator for good personal hygiene habits. A summary of the responses is presented in Table 4.40

At the community level, tobacco smoking and alcohol consumption was low; illicit sexual activities were at a very low rate; adultery is forbidden in the communities. There are no brothels in the area. It was indicated that people habitually wash their hands before they eat and after using the toilet. Quantitative assessment of these indicators from community survey is presented in Table 4.40. This shows a fair record of health-related habits amongst the people.

Alcohol and tobacco are vital health indicators (WHO 2010) and their use is a critical factor in psychosocial health of the individual, and the community by extension. High indulgence in illicit sexual practice is a prime indicator in sexually-transmitted infections (STI) and could be a source of major health concern for individuals, households and the community.

Table 4.40: Qualitative rating of common lifestyle/habits at community level in Adiabo

COMMUNITY	LIFESTYLE/HABIT			
	Tobacco Smoking	Alcohol consumption	Illicit Sexual Activities	Hand washing
Adiabo Ikot Mbo Otu	2	2	1	4
Adiabo Esine Ufot	2	2	1	4

Rating at FGD on a 5-point scale: 1 (Very low), 2 (Low), 3 (High) and 4 (Very high) or 0 (Inexistent); based on the people's knowledge of their environment.

4.11.5.12 Community Concerns and Needs

The communities expressed acceptance of the proposed project but however raised the concern of environmental pollution; with expectations that proper environmental management should be ensured to mitigate the adverse impact of the project.

The priority health and other needs of the communities are listed in Table 4.41.

Table 4.41: Health and other needs of communities

S/N	COMMUNITY	NEED
1	Adiabo Ikot Mbo Otu	Potable water, improved health facility, roads and drainage, fire station
2	Adiabo Esine Ufot	Potable water, health facility, electricity, roads and drainage

Source: FGD, 2025

5. ASSOCIATED AND POTENTIAL IMPACTS

This chapter presents a comprehensive assessment of the associated and potential environmental and Socioeconomic impacts arising from the development and operation of the proposed Agro-Industrial Hub (AIH). The chapter evaluates the potential interactions between project designs, activities and the surrounding physical, biological, and human environments across all project phases - site preparation, construction, operation, and decommissioning.

The objective of this impact assessment is to identify both adverse and beneficial impacts, determine their significance, and propose appropriate mitigation or enhancement measures. It also considers cumulative effects and aligns the assessment with national regulatory requirements and international best practices. This analysis provides the basis for informed decision-making and the development of effective environmental and social management strategies for the project. The stepwise approach for the assessment is illustrated in Figure 5.1.

5.1 Impact Identification and Evaluation Methodology

Whatever the impact and specific technique used to analyze it, prediction and evaluation are usually based on a sound methodological framework, which covers the following:

- The overall prediction and evaluation process;
- Choice of prediction technique;
- Criteria for evaluating significance;
- The design of mitigation measures; and
- Indirect impacts, long range impacts and uncertainty.

5.1.1 Summary of Environmental Impact Indicators

The environmental impact indicators are easily observable parameters that will indicate change/deviation, which can be used to monitor the various environmental components, as presented in Table 5.1.

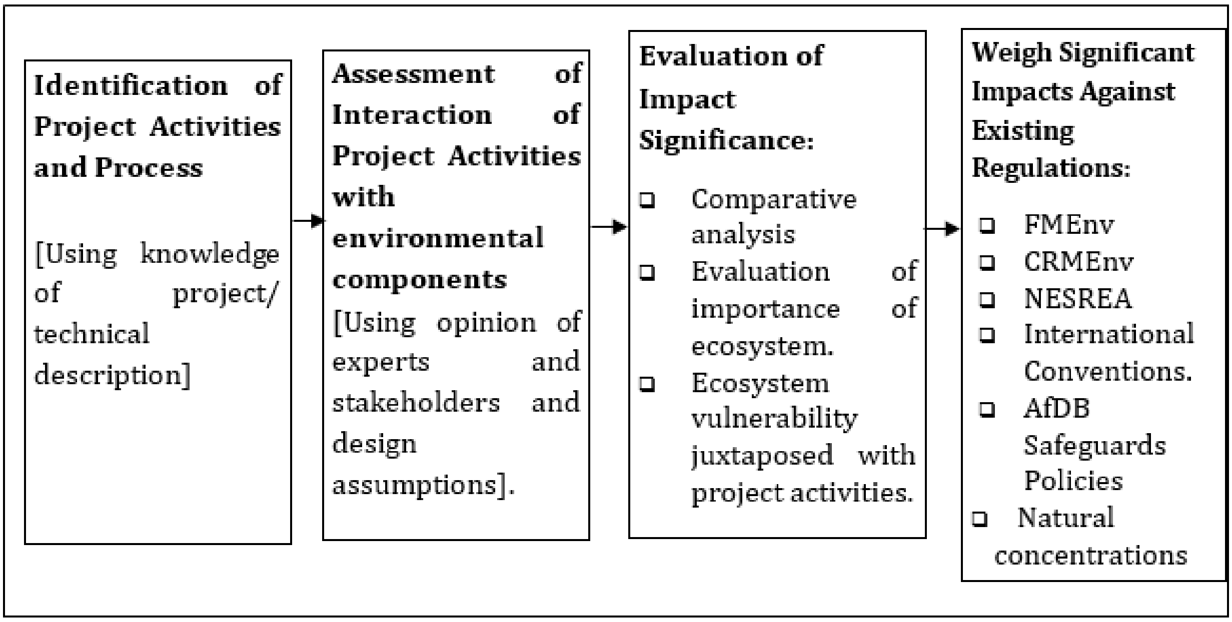


Figure 5.1: Schematic Representation of Potential Impact Assessment Approach

Table 5.1: Environmental Components and Potential Indicators

S/N	ENVIRONMENTAL COMPONENTS	IMPACT INDICATORS
1.	Air Quality	SPM, CO2, NOx, SOx, CO, VOC, CH4, NH3, etc.
2.	Noise	Noise level dB(A)
3.	Soil/Agriculture	Soil type and structure, physico-chemical, heavy metals load and microbiological characteristics, etc.
4	Terrestrial flora and fauna	Spp. abundance and diversity
5	Surface Water Quality	Dissolved and suspended solids, turbidity, toxicity, physico-chemistry, heavy metals content and microbiological char characteristics, etc
6	Ground water quality	Dissolved and suspended solids, turbidity, toxicity, physico-chemistry, heavy metals content and microbiology
7	Hydrology	Seasonality, dissolved and suspended solids, turbidity, toxicity, physico-chemistry, heavy metals content and microbiological char characteristics, etc
8	Community and workplace safety	Accident and incident records
9	Socioeconomic/Health	Needs and concern of host communities, perception on the proposed project/health risks, waste streams, handling treatment and disposal, income/livelihoods, employment, etc.
10	Public health and safety	Accident and incident records

5.1.2 Qualitative and Quantitative Impact Risk Evaluation

The identification of potential impacts of the proposed project was followed by impact prediction using the most commonly used impact prediction tools particularly, the environmental management system (EMS) ISO14001 approach and professional judgement. These impact prediction tools have allowed the prediction of changes that will take place to the baseline environment (biophysical, cultural and socioeconomic).

The impacts identified and predicted were characterized. Although the characteristics of impacts can vary, the assessment took into consideration typical parameters such as the following:

- Nature of impacts (beneficial, adverse, direct, indirect, cumulative);
- Magnitude of impacts (severe, moderate, low);
- Extent/location of impacts (area/volume covered, distribution);
- Timing of impacts (during construction, operation, decommissioning, immediate, delayed, rate of change);
- Duration of impacts (short term, long term, intermittent, continuous);
- Normality/abnormality of impacts;
- Likelihood of impacts (probability, uncertainty or confidence in the prediction).

The potential impacts were then quantified to determine their significance using a set of criteria and weighting scale. The following are the criteria:

- Legal/Regulatory Requirements (L)
- Risk Factor (R)
- Frequency of Occurrence of Impact (F)
- Importance of Impact on Affected Environmental Components (I)
- Public Perception (P)

An ISO14001 Environmental Management System (EMS) approach was adopted for rating of significance of the project impacts and is presented as follows:

1. Legal/Regulatory Requirements **(L)** – The criterion is to essentially determine whether there is a legal/regulatory requirement or permit.
   - 0 = There is no legal/regulatory requirement
   - 3 = There is legal/regulatory requirement
   - 5 = There is a legal/regulatory requirement and permit
2. Risk Factor – A risk assessment matrix (RAM) evaluates the risk factor of the impacts
   - 1 = Low risk
   - 3 = Medium risk
   - 5 = High risk
3. Frequency of impact (F) – What is the frequency rating of impact based on the RAM?
   - 1 = Low frequency
   - 3 = Medium
   - 5 = High frequency
4. Importance of impacts and environmental component affected (I) – What is the rating of importance based on consensus of opinions?
   - 1 = Low
   - 3 = Medium
   - 5 = High

5. Public perception/concerns (P) – What is the rating of public perception and concerns on project impacts based on consultations and interviews

1 = Low perception/concerns

3 = Medium perception/concerns

5 = High perception/concerns

The above criteria and rating of potential impacts of the project activities was based on a number of factors including the following:

- The known and likely presence of environmental receptors and resources.
- Vulnerability or sensitivity of affected resources and receptors.
- Ability of receptors or resources to absorb change
- The extent, nature and duration of physical change resulting from the construction and operation of the AIH.

The rating of each of the impacts resulting from the project activities were also based on EMS ISO14001 approach where the criteria are summed up and categorized as either significant or not significant. That is where:

- $L+R+F+I+P \geq 15$; $F+I > 6$ or $P=5$, the impact significance is regarded as high;
- $L+R+F+I+P \geq 8$ but < 15 the impact significance is regarded as medium; and
- $L+R+F+I+P \leq 8$ the impact significance is regarded as low or not significant.

Table 5.2 presents a simplified assessment matrix that summarizes project activities and the associated and potential impacts and their rating.

Table 5.2: Simplified Assessment Matrix of Project Action and Environmental Impacts

Project Phase	**Project Activity**	**Potential Impact**	**Impact Receptors**	**Impact Qualification**								**Impact Quantification**					**Overall Rating**	**Overall Significance**
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
Pre-construction Phase	Equipment and Personnel Mobilization	Noise pollution from heavy duty trucks, equipment, and people	➢Host Communities Mobilized construction workers	x			x	x		X		0	3	3	3	1	10	Medium
		Air pollution from vehicle emission brought on by elevated concentration of CO, NO_2, SPM, SO_2, etc		x			x	x		X		0	3	3	3	2	11	Medium
	Site Clearing	Vegetation loss of about 37.94 ha and habitat disturbance of 12.5 ha	➢Host Communities ➢Ecosystem	x			x	x		X		3	3	1	3	3	13	Medium
		Removal of top soil of about 382,772 m^3 and soil compaction increased erosion potential		x		x		x		X		0	3	5	5	3	16	High
		Reduced carbon sequestration capacity due to vegetation loss of about 14.6 ha amounting to about 57,997.70 m^3 biomass	➢Ecosystem	x			x	x				3	5	3	3	3	17	High
		Increased noise levels, vibration and air quality degradation from machines and equipment	➢Host Communities ➢Mobilised Individuals (construction workers)	x			x	x		X		3	3	1	3	3	13	Medium
		Dust generated from about 382,772 m^3 soil stockpiles and handling	➢Host communities ➢Construction workers	x			x	x		X		1	3	1	3	2	10	Medium
		Vegetative waste generation due to trees, shrubs and grasses clearing	➢Ecosystem	x			x	x		X		3	3	1	3	2	12	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Overall Significance
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Increased erosion potential due vegetation loss		x			x	x		X		3	3	1	3	3	13	Medium
		Reduction in structural stability and percolation ability of soil due to compaction and other engineering activities		x			x	x		X		3	3	1	3	3	13	Medium
Construction Phase	Site Preparation through; ➢Removal of vegetation and soil compaction from 117.5 ha	Increase dust generation from cleared land and windblown stockpiles.	➢Host communities ➢Construction workers ➢Ecosystem	x			x	x		X		3	1	1	3	3	11	Medium
		Increased soil erosion potential; reduction in structural stability and percolation ability of soil.		x			x	x		X		5	5	3	3	3	19	High
	Civil and Construction activities through ground levelling, excavation and foundation	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site		x		x		x		x		0	3	3	3	3	12	Medium
		Air quality impacts due to emissions of about 164,082 m^3 from the operation of heavy-duty construction machines and motors vehicles on site		x		x		x		x		0	3	3	3	3	12	Medium
	Cement mixing, concrete batching and handling	Contamination of surface water sources		x			x	x			x	2	1	3	3	3	12	Medium
		Poor air quality to the release fine dust, including $PM_{2.5}$ and PM_{10}, into the air		x			x	x			x		1	3	3	3	10	Medium
		Batching plants and mixing sites generate construction waste of about 87 m^3 in form of cement bag, formwork waste, scrap metals and fasteners		x			x	x		x		3	3	1	3	3	11	Medium
		Spills of chemicals, fuels, or other pollutants can contaminate the soil.		x			x	x		x		3	1	1	3	3	11	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Overall Significance
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Leaks from vehicles or equipment can also lead to soil contamination.		x			x	x		x		3	1	1	3	2	10	Medium
	Haulage of construction/building materials	Increased GHG emissions from trucks, heavy duty machines and equipment of about 164,082 tCO_2e		x			x	x			x	2	3	3	2	3	13	Medium
		Increased SPM due to wind blowing particles from operation trucks hauling sands and aggregates		x			x		x		x	3	3	3	3	3	15	Medium
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Alteration of landscapes due to the removal of topsoil, excavation of large pits, and creation of spoil heaps.	➢Ecosystem	x		x	x	x			x	3	2	2	3	3	13	Medium
		Heavy machinery on and around the quarry can also compact soil, inhibiting future vegetation growth.		x			x	x		x		3	1	1	3	2	10	Medium
		Quarrying activities like drilling, blasting, crushing, and transporting materials generate large amounts of dust.		x			x	x			x	3	2	3	3	3	14	Medium
		Heavy machinery and frequent blasting create significant noise and vibrations that can disturb wildlife and communities near the quarry.	➢Host communities ➢Construction workers	x			x	x			x	2	1	3	3	3	12	Medium
		Increase air quality pollution and greenhouse gas emission due to machinery used in quarries emits pollutants like nitrogen oxides and carbon dioxide (CO_2)		x			x	x			x	3	2	2	3	3	13	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Overall Significance
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site	➢Ecosystem	x		x		x		x		2	2	5	4	5	18	High
		Disruption of wildlife migration patterns		x			x	x		x		3	1	1	3	2	10	Medium
		Introduction of pollutants (such as cement dust, leftover cement mix) into nearby water bodies through run-off	➢Host communities	x			x	x			x	2	1	3	3	3	12	Medium
		Soil contamination due to improper disposal of construction materials waste (e.g. cement bag, formwork waste, scrap metals and fasteners etc.)	➢Host communities ➢Ecosystem	x		x		x		x		2	2	5	4	5	18	High
Operational Phase	CR SAPZ-AIH facilities and operations	Increase noise level from the operations of various machines and equipment such as power plant	➢Host communities ➢Ecosystem	x		x		x		x		1	1	4	3	2	12	Medium
		The daily release of nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons, and particulate matter ($PM_{2.5}$, PM_{10}) from machineries and equipment directly affects local air quality		x			x	x		x		3	1	1	3	2	10	Medium
		Streams of agricultural waste generate such as peeling process, separations of raw materials and processed waster from production		x		x		x	x			3	2	4	3	2	14	Medium
		Increase soil pollution potential due to spilled fuel, spent oil, lubricants, aluminum oxide paint etc. during routine maintenance																

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Overall Significance
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		of the operating machineries and equipment																
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Increase noise level and dust generation due to the demolition and removal of camps components and other structures	➢Construction worker	x		x		x		x		1	1	4	3	3	12	Medium
		Increase noise and air quality pollution due to transfer of heavy-duty equipment and construction machineries	➢Host communities ➢Construction worker	x			x	x			x	1	1	4	3	3	12	Medium
		Solid waste generation and improper disposal waste facility		x		x		x		X		1	1	4	3	2	11	Medium

Table 5.3: Simplified Assessment Matrix of Project Action and Social Impacts

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Rating	Overall Significar
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
Pre-construction Phase	Land takeover (repossession) of 130 ha	Economic displacement of 145 households losing farmlands and crops	Host communities	X		x		x		x		5	5	4	5	5	24	High
		Conflicts may emerge due to insufficient stakeholders' engagement and/or perceived inadequate compensation for farmland and crops loss or perceived disparity in compensation		X		x		x		x		5	3	2	3	5	18	High
	Equipment and Personnel Mobilization	Population surge of about 500 workers leading to pressure on available resources (e.g, water, space etc.)	➢ Host Communities ➢ Mobilised Individuals (construction workers)	X		x		x		x		0	1	1	3	5	10	Medium
		Outbreaks of communicable diseases (eg. Flu, Tuberculosis, Ringworm		x		x		x		x		0	2	1	3	5	11	Medium
		Worsening anti-water and anti-sanitation practices;		x		x		x		x		0	1	1	3	5	10	Medium
		Stranger Elements; new levels of social interaction and strange sexual life; incidence of sexually transmitted infections, (STI), HIV/AIDS.		x		x		x		x		0	3	1	3	1	8	Medium
		Risk of respiratory diseases in personnel and members of the community		x			X	x		x		0	3	2	3	3	11	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Rating	Overall Significan
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Reducing aesthetic value of the area.		x			x	x		x		3	1	1	3	3	11	Medium
		Population surge of about 500 workers will increase the domestic waste generation by ~300 m^3 of solid waste leading to sanitation challenges.		x			x	x			x	2	2	5	2	3	14	Medium
	Site Clearing	Increased earnings to local laborer from the clearing of vegetation and site preparation Improved standard of living	➢ Host Communities		x		x	x		x		N	N	N	N	N		
		Reduce crime and social vices due to various engagement through job opportunities			x		x	x		x		N	N	N	N	N		
		Reduced local landscape aesthetic value due to natural vegetation clearing		x			x	x			x	2	1	1	1	2	7	Low
		Clearing activities may eliminate access to plant used for medicinal purpose and other cultural practices		x			x	x			x	2	1	1	1	2	7	Low
Construction Phase	Site Preparation through; ➢ Removal of vegetation and soil compaction from 117.5 ha	Disruption of established social ties and support networks due to the displacement of farming household	➢ Host Communities	x			x	x		x		3	1	1	3	3	11	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Rat ing	Overall Significar
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
	➢ Civil and Construction activities through ground levelling, excavation and foundation	Destruction of crops and farm lands due to excavation and grading of farmland	➢ Host Communities	x			x	x		x		3	1	1	3	3	11	Medium
		Respiratory illness from airborne dust due to earthwork activities could lead to common colds, flu, asthma etc.		x			x	x		x		2	3	1	3	3	12	Medium
		Prolonged exposure to noise from earthwork activities can cause stress, hearing loss, and sleep disturbance.		x			x	x		x		2	3	1	3	3	12	Medium
	Hiring of construction personnel	Employment of community locals	➢ Host communities		x	x		x		x								
		Boost of local economy and improvement of standard of living through job opportunities and high purchasing rate			x		x	x		x								
		Provision or improvement of local infrastructure and amenities			x	x		x		x								
		Conflicts may emerge during site clearing and preparation activities due to insufficient stakeholder engagement and/or perceived disparities in employment opportunities		x		x		x			x	2	3	3	2	3	13	Medium
	Cement mixing, concrete	Water-related health conditions due to water source contamination	➢ Host communities	x			x	x			x	2	1	3	3	3	12	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Rating	Overall Significance
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
	batching and handling		➢ Construction workers															
		Occupational, health and safety concerns for the workers due to potential skin and eye irritation, respiratory and allergic concerns.	➢ Construction Workers	x		x	x	x			x	5	5	3	3	3	19	High
		Abrasive damage to the lung due inhalation of airborne dust from cement and silica.		x		x	x	x			x	5	5	3	2	3	18	High
		Damage to the natural landscapes due to quarrying for raw materials	➢ Ecosystem	x		x		x	x		x	5	5	2	2	2	16	High
		Destruction of flora and fauna habitats and potentially disrupting ecological balance due to quarrying for raw materials		x		x		x	x		x	5	5	2	2	2	16	High
	Haulage of construction/building materials	Aggregates falling off and hitting and damaging third party windshields and causing other forms of injuries	➢ Road Users	x			x	x			x	3	2	2	3	3	13	Medium
		Deterioration of existing roads	➢ Host Communities ➢ Road Users	x		x		x			x	2	3	3	2	3	13	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Rating	Overall Significar
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Increased accident rate due to increased movement of trucks and other earth-moving vehicles	➢ Road Users ➢ Construction workers	x		x		x			x	2	4	3	2	3	14	Medium
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Provide employment for the locals	➢ Host Communities		x		x	x		x		N	N	N	N	N		
		Large and unmanaged quarry pits poses safety risks to community members		x			x	x			x	1	1	2	3	3	10	Medium
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site cause stress, hearing loss, and sleep disturbance.	➢ Host Communities ➢ Construction workers	x		x		x		x		1	3	3	3	3	13	Low
		Impact on water quality if hazardous wastes are discharged to watercourses or from runoff from inappropriately stored hazardous waste		x			x	x			x	2	2	5	2	3	14	Medium
Operational Phase	CR SAPZ-AIH facilities	Employment of community locals	➢ Host communities		x	x		x		x								
		Boost of local economy and improvement of standard of			x		x	x		x								

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Rat ing	Overall Significar
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
	and operations	living through job opportunities and high purchasing rate																
		Provision or improvement of local infrastructure and amenities			x	x		x		x								
		Reduction in crime and social vices through engagement of local youth		x		x		x		X								
		Enhance socio-economic potential of the locals and increase interaction beyond immediate localities			x	x	x	x	x	x								
		Pressure on local housing and infrastructure due to influx of people seeking for job opportunity and those working in the area		x	x	x		x	x	x		1	2	5	4	3	1 5	Medium
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Job opportunity for the demolition exercise	➢ Host Communities		x		x	x	x									
		Positively improve living standard of the youth			x		x	x	x									
		Reduction in crime and social vices through engagement of local youth			x		x	x	x									
		Health and safety risks to workers from demolition activities	➢ Construction worker	x			x	x		x		1	1	4	4	3	1 3	Medium

5.2 Description of Potential Impacts

The potential impacts of the project across its different phases (Pre-Construction, Construction, Operational, and Decommissioning) involves specific activities with varying levels of interaction with the biophysical and socio-economic environment. The impacts are categorized as adverse or beneficial, direct or indirect, short-term or long-term, local or regional, and are rated based on their significance.

5.2.1 Pre-Construction Phase

Equipment and Personnel Mobilization
Environmental Impacts

- **Noise pollution from heavy-duty trucks, equipment, and personnel movement**: The mobilization of heavy trucks, construction machinery, and workers will introduce continuous noise into the project area. This is an **adverse, short-term, direct, and normal impact**, because it results from routine mobilization activities. Although temporary, the noise can cause considerable disturbance to the host environment, affecting both human comfort and ecological balance. Considering its limited duration but widespread effect, the **overall significance is Medium**.
- **Air pollution from vehicle emissions**: Exhaust emissions from mobilized vehicles and equipment will increase the concentration of pollutants such as carbon monoxide, nitrogen oxides, sulphur oxides, and suspended particulate matter in the atmosphere. This is an **adverse, short-term, direct, and normal impact**, as it originates directly from fuel combustion and dissipates after mobilization ends. However, poor air circulation may worsen its immediate effects on local air quality, making the **overall significance Medium**.

Social Impacts

- **Population surge and pressure on local resources**: The influx of approximately 500 workers will create a sudden increase in demand for food, water, housing, and other social amenities. This situation is **beneficial, short-term, direct, and normal** in terms of stimulating local economic activity and service demand, but simultaneously **adverse, short-term, direct, and normal** as it overstretches already limited community resources. The competing outcomes balance each other, with an **overall significance of Medium**.
- **Outbreaks of communicable diseases**: High population density and increased interaction between mobilized workers and the local community increase the likelihood of disease transmission. Respiratory illnesses such as flu and tuberculosis, as well as skin infections like ringworm, could spread easily. This is an **adverse, short-term, direct, and abnormal impact**, as it introduces public health risks beyond normal community conditions. Because of its potential to affect both workers and residents, the **overall significance is Medium**.
- **Poor sanitation and hygiene practices**: Influx of workers may lead to indiscriminate waste disposal, inadequate toilet facilities, and increased water contamination, resulting in declining sanitation levels. This constitutes an **adverse, short-term, direct, and abnormal impact**, since it could trigger public health challenges not typical of the community under normal conditions. The **overall significance is Medium**.

- **Risk of sexually transmitted infections (STIs), including HIV/AIDS**: The arrival of new groups of workers introduces different social dynamics and relationships, which may increase exposure to STIs and HIV/AIDS. This is an **adverse, long-term, indirect, and abnormal impact**, as the effects extend beyond the mobilization period and have lasting health and social consequences. The **overall significance is Medium**.
- **Respiratory health risks**: Exposure to exhaust fumes and dust from mobilized vehicles and equipment may cause short-term respiratory conditions such as coughing, asthma aggravation, and eye irritation. This is an **adverse, short-term, direct, and normal impact**, as it arises directly from vehicle use. The **overall significance is Medium**.
- **Reduction in local aesthetic value**: Increased movement of vehicles, dust emissions, and temporary worker camps will degrade the visual appeal of the project environment. This is an **adverse, short-term, indirect, and normal impact**, as it does not directly damage environmental components but reduces the attractiveness of the locality. The **overall significance is Medium**.
- **Increase in solid waste generation**: The influx of 500 workers will result in an estimated 300 m^3 of domestic waste, which requires proper collection and disposal. If not managed, this becomes an **adverse, short-term, direct, and normal impact**, as poor waste handling can cause pollution and health hazards. The **overall significance is Medium**.

Site Clearing
Environmental Impacts

- **Vegetation loss and habitat disturbance**: Clearing of approximately 37.94 hectares of land and disturbance of 12.5 hectares of habitat will significantly alter the ecological setting. This is an **adverse, long-term, direct, and normal impact**, as it directly removes natural vegetation and reduces available habitat for wildlife. Biodiversity depletion is expected, and natural regeneration may be slow. The **overall significance is Medium**.
- **Topsoil removal and soil compaction**: The extraction of about 382,772 m^3 of topsoil coupled with soil compaction will degrade soil fertility and increase erosion susceptibility. This represents an **adverse, long-term, direct, and abnormal impact**, as it permanently alters soil structure and productivity. Given the scale of soil disturbance, the **overall significance is High**.
- **Reduced carbon sequestration**: Clearing of 37.94 hectares of vegetation will reduce the carbon storage capacity of the environment, resulting in a biomass loss of about 164,720.23 m^3. This is an **adverse, long-term, direct, and abnormal impact**, as it weakens the area’s role in climate regulation. The **overall significance is High**.
- **Noise, vibration, and degraded air quality from equipment**: Operation of clearing equipment will release noise, vibration, and exhaust gases, leading to deterioration of local air quality and temporary disturbance of the environment. This is an **adverse, short-term, direct, and normal impact**, with an **overall significance of Medium**.
- **Dust generation from soil stockpiles**: Movement and storage of excavated soil will generate dust particles, lowering ambient air quality and increasing respiratory risks. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance of Medium**.
- **Vegetative waste generation**: Large quantities of shrubs, grasses, and tree debris will be produced, requiring proper handling and disposal. This is an **adverse, short-term, direct, and normal**

impact, as unmanaged waste could create secondary environmental concerns. The **overall significance is Medium**.

- **Increased erosion potential**: Vegetation removal leaves soils exposed to wind and water erosion, potentially leading to land degradation. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance rated Medium**.
- **Reduced soil structural stability and percolation**: Heavy equipment use during clearing will compact soils, reducing their ability to absorb water and sustain vegetation. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance considered Medium**.

Social Impacts

- **Increased earnings for local laborers**: Engagement of local workers during site clearing provides jobs and income, improving household livelihoods. This is a **beneficial, short-term, direct, and normal impact** with positive implications for poverty reduction.
- **Reduction in crime and social vices**: Employment opportunities reduce idleness among youth, helping to minimize crime and anti-social behaviors. This is a **beneficial, short-term, indirect, and normal impact**, contributing to community stability.
- **Reduction in local aesthetic value**: Loss of vegetation reduces the scenic appeal of the project area. This is an **adverse, long-term, indirect, and normal impact**, with the **overall significance rated Low**.
- **Loss of medicinal and cultural plant resources**: Clearing activities may remove species used for traditional medicine or cultural practices. This is an **adverse, long-term, indirect, and normal impact**, with an **overall significance of Low**.

Land Takeover (Repossession of 130 ha)
Social Impacts

- **Economic displacement of households**: About 145 households will lose farmland and crops due to land repossession, disrupting their primary means of livelihood. This is an **adverse, long-term, direct, and abnormal impact** with profound socio-economic implications. Because the displacement is permanent and affects household income security, the **overall significance is High**.
- **Conflicts due to inadequate or unequal compensation:** Where compensation for land and crops is perceived as inadequate or unfairly distributed, disputes and grievances are likely to arise. This represents an **adverse, long-term, indirect, and abnormal impact**, as it undermines community cohesion and may escalate into social conflict. The **overall significance is High**.

5.2.2 Construction Phase

Site Preparation (Removal of Vegetation and Soil Compaction from 117.5 ha)
Environmental Impacts

- **Increase in dust generation from cleared land and stockpiles**: The removal of vegetation and exposure of bare soils will generate dust, particularly when stockpiles are dispersed by wind. This is an **adverse, short-term, direct, and normal impact**, since it results directly from site preparation activities and will reduce once surfaces are stabilized. The impact contributes to reduced air quality and discomfort in nearby areas, with the **overall significance rated Medium**.

- **Increased soil erosion and reduction in structural stability**: Soil compaction and vegetation removal will leave the ground vulnerable to erosion, while also diminishing its structural integrity and water infiltration capacity. This is an **adverse, long-term, direct, and abnormal impact**, as it fundamentally alters soil properties beyond natural recovery without intervention. Given its persistence and severity, the **overall significance is High**.

Social Impacts

- **Disruption of established social ties and support networks**: Farming households that depend on the land may experience displacement and disruption of long-standing social and economic support systems. This is an **adverse, long-term, indirect, and abnormal impact**, since it affects the socio-cultural structure of communities in a way that is not easily reversible. The **overall significance is Medium**.

Civil and Construction Activities (Ground Levelling, Excavation, and Foundation Works)
Environmental Impacts

- **Noise from engines, machinery, and vehicle operations**: The operation of heavy-duty construction equipment and vehicles will produce significant noise on the site. This is an **adverse, short-term, direct, and normal impact**, persisting for the duration of construction but diminishing once the phase is complete. The **overall significance is Medium**.
- **Air quality impacts due to emissions from heavy-duty equipment and vehicles**: Construction machinery will release exhaust gases, including CO, NOx, and particulate matter, which degrade air quality in the immediate area. This is an **adverse, short-term, direct, and normal impact**, continuing for as long as machines are in use. The **overall significance is Medium**.

Social Impacts

- **Destruction of crops and farmlands**: Excavation and grading works may encroach on croplands, leading to direct loss of agricultural output. This is an **adverse, short-term, direct, and normal impact**, as it stems directly from construction earthworks. The **overall significance is Medium**.
- **Respiratory illness from airborne dust**: Dust released during earthworks can lead to respiratory ailments such as asthma and bronchitis. This is an **adverse, short-term, direct, and normal health impact**, with the **overall significance considered Medium**.
- **Stress, hearing loss, and sleep disturbance from prolonged noise exposure**: Workers and residents near the construction site may experience stress, fatigue, and hearing impairment from persistent exposure to construction noise. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance rated Medium**.

Cement Mixing, Concrete Batching, and Handling
Environmental Impacts

- **Contamination of surface water sources**: Runoff from batching activities may carry cement residues and chemicals into surface water bodies, causing contamination. This is an **adverse, short-term, direct, and abnormal impact**, introducing pollutants that are not naturally occurring in these waters. The **overall significance is Medium**.
- **Poor air quality from release of fine dust ($PM_{2.5}$, PM_{10})**: Dust emissions from batching and handling processes reduce ambient air quality, especially near mixing sites. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance assessed as Medium**.
- **Generation of construction waste (87 m^3 of debris)**: Batching and mixing will produce waste in the form of cement bags, formwork scraps, and metals. This is an **adverse, short-term, direct, and normal impact**, contributing to solid waste challenges on site. The **overall significance is Medium**.
- **Soil contamination from chemical or fuel spills**: Accidental spills of fuels, lubricants, or cement residues can degrade soil quality. This is an **adverse, long-term, direct, and abnormal impact**, as soil contamination may persist over time. The **overall significance is Medium**.

Social Impacts

- **Water-related health conditions from contamination**: Communities relying on affected water sources may suffer gastrointestinal and other waterborne diseases. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance rated Medium**.
- **Occupational health and safety risks to workers**: Workers exposed to cement dust and chemicals are at risk of skin and eye irritation, respiratory ailments, and allergic reactions. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance assessed as High**.
- **Abrasive lung damage from inhalation of dust**: Prolonged inhalation of cement and silica dust particles can cause severe lung damage. This is an **adverse, long-term, direct, and abnormal impact**, considered of **High significance**.

Haulage of Construction and Building Materials
Environmental Impacts

- **Greenhouse gas emissions from haulage trucks and machinery**: The transportation of materials will emit CO_2 and other greenhouse gases, contributing to air pollution and climate change. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance of Medium**.
- **Increased suspended particulate matter from haulage operations**: Windblown particles from trucks hauling sand and aggregates will degrade air quality. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance rated Medium**.

Social Impacts

- **Falling aggregates causing road accidents and injuries**: Poorly secured loads may fall from moving trucks, endangering other road users. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance of Medium**.
- **Deterioration of existing roads**: Heavy vehicle use will degrade road surfaces and accelerate wear and tear. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance considered Medium**.
- **Increased accident rate from high truck movement**: The rise in traffic involving large trucks increases the likelihood of accidents. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance rated Medium**.

Extraction, Processing, and Transportation of Quarried Materials
Environmental Impacts

- **Alteration of landscapes through excavation and spoil heaps**: Large pits and heaps formed during quarrying alter the natural landscape permanently. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance assessed as Medium**.
- **Soil compaction from heavy machinery**: Frequent use of quarry machinery compacts soils, reducing their ability to support vegetation recovery. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance rated Medium**.
- **Dust emissions from quarrying activities**: Blasting, drilling, and crushing of materials generate significant dust, reducing air quality. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance of Medium**.
- **Noise and vibrations from blasting and heavy machinery**: Quarry operations generate continuous noise and vibrations that disturb communities and wildlife. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance considered Medium**.
- **Air pollution and GHG emissions from quarry machinery**: The use of heavy equipment in quarries releases greenhouse gases and pollutants such as NO_x and CO_2. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance assessed as Medium**.

Social Impacts

- **Employment opportunities for local workers**: Quarrying activities will create jobs for locals, providing economic benefits. This is a **beneficial, short-term, direct, and normal impact** with positive socio-economic significance.
- **Safety risks from unmanaged quarry pits**: Abandoned or poorly managed pits present hazards to community members, particularly children. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance rated Medium**.

Construction of Fences, Buildings, and Utilities
Environmental Impacts

- **Noise from engines, heavy machinery, and vehicles**: Construction works will generate substantial noise over extended periods. This is an adverse, short-term, direct, and normal impact, with the overall significance assessed as High.
- **Disruption of wildlife migration patterns**: Fences and buildings may interfere with natural wildlife movement routes. This is an **adverse, long-term, indirect, and normal impact**, with the **overall significance of Medium**.
- **Introduction of pollutants into nearby water bodies**: Runoff from construction sites carrying cement residues and chemicals contaminates water sources. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance considered Medium**.
- **Soil contamination from improper waste disposal**: Cement bags, scrap metals, and formwork waste can pollute soil if disposed of improperly. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance rated High**.

Social Impacts

- **Noise-induced stress and health impacts**: Prolonged noise from construction activities may lead to stress, fatigue, and hearing challenges. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance assessed as Medium**.

- **Water quality impacts from hazardous waste runoff**: Hazardous construction materials stored or disposed of inappropriately may contaminate watercourses. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance rated Medium**.

5.2.3 Operational Phase

CR SAPZ–AIH Facilities and Operations
Environmental Impacts

- **Increase in noise levels from operational machinery and equipment**: The continuous operation of machinery, including power plants and processing equipment, will elevate noise levels within and around the facility. This is an **adverse, long-term, direct, and normal impact**, as it is a natural consequence of facility operations. While persistent throughout the operational life, its effects are localized. The **overall significance is Medium**.
- **Air quality degradation from machinery emissions**: The daily release of pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons, and particulate matter ($PM_{2.5}$ and PM_{10}) from operational machinery will reduce local air quality. This is an **adverse, long-term, direct, and normal impact**, as it is tied directly to ongoing facility functions. The persistence of emissions makes the **overall significance Medium**.

- **Generation of agricultural waste streams**: Processing activities such as peeling, separation of raw materials, and production will generate significant volumes of agricultural waste. This is an **adverse, long-term, direct, and normal impact**, as it occurs regularly throughout operations. If not effectively managed, it may contribute to environmental pollution. The **overall significance is Medium**.
- **Soil pollution from spills and maintenance activities**: Routine maintenance of machinery, including the use of fuels, lubricants, and aluminum oxide paints, poses a risk of soil contamination from spills and leakages. This is an **adverse, long-term, direct, and abnormal impact**, as contamination introduces pollutants not naturally present in soils and persists over time. The **overall significance is Medium**.

Social Impacts

- **Employment of community members**: Facility operations will create direct and indirect jobs for community members, boosting household incomes. This is a **beneficial, long-term, direct, and normal impact**, contributing positively to livelihoods and poverty reduction.
- **Boost to local economy and standard of living**: Employment and trade opportunities associated with the facility will enhance purchasing power and improve living standards. This is a **beneficial, long-term, indirect, and normal impact**, with broad socio-economic benefits.
- **Improvement of local infrastructure and amenities**: Facility development and associated services may improve roads, utilities, and other community infrastructure. This is a **beneficial, long-term, indirect, and normal impact**, which strengthens community development.
- **Reduction in crime and social vices**: Engagement of local youths in gainful employment will reduce idleness, helping to minimize crime and antisocial behavior. This is a **beneficial, long-term, indirect, and normal impact**, supporting social stability.
- **Enhanced socio-economic interactions**: The presence of the facility will increase opportunities for trade, collaboration, and social exchange beyond local boundaries. This is a **beneficial, long-term, indirect, and normal impact**, fostering regional integration.
- **Pressure on housing and infrastructure due to population influx**: Influx of workers and job seekers will create pressure on housing, water, and other local infrastructure. This is an **adverse, long-term, indirect, and normal impact**, as it results from increased demand beyond existing capacity. The **overall significance is Medium**.

5.4.4 Decommissioning Phase

Demolition and Removal of Camps, Cabins, and Equipment

Environmental Impacts

- **Increase in noise and dust generation from demolition activities**: The dismantling of camps, cabins, and associated structures will produce significant noise and dust emissions. This is an **adverse, short-term, direct, and normal impact**, arising naturally from demolition operations. While temporary, it can affect both the environment and human comfort. The **overall significance is Medium**.

- **Increase in noise and air pollution from transfer of heavy-duty equipment**: The removal and transportation of heavy-duty construction machinery will elevate noise levels and release vehicular emissions. This is an **adverse, short-term, direct, and normal impact**, with effects ceasing once equipment is evacuated from the site. The **overall significance is Medium**.
- **Generation of solid waste from dismantled facilities**: Demolition will generate substantial volumes of solid waste, including debris from structures and equipment parts. Improper disposal of this waste poses risks of soil and water contamination. This is an **adverse, short-term, direct, and abnormal impact**, as it introduces waste materials that are not naturally present in the environment. The **overall significance is Medium**.

Social Impacts

- **Job opportunities from demolition activities**: The decommissioning process will create employment for local workers involved in demolition, waste handling, and equipment removal. This is a **beneficial, short-term, direct, and normal impact**, improving short-term household incomes.
- **Improvement in youth livelihoods and reduction in social vices**: Engagement of local youths during decommissioning may enhance their living standards and reduce crime or antisocial behavior by providing productive opportunities. This is a **beneficial, short-term, indirect, and normal impact**, contributing positively to social wellbeing.
- **Health and safety risks to demolition workers**: Workers engaged in demolition activities face risks of accidents, injuries, dust inhalation, and other occupational hazards. This is an **adverse, short-term, direct, and normal impact**, given the physically intensive and hazardous nature of demolition works. The **overall significance is Medium**.

6. IMPACTS MITIGATION MEASURES

This chapter presents environmental and social mitigation measures that have been identified through the impact assessment process. As presented earlier in Chapter Five, the proposed project will definitely impact on various components of the biophysical, health and social environments and the identified negative impacts have been ranked accordingly. To mitigate the significant medium and high-ranking negative impacts identified as a result of the proposed development, a number of steps have been taken as well as enhance those impacts identified as positive to preserve the environment. The mitigation measures proposed for the predicted impacts took cognizance of the following:

- Environmental laws in Nigeria and permissible limits for waste streams (FEPA, 1991);
- AfDB's guidelines for mitigation measures are designed to:
    - Integrate environmental and social considerations into all aspects of project planning and implementation.
    - Minimize negative impacts on the environment and communities.
    - Promote sustainable development and social inclusion.
    - Ensure accountability and transparency in project management.
- Best Available Technology for sustainable development;
- Feasibility of application of the measures in Nigeria;
- Concerns and views of stakeholders during extensive consultations conducted during the study, and
- The residual effects that arise despite the mitigation measures have also been discussed for effective mitigation to a low level.

The mitigation measures for both the impacts before, and during the construction and operational phases are discussed in Table 6.1 below, with respective environmental monitoring and management requirements.

Impact Mitigation Measures

For those associated/potential impacts that were identified during the pre-construction phase, the proposed mitigation measures are addressed as presented in Table 6.1.

Table 6.1:Environmental Impact Mitigation Measures across the Project Phases

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
Pre-construction Phase	Equipment and Personnel Mobilization	Noise pollution from heavy-duty trucks, equipment, and personnel movement	➢Host Communities ➢Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: Restrict mobilization of heavy-duty trucks, equipment, and personnel to daylight hours. Maintain machinery with functional silencers Install temporary noise barriers near sensitive receptors such as school area, religious area etc. Limit engine idling times.	Low
		Air pollution from vehicle emissions (CO, NO_2, SPM, SO_2)	➢Host Communities ➢Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: Ensure low-emission or fuel-efficient heavy-duty trucks, equipment is mobilised for the project Conduct periodic emission testing to ensure low emission output Enforce "no idling" policy for resource maximization Use low-sulfur fuels where possible.	Low
	Site Clearing	Vegetation loss of about 37.94 ha and habitat disturbance of 12.5 ha	➢Host Communities ➢Ecosystem	Medium	CR-SAPZ shall: Give adequate notice to tenant farmers before clearing Target post-harvest period for clearing to ensure farmers have harvested their crops Restrict clearing to project footprint; Replant native species; Prepare and implement a flood and erosion control plan.	Low
		Removal of top soil of about 382,772 m3 and soil compaction increased erosion potential	➢Host Communities ➢Ecosystem	High	CR-SAPZ shall: Strip and store topsoil separately (to a depth of 150–300 mm) before excavation for later re-use in site rehabilitation. Limit clearing and topsoil removal to the smallest area necessary at any one time to reduce exposure. Avoid heavy machinery movement on wet soils to minimize compaction.	Low
		Reduced carbon sequestration capacity	➢Ecosystem	High	CR-SAPZ shall: Clear the vegetation from the project footprint selectively;	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		due to vegetation loss of about 37.94 ha amounting to about 164.720.23 m^3			Implement compensatory afforestation by planting native species of trees and shrubs along the entire site perimeter and internal fences and the proposed internal major and minor road network at 10 m interval. This will give about 1098 trees. At maturity, in 4-6 years, these will increase the annual carbon sequestration capacity of the site by 15.25 tons of CO_2. Avoid ecologically sensitive area by preserving the 36 ha of riparian vegetation along the water/ drainage channel within the AIH site (BMP refers)	
		Increased noise levels, vibration and air quality degradation from machines and equipment	➢Host Communities ➢Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: Schedule noisy operations to avoid early mornings (6 am - 10 am) and nights (7pm – 6am). Maintain equipment in good working condition to reduce noise output and emission. Apply water sprays to suppress dust.	Low
		Dust generated from about 382,772 m^3 soil stockpiles and handling	➢Host communities ➢Construction workers	Medium	CR-SAPZ shall: Cover stockpiles with tarpaulins. Wet exposed surfaces during dry periods. Limit vehicle speeds on unpaved roads to ≤ 20 km/h (Traffic MP refers) Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO. Evacuate vegetative waste as soon as they generated to avoid putrefaction	Low
		Vegetative waste generation due to trees, shrubs and grasses clearing	Ecosystem	Medium	CR-SAPZ shall: Reuse chipped material for mulching or erosion control.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		Increased erosion potential due vegetation loss	Ecosystem	Medium	CR-SAPZ shall: Install silt fences and sediment traps Restrict machinery movement to defined access routes and stabilize exposed soil promptly.	Low
		Reduction in structural stability and percolation ability of soil due to compaction and other engineering activities	Ecosystem	Medium	CR-SAPZ/DBOC shall: De-compact soils in non-structural areas post-works Use light-weight equipment where possible. Construct silt fences to prevent the wash away of the topsoil Construct sediment basins to capture sediment-laden runoff from rainfall	Low
Construction Phase	Site Preparation through; • Removal of vegetation and soil compaction from 37.94 ha	Increase dust generation from cleared land and windblown stockpiles.	➢Host communities ➢Construction workers	Medium	CR-SAP shall:. Regularly spray water on exposed soil surfaces and stockpiles, especially during dry or windy conditions. Cover stockpiles with tarpaulin, geotextile sheets, or fast-growing ground cover vegetation to reduce wind erosion. Restrict vehicle speeds on unpaved surfaces to ≤ 20 km/h to reduce dust from movement. Schedule high-dust-generating activities (e.g., grading, excavation) during periods of low wind speeds. Evacuate vegetative waste as soon as they generated to avoid putrefaction Provide and enforce the use of appropriate PPE OHSP & LMP refer)	Low
		Increased soil erosion potential; reduction in structural stability and percolation ability of soil.		Medium	CR-SAPZ/DBOC shall : Strip and store topsoil separately for later use in site restoration Limit clearing to the minimum area of about 37.94 ha Avoid machinery movement on wet soils. Install erosion controls (silt fences, sediment basins) before earthworks. Maintain buffer vegetation along waterways (FECP refers).	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	➢Civil and Construction activities through ground levelling, excavation and foundation	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site		Medium	CR-SAPZ/DBOC shall: Monitor noise levels regularly to ensure compliance with FMEnv standards. Use temporary noise barriers or acoustic screens near sensitive receptors (schools, hospitals, residences). Provide hearing protection (ear muffs/plugs) to workers exposed to noise >85 dB(A). Maintain all machinery to manufacturer specifications to minimise noise. Fit equipment with functional silencers/mufflers. Restrict noisy operations to 07:00–18:00 and avoid night-time work.	Low
		Air quality impacts due to emissions of about 164,082 m^3 from the operation of heavy-duty construction machines and motors vehicles on site		Medium	CR-SAPZ/DBOC shall: Regularly spray water on exposed soil surfaces and haul roads during dry conditions. Cover soil stockpiles with tarpaulin to prevent wind erosion. Limit vehicle speeds on unpaved surfaces to ≤ 20 km/h. Use low-emission or well-maintained machinery and vehicles	Low
	Cement mixing, concrete batching and handling	Contamination of surface water sources		Medium	CR-SAPZ/DBOC shall: Site batching plants at least 200 m away from water bodies and outside flood-prone zones. Prevent direct discharge of wastewater into drains or watercourses. Implement spill prevention and response protocols for cement and additives	Low
		Poor air quality to the release fine dust, including $PM_{2.5}$ and PM_{10}, into the air		Medium	CR-SAPZ/DBOC shall: Store cement in sealed silos or under cover to prevent wind exposure. Fit cement silos with dust filters and use enclosed transfer systems	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Spray water or use fogging systems at aggregate transfer points. Enforce the use of PPE (P2/N95 masks) for workers handling dry cement.(OHSP and LMP refer) Limit drop heights during loading/unloading to reduce airborne dust.	
		Batching plants and mixing sites generate construction waste of about 87 m^3 in form of cement bag, formwork waste, scrap metals and fasteners		Medium	CR-SAPZ/DBOC shall: Implement a waste minimization plan to avoid over-mixing. Segregate concrete waste for reuse in backfilling or road base where feasible. Collect and store non-recyclable residues in designated waste areas. Dispose of hardened waste through licensed waste contractors. Maintain accurate waste disposal records for compliance tracking.	Low
		Spills of chemicals, fuels, or other pollutants can contaminate the soil.		Medium	CR-SAPZ/DBOC shall: Store fuels, oils, and chemical admixtures in bunded areas with impermeable flooring. Use drip trays during refueling and equipment servicing. Train workers in safe handling of chemicals and emergency spill response Keep spill kits accessible at all batching and storage locations Immediately clean contaminated soil and dispose of as hazardous waste.	Low
		Leaks from vehicles or equipment can also lead to soil contamination.		Medium	CR-SAPZ/DBOC shall: Conduct daily inspections of mixers, pumps, and other equipment for leaks. Repair or replace defective equipment immediately. Park machinery on impermeable surfaces with containment bunds.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Capture leaks with absorbent pads or trays and dispose of them appropriately. Maintain a preventive maintenance schedule for all batching equipment.	
	Haulage of construction/building materials	Increased GHG emissions from trucks, heavy duty machines and equipment of about 164,082 tCO_2e		Medium	CR-SAPZ/DBOC shall: Use fuel-efficient or low-emission vehicles for all construction activities. Implement a preventive maintenance schedule to ensure engines operate efficiently. Optimize delivery routes to minimize travel distance and idle time. Enforce “no-idling” policy for stationary vehicles. Monitor fuel consumption and emissions regularly to track efficiency improvements.	Low
		Increased SPM due to wind blowing particles from operation trucks hauling sands and aggregates		Medium	CR-SAPZ/DBOC shall: Cover all loads with tarpaulin before transportation. Avoid overloading trucks to prevent spillage. Apply water spraying to haul roads during dry conditions. Restrict haulage truck speeds to $\leq$ 30 km/h in communities and unpaved areas (Traffic MP refers). Install wheel-wash facilities at site exits to reduce dust tracking onto public roads.	Low
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Alteration of landscapes due to the removal of topsoil, excavation of large pits, and creation of spoil heaps.	Ecosystem	Medium	CR-SAPZ/DBOC shall: Restrict quarrying to approved and licensed areas. Maintain buffer zones around sensitive habitats and water bodies. Implement progressive rehabilitation by regrading and re-vegetating disturbed areas. Use visual screening (vegetative buffers or berms) to minimize landscape intrusion.	Low
		Heavy machinery on and around the quarry can also compact soil,		Medium	CR-SAPZ/DBOC shall: Limit heavy machinery movement to designated haul routes.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		inhibiting future vegetation growth.			Use low ground-pressure machinery where feasible. De-compact soils in non-operational areas through scarification or ripping after use. Apply mulch or ground cover vegetation to restore infiltration and prevent erosion.	
		Quarrying activities like drilling, blasting, crushing, and transporting materials generate large amounts of dust.		Medium	CR-SAPZ/DBOC shall: Use water spray systems at crushers, conveyors, and loading points. Enclose conveyors and material handling systems where possible. Schedule blasting during low-wind conditions and notify nearby communities in advance. Monitor dust levels and adjust suppression measures as needed. Require workers in dusty areas to wear approved PPE (P2/N95 masks) (OHSP and LMP refer)	Low
		Heavy machinery and frequent blasting create significant noise and vibrations that can disturb wildlife and communities near the quarry.	➢Host communities ➢Construction workers	Medium	CR-SAPZ/DBOC shall: Limit blasting to designated times and avoid night-time operations. Maintain and fit machinery with noise-reducing devices. Install seismographs to monitor vibration levels and ensure they remain below damage thresholds. Notify local communities at least 24 hours before blasting. Provide hearing protection to workers in high-noise areas.	Low
		Increase air quality pollution and greenhouse gas emission due to machinery used in quarries emits pollutants like nitrogen oxides and carbon dioxide (CO_2)		Medium	CR-SAPZ/DBOC shall: Maintain engines to operate at peak efficiency. Use fuel-efficient or low-emission equipment. Optimize operational schedules to reduce idle times. Monitor fuel use and emissions regularly.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site	Ecosystem	High	CR-SAPZ/DBOC shall: Maintain machinery in good working condition and fit silencers/mufflers. Restrict high-noise operations to between 11 am –4 pm. Install temporary acoustic barriers near noise-sensitive receptors Provide hearing protection (ear muffs/plugs) to workers. Conduct periodic noise monitoring to ensure compliance with FMEnv standards.	Low
		Disruption of wildlife migration patterns		Medium	CR-SAPZ/DBOC shall: Incorporate wildlife crossings (culverts, underpasses) where feasible. Avoid construction during peak breeding or migration seasons. Maintain vegetative corridors where possible. Limit night-time work and use down-shielded lighting to reduce disturbance.	Low
		Introduction of pollutants (such as cement dust, leftover cement mix) into nearby water bodies through run-off	Host communities	Medium	CR-SAPZ/DBOC shall: Install sediment barriers, silt fences, or sediment basins to capture runoff. Collect cement slurry and wash water in lined containment pits. Dispose of concrete debris through licensed waste handlers. Prevent construction materials from entering drainage channels and water bodies.	Low
		Soil contamination due to improper disposal of construction materials waste (e.g. cement bag, formwork waste, scrap metals and fasteners etc.)	➢Host communities ➢Ecosystem	Medium	CR-SAPZ/DBOC shall: Store hazardous materials in bunded, leak-proof containers. Designate and manage hazardous waste storage areas. Engage FMEnv-approved contractors for hazardous waste disposal.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Train workers in proper handling of asphalt, paints, and chemical additives. Clean spills immediately and dispose of contaminated soil as hazardous waste.	
Operational Phase	CR SAPZ-AIH facilities and operations	Increase noise level from the operations of various machines and equipment such as power plant	➢Ecosystem	Medium	CR-SAPZ shall: Install acoustic enclosures, silencers, or mufflers on noisy equipment. Schedule high-noise activities during daytime working hours to minimize community disturbance. Implement preventive maintenance to reduce unnecessary noise from faulty machinery. Provide hearing protection devices (earplugs, earmuffs) to workers in high-noise zones (OHSP and LMP refers). Establish a noise monitoring program to ensure compliance with permissible limits. Introduce green buffer zones (trees/shrubs) around the facility to dampen noise propagation (BMP refers_	Low
		The daily release of nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons, and particulate matter (PM) from traffic directly affects local air quality		Medium	CR-SAPZ/ shall: Promote regular maintenance of company vehicles and machinery to ensure optimal combustion and reduced emissions. Encourage shuttle buses, or non-motorized transport for staff to reduce traffic volume. Establish dust suppression measures (e.g., water spraying on unpaved roads). Implement traffic management plans to avoid congestion within and around the site. Monitor air quality periodically and report findings to relevant environmental authorities. Use fuel-efficient driving practices and train drivers accordingly.	Low
		Streams of agricultural waste generate such as	➢Host communities	Medium	CR-SAPZ shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		peeling process, separations of raw materials and processed waster from production	➢Ecosystem		Implement waste segregation at the source (separate organic, recyclable, and non-recyclable waste). Adopt waste-to-compost or waste-to-energy systems for organic waste. Install sedimentation tanks or filter screens in wastewater discharge points to trap solid waste. Establish agreements with local farmers for reuse of organic waste as animal feed or soil conditioners (where safe). Regularly monitor effluent quality to ensure compliance with environmental standards. Provide staff training on proper waste handling and disposal.	
		Increase soil pollution potential due to spilled fuel, spent oil, lubricants, aluminum oxide paint etc. during routine maintenance of the operating machineries and equipment		Medium	CR-SAPZ shall: Create designated maintenance areas with impermeable flooring and oil interceptors to prevent soil infiltration. Implement spill prevention and response plans, including spill kits and trained personnel. Store fuels, lubricants, and chemicals in bunded (contained) storage facilities. Dispose of spent oil and hazardous waste through licensed waste management companies. Conduct regular inspection and maintenance of storage tanks, pipelines, and machinery. Use drip trays under parked or idle equipment to catch leaks. Prohibit direct disposal of any hazardous materials into the environment.	Low
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Increase noise level and dust generation due to the demolition and removal of camps	➢Construction worker	Medium	CR-SAPZ/DBOC shall: Restrict demolition works to daylight hours (11 am – 4pm) to minimize disturbance. Maintain and fit demolition machinery with effective silencers/mufflers	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		components and other structures			Use controlled dismantling methods rather than high-impact demolition where possible. Install temporary noise barriers near sensitive receptors. Provide hearing protection to workers and monitor noise levels to comply with FMEnv standards (OHSP refers)	
		Increase noise and air quality pollution due to transfer of heavy-duty equipment and construction machineries	➢Host communities ➢Construction worker	Medium	CR-SAPZ/DBOC shall: Spray water on debris and demolition areas to suppress dust during operations. Cover trucks transporting debris with tarpaulins. Store demolition waste in enclosed or covered areas. Restrict vehicle speeds on unpaved surfaces to ≤ 20 km/h Require all workers in dusty areas to wear dust masks (P2 or N95) (OHSP refers).	Low
		Solid waste generation and improper disposal waste facility		Medium	CR-SAPZ/DBOC shall: Segregate demolition waste into recyclable (metal, timber) and non-recyclable fractions. Reuse or recycle materials where feasible (e.g., scrap metal to recycling plants). Store waste in designated, secure areas before disposal. Engage licensed waste disposal contractors for final disposal. Maintain waste tracking documentation for regulatory compliance.	Low
	Decommissioning traffic diverted road for road users as alternative during construction	Dust emissions from temporary diversion dismantling or degradation	➢Ecosystem	Medium	CR-SAPZ/DBOC shall: Water exposed surfaces during dismantling Clear debris promptly and dispose of it at approved sites. Re-vegetate disturbed areas immediately Use erosion control structures where needed.	Low
		Soil compaction or damage during diversion closure		Medium	CR-SAPZ/DBOC shall: De-compact soils in affected areas using tillage methods. Restore topsoil and plant native vegetation. Ensure drainage systems are functional after closure Monitor restored areas for 6–12 months.	Low

Table 6.2: Environmental Impact Mitigation Measures across the Project Phases

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
Pre-construction Phase	Equipment and Personnel Mobilization	Noise pollution from heavy-duty trucks, equipment, and personnel movement	➢Host Communities ➢Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: -Restrict mobilization of heavy-duty trucks, equipment, and personnel to daylight hours. -Maintain machinery with functional silencers -Install temporary noise barriers near sensitive receptors such as school area, religious area etc. -Limit engine idling times.	Low
		Air pollution from vehicle emissions (CO, NO_2, SPM, SO_2)	➢Host Communities ➢Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: -Ensure low-emission or fuel-efficient heavy-duty trucks, equipment is mobilised for the project -Conduct periodic emission testing to ensure low emission output -Enforce "no idling" policy for resource maximization -Use low-sulfur fuels where possible.	Low
	Site Clearing	Vegetation loss of about 37.94 ha and habitat disturbance of 12.5 ha	➢Host Communities ➢Ecosystem	Medium	CR-SAPZ shall: -Give adequate notice to tenant farmers before clearing -Target post-harvest period for clearing to ensure farmers have harvested their crops -Restrict clearing to project footprint; -Replant native species; -Prepare and implement a flood and erosion control plan.	Low
		Removal of top soil of about 382,772 m^3 and soil compaction increased	➢Host Communities ➢Ecosystem	High	CR-SAPZ shall: -Strip and store topsoil separately (to a depth of 150–300 mm) before excavation for later re-use in site rehabilitation. -Limit clearing and topsoil removal to the smallest area necessary at any one time to reduce exposure.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		erosion potential			-Avoid heavy machinery movement on wet soils to minimize compaction.	
		Reduced carbon sequestration capacity due to vegetation loss of about 37.94 ha amounting to about 164.720.23 m^3	➢Ecosystem	High	CR-SAPZ shall: -Clear the vegetation from the project footprint selectively; -Implement compensatory afforestation by planting native species of trees and shrubs along the entire site perimeter and internal fences and the proposed internal major and minor road network at 10 m interval. This will give about 1098 trees. At maturity, in 4-6 years, these will increase the annual carbon sequestration capacity of the site by 15.25 tons of CO_2. -Avoid ecologically sensitive area by preserving the 36 ha of riparian vegetation along the water/ drainage channel within the AIH site (BMP refers)	Low
		Increased noise levels, vibration and air quality degradation from machines and equipment	➢Host Communities ➢Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: -Schedule noisy operations to avoid early mornings (6 am - 10 am) and nights (7pm – 6am). -Maintain equipment in good working condition to reduce noise output and emission. -Apply water sprays to suppress dust.	Low
		Dust generated from about 382,772 m^3 soil stockpiles and handling	➢Host communities ➢Construction workers	Medium	CR-SAPZ shall: -Cover stockpiles with tarpaulins. -Wet exposed surfaces during dry periods. -Limit vehicle speeds on unpaved roads to ≤ 20 km/h (Traffic MP refers) -Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					-Evacuate vegetative waste as soon as they generated to avoid putrefaction	
		Vegetative waste generation due to trees, shrubs and grasses clearing	Ecosystem	Medium	CR-SAPZ shall: -Reuse chipped material for mulching or erosion control.	Low
		Increased erosion potential due vegetation loss	Ecosystem	Medium	CR-SAPZ shall: -Install silt fences and sediment traps -Restrict machinery movement to defined access routes and stabilize exposed soil promptly.	Low
		Reduction in structural stability and percolation ability of soil due to compaction and other engineering activities	Ecosystem	Medium	CR-SAPZ/DBOC shall: -De-compact soils in non-structural areas post-works -Use light-weight equipment where possible. -Construct silt fences to prevent the wash away of the topsoil - Construct sediment basins to capture sediment-laden runoff from rainfall	Low
Construction Phase	Site Preparation through; • Removal of vegetation and soil compaction from 37.94 ha	Increase dust generation from cleared land and windblown stockpiles.	➢Host communities ➢Construction workers	Medium	CR-SAP shall:. -Regularly spray water on exposed soil surfaces and stockpiles, especially during dry or windy conditions. -Cover stockpiles with tarpaulin, geotextile sheets, or fast-growing ground cover vegetation to reduce wind erosion. -Restrict vehicle speeds on unpaved surfaces to ≤ 20 km/h to reduce dust from movement.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					-Schedule high-dust-generating activities (e.g., grading, excavation) during periods of low wind speeds. -Evacuate vegetative waste as soon as they generated to avoid putrefaction -Provide and enforce the use of appropriate PPE OHSP & LMP refer)	
		Increased soil erosion potential; reduction in structural stability and percolation ability of soil.		Medium	CR-SAPZ/DBOC shall : -Strip and store topsoil separately for later use in site restoration -Limit clearing to the minimum area of about 37.94 ha -Avoid machinery movement on wet soils. -Install erosion controls (silt fences, sediment basins) before earthworks. -Maintain buffer vegetation along waterways (FECP refers).	Low
	Civil and Construction activities through ground levelling, excavation and foundation	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site		Medium	CR-SAPZ/DBOC shall: -Monitor noise levels regularly to ensure compliance with FMEnv standards. -Use temporary noise barriers or acoustic screens near sensitive receptors (schools, hospitals, residences). -Provide hearing protection (ear muffs/plugs) to workers exposed to noise >85 dB(A). -Maintain all machinery to manufacturer specifications to minimise noise. -Fit equipment with functional silencers/mufflers. -Restrict noisy operations to 07:00–18:00 and avoid night-time work.	Low
		Air quality impacts due to emissions of		Medium	CR-SAPZ/DBOC shall: -Regularly spray water on exposed soil surfaces and haul roads during dry conditions.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		about 164,082 m^3 from the operation of heavy-duty construction machines and motors vehicles on site			-Cover soil stockpiles with tarpaulin to prevent wind erosion. -Limit vehicle speeds on unpaved surfaces to ≤ 20 km/h. -Use low-emission or well-maintained machinery and vehicles	
	Cement mixing, concrete batching and handling	Contamination of surface water sources		Medium	CR-SAPZ/DBOC shall: -Site batching plants at least 200 m away from water bodies and outside flood-prone zones. -Prevent direct discharge of wastewater into drains or watercourses. -Implement spill prevention and response protocols for cement and additives	Low
		Poor air quality to the release fine dust, including $PM_{2.5}$ and PM_{10}, into the air		Medium	CR-SAPZ/DBOC shall: -Store cement in sealed silos or under cover to prevent wind exposure. -Fit cement silos with dust filters and use enclosed transfer systems -Spray water or use fogging systems at aggregate transfer points. -Enforce the use of PPE (P2/N95 masks) for workers handling dry cement.(OHSP and LMP refer) -Limit drop heights during loading/unloading to reduce airborne dust.	Low
		Batching plants and mixing sites generate construction		Medium	CR-SAPZ/DBOC shall: -Implement a waste minimization plan to avoid over-mixing. -Segregate concrete waste for reuse in backfilling or road base where feasible.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		waste of about 87 m^3 in form of cement bag, formwork waste, scrap metals and fasteners			-Collect and store non-recyclable residues in designated waste areas. -Dispose of hardened waste through licensed waste contractors. -Maintain accurate waste disposal records for compliance tracking.	
		Spills of chemicals, fuels, or other pollutants can contaminate the soil.		Medium	CR-SAPZ/DBOC shall: -Store fuels, oils, and chemical admixtures in bunded areas with impermeable flooring. -Use drip trays during refueling and equipment servicing. -Train workers in safe handling of chemicals and emergency spill response -Keep spill kits accessible at all batching and storage locations -Immediately clean contaminated soil and dispose of as hazardous waste.	Low
		Leaks from vehicles or equipment can also lead to soil contamination.		Medium	CR-SAPZ/DBOC shall: -Conduct daily inspections of mixers, pumps, and other equipment for leaks. -Repair or replace defective equipment immediately. -Park machinery on impermeable surfaces with containment bunds. -Capture leaks with absorbent pads or trays and dispose of them appropriately. -Maintain a preventive maintenance schedule for all batching equipment.	Low
	Haulage of construction/building materials	Increased GHG emissions from trucks,		Medium	CR-SAPZ/DBOC shall: -Use fuel-efficient or low-emission vehicles for all construction activities.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		heavy duty machines and equipment of about 164,082 tCO_2e			-Implement a preventive maintenance schedule to ensure engines operate efficiently. -Optimize delivery routes to minimize travel distance and idle time. -Enforce "no-idling" policy for stationary vehicles. -Monitor fuel consumption and emissions regularly to track efficiency improvements.	
		Increased SPM due to wind blowing particles from operation trucks hauling sands and aggregates		Medium	CR-SAPZ/DBOC shall: -Cover all loads with tarpaulin before transportation. -Avoid overloading trucks to prevent spillage. -Apply water spraying to haul roads during dry conditions. -Restrict haulage truck speeds to ≤ 30 km/h in communities and unpaved areas (Traffic MP refers). -Install wheel-wash facilities at site exits to reduce dust tracking onto public roads.	Low
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Alteration of landscapes due to the removal of topsoil, excavation of large pits, and creation of spoil heaps.	Ecosystem	Medium	CR-SAPZ/DBOC shall: -Restrict quarrying to approved and licensed areas. -Maintain buffer zones around sensitive habitats and water bodies. -Implement progressive rehabilitation by regrading and re-vegetating disturbed areas. -Use visual screening (vegetative buffers or berms) to minimize landscape intrusion.	Low
		Heavy machinery on and around the quarry can also compact soil, inhibiting future		Medium	CR-SAPZ/DBOC shall: -Limit heavy machinery movement to designated haul routes. -Use low ground-pressure machinery where feasible. - De-compact soils in non-operational areas through scarification or ripping after use.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		vegetation growth.			-Apply mulch or ground cover vegetation to restore infiltration and prevent erosion.	
		Quarrying activities like drilling, blasting, crushing, and transporting materials generate large amounts of dust.		Medium	CR-SAPZ/DBOC shall: -Use water spray systems at crushers, conveyors, and loading points. -Enclose conveyors and material handling systems where possible. -Schedule blasting during low-wind conditions and notify nearby communities in advance. -Monitor dust levels and adjust suppression measures as needed. -Require workers in dusty areas to wear approved PPE (P2/N95 masks) (OHSP and LMP refer)	Low
		Heavy machinery and frequent blasting create significant noise and vibrations that can disturb wildlife and communities near the quarry.	➢Host communities ➢Construction workers	Medium	CR-SAPZ/DBOC shall: -Limit blasting to designated times and avoid night-time operations. -Maintain and fit machinery with noise-reducing devices. -Install seismographs to monitor vibration levels and ensure they remain below damage thresholds. -Notify local communities at least 24 hours before blasting. -Provide hearing protection to workers in high-noise areas.	Low
		Increase air quality pollution and greenhouse gas emission due to machinery used in		Medium	CR-SAPZ/DBOC shall: -Maintain engines to operate at peak efficiency. -Use fuel-efficient or low-emission equipment. -Optimize operational schedules to reduce idle times. -Monitor fuel use and emissions regularly.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		quarries emits pollutants like nitrogen oxides and carbon dioxide (CO_2)				
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site	Ecosystem	High	CR-SAPZ/DBOC shall: -Maintain machinery in good working condition and fit silencers/mufflers. -Restrict high-noise operations to between 11 am – 4 pm. -Install temporary acoustic barriers near noise-sensitive receptors -Provide hearing protection (ear muffs/plugs) to workers. -Conduct periodic noise monitoring to ensure compliance with FMEnv standards.	Low
		Disruption of wildlife migration patterns		Medium	CR-SAPZ/DBOC shall: -Incorporate wildlife crossings (culverts, underpasses) where feasible. - Avoid construction during peak breeding or migration seasons. -Maintain vegetative corridors where possible. -Limit night-time work and use down-shielded lighting to reduce disturbance.	Low
		Introduction of pollutants (such as cement dust, leftover cement mix) into nearby water bodies	Host communities	Medium	CR-SAPZ/DBOC shall: -Install sediment barriers, silt fences, or sediment basins to capture runoff. -Collect cement slurry and wash water in lined containment pits. -Dispose of concrete debris through licensed waste handlers.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		through run-off			-Prevent construction materials from entering drainage channels and water bodies.	
		Soil contamination due to improper disposal of construction materials waste (e.g. cement bag, formwork waste, scrap metals and fasteners etc.)	➢Host communities ➢Ecosystem	Medium	CR-SAPZ/DBOC shall: -Store hazardous materials in bunded, leak-proof containers. -Designate and manage hazardous waste storage areas. -Engage FMEnv-approved contractors for hazardous waste disposal. -Train workers in proper handling of asphalt, paints, and chemical additives. -Clean spills immediately and dispose of contaminated soil as hazardous waste.	Low
Operational Phase	CR SAPZ-AIH facilities and operations	Increase noise level from the operations of various machines and equipment such as power plant	➢Ecosystem	Medium	CR-SAPZ shall: -Install acoustic enclosures, silencers, or mufflers on noisy equipment. -Schedule high-noise activities during daytime working hours to minimize community disturbance. -Implement preventive maintenance to reduce unnecessary noise from faulty machinery. -Provide hearing protection devices (earplugs, earmuffs) to workers in high-noise zones (OHSP and LMP refers). -Establish a noise monitoring program to ensure compliance with permissible limits. -Introduce green buffer zones (trees/shrubs) around the facility to dampen noise propagation (BMP refers_	Low
		The daily release of nitrogen		Medium	CR-SAPZ/ shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		oxides (NOx), carbon monoxide (CO), hydrocarbons, and particulate matter (PM) from traffic directly affects local air quality			-Promote regular maintenance of company vehicles and machinery to ensure optimal combustion and reduced emissions. -Encourage shuttle buses, or non-motorized transport for staff to reduce traffic volume. -Establish dust suppression measures (e.g., water spraying on unpaved roads). -Implement traffic management plans to avoid congestion within and around the site. -Monitor air quality periodically and report findings to relevant environmental authorities. -Use fuel-efficient driving practices and train drivers accordingly.	
		Streams of agricultural waste generate such as peeling process, separations of raw materials and processed waster from production	➢Host communities ➢Ecosystem	Medium	CR-SAPZ shall: -Implement waste segregation at the source (separate organic, recyclable, and non-recyclable waste). -Adopt waste-to-compost or waste-to-energy systems for organic waste. -Install sedimentation tanks or filter screens in wastewater discharge points to trap solid waste. -Establish agreements with local farmers for reuse of organic waste as animal feed or soil conditioners (where safe). -Regularly monitor effluent quality to ensure compliance with environmental standards. -Provide staff training on proper waste handling and disposal.	Low
		Increase soil pollution potential due to spilled fuel, spent oil,		Medium	CR-SAPZ shall: -Create designated maintenance areas with impermeable flooring and oil interceptors to prevent soil infiltration.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		lubricants, aluminum oxide paint etc. during routine maintenance of the operating machineries and equipment			-Implement spill prevention and response plans, including spill kits and trained personnel. -Store fuels, lubricants, and chemicals in bunded (contained) storage facilities. -Dispose of spent oil and hazardous waste through licensed waste management companies. -Conduct regular inspection and maintenance of storage tanks, pipelines, and machinery. -Use drip trays under parked or idle equipment to catch leaks. -Prohibit direct disposal of any hazardous materials into the environment.	
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Increase noise level and dust generation due to the demolition and removal of camps components and other structures	➢Construction worker	Medium	CR-SAPZ/DBOC shall: -Restrict demolition works to daylight hours (11 am – 4pm) to minimize disturbance. -Maintain and fit demolition machinery with effective silencers/mufflers -Use controlled dismantling methods rather than high-impact demolition where possible. -Install temporary noise barriers near sensitive receptors. -Provide hearing protection to workers and monitor noise levels to comply with FMEnv standards (OHSP refers)	Low
		Increase noise and air quality pollution due to transfer of heavy-duty equipment and construction machineries	➢Host communities ➢Construction worker	Medium	CR-SAPZ/DBOC shall: -Spray water on debris and demolition areas to suppress dust during operations. -Cover trucks transporting debris with tarpaulins. -Store demolition waste in enclosed or covered areas. - Restrict vehicle speeds on unpaved surfaces to ≤ 20 km/h	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					-Require all workers in dusty areas to wear dust masks (P2 or N95) (OHSP refers).	
		Solid waste generation and improper disposal waste facility		Medium	CR-SAPZ/DBOC shall: -Segregate demolition waste into recyclable (metal, timber) and non-recyclable fractions. -Reuse or recycle materials where feasible (e.g., scrap metal to recycling plants). -Store waste in designated, secure areas before disposal. -Engage licensed waste disposal contractors for final disposal. -Maintain waste tracking documentation for regulatory compliance.	Low
	Decommissioning traffic diverted road for road users as alternative during construction	Dust emissions from temporary diversion dismantling or degradation	➢Ecosystem	Medium	CR-SAPZ/DBOC shall: -Water exposed surfaces during dismantling -Clear debris promptly and dispose of it at approved sites. -Re-vegetate disturbed areas immediately -Use erosion control structures where needed.	Low
		Soil compaction or damage during diversion closure		Medium	CR-SAPZ/DBOC shall: -De-compact soils in affected areas using tillage methods. -Restore topsoil and plant native vegetation. -Ensure drainage systems are functional after closure -Monitor restored areas for 6–12 months.	Low

Table 6.3: Social Impact Mitigation Measures across the Project Phases

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
Pre-construction Phase	Land takeover (repossession) of 130 ha	Economic displacement of 145 households losing farmlands and crops	➢ Host communities	High	CR-SAPZ shall: Prepare and implement a Livelihood Restoration /Enhancement Plan (LRP) which will aim at improving the PAPs' livelihood through agro-industrial productivity and earnings and subsequently integrate the identified tenant-farmers who currently use the 130ha designated for the proposed AIH into the SAPZ Program.	Low
		Conflicts may emerge due to insufficient stakeholders' engagement and/or perceived inadequate compensation for farmland and crops loss or perceived disparity in compensation		High	CR-SAPZ shall: Establish a transparent and inclusive stakeholder engagement plan (Check appendix) Disclose the eligibility and entitlement criteria of the LRP during stakeholder engagement workshop (details in Chapter AP 4), Deploy independent grievance redress mechanism (GRM) to the PAPs with community/PAPs representative (Check Appendix) Promptly implement the LRP, GRM, & stakeholder engagement plan (SEP) and ensure transparency Work with community-appointed CLO	
	Equipment and Personnel Mobilization	Population surge of about 500 workers leading to pressure	➢ Host Communities	Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		on available resources (e.g, water, space etc.)	➢ ➢ Mobilised Individuals (construction workers)		Provide separate project accommodation, water, and sanitation for workers. Coordinate with local authorities to manage resource use. Avoid reliance on community water supply systems.	
		Outbreaks of communicable diseases (eg. Flu, Tuberculosis, Ringworm		Medium	CR-SAPZ/DBOC shall: Conduct pre-employment health screening for workers. Maintain an on-site clinic with trained medical staff.-Organize regular health awareness programs for workers and communities.	Low
		Worsening anti-water and anti-sanitation practices;		Medium	CR-SAPZ/DBOC shall: Install adequate and gender-segregated toilet facilities. Enforce daily cleaning and waste management procedures. Provide potable water for drinking and cooking through the installation of borehole.	Low
		Stranger Elements; new levels of social interaction and strange sexual life; incidence of sexually transmitted infections, (STI), HIV/AIDS.		Medium	CR-SAPZ/DBOC shall: Conduct awareness and prevention campaigns. Provide free condoms and voluntary HIV testing. Partner with local health NGOs for outreach.	Low
		Risk of respiratory diseases in personnel		Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		and members of the community			Provide workers with PPE such as N95 masks. Maintain dust suppression measures in work areas. Schedule dust-generating activities during low-wind periods.	
		Reducing aesthetic value of the area.		Medium	CR-SAPZ/DBOC shall: Screen camps and laydown areas with green fencing. Maintain cleanliness and landscaping in project areas.	Low
		Population surge of about 500 workers will increase the domestic waste generation by ~300 m^3 of solid waste leading to sanitation challenges.		Medium	CR-SAPZ/DBOC shall: Use dedicated project water sources. Install rainwater harvesting systems for non-potable uses. Segregate waste and recycle where feasible. Engage licensed waste disposal contractors. Prohibit indiscriminate dumping.	Low
	Site Clearing	Increased earnings to local labourer from the clearing of vegetation and site preparation	Host communities		CR-SAPZ/DBOC shall: Prioritize recruitment of local labour from host and neighbouring communities. Offer fair wages aligned with or above local market rates. Provide short-term contracts that allow multiple community members to benefit.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Offer on-the-job skills training to improve employability beyond the project.	
		Improved standard of living			CR-SAPZ/DBOC shall: Facilitate prompt payment to workers to support household needs. Provide financial literacy sessions to help workers manage increased income. Support community infrastructure initiatives (e.g., water points, sanitation facilities) from project social investment funds. Encourage local procurement of goods and services to boost community economy.	Low
		Reduce crime and social vices due to various engagement through job opportunities			CR-SAPZ/DBOC shall: Ensure job opportunities are widely publicized within the community to avoid favouritism perceptions. Engage unemployed youth and vulnerable groups in project employment. Combine employment with life skills and vocational training programs. Establish a transparent recruitment process to enhance trust and social cohesion.	Low
Construction Phase	Site Preparation through;	Disruption of established social ties and support networks due to the	Host Communities	Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	• Removal of vegetation and soil compaction from 37.94 ha	displacement of farming household			Conduct early and inclusive stakeholder engagement sessions to understand community linkages before clearance. Stage clearing works to minimize prolonged disruption and ensure temporary connections remain open. Document and monitor social impacts, adjusting mitigation in collaboration with community leaders.	
	➢ Civil and Construction activities through ground levelling, excavation and foundation	Destruction crops and farm lands due to excavation and grading of farmland		Medium	CR-SAPZ/DBOC shall: Carry out detailed asset and crop inventory with community representatives before works. Provide compensation at full replacement value before disturbance. Confine machinery to designated work areas to prevent accidental damage.	Low
		Respiratory illness from airborne dust due to earthwork activities could lead to common colds, flu, asthma etc.		Medium	CR-SAPZ/DBOC shall: Apply continuous dust suppression using water spraying, especially during dry and windy periods. Provide high-grade PPE (N95 or equivalent) to all exposed workers. Limit earthworks during peak wind conditions and ensure material stockpiles are covered. Monitor ambient air quality and adjust suppression measures as needed.	Low
		Prolonged exposure to noise from earthwork activities		Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		can cause stress, hearing loss, and sleep disturbance.			Restrict high-noise activities to 11 am –4 pm to reduce disturbance. Maintain equipment silencers/mufflers and replace defective components immediately. Install portable noise barriers near sensitive receptors such as schools and residences. Provide certified hearing protection to all workers in high-noise zones and rotate shifts to limit exposure duration.	
	Hiring of construction personnel	Employment of community locals	Host Communities		CR-SAPZ/DBOC shall: Implement a "Local First" hiring policy with clear targets for local workforce participation. Publicly advertise job openings in community meeting points and through local leaders. Provide on-the-job training to enhance transferable skills for post-project employment. Maintain transparent recruitment records to build trust.	Low
		Boost of local economy and improvement of standard of living through job opportunities and high purchasing rate			CR-SAPZ/DBOC shall: Source consumables, food supplies, and basic services from local businesses where feasible. Provide vendor development training to help local suppliers meet quality and safety requirements.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Ensure prompt payment to contractors and suppliers to maintain cash flow in the community. Encourage the hiring of local transporters and service providers.	
		Provision or improvement of local infrastructure and amenities			CR-SAPZ/DBOC shall: Work with community representatives to identify priority infrastructure needs. Use durable, low-maintenance materials for any amenities provided. Employ local labour during construction to maximize community benefit. Commit to periodic maintenance during the project life.	Low
		Conflicts may emerge during site clearing and preparation activities due to insufficient consultations and/or perceived disparities in employment opportunities		Medium	CR-SAPZ/DBOC shall: Establish a transparent and inclusive stakeholder engagement plan that structure structured consultations before and during recruitment, ensuring participation of women, youth, and vulnerable groups. Clearly communicate job selection criteria, wage rates, and timelines. Operate a grievance redress mechanism accessible to all community members. Conduct regular social monitoring to detect and address tensions early through independent grievance redress mechanism (GRM). See appendix. Work with community-appointed CLO	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	Cement mixing, concrete batching and handling	Water-related health conditions due to water source contamination	➢ Host communities ➢ Construction workers	Medium	CR-SAPZ/DBOC shall: Locate batching plants at least 200 m from community water sources. Install impermeable containment for wash water and cement residue. Treat all wastewater before discharge. Monitor water quality regularly during batching operations.	Low
		Occupational, health and safety concerns for the workers due to potential skin and eye irritation, respiratory and allergic concerns.	➢ Construction workers	High	CR-SAPZ/DBOC shall: Provide full PPE (gloves, goggles, masks, protective clothing) for all cement handling operations. Conduct regular safety training on handling hazardous materials. Ensure availability of eye wash stations and emergency showers. Implement health monitoring for early detection of occupational illnesses.	Low
		Abrasive damage to the lung due inhalation of airborne dust from cement and silica.		High	CR-SAPZ/DBOC shall: Use enclosed or covered systems for cement transfer and storage. Apply local exhaust ventilation in enclosed workspaces. Issue high-efficiency particulate respirators to all workers in dusty areas. Minimize manual handling of dry cement and keep handling areas damp where possible.	Low
		Damage to the natural landscapes	➢ Ecosystem	High	CR-SAPZ/DBOC shall::	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		due to quarrying for raw materials			Restrict quarrying strictly to approved and designated extraction zones as per environmental permits. Implement phased extraction to limit the exposed area at any one time. Undertake progressive reclamation by backfilling and re-vegetating quarried sections immediately after use. Preserve visual aesthetics by maintaining vegetative buffers and using natural landscaping techniques to screen disturbed areas from public view.	
		Destruction of flora and fauna habitats and potentially disrupting ecological balance due to quarrying for raw materials		High	CR-SAPZ/DBOC shall:: Conduct baseline biodiversity surveys prior to extraction to map critical habitats (reference BMP for details). Establish and enforce ecological buffer zones where no quarrying is allowed. Schedule extraction activities to avoid sensitive breeding and nesting periods for wildlife. Implement habitat restoration programs, including replanting native species and creating alternative habitats to offset ecological losses.	Low
	Haulage of construction materials	Aggregates falling off and hitting and damaging third party windshields and causing other forms of injuries	➢ Road Users	Medium	CR-SAPZ/DBOC shall:: Require that all loads to be covered with tarpaulins before leaving the site	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Develop and enforce a project-specific Traffic Management Plan (Available in Chapter 7). Enforce strict speed limits through speed governors and GPS tracking. Position traffic marshals at critical community crossings.	
		Deterioration of existing roads	➢ Host Communities ➢ Road Users	Medium	CR-SAPZ/DBOC shall: Require all loads to be covered with tarpaulins before leaving the site Use secure load restraint systems to prevent spillage. Conduct regular inspections of truck loading practices. Enforce penalties for non-compliance.	Low
		Increased accident rate due to increased movement of trucks and other earth-moving vehicles	➢ Road Users ➢ Construction workers	Medium	CR-SAPZ/DBOC shall: Use designated haulage routes agreed with local authorities. Schedule heavy loads to avoid peak traffic times. Repair any project-related road damage promptly. Monitor road conditions weekly and take corrective action as needed.	Low
	Extraction, processing, and transportation of quarried materials (such as laterite, sand, and stone)	Provide employment for the locals	➢ Host Communities		CR-SAPZ/DBOC shall:: Award labour and transport contracts to local businesses and individuals. Offer job-specific training to improve quality and safety performance.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Provide fair wages and good working conditions. Ensure transparent selection to avoid favouritism.	
		Large and unmanaged quarry pits pose safety risks to community members	➢ Host Communities	Medium	CR-SAPZ/DBOC shall: Erect fencing or barriers around active and inactive pits. Post clear warning signage in local languages. Rehabilitate and backfill unused pits promptly. Conduct regular inspections to ensure safety measures remain intact.	Low
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site cause stress, hearing loss, and sleep disturbance.	➢ Host Communities ➢ Construction workers	Medium	CR-SAPZ/DBOC shall: Limit noisy operations to daylight hours (11 am – 5 pm). Maintain silencers/mufflers on machinery. Provide hearing protection to all workers. Monitor noise at sensitive locations and adjust activities if limits are exceeded.	Low
		Impact on water quality if hazardous wastes are discharged to watercourses or from runoff from inappropriately stored hazardous waste		Medium	CR-SAPZ/DBOC shall: Construct bunded and covered hazardous waste storage areas with impermeable flooring located away from water bodies; Install spill containment and drainage interception systems Implement strict waste labelling and segregation protocols	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
Operational Phase	CR SAPZ-AIH facilities and operations	Employment of community locals	➢ Host Communities		CR-SAPZ/DBOC shall: Develop and implement a transparent recruitment policy prioritising local labour Collaborate with community leaders to identify suitable candidates; Provide vocational and on-the-job training; Establish fair wages and safe working conditions to retain local workforce	
		Boost of local economy and improvement of standard of living through job opportunities and high purchasing rate			CR-SAPZ/DBOC shall: Encourage local procurement of goods and services; Provide business capacity-building workshops for local entrepreneurs; Facilitate microcredit or small loan schemes for community-based suppliers; Support the creation of cooperatives to meet project supply needs.	
		Provision or improvement of local infrastructure and amenities			CR-SAPZ/DBOC shall: Collaborate with local government to identify infrastructure gaps; Co-fund or contribute to road, water, and power upgrades; Maintain project-built infrastructure for community use; Ensure accessibility and sustainability of amenities post-project.	
		Reduction in crime and social vices			CR-SAPZ/DBOC shall:	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		through engagement of local youth			Create targeted youth employment programs; Partner with NGOs for vocational training and mentorship schemes; Integrate conflict resolution and life skills training into employment programs.	
		Enhance socio-economic potential of the locals and increase interaction beyond immediate localities			CR-SAPZ/DBOC shall: Promote local products through project-linked supply chains; Provide internet connectivity and ICT training to expand market access.	
		Pressure on local housing and infrastructure due to influx of people seeking for job opportunity and those working in the area			CR-SAPZ/DBOC shall: Develop worker housing plans to minimise strain on community resources; Implement local recruitment to reduce external migration Coordinate with authorities to upgrade water, sanitation, and transport systems; Establish rent control measures in partnership with local government to prevent inflation.	Low
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Job opportunity for the demolition exercise	➢ Host Communities		CR-SAPZ/DBOC shall: Prioritize hiring from host and adjoining communities to maximize local benefit. Offer short-term training in demolition safety, waste handling, and equipment operation to improve skills for future employment.	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Maintain transparent recruitment processes with publicized criteria and timelines. Ensure fair wages and prompt payment to all workers engaged in decommissioning activities.	
		Positively improve living standard of the youth			CR-SAPZ/DBOC shall: Facilitate prompt wage disbursement to support household income stability. Encourage local expenditure by sourcing goods and services from community businesses. Provide financial literacy sessions to help workers manage increased income effectively. Support local service providers (e.g., catering, transport) to supply the demolition workforce.	
		Reduction in crime and social vices through engagement of local youth			CR-SAPZ/DBOC shall: Actively recruit unemployed youth for demolition-related roles. Pair work engagement with vocational and life-skills training to create post-project livelihood options. Partner with community leaders to identify at-risk individuals for priority hiring. Maintain worker engagement in structured activities to reduce idle time and the risk of anti-social behaviour.	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		Health and safety risks to workers from demolition activities	➢ Construction workers	Medium	CR-SAPZ/DBOC shall: Provide full PPE (hard hats, steel-toe boots, gloves, safety goggles, high-visibility vests, and dust masks) to all demolition workers. Conduct comprehensive safety briefings before starting demolition tasks. Use controlled demolition techniques to minimize collapse hazards and debris spread. Maintain clearly marked exclusion zones to protect workers and the public. Ensure first-aid facilities, trained medical personnel, and emergency response plans are in place and functional on-site (refer OHSP).	Low

7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Environmental and Social Management Planning is a critical component of sustainable project development. The Environmental and Social Management Plan (ESMP) serves as a practical tool to guide the implementation of mitigation and enhancement measures identified in the Environmental and Social Impact Assessment (ESIA). It ensures that potential adverse environmental and social impacts arising from the proposed project, are managed effectively, while positive impacts are enhanced and leveraged for community development. Therefore, a robust ESMP is needed to:

- Minimize project-related environmental degradation,
- Promote community health and safety,
- Enhance employment and livelihood benefits, and
- Ensure compliance with Nigerian environmental regulations and international environmental best practices.

This chapter elaborates the management plans (MPs) monitoring responsibilities, capacity-building initiatives, reporting protocols, and budget estimates to ensure the project's alignment with principles of environmental sustainability and social equity.

7.1 Objectives of the ESMP

The long-term objectives of the ESMP are to:

- Translate the ESIA findings into implementable actions.
- Provide a structured approach for the prevention, minimization, and control of environmental and social impacts.
- Outline institutional arrangements and roles for implementing and supervising mitigation and monitoring actions.
- Ensure the participation of all stakeholders, including local communities, in the management of project impacts.
- Promote compliance with national environmental policies, state laws, and relevant international guidelines such as those from the AfDB, and the International Labour Organization (ILO).

7.2 Scope of the ESMP

The scope of this ESMP includes giving guidelines to all parties involved in the implementation of the proposed project in fulfilment of its environmental and social requirements. The ESMP has the following long-term objectives:

- Ensuring that environmental management conditions and requirements are implemented during the construction, post-construction period; and decommissioning phase.
- Ensuring that the interests of the general public and other stakeholders are considered throughout the construction and operational phases of the project; and
- Ensuring that maximum socioeconomic benefits accrue to the project area and the entire country.

7.3 Institutional Arrangements and Responsibilities

The institutions include but are not limited to:

- CR SAPZ: Overall ESMP implementation, monitoring oversight, and reporting.
- DBO Contractors: Daily implementation of mitigation measures and reporting incidents.
- Federal Ministry of Environment (FMEnv): Regulatory oversight, periodic audits, and ESIA approval.
- Cross River State Ministry of Environment: Monitoring of compliance with state-specific environmental standards.
- Community Liaison Officers (CLOs): Engagement, grievance management, and feedback loop between project and host communities.
- Independent Environmental Consultant: Monitoring, reporting, and auditing of ESMP implementation.

7.4 Environmental and Social Monitoring Plan

The Environmental and Social Monitoring Plan (ESMoP) is a vital element of the Environmental and Social Management Plan (ESMP), designed to ensure continuous assessment of the project's environmental and social performance over time. Its primary goal is to track the effectiveness of mitigation measures, verify compliance with applicable laws and standards, and identify any emerging issues that require corrective actions.

Given the extent of the project and interaction with various environmental media, monitoring is necessary. Monitoring data provides the basis for evaluating environmental trends, engaging stakeholders meaningfully, and making evidence-based decisions throughout the life cycle of the project.

Table 7.1: Institutional Arrangements and Responsibilities

Institution/Entity	Responsibility
CR SAPZ	ESMP oversight, policy enforcement, budgeting, inter-agency coordination, compliance reporting and grievance redress mechanism (GRM)
Project Contractors	Day-to-day ESMP implementation, incident reporting, corrective actions
Federal Ministry of Environment (FMEnv)	ESIA approval, regulatory inspections, enforcement of national environmental regulations
Cross River Ministry of Environment	State-level monitoring, local compliance checks, community engagement support
Community Liaison Officers (CLOs)	Local stakeholder engagement, conflict mediation, grievance logging
Independent Environmental Consultants	Periodic environmental monitoring and reporting to regulators
Third-Party Auditors (if required)	Independent verification of ESMP implementation and performance assessments

7.4.1 Objectives of the Environmental and Social Monitoring Plan

The key objectives of the Environmental and Social Monitoring Plan include:

- Ensuring that the proposed mitigation and enhancement measures are effectively implemented.
- Detecting unanticipated adverse impacts and providing early warning signals.
- Establishing accountability by tracking environmental performance indicators.
- Ensuring compliance with Nigerian environmental laws, sectoral guidelines, and international best practices (e.g., AfDB's ISS, ISO 14001).
- Providing a feedback loop to improve future environmental and social management.

7.4.2 Monitoring Parameters and Indicators

To effectively monitor the impacts and outcomes of the project, a wide range of environmental and social indicators have been identified. These are based on baseline data, predicted impacts, and regulatory requirements.

Table 7.2: Key Monitoring Indicators

Environmental/Social Component	Key Indicators	Monitoring Frequency	Method/Standard
Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, VOCs	Quarterly (construction & operation)	APHA 2017 / FMEnv guidelines
Noise and Vibration	Ambient noise (dB(A)), vibration levels	Monthly	WHO/FEPA Noise Standards
Surface Water Quality	pH, DO, BOD_5, COD, TSS, oil & grease, heavy metals (Pb, Cd, Fe), E. coli	Quarterly	APHA 2017
Groundwater Quality	pH, EC, TDS, nitrate, chloride, iron, manganese, coliform	Bi-annually	APHA 2017
Soil Quality	pH, organic carbon, heavy metals (Cd, Pb, Zn, Fe), hydrocarbons	Bi-annually	ASTM D4972 / FMEnv
Biodiversity (Flora/Fauna)	Species abundance, diversity index, wildlife sightings, invasive species occurrence	Bi-annually	Field survey / transect method
Vegetation Cover	Percentage vegetation cleared vs. replanted, tree survival rate	Quarterly	Field inspection
Waste Management	Quantity and type of waste generated, segregation efficiency (%), volume recycled, compliance with disposal protocol	Monthly	Inspection, weighbridge records
Effluent Management	pH, BOD_5, COD, TSS, oil & grease before and after treatment	Monthly	IFC/WB EHS Guidelines
Gaseous Emissions (Generator, Processing)	CO_2, NOx, SO_2, particulate matter	Quarterly	Stack monitoring / IFC standards
Occupational Health and Safety (OHS)	Number of incidents, LTIs, PPE compliance rate (%), first aid availability	Monthly	HSE audit / ILO guidelines
Community Health & Safety	Number of grievances, communicable disease cases, GBV/SEA incidents, road accidents	Quarterly	Medical records / GRM reports

Socio-Economic Indicators	Employment (male/female ratio), number of local workers, livelihood restoration status	Bi-annually	Survey / field verification
Stakeholder Engagement	Number of meetings held, grievance resolution rate (%)	Quarterly	GRM & engagement logs
Decommissioning Phase (if applicable)	Volume of waste dismantled, % recycled/reused, soil/water contamination status	Once (at closure)	Environmental Audit

7.4.3 Monitoring Approach and Methodology

A combination of **qualitative** and **quantitative** methods will be applied to collect accurate, replicable, and timely data. **Monitoring Methods Include:**

- Air and Noise Monitoring: Portable air quality samplers and dosimeters will be used in compliance with FMEnv and NESREA standards.
- Water and Soil Sampling: Samples will be collected quarterly and tested at certified laboratories according to WHO and NESREA protocols.
- Visual Inspections: Routine site assessments by the HSE team and environmental officers to evaluate compliance.
- Social Surveys and Interviews: Periodic household surveys, focus group discussions (FGDs), and key informant interviews (KIIs) to assess community perceptions.
- Occupational Safety Audits: Internal inspections and external audits to review adherence to OHS protocols.

7.4.4 Monitoring Frequency and Locations

Monitoring will be conducted at different frequencies depending on the project phase (pre-construction, construction, operation) and the sensitivity of the component involved as presented in Table 7.3.

Table 7.3: Proposed Monitoring Schedule

Component	Location	Frequency	Responsibility
Air Quality	Power plant, processing facilities	Monthly	HSE Unit/Environmental Consultant
Noise	Nearby residential and project boundary	Monthly	Environmental Officer
Surface/groundwater	Nearby boreholes, estuary points	Quarterly	Water Analyst/Consultant
Soil Quality	Fuel storage, workshop areas and other spill-prone areas	Bi-annually	Environmental Consultant
Waste Management	entire facility	Weekly	Waste Coordinator/Site Engineer
Employment Metrics	HR office, local community	Quarterly	HR Unit/CSR Officer

Component	Location	Frequency	Responsibility
Community Health	Local health facilities, community	Quarterly	Public Health Consultant
Safety & Accidents	Entire project site	Monthly	Safety Officer
Biodiversity	Coastal/mangrove areas	Bi-annually	Ecologist
Grievance Redress	CLO office, project office	Monthly	CLO/Community Grievance Desk

7.4.5 Monitoring Reporting and Documentation

All monitoring activities will be thoroughly documented and reported in a timely and transparent manner. **Reporting Structure:**

- Daily Site Logs (kept by Site Environmental and Safety Officers)
- Weekly Progress Reports (submitted to CR SAPZ Program Management)
- Monthly Environmental and Social Reports (reviewed by internal compliance team)
- ESMP Performance Reports (submitted to FMEnv quarterly and monthly to AfDB)
- Annual Environmental and Social Audit Reports (prepared by independent auditors)

All reports will include:

- Summary of findings,
- Analysis of trends,
- Comparison with baseline values and legal thresholds,
- Non-conformance and corrective actions taken,
- Lessons learned and continuous improvement recommendations.

7.4.6 Roles and Responsibilities

Clear roles and responsibilities are outlined to ensure efficient implementation of the monitoring plan.

Table 7.4: Roles in Monitoring plan

Stakeholder	**Role in Monitoring**
CR SAPZ (Project Proponent)	Budgetary provision, overall supervision, data compilation
Contractors/Subcontractors	Routine field monitoring, immediate reporting of incidents
Independent Environmental Consultants	Conduct specialized monitoring and lab analyses
FMEnv & Cross River Ministry of Environment	Regulatory oversight, spot checks, legal enforcement
Community Liaison Officer (CLO)	Stakeholder interface, grievance resolution tracking
External Auditors (if required)	Third-party compliance verification

7.4.7 Key Performance Indicators (KPIs)

The following KPIs will be used to evaluate ESMP implementation success:

Environmental KPIs:

- Effluent Quality
- Ambient air level
- % of planted trees (re-vegetation)
- <5% deviation from baseline environmental conditions
- 100% waste segregation and proper disposal.
- Surface and groundwater quality level and rating

Social KPIs:

- 95% compliance with mitigation actions.
- 80% of community grievances resolved within 14 days.
- Zero fatality and <1 LTIFR (*Lost Time Injury Frequency Rate*) annually.
- >50% of workforce sourced locally.

7.5 Capacity Building and Training

Capacity building and training are essential components for the successful implementation of environmental and social mitigation and monitoring plans throughout the life cycle of the CR SAPZ's AIH project. A well-structured capacity development strategy ensures that both project personnel and relevant stakeholders including contractors, host communities, and regulatory institutions possess the knowledge, skills, and tools necessary to comply with environmental standards, occupational health and safety protocols, and social engagement obligations.

The goals are to:

- Enhance technical and managerial capabilities of project staff for effective environmental and social management.
- Equip the workforce with knowledge and skills to ensure health and safety, waste management, pollution control, and emergency response.
- Foster local community participation in environmental stewardship and benefit-sharing.
- Strengthen the institutional capacity of local authorities and project proponents to oversee and enforce compliance measures.

7.5.1 Identified Training Needs

Training needs were identified through a gap analysis of expected job functions, existing staff capacities, and stakeholder roles. Key thematic areas for capacity development are presented in Table 7.5.

Table 7.5: Key thematic areas for capacity development

Training Theme	Topics Covered	Budget (N)
Environmental Management	ESMP implementation, pollution prevention, air and water quality management, biodiversity protection, ESIA compliance	1,500,000
Health and Safety (HSE)	Hazard identification, use of PPE, fire safety, confined space entry, first aid, occupational health, OS4 community health/safety	500,000
Waste Management	Segregation, storage, transportation, treatment and disposal of general and hazardous waste	500,000
Social Safeguards	Stakeholder engagement, grievance redress mechanism, gender sensitivity, community relations, GBV/SEA sensitization training for contractors and workers, OS2 labor, OS5 vulnerable groups	Check with SEP & GRM
Emergency Response	Spill response, fire drills, evacuation protocols, natural hazard response	1,000,000
Monitoring and Evaluation	Data collection, environmental audits, reporting procedures, corrective actions	1,000,000
Regulatory Compliance	Nigerian laws, AfDB's ISS, ISO 14001/45001 awareness	500,000
Total		5,000,000

7.5.2 Training Schedule and Facilitator

Capacity building is vital for ensuring that all personnel involved in project implementation understand their environmental and social responsibilities as shown in Table 7.6.

Table 7.6: Training Schedule and Facilitator

Training Topic	Target Audience	Frequency	Facilitator
ESMP Implementation & HSE Protocols	Contractor Staff, Supervisors	Bi-annually	HSE Consultant
Community Engagement & Conflict Management	CLOs and Community Representatives	Annually	Social Specialist
Emergency Response and Spill Control	Security, Staff, Maintenance Team	Quarterly	SEMA, Fire Department, FRSC / Environmental Firm
Environmental Laws and Regulations	Project Managers, Legal Advisors	Annually	FMEnv/CRMEnv, NESREA

7.6 Budget for ESMP Implementation

To effectively implement the environmental and social management measures necessary budgetary provisions have been made for this ESMP. The budgets for the ESMP include the environmental and social management costs other than the good engineering practices, cost of environmental and resettlement monitoring. All administrative costs for implementing the ESMP shall be budgeted for as part of the project costing.

The cost of each measure has been estimated and included in the overall ESMP budget as indicated in Table 7.7

Table 7.7: ESMP Budget Summary

S/No	Element	Responsible	N
1	Mitigation Measures	SPIU, DBOC	114,000,000.00
2	Special Initiatives for ESMP Implementation		12,000,000.00
2	Monitoring & Audit	SPIU, DBOC, ESIC	53,000,000.00
3	Training	SPIU, DBOC/HSE Officer, ESIC,	5,200,000.00
Sub-total			184,200,000.00
	10% contingency		18,420,000.00
Grand total			**202,620,000.00**

Implementation Schedule

The provisional time schedule for preparing contract documents, awarding of tenders and start of construction has to be taken into consideration in the implementation schedule for the ESMP (Table 7.8).

The contractor is expected to prepare and submit a plan of action covering the means by which the construction related environmental and social mitigation measures recommended in the ESMP will be implemented once a notice to proceed is received.

The DBOC shall strictly follow the Action plan, mitigation action required at the pre-construction phase which would have been implemented

The key elements of the implementation schedule plan which are shown in Table 7.8 are as listed below:

- Preparation and submission of the Action plan;
- Nominating Environmental Management Representative;
- Finalizing site and layout plans for construction camps/temporary yards incorporating environmental requirements;
- Preparation and submission of construction schedule;
- Implementation of mitigation and enhancement measures;
- Environmental auditing (SPIU, ESIC /FMEnv);
- Monitoring and reporting on ESMP implementation (SPIU, FMEnv &ESIC)

Table 7.8: ESMP Implementation Schedule

Activity	Responsible	Pre-construction			Construction						Operation				
		Q3 25	Q4 25	Q1 2 26	Q2 26	Q3 26	Q4 26	Q1 26	Q2 26	Q3 26	Q4 26	Q1 26	Q2 26	Q3 26	Q4 26
Disclosure of E& S Instruments	SPIU/FMEnv														
Allocation Budget for ESMP	SPIU														
Appointing Support Staff for ESMP	SPIU														
Review of Approval of Contractor's ESMP & Safety Plan	SPIU														
Finalizing site and layout plan of construction plan	SPIU														
Implementation of Mitigation Measures	SPIU/ESIC & FMEnv														
Supervising ESMP Implementation	SPIU/ESIC														
Environmental Audit	SPIU/ESIC & FMEnv														
Monitoring & Reporting on ESMP Implementation	SPIU/ESIC & FMEnv														
Environmental Training	SPIU & ESIC														

7.7 The ESMP

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 for various components is presented in **Error! Reference source not found.** and **Error! Reference source not found.**.

7.8 Specific E&S Management Plans (MPs)

Specific E&S management plans have been prepared, complementary to this document, to comply the nine AfDB's OSs triggered by the proposed AIH, as presented in Table 7.9 and the sections following. The SEP, LRP and PMP have been prepared as stand-alone E&S instruments. The SEP (with GRM), RAP (with LRP) and PMP have been prepared as stand-alone E&S instruments while the details MPs are presented in Appendix 7.

Table 7.9: Environmental Management Plan for *all* Phases of the proposed Project

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Pre-Construction Phase							
Land take and potential physical/cultural heritage disturbance	Conduct chance-find procedure; avoid sensitive cultural/religious sites; compensate land-takers appropriately; buffer zones for sacred areas	CR-SAPZ/DBOC	N1 million	Physical buffer zones for sacred areas, records of compensation	FMEnv / State Min. Env.		N1 million
Traffic and community safety risks from mobilization of equipment	Traffic management plan; warning signage; community awareness; trained drivers	CR-SAPZ/DBOC	N2 million	Installed signages, record of community awareness campaigns and driers training	FMEnv / State Min. Env. FRSC	Quarterly	N500,000
Greenhouse gas (GHG) emissions from site preparation activities	Energy-efficient machinery; limit unnecessary trips; tree planting offset program	CR-SAPZ/DBOC	N2 million	Planted trees	FMEnv / State Min. Env.	During pre-construction	N500,000
Noise pollution from heavy-duty trucks, equipment, and personnel movement	Restrict mobilization to daylight hours; maintain silencers; install temporary noise barriers; limit idling times	CR-SAPZ/DBOC	₦2 million	Noise level dB(A) at site boundary	FMEnv / State Min. Env.	Monthly	₦4 million
Air pollution from vehicle emissions (CO, NO_2, SPM, SO_2)	Use low-emission trucks/equipment; conduct periodic emission testing; enforce "no idling" policy	CR-SAPZ/DBOC	₦1 million	Air quality readings (NOx, PM)	FMEnv / NESREA	Monthly	₦500,000
Vegetation loss of about 37.94 ha and habitat disturbance of 12.5 ha	Restrict clearing to project footprint; replant native species; implement flood and erosion control plan	CR-SAPZ/DBOC	₦4 million	Area cleared vs. replanted; biodiversity survey	FMEnv / State Min. Env.	Quarterly	N1 million
Construction Phase							

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Groundwater contamination from fuel storage, lubricants, chemicals	Bunded storage; drip trays; groundwater monitoring wells; spill response kits. Waste management issues (general solid waste, packaging, food waste)						
Dust generation from cleared land and stockpiles	Regularly spray water on exposed soil; cover stockpiles; restrict vehicle speeds; schedule high-dust activities during low wind	CR-SAPZ/DBOC	₦5 million	$PM_{10}/PM_{2.5}$ readings at site boundary	FMEnv / NESREA	Weekly	₦500,000
Increased soil erosion potential; reduction in structural stability and percolation ability of soil	Strip and store topsoil separately; limit clearing; avoid machinery on wet soils; install erosion controls	CR-SAPZ/DBOC	₦10 million	Soil stability tests; erosion evidence	FMEnv / NESREA	Quarterly	₦5 million
Noise from operations of engines and heavy-duty construction machines	Monitor noise levels; use temporary barriers; provide hearing protection; maintain machinery; restrict noisy operations to 07:00–18:00	CR-SAPZ/DBOC	₦1 million	Noise level dB(A)	FMEnv / State Min. Env.	Monthly	₦500,0000
Contamination of surface water from cement mixing, concrete batching and handling	Site batching plants ≥200 m from water; prevent discharge into drains; implement spill prevention and response	CR-SAPZ/DBOC	₦2.5 million	Water quality (pH, turbidity, hydrocarbons)	FMEnv / NESREA	Quarterly	₦1 million
Alteration of landscapes due to quarrying	Restrict quarrying to approved areas; maintain buffer zones; implement progressive rehabilitation; use visual screening	CR-SAPZ/DBOC	₦5 million	Quarry inspection reports; landscape restoration progress	FMEnv / State Min. Env.	Quarterly	₦1 million
Operational Phase							
Increase noise level from the operations of various machines and equipment such as power plant	Install acoustic enclosures; schedule high-noise activities daytime; preventive	CR-SAPZ	₦1 million	Noise level dB(A) within facility and boundary	FMEnv / State Min. Env.	Quarterly	₦500,000

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
	maintenance; hearing protection; noise monitoring						
Daily release of nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons, and particulate matter (PM) from traffic directly affects local air quality	Maintain vehicles and machinery; encourage shuttle buses; dust suppression; traffic management plans; monitor air quality	CR-SAPZ	₦1 million	Air quality (NOx, CO, PM)	FMEnv / NESREA	Quarterly	₦ 500,000
Streams of agricultural waste generated such as peeling process, separation of raw materials and processed waste from production	Implement waste segregation; adopt waste-to-compost or energy; install sedimentation tanks; agreements with farmers for reuse; effluent quality monitoring	CR-SAPZ	₦1 million	Waste volume; effluent quality	FMEnv / State Min. Env.	Quarterly	₦500,000
Increase soil pollution potential due to spilled fuel, spent oil, lubricants, paints during routine maintenance of operating machineries and equipment	Designated maintenance areas; spill prevention; bunded fuel storage; licensed hazardous waste disposal; regular inspection	CR-SAPZ	₦2 million	Soil contamination reports	FMEnv / NESREA	Quarterly	₦1 million
Decommissioning Phase							
Increase noise level and dust generation due to demolition and removal of camps components and other structures	Restrict demolition works to daylight hours; maintain silencers; controlled dismantling; install noise barriers; provide hearing protection	CR-SAPZ/DBOC	₦1 million	Noise level dB(A); dust concentration	FMEnv / State Min. Env.	Monthly	₦500,000
Increase noise and air quality pollution due to transfer of heavy-duty	Spray water on debris; cover trucks; store demolition waste enclosed; restrict vehicle speeds; require dust masks	CR-SAPZ/DBOC	₦1 million	Air quality; dust levels	FMEnv / NESREA	Monthly	₦ 500,000

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
equipment and construction machineries							
Solid waste generation and improper disposal waste facility	Segregate demolition waste; reuse/recycle materials; store waste securely; engage licensed contractors; maintain waste tracking	CR-SAPZ/DBOC	₦500,00	Waste audit records	FMEnv / State Min. Env.	Quarterly	₦200,000
			₦40 million				**₦19.2 million**

Table 7.10: Social Management Plan for *all* Phases of the proposed Project

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Pre-Construction Phase							
Economic displacement of 185 households losing farmlands and crops	Prepare and implement Livelihood Restoration Plan (LRP); integrate tenant farmers into SAPZ Program before land acquisition	CR-SAPZ	₦30 million	% PAPs compensated; # of livelihood activities implemented	FMEnv / Independent RAP Consultant	Quarterly	₦3 million
Conflicts due to inadequate or unequal compensation	Establish transparent and inclusive stakeholder engagement; deploy independent grievance redress mechanism	CR-SAPZ	₦5 million	# Disputes resolved; stakeholder satisfaction surveys	FMEnv / Independent RAP Consultant	Quarterly	₦1 million

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Exclusion of vulnerable groups in compensation and support	Conduct inclusive consultations with women, youth, tenant farmers; provide targeted livelihood support	CR-SAPZ	₦4 million	% Vulnerable PAPs included; # targeted supports delivered	FMEnv / State Min. Women Affairs	Bi-annually	₦1 million
Loss of access to communal resources (forests, grazing)	Provide alternative resource access and support community forest management programs	CR-SAPZ	₦5 million	Records of alternative sites provided	State Min. Agriculture / Forestry	Annually	₦2 million
Loss of cultural heritage / sacred sites (if encountered during land take)	• Conduct a cultural heritage and archaeological survey before land clearing, implement a Chance-Find Procedure (CFP) aligned with AfDB OS1 and Nigerian heritage regulations. Engage traditional councils and elders to identify and protect sacred sites. Halt work immediately upon discovery of artefacts and notify relevant authorities.	CR-SAPZ	₦1 million	Number of heritage screening reports prepared. • Evidence of CFP implementation. • Documentation of consultations with traditional leaders.	CR-SAPZ SPIU / FMEnv / Ministry of Culture & Tourism	Pre-construction and as required	₦1,500,000
Poor stakeholder engagement and resentment	Establish CLO system; regular community meetings; information disclosure in local language	CR-SAPZ/Contractor CLO	₦4 million	# of meetings held; community satisfaction surveys	FMEnv / State Min. Env.	Quarterly	₦1 million
Mistrust and misinformation about project objectives	• Conduct proactive awareness and information campaigns. • Use local radio, town criers, and translated leaflets for communication.	CR-SAPZ SPIU / CLO / Contractor	₦1.5 million	• Number of sensitization sessions held.• Level of community awareness.•	CR-SAPZ SPIU / Ministry of Information / AfDB E&S Team	Monthly during pre-construction	₦800,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
	• Deploy Community Liaison Officers (CLOs) to sustain dialogue. • Establish feedback channels (notice boards, grievance registers).			Functioning grievance redress channels.			
Construction Phase							
Influx of migrant workers leading to social tension and pressure on housing	Enforce worker code of conduct; prioritize local hiring; provide separate worker housing through camps	CR-SAPZ/Contractor	₦ 3 million	Worker demographic records; local rental costs	FMEnv / State Min. Labour	Quarterly	₦1 million
Security risks (petty theft, crime)	Collaborate with local security agencies; issue worker ID cards; secure camps	CR-SAPZ/Contractor	₦2 million	# security incidents recorded	CLO / Police	Quarterly	₦1 million
Gender-based violence (GBV) and sexual exploitation/abuse (SEA)	Implement GBV Action Plan; awareness campaigns; zero-tolerance policy; partner NGOs	CR-SAPZ/NGO partner	₦1.5 million	# GBV cases reported/resolved	FMEnv / State Min. Women Affairs	Quarterly	₦ 500,000
Child labour risks	Enforce Labour Act; monitor recruitment; contractor penalties for under-age workers	CR-SAPZ/Contractor	₦1 million	Worker age records; inspection reports	State Min. Labour	Continuous	₦ 500,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Pressure on water/food resources	Provide boreholes for camps; regulate sourcing from local markets; coordinate with local councils	CR-SAPZ/Contractor	₦2 million	Water use records; community complaints	State Min. Water Resources	Monthly	₦500,000
Disruption to community transport and trade routes	Provide safe diversions; signage; consult traders before road closures	CR-SAPZ/Contractor	₦1 million	# of complaints; accident records	FRSC / State Min. Works	Monthly	₦500,000
Dust and noise impacts on sensitive receptors (schools, hospitals, markets)	Create buffer zones; wetting near receptors; schedule works off-peak hours	CR-SAPZ/Contractor	₦1.5 million	Health statistics; community complaints	State Min. Health / FMEnv	Quarterly	₦500,000
Operational Phase							
Strain on local infrastructure (schools, clinics, water supply) due to operational workforce	CSR support to upgrade facilities; joint planning with LGAs	CR-SAPZ	₦5 million	# of CSR projects implemented; capacity usage rates	State Govt / LGA	Annually	₦1 million
Occupational fatigue and psychosocial stress among workforce	Limit working hours; rest breaks; wellness checks and counselling	CR-SAPZ	₦1.5 million	Worker OHS records; absenteeism	HSE Unit / FMEnv	Quarterly	₦500,000
Loss of social cohesion due to long-term influx of non-local workers	Promote cultural integration programs; respect local customs; support community events	CR-SAPZ/CLO	₦1 million	Records of community events supported	Traditional Councils	Annually	₦ 500,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Occupational accidents and injuries (falls, machinery, electrocution, etc.)	• Develop and implement a comprehensive OHS Management Plan.• Enforce mandatory use of PPEs.• Conduct daily toolbox talks and periodic safety training.• Maintain on-site first aid stations and emergency response systems.• Display safety signage and restrict unauthorized access.	Contractor / CR-SAPZ SPIU / State Ministry of Labour	₦5 million	• Number of OHS trainings conducted.• PPE compliance rate.• Record of accidents/incidents and corrective actions.	CR-SAPZ SPIU / AfDB Supervision Mission / FMEnv	Weekly and quarterly audits	₦1. million
Spread of communicable diseases (HIV/AIDS, STIs, COVID-19, malaria)	• Organize health awareness and sensitization programs.• Provide voluntary testing, counselling, and free PPE for workers.• Distribute condoms and promote good hygiene.• Collaborate with local health centres for periodic outreach.• Maintain sanitation and vector control in worker camps.	Contractor / Local Health Centres / CR-SAPZ SPIU	₦ 2 million	• Number of awareness campaigns held.• Number of workers tested and trained.• Health surveillance and incident reports.	CR-SAPZ SPIU / Ministry of Health / FMEnv	Quarterly	₦ 500,000
Inflationary pressure on local goods and services (housing, food, transport)	• Promote local procurement to stabilize prices. • Create price-monitoring committees with community leaders.	CR-SAPZ SPIU / Contractor / Local Government Council	₦ 1 million	• Evidence of local procurement policy implementation.	CR-SAPZ SPIU / Local Government / FMEnv	Quarterly	₦ 500,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
	• Provide temporary staff accommodation to reduce pressure on local housing .• Liaise with local government to regulate rent increases.			• Periodic price trend monitoring reports. • Number of worker accommodations provided.			
Marginalization of women and youth in employment opportunities	• Implement gender- and youth-inclusive employment policy. • Provide training and skill-building programs for local women and youth. • Ensure equal pay and fair participation in project jobs. • Track participation data by gender and age.	Contractor / CR-SAPZ SPIU / Ministry of Women Affairs	₦ 2 million	• Percentage of women/youth employed. • Training attendance records.• Employment database showing gender distribution.	CR-SAPZ SPIU / Ministry of Women Affairs / AfDB E&S Team	Monthly during construction	₦ 1 million
Decommissioning Phase							
Loss of livelihoods for local workers after decommissioning	Prepare and implement workforce transition/exit plan; support retraining	CR-SAPZ	₦5 million	# of workers retrained; post-exit employment rates	FMEnv / State Min. Labour	Annually	₦5 million
Community grievances during site closure	Maintain active grievance redress system throughout decommissioning; publicize closure schedule	CR-SAPZ/CLO	₦5 million	# grievances logged/resolved	FMEnv / State Min. Env.	Monthly	₦ 1million

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
TOTAL	**-**	**-**	**₦74 million**				**₦27.8 million**

Table 7.9: Specific E&S Management Plans & their Triggered AfDB's Operational Safeguards

Operational Safeguard	Management Plan
Environmental and Social Operational Safeguard 1: Assessment and Management of Environmental and Social Risk and Impact	Environment & Social Mgt Plan
Environmental and Social Operational Safeguard 2: Labour and Working Conditions	Labour Mgt. Plan
Environmental and Social Operational Safeguard 3: Resources Efficiency and Pollution Prevention and Management	Waste Mgt Plan
	Pest Mgt Plan
Environmental and Social Operational Safeguard 4: Community Health, Safety and Security	OHSP
	Traffic Mgt Plan
Environmental and Social Operational Safeguard 5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	Livelihood Restoration Plan
Environmental and Social Operational Safeguard 6: Habitat and Biodiversity Conservation, and Sustainable Management of Living Natural Resources	Biodiversity Mgt Plan
	Climate Change Mgt Plan
	Flood & Erosion Control Plan
Environmental and Social Operational Safeguard 8: Cultural Heritage	Cultural Heritage Mgt Plan
Environmental and Social Operational Safeguard 10: Stakeholder Engagement and Information Disclosure	Stakeholder Engagement Plan

7.9 Stakeholder Engagement Plan (SEP)

Stakeholder Engagement Plan (SEP) has been prepared as a stand-alone document for the Cross River State Special Agro-Industrial Processing Zone (CR-SAPZ) Program, covering the proposed Agro-Industrial Hub (AIH) at Adiabo, Odukpani LGA, and the Agricultural Transformation Centre (ATC) at Okuku, Yala LGA. This section provides a comprehensive overview of the Stakeholder Engagement Plan (SEP) document. The SEP outlines the framework for transparent, inclusive, and continuous engagement with stakeholders across the project lifecycle – from pre-construction through operation to decommissioning.

The document details:

- The background, objectives, and scope of the CR-SAPZ program.
- Project descriptions, benefits, and sustainability considerations.
- Applicable policy, legal, and institutional frameworks at national, state, and international levels.
- Stakeholder identification, mapping, and categorisation, including provisions for vulnerable groups.
- Records of engagement conducted to date and key issues raised.
- The guiding principles, objectives, and strategies for ongoing stakeholder engagement.
- Processes for information disclosure, roles and responsibilities of institutions, and resource allocation.
- A structured Grievance Redress Mechanism (GRM) for managing community concerns fairly and transparently.

- Monitoring, evaluation, and reporting frameworks, including Key Performance Indicators (KPIs).
- Capacity-building programs for both project teams and communities.
- A dedicated budget and implementation schedule for effective SEP delivery.

The SEP serves as both a strategic tool and social contract, ensuring that project implementation aligns with Nigerian laws, AfDB Integrated Safeguards System, IFC Performance Standards, and the Sustainable Development Goals (SDGs). It is designed to foster trust, manage risks, and maximize shared benefits among host communities, government, investors, and development partners.

Methodology of Stakeholder Engagement

The engagement process combined both qualitative and participatory approaches, ensuring inclusiveness, transparency, and representativeness. Key stages and methods included:

i. Stakeholder Identification and Mapping: Stakeholders were categorized into primary (directly affected) and secondary (indirectly affected or interested) groups. These included local communities (Adiabo, Ikot Omin, Ikot Effanga, Ikot Udo Ossiom, and Ikot Okon Edem), traditional institutions, women's associations, youth groups, farmers, transport unions, and vulnerable persons (widows, elderly, and persons with disabilities).
ii. Notification and Sensitization: Official letters, radio announcements, and community briefings were used to inform stakeholders ahead of meetings. Sensitization meetings were held in coordination with the Cross River State Ministry of Agriculture and Natural Resources and local government representatives.

Engagement Techniques

i. Community-wide consultations and town hall meetings were conducted using focus group discussions (FGDs), key informant interviews (KIIs), and open plenary sessions.
ii. Separate sessions for vulnerable and women's groups were organized to ensure open dialogue on gender-specific and inclusion concerns.
iii. Visual aids and local interpreters were used to enhance participation and comprehension.

Documentation and Validation

All meetings were recorded through attendance sheets, photographs, and minutes, later validated with community representatives to ensure accuracy and mutual understanding.

Description of Stakeholder Engagement Activities

i. Consultations were carried out between May - June 2025, covering all project-affected communities and institutional stakeholders.
ii. Discussions focused on project objectives, potential environmental and social impacts, land access, compensation, employment opportunities, and community development expectations.
iii. Representatives from government ministries (Environment, Agriculture, Lands, Women Affairs), local NGOs, and traditional councils participated actively.
iv. Photographic documentation and signed attendance sheets are attached within the main report (Plate 7.1-7.6), while the full records are compiled in Annex 4: Stakeholder Engagement Documentation.

Plate 7.20: Consultation Meeting with the Chairman, Yala LGA, Councilors, Ipuole Okuku

Plate 7.21: Consultation meeting on 27.06.2025 at Sanctus Hotel, Okuku with Ipuole Okuku community elders, youth and women leaders (left); FGD with community elders, youth and women leaders (Middle left); FGD with community women (Middle right); and Key Informant

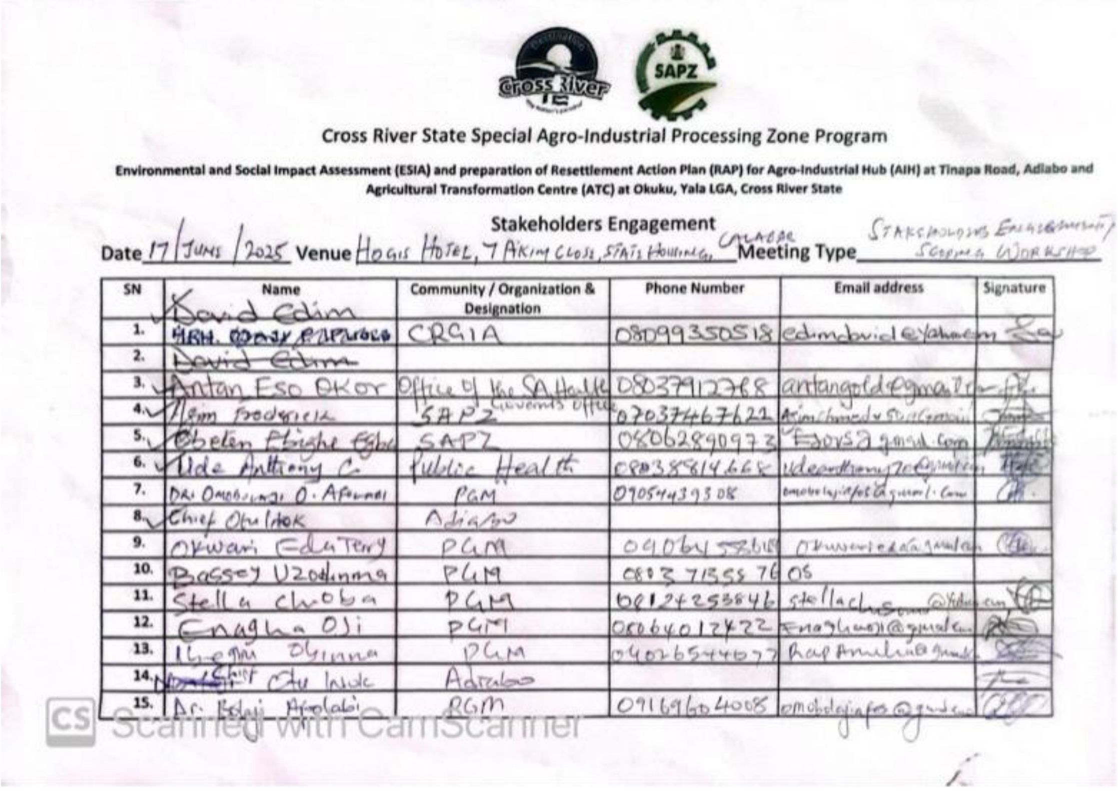
 

Plate 7.22: (Right): Focused Group Meeting with Elders of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot Communities at Adiabo Town Hall On 18.06.2025

Plate 7.23: (Left): Consultation Meeting with Leaders of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot at Adiabo Town Hall on 18.06.2025

Plate 24: Cross sections of participants at the stakeholders engagement/scoping workshop (top left), NESREA Rep. making his contribution (top-middle); CR-SAPZ Rep. fielding questions from participants (top right); FMEnv. Rep sitting among Adiabo contingent at the work (down left), the FMEnv. Rep making addressing the workshop, surrounded by the Clan Head of Okuku, the Chairman of Yala LGA and a rep of Clan Head of Adiabo (down middle) and reps of the Nigerian Navy, NSCDC, Customs, among other participants (down right).

Plate 7.6: Attendance from the Stakeholder Engagement Workshop Held at Hogis Hotel, Calabar on 17/07/2025.



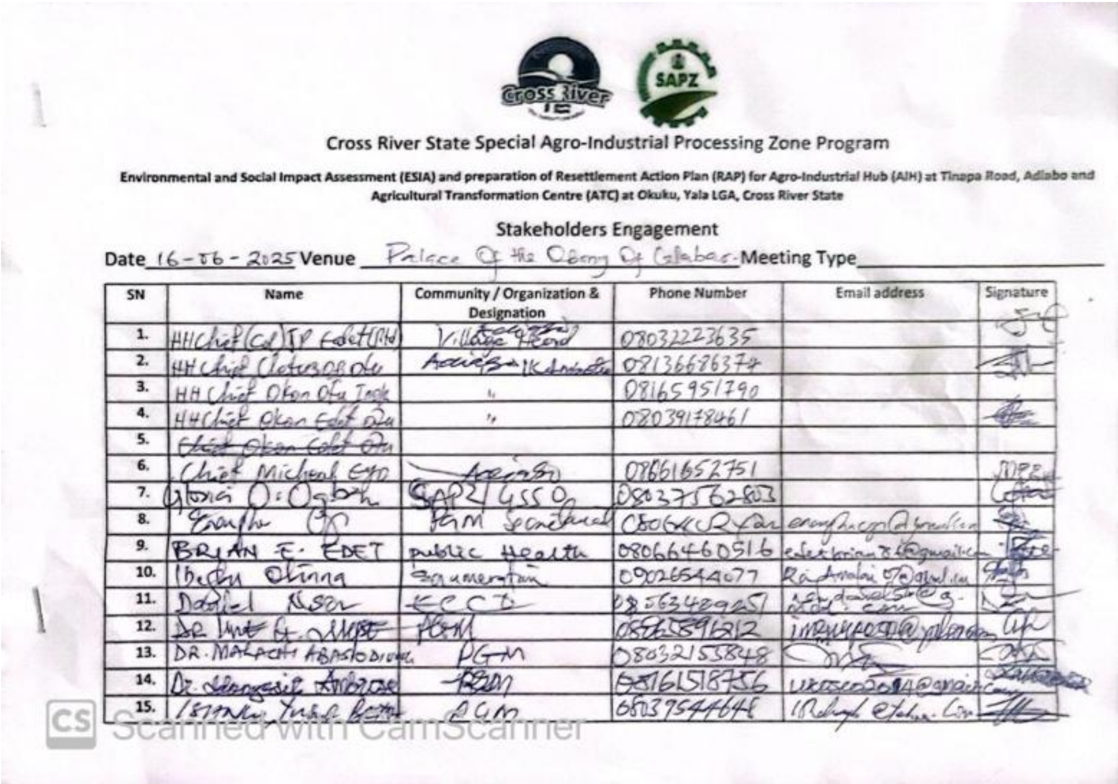
Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Stakeholders Engagement

Date 17/JUNE/2025 Venue Hogis Hotel, 7 Akim Close, State Housing, Calabar Meeting Type Stakeholders Engagement/Scoping Workshop

SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	David Edim / [illegible]	CRGIA	08099350518	edimdavid@yahoo.com	
2.	~~David Edim~~				
3.	Antan Eso Okor	Office of the SA Health Governor's Office	08037912768	antangold@gmail.com	
4.	Asim Frederick	SAPZ	07037467622	[illegible]	
5.	Obeten Ebighe Egbe	SAPZ	08062890973	[illegible]@gmail.com	
6.	Ude Anthony C.	Public Health	08038814668	udeanthony[illegible]	
7.	Dr. Omobolanle O. Afolabi	PGM	09054439308	[illegible]@gmail.com	
8.	Chief Ofu Itok	Adiabo			
9.	Okwari Edu Terry	PGM	09064558[illegible]	[illegible]@gmail.com	
10.	Bassey Uzodinma	PGM	08037135576	08	
11.	Stella Choba	PGM	08124253846	stellach[illegible]@yahoo.com	
12.	Enagha Oji	PGM	08064012422	enaghaoji@gmail.com	
13.	Ikegam Obinna	PGM	09026544077	Rap Analyst@gmail	
14.	Chief Otu Inok	Adiabo			
15.	Dr. Bolaji Afolabi	PGM	09169604008	[illegible]@gmail.com	



Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Stakeholders Engagement

Date 16-06-2025 Venue Palace Of the Obong Of Calabar Meeting Type

SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	HH Chief (Col) J.P Edet (Rtd)	Village Head	08032223635		
2.	HH Chief [illegible]	[illegible] Ik Adiabo	08136686374		
3.	HH Chief Okon Ofu Itok	"	08165951790		
4.	HH Chief Okon Edet Otu	"	08039178461		
5.	~~Chief Okon Edet Otu~~				
6.	Chief Michael Eyo	Adiabo	07661652751		
7.	Gloria O. Ogbeh	SAPZ/ GSSO	08037562803		
8.	Enagha Oji	PGM Secretariat	08064012422	enaghaoji@gmail.com	
9.	BRIAN E. EDET	public Health	08066460516	edetbrian[illegible]@gmail.com	
10.	Ikegam Obinna	Enumeration	09026544077	RapAnalyst07@gmail.com	
11.	Daniel Nson	ECCD	08563489251	[illegible]@g.com	
12.	Dr Umoh [illegible]	PGM	08[illegible]96212	[illegible]@yahoo.com	
13.	DR. MALACHI ABASIODIONG	PGM	08032153848		
14.	Dr. [illegible]	PGM	08161518756	[illegible]@gmail.com	
15.	[illegible]	PGM	08037544646	[illegible]@yahoo.com	

Inclusion of Vulnerable Groups

Special efforts were made to ensure vulnerable persons were heard and their interests incorporated:

i. Women-only focus groups addressed concerns over livelihood disruption, domestic water access, and inclusion in project jobs.
ii. Elderly and widows emphasized security of tenure and compensation fairness.
iii. Persons with disabilities raised mobility and access concerns during construction.
Inputs from these groups directly informed mitigation measures related to employment, compensation, and accessibility.

Analysis of Stakeholder Inputs and Influence on ESIA Outcomes

Stakeholder feedback substantially shaped the ESIA's environmental and social management approach:

i. Concerns about land acquisition and livelihood loss led to inclusion of a Livelihood Restoration Plan within the ESMP (and other concerns summarize in the Table 7.11)
ii. Requests for local employment and skills training informed the capacity-building component of the ESMP.
iii. Fears about environmental pollution and health risks guided specific mitigation on waste handling, water protection, and construction monitoring.
iv. The need for continuous dialogue led to establishment of a Grievance Redress Mechanism (GRM), anchored at community level.

Table 7.11: Summary of Stakeholder Concerns and Responses

S/N	Stakeholder Group / Community	Key Concerns Raised	ESIA Response / Mitigation Measure
1	Adiabo Community	Fear of land loss and crop displacement	Land acquisition plan with fair compensation and livelihood restoration framework included in ESMP.
2	Ikot Effanga & Ikot Udo Ossiom	Employment opportunities for youths	Local hiring policy and capacity-building programme incorporated.
3	Women Associations (Adiabo, Ikot Omin)	Disruption of domestic water sources and markets	Borehole rehabilitation and water source protection during construction.
4	Farmers' Cooperative	Access to farmlands post-construction	Construction scheduling to avoid planting season; alternative access routes planned.
5	Vulnerable Groups (Elderly, Widows, PWDs)	Inclusion in compensation and project activities	Dedicated inclusion plan and GRM accessibility provisions.
6	Traditional Leaders and Chiefs	Cultural heritage and community recognition	Respect for traditional protocols; community liaison officer appointed.
7	Cross River State Ministries (Environment, Agriculture, Lands)	Compliance with state environmental and land laws	ESIA aligned with FMEnv/CRSMEnv requirements and AfDB ISS.
8	Youth Associations	Fear of insecurity and lack of information	Regular information sharing through community committees and periodic site meetings.

Reference is made to the complete Stakeholder Engagement Plan (SEP) document prepared for the CR-SAPZ Program (August 2025) for full details on methodology, engagement records, technical frameworks, budgetary provisions, and monitoring mechanisms.

7.10 Grievance Redress Mechanism (GRM)

The development of the AIH at Adiabo in Odukpani LGA will affect diverse communities through land acquisition, economic displacement, environmental disturbances, and social interactions between workers and host communities. Inevitably, grievances may arise. A Grievance Redress Mechanism (GRM) is therefore required to provide an accessible, transparent, and fair process for receiving, assessing, and resolving complaints related to the project.

The GRM is intended to:

- Ensure concerns of Project Affected Persons (PAPs), workers, and stakeholders are addressed promptly.
- Prevent escalation of disputes into social conflict or litigation.
- Build trust between the project and host communities.
- Strengthen compliance with Nigerian laws, FMEnv/NESREA requirements, World Bank safeguard standards and African Development Bank's Integrated Safeguards System (ISS).

Objectives of the GRM

The objectives of the GRM include:

- Provide multiple accessible channels for lodging complaints.
- Establish a structured process for receiving, recording, and addressing grievances.
- Ensure PAPs and vulnerable groups have equal access to resolution mechanisms.
- Promote timely and transparent resolution of issues.
- Strengthen accountability of the proponent, contractors, and government institutions.

Scope of the GRM

The GRM covers grievances related to:

- Land acquisition & compensation (delays, inadequate compensation, eligibility disputes).
- Livelihood restoration (loss of farmland, access to natural resources, employment).
- Environmental issues (dust, noise, vibration, water pollution, waste mismanagement).
- Occupational Health & Safety (OHS) (worker safety, accidents, poor PPE compliance).
- Community health & safety (traffic accidents, communicable diseases, GBV/SEA).
- Social conflicts (labour influx, cultural site disturbance, conflicts over jobs).
- Contractor behaviour (misconduct, corruption, disrespect for local customs).

Principles Guiding the GRM

Every effective GRM must be built on a foundation of guiding principles that guarantee fairness, accessibility, and accountability. These principles are critical in ensuring that grievances are not only resolved, but that communities, workers, and stakeholders trust the process and view it as legitimate. For AIH, the principles reflect both international safeguard standards (ESS10, ESS5) and local socio-cultural realities, balancing formal procedures with traditional methods of dispute resolution.

Key Principles:

- **Accessibility**: Grievance channels must be free, simple, and available to all (including vulnerable groups).
- **Inclusivity**: Women, youth, elderly, disabled, and marginalized groups must have equal access.

- **Transparency**: Procedures, timelines, and outcomes must be communicated clearly to complainants.
- **Timeliness**: Complaints must be addressed promptly to avoid escalation.
- Fairness and Neutrality: Resolutions must be impartial and acceptable to all parties.
- **Confidentiality**: Sensitive cases, especially GBV/SEA, must be handled discreetly with survivor protection.
- **Cultural Sensitivity**: Traditional and community-based conflict-resolution mechanisms should be respected and incorporated.
- **Accessibility**: Free, simple, and open to all affected stakeholders.
- **Inclusivity**: Special provisions for women, youth, elderly, and persons with disabilities.
- **Transparency**: Clear communication on procedures and outcomes.
- **Confidentiality**: Sensitive grievances (e.g., GBV/SEA, labour disputes) handled discreetly.
- **Timeliness**: Strict timeframes for each resolution step.
- **Fairness**: Neutral and unbiased review, ensuring both complainants and project parties are heard.
- **Cultural Appropriateness**: Incorporates traditional dispute-resolution mechanisms where acceptable.

GRM Structure and Levels

The GRM for AIH adopts a multi-tiered structure, ensuring that complaints are resolved as close to the source as possible while providing clear escalation channels for unresolved issues. This structure balances local ownership (community level) with formal oversight (project, state, federal levels), creating a transparent system that allows grievances to flow upwards when necessary. The GRM structure and levels for the AIH is presented in Table 7.10.

Table 7.10: GRM Structure and Levels for the AIH

Level	Responsible Institutions/Actors	Scope of Responsibilities	Timeframe for Resolution
Level 1 – Community Level (First Contact)	- Community Liaison Officers (CLOs) - Community Grievance Committees (CGCs) - Traditional & Religious Leaders	- First point of contact for PAPs and local communities. - Register complaints in logbooks. - Attempt informal resolution through dialogue and local mediation. - Verify complaints before escalation.	≤ 7 days
Level 2 – Project Level (Operational Resolution)	- Project Grievance Redress Committee (PGRC) chaired by CR-SAPZ Social Specialist. - Contractor HSE & Social Officers. - CLOs & PAP rep. - State Ministry rep. - NGOs/CSOs (observers).	- Hear unresolved grievances from community level. - Investigate technical, social and environmental issues. - Provide binding project-level resolutions. - Maintain grievance database and reporting.	≤ 30 days

Level	Responsible Institutions/Actors	Scope of Responsibilities	Timeframe for Resolution
Level 3 – State Level (Oversight Resolution)	- Cross River State Ministry of Environment - Ministry of Lands - Ministry of Women Affairs - Ministry of Health	- Address complex or escalated grievances. - Oversee land acquisition, compensation, and gender-based issues. - Provide state-level enforcement and support.	≤ 45 days
Level 4 – Federal Level (Policy & Enforcement)	- Federal Ministry of Environment (FMEnv). - NESREA (enforcement). - Federal Ministry of Agriculture and Food Security (FMAFS - AfDB - Independent Consultants (auditors). -	- Final project-level oversight and enforcement. - Handle systemic grievances affecting multiple states. - Review and enforce compliance with safeguards. - Ensure corrective action for unresolved cases.	≤ 60 days
Level 5 – Judicial Recourse (Last Resort)	- Nigerian Courts of Law	- Provides legal recourse for complainants dissatisfied with project/state/federal outcomes. - Acts as ultimate appeal mechanism outside GRM.	Dependent on legal process

GRM Process

The Grievance Redress Mechanism (GRM) process defines the step-by-step pathway for receiving, recording, investigating, resolving, and closing complaints. Given the size and sensitivity of AIH project under CR-SAPZ program, grievances may range from routine nuisances (e.g., dust, traffic delays) to serious issues (e.g., compensation disputes, environmental contamination, GBV/SEA cases). The process therefore adopts a tiered structure, starting with community-level resolution (informal, fast, and low-cost), escalating to project and institutional levels only when necessary. This ensures that most grievances are resolved close to the source, while retaining higher-level mechanisms for oversight and accountability.

Table 7.11 outlined the steps towards GRM process which ensure timeliness, transparency, and fairness, while balancing community dispute-resolution traditions with formal project obligations.

Table 7.11: Steps towards GRM Process

Step	Process Description	Actors Involved	Key Outputs/Tools	Timeline
1. Submission of Complaints	Stakeholders submit grievances through multiple accessible channels: CLOs, CGCs, suggestion boxes, hotline, SMS, email, NGOs (for GBV/SEA). Submissions may be verbal, written, or anonymous.	PAPs, CLOs, NGOs/CSOs	Complaint form, verbal intake records, suggestion box slips	Immediate (continuous)
2. Registration & Categorization	Complaint logged in **Grievance Register** with unique ID. - Categorized as: - A (Urgent: OHS, GBV/SEA, accidents) - B (High Priority: land/compensation, major environmental issues) - C (Routine: nuisances like dust, noise).	CLOs, Contractor HSE/Social Officers	Grievance Register, acknowledgement slip to complainant	Within 2 working days
3. Acknowledgement	Complainant formally acknowledged, informed of category, expected resolution time, and contact person.	CLOs, Contractor	Acknowledgement slip or verbal confirmation	Within 48 hours
4. Assessment & Investigation	Investigation conducted: - Community verification (elders, CGCs). - Technical inspection (Contractor HSE/engineers). - Social assessment (CR-SAPZ Social Specialist). - Confidential handling for GBV/SEA.	CLOs, Contractor HSE, Engineers, CR-SAPZ Social Specialist, NGOs	Investigation reports, site visit records	Initiated within 5 working days
5. Resolution Proposal	Options discussed with complainant: corrective actions, compensation adjustments, worker sanctions, or RAP support. Solution agreed and documented.	PGRC, CLOs, Contractor, PAP reps	Resolution proposal form, signed agreement	≤ 14–30 days (depending on category)
6. Implementation & Feedback	Corrective measures implemented. CLO verifies satisfaction. Complainant signs off resolution. If unsatisfied, grievance escalated.	Contractor, CLOs, PGRC	Corrective action records, signed closure form	As per agreed resolution timeframe

Step	Process Description	Actors Involved	Key Outputs/Tools	Timeline
7. Escalation	If unresolved, grievance escalated to: - **Level 2:** PGRC (project level). - **Level 3:** State Ministries (Environment, Lands, Women Affairs). - **Level 4:** Federal (CR-SAPZ, FMAFS, FMEnv, NESREA). - **Level 5:** Nigerian Courts (final resort).	CLOs, PGRC, State Ministries, FMEnv, NESREA, Courts	Escalation records, hearing minutes	Depending on level: 30–60 days
8. Closure	Resolved grievance marked "closed" in register. Outcome documented and shared with complainant and community. Closed cases reviewed in quarterly reports.	CLOs, Contractor, PGRC	Updated grievance log, quarterly reports	Upon resolution

7.11 Institutional Roles and Responsibilities

Effective implementation depends on clear roles across community, project, state, and federal levels. Table 7.12 presents the details of the institutional roles and responsibilities for the GRM.

Table 7.12: Institutional Roles and Responsibilities

Institution/Actor	Roles and Responsibilities
Community Liaison Officers (CLOs)	- First point of contact for grievances. - Register complaints in logbook. - Conduct initial screening and categorization. - Facilitate informal resolution with community leaders. - Provide feedback to complainants.
Community Grievance Committees (CGCs)	- Comprised of elders, women, youth, vulnerable group representatives. - Support CLOs in verifying complaints. - Provide culturally sensitive advice on resolutions.
Contractors (HSE/Social Officers)	- Implement corrective actions for environmental, health, and safety grievances. - Report incidents and accidents. - Maintain grievance database at project level.
Project Grievance Redress Committee (PGRC)	- Chaired by CR-SAPZ Social Specialist. - Includes CLOs, Contractor HSE, PAP representatives, NGO observer. - Reviews unresolved grievances. - Provides binding resolutions at project level.
Cross Rivers SAPZ	- Ensure financing and oversight of GRM. - Integrate grievance reports into ESMP/RAP monitoring.
Federal Ministry of Environment (FMEnv)	- Provides regulatory oversight. - Monitors implementation of grievance resolutions. - Reviews quarterly reports.
NESREA	- Ensures environmental grievances (pollution, waste, emissions) comply with national standards. - Enforces sanctions where necessary.
State Ministries (Environment, Lands, Labour, Women Affairs, Health)	- Provide oversight of land, compensation, labour rights, gender issues. - Step in for state-level grievance resolution.
NGOs/CSOs (e.g., Women's groups, health NGOs)	- Act as independent observers. - Provide safe channels for GBV/SEA reporting Support vulnerable groups in accessing grievance channels.
Independent Consultant/Auditor	- Conduct periodic audits of GRM effectiveness. - Verify records, timeframes, and outcomes.

7.12 Monitoring and Reporting

7.12.1 Monitoring Indicators

1. Input Indicators
   - Number of CLOs trained.
   - Budget allocated for GRM operations.
2. Process Indicators
   - Number of grievances received by category (land, environment, health, GBV, etc.).
   - % of grievances acknowledged within 48 hours.
   - % of grievances investigated within 14 days.
3. Output Indicators
   - % of grievances resolved at community level (Level 1).
   - % of grievances escalated to PGRC or FMEnv.
   - Average time taken to resolve grievances.
4. Outcome Indicators
   - Stakeholder satisfaction rate (measured via surveys).
   - Reduction in conflict incidents (land disputes, protests).
   - Number of GBV/SEA cases referred to service providers.

7.12.2 Reporting Mechanism

- Monthly Reports: CLOs submit logs of complaints received, resolved, or pending.
- Quarterly Reports: Contractors compile grievance statistics and outcomes, submitted to CR-SAPZ and FMEnv/NESREA.
- Annual Public Report: Summary of grievances, resolutions, and trends disclosed to stakeholders in simple, non-technical formats (e.g., pamphlets, community meetings).
- Independent Audits: Annual third-party verification of GRM effectiveness.

7.13 Budget for GRM

Implementing a functional GRM requires dedicated financial resources. Without a budget, the system risks becoming a "paper mechanism" without operational capacity. For AIH, the budget covers institutional set-up, capacity building, communication tools, monitoring, and independent audits, ensuring that grievances are handled professionally, transparently, and in line with national and international safeguards. Details of the GRM budget is presented in

Table 7.13

Table 7.13: Budget for GRM

Activity	Description	Estimated Cost (₦)	Responsible Party
Establishment of GRM Committees	Formation of CGCs in all host communities; set-up of PGRC at project level	4m	CR-SAPZ/DBOC
Training of CLOs, CGCs, Contractors, PGRC	Initial training + annual refresher on grievance handling, mediation, GBV response	6m	FMEnv / Independent Consultants
Awareness Campaigns	Radio jingles, posters, flyers, community theatre, info boards on GRM	4m	CLOs / NGOs
IT & Data Management System	Digital grievance register, SMS hotline, database management	3m	CR-SAPZ/DBOC
GBV/SEA Confidential Mechanisms	Female focal persons, safe houses, referral support, NGO partnerships	8m	DBOC/ NGO
Independent Audits & Evaluations	Annual third-party audits of GRM effectiveness	5m	Independent Consultant

Total GRM Budget: ₦30 million

Conclusion

The expanded Grievance Redress Mechanism (GRM) provides a structured, multi-level system that ensures timely, fair, and transparent handling of complaints across AIH project. With clearly defined roles, robust monitoring, tailored capacity building, and adequate budgetary provisions, the GRM strengthens the project's social license to operate and reduces risks of conflict, litigation, and reputational damage.

7.14 Capacity Building for GRM

The effectiveness of the GRM for AIH project depends on the competence, preparedness, and awareness of all actors involved. Since the project cuts across multiple states and involves communities with varying literacy levels, traditional governance systems, and social dynamics, a comprehensive capacity-building programme is required.

This programme will ensure that:

- CLOs, contractors, and grievance committees are skilled in handling complaints.
- Regulators and ministries are prepared to supervise and provide technical backstopping.
- Communities and PAPs are aware of their rights, know how to access the GRM, and trust it to deliver fair outcomes.
- Sensitive grievances (e.g., GBV/SEA) are addressed in a survivor-centered and confidential manner.

Capacity building will therefore combine formal training, awareness-raising, mentoring, and periodic refreshers across all levels of the GRM structure.

7.15 Capacity Building Objectives

The key objectives are to:

1. Build the technical capacity of GRM actors to manage grievances fairly, efficiently, and transparently.
2. Strengthen conflict resolution and mediation skills at community and project levels.
3. Develop confidential and sensitive handling skills for GBV/SEA grievances.
4. Enhance the capacity of PAPs and communities to understand their rights and use the GRM effectively.
5. Institutionalize monitoring and reporting practices so grievance data can inform project decisions.
6. Ensure long-term sustainability of the GRM by embedding skills in both formal institutions (ministries, regulators) and informal ones (traditional leaders, CGCs).

7.16 Target Groups and Training Focus

The GRM for AIH project involves a diverse set of actors operating at different levels from community representatives who are the first point of contact, to contractors and project committees that manage day-to-day operations, to state and federal ministries responsible for oversight and enforcement. Each group requires tailored training that matches its specific roles, responsibilities, and level of influence within the grievance process.

Capacity-building efforts must therefore be **differentiated**:

- **Community actors** (CLOs, CGCs, PAPs) need training in communication, grievance intake, and mediation, with strong emphasis on **local language and cultural sensitivity**.
- **Project actors** (Contractors, PGRC) require technical and procedural training to ensure grievances are **investigated, documented, and resolved fairly**.
- **Institutional actors** (State Ministries, CR-SAPZ, FMEnv, NESREA) need higher-level training on **policy, oversight, and systemic monitoring** of grievance data.

- **Specialized actors** (NGOs, GBV/SEA focal points) must be prepared to handle **sensitive cases** confidentially and provide survivor-centered support.

By focusing training on the **unique roles and needs** of each group, the project ensures that the GRM is **responsive, inclusive, and effective** across all levels of implementation. The details of the target groups and training focus of all actors/stakeholders is presented in

Table 7.14

Table 7.14: Target Groups and Training Focus

Target Group	Capacity-Building Focus	Training/Support Activities	Estimated Cost (₦ Million)	Remark
Community Liaison Officers (CLOs)	- Complaint intake & documentation. - Mediation and community conflict management. - Gender-sensitive engagement.	-Training workshops on grievance intake & database use. -Mentoring by FMEnv specialists.	3.0	Covers 3-day workshop logistics, facilitator fees, and materials
Community Grievance Committees (CGCs)	-Local dispute mediation. -Cultural and gender inclusivity. -Verification of complaints.	- Village-level mediation training - Participatory learning with role-play.	- 2.5	Community-level facilitation and training sessions
DBOCs (HSE & Social Officers)	- Investigation of technical/environmental grievances. - Corrective action planning. - OHS and labour grievance handling.	- On-site technical drills. - Workshops on grievance reporting protocols.	- 3.0	- Contractor-based technical training modules
Project Grievance Redress Committee (PGRC)	- Mediation and arbitration. - Transparency and accountability.	- Multi-stakeholder workshops. - Mock arbitration sessions.	- 2.5	- Cost includes venue, documentation, and expert facilitators

Target Group	Capacity-Building Focus	Training/Support Activities	Estimated Cost (₦ Million)	Remark
	- Documentation and disclosure of resolutions.			
State Ministries (Environment, Lands, Women Affairs, Health)	- Oversight of escalated grievances. - Land acquisition & compensation disputes. - Gender and health-related grievance resolution.	-Technical policy seminars. -Study visits to projects with effective GRMs.	-4.0	-Includes travel, accommodation, and expert sessions
FMEnv & NESREA Officers	- National safeguard monitoring. - Evaluation of grievance data trends. - Enforcement mechanisms.	-Federal-level training on monitoring tools. -Cross-ministerial coordination sessions.	-3.5	-Cost derived from regulatory training benchmarks
NGOs/CSOs & GBV/SEA Focal Points	- Survivor-centered case management. - Confidentiality protocols - Referral pathways to health, psychosocial, and legal support.	- Specialized NGO-led GBV/SEA training. - Partnership building with service providers.	- 2.0	Cost for specialized facilitators and sensitization materials
PAPs & Host Communities	- Awareness of GRM rights and procedures. - How to lodge complaints effectively. - Role of community committees in ensuring fairness.	- Town-hall meetings in local languages - Community theatre and radio awareness campaigns.	- 2.5	Communication materials, radio airtime, and logistics
Total			- **23.0 million**	

7.17 Capacity-Building Methods

To ensure training is practical, sustainable, and inclusive, the following approaches will be adopted:

1. Formal Training Workshops – Structured training sessions for CLOs, contractors, and government officers.
2. On-the-Job Mentoring – CLOs and CGCs supported by FMEnv and independent consultants during actual grievance handling.

3. Community Awareness Campaigns – Flyers, posters, radio programs, and community theatre in local languages.
4. Simulation Exercises – Mock grievance-handling and GBV/SEA case management exercises.
5. Exchange Visits – Exposure of state officers and PGRC members to other projects with best-practice grievance systems.
6. Refresher Courses – Annual training updates based on lessons learned and audit findings.

Expected Outcomes of Capacity Building

By the end of the programme:

- CLOs and CGCs will be confident in receiving, documenting, and resolving grievances.
- PGRC members will handle complex disputes with transparency and fairness.
- State and federal regulators will have robust monitoring systems for grievance tracking.
- NGOs and GBV/SEA focal points will ensure safe, survivor-centered grievance channels.
- Communities will feel empowered, informed, and able to hold the project accountable.

7.18 Institutional Arrangement for SEP and GRM Implementation

The implementation of the SEP and the GRM for AIH project requires a multi-tiered institutional framework. This structure ensures that responsibilities are clearly allocated across federal, state, local, project, and community levels, while also creating coordination and oversight mechanisms to guarantee transparency, accountability, and timely action. The institutional arrangement also integrates capacity building and training measures, recognizing that many local actors (e.g., CLOs, community committees, PAP representatives) require new skills to handle stakeholder engagement and grievance management effectively.

7.18.1 Institutional Structure and Roles

The AIH project involves a wide range of stakeholders and institutions with different responsibilities. To ensure smooth implementation of the SEP and the GRM, a multi-tiered institutional structure has been adopted (details in Table 7.15).

This structure ensures that:

- Federal institutions provide policy direction, financing, and regulatory oversight.
- State ministries handle local oversight, especially on land acquisition, environmental management, and gender inclusion.
- Local governments serve as facilitators, mobilizing communities and supporting engagement at grassroots level.
- Project-level institutions (Contractors, PGRC, Independent Monitors) manage day-to-day implementation, corrective measures, and reporting.

- Community-level institutions (CLOs, Community Grievance Committees, traditional leaders) are the first contact point for project-affected persons (PAPs) and ensure culturally appropriate engagement.

By distributing responsibilities across these levels, the arrangement promotes accountability, efficiency, and inclusivity, while ensuring that grievances and engagement are managed close to the source before escalation.

Table 7.15: Institutional Levels and Roles

Institutional Level	Key Institutions/Actors	Roles and Responsibilities
Federal Level	- FMAFS - Federal Ministry of Environment (FMEnv) - NESREA	- Provide overall project oversight and financing. - Approve ESIA and supervise compliance with environmental and social safeguards. - Review quarterly SEP and GRM reports. - Monitor grievance resolution trends and enforce corrective measures. - Provide technical capacity support to project and state actors.
State Level	- CR-SAPZ - Cross Rivers State Ministries of Environment - State Ministry of Lands, Housing & Urban Development - State Ministry of Women Affairs & Social Development - State Ministry of Health	- Provide state-level monitoring of SEP and GRM activities. - Address escalated grievances from project and community levels. - Oversee land acquisition and compensation disputes. - Ensure women, vulnerable groups, and health concerns are integrated into engagement and grievance handling. - Participate in Project Grievance Redress Committee (PGRC).
Local Government Level	- Local Government Authorities (LGAs) of the project corridor	- Mobilize and sensitize communities for consultations. - Support RAP verification and compensation distribution. - Facilitate local grievance hearings alongside CLOs. -Participate in Community Grievance Committees (CGCs).
Project Level	- Contractor (HSE & Social Officers) - Project Grievance Redress Committee (PGRC) - Independent Consultant/Monitor	- Manage day-to-day SEP and GRM implementation. - Investigate and resolve project-related grievances. - Maintain grievance registers and databases. - Implement corrective actions for environmental, social, and OHS issues. - Conduct annual independent audits of SEP and GRM performance. - Report monthly and quarterly to CR SAPZ and FMEnv.

Institutional Level	Key Institutions/Actors	Roles and Responsibilities
Community Level	- Community Liaison Officers (CLOs) - Community Grievance Committees (CGCs) - Traditional & Religious Leaders- NGOs/CSOs	- Serve as first point of contact for PAPs and local communities. - Register and categorize grievances, attempt resolution at community level. - Verify and escalate unresolved complaints to project level. - Facilitate consultations, FGDs, and information disclosure. - Act as cultural mediators in dispute resolution. - Provide safe channels for GBV/SEA cases and awareness campaigns.

7.18.2 Communication and Escalation Flow

The institutional arrangement for AIH project is designed to resolve issues as close to the source as possible, while retaining higher levels of authority for oversight and final decision-making. The communication and escalation flow of the AIH project follow a bottom-top-approach.

- **Community Level (First Contact):** Project Affected Persons (PAPs) and local residents raise grievances through Community Liaison Officers (CLOs) or Community Grievance Committees (CGCs). Minor grievances are resolved locally with support from traditional leaders and NGOs. Unresolved cases are escalated upward.
- **Project Level (Operational Resolution):** The Contractor's HSE and Social Officers investigate issues, and unresolved grievances are presented to the Project Grievance Redress Committee (PGRC). The PGRC includes representatives of CR SAPZ, contractors, CLOs, PAPs, State Ministries, and NGOs, ensuring transparency. If still unresolved, complaints are escalated to state-level institutions.
- **State Level (Oversight & Dispute Management):** The State Ministries of Environment, Lands, Women Affairs, and Health provide state-level oversight and address complex grievances, particularly those related to compensation, land acquisition, and social inclusion. State-level institutions can enforce corrective measures and refer escalated cases to federal level.
- **Federal Level (Policy & Enforcement):** Federal Ministry of Environment (FMEnv) and NESREA enforce compliance with environmental and social standards. They review quarterly reports and provide direction on systemic issues.
- Independent Oversight: Independent consultants/auditors verify SEP and GRM effectiveness annually. Their findings inform both the project proponent and regulatory authorities, ensuring transparency and accountability.

7.18.3 Key Features of the Institutional Framework

- **Bottom-up escalation**: Issues move from community to project to state to federal, ensuring early resolution and limiting burden on higher authorities.

- **Horizontal support:** NGOs/CSOs, traditional leaders, and community committees support cultural sensitivity and inclusiveness.
- **Independent oversight:** Annual audits ensure credibility and trust.
- **Integration with SEP and GRM:** The same structure supports stakeholder engagement (SEP) and grievance handling (GRM), reducing duplication.

7.19 Implementation Schedule for SEP and GRM

The implementation schedule provides a time-bound plan for executing the SEP and the GRM throughout the project lifecycle (details in

Table 7.16). It ensures that activities are not only well-sequenced but also matched with institutional responsibilities, enabling effective monitoring and accountability.

Table 7.16: Implementation Schedule of SEP and GRM by Project Phase

Project Phase	Activity	Description	Responsible Institutions	Frequency/Timing
Pre-Construction	Stakeholder Identification & Mapping	Detailed mapping of PAPs, vulnerable groups, NGOs, state actors	DBOCs, FMEnv, CLOs, Independent Consultant	Once, before RAP finalization
	Disclosure of ESIA & RAP	Translate and share ESIA/RAP summaries with communities	DBOCs, CLOs, NGOs	Once, prior to land acquisition
	Community Sensitization Meetings	Awareness campaigns on project impacts, rights, and GRM access	CLOs, LGAs, Traditional Leaders	Bi-monthly
	Establishment of GRM Structures	Formation of CGCs, appointment of CLOs, PGRC set-up	FMAFS, DBOCs, State Ministries	One-time, before construction
	Training of CLOs, CGCs, PGRC Members	Training on grievance handling, mediation, GBV/SEA protocols	FMEnv, NGOs, Consultants	One-time + annual refresher

Project Phase	Activity	Description	Responsible Institutions	Frequency/Timing
	Initial Engagement with PAPs	RAP consultations, livelihood restoration planning	DBOCs, CLOs, State Ministries	Before displacement
Construction	Regular Community Consultations	Meetings on employment, safety, and impacts (dust, noise, traffic)	DBOCs, CLOs, CGCs, NGOs	Monthly
	Disclosure of Work Schedules	Notice of blasting, road closures, diversions	DBOCs, CLOs	Weekly (where relevant)
	Operation of GRM	Receipt, registration, investigation, and resolution of grievances	CLOs, DBOCs, PGRC, State Ministries	Continuous
	GBV/SEA Awareness Programs	Sensitization on zero tolerance for abuse and survivor pathways	NGOs, CLOs, Women Affairs Ministry	Quarterly
	Monitoring & Reporting	Monthly grievance logs; quarterly SEP/GRM reports to FMEnv	DBOCs, FMEnv, NESREA	Monthly/Quarterly
Operation	Stakeholder Engagement Forums	Dialogue on road safety, tolling, environmental monitoring	CR-SAPZ, State Ministries, CLOs	Quarterly
	Continued GRM Operation	Handle complaints (accidents, road safety, compensation follow-ups)	CLOs, PGRC, FMEnv	Continuous
	Annual Stakeholder Survey	Assess satisfaction with SEP/GRM effectiveness	Independent Consultant	Annually
	Refresher Capacity Training	Update training for CLOs, PGRC, and State staff	FMEnv, NGOs, Consultants	Annually
Decommissioning	Early Consultation with Communities	Discuss closure, site restoration, and land use transition	CR-SAPZ, DBOCs, CLOs, LGAs	At least 6 months before closure
	Disclosure of Decommissioning Plan	Share timelines and mitigation measures	CR-SAPZ, CLOs	Once, before decommissioning begins

Project Phase	Activity	Description	Responsible Institutions	Frequency/Timing
	GRM Continuity	Ensure unresolved grievances are addressed during closure	CLOs, PGRC, FMEnv	Continuous during closure
	Final Evaluation & Lessons Learned	Independent review of SEP & GRM performance	Independent Consultant, FMEnv, NESREA	Once, post-closure

Key Features of the Schedule

- Early Action in Pre-Construction: GRM structures must be in place before land acquisition.
- High Intensity During Construction: Frequent community consultations and grievance handling to address active impacts.
- Steady Engagement in Operation: Focus shifts to road safety, tolling, and residual livelihood concerns.
- Closure with Accountability: Transparent decommissioning plans and lessons learned feed into future projects.

8. DECOMMISSIONING AND ABANDONMENT

Decommissioning covers the AIH project cessation of operations and the removal of inventory to obtain a state of passive safety. This phase though quite unlikely should be discussed for completeness of this report.

In other words, during the planning of any project, it is important to put in place plans to recover and/or restore the project site to its original state after the project is closed or decommissioned. This requires the good understanding of all the environmental components of the project on the ecosystem during its lifespan. It is therefore environmentally wise to take into cognisance, this component during the planning stage.

8.1 Decommissioning Activities

At the completion of the life of this Asphalt and Concrete project, SPIU shall follow regulatory standard procedures for decommissioning. A decommissioning team shall plan and implement the guidelines for decommissioning to ensure that the best and practicable methods available to clean up the project site have been used. The following activities are involved in decommissioning:

The likely impacts will be:

- Soil erosion resulting from improper reinstatement of excavated sites
- Hazards and associated accidents with decommissioning
- Waste management problems

8.1.1 Rehabilitation Activities

The statutory regulations require project owner to rehabilitate the area to be relinquished to the satisfaction of the FMEnv. The biological objective, amongst others, of any such rehabilitation programme is to ensure that an ecologically functional system to enable satisfactory flora growth is achieved. In line with this, SPIU shall put in place a policy to carry out a restoration programme at the end of project's economic life. In carrying out this programme, the following shall be considered.

- Asphalt - the objective is to prevent the asphalt which is a petroleum derivative from melting and leaking into the environment. These should be removed for disposal by certified hazardous materials Disposal Company. The base concrete materials shall be removed from locations and may be used as landfill materials in designated sites.
- Site restoration upon completion (suspension or abandonment), all excavation shall be filled. Beyond this, the procedures to be applied in the restoration of cleared areas shall be the subject of a detailed integrated study. This study shall utilize the services of ecological and hydrological specialists who will assist in determining strategies for site restoration. The goal of the study shall be a detailed field-specific restoration plan. The success of any restoration process is measured by the similarity of the vegetation on the restored land to that of its surroundings. However, this success is a manifestation of the reinstatement of the physical, chemical and hydrological characteristics of the soil, bearing in mind

that the single most significant factor, which will likely inhibit re-vegetation, is compaction / cementing of soil surface. The ripping apart of the compacted/cemented areas will be a major key to a successful restoration programme. The restoration operations will take intensive management for a number of years to ensure success.

- The site remediation measures shall depend on the environmental characterization of the project area as well as the predicted potential and associated impacts based on the assessment that shall be carried out then.

Suffice it to say, however the following measures shall be planned for implementation after de-commissioning/closure:

- All debris shall be removed from the environment
- Reinstatement of all excavated routes to their original status to minimise negative impacts
- Grading of site to its original landscape to prevent erosion
- Good waste management plan shall be put in place
- Appropriate pension schemes shall be put in place for project workers for their up keep when the project is closed or de-commissioned.

8.1.2 Clean–Up and Restoration

The corridor and coterminous areas shall be cleared of all debris, rubbish and unused materials and disposed of in accordance with the waste management plan.

9. CONCLUSION

The Environmental Impact Assessment of the AIH project shows that the project will have significant economic benefits in the local, state and national economy. The project also indicated positive impact on the socio-economic life of the people by way of skilled and unskilled employment and provision of social amenities. Increase evacuation of food from rich rural agricultural areas of Cross River State will impact positively on the national, State and local economy as well as on the internal revenue base of the State. The economic gains of the proposed project to the economy of Nigeria cannot be overemphasized. However, there will be some temporary (short-term) negative impacts particularly on the soil and air quality and occurring mostly during the construction and operations activities.

9.1 Outcome

The ESIA of the proposed project shows that the project can be executed and operated with minimal negative impacts on the surrounding environment and humans by strict adherence and implementation of the recommended mitigation measures. The ESIA has also developed an Environmental and Social Management Plan (ESMP), which incorporates various mitigation measures that will eliminate or reduce the potential impacts of the proposed project implementation on the environment. Mitigation measures were subsequently developed for adverse impacts based on industry best practice, available technology and HSE considerations.

9.2 Conclusion

Given the foregoing, the following conclusions can be made:

- The proposed project is quite desirable because of its obvious economics, and social benefits, which are considered to out-weigh the negative environmental and social impacts.
- Impacts on other environmental resource and the social environment are considered minimal and localized in nature.
- Appropriate institutional framework, working with relevant regulatory authorities shall be set up to implement the mitigation measures recommended while the proposed monitoring programmes shall be set in motion as soon as possible.
- The ESMP shall be implemented and maintained throughout the duration of the project with the adverse impacts mitigated to as low as reasonably practicable levels. Impact mitigation monitoring shall also be carried out with the involvement of regulators to check compliance with the ESMP.
- The proposed project can be executed within the ambit of sustainable development and this indeed forms the basis for the actual project implementation.

9.3 Recommendation

Against the foregoing background, we strongly recommend the proposed AIH project for ESIA Approval because the mitigation measures that have been proffered will adequately address the identified impacts from the project; and the CR-SAPZ is committed to ensuring strict implementation of the project's ESMP.

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APPENDICES

APPENDIX 1.1: Terms of Reference

FEDERAL MINISTRY OF ENVIRONMENT

Environment House

Independence Way South, Central Business District, Abuja -FCT.

Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMENV/EA/EIA/8729/VOL.1/99
21st July, 2025.

The State Program Coordinator,
Special Agro-Industrial Processing Zones Program,
5 Donald Duke Boulevard, Diamond Hill,
Calabar,
Cross River State.

RE: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CROSS RIVER AGRO-INDUSTRIAL HUB (AIH) LOCATED AT ADIABO, ODUKPANI LGA, CROSS RIVER STATE.

Please refer to your letter dated 25th May, 2025 and the Ministry's letter Ref: FMEnv/EA/EIA/8729/VOL.1/68 dated 13th June, 2025 on the above project.

2. Following the conclusion of the Site Verification, Scoping Workshop and Data Gathering Exercises already conducted. I am directed to request you to forward to the Ministry the report of the Scoping workshop incorporating significant issues raised during the exercise and also to inform you that the next stage of the EIA process is Laboratory Analysis of the samples collected.

3. Please note that the Laboratory analysis of the samples must be carried out in an FMEnv accredited laboratory and shall be witnessed by officials of the Ministry. You are to ensure Quality Assurance /Quality Control measures for the laboratory analyses in line with standard practices and notify the Ministry in good time to enable adequate participation in the exercise.

4. The following should be forwarded to the Federal Ministry of Environment before submission of the draft EIA report:

i. Evidence of accreditation by the Federal Ministry of Environment for the laboratory where the samples analyses would be carried out.
ii. Chain of Custody form for the samples collected for analysis.
iii. Certificate of analysis duly stamped and signed by the laboratory Manager.
iv. Evidence of Laboratory analysis witnessing by Federal Ministry of Environment.

5. Upon completion of the EIA study, you are required to submit to the Ministry Two (2) hard and two (2) electronic copies of the draft EIA report and also email a copy to eia@ead.gov.org and copy info@ead.gov.ng. Furthermore, additional hard copies should be placed at Cross River State Ministry of Environment, Federal Ministry of Environment, Calabar, Cross River State and the Local Government Area affected by the proposed project.

6. Thank you for your cooperation.

Engr. (Mrs) Charity B. Malgwi
For: Honourable Minister

Appendix 4.1

Table A4.1: Field meteorological measurements

Sample code	Temperature (ºC)	Rel. humidity (%)	Pressure (mmHg)	Wind speed	Wind direction
AAIH/FM/01	26.2	79.4	761.62	0.40	316º NW
AAIH/FM/02	28.1	70.3	760.06	0.50	45º NE
AAIH/FM/03	25.5	77.6	760.06	0.47	325º NW
AAIH/FM/04	27.5	77.7	760.06	0.75	314º NW
AAIH/FM/05	28.7	77.9	760.06	1.04	245º SW
AAIH/FM/06	26.8	75.6	760.06	0.93	240º SW
AAIH/FM/07	26.0	74.2	760.06	0.86	320º NW
AAIH/FM/08	23.9	74.3	760.06	1.18	5º N
AAIH/FM/09	27.4	74.3	760.06	1.22	40º NE
AAIH/FM/10	28.5	73.3	760.06	1.50	70º ENE
CTRL	28.8	73.6	760.06	1.09	40º NE
Mean±SD	27.04±2.5	75.46±2.7	760.22±0.5	0.89±0.4	-
Range	23.9-28.8	70.3-79.4	760.06-761.62	0.40-1.50	-

Table A4.1.1: Annual Rainfall (MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	TOTAL
1994	40.7	0	167.3	328.2	255.3	294.2	609.5	424.5	290	265.2	229.7	0	242.05	0	609.5	2904.6
1995	Trace	21.1	366.1	248.3	208.6	375.2	632.4	467.4	696.8	496.1	243.8	69.7	347.8	21.1	696.8	3825.5
1996	2.4	162.2	161.5	314.5	299.5	435.3	401.1	425.4	615.2	357.4	40.5	106.8	276.8	2.4	615.2	3321.8
1997	61	0	139.4	228.7	328.2	633.1	796.6	492.6	211.2	319.1	214.3	68.2	291	0	796.6	3492.4
1998	25.4	6	174	119.1	211.6	504.5	255.2	353.7	365	437.1	286.3	33.6	230.9	6	504.5	2771.5
1999	86	49.3	203	311.4	180	270.3	349.9	494.5	368.3	463.7	207.2	0.3	248.7	0.3	494.5	2983.9
2000	66	0	95.9	166.4	217	250.6	597.9	392	577.6	232.9	153.6	57.5	233.9	0	597.9	2807.4
2001	0	11.6	151.7	371.8	491.4	390.5	268.5	457	455.7	381	217.1	5.7	266.8	0	491.4	3202
2002	0	13.5	154.6	383.2	301.3	344.6	274.1	623.5	284.3	285.8	126	6.8	233.1	0	623.5	2797.7
2003	26.7	103.2	226.6	283	315.3	202.2	327.4	398.6	399.2	224.1	148.5	2.9	221.4	2.9	399.2	2657.7
2004	19.9	73.5	278.4	270.2	308	303.5	391.9	335.5	196.4	168.3	0.6	25.6	197.7	0.6	391.9	2371.8
2005	33.8	35.3	295.9	299.9	263.9	615.6	808.2	624	230.4	279.8	182.3	32.9	308.5	32.9	808.2	3702
2006	84.7	57.1	323	166.1	430.8	227.7	484.9	273.4	536.3	175.3	134.4	0.1	241.2	0.1	536.3	2893.8
2007	0	51.1	181.6	265.9	384.2	583.5	492.2	415.5	561.7	197.9	262.1	33.1	285.7	0	583.5	3428.8
2008	15.1	1	184.1	216.4	386.8	437	597.7	510.2	217.9	315	102.5	77.1	255.1	1	597.7	3060.8
2009	89.7		87.5	150.5	308.9	218.3	577.4	507.1	273.9	148.1	126.9	0	226.2	0	577.4	2488.3
2010	31.8	88.2	63.6	130.4	306.5	611.3	382.6	406.7	451.3	325.1	27.2	56.7	240.1	27.2	611.3	2881.4
2011	TR	153.4	123.1	208.5	340.9	388.6	648.6	573.7	251.8	519.9	325.2	43.8	325.2	43.8	648.6	3577.5
2012	32.6	376.7	36	99.9	439.4	498.8	637.1	861.3	619.4	410.4	126.5	30.6	347.4	30.6	861.3	4168.7
2013	44.26	39.48	167.96	185.86	363.44	415.56	506.96	422.58	408.22	232.28	130.62	33.4	245.9	33.4	507	2950.62
2014	34.15	58.74	127.98	194.34	345.46	447.74	539.7	482.64	351.32	301.2	168.78	42.14	257.8	34.15	539.7	3094.19
2015	42.3	123.9	98.86	161.14	356.5	430.8	568.68	571.8	362.86	343.7	141.66	41.64	270.32	41.64	571.8	3243.84
2016	33.43	39.5	185.72	245.8	337.65	380.44	472.98	449.41	380.43	248.48	134.65	27.13	244.6	27.13	472.98	2935.62
2017	30.17	53.45	188.19	249.63	348.91	392.98	477.59	465.93	350.81	274.57	150.25	25.88	250.7	25.88	477.59	3008.36
2018	36.86	63.01	153.74	207.35	350.39	413.5	513.18	478.47	370.73	280.05	145.19	34.04	253.88	34.04	513.18	3046.51
2019	35.38	67.72	150.9	211.65	347.78	413.09	514.43	489.65	363.23	289.6	148.11	34.17	255.48	34.17	514.43	3065.71
2020	35.63	69.52	155.48	215.12	348.25	406.16	509.37	491.05	365.61	287.28	143.97	32.57	255	32.57	509.37	3060.01
2021	34.29	58.64	166.81	225.91	346.6	401.24	497.51	474.9	366.16	275.99	144.43	30.76	251.94	30.76	497.51	3023.24
2022	36.01	64.11	160.8	225.88	347.92	407.26	519.59	489.07	365.11	286.31	144.65	32.22	256.58	32.22	519.59	3078.93
2023	35.77	56.29	145.9	210.99	346.81	410.16	502.32	473.29	370.57	281.95	145.54	30.84	250.87	30.84	502.32	3010.43

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	TOTAL
2024	35.02	65.21	149.5	217.69	347.4	406.95	504.44	496.93	366.39	277.22	146.8	31.14	253.72	31.14	504.44	3044.69
MEAN	36.17	65.43	169.84	229.48	327.89	403.57	505.16	478.14	387.87	302.61	158.04	33.78	260.2	17.96	566.94	3093.54
MIN	0	0	36	99.9	180	202.2	255.2	273.4	196.4	148.1	0.6	0	197.7	0	391.9	2371.8
MAX	89.7	376.7	366.1	383.2	491.4	633.1	808.2	861.3	721.2	519.9	325.2	106.8	347.8	43.8	861.3	4168.7
TOTAL	1049.07	1962.77	5265.14	7113.76	10164.71	12510.68	15659.95	14822.32	12023.84	9380.83	4899.35	1047.33	8066.34	556.84	17575.21	95899.75

Table A4.1.2: Relative Humidity

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	Total
1994	76	80	84	85	85	87	94	94	90	87	84	69	84.6	69	94	1015
1995	72	78	84	85	85	88	90	90	88	87	82	86	84.6	72	90	1015
1996	85	81	86	84	82	86	91	92	91	86	83	84	85.9	81	92	1031
1997	84	71	80	84	84	89	90	91	86	85	86	82	84.3	71	91	1012
1998	73	77	78	82	82	85	88	90	89	87	86	83	83.3	73	90	1000
1999	81	86	83	87	84	85	88	89	89	89	88	80	85.8	80	89	1029
2000	81	70	78	81	84	85	91	92	91	88	86	79	83.8	70	92	1006
2001	82	70	83	85	84	87	90	93	89	87	86	85	85.1	70	93	1021
2002	67	75	85	84	84	86	88	91	87	87	85	81	83.3	67	91	1000
2003	81	82	82	84	86	86	87	92	90	85	86	82	85.3	81	92	1023
2004	87	80	76	85	82	90	90	86	87	87	86	81	84.8	76	90	1017
2005	78	79	86	82	85	90	89	90	89	87	85	84	85.3	78	90	1031.3
2006	86	85	81	84	84	84	88	90	87	84	84	87	85.3	81	90	1024
2007	87	82	80	85	86	87	89	84	90	87	86	86	85.8	80	90	1029
2008	89	86	84	82	84	88	92	91	89	86	86	85	86.8	82	92	1042
2009	86	85	82	85	84	87	89	91	88	89	86	85	86.4	82	91	1037
2010	85	84	82	87	85	88	89	90	89	85	85	83	86	82	90	1032
2011	82	70	83	85	84	87	90	93	89	87	86	85	85.1	70	93	1021
2012	67	75	85	84	84	86	88	91	87	87	85	81	83.3	67	91	1000
2013	83	80	83	85	85	87	90	90	89	87	86	84	85.75	80	90	1029
2014	82	80	83	85	84	87	90	91	88	87	86	84	85.58	80	91	1027
2015	81	79	83	85	84	87	89	91	88	87	86	84	85.3	79	91	1024
2016	80	79	82	84	84	87	90	91	89	87	85	82	85	79	91	1020

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	Total
2017	83	80	82	84	84	87	89	90	89	86	86	84	85.3	80	90	1024
2018	81.8	79.6	82.6	84.6	84.2	87.0	89.6	90.6	88.6	86.8	87.54	82.75	85.5	79.6	90.6	1025.69
2019	81.56	79.52	82.52	84.52	84.04	87.0	89.52	90.72	88.52	86.76	86.22	83.68	85.4	79.52	90.72	1024.58
2020	81.47	79.42	82.42	84.42	84.05	87.0	89.42	90.66	88.62	86.71	86.55	82.55	85.27	79.4	90.66	1022.19
2021	81.57	79.51	82.31	84.31	84.06	87.0	89.51	90.6	88.75	86.65	84.28	83.64	85.18	79.51	90.6	1022.9
2022	81.45	79.57	82.65	84.48	83.83	86.94	89.45	90.75	88.52	86.76	85.23	82.68	85.19	79.57	90.75	1107.5
2023	81.67	79.56	82.6	84.58	84.13	86.71	89.55	90.53	88.67	86.67	84.54	81.46	85.06	79.56	90.53	1020.67
2024	81.43	79.41	82.41	84.39	83.99	87.03	89.51	90.69	88.74	86.63	86.47	83.59	85.36	79.41	90.69	1024.29
MEAN	79.6	79.4	82.4	84.0	84.3	87.2	89.9	90.9	88.8	87.1	85.64	81.5	85.09	79	91	1020.74
MIN	50	66	75	78	79	83	87	84	86	84	82	69	82.4	50	87	923
MAX	89	87	88	88	88	92	94	94	92	89	90	87	94	87	94	1078
Total	2508.95	2450.59	2552.51	2614.3	2607.3	2694.68	2775.56	2807.55	2748.42	2687.98	2650.83	2566.35	2638.69	2386.57	2818.55	31757.12

Table A4.1.3: Annual Maximum Temperature (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Min	Max	Total
1994	31.7	33.2	32.6	32.1	31.2	29.8	27.5	27.4	28.8	29.7	30.9	32.5	**Mean**	**Min**	**Max**	**Total**
1995	32.7	34.1	32.6	32.4	31.5	30.9	29.4	29.3	30.3	30.1	30.5	31.5	30.6	27.4	33.2	367.4
1996	32.6	33.8	31.7	32.1	31.9	29.8	28.3	27.3	28.1	29.3	31.5	32.5	31.3	29.3	34.1	375.3
1997	31.9	33.6	32.7	30.8	31	29.4	28.7	28	29.9	30.7	31.4	32.3	30.7	27.3	33.8	368.9
1998	32.9	35	34.2	33.1	32.5	31.1	29.5	28	29.2	30.3	31.5	31.1	30.9	28.0	33.6	370.4
1999	31.9	32.3	32.3	31.1	30.8	30.1	29.3	29.2	28.7	29.3	30.4	32.3	31.5	28.0	35.0	378.4
2000	32.7	33.8	34.3	32.2	31.6	30.5	29	28.2	28.7	29.8	31.3	32	31.3	28.7	32.3	367.7
2001	32.4	34.3	32.5	32	31.6	30.1	28.5	27.1	28.2	30.2	31.3	32.2	31.2	28.2	34.3	374.1
2002	32.5	34.3	32	32	31.9	30.2	29.6	28.2	29.6	29.7	31.2	32.1	30.9	27.1	34.3	370.4
2003	33.1	34.2	33.3	32.1	31.4	30.2	30.2	28.7	29.8	31	31.5	31.6	31.4	28.2	34.3	373.3
2004	32.4	34	32	31	30	30	28	30	30.2	30	32	31.9	31.4	28.7	34.2	377.1
2005	32.6	34	32.4	32.5	31.2	29.1	28	26.7	29	29.5	31.3	30.8	31.0	28.0	34.0	371.5
2006	31.8	32.6	30.2	31.7	30.2	28.2	28.2	27.8	28.2	30.1	30.6	32	30.6	26.7	34.0	367.1
2007	29.9	31.3	32.1	31.9	30.8	29.6	27.3	27.8	27.7	29.2	30.3	31.2	30.1	27.8	32.6	361.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Min	Max	Total
2008	31.3	32.5	32.1	32.3	30.9	28.7	27.9	27.3	28.6	29.3	30.8	31.3	29.9	27.3	32.1	358.1
2009	30.8	31.8	32.1	31	30.7	29.2	27.4	26.4	27.5	28.9	29.9	30.4	30.3	27.3	32.5	363.0
2010	33.8	33.1	33	33.1	31.5	29.8	28.8	28.2	28.9	31.8	30.8	31.7	29.7	26.4	32.1	356.1
2011	32.5	34.3	32	32	31.9	30.2	29.6	28.2	29.6	29.7	31.2	32.1	31.2	28.2	33.8	374.5
2012	33.1	34.2	33.3	32.1	31.4	30.2	30.2	28.7	29.8	31	31.5	31.6	31.2	28.2	34.3	373.3
2013	31.90	32.87	32.43	32.07	31.20	29.62	28.53	27.77	28.68	29.98	30.75	31.38	31.4	28.7	34.2	377.1
2014	32.23	33.13	32.49	32.09	31.27	29.62	28.74	27.76	28.85	30.11	30.83	31.41	30.6	27.77	32.87	366.2
2015	32.39	33.23	32.55	32.06	31.33	29.77	28.88	27.84	28.89	30.25	30.83	31.43	30.7	27.76	33.13	368.53
2016	31.92	33.39	32.58	31.74	31.06	29.75	28.24	27.75	28.74	29.55	30.84	31.47	30.8	27.84	33.23	369.45
2017	32.01	33.40	32.50	31.82	31.08	29.71	28.38	27.81	28.80	29.70	30.89	31.49	30.6	27.75	33.39	367.03
2018	32.09	33.2	32.51	31.96	31.19	29.69	28.55	27.79	28.79	29.92	33.4	33.7	30.6	27.81	33.40	367.79
2019	32.13	33.27	32.53	31.93	31.19	29.71	28.56	27.79	28.81	29.91	31.4	31.2	31.1	27.79	33.7	372.89
2020	32.11	33.3	32.53	31.9	31.17	29.73	28.52	27.8	28.81	29.86	32.3	33.6	30.7	27.79	33.27	368.43
2021	32.05	33.31	32.53	31.87	31.14	29.72	28.45	27.79	28.79	29.79	33.2	32.0	31.0	27.8	33.6	371.73
2022	32.07	33.29	32.53	32.04	31.1	29.83	28.54	27.86	28.84	29.97	31.8	31.7	31.0	27.79	33.31	370.64
2023	32.13	33.1	32.5	31.95	31.15	29.65	28.41	27.82	28.77	30.07	33.1	31.2	31.0	27.86	33.29	369.76
2024	31.99	33.36	32.35	31.96	31.32	29.72	28.44	27.84	28.97	30.01	32.6	30.5	30.8	27.82	33.1	369.85
MEAN	32.0	33.4	32.5	31.8	31.1	29.7	28.4	27.8	28.8	29.7	31.5	31.7	30.8	27.3	34.3	369.6
Min	29.9	31.3	30.2	30.8	30.0	28.2	27.3	26.4	27.5	28.9	29.9	30.4	29.7	26.4	32.1	356.1
Max	33.8	35.0	34.3	33.1	32.5	31.1	30.2	30.0	30.3	31.8	33.4	33.7	31.5	28.7	35.0	378.4
Total	992.0	1035.9	1007.1	986.8	964.7	921.2	880.6	861.8	892.6	921.9	976.4	981.8	954.7	846.5	1063.3	11450.6

Table A4.1.4: Annual Minimum Temperature (ºC)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	Min	Max	Total
1994	22.6	24.1	23.5	23	22.4	21.9	21.5	22.7	22.8	22.6	22.6	21.1	22.6	21.1	24.1	271.8
1995	21.9	23.1	22.6	23.1	22.6	22	21.6	21.7	21.6	21	22.5	21.9	22.1	21.0	23.1	265.0
1996	21.9	23.7	23.2	22.6	22.9	22	21.5	21.4	21.4	21.1	22.4	22.7	22.2	21.1	23.7	266.8
1997	22.5	21.6	22.9	22.1	22	21.7	21.1	22.6	23.2	22.8	22.8	22.6	22.3	21.1	23.2	267.9
1998	21.5	24.7	24.3	23.8	23.3	23.2	22.6	22.3	22.3	22.3	22.6	21.9	22.9	21.5	24.7	274.8
1999	22	22.5	22.2	22.3	22.2	21.9	21.1	21.4	22.6	22.7	22.9	22.6	22.2	21.1	22.9	266.4

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	Min	Max	Total
2000	23.9	23.2	24.3	23.6	23.7	23.1	22.8	22.5	23	23	23.4	22.5	23.3	22.5	24.3	279.0
2001	22.4	23.4	23.7	23.7	23.7	23	22.8	22.6	22.8	23.2	23.7	24.1	23.3	22.4	24.1	279.1
2002	22.5	23.5	24.3	24	23.6	23.4	23.5	22.9	23.3	23.1	23.4	23.3	23.4	22.5	24.3	280.9
2003	23.4	24.4	24.4	23.6	23.6	23.3	23	23.1	22.9	23.4	23.6	23.3	23.5	22.9	24.4	281.0
2004	24	25	24	24	23	23	23	23	22.7	23	23	23.4	23.4	22.7	25.0	280.1
2005	21.7	25.2	24	24.6	23.8	23.7	23	22.9	23.3	23.1	23.8	23.3	23.5	21.7	25.2	282.4
2006	24.6	24.3	23.6	24.3	23.6	23.2	23.2	23.3	23.2	23.3	23.6	23.1	23.6	23.1	24.6	283.3
2007	21.1	22.9	22.5	22.8	22.9	22.3	22.5	22.1	22.3	22.4	22.3	23	22.4	21.1	23.0	269.1
2008	22.3	22.9	23	23.1	23	22.6	22.4	22.7	22.7	22.6	22.6	22.7	22.7	22.3	23.1	272.6
2009	22.6	23.4	23	23	22.8	22.5	22.1	21.7	21.9	21.8	22.2	22.3	22.4	21.7	23.4	269.3
2010	24.3	25	24.7	24.4	24.5	23.5	23.3	23	23	23.4	23.1	22.6	23.7	22.6	25.0	284.8
2011	22.6	21.4	23.4	24	23.8	22.5	22.8	21.9	22.9	22.7	23.4	19.8	22.6	19.8	24.0	271.2
2012	19.4	21.8	24.6	23.9	23	23	21.9	21.7	22.6	22.3	22.1	20.2	22.2	19.4	24.6	266.5
2013	22.05	22.90	23.53	23.53	23.33	22.73	22.50	22.18	22.57	22.53	22.62	21.77	22.68	21.77	23.53	272.24
2014	22.21	22.90	23.71	23.66	23.41	22.81	22.50	22.20	22.61	22.56	22.67	21.56	22.73	21.56	23.71	272.80
2015	22.19	22.90	23.82	23.75	23.47	22.84	22.52	22.11	22.60	22.55	22.68	21.37	22.73	21.37	23.82	272.80
2016	22.48	23.44	23.59	23.49	23.22	22.77	22.46	22.38	22.65	22.62	22.97	22.52	22.88	22.38	23.59	274.59
2017	22.43	22.62	23.79	23.84	23.60	23.32	22.87	22.51	22.50	22.60	22.70	23.05	22.99	22.50	23.84	275.83
2018	22.27	22.95	23.69	23.65	23.41	22.89	22.57	22.28	22.59	22.57	23.6	22.63	22.92	22.27	23.69	275.10
2019	22.32	22.96	23.72	23.68	23.42	22.93	22.58	22.3	22.59	22.58	23.44	25.17	23.14	22.30	25.17	277.69
2020	22.34	22.97	23.72	23.68	23.42	22.95	22.6	22.31	22.59	22.58	22.56	25.22	23.16	22.31	25.22	277.94
2021	22.37	22.99	23.7	23.67	23.41	22.97	22.62	22.36	22.58	22.59	24.16	23.48	23.16	22.36	24.16	277.90
2022	22.26	22.87	23.87	23.54	23.39	22.89	22.53	22.33	22.77	22.67	22.51	24.05	23.05	22.26	24.05	276.68
2023	22.21	23.0	23.72	23.56	23.46	22.99	22.41	22.3	22.7	22.66	23.67	23.26	23.08	22.30	23.72	276.94
2024	22.47	23.21	23.61	23.83	23.37	22.91	22.55	22.33	22.57	22.5	23.11	26.10	23.21	22.33	26.10	278.56
MEAN	22.6	23.8	23.8	23.6	23.3	22.9	22.5	22.5	22.6	22.7	23.0	22.7	22.9	21.8	23.9	274.6
MIN	19.4	21.4	22.2	22.1	22.0	21.7	21.1	21.4	21.4	21.0	22.1	19.8	22.1	19.4	22.9	265.0
MAX	24.6	25.2	24.7	24.6	24.5	23.5	23.5	23.3	23.3	23.4	24.1	26.1	23.7	22.7	26.1	284.8
TOTAL	700.2	737.0	737.8	731.3	723.0	709.6	697.8	696.3	701.8	702.8	713.2	703.3	711.2	676.2	740.4	8514.2

Table A4.2: Air quality measurements

Sample code	NO_2 (ppm)	SO_2 (ppm	H_2S (ppm	CO (ppm)	CO_2 (ppm)	NH_3 (ppm)	Cl_2 (ppm)	HCN (ppm)	TVOC (mg/m^3)	CH_4 (ppm)	CH_2O (mg/m^3)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
AAIH/AQ/01	0.1	0.1	0.2	3.0	667	4.0	0.2	1.0	0.627	0.5	0.082	62	87
AAIH/AQ/02	0.2	0.3	<0.1	5.0	675	4.0	0.3	2.0	0.663	1.5	0.086	71	125
AAIH/AQ/03	0.1	0.2	0.3	5.0	611	6.0	0.1	1.0	0.625	1.0	0.032	65	142
AAIH/AQ/04	0.1	0.2	0.1	3.0	580	6.0	0.1	1.0	0.528	1.5	0.071	68	177
AAIH/AQ/05	0.1	0.1	0.1	4.0	520	5.0	0.1	<1.0	0.337	0.5	0.088	70	181
AAIH/AQ/06	0.2	0.1	0.1	4.0	544	5.0	0.1	<1.0	0.205	0.5	0.045	53	126
AAIH/AQ/07	0.2	0.2	<0.1	4.0	530	5.0	0.1	<1.0	0.182	0.5	0.028	53	133
AAIH/AQ/08	0.2	0.2	0.2	5.0	461	5.0	<0.1	<1.0	0.114	1.0	0.036	58	140
AAIH/AQ/09	0.1	0.1	0.2	2.0	444	5.0	<0.1	<1.0	0.125	1.5	0.040	71	191
AAIH/AQ/10	0.1	0.1	0.1	2.0	430	5.0	0.1	<1.0	0.138	1.5	0.022	53	112
CTRL	0.1	0.1	0.1	2.0	470	4.0	<0.1	1.0	0.158	0.5	0.055	49	133
Mean±SD	**0.14±0.1**	**0.16±0.1**	**0.11±0.1**	**3.7±1.2**	**546.2±87.4**	**5.0±0.7**	**0.09±0.1**	**<0.1±1.2**	**0.354±0.2**	**1.0±0.5**	**0.053±0.02**	**62.4±7.7**	**141.4±32.8**
Range	**0.1-0.2**	**0.1-0.3**	**<0.1-0.3**	**2.0-5.0**	**430-675**	**4.0-6.0**	**0.2-0.4**	**<1.0-2.0**	**0.114-0.663**	**0.5-1.5**	**0.022-0.088**	**53-78**	**87-191**
FME limit (1991)	**0.04-0.06**	**0.01-0.1**	**-**	**10.0-20.0**		**200**	**-**	**-**	**-**		**-**	**250**	**250**

Table A4.2.1: Noise levels of the study area

Sample code	Noise level [dB(A)]	Minimum [dB(A)]	Maximum [dB(A)]
AAIH/NL/01	69.7	60.6	71.2
AAIH/NL/02	73.5	68.5	78.3
AAIH/NL/03	71.2	69.3	77.5
AAIH/NL/04	65.3	57.2	68.9
AAIH/NL/05	69.4	58.8	70.6
AAIH/NL/06	62.7	57.6	64.6
AAIH/NL/07	58.7	55.2	60.7
AAIH/NL/08	55.6	47.8	58.8

Sample code	Noise level [dB(A)]	Minimum [dB(A)]	Maximum [dB(A)]
AAIH/NL/09	49.9	42.9	51.4
AAIH/NL/10	63.7	58.3	66.3
CTRL	69.7	64.3	72.2
Mean±SD	**63.97±7.5**	**57.62±8.1**	**66.83±8.4**
Range	**49.9-73.5**	**42.9-69.3**	**51.4-78.3**
FME limit (1991)	**90 [dB(A)]**		

AAIH = Adiabo Agro-Industrial Hub   NL = Noise Level

Table A4.3: Results of the Physicochemical Characteristics of Soil Samples

Parameter	SS_1		SS_2		SS_3		SS_4		SS_5		CTRL	
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS
Permeability (%)	35.3	30.5	37.4	34.8	39.8	33.6	32.4	29.9	36.5	32.4	37.7	31.6
Porosity (%)	37.8	35.7	37.5	32.2	40.6	36.2	38.8	32.2	36.6	33.4	38.6	33.6
Bulk density (mg/kg)	1.48	1.57	1.39	1.44	1.35	1.42	1.39	1.47	1.37	1.45	1.28	1.33
% Sand	72	74	73	72	65	71	70	75	68	74	67	72
% Silt	18	10	8	5	8	3	10	3	10	7	11	4
% Clay	10	16	19	23	27	26	20	22	22	19	22	24
Textural Class (USDA)												
pH	5.29	6.47	5.33	6.40	5.52	6.27	4.76	6.56	4.76	6.45	5.25	6.44
Organic Carbon (%)	2.01	1.92	2.91	2.13	2.01	1.22	1.64	1.42	1.08	1.01	1.90	1.68
Total Nitrogen (%)	0.50	0.35	0.65	0.53	0.05	0.03	0.07	0.06	0.06	0.04	0.01	0.02
Avail. P(Mg/kg)	14	11	23	26	20	19	14	13	31	30	18	17
Conductivity (dS/m)	0.080	0.084	0.060	0.062	0.073	0.069	0.052	0.047	0.073	0.068	0.060	0.053
Moisture content (%)	33.2	35.5	31.6	38.2	31.6	34.5	30.9	36.6	34.8	39.9	35.5	38.2
Nitrate (mg/kg)	5.34	3.62	6.21	4.08	5.77	4.29	6.47	4.32	5.58	4.11	5.60	4.28
Phosphate (mg/kg)	3.47	2.32	4.08	3.18	3.45	2.23	4.11	3.21	4.22	3.44	3.67	2.45
Sulphate (mg/kg)	2.22	1.48	2.52	1.38	2.71	1.29	3.17	2.09	3.22	2.14	2.82	1.37
Calcium (cmol/kg)	4.80	4.20	1.30	1.25	4.0	3.70	3.46	3.29	3.09	2.90	3.39	3.59

Parameter	SS_1		SS_2		SS_3		SS_4		SS_5		CTRL	
	TS	**SS**	**TS**	**SS**	**TS**	**SS**	**TS**	**SS**	**TS**	**SS**	**TS**	**SS**
Magnesium (cmol/kg)	1.10	1.05	0.70	0.65	0.60	0.50	1.05	0.98	0.99	0.83	0.83	0.83
Potassium (cmol/kg)	0.12	0.11	0.08	0.10	0.11	0.11	0.20	0.15	1.57	0.84	0.18	0.14
Sodium (cmol/kg)	0.09	0.08	0.07	0.08	0.09	0.05	0.15	0.04	0.06	0.05	0.08	0.06
Exchange Acidity (cmol/kg)	0.53	0.55	1.34	1.53	0.52	0.52	1.28	1.62	0.60	0.68	0.83	0.92
THC (mg/kg)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium (mg/kg)	0.010	0.006	0.012	0.008	0.007	0.003	0.010	0.002	0.014	0.010	0.013	0.009
Nickel (mg/kg)	0.022	0.014	0.031	0.025	0.032	0.026	0.026	0.015	0.011	0.008	0.015	0.006
Iron (mg/kg)	47.7	41.5	44.6	35.2	45.2	39.4	49.1	41.8	36.6	27.7	25.5	23.4
Lead (mg/kg)	1.301	1.103	1.211	1.165	1.251	1.087	1.211	1.242	1.141	1.252	1.115	1.101
Copper (mg/kg)	2.05	2.11	2.71	2.25	2.17	2.44	2.52	2.22	2.76	2.52	2.35	2.11
Zinc (mg/kg)	4.44	3.67	4.51	4.08	3.88	3.32	3.27	3.05	3.42	3.27	3.72	3.51

Source: Laboratory Analysis (2025); TS = Surface Soils (0 – 15cm); SS = Subsurface soils (15 – 30cm); CTRL = Control

Table A4.4: Internationally recognised thresholds for key soil parameters

Parameter	Permissible Range	Agency/Source	Implication for SAPZ
Soil pH	5.5 – 7.0	Landon, 1991	Below this affects nutrient availability and microbial activity
Organic Carbon	> 2.0%	Brady & Weil, 1996	Low levels reduce fertility and soil structure
Total Nitrogen	> 0.15%	FAO, 2006	Below this causes nitrogen deficiency
Available Phosphorus	15 – 30 mg/kg	Paul & Clark, 1989	Low P reduces root growth
Exchangeable Ca	10 – 20 cmol/kg	Sobulo & Adepetu, 1987	Low Ca limits nutrient uptake
Exchangeable Mg	3 – 8 cmol/kg	FPDD, 1990	Below 1.0 leads to Mg deficiency
Exchangeable K	0.6 – 1.2 cmol/kg	FPDD, 1990	Deficiency stunts plant growth
Fe	<100 mg/kg	Brady & Weil, 1996	Toxicity unlikely at observed levels
Zn	10 – 300 mg/kg	Bohn *et al*., 1985	Marginal deficiency risk
Cu	2 – 100 mg/kg	Bohn *et al*., 1985	Adequate but borderline
Pb	<70 mg/kg	Brady & Weil, 1996	Safe for food production
THC	<50 mg/kg	FMEnv Nigeria	No contamination risk

Table A4.5: A Check list of the Fauna Species in the Study Area

S/N	Family/ Order	Common Names	Zoological Names	Abundance	2016 IUCN Status
1	Rodentia	Red-legged sun squirrel	Helioscius rufobrachium	4	LC
2		Pygmy striped squirrel	Myosciurus pumilio	*	LC
3		Crested porcupine	Hystrix cristata	*	LC
4		Grass-cutter	Thryonomys swinderianus	4	LC
5		Giant rat	Cricetomys gambiannus	4	DD
6		Bush tailed porcupine	Atherurus africanus	*	LC
7		Marsh cane-rat	Thryonomis spp	1	LC

S/N	Family/ Order	Common Names	Zoological Names	Abundance	2016 IUCN Status
8		Green squirrel	Paraxerus poensis	1	LC
9		Bush rat	Rattu rattus	3	LC
10		common rat	Rattus norvegicus	6	LC
11		Bush rat	Rattus fuscipes	2	LC
12	Pongidae	Robust chimpanzee	Pan troglodytes		
13	Manidae	Giant pangolin	Manis gigantea	-	VU
14		Ground pangolin	Smutsia gigantea	*	VU
15	Canidae	Pale fox	Vulpes pallid	*	LC
16	Bovidae	Congo forest buffalo	Syncerus caffer nanus	*	NE
17	Molossidae	Giant pangolin	Manis gigantea	-	VU
18		Ground pangolin	Smutsia gigantea	*	VU
19	Primata	white throated monkey	Cercopithecus erythrogaster	*	Vu
20		black throated colored monkey	Cercopithecus roloway	*	EN
21		Blue Monkey	Cercopithecus mitis	*	LC
22		Old world monkey	Mandrillus leucophaeus	*	EN
23		Mona monkey	Cercopithecus mona	*	LC
24	Viverridae	Blotched genet	Genetta tigrine	*	LC
25		African civet	Civettictis civetta	*	LC
26		African palm civet	Nandinia binotata	*	LC
27		Cape clawless otter	Aonyx capensis	*	NT
28		Small Indian Mongoose	Herpestes auropunctatus	1	NA
29	Artiodactyla	Bush pig	Potamochoerus porcus	*	LC
30		Sitatunga or marshbuck	Tragelaphus spekii	1	LC
31		Water chevrotain	Hyemoschus aquaticus	-	LC
32		Blue duiker	Cephalophus monticola	1	LC
33		Red-flanked duiker	Cephalophus rufilatus	*	LC
34		Bush duck	Tragelaphus scriptus	1	LC
35	Accipitridae	Back kite	Milvus migrans	4	LC
36		Hooded vulture	Necrosyrtes monachus	2	CR
37		African harrier hawk	Polyboroides typus	2	LC
38	Rallidae	African rail	Rallus caerulescens	2	LC
39	Phasianidae	Double-spurred Francolin	Francolinus bicalcaratus	4	LC
40	Apodidae	African palm swift	Cypsiurus parvus	1	LC
41		Little swift	Apus affinis	3	LC
42	Tytonidae	Barn owl	Tyto alba	4	LC
43		Owl	Strix alba	2	LC
44	Muscicapidae	Cassins flycatcher	Muscicapa cassini	*	LC

S/N	Family/ Order	Common Names	Zoological Names	Abundance	2016 IUCN Status
45		Rusty-tailed Flycatcher	Muscicaparuficauda	1	LC
46	Columbidae	Red eyed dove	Streptopelia semitorquata	4	LC
47		Blue headed wood dove	Turtur brehmeri	5	LC
48		African green fruit pigeon	Treron calvus	1	LC
49	Numididae	Guinea fowl	Numida meleagris	9	LC
50	Anatidae	Bush duck fowl	Nettapus auratus	3	LC
51		African black duck	Anas sparsa	4	LC
52	Agamidae	Common rainbow lizard	Agama agama	*	LC
53	Boidae	Boa	Boa constrictor	-	LC
54	Scinidae	Skink	Mabuya cochonaev	6	LC
55		West African dwarf crocodile	Osteolaemus tetraspis	*	Vu
56		Rock python	Python bivittatus	*	LC
57		Spitting cobra	Naja nigricollis	1	LC
58		Nile monitor	Varanus niloticus	1	LC

Source: PGM Survey, 2025

Asterisk (*) indicate species sighted indirectly, minus Asterisk (-) indicates absence, LC = Least Concern, Vu = Vulnerable, CR = Critically Endangered, NT = Near Threatened, EN = Endangered, DD = Data deficient, NA= Not Assessed.

Table A4.6: Composition and abundance of Phytoplankton species in Calabar River (per litre) during Wet Season

Phytoplankton species	SW -1	SW -2	SW-3	SW -4	SW -5
BACILLARIOPHYCEAE					
Diatoma elongatom	12	14	13	-	-
Novicula caspidata	-	-	25	11	-
Novicula bacillum	13	-	-	9	15
Asterionella Formosa	15	-	21	-	-
Flagilaria acus	-	11	-	5	21
Novicula linearus	21	-	-	12	-
Novicula gracillis	-	15	-	-	9
Synedra ulna	17	-	27	-	22
Total	78	40	86	37	67
CHLOROPHYCEAE					
Closterium acotum	9	15	-	11	15
Closterium kutzingii	12	-	-	16	-
Scenedesmus acutus	-	11	-	-	26
Scenedesmus quadricauda	11	-	14	-	-
Total	32	26	14	27	41

EUGLENOPHYCEAE	-	-	-	-	-
Euglena acus	-	-	-	-	-
Astasia urvata	-	13	-	-	8
Phacus mirabilis		-	8	-	-
Total	0	13	8	0	8
Cyanophyceae	-	14	9	-	-
Oscillatoria limnetica	0	9	-	5	-
Oscillatoria redeke	14	-	13	8	-
Anacustis aureginosa	-	-	-	-	-
Total	14	23	22	13	0
Number of Species	9	8	7	8	6
GRAND TOTAL	124	102	130	77	116

Source: PGM Fieldwork, 2025

Table A4.7: Composition and abundance of Phytoplankton species in Calabar River (per litre) during Dry season

Phytoplankton species	WS-1	WS-2	WS-3	WS-4	WS-5
BACILLARIOPHYCEAE					
Achnanthes delicatula	15	-	28	-	-
Achnanthes linearis	23	-	14	-	21
Diatoma elongatom	-	16	12	23	13
Navicula cuspidata	-	10	-	19	24
Novicula gracillis	41	-	-	18	-
Novicula placentula	33	16	21	-	18
Asterionella Formosa	-	24	13	-	33
Flagilaria acus	36	-	18	19	15
Synedra elegans	15	26	38	-	-
Synedra ulna (Kurtz)	47	-	-	31	-
Total	**210**	**92**	**144**	**110**	**124**
CHLOROPHYCEAE					
Actinastrium gracilinum	-	21	-	23	-
Closterium acotum	15	-	-	-	-
Closterium circulare	24	31	18	16	23
Closterium kutzingii	-	-	-	10	24
Scenedesmus acutus	22	-	16	28	31
S. quadricauda	-	13	22	-	-
Total	**61**	**65**	**56**	**77**	**78**
EUGLENOPHYCEAE					
Euglena acus	17	-	20	14	21
Euglena gracilis	-	10	-	-	-
Astasia urvata	15	14	13	-	-
Phacus mirabilis	18	-	12	-	12
Total	**50**	**28**	**45**	**14**	**33**
Cyanophyceae					

Anabaena affinis	14	12	18	-	-
Oscillatoria limnetica	-	-		-	19
Oscillatoria redeke	10	-	14	-	14
Anacustis aureginosa	16	12	-	-	-
Total	**40**	**24**	**32**	**0**	**33**
Number of Species	**16**	**12**	**15**	**10**	**13**
GRAND TOTAL	**361**	**209**	**277**	**201**	**268**

Source: EIA of General Electric at CEFTZ

Table A4.8: Composition and abundance of Zooplankton species in Calabar River (per litre) during Wet season

Zooplankton Taxa	WS-2	WS-3	WS-5	WS-6	WS-8
COPEDPODA	-	-	3	3	4
Copepod nauplius	2	-	1	4	2
Diaptomus sp	-	4	-	2	1
Oncaea venusta	3	-	2	-	-
Paracalanus parvus					
Total	**5**	**4**	**6**	**9**	**7**
ROTIFERA					
Branchinonus sp	2	-	-	3	1
Keratella quadrata	1	1	2	-	-
Platyia sp	-	-	-	1	2
Total	**3**	**1**	**2**	**4**	**3**
CLADOCERA					
Balanus sp	2	-	1	-	1
Podon polyphemides	-	-	-	-	1
Porellana sp	-	-	0	1	-
Total	**2**	**0**	**1**	**1**	**2**
GASTROPODA					
Carinaria lamarchi	-	1	1	-	2
Total	**0**	**1**	**1**	**0**	**2**
Number of Species	**5**	**3**	**6**	**6**	8
GRAND TOTAL	**10**	**6**	**10**	**14**	**14**

Table A4.9: Composition and abundance of Zooplankton species in Calabar River (per litre) during Dry season

Zooplankton species	WS-1	WS-2	WS-3	WS-4	WS-5
COPEDPODA					
Calanus calanus	-	-	7	6	-
Calanus finmarchicus	6	5	4	5	8
Copepod nauplius	5	7	-	8	-
Cyclops strenunous	-	5	7	-	6
Diaptomus glacitis	-	-	6	5	-
Paracalanus parvus	5	-	8	5	5

Total	**16**	**17**	**32**	**29**	**19**
ROTIFERA					
Branchinonus sp	4	-	6	-	5
Keratella cochlearis	2	-	8	-	5
Litsplancha girodi	-	7	8	7	-
Platyia sp	4	4	-	7	7
Total	**10**	**11**	**22**	**14**	**17**
CLADOCERA					
Daphnia ambigua	-	5	5	-	3
Daphnia pulex	-	3	8	3	-
Eradne spinfera	8	-	8	4	-
Podon sp	3	-	3	8	6
Porellana sp	4	4	-	-	5
Total	**15**	**12**	**24**	**15**	**14**
GASTROPODA					
Carinaria lamarchi	-	3	3	-	4
Total	**0**	**3**	**3**	**0**	**4**
Number of Species	**9**	**9**	**13**	**10**	**10**
GRAND TOTAL	**41**	**43**	**81**	**58**	**54**

APPENDIX 4.3: ATTENDANCE LISTS

18-06-2025 Attendance List Focused Group Discussion meeting with Adiabo Communities

S/N	NAME	COMMUNITY	PHONE NUMBER	POSITION	SIGN
1.	Chief (Col) Moses Effiong	Adiabo	08033078267		
2.	HH Chief Okon Ofu Inok	Esin Ufot Adiabo	07086121046		
3	HH Chief Ukpabio O. A. Ofu	Adiabo	08032087947		
4.	HH Chief Okon Edet Ofu	Adiabo	08039178461		
5.	Chief Micheal Eyo	"	08061652751		
6.	Edet Nyon Efim	"	070395345 2		
7	Francis Dominic Hogan	"	08068348460	Youth	
8.	Bassey Edet Essien	"	08067289372	Youth	
9.	Etim Monk	"	07062054204	"	
10.	Solomon Okon Udo	Esine Ufot Adiabo	08066153924 1	"	
11.	Deborah Oku	Adiabo	08108517508	"	
12.	Offiong Edem Eyo	Adiabo	07038380558	"	
13.	Rose Malachy Effiong	"	08066384696	"	
14.	Bassey Thompson	"	08038700609	"	
15	Gabriel Okon Asuquo	"	08030890868	Youth Leader	
16	Etim Effiong Edem	"	09028255984	Youth	
17	Nene Effiong Etim Ita	"	07089377661	"	
18.	Seraphina Nya Effiong	"	08138810492	"	
19.	Esther Ewa Ekeng	"		"	
20.	Mary Efiom Effa	"	09079153932	"	
21	Ayi Okon Etim	"	07062191540	"	
22.	Bassey Okon Effiong	"	07033749186	"	
23	Ikwo Philip Ukpong	"	08025919787	"	

S/N	NAME	COMMUNITY	PHONE NUMBER	POSITION	SIGN
24	Nsidibe Oku Oku	Adiabo	08067289372	Youth	
25	Glory Okon Ekpenyong	"		"	
26	Anse Ekpo Ko	"		"	
27	Queeneth Ekpo Archibong	"	08138890171	"	
28	Peace Chukwuma Egwu	"	09024621359	Youth	
29	Veronica Emmanuel Ewa	"	08064312195		
30.	Angela Edet Nyong	"	09012717493	"	
31	Florence Edet Nyong	"	07066563512	"	

Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Stakeholders Engagement

Date 17-JUNE-2025 Venue Hogis Hotel, 7 Akim Close, State Housing Calabar Meeting Type STAKEHOLDERS ENGAGEMENT SCOPING WORKSHOP

SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	Dr. Musa Gashau	FMEnv, Abuja	08033141766	musagashau@yahoo.com	
2.	Dominic Fred, KSC	SEMA	08064553090	[illegible]	
3.	Barr. Mrs. Lilian E. Ugbong	CRIRS	08051761754	lilianenya33@gmail.com	
4.	Chief Michael Eyo	Adiabo	08061652751		
5.	Solomon Okon	Adiabo	08066153941		
6.	Okkon Edem	Adiabo	07059380556		
7.	HH Chief Cletus Okon Edu	Adiabo	08032087947		
8.	Hon Dr. Fred Okem	C/MAN, Yala	080272895990		
9.	Jesam Okpi Iwara	PC CRGS for DG CRGLIA	07035163746	Jesamlara@gmail.com	
10.	Chief (Col) Moses Effiong	Adiabo Ikot Mbo Otu	08033078267	moseseffiong932@gmail.com	
11.	Engr. Dr. Enang Egbe	CR-SAPZ IE	08069016498	enangegbe@gmail.com	
12.	Dr. Eyo O. O. Edet	SAPZ PGM	08037625203	eyoooo53@yahoo.com	
13.	Chief Joseph Jiko	CUP & Works	07085990475	josephjiko@gmail.com	
14.	Mr Emmanuel A. Basey	NIWA	08034347089	emmanuelabasey@gmail.com	
15.	Sabeezah Nazolah Saleh	NIWA	07036111298	salehsabey90@hotmail	

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Stakeholders Engagement

Date 16-06-2025 Venue Palace Of the Obong Of Calabar. Meeting Type

SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	HH Chief (Col) J P Edet (Rtd)	Village Head	08032223635		
2.	HH Chief Cletus Okon Edu	Adiabo Ikot Anwatim	08136686374		
3.	HH Chief Okon Ofu Inok	"	08165951790		
4.	HH Chief Okon Edet Otu	"	08039178461		
5.	~~Chief Okon Edet Otu~~				
6.	Chief Michael Eyo	Adiabo	08061652751		
7.	Gloria O. Ogbeh	SAPZ ESSO	08037562803		
8.	Enang Egbe	PIM Secretariat	08069016498	enangthecpa@gmail.com	
9.	BRIAN E. EDET	public Health	08066460516	edetbrian@gmail.com	
10.	Ibeju Okinna	Enumeration	09026544077	[illegible]	
11.	Daniel Nsor	ECCD	08156348925	[illegible]@gmail.com	
12.	Dr Inyang A. Ukpe	PCM	08062896212	[illegible]@yahoo.com	
13.	DR. MALACHI ABASIODIONG	PGM	08032155848		
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15.	Ibianga Yusuf Bassey	AGM	08037544648	[illegible]@yahoo.com	

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Stakeholders Engagement

Date 17/JUNE/2025 Venue HOGIS HOTEL, 7 AKIM CLOSE, STATE HOUSING, CALABAR Meeting Type STAKEHOLDERS ENGAGEMENT/SCOPING WORKSHOP

SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	David Edim HRH. [illegible]	CRGIA	08099350518	edimdavid@yahoo.com	[illegible]
2.	~~David Edim~~				
3.	Antan Eso Okor	Office of the SA Health Governor's Office	08037912768	antangold@gmail.com	[illegible]
4.	Asim Frederick	SAPZ	07037467622	Asimchmed[illegible]@gmail	[illegible]
5.	Obelen Ebighe Egbe	SAPZ	08062890973	Ebors@gmail.com	[illegible]
6.	Ude Anthony C.	Public Health	08038814668	udeanthony70@gmail.com	[illegible]
7.	DR. OMOBOLANJI O. AFOLABI	PGM	09054439308	omobolajiafos@gmail.com	[illegible]
8.	Chief Otu Itok	Adiabo			
9.	Okwari Edu Terry	PGM	09064553619	Okwariedu@gmail.com	[illegible]
10.	Bassey Uzodinma	PGM	08037135576	05	
11.	Stella Chioba	PGM	08124253846	stellach[illegible]@yahoo.com	[illegible]
12.	Enagha Oji	PGM	08064012422	Enaghaoji@gmail.com	[illegible]
13.	Ihegmu Obinna	PGM	09026544077	hap Amelia@gmail	[illegible]
14.	Chief Otu Inok	Adiabo			[illegible]
15.	Dr. Bolaji Afolabi	PGM	09169604008	omobolajiafos@gmail.com	[illegible]

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SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	Dr. Musa Gashan	FMEnv, Abuja	08033141766	musagashan@yahoo.com	[illegible]
2.	Dominic Fred, KPI	SEMA	08064553090	[illegible]	[illegible]
3.	BARR MRS LILIAN E. UKPONG	CRIRS	08051761754	lilianenya33@gmail.com	[illegible]
4.	Chief Michael Eyo	ADIABO	08061652751		[illegible]
5.	Solomon Okon		08066153941		[illegible]
6.	Okkon Edem	Adiabo	07059358056		[illegible]
7.	[illegible]	Adiabo	08032087947		[illegible]
8.	Hon Dr. Fred Orem	CMHM, Yala	08022789599	0	[illegible]
9.	Jesam Okoi Iwara	PC CRGG for DG CRGIA	08035163946	JesamIwara@gmail.com	[illegible]
10.	Chief (Col) Moses Effiong	Adiabo Ikot Mbo Otu	08033078267	moseseffiong932@gmail.com	[illegible]
11.	Engr. Dr. Enang Egbe	CR-SAPZ IE	08069016498	enangegbe@gmail.com	[illegible]
12.	Dr. Eyo D. D. Edet	[illegible] PGM	08037625203	eyoowe[illegible]@yahoo.com	[illegible]
13.	Chief Joseph Joko	CRP & Works	07085990475	josephjoko[illegible]	[illegible]
14.	Mr Emmanuel A. Bassey	NIWA	08034347089	emmanuelabassey@gmail	[illegible]
15.	[illegible]	NIWA	07036111298	[illegible]	[illegible]

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SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	David Edim / HRH. [illegible]	CRGIA	08099350518	edimdavid@yahoo.com	
2.	~~David Edim~~				
3.	Antan Eso Okor	Office of the SA Health Governor's Office	08037912768	antangold@gmail.com	
4.	Asim Frederick	SAPZ	07037467622	[illegible]@gmail	
5.	Obelen Ebighe Egbe	SAPZ	08062890973	[illegible]@gmail.com	
6.	Ude Anthony C.	Public Health	08038814668	udeanthony70@gmail.com	
7.	DR. OMOBOLANJI O. AFOLABI	PGM	09054439308	omobolajiafos@gmail.com	
8.	Chief Otu Itok	Adiabo			
9.					
10.					

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SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	Acc Ikoh Gabriel	NSCDC	07069027338	Ikohgabriel@gmail	
2.	LT(NN) SA AMUDA	NIGERIAN NAVY	09033859110	[illegible]@gmail.com	
3.	AC I. BASSEY	Nig. Customs	08069255639	[illegible]@customs.gov.ng	
4.	HH Chief Okon Edet Otu	Adiabo Ikot Mbo Otu	08039178461	edet7729@gmail	
5.	HH Chief Mary E. Otu	Adiabo Ikot Mbo Otu	07032878327		
6.	Mta Bassey Edet	Adiabo Ikot Mbo Otu	09035894976		
7.	Mrs Veronica Ekpo Esien	Esin Ufot Adiabo	07013309723		
8.	Prof Ekom R. Akpan	UNIV. of Calabar	07032192266	[illegible]@gmail.com	
9.	Dr Ime Umoe	PGM	08065891212	[illegible]@yahoo.com	
10.	DR. MALACHI ABASIEDIONG	PGM	08032155848	malachiabasi@gmail.com	
11.	Prof Ekpo Antai	PGM	08037454788	expo.eyoa@yahoo.com	
12.	Prof. A. J. Ukpong	PGM	08033189441	andyukpong@yahoo.com	
13.	Dr. [illegible]	PGM	08161518756	ukosco2014@gmail.com	
14.	ARONG OKON OKIO	Env. Comm. Researcher	07047752257	okonarong96@gmail.com	
15.	ADENIMIKE ADI	SAPZ (KMC)	07031112810	adiadenmike@gmail.com	

Management Plans

A. Labour Management Plan (LMP)

Labour is a critical component of project success, especially for large-scale infrastructure and agricultural processing projects like the Agro-Industrial Hubs (AIHs) at Adiabo, Odukpani Local Government Area in Cross Rivers State under the Cross River Special Agro-industrila Processing Zones (CR-SAPZ) program. Labour activities must be managed to safeguard workers' rights, prevent social risks, and promote sustainable development.

This LMP serves as a guiding document to:

- Define policies, procedures, and standards for labour management across the project lifecycle (pre-construction, construction, operation, decommissioning).
- Address potential labour risks, including unfair recruitment, occupational hazards, worker grievances, child labour, forced labour, discrimination, sexual exploitation, and community tension.
- Promote compliance with Nigerian Labour Laws, AfDB Safeguard Requirements (OS2), ILO Conventions, and other relevant regulations.

This LMP applies to:

- Direct workers (hired by CR-SAPZ or its implementing partners)
- Contracted workers (hired by contractors and subcontractors)
- Primary supply workers (involved in the provision of core project inputs)
- Community workers (where applicable in social or community-driven activities)

Objectives of the LMP

The LMP is designed to achieve the following:

1. Ensure fair, safe, and respectful treatment of all project workers.
2. Prevent exploitation, discrimination, harassment, and abuse.
3. Establish transparent recruitment and labour relations processes.
4. Provide safe working environments, minimizing accidents and health risks.
5. Mitigate adverse effects of labour influx on host communities.
6. Prevent child labour and forced labour.
7. Promote grievance redress for all worker categories.
8. Support skills development and socio-economic opportunities, especially for vulnerable groups such as women, youth, and persons with disabilities.
9. Align labour practices with applicable laws, standards, and community expectations.

Overview of Project Workforce

Categories of workers

The project anticipates the following labour classifications:

- **Direct Workers:** Employed directly by CR-SAPZ or its affiliated agencies for management, supervision, administration, or operational roles. Includes permanent and temporary employees.
- **Contracted Workers:** Employed through contractors, subcontractors, or service providers for construction, equipment installation, logistics, security, cleaning, etc.
- **Primary Supply Workers:** Workers engaged by vendors supplying essential materials (e.g., construction aggregates, machinery, agricultural equipment) where procurement is critical to project function.

- **Community Workers:** Residents from nearby communities engaged for specific project-support activities, especially in environmental conservation or small infrastructure works.

Estimated Workforce Size

The workforce of the proposed project will be determined as the project commences. The estimated workforce for the proposed project is presented in Table LM 1.

Table LM 1: Estimated Workforce Size

Phase	Estimated Size	Notes
Pre-construction	TBD	Includes site clearance and preparatory works
Construction	TBD	Covers civil works, structural erection, utilities
Operation	TBD	Processing plant staff, administration, technical support
Decommissioning	TBD	Based on project lifespan, specialized roles

TBD = To be determined

Labour Sourcing Strategy

- Transparent, merit-based recruitment practices with preference for qualified local candidates.
- Advertisement of vacancies through community channels, local authorities, and public notice boards.
- Engagement with community representatives to maximize local hiring and skills transfer.
- Contractors required to adopt fair labour practices aligned with the LMP.

Legal Framework and Applicable Standards

The project's labour management is governed by:

National Legislation

- **Labour Act CAP L1, LFN 2004** – Governs employment contracts, wages, working conditions, child labour prohibition.
- **Factories Act CAP F1, LFN 2004 –** Occupational health and safety requirements for industrial operations.
- **Employee Compensation Act, 2010** – Compensation for work-related injuries, disabilities, and fatalities.
- **National Minimum Wage Act, 2024** effective from July 2024 Prescribes ₦70,000 per month as the national minimum wage, subject to periodic revision.
- **National Policy on Occupational Safety & Health, 2021** – Strengthens workplace health, safety, and welfare.
- **Violence Against Persons (Prohibition) Act, 2015** – Criminalizes harassment, Gender-based Violence (GBV), Sexual Exploitation and Abuse (SEA), and workplace abuse.
- **Trade Unions Amendment Act, 2005** – Regulates freedom of association and collective bargaining rights.

International Standards

- ILO Core Conventions (Freedom of Association, Forced Labour, Child Labour, Equal Remuneration, Non-discrimination).

- AfDB Operational Safeguard 2 – Labour and Working Conditions.
- United Nations Guiding Principles on Business and Human Rights.

TERMS AND CONDITIONS OF EMPLOYMENT

Employment Contracts

- All project workers will receive written contracts specifying:
    - Job roles and responsibilities.
    - Wages, benefits, and allowances.
    - Working hours, overtime provisions.
    - Leave entitlements (annual, maternity/paternity, sick leave).
    - Termination clauses.
    - Disciplinary procedures.

Contracts must be in a language understandable to the worker, with clear explanation provided.

Wages and Remuneration

- Wages meet or exceed the national minimum wage.
- Overtime compensated according to Nigerian labour laws.
- Timely payment, not exceeding monthly intervals.
- Benefits aligned with applicable laws (pensions, health insurance, accident cover).

Working Hours and Rest Periods

- Maximum 48 hours per week (6 working days).
- Minimum one full rest day per week.
- Overtime is voluntary and capped at legal limits.

Non-Discrimination and Equal Opportunity

- No discrimination based on gender, ethnicity, religion, disability, age, or sexual orientation.
- Active encouragement of female participation, especially in non-traditional roles.
- Reasonable accommodation for persons with disabilities.

Occupational Health and Safety (OHS)

OHS Management

- Site-specific Health and Safety Plan (HASP) prepared before construction.
- Hazard identification and risk assessments conducted regularly.
- Strict compliance with Nigerian OHS laws, Factories Act, and ILO OSH Guidelines.

Health and Safety Measures

- Provision and mandatory use of appropriate PPE (hard hats, boots, gloves, etc.).
- Safety induction and periodic refresher training for all workers.
- Establishment of first aid posts, emergency medical services, and evacuation protocols.
- Installation of safety signage, fencing of hazardous areas, and traffic control.

Accident and Incident Management

- Immediate reporting and investigation of all incidents.
- Maintenance of an incident register.
- Corrective actions implemented promptly.

Grievance redress mechanism for workers

A dedicated GRM will be in place to:

- Allow workers to report complaints or concerns confidentially.
- Offer multiple channels: suggestion boxes, direct HR contacts, anonymous reporting lines.
- Ensure resolution within 14 working days where possible.
- Protect whistle-blowers and ensure non-retaliation.
- Track grievances, with regular monitoring and reporting to management.

LABOUR INFLUX MANAGEMENT

Risks of Labour Influx

- Increased demand for accommodation, water, and health services during the construction and operational phase of the project.
- Social tensions with host communities.
- Risk of GBV, SEA, and communicable disease transmission.

Mitigation Measures

- Local recruitment prioritized for unskilled/semi-skilled positions.
- Worker accommodations located away from sensitive community areas such as Efe Ekpe sacred site.
- Code of Conduct addressing respectful behaviour towards host communities.
- Health screenings and awareness programs for workers.
- Stakeholder engagement with local leaders and authorities through stakeholder engagement workshop, focus group discussion and key informant interviews.

PREVENTION OF GBV, SEA, HARASSMENT AND GENDER INEQUALITY

- Mandatory signing of a Worker Code of Conduct prohibiting:
    - Sexual harassment.
    - Exploitation, abuse, or violence.
    - Disrespectful treatment of women, children, and vulnerable persons.
- GBV/SEA risk assessments integrated into project planning such as gender management plan (GMP).
- Gender equality will be duly considered and gender-specific job opportunities will be integrated to the (GMP).
- Partnerships with local NGOs for survivor support services.
- Clear, survivor-centered GBV reporting mechanisms, with confidentiality maintained.
- Regular training sessions for workers on gender sensitivity and GBV prevention.

Roles and Responsibilities

The role and responsibilities of the stakeholders for the proposed project are highlighted in

Table LM 2: Role and Responsibilities of the Stakeholders

Stakeholder	Responsibilities
CR-SAPZ Management	Overall LMP oversight, contractor compliance monitoring, reporting
Contractors	Full LMP compliance, worker welfare, OHS implementation

Stakeholder	Responsibilities
OHS Officers	Enforce safety measures, training, risk assessments
HR Personnel	Recruitment, contracts management, grievance administration
Independent Auditors	Periodic labour audits, verification of standards

Monitoring, Evaluation, And Reporting

Internal Monitoring

- Monthly reports on workforce composition, OHS incidents, grievances, and GBV cases.
- Random inspections of worksites, accommodations, and facilities.
- Contractor performance reviews.

External Monitoring

- Engagement of independent monitors during peak labour phases.
- Collaboration with government labour inspectors.
- Inclusion of labour indicators in environmental and social monitoring frameworks.

Capacity Building and Training

- Comprehensive induction training for all workers on:
  - OHS requirements.
  - Workers' rights and responsibilities.
  - GRM procedures.
  - GBV and SEA prevention.
- Contractor management training on LMP obligations.
- Ongoing refresher courses at regular intervals.

Conclusion

This LMP provides a robust framework to manage the project's labour force in compliance with Nigerian laws, AfDB safeguards, and international labour standards. It protects workers' rights, promotes welfare, manages social risks, and enhances local development. Continuous monitoring, capacity building, and stakeholder engagement will ensure its effectiveness throughout the project lifecycle.

B. Waste Management Plan

Baseline Waste Management of the Project Area

The generation and management of wastes to a large extent depends on the environment, occupation and other livelihood activities of a people. The Adiabo people are largely agrarian people with large dependency on the agricultural land and other natural resources within their environment for both household use, economic activities and leisure. Other economic activities include fishing, livestock rearing, transportation, petty trading and artisanship. The daily activities of the people generate huge amounts of solid wastes which litter the environment due to indiscriminate disposal and management of the wastes by majority of the dwellers and indigenes of the communities.

The wastes commonly observed include:

- Farm produce wastes
- Woods

- Papers
- Nylons Plastics, putrescible, electronics, wood, textile, furniture, cans, glass
- kitchen/food processing wastes

Waste Disposal Systems in Adiabo Communities

It was observed during the study that the people suffer from the lack of adequate government presence in terms of waste management as no public receptacle were found in the study area. This has led to the residents improvising on ways to best manage their waste in a bid to save their immediate environment. From observations and investigations, the people of Adiabo dispose those wastes in various ways. These are discussed below in order of prevalence.

Open dumping:

Plate WM 1: Open Dumping of Wastes in the Study

Plate WM 2: Burning of Waste in the Study Area

This is a predominant method of waste disposal in the area. Wastes are dumped in open areas, often at the back of the houses and nearby bush patches. In another variant, some community members who have vehicles collect wastes in private dustbins and periodically empty them at a waste dump at 8^{th} mile (Figure 3.17). These wastes accumulate for long period of time without proper handling. Studies revealed that the waste management practices by the residents of the study area are unhealthy as the effects of stray wastes and indiscriminately disposed waste can be seen in the communities.

This form of waste management creates breeding sites for disease vectors and agents such as flies, mosquitoes and other insects, and also provide food and shelter for rodents. Indiscriminate dumping of wastes can also lead to the contamination of water bodies and increase the risk of waterborne diseases. The proliferation of sickness and diseases lead to economic loss to affected families and loss of manpower to the nation's economy.

Burning: This is widely practiced in the study area. In the absence of adequate public waste collection services, community members resort to wastes burning as a convenient way to manage household wastes. This poses environmental risks such as air pollution to the people.

Burying: Although not very common, it is still practiced by the people. Households usually dig a pit where wastes are dumped and covered when the pit is filled. This is not an effective waste management method especially as nylon and plastics are involved.

Government Involvement: The involvement of the Odukpani Local Government Council in waste management is poor as observed during the study. Neither designated receptacle points or public refuse collection bins were noticed. However, as a part of its responsibilities, it was revealed that the Local Government Councils' personnel do evacuate the wastes at the dump site at 8^{th} mile periodically. The study involved a visit to the General Manager, Cross River State Waste Management Agency and his

Directors. During discussions, it was revealed that the State's dumpsite on Lemna Road (Plates 5) was currently filled up, consequently arrangements were on to move to a proper dumpsite.

Plate WM 3: A Waste Management

Plate WM 4: At the Premises of the CRS

Plate WM 5: Filled Dumpsite Needing Re-location

Waste Stream Classification

All waste types anticipated during the project lifecycle are identified and categorized as follows:

Waste Stream	Source	Category
Domestic waste	Workers' camps, canteens, offices	Non-hazardous solid waste
Construction debris	Excavation, clearing, concrete, scrap metal, packaging	Non-hazardous inert waste
Hazardous waste	Used oil, fuel residues, spent batteries, solvents, paints	Hazardous waste
Agricultural by-products	Crop residues, husks, peels, and organic remains	Biodegradable waste
Medical waste	First aid facilities and clinics	Biohazardous waste
E-waste	Obsolete electrical/electronic equipment	Hazardous recyclable waste
Gaseous emissions	Machinery exhaust, incineration, organic decomposition	Gaseous waste

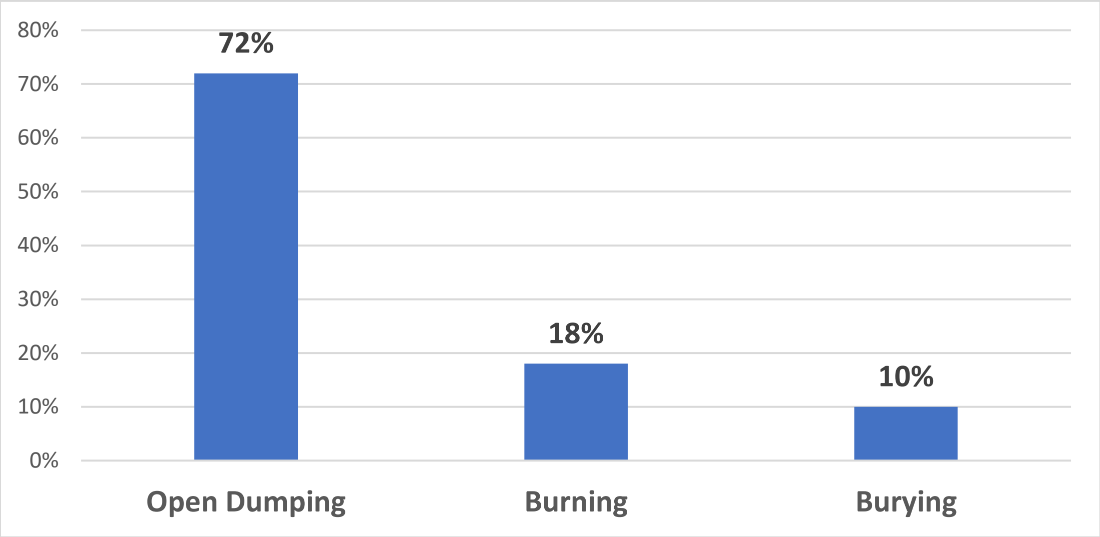
Each waste category will have specific handling, treatment, and disposal measures to prevent pollution and ensure safety.

Management of Human Waste

Investigations revealed that about 80% of the household members dispose human waste by pit toilets. There is the practice of open defecation in bushes by farmers and defecation into the water bodies by fishermen.

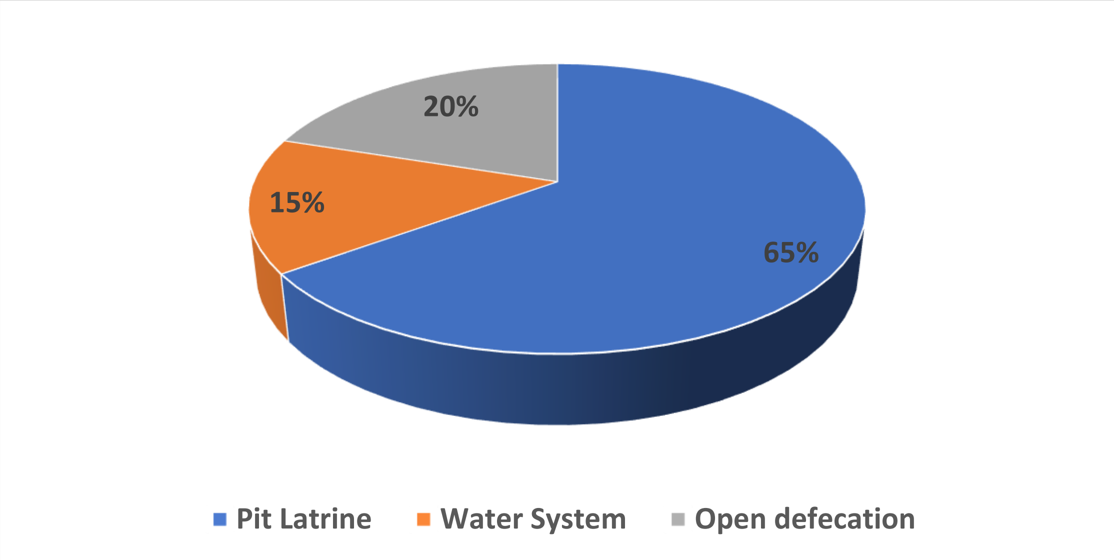
Table WM 1: Sources of Waste Streams in the Project Area

Sources of Wastes	Activities	Types of Waste Generated	Composition	Current Disposal Method(s)
Domestic	Domestic activities from households.	Plastics, putrescible, electronics, wood, textile, furniture, cans, glass	Biodegradables, wood products, textiles and other non – biodegradable wastes	Mainly open dumps and open burning.
Commercial	Open markets, restaurants, shops, agricultural products processing and other commercial activities.	Plastics, putrescible, paper, cardboard, cans, glass.	Biodegradable and non-biodegradables	Mainly open dumps, occasional burning.
Construction, Artisanship and other industries.	Small scale artisanship activities, chemical and hydrocarbon activities, construction and manufacturing industries, associated activities and provision of personal services.	Debris from demolition, concrete materials, packaging from construction materials, electrical and electronics, plastics, chemicals, iron cuttings and oil sludge.	Biodegradable and non-biodegradables	Burying of waste, open dumps and sales of demolition debris for reuse.
Institutional	Churches, Schools, Clinics/TBAs etc.	Large volume of papers, cardboards, putrescible, electronics, plastics, cans, furniture materials, medical waste etc.	Readily and non-readily degradable wastes.	Open dumps and open burning.



Source: Fieldwork 2025

Current Human Waste Disposal Method in the study area



Source: Fieldwork 2025

Waste Management Hierarchy

The CR-SAPZ Project will adopt the "4R hierarchy"—Reduce, Reuse, Recycle, Recover, and Dispose—as a guiding principle:

- Reduce: Avoid unnecessary material use and minimize waste at source.
- Reuse: Encourage reusing construction materials (e.g., wooden pallets, metal scraps).
- Recycle: Facilitate recycling of plastics, paper, and metallic waste through approved recyclers.
- Recover: Recover energy from biodegradable waste where feasible.
- Dispose: Final disposal at approved and environmentally compliant dumpsites only.

This approach reduces landfill dependence, lowers carbon footprint, and promotes resource efficiency.

Waste Segregation

- Waste shall be segregated at source using color-coded bins and clearly labelled containers (e.g., green for biodegradable, yellow for recyclables, red for hazardous).

- Contractors and site personnel shall be trained in segregation procedures.
- Separate collection points will be designated for hazardous waste to prevent contamination of non-hazardous materials.
- The SPIU Environmental and Social Officer will conduct weekly audits of segregation practices.

Waste Collection, Storage, and Transportation

- Waste shall be collected daily and transported by licensed waste handlers approved by the Cross River State Waste Management Agency (CRSWMA).
- Temporary onsite storage facilities shall be bunded, roofed, and ventilated to prevent leachate and odor generation.
- Vehicles transporting waste shall be covered, leak-proof, and labelled in accordance with NESREA transportation standards.
- Waste manifests will be used to track all hazardous waste movements until final disposal.

Waste Treatment and Disposal

- Non-hazardous waste will be transported to the Calabar Municipal Dumpsite and other CRSWMA-approved landfill sites for final disposal.
- Hazardous waste (used oil, paint, batteries) shall be collected and handed over to FMEnv-licensed hazardous waste contractors for treatment and safe disposal.
- Organic waste from agricultural operations shall be composted or used for biogas generation where feasible.
- Medical waste from clinics shall be treated via autoclaving or incineration at an approved facility.
- Disposal sites will be periodically monitored for compliance and environmental integrity.

Gaseous Waste Management

To minimize gaseous emissions:

- Use low-emission machinery and conduct regular maintenance.
- Prohibit open burning of waste on-site.
- Ensure generators and incinerators are fitted with emission control devices.
- Monitor ambient air quality quarterly for CO, SO_2, NO_2, PM_{10}, and $PM_{2.5}$ against NESREA and WHO standards.
- Maintain a log of fuel usage and emission records to track performance.

Current Solid Waste Management Systems in the Study Area

Based on the foregoing baseline waste management situation in the project area, the following provisions are recommended:

The Overall Waste Management Objectives related to the proposed project should include-

- Ensure effective procurement and use of bought- in materials in order to minimize waste generation
- Maximize the re-use /recycling of relevant wastes
- Proper classification of wastes
- Prudent disposal of non-reusable/non-recyclable wastes

- All waste management facilities should be designed and installed according to specifications
- Provision of any permitting requirement for waste treatment and disposal
- Timely and efficient monitoring and inspection of all waste management facilities
- Ensure proper record keeping on waste activities
- Provision of effective training to staff and Contractor personnel.
- Finally, identify and engage Third Party Contractors for proper waste handling.

Potential Waste Generating Activities of the Proposed Agricultural Hub Project

Site Preparation

- Land clearing and stumping
- Site grading
- Mobilization to site
- Equipment delivery and setup
- Stock piling of aggregates for construction
- Temporary structures (site office, security posts, storage)

Facility Construction phase

- Earthworks
- Excavations for foundations
- Building and infrastructure construction
- Welding and fabrication
- Power generating plant installation and wiring
- Material storage
- Construction of drainage structures
- Grassing and revegetation

Facility Decommissioning phase

- Dismantling of temporary and permanent structures
- Removal of machinery and equipment
- Dismantling of utility infrastructure
- Excavation and restorations of land
- Waste from decontamination and cleanup
- Disposal of organic and agricultural residues
- Sanitary facility closure
- Packing and relocation.

Table WM 2: Expected Wastes Streams from the Proposed Project

Project Phase	Activities	Type of Waste	Composition
Mobilization	Land clearing, Site grading, equipment delivery and setup, temporary structures -site office, security posts, storage)	Top soil, Vegetative waste, wood, metals, plastics etc. Emissions of atmospheric pollutants from vehicle /machinery exhausts Dust, Noise from machinery and equipment., Spent oil	Bio-degradable and non-biodegradable wastes
Construction	Building and Infrastructure construction, Welding and fabrication, Internal Roads.	Cement/concrete, cartons, papers, nylon, wood pieces, zinc and other metals, rags, POP droppings, paints, paint containers etc.	Bio-degradable and non-biodegradable wastes
Decommissioning	Decommissioning Activities: Dismantling of temporary and permanent structures, Removal of machinery and equipment, Dismantling of utility infrastructure, Excavation and restorations of land, Waste from decontamination and cleanup, disposal of organic and agricultural residues, Sanitary facility closure, and Packing and relocation.	Concrete, bricks, tiles, wood, steel, used oil, chemicals, agrochemical containers, plant residues, food waste, manure, batteries, old panels, wiring, control boxes, pipes, sheets, frames, fencing wires, packaging materials, papers, plastics, PPEs, sewage, and cleaning waste	Construction & Demolition waste, Hazardous waste, Organic waste, electronic waste, Scrap metals, General solid waste, and Sanitary waste.

At the project site all the components of the project shall adopt the best waste management practice, whereby sorting of the waste for proper management will be done at the various waste streams. Labelled receptacles with various type of waste shall be placed at the various component of the projects site. All the waste from the various receptacles shall be conveyed to the waste management unit for proper disposal by a retained accredited waste management contractor.

Waste Quantification

This section seeks to quantify waste that will emanate from the proposed project. For the quantification, a universally acceptable formula for the quantification of the various types of waste shall be adopted. Therefore, the following assumptions will be adopted to ease the calculations as actual mass of excavations and demolitions cannot be exact. However, the assumptions will help to estimate an adequate budget and equipment planning for the site clearance exercise as stated in Table WM 3.

The evaluation of the potential impacts associated with waste management is conducted with the consideration of Nigerian legislations and Cross River State legislation (see, Legal and Administrative Frameworks). It makes reference to AfDB's OS 3, Resource Efficiency and Pollution Prevention. The intention for the development is that storage, handling and disposal of hazardous and non-hazardous waste will be consistent with good EHS practice for waste management and widely adopted tropical land development ESIA/ESMP studies (e.g, FAO, IPCC, Nigerian forestry manuals). The map below, showing the proposed project location, maps out areas marked up for tree clearing, hence giving credence to the estimated volumes of clearing waste calculated below.

Table WM 3: Quantification of Waste

SN	ITEM	QUANTITY	UNIT
1	Woodland		
a.	Tree trunk		
	· Total land mass	1,300,000.00	m^2
	· Land with trees available for clearing	144,400.00	m^2
	· Total tree occupied area for conservation	360,000.00	m^2
	· Average tree height	4.00	M
	· Average tree diameter	0.08	M
	· Number of trees (400/ha)	5,776.00	Stands
	· Volume of each tree trunk	0.02	m^3
	· Total volume of tree trunks	116.07	m^3
	· Assumed bulking factor	1.60	m^3
	Total volume of tree trunk waste	185.72	m^3
b.	Tree crown		
	· Number of trees with crown (60%)	3,465.60	Stands
	· Estimated volume of tree crown on each tree	0.05	m^3
	· Total volume of tree crown	173.28	
	· Assumed volume reduction factor	0.30	m^3
	Total volume of tree crown waste	51.98	m^3
c.	Shrubs		
	· Area occupied by shrubs (10% of land available for clearing)	14,440.00	m^2
	· Shrub height	1.50	M
	· Assumed volume bulking factor	2.00	
	Total volume of shrub waste	43,320.00	m^3
d.	Grassland		
	· Grass height (shaded)	0.50	M
	· Grass covering area (5% of landmass)	7,220.00	m^2
	· No. of grass per square meter	10.00	Stands
	· Assumed volume reducing factor	0.40	
	Total volume of grass waste	14,440.00	m^3
	Total volume of tree trunk waste	185.72	m^3
	Total volume of tree crown waste	51.98	m^3
	Total volume of shrub waste	43,320.00	m^3
	Total volume of grass waste	14,440.00	m^3

SN	ITEM	QUANTITY	UNIT
	TOTAL VEGETATIVE WASTE VOLUME	57,997.70	m^3
SOIL			
2	Top soil		
a.	Total area for project	940,000.00	m^2
	· Excavation depth (graded)	0.25	M
	· Assumed volume bulking factor	1.30	
		305,500.00	m^3
b.	Perimeter fencing excavation		
	· Excavation depth	0.25	M
	· Excavation width	0.60	M
	· Approximate perimeter	4,600.00	M
	· Assumed volume bulking factor	1.30	
	Total soil volume removed for fencing	897.00	m^3
	Total top soil volume removed in the landmass	305,500.00	m^3
	Total soil volume removed for fencing	897.00	m^3
	TOTAL TOPSOIL WASTE VOLUME	306,397.00	m^3
Total			
	Total vegetative waste volume	57,997.70	m^3
	Total top soil waste volume	306,397.00	m^3
	Total clearing waste by volume	364,394.70	m^3

Other forms of waste quantified based on defined assumptions include the following:

3. Construction Waste from Temporary Buildings & Storage
Assumptions:

Temporary setup = 2 admin buildings + 2 warehouses

Total waste types: cement bags, wood offcuts, plastics, metal scraps

Estimates based on medium-scale temporary facility:

Table WM 4: Construction Waste Calculation

Material Type	**Volume Estimate**
Cement bag waste (800 bags @ 0.04 m^3)	32 m^3
Plastic packaging & polythene	20 m^3
Cartons, wood offcuts, formwork waste	25 m^3
Scrap metals and fasteners	10 m^3
Total: 32 + 20 + 25 + 10 = 87 m^3	**87 m^3**

Estimated Construction Waste (Temporary Setup): ~87 m^3
(Typical bulk density range for mixed construction & demolition (C&D) waste ~300-600 kg/m^3. Assumption adopted: 500 kg/m^3 (0.5 t/m^3) for tonnes to cubic meter conversion)

4. Estimated Domestic Waste Generation

Assumptions:

Average domestic waste per worker per day: 0.5 kg

Workdays per month: 25 days

Number of workers/durations: 500 workers for 12 months

These assumptions align with construction site norms and standards from UNEP/FAO waste management guidance in tropical developing countries.

Calculations:

Workforce: 500 men

Duration: 12 months × 25 workdays = 300 days

Total worker-days: 500 workers x 300 days = 150,000 man-days

Total waste:

= 150,000 man-days x 0.5 kg/day = 75,000 kg (75 tonnes) = 300 m^3

(Average density of uncompressed mixed municipal solid waste = 250 kg/m^3 for tonnes to cubic meter conversion)

Recommended Waste Handling Measures

Provide Labeled Bins: Ensure color-coded bins for segregated waste collection (organic/inorganic).

Engage Licensed Waste Collectors: Contract registered domestic waste contractors for evacuation.

Onsite Composting: Organic waste may be composted and used during agricultural operations later.

Sanitation Maintenance: Provide and service portable toilets or onsite latrines.

Worker Orientation: Conduct awareness campaigns on hygiene and waste disposal best practices.

Waste Tracking: Monitor and record volume trends to improve planning and minimize pollution risks.

Estimated Greenhouse Gas Emissions

Assumptions:

Fuel Type: Diesel

Diesel Emission Factor: 2.68 kg CO_2 per litre (IPCC default for diesel combustion)

Average Machinery Diesel Use/Day: 400 litres/day (medium-scale land clearing, 5–7 heavy machines)

Workdays/Month: 25 days (excluding Sundays and rain delays)

Key Duration for Estimation: 12 months

Calculations:

Duration = 12 months × 25 workdays/month = 300 days

Fuel consumed = 400 litres/day × 300 days = 120,000 litres

Emissions = 120,000 litres × 2.68 kg CO_2/litre = 321,600 kg CO2

Total Emissions (CO_2) ≈ 321.60 tonnes (164,082 m^3)
(STP 0°C (273.15 K) and 1 atm, while Density of CO_2 at STP: ≈ 1.96 kg/m^3 for tonnes to m^3 conversion)

Recommendations to Reduce Emissions

- Use low-emission or bio diesel-compatible machinery
- Ensure machines are well-maintained to optimize fuel efficiency
- Minimize idling time and apply efficient work planning
- Offset carbon with tree planting programs or carbon credits

Table WM 5: Summary Table of Estimated Waste Volumes

Waste Type	Estimated Volume (m^3)	Source/Activity
Vegetation Waste (biomass)	57,997.70	Trees, shrubs, grasses (Vegetation clearance)
Topsoil Waste/Excavated soil (Fencing)	306,397	Organic-rich upper soil layer and Subsoil from trenching perimeter fence
Construction Waste (Temporary)	87	Temporary buildings and storage erection
Domestic Waste Generation	300	Daily consumables by onsite workers
Greenhouse Gas Emissions (CO_2)	164,082	Combustion of diesel by heavy duty machinery
Total Estimated Volume	**528,863.70**	**Site Preparation (Mobilization + Construction) waste volume**

Table WM6: Recommended Waste Handling Options

Waste Type	Suggested Handling
Vegetation Waste	Composting, mulching, trunk and branches for reuse
Topsoil	Stockpiling for landscaping and erosion control
Excavated Soil	Filling low-lying areas or access roads
Construction/Domestic Waste	Segregation, reuse, or safe disposal

Environmental Considerations

- Controlled burning should be avoided due to air quality regulations
- Vegetation clearance should be phased to reduce erosion
- Temporary soil storage must include silt fencing and runoff control
- Use impermeable liners beneath temporary waste storage areas.

Table WM 7: Environmental Components and Potential Indicators

S/N	Environmental Components	Impact Indicators
1	Air quality	SPM, CO_2, NO_X, SO_X, CO, VOC, CH_4, NH_3, etc.
2	Noise	Noise level dB(A)
3	Soil/Agriculture	Indiscriminate municipal waste dumping, hazardous waste and tailings, etc., on arable lands
4	Surface water	Waste dumped into rivers, entrainments from storm water emptying into the rivers
5	Ground water	Ground water contamination through infiltration of decomposing wastes
6	Socioeconomic/Health	Waste management concerns of host communities, perception on the proposed project/health risks, waste streams, handling treatment and disposal.

Table WM 8: Potential Impacts and Mitigation Measures for Waste

Sn.	Potential Impacts	Mitigations Measures for Waste Generated
1.	**Project Mobilization:** Direct impacts associated with transportation of equipment, materials and personnel to site include:	
	Emissions of atmospheric pollutants from vehicle exhaust	CR-SAPZ shall ensure all operational vehicles and heavy-duty machines are regularly serviced in line with manufacturer recommendations in order to maintain optimal performance and curb pollutant emissions during their operations.
	Increased noise levels	CR-SAPZ shall ensure all its operational machines are regularly serviced and are in line with industry best practice to curb excessive noise during operations. CR-SAPZ shall carry out its operations at periods in line with agreements reached in the MoU within Environmentally Sensitive Areas (ESAs) in order to mitigate noise impacts
2.	**Site Preparation:** Vegetation clearing and removal of topsoil/excavation at project site	
	Vegetation clearance	CR-SAPZ shall handle the waste in the following ways: Lumbering them into smaller sizes which will then be sold to the communities at cheaper rates for fuel wood and or furniture. Lumbering the trunks to the standard sizes required for building wood works such as, purlins, rafters, etc. and then sell to the dealers in such materials. Keeping the lumbered logs for onward use by building contractors for the building development. Composted on site for future landscaping purposes; or Disposed of at a suitable facility as agreed with Cross River State Waste Management Agency.
	Climatic change due to carbon cycle distortion by trapped CO_2 in cleared vegetation,	CR-SAPZ shall limit site clearing to specified area in the design.
	Waste generation	Where waste generation cannot be avoided, CR-SAPZ shall reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and environment

Sn.	Potential Impacts	Mitigations Measures for Waste Generated
	Dust generated from storage of stockpiles of site clearance waste or from chipping/crushing material on site, dust from handling the waste on site and dust from transporting this material to off-site waste management facilities	CR-SAPZ shall prohibit open-back waste conveyance as every truck conveying clearance debris shall be covered using covered waste vans e.g., Automated compactors. CR-SAPZ shall ensure the watering of cleared surfaces to reduce dust.
	Odour associated with decomposing site clearance waste stored for long periods of time on site and from waste management activities	CR-SAPZ shall ensure timely evacuation of waste (6pm-7am) using covered waste vans e.g. Automated compactors.
	Water quality impacts from inappropriate storage and runoff from waste entering watercourses or of material inappropriately deposited in an unsuitable landfill or dump	CR-SAPZ shall store waste where there is inaccessibility for water to drain it to the drainage system.
	Impact to terrestrial ecology if waste is inappropriately dumped around the site (e.g. in mangrove areas) or through windblown litter	CR-SAPZ shall prohibit open-back waste conveyance as every truck conveying clearance debris shall be covered or using covered waste vans e.g., Automated compactors. CR-SAPZ shall ensure timely disposal of waste to approved waste management facilities with the consent of Cross River State Waste management Agency.
	Health impact associated with storage of putrescible materials (pests, vermin) or associated with material inappropriately deposited in an unsuitable landfill or dump	CR-SAPZ shall ensure that domestic wastes are transported to a suitable facility as approved by the government for effective and efficient disposal.
	Site Preparation: Demolition of structures	
	Dust (Greenhouse emission) generated from storage of stockpiles of site clearance waste or from demolition, chipping/crushing material on site, dust from handling the waste on site and dust from transporting this material to offsite waste management facilities.	CR-SAPZ shall ensure inert construction wastes including concrete waste will be crushed and reused as fill and in reclamation works where appropriate. CR-SAPZ shall ensure that transportation of waste off the site to dumpsites or landfills are carried out by compactors to avoid stray litters.
	Localized increase in ambient concentrations of emissions from exhaust of fuel combustion engines.	CR-SAPZ shall ensure all operational vehicles and heavy-duty machines are regularly serviced in line with manufacturer recommendations in order to maintain optimal performance and curb pollutant emissions during operations.
3.	**Construction:** Construction of buildings and Support facilities.	
	Noise from the operations of engines, heavy duty construction machines and motors on site	CR-SAPZ shall ensure all its operational machines are regularly serviced and are in line with industry best practice to curb excessive noise during operations. CR-SAPZ shall carry out its operations at periods in line with agreements reached in the MoU within Environmentally Sensitive Areas (ESAs) in order to mitigate noise impacts

Sn.	Potential Impacts	Mitigations Measures for Waste Generated
	Construction: General waste generation	
	Odour associated with poor storage of waste or inadequate odour control for waste processing at the project site.	CR-SAPZ shall ensure timely evacuation of waste (6pm-7am) using covered waste vans e.g., Automated compactors.
	Impacts to water quality from inappropriate storage, leakage of leachate from putrescible waste and runoff from waste entering watercourses or of material inappropriately deposited in an unsuitable waste dumpsite.	CR-SAPZ shall store waste where there is inaccessibility to water and drainage system.
	Impacts to terrestrial ecology are associated with inappropriate dumping in sensitive areas (e.g. mangroves) and inadequate storage/coverage during transport resulting in windblown litter.	CR-SAPZ shall ensure timely disposal of waste to approved waste management facilities with the consent of Cross River State Waste management Agency.
	Health impacts can be associated with vermin and pathogens associated with poor storage of waste.	CR-SAPZ shall ensure that all domestic wastes are transported to a suitable facility as approved by the government for suitable disposal.
4.	**Decommissioning**	
	Accumulation of demolition debris (concrete, bricks, timber) causing land degradation and visual nuisance	CR-SAPZ shall: • Segregate reusable/recyclable materials • Use covered trucks for haulage • Dispose at approved dumpsites only
	Used lubricants, metal scraps, and oil spills from machinery contaminating soil and water	CR-SAPZ shall: • Collect and store oils in labeled drums • Engage licensed waste oil handlers • Clean spills with absorbent materials
	Accumulation of e-waste (cables, wires, electronics) causing soil and potential heavy metal contamination	CR-SAPZ shall: • Sort e-waste and store safely • Send to NEMC-approved or OEM-approved recyclers • Avoid open burning of materials
	Toxic sludge, contaminated PPE and rags from tank cleaning polluting environment	CR-SAPZ shall: • Engage hazardous waste handlers • Label and contain sludge in sealed drums • Ensure PPE disposal complies with HSE standards
	Biomass and organic waste (branches, shrubs, grasses) causing fire risk and greenhouse gas emissions if burnt	CR-SAPZ shall: • Shred and compost biomass waste • Avoid burning • Use cleared vegetation for mulching or local fuelwood needs
	Scattered or uncovered waste piles causing windblown litter, odor, and unauthorized scavenging	CR-SAPZ shall: • Cover stockpiles with tarpaulin • Fence off temporary storage zones • Enforce site waste control procedures
	Office and domestic waste (paper, plastics, food remains) creating	CR-SAPZ shall: • Provide labeled bins for recyclables and organic waste

Sn.	Potential Impacts	Mitigations Measures for Waste Generated
	vermin attraction and unsanitary conditions	• Ensure daily collection • Clean site prior to staff exit
	Improper sludge removal causing groundwater and surface water contamination	CR-SAPZ shall: • Use leakproof vacuum tankers • Transport to registered sewage treatment facility • Avoid discharge near water bodies
	Waste drop-off during transport causing roadside littering and community nuisance	CR-SAPZ shall: • Use well-covered trucks for waste transport • Maintain proper haul route documentation • Monitor haulage compliance
	Abandoned agrochemical containers leaching toxins into soil and water	CR-SAPZ shall: • Triple rinse containers • Store separately from general waste • Return to supplier or dispose via hazardous waste facility

Assumptions and Calculations for Clearance Waste

Calculation for Tree trunk waste (A tree-trunk is a cylinder by assumption, hence its volume is determined by the formula for finding the volume of a cylinder =)

Where: π = a mathematical constant = 3.142,

r2 = radius of tree trunk (half the diameter) = 0.225 m2
h = height of tree trunk = 30meters

Total volume of tree trunks x Assumed bulking factor = Tree trunk

Calculation for tree crown waste = Total volume of tree crown x assumed volume reducing factor

Calculation for shrub waste = total shrub occupied area x shrub height x assumed volume reducing factor

Calculation for Grass waste = Grass occupied area/No. of grass/m2 x Grass height x assumed reduction factor

Calculation for top soil waste:

Total landmass area x excavation depth (graded) x assumed volume bulking factor

Total fencing area x Assumed volume bulking factor

Table WM 9: Waste Management Matrix

Waste	Waste Source	Character	Frequency	Estimated Quantity (12 Months Duration)	Treatment Method	Transport	Final Disposal	Responsible Party	Regulatory/ Permitting
Vegetative Waste	Land clearing	Solid	Initial Construction phase	17,414.10 tonnes (57,997.70 m^3)	Mulching, composting	Accredited Third Party Contractor	Landscaping/ Soil amendment/Sales to Farmers as manure	CR-SAPZ	
Removed Top Soil/Fence Trenching	During Excavation	Solid	Construction phase	367,676.40 tonnes (306,397 m^3)	Accredited Third Party Contractor	Accredited Third Party Contractor	Landscaping/ Soil amendment	CR-SAPZ	
Domestic Waste	Domestic Activities	Solid	Daily	75 tonnes (300 m^3)	Segregation, collection	Accredited Third Party Contractor	Recycle, compost, landfill	CR-SAPZ	
Emission Waste (CO_2)	Fumes from Automobiles	Gaseous	Daily	322.21 tonnes (164,082 m^3)	Scrubbers. Filtration, Maintenance		Emissions control, Carbon offset	CR-SAPZ	CR-SAPZ
Construction Waste	During Construction activities	Solid	Construction Phase	43.5 tonnes (87 m^3)	Source separation	Accredited Third Party	Reuse or disposal in authorised site/ landfill	CR-SAPZ	

Emergency Preparedness for Waste-Related Incidents

Emergency protocols have been established for accidental waste spills, fires, or contamination events:

- Prepare a Waste Spill Response Plan and maintain spill kits at critical areas.
- Train staff on emergency procedures, containment, and reporting.
- Provide Personal Protective Equipment (PPE) for cleanup teams.
- Report all major incidents to FMEnv and CRSMEnv within 24 hours.
- Maintain an Incident Register for all waste-related emergencies.

Institutional Responsibilities

Institution	Responsibilities
SPIU Environmental Officer	Oversee implementation of the WMP, reporting, and audits.
DBO Contractor	Implement waste management procedures on-site; maintain records.
CRSWMA	Approve waste transporters and final disposal sites.
FMEnv / NESREA	Regulatory oversight, compliance monitoring, and environmental audits.
Community Representatives	Support community awareness and monitoring of waste management practices.

Key Performance Indicators (KPIs)

Indicator	Target / Frequency
Percentage of waste segregated at source	≥ 90% of total waste generated
Frequency of waste collection	Daily during construction; twice weekly during operation
Number of waste-related incidents	Zero incidents per quarter
Volume of waste recycled or reused	≥ 40% of total waste
Staff trained in waste handling	100% of workforce annually
Compliance with FMEnv/NESREA standards	100% compliance, verified by quarterly audit

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Monitoring and Reporting

- Waste management performance will be **monitored monthly** by the SPIU E&S Unit.
- Quarterly environmental reports will be submitted to **FMEnv**, **NESREA**, and **AfDB** detailing waste quantities, treatment methods, and compliance status.
- Annual third-party audits will evaluate long-term effectiveness and recommend improvements.

C. Occupational Health and Safety Plan

The Occupational Health and Safety Plan is established to provide an overview of CR-SAPZ commitment to safe operation of the Agro-industrial Hub facility. CR-SAPZ proposes to develop an Agro-industrial Hub in Adiabo, Odukpani Local Government Area of Cross River State. The proposed infrastructure will include office buildings, training centres, general services fencing, internal access roads / parking, drainage, power supply, water, and sewerage, effluent management, health, and safety. Specialized services will include quarantine, quality control, laboratory and certification centres, breeding centres, business support services (administrative knowledge/ICT/procurement/employment centres, and activities to implement the Environmental and Social Management Plan.

Commitment to Health, Safety and Environment

CR-SAPZ operates a Sustainability Policy and Commitment, which has been developed over the years and applies to all its operations. It comprises three main elements:

- CR-SAPZ Commitment on Safety.
- CR-SAPZ Commitment on Environment; and
- CR-SAPZ Commitment on Communities.

The policy commitments have been elucidated in CR-SAPZ's HSEMS. The primary vehicles through which CR-SAPZ shall meet its HSE policy and commitments are its comprehensive HSE Management System and the associated planning documents.

Leadership And Commitment

In order to achieve a continuous improvement in the CR-SAPZ's HSE performance during project execution and operations; an HSE Management System that will be commensurate with potential risks associated with the project has been put in place. To this end, Health, Safety and Environment (HSE) policies have been developed, signed and dated by the chief executive. These policies are on display in our offices after having been discussed with each employee. The issuance of this document is guided by and in compliance with existing regulatory framework, which includes Acts and legislations enforceable by relevant environmental and occupational health and safety regulatory bodies, mainly the Federal Ministry of Environment (FMEnv): National Guidelines on Environmental Management System (EMS) in Nigeria (FEPA 1991).

Policy Statement and Strategic Objectives

HSE Policy Statement

CR-SAPZ places great emphasis on maintaining the highest standard of safety, health and environmental protection. The purpose of this safety management plan is to outline how CR-SAPZ intends to implement its HSE Management principles during the implementation of the proposed Agro-industrial hub project and operations. All CR-SAPZ employees must perform their activities in compliance with the HSE policy. Every employee is responsible for their safety and that of their colleagues at work. Any activity must be suspended when the employee believes that it cannot be carried out in compliance with the policy, and must report this immediately to his/her supervisor.

Strategic Objectives

CR-SAPZ wishes to achieve these set HSE goals, which provide the basis for judging progress and achievement.

Community Affairs:

To maintain a very good relationship with the communities around our areas of operation and to be sensitive to their needs.

Safety:

- To maintain a Zero Lost Time Injury.
- To maintain a Zero Fatality.
- To maintain a Zero Road Traffic Accident.
- To improve skill and competence on the job and in HSE by training at least 90% of the workforce.

Health:

- To ensure that all members of staff are physically/mentally fit for their job.
- To carry out a regular inspection of project, accommodation and toilet facilities.
- To ensure that a clinic and an ambulance are available for staff use.
- To ensure that toilet facilities are provided and are in good condition at all times.

Environment:

- To maintain a policy of "NO POLLUTION" at all times, in all our areas of operation.
- To ensure proper disposal of domestic waste generated.
- To participate in the promotion of better environment through rehabilitation.

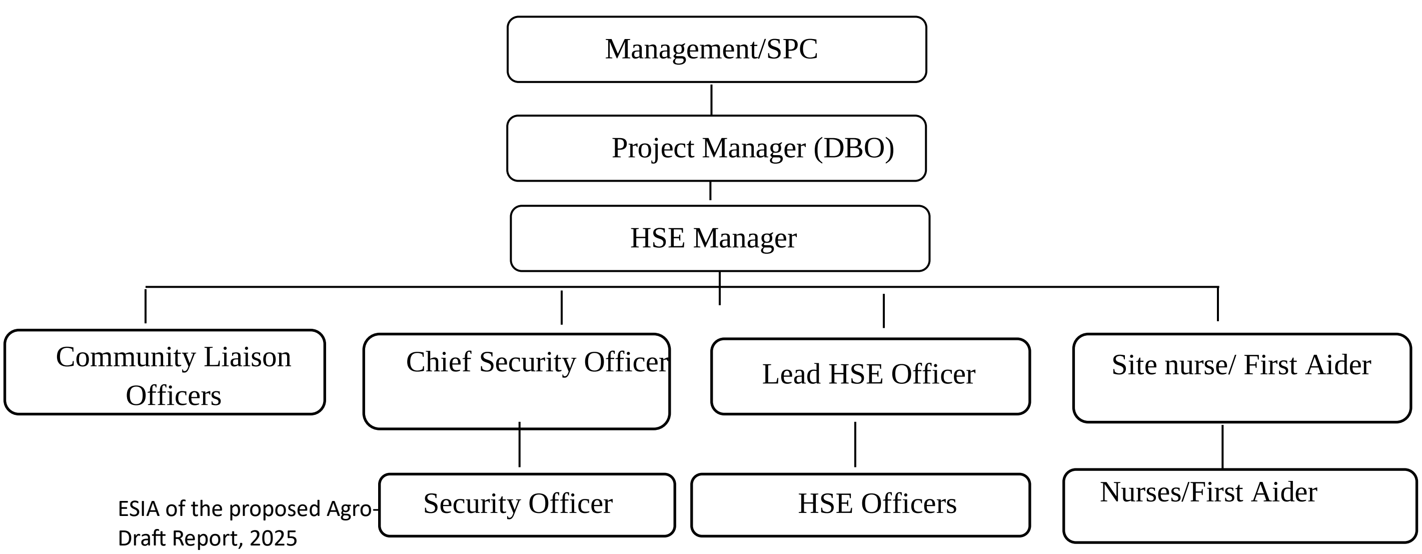
***Security*:**

- To reduce the frequency of thefts of tools and equipment.
- To prevent arson on staff and company property.
- To raise security awareness of all staff.

HSE Organization, Responsibilities, Resources, Standard and Document

HSE Organization

Successful handling of HSE matters will be a line responsibility. That is, those directly involved in all phases of operations (the staff and supervisors up to the SPC) are responsible for applying the HSE MS to the various activities.



Roles and Responsibilities

Management

CR-SAPZ management comprises the State Program Coordinator (SPC) and top management staff. Management is responsible for ensuring availability of adequate resources (personnel, equipment, etc.) for effective operation of the HSE management on site.

Individual departments shall identify their human resources needs and forward their requirement to management.

Project /Operations Manager

The project and operations manager will ensure that safety programs and the resources provided are adequate for the project/operations:

- To assess project safety performances
- To participate in project safety, steering team meeting
- To ensure that the management personnel participate actively in the safety program implementation
- To ensure that all laws and regulations in matters of HSE are complied with.

HSE Manager

The HSE Manager will:

- Conduct regular inspections in association with line supervision, to ensure that only safe methods of work are in operation and that all safety requirements, including statutory regulations, are being observed. The HSE coordinator will take action to rectify faults in compliance with company policy.
- Maintain current knowledge of published safety literature, safety regulations and other communications and notices requiring management attention.
- Carry out investigations to determine the cause of accidents and dangerous occurrences and recommend measures to prevent a recurrence of incidents.
- Collaborate with the project manager in the development of required revisions to existing procedures, rules and regulations in addition to proposing change.
- Make thorough analysis of statistical data and inspection, delineate problem area and make recommendations; keep an up-to-date record of all information connected with accident prevention, including accident/injury reports and an analysis of accident trends.
- Conduct independent audit to ensure compliance and ensure daily permit-to-work is obtained.
- Participate in making job hazard analysis (JHA) with the project manager.
- Take part in the review of all accidents and assists in investigating the accident.
- Ensure proper use of PPE.
- Collaborate with the project manager in the development and preparation of the agenda for safety meetings at a monthly/weekly interval.
- Carry out routine safety check on the operation of all divisions in the organisation.

Safety Officer

- Attend all safety issues.
- Conduct site and project HSE orientation for all personnel visiting the site for the first time.
- Ensure investigation of minor incidents, first aid cases and near misses
- Participate in the delivery of toolbox meetings and HSE-related meetings on site.
- Prepare HSE Report.
- Ensure the implementation of HSE procedures of work activities.
- Ensure that all employees and subcontractors have received appropriate HSE information, induction and training.

Line Supervisors (Site Manager, Site Engineers & Foremen)

- Attend HSE meetings
- Actively promote all HSE programs on the project site during all operations
- Participate actively in all safety issues as required on the project
- To ensure the work permits are approved prior commencement of work to be carried out that day.
- Implement work methods, statement, and risk assessments for work that is to be carried out in their areas of responsibility.

Obligations of all Personnel

- To keep safety rules at worksite
- To attend Safety orientation briefings
- To wear PPE at all times
- Promoting HSE through active participation in the execution of AIH HSE plans.
- Participating in incident/accident investigation as required
- Endorsement of the project partnership philosophy of GOAL ZERO.

Performance target is met through targeting ZERO LTI, ZERO TRIR, no serious illness, and no malaria cases.

Resources

Management of CR-SAPZ shall demonstrate her commitment to the achievement of the HSE policies by allocating sufficient resources, including finances and materials and systems, for the effective operation of the HSE MS.

- The following issues are considered in resource allocation:
- Prompt rectification of identified HSE deficiencies.
- Training to bridge competence gaps or enhance competencies.
- Emergency response facilities.
- Provision of required personal protective equipment (PPE).
- Availability of management for HSE audits and reviews.

Competency and training

CR-SAPZ maintains a policy that an effective and efficient Community Affairs, Safety, Health, Environment and Security (CASHES) training programme shall always be in place as part of enhancing its HSE MS. This has led to the adoption of some principles of which the minimum requirements could be "software" issues (procedures, documentation, etc.) or "hardware" items (resources, PPEs, etc.). These shall be in place for CR-SAPZ's HSE MS to be considered as acceptable. Best HSE MS can only be achieved through adequate training of the entire work force.

CR-SAPZ is responsible for generating, maintaining, and enhancing a high level of HSE awareness amongst its workers engaged in the execution of studies for any project at all times.

The HSE induction package shall include, but not limited to the following;

- The CR-SAPZ's Community Affairs, Safety, Health, Environment and Security Policies
    - These are simple and concise statements of the HSE beliefs of the company, signed by the SPC and gives the following messages;
    - Preservation of health and safety of all company and contractor personnel and members of the public
    - Preservation of the integrity and security of company assets.
    - Minimization of the impact of operations on the environment.
- Safety training shall be provided for all category of staff on the following;
    - Fire alarms
    - Fire extinguishers and their locations
    - Emergency escape routes and muster points
    - Personal protection equipment

The effectiveness and relevance of training should be measured through briefing and debriefing of staff before and after training courses, and monitoring of improvement after training.

Communication

CR-SAPZ maintains the policy that all incidents and accidents shall be reported immediately through the available means of communication to the appropriate authorities. The severity of such incident or accident shall determine the level of urgency required for such reports. For instance, a fatal accident must be reported immediately through the line within 24 hours. Such immediate notification shall be followed by a full report within the periods specified from reporting of details of various categories of accidents.

HSE meetings

HSE meetings shall be held at various levels throughout the duration of the execution of the project, with information cascaded accordingly. It is mandatory for all staff to attend an organized HSE meeting at least once a month throughout the duration of the project. This is to continuously increase HSE awareness, ensure effective dissemination and communication of HSE issues with Management.

Attendance at these meetings shall be recorded as part of staffer's individual tasks and targets. Records of such HSE meetings shall be made and kept in the custody of the HSE Manager.

Toolbox Talks

This is a pep talk given to workers by the HSE Manager, geared towards preparing the workers first thing in the morning before the commencement of work. Before the commencement of work each day, the HSE Manager shall assemble all the workers at the muster point and spend about 10 minutes to brief them on the nature of the day's job and the potential hazards associated with it. All workers must be present during this briefing, and any absentee will not be allowed to carry out his/her job for that day.

Staff shall at this meeting present their thoughts regarding safe practices and procedures and provide the group with any knowledge of hazardous conditions or actions in their operations.

- Toolbox talks are very effective (if properly carried out) for:
- Sharing information with many people quickly.
- Stimulating group ideas and interaction.
- Giving inspirational boost.
- Helping to build cooperative communication climate.
- Providing last form of personal training before work commencement.

Standards and Documents

Proper documentation will enhance HSE management by making relevant information readily available, promoting awareness of responsibilities and correct task performance and demonstrating the existence of systems and practices. For the execution of projects/studies, the following records shall be kept:

- Staff exposure man-hours and HSE performance statistics
- Minutes of HSE meetings
- Toolbox talks: topics discussed, name of presenter, attendance and activity for the day.
- Results of hazards and effect management.
- Field HSE inspection.
- HSE audits/performance review and follow up of recommendations.
- HSE suggestions.
- Incident and accident records and investigation report.
- Preventive/routine maintenance schedule and reports
- Staff records

Planning and Procedure

CR-SAPZ shall maintain procedures for monitoring the relevant aspects of HSE performance and for establishing and maintaining records of the results, with a view to knowing the extent to which planned objectives and performance criteria have been met. Monitoring will result in corrective actions with measures to prevent recurrence, whenever there are deviations from set performance criteria.

- Personal Protective Equipment: Workers must ensure regular use of PPE equipment.

- Lifting Equipment: Every lifting equipment must be checked and ensured to be in safe working condition before use.
- Equipment Operations: In the process of operating the equipment, safety precautions must be taken to avoid accidents.
- Transportation Safety: CR-SAPZ will ensure that equipment to be used is in good working condition to transport material to site.
- Housekeeping: All wastes generated must be evacuated to the designated disposal areas.
- Warning Signs and Instructions: When there is warning sign, workers will be notified and instructed on further action.
- Safety Awareness: Workers must be at safety awareness at all times.
- Hot Work: Every equipment for hot work must be in good condition before usage. Fire extinguishers and other fire apparatus will be in place before hot work is done. Permit for Hot work must be granted before hot work is done.
- Firefighting Drills and Training: Workers will be kept physically fit by drills and trained to fight fire. Fire equipment will be available.

Procedure When Fire is Discovered:

- Raise alarm
- Assess the magnitude and location of the fire
- Activate muster point
- Direct all workers to muster point
- To direct all workers out of the place to a safe zone
- The fire man on duty to fight the fire must be well dressed with complete PPE.
- Extinguish the fire with the appropriate firefighting equipment.

Equipment Control: When fire erupts, workers on site will disconnect every equipment under pressure to avoid more problems. Remove every material on walkway to allow free access for fire personnel.

Personnel Control Movement: Security of workers in and out of the premises must be regulated by security personnel.

Scaffolding Security: Scaffold must be used when installation have gone up. Every fabricator/worker working at height must wear safety harness belt and a lifeline must be provided.

Emergency Response Procedure: On observing the alarm or approved signal, each personnel shall:

1. Stop work immediately, take precautions for safe evacuation e.g. disconnect valves under pressure and keep tools out of walkway
2. Leave the workplace to a muster point closer to him/her
3. Remain at the muster point for roll call by the supervisor to identify any missing person(s).

In case of medical evacuation from site, victims will be taken to the clinic.

Implementation, Monitoring and Corrective Action

CR-SAPZ management shall ensure the implementation of the procedures and actions in the HSE plan by providing leadership, resources, and engaging appropriate management mechanisms for responsibility compliance at all levels, as well as monitoring, in line with the HSE Management Plan.

Monitoring

Active HSE performance monitoring, which provides information in the absence of any incident, ill-health or damage to the environment shall involve the following;

- Regular monitoring of progress in implementing HSE plans.
- Regular inspection of facilities and equipment.
- Health surveillance of staff, including exposure monitoring and medical surveillance
- Recording of minutes of HSE related meetings.
- Recording of training needs and training records.

Reactive HSE performance monitoring, which provides information on incidents: near-miss incidents, ill-health or environmental damage and equally provides insights into the means of preventing similar incidents in the future shall be monitored as follows:

- Reporting on situation of non-compliance with HSE requirements.
- Reporting on incidents (including near-misses), which affected or could have affected HSE performance.
- Investigations to identify the root causes for the foregoing and to determine measures to prevent reoccurrence.
- Recording of hazards observed and action to prevent reoccurrence.
- Recording of HSE performance statistics: exposure man-hours, LTI, MTC, FAC.
- Following up on audit/review.

Corrective Action

Appropriate response shall be given to conditions of non-conformance of our operations and activities with set HSE objectives and the principles of good environmental management.

- Management has responsibility to handle and investigate non-conformance.
- The HSE Manager, has a role in timely remedial actions to mitigate any impacts, initiate and complete corrective and preventive actions.

Audit

CR-SAPZ shall maintain procedures for audits to be carried out as part of normal business control to determine whether the HSE management system elements and activities are adequate for achieving the HSE policies and objectives and are being implemented effectively, and to identify improvements.

HSE audits shall address the following elements of the HSE management system:

- Organization, resources and documentation.
- Hazards and effects management.
- Planning.
- Implementation and monitoring.

Audits may be internal (by CR-SAPZ's staff) or external. CR-SAPZ HSE Audit plan covers the following:

- HSE MS audit
- Departmental/cross-departmental HSE audits
- Technical HSE audit
- Hazard management audit
- Occupational Health audit
- Audit training.

Review

Top management of CR-SAPZ, including the SPC and senior management, shall review at appropriate intervals the HSE management system and its performance to ensure its continuing suitability and effectiveness. The review will address, as a minimum, the following:

- Whether or not there are changes to the HSE management system elements such as policies, objectives, HSE and emergency plans etc.
- Resource allocation for HSE management system implementation and maintenance.
- Audit reports and the status of implementation of recommendations.
- Any concerns/suggestions expressed by stakeholders such as employees, clients and government agencies.
- The review process will be documented and its results recorded to facilitate the implementation of the agreed changes.

Waste Management

CR-SAPZ shall be fully responsible for the disposal of any waste generated during the execution of any project. Dumping of waste into creeks, rivers, and other watercourses is strictly prohibited. Dumping of waste on land shall only be at an appropriately designated dumping site approved by the local authorities or regulatory agency, provided such waste is non-toxic. The method of dumping shall be such as would not affect any ground water sources.

CR-SAPZ's waste management policy ensures:

Commitment to waste management by ensuring and reviewing environmental policies.

- All practical and reasonable measures shall be taken to minimise the generation of waste, as well as to manage / dispose of unavoidable waste in an environmentally acceptable manner.
- Waste Management Plan shall catalogue waste identification, quantification and appropriate disposal methods.
- Waste streams shall be monitored and recorded, while efforts will be taken to progressively reduce emission or discharge of waste known to have a negative impact on the environment with the eventual aim of eliminating them.
- Chemicals shall only be used when operationally necessary. In selecting chemicals for use, the HSE aspects shall be considered together with commercial and process performance attributes with the aim of choosing the least harmful.

- All chemicals shall be transported, stored, used and disposed of in accordance with statutory regulations and in a safe/environmentally acceptable manner.
- No new chemical shall be accepted from a supplier without the Materials Safety Data Sheet (MSDS).
- Every chemical shall be covered with a Safe Handling of Chemicals (SHOC) card and shall be acquired, used and disposed of in compliance with FMEnv regulations.
- All chemical handlers shall be specifically trained in the Safe Handling of Chemicals.

Conclusion

CR-SAPZ believes that good HSE performance is an integral part of efficient and profitable business management. We recognize that HSE management is a line responsibility hence management and employees are committed to the principle of safe operations to safeguard heath, promote safety and security of life and property, as well as minimize or eliminate the impact of activities on the environment in delivering on the Agro-industrial hub project and its operation.

D. Biodiversity Management Plan (BMP)

The Biodiversity Management Plan (BMP) is a crucial component of the Environmental and Social Impact Assessment (ESIA) for the Agro-Industrial Hub (AIH) in Adiabo, Odukpani Local Government Area, Cross River State. The BMP outlines comprehensive strategies to identify, mitigate, monitor, and manage the biodiversity impacts associated with the development, construction, and operation of the AIH. This document draws on field studies, ecological assessments, and regulatory frameworks to provide a robust framework for biodiversity conservation.

Objectives of the Biodiversity Management Plan

The overarching objectives of this BMP are:

- To conserve and enhance biodiversity within and surrounding the project area.
- To prevent, reduce, or offset adverse impacts on species, habitats, and ecosystem services.
- To promote the sustainable use of biological resources by local communities.
- To support regulatory compliance and alignment with AfDB's Operational Safeguard 6, Convention on Biological Diversity (CBD), and Nigerian environmental laws.
- To engage stakeholders and local communities in biodiversity stewardship.

Baseline Ecological Description

Terrestrial Ecosystems

The AIH is located in an ecologically diverse area characterized by multiple vegetation types:

- **Rainforest:** Dominated by tall emergent trees such as *Klainedosa gabonensis*, *Hevea brasiliensis*, and *Terminalia superba*. The understory includes climbers and shrubs like *Chloromolaena odorata* and *Xylopia ethiopica*.
- **Freshwater Swamp Forest:** Characterized by stilt-rooted trees like *Raphia hookerii* and *Lophira alata*, with dense undergrowth and seasonal flooding.

- **Cultivated Areas and Plantations:** Include cassava, maize, yams, banana, and *Elaeis guineensis*.

Faunal Diversity

Faunal surveys indicate the presence of:

- **Mammals:** *Thryonomys swinderianus*, *Cricetomys gambianus*, and other small mammals.
- **Birds:** Species such as *Ploceus cucullatus*, *Turdus pelios*, and *Francolinus bicalcaratus*.
- **Reptiles and Amphibians:** *Python sebae*, *Agama agama*.

Aquatic Ecosystems

The site includes a tributary of the Cross River. Macroinvertebrate surveys identified species like *Chironomidae*, *Hydrophilidae*, and *Gerridae*, while fish species included *Clarias gariepinus* and *Tilapia zilli*.

Threatened, Endemic and Invasive Species

- **Threatened Flora:** *Klainedosa gabonensis*, *Adansonia digitata*, and *Isoberlinia doka*.
- **Invasive Species:** *Chromolaena odorata*, *Panicum lax*, *Mimosa pudica*.
- **Conservation Status:** A Shannon index of 2.15 indicates moderate species diversity.

Impact Identification and Assessment

Potential Impacts

- Habitat fragmentation and loss from land clearing resulting to biomass of 57,997.70 m^3.
- Reduction of carbon sequestration capacity of the site by an estimated 164,082 m^3 of Greenhouse Gas Emissions (CO_2).
- Alteration of hydrological regimes affecting freshwater systems.
- Noise, dust, and air pollution disturbing wildlife.
- Increased risk of invasive species introduction.
- Unregulated hunting and logging by workers or opportunistic locals.

Impact Significance

The construction phase is expected to have the most significant impacts due to extensive land use changes. If not managed, these impacts may lead to irreversible biodiversity loss. Operational phase impacts are relatively moderate and more manageable with mitigation.

Biodiversity Conservation and Management Measures

Avoidance Measures

- Site key infrastructures away from sensitive habitats (as indicated in Figure 3.2).
- Retain the existing natural riparian buffer of about 36 ha (as indicated in figure 3.2*)*.
- Avoid clearance during critical breeding/nesting periods.

Minimization Measures

- Use low-impact vegetation clearing methods such as forestry mulching, selective land clearing and manual clearing using hand tools.
- Install silt fences and erosion control near streams (refer to FECP).
- Enforcement of endangered species act which prohibit bushmeat hunting of certain animals and illegal logging activities by workers and the public.

Restoration and Rehabilitation

- Restore disturbed areas using native species such as *Elaeis guineensis, Musa acuminate, Gmeline arborea and Ceiba pentendra*.
- Maintain ecological corridors for species movement.

Alien and Invasive Species Management

- Conduct pre-import inspections of materials.
- Manually remove invasive species with techniques such as hand-pulling, mulching and cutting.
- Educate workers on alien species identification.

Biodiversity Monitoring Plan

Indicator	Methodology	Frequency	Responsible Entity
Flora species richness	Quadrat sampling, visual ID	Bi-annually	Environmental Officer
Fauna presence and abundance	Transects, camera traps, interviews	Quarterly	External Ecologist
Aquatic species diversity	Kick sampling, netting	Annually	Biodiversity Consultant
Invasive species occurrence	Transect walks, ground truthing	Quarterly	Trained field teams
Habitat condition	Visual inspection, drone imagery	Monthly	HSE Supervisor

Institutional Framework and Responsibilities

- **CR-SAPZ Project Management:** Overall accountability for BMP implementation.
- **Environmental/HSE Officer:** Day-to-day monitoring and enforcement.
- **Third-party Ecological Consultant:** Technical studies, validation, reporting.
- **Community Stakeholders:** Watchdog roles, participatory monitoring.
- **Federal & Cross River State Ministries of Environment:** Oversight, permitting, compliance checks.

Capacity Building and Community Engagement

- Train staff on ecological conservation and BMP procedures.
- Establish community biodiversity committees.
- Organize workshops on sustainable agriculture and bushmeat alternatives.

- Engage in school biodiversity clubs and awareness campaigns.

Reporting And Compliance

- Quarterly progress reports to CR-SAPZ and FMEnv and monthly to AfDB
- Annual biodiversity compliance audits.
- Public disclosure of ecological performance which will be embedded in the Stakeholder Engagement Plan (SEP).
- Mid- and end-term BMP evaluations tied to project milestones.

Biodiversity Offsets

The project area covers a perimeter of 4828m and consequently, a total of 483 trees were proposed to be planted along the perimeter at 10m interval. Similarly, the major and minor internal roads cover 3480m and 2670m respectively and thus 348 and 267 trees were proposed along the major and minor roads respectively. In all, a total of 1098 trees were proposed within the project vicinity as the biodiversity offsets. There also exist an existing vegetation along the seasonal stream/drainage channel which is recommended for conservation. This approach will not only conserve the biodiversity, but will also check climate change, flooding and erosion.

Adiabo Project Site Showing Proposed Tree Planting Locations

Outline of the proposed tree planting along the perimeter, major and minor roads

Summary of proposed Trees within the project site

SN	Location description	Length (m)	Estimated trees
1	Perimeter	4828	483
2	Major internal road	3480	348
3	Minor internal road	2670	267
Total Proposed Trees		**-**	**1098**

N/B: Proposed trees should be planted at 10m interval

Conclusion

The BMP provides a roadmap for ensuring that the AIH project aligns with conservation objectives and sustains the ecological fabric of Adiabo. Through proactive measures, stakeholder participation, and robust monitoring, biodiversity values can be maintained while supporting development goals.

E. Traffic Management Plan

The aim of a traffic management plan is to identify hazards and risks and provide a way of minimizing them. In the context of this project, this traffic management plan describes procedures and protocols for site access, traffic routing and management, and contractor company guidelines with respect to vehicle and employee transportation in delivering their obligations on this intervention project. Public, employee and contractor safety are the primary goal of this plan. Most importantly, traffic within the project area will be dynamic throughout the course of execution of this works and the safety of other road users is essential during this time. Meanwhile, to effectively manage traffic along the project area, there would be designated checkpoints for vehicle inspection and monitoring.

This Traffic Management Plan (TMP) for a Special Agro-Industrial Processing Zone (SAPZ) project site in Adiabo, Odukpani LGA of Cross River State involve strategies to manage traffic flow, ensure safety, and minimize disruptions during the construction and operational phases. The plan addresses both internal and external traffic, including vehicle types, routes, and parking, likewise outlining procedures for emergency situations and consider the needs of various stakeholders.

An overview of the Traffic Situation in the Area

The project site which is located along Tinapa road is connected by road while a stream which is a tributary of Calabar river traverses the project area which will also serves as a mean of transportation during the full operation of the facility (Figure 1.1). As demonstrated in Figure TM 1, the major mean of transportation within and outside the project vicinity is by road and all traffic management strategies focuses mostly on road transportation.

Objectives and Scope of the Traffic Management Plan (TMP)

This Traffic Management Plan (TMP) is designed to ensure the safe, efficient, and coordinated movement of vehicles, equipment, materials, and personnel in and around the SAPZ Project Site. The plan supports construction, logistics, operational, and emergency requirements with minimal disruption to surrounding communities and road users. This plan covers: the construction phase, operational phase, internal site traffic, external (access road) traffic, traffic safety, controls, and emergency procedures. In summary, the objectives of the TMP are:

- To reduce the risk of traffic accidents
- To manage construction and operational logistics effectively
- To ensure smooth traffic flow within and around the SAPZ
- To minimize disruption to nearby communities

Traffic Interaction with Existing Routes

Two major routes will be affected by the project during the construction and operational phase of the project. These include the Tinapa road and the Calabar-Ikom highway (Figure 1.2) especially around the Tinapa junction. The existing carriageway will be affected by traffic especially in transporting construction materials and machineries to/from the project site as well as transportation of agricultural products from the site. Although this effect will be temporal, flagmen will be stationed at strategic points that are likely to be affected such as the entry/exit point to the project site and Tinapa junction

Traffic Demand, Classification and Vehicle Types

At all the phases of the project, there are various traffic demands and associated vehicles. For instance, during the initial construction phase, the plan might involve diverting traffic on a specific road to allow for heavy vehicle access to the site. Consequently, flagmen would be stationed at key intersections to manage traffic flow and ensure safety. On the other hand, once the SAPZ is operational, the plan could include designated delivery zones and parking areas, as well as traffic calming measures like speed bumps to control traffic speeds within the zone. Public transportation options would also be considered. Howbeit, the traffic demands, classification and vehicle types are summarized herein based on the major phases:

Construction Phase

Several vehicles which may disrupt traffic flows will be used. These as summarized in Table 1 include: heavy vehicles (e.g., excavators, dump trucks, concrete mixers), delivery trucks (e.g., raw materials, machinery), personnel buses and light vehicles, fuel and water tankers, among others.

Table TM 1: Vehicular Demands and their Purpose During Construction Phase

Vehicle Type	Estimated Volume	Purpose
Heavy-duty trucks (e.g. dumpers, concrete mixers)	50–70/day	Earthworks, concrete delivery
Construction equipment (excavators, cranes)	10–20/day	Site preparation and structure erection
Light vehicles & pickups	40–60/day	Engineers, supervisors, logistics
Personnel buses	5–10/day	Labour transport

Operational Phase

During the operational phase, major vehicles needed include agricultural produce delivery trucks, export container trucks, employee and visitor vehicles, waste management trucks, among others. Their functions are summarized in Table TM 2.

Table TM 2: Vehicular Demands and their Purpose During Operational Phase

Vehicle Type	Estimated Volume	Purpose
Produce delivery trucks (5–20 tons)	80–100/day	Input and output transport
Container trucks	20–40/day	Processed goods export
Waste management trucks	5/day	Residue & waste removal
Staff cars and motorcycles	100–150/day	Employee commute
Visitors/official cars	10–30/day	Inspections and business visits

A well-designed plan can reduce the risk of accidents involving vehicles, personnel, and equipment, especially during loading, unloading, and transportation of potentially hazardous materials. By streamlining traffic flow and access routes, the plan can improve efficiency and reduce delays, leading to faster exploration and production cycles. A traffic management plan should include protocols for emergency evacuations, spill response, and other potential hazards, ensuring the safety of personnel and minimizing environmental damage. Hence, the following strategies are summarized for effective traffic management in the project area.

Table TM 3: Traffic Management Plan (TMP) for Adiabo SAPZ

		Monitoring					
Summary of Potential Impact	**Mitigation Measures**	**Requirement/ Parameters**	**Frequency**	**Performance Indicators**	**Implementation**	**Supervision**	**Cost**
Traffic congestion and Control Measures as vehicle movement within plant which increased traffic from surveys and site access	a) Signage: Clear, reflective, multilingual signs (in both English and local languages) b) Speed Limits: Enforced on all internal and external routes c) Convoy Rules: For heavy vehicles, especially during night travel or in high-risk areas d) Escort Services: Armed or security escort in high-risk zones	Traffic signage at designated points	Once the old signage faded	Installation of traffic signage at designated points Compliance with traffic and other related rules	Security/HSE Unit	CR SAPZ	#2,000,000
	All traffic on routes to and from the site will be radio controlled. Where this is not possible, signage will be installed at appropriate locations to warn the public along these routes.	Purchase of communication gadgets and pasting of signage	Only replaced when faded	Effective use of the gadgets for maximum service delivery	Security/HSE Units	CR SAPZ	#7,000,000
Personnel and Training	This includes traffic marshals deployed at junctions, work zones. It also includes driver training on safety, environmental awareness, and defensive driving and regular toolbox talks and simulation drills for emergencies	Training workshops	Annually	Effective service delivery	HSE Unit	CR SAPZ	#5,000,000
Emergency and Incident Management	This includes traffic incident response teams on-call 24/7, evacuation routes mapped and marked, first aid kits and communication devices in all vehicles, link with local emergency services and environmental response units, among others.	Site plan map mounted at the premises, muster point identification	-	Availability of site map, first aid kits and other devices	HSE UNIT	CR SAPZ	#2,000,000
Monitoring and Reporting	This approach includes GPS tracking of company vehicles, monthly traffic audits and road condition assessments and incident logs maintained and analyzed for trends, among others.	GPS and trackers installation	-	Purchase of the devices and successful installation	Security Unit	CR SAPZ	#10,000,000

		Monitoring					
Summary of Potential Impact	**Mitigation Measures**	**Requirement/ Parameters**	**Frequency**	**Performance Indicators**	**Implementation**	**Supervision**	**Cost**
Community Engagement: **.**	Community participation in effective traffic management in the area is very important. This should include advance notice of large vehicle movements through local radio, signage, town halls; hiring local drivers and traffic marshals; grievances redress system for reporting traffic issues and support community road upgrades as part of CSR	Stakeholders' engagement	Annually	Review and auditing of stakeholders engagement exercise	Administrative Unit	CR SAPZ	#5,000,000
Site Safety and Security	In the interest of site security and public safety, access to operational areas related to the execution of this contract will be restricted to authorized site personnel through the usage of signs and gates where appropriate.	Pasting of signage	Only replaced when faded	Monitoring of the signpost for replacement when necessary	HSE Units	CR SAPZ	#3,000,000
Monitoring Tools	CCTV camera systems at gates and key intersections, RFID or barcode-based vehicle tracking, Incident reporting system for traffic violations and near-misses	CCTV Camera	Replaced or repaired when lost/damaged	Assessment to ensure that the CCTV cameras and other devices are in working condition	Security unit	CR SAPZ	#10,000,000
	Facilities that potentially present danger to persons or wildlife such as the electrical, equipment staging area and workers camp will be fenced or barricaded as appropriate to prevent general access.	Fencing	Permanent	Monitoring to ensure proper fencing is done	Construction contractor	CR SAPZ	#20,000,000
Compliance:	The stipulated strategies would be in line with Nigerian laws (FRSC regulations, NURTW coordination) and corresponds with international	-	-		-	-	-

		Monitoring					
Summary of Potential Impact	**Mitigation Measures**	**Requirement/ Parameters**	**Frequency**	**Performance Indicators**	**Implementation**	**Supervision**	**Cost**
	standards (ISO 39001 (Road Traffic Safety), IFC/World Bank EHS Guidelines).						
Review and Updates:	This has to do with frequent (probably quarterly) reviews of the TMP, post-incident updates or after major operational changes, regular community feedback sessions, among others. Road signs should be placed at appropriate points along the project area as demonstrated in Figure 6.1	-	-		-	-	-

Traffic Management Model

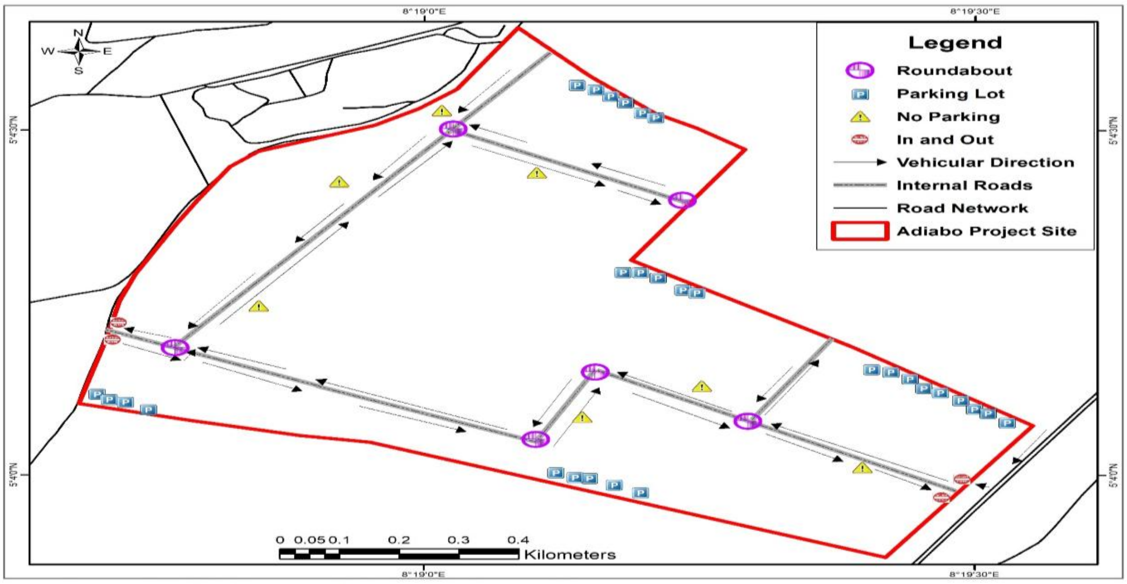


Figure TM 3: Proposed Area for Road Signal along the Project Environment

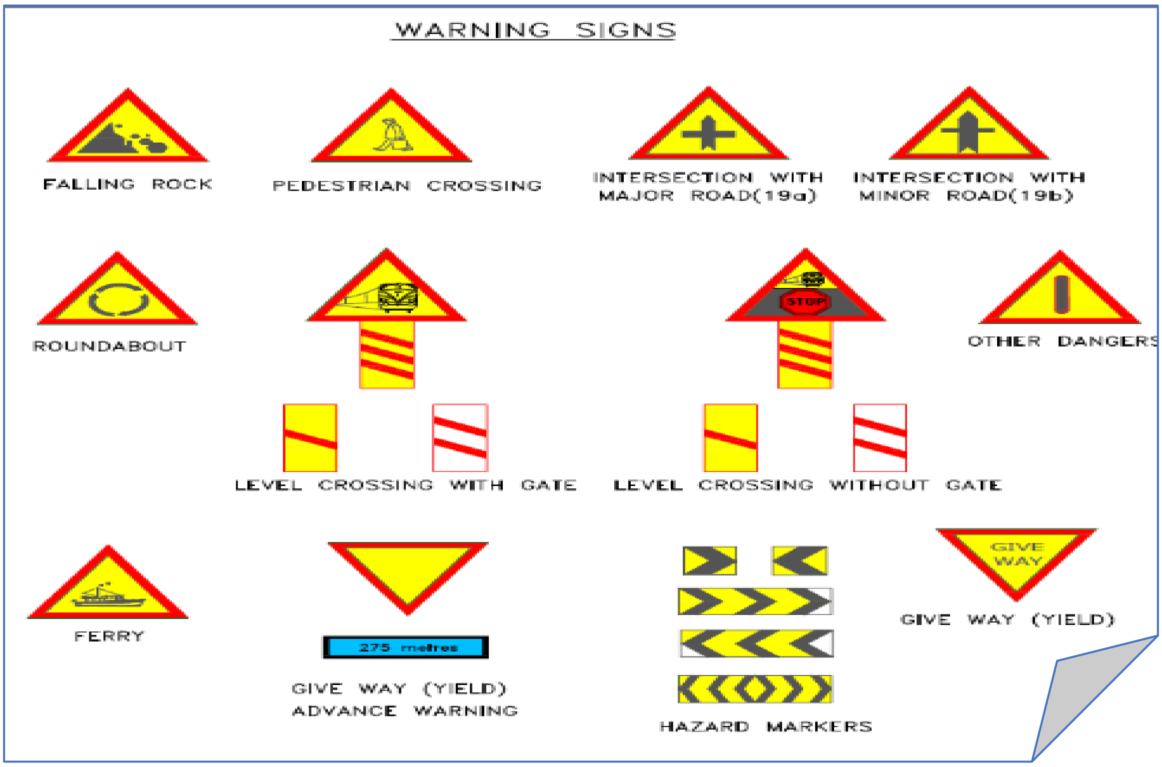
Figure TM 1 clearly illustrated the management plan for traffic within the facility showing the proposed entry/exit points, parking lots, no parking, crossings, among others. The parking lot allocate suitable parking space for staff and visitors and the objective of designing and operating parking areas involves providing an access point capacity more than the peak rate of traffic flow that traverses the driveway. On the other hand, parking restriction sign (No Parking) allows for free flow of traffic across the facility (Figure 7.1).

Management, Monitoring And Enforcement

Effective traffic management shall comprise of traffic coordinator, traffic marshals, security officers, among others and their role is summarized in Table 7.2.

Table TM 4: Traffic Control Team

SN	Role	Responsibility
1	Traffic Coordinator	Oversees plan implementation
2	Traffic Marshals	Enforce compliance and report violations
3	Security Officers	Control gate access and vehicle logs



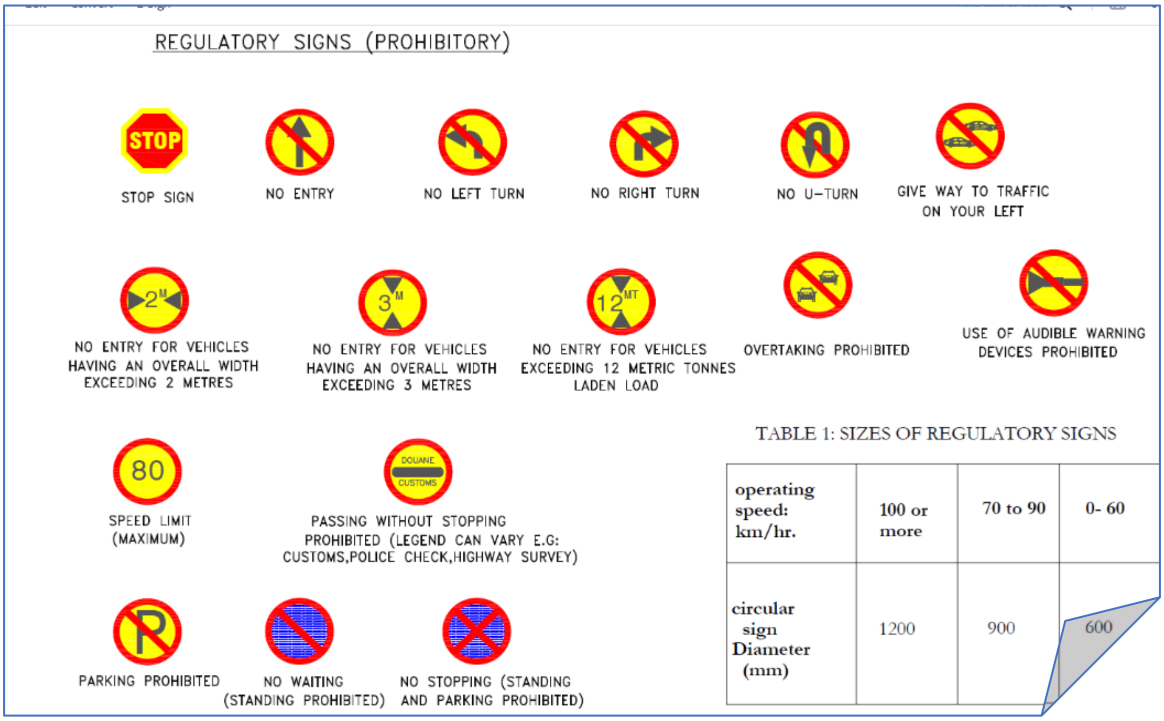
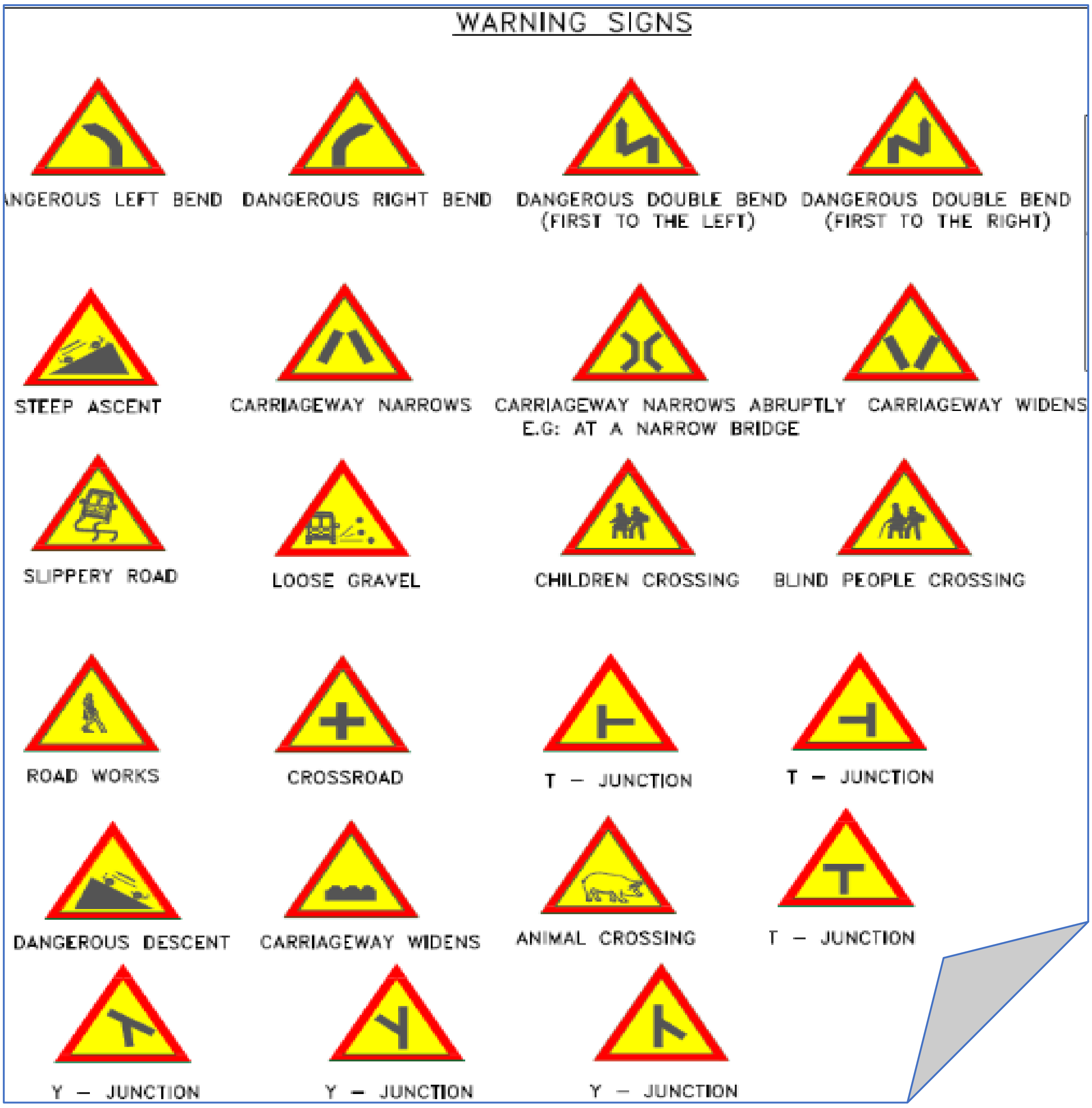
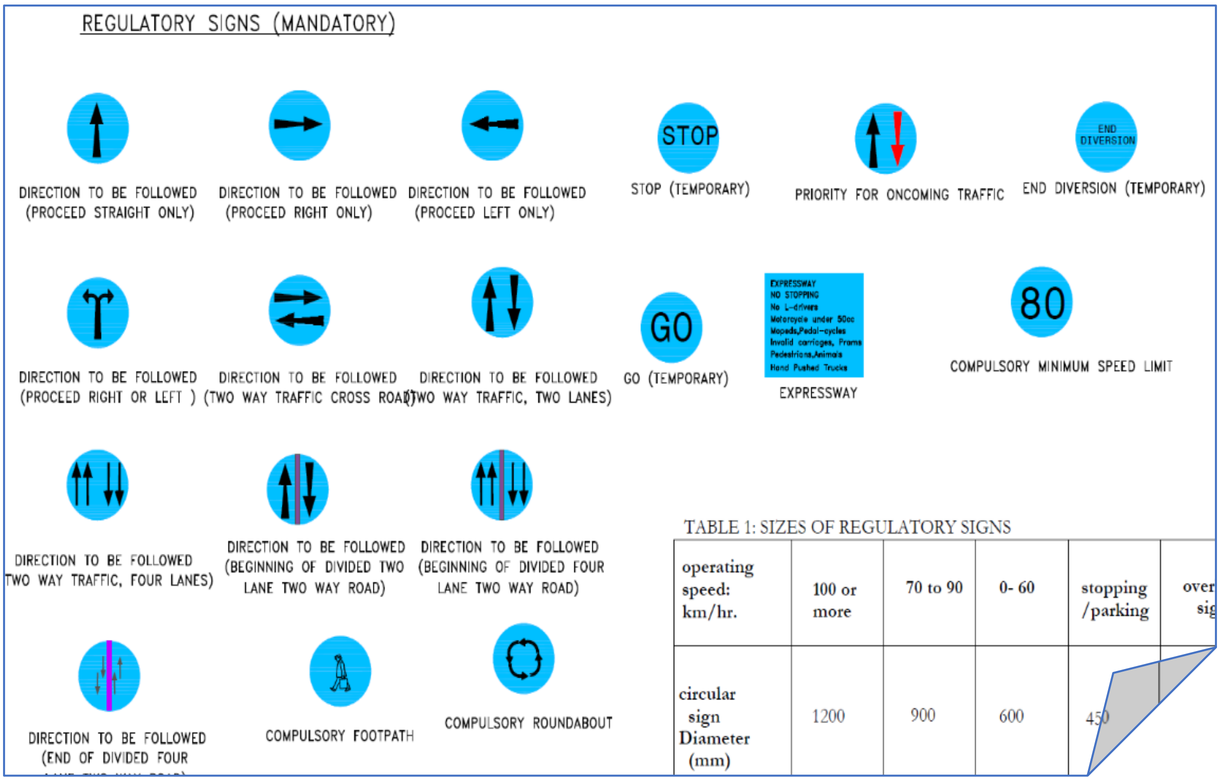


TABLE 1: SIZES OF REGULATORY SIGNS

operating speed: km/hr.	100 or more	70 to 90	0- 60
circular sign Diameter (mm)	1200	900	600


WARNING SIGNS
NGEROUS LEFT BEND
DANGEROUS RIGHT BEND
DANGEROUS DOUBLE BEND (FIRST TO THE LEFT)
DANGEROUS DOUBLE BEND (FIRST TO THE RIGHT)
STEEP ASCENT
CARRIAGEWAY NARROWS
CARRIAGEWAY NARROWS ABRUPTLY E.G: AT A NARROW BRIDGE
CARRIAGEWAY WIDENS
SLIPPERY ROAD
LOOSE GRAVEL
CHILDREN CROSSING
BLIND PEOPLE CROSSING
ROAD WORKS
CROSSROAD
T – JUNCTION
T – JUNCTION
DANGEROUS DESCENT
CARRIAGEWAY WIDENS
ANIMAL CROSSING
T – JUNCTION
Y – JUNCTION
Y – JUNCTION
Y – JUNCTION



F. Flood and Erosion Control Plan (FECP)

Flooding remains one of the most pressing environmental challenges in Nigeria, particularly in regions experiencing unregulated development, activities and increasing climate variability. Erosion, on the other hand, refers to the gradual removal of soil and surface materials due to high-velocity water flow, often intensified by human activities. In addition to human-induced causes, natural processes, such as wind action and rock weathering, also contribute significantly to soil erosion, especially in arid and semi-arid regions. These processes gradually break down geological formations, making soil more susceptible to erosion, which in turn increases sedimentation in rivers, streams, and drainage channels. This sediment build-up reduces the capacity of these water bodies to effectively convey stormwater, thereby increasing the frequency and intensity of flooding events.

Both phenomena are exacerbated by climate change and poor land use practices such as deforestation, inadequate drainage design, and construction along waterways. Therefore, addressing both anthropogenic and natural drivers of soil erosion is critical to achieving effective flood control and promoting sustainable environmental management.

The Adiabo project area, located in Odukpani Local Government Area of Cross River State, lies within the lowland rainforest belt of Nigeria’s humid tropical zone, with elevation levels ranging from approximately 43 to 132 feet above sea level. The topography, characterized by a gentle slope of 0–2%, is generally undulating to gently rolling, interspersed with low-lying, flood-prone areas and seasonally waterlogged plains.

The soil structure is predominantly sandy-loam to clayey, moderately deep, and ranges from well-drained to poorly drained, with loosed topsoil in some areas. This attribute makes the land vulnerable to periodic flooding, gully formation, sheet wash and surface runoff. These challenges are exacerbated by high-intensity rainfall, insufficient drainage infrastructure, high water table and fragile soil condition. The terrain gradually slopes towards the Calabar river as shown in figure FE1, increasing the risk of erosion and sediment transport into nearby waterways. Vegetation in Adiabo reflects the characteristics of the humid tropical rainforest ecosystem, comprising secondary forest, farmlands, fallow and riparian vegetation along water bodies. Dominant economic trees include raffia palm, oil palm, rubber, timber, mango, coconut, bamboo, plantain and banana along with undergrowth such as ferns, shrubs, and grasses. Agricultural activities have significantly modified the natural vegetation, resulting in visible patches of cultivated land supporting crops like cassava, cocoyam, maize, melon, okra, vegetables. Bamboo fencing, traditionally used as boundary markers and barriers against intrusion is also a notable feature in the community.

If not properly managed, these environmental hazards may compromise the integrity of the proposed infrastructure disrupt the Agro-processing activities, and pose risk to both workers and local residents. An effective flood and erosion control plan is essential to mitigate the growing risks associated with stormwater runoff, river overflow, and anthropogenic alterations to the landscape.

This Flood and Erosion Control Plan (FECP) is developed as a strategic and adaptive framework to proactively address the growing environmental concerns faced by Adiabo community which happens to be the project area. particularly in light of the proposed Agro-Processing Hub. This plan aims to guide proactive, inclusive, and sustainable measures to mitigate the risks of flooding and erosion while promoting environmental resilience and infrastructural integrity in and around the project area

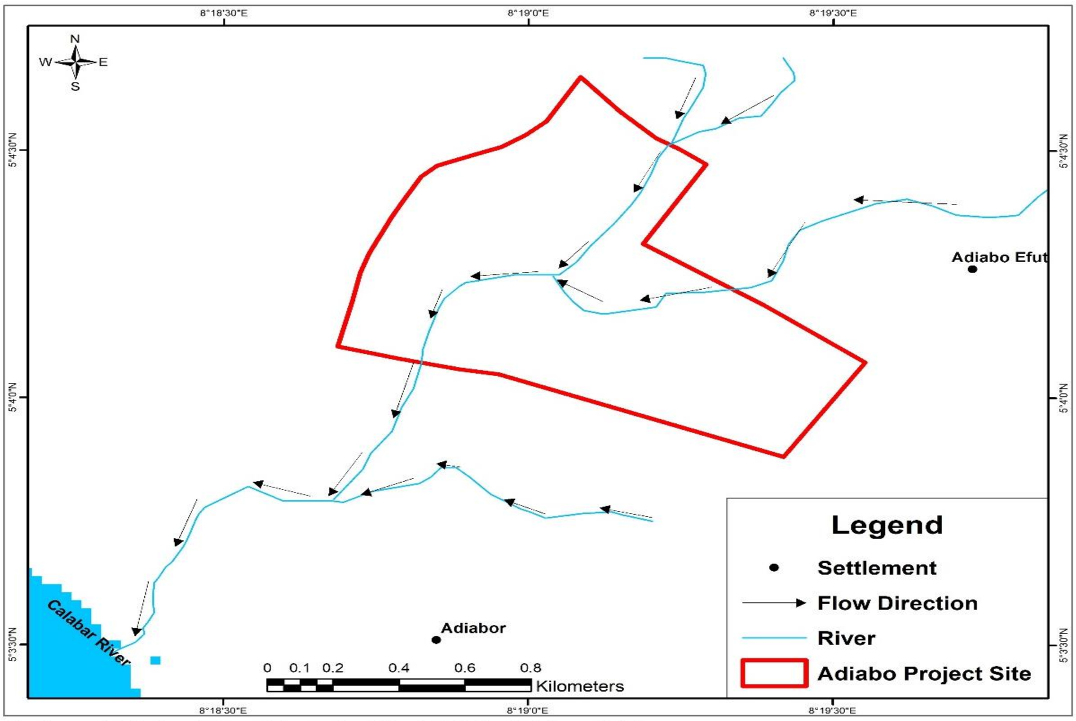


Figure FE 1: Drainage (hydrology) Map of the project site in Adiabo showing tributary flow direction and connection to Calabar River.

Aims of the FECP

The primary aim of the plan is to:

Safeguard infrastructure, farmlands, community asset, and conserve natural ecosystems from hydrological geomorphological hazards.

Objectives of the FECP

The specific objectives of the FECP are to:

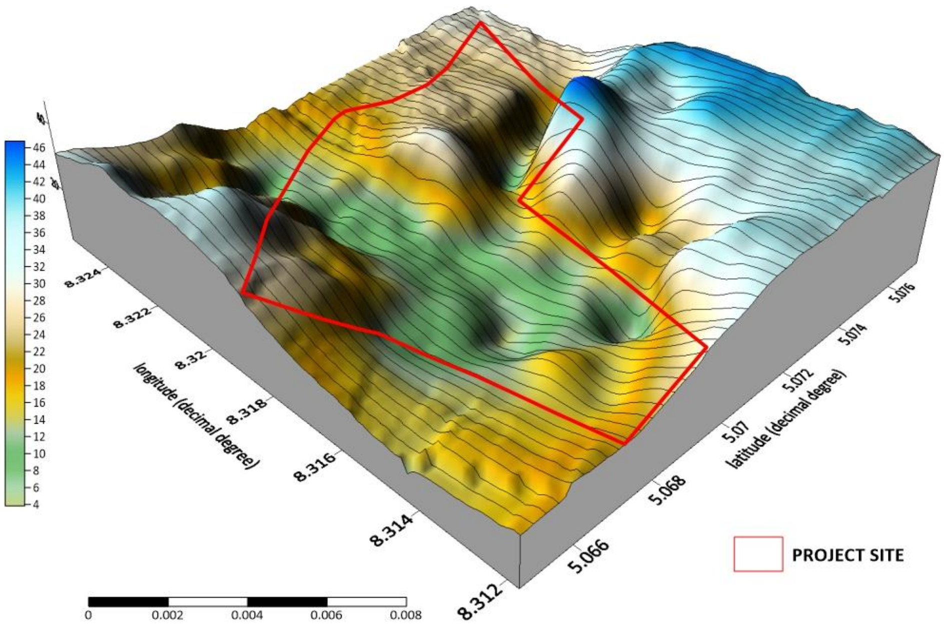
- Prevent or significantly reduce the occurrence of flooding and erosion within and around the project site and its environs.
- Mitigate flood risks associated with seasonal rainfall patterns and rising water tables, and increasing runoff.
- Prevent soil degradation, gully formation and sediment displacement through physical (e.g. proper drainage channels), biological (e.g. revegetation), and structural (cculverts, check dams) controls measures.
- Strengthen infrastructure resilience through climate-smart planning, design and engineering approaches aligned with vision of the Agro-hub.
- Safeguard nearby communities, livelihoods, agricultural lands, and surface water bodies, including the tributaries of Cross-river.
- Integrate traditional ecological knowledge with modern engineering, actively engage stakeholders, and align with national and international best practices for coastal resilience flood and erosion control.
- Conserve natural floodplains, stream channels, riparian zones and wetland that serve as ecological buffers natural barriers to flooding.

Baseline Conditions

Comprehensive field investigations and environmental site assessments conducted within the project area in Adiabo Community, Odukpani LGA, Cross River State, have provided critical insights into the baseline hydro-climatic and geomorphological characteristics that may influence project planning and sustainability. The following key observations were recorded:

- A tributary of the Calabar River traverses the project site, maintaining a direct hydrological connectivity with the main river at approximately 1,200 m distance. This tributary plays a critical role in shaping local drainage patterns and contributes to surface water movement across the area. Its proximity poses a potential risk of seasonal inundation, especially during peak rainfall periods. Terrain analysis confirmed notable eelevation variability across the site. Areas of relatively higher ground are interspersed with depressions and the shallow basins, increasing the site's susceptibility of the area to flood/erosion. These variations are critical for drainage planning, construction siting, and flood control interventions.
- The site is characterized by gently undulating topography with several low-lying depressions and flood-prone gullies. These gullies, if left unmanaged, may evolve into major erosion corridors or flood ways, posing environmental and infrastructural risks.
- The location experiences a humid tropical climate, with mean annual rainfall exceeding. 4,000mm, Peak rainfall typically occurs between May–August, This prolonged wet season significantly impacts surface hydrology, runoff intensity, and the potential for flash floods and prolonged waterlogging in poorly drained zones. Soil composition within the area are predominantly muddy, sandy and loamy in texture, with moderate susceptibility to sheet and rill erosion, especially when vegetation cover is removed. In aaddition, soil permeability varies, with certain zones prone to surface sealing, leading to poor infiltration and exacerbating runoff and flood potential.
- Historical flood pattern and hydrological records suggest that the area is prone to shallow to moderate inundation during peak rainfall seasons. especially along the site's southern and western boundaries of the location where surface water tends to accumulate and drainage is impeded by natural depressions, as indicated in Figure FE 2 and Plates FE 1.
- Vegetation in the area includes a mosaic of secondary forest, shrubs, and grasses, with some cultivated farmland patches. While vegetation offers a degree of erosion control, continuous land clearing and farming practices may degrade natural buffers, increasing the vulnerability of the land to both erosion and flood damage.
- Community consultations revealed a long-standing concern regarding the lack of engineered drainage infrastructure. Residents rely on natural gullies and footpaths for water evacuation during storms. Any disruption to these informal drainage channels, especially from construction activities, could amplify flood risks and lead to environmental degradation if not proactively addressed in the project design.

These baseline environmental conditions underscore the importance of incorporating integrated flood control, erosion mitigation, and stormwater management strategies into the design and implementation of the proposed AIH project at Adiabo. Understanding these dynamics is vital to ensuring environmental sustainability and community resilience in the face of climate variability.



3D SURFACE MODEL OF ADIABO PROJECT SITE [Projection: Perspective; Rotation: 45°; Tilt: 30°; Field of View: 45°]

Figure FE 2. Digital Elevation Model of Adiabo

Plate FE 1: Flooding of the Tinapa Road during a rainy day

Plate FE 2: Evidence of sheet erosion at proposed AIH site, Adiabo

Flood and Erosion Control Measures for Effective Management in Adiabo community.
To effectively mitigate the recurring threats of flood and soil erosion risks at the proposed AIH site, a combination of structural, vegetative, and engineering control measures has been considered at the project design level, subject to detailed geotechnical and hydrological investigations.

Site Planning and Engineering Flood Controls

Topographic regrading: Elevate critical structures above 1-in-25-year flood levels using engineered fill and compacted construction platforms. This measure ensures structural stability, flood resilience, and prolonged foundation integrity.

Drainage Masterplan: Develop a site stormwater management system including:

- Primary and secondary channels to efficiently collect and convey surface runoff away from sensitive areas.
- Concrete-lined trapezoidal drains with a depth of ≥ 0.5 m and a slope gradient of 1% designed to manage runoff velocity and prevent scouring.
- Vegetated swales and bioswales along peripheries to encourage infiltration, filter sediments, and enhance groundwater recharge.

Retention ponds and Basins: buffer ponds to capture and store storm water during rainfall and gradually release post-rainfall into the downstream channels to prevent flash flooding.

Check Dams: Use small rock-fill check dams along identified internal streams and channels to reduce flow velocity and trap sediment transport, thereby enhancing downstream water quality and stabilizing embankments.

Culvert Design Optimization: Existing culverts, along the flow route of storm water from the site to the river, will be evaluated and expanded to accommodate peak flow volumes. This will reduce the risk of blockage and overtopping, which commonly leads to erosion and localized flooding.

Permeable Pavement Systems: Within pedestrian and parking zones, permeable surfaces will be adopted to enhance stormwater infiltration, reduce surface runoff, and mitigate waterlogging.

Soil Erosion Prevention Measures in Adiabo Community

To safeguard the integrity of the landscape and minimise land degradation within the project area in Adiabo Community, a strategic mix of structural and vegetative soil erosion control measures has been incorporated into the site design. These measures are aimed at reducing surface runoff, preventing gully formation, and enhancing long-term soil stability.

Structural Measures

- Gabion and Ripraps: Heavy-duty gabion mattresses and riprap to be installed at vulnerable riverbanks, stream edges and culvert outlets to prevent gully initiation and expansion of the gullies. These structures dissipate energy from flowing water and protect embankments from scouring and undercutting.
- Terracing and contour Trenching: Should be applied along project slopes >6% gradient to slow water movement, increase infiltration and reduce erosion potential, especially around cleared or disturbed project area.
- Sediment Traps and Barriers: Temporary erosion control devices such as silt fences, sediment traps, and sandbag check dams will be installed at critical locations to capture suspended sediments and prevent sedimentation of downstream watercourses, during construction.
- Reinforced Embankments: In flood-prone zones, engineered embankments will be reinforced with stone pitching and geotextile membranes to ensure long-term slope stability.
- Preservation of Wetlands: Existing natural wetlands within or adjacent to the project area should be preserved and integrated into the overall flood control strategy.

B. **Vegetative Measures**

To support long-term flood and erosion control of the project in Adiabo community, natural stabilisation strategies will be implemented alongside engineering controls. These vegetative measures enhance soil binding, reduce surface runoff, and promote ecological resilience.

- Hydro-seeding and Grass Carpeting: Stabilise exposed or soil surfaces with deep-rooted, fast-growing grass species such as Guinea grass and Vetiver grass due to their high soil-binding capacity and effectiveness in reducing surface erosion.
- Afforestation of Slopes: Plant native trees such as Gmelina, Acacia (White Teak), Acacia auriculiformis (Earleaf Acacia), and Albizia (Siris Tree). These species were selected for their canopy coverage, fast-growing nature, adaptability to tropical conditions, slope stabilisation and erosion control, deep roots, and ability to anchor soil, and reduce rainfall impact.
- Riparian Buffers: Preserve the about 36 ha vegetation buffer along and around stream banks to protect water quality and streambank integrity, minimise surface runoff, maintain ecosystem balance within the watershed area and trap sedimentation.
- Agroforestry Integration: On farmlands adjacent to the site, agroforestry practices will be encouraged to promote sustainable land use while providing erosion control through integrated planting of crops and tree species.
- Community Greenbelts: Designated greenbelts and parklands will be incorporated into the layout to act as flood plains and water sinks, while enhancing environmental aesthetics and community well-being.

Refer to Figure 3.2 in Chapter 3 for the AIH site's vegetation map indicating clearance and conservation zones.

C. **Erosion-Control Landscaping**

This section outlines a comprehensive erosion-control landscaping and management plan tailored for the proposed AIH in Adiabo Community, Odukpani LGA, Cross River State. The interventions are designed to sustainably manage runoff, stabilise soil, prevent erosion, and protect the ecological integrity of the project site throughout the construction and operational phases.

Erosion-Control Landscaping.

Design green belts and shelterbelts using indigenous, low-runoff landscape species such as Vetiver grass, Elephant grass (Pennisetum purpureum), and Acacia auriculiformis (Earleaf tree) to serve as windbreaks and erosion buffers.

Apply mulch or biodegradable ground covers over exposed soil to reduce erosion and retain moisture until permanent vegetation is established.

Construction Phase Measures

To reduce erosion and sedimentation during construction, targeted preventive measures are applied at critical stages. The table outlines key on-site actions, their purposes, and when they should be carried out to maintain environmental safeguards throughout the construction period.

Table FE 1: Construction Phase Measures

Measures	Description	Timeline
Diversion Berms	Create temporary earth bunds to divert runoff away from work zones.	Pre-construction
Stabilized Site Entry	Use rock pads and sediment wash pits to reduce sediment tracking by vehicles.	Ongoing
Slope Protection	Geotextile fabric application and turfing on newly cut embankments to prevent slope failure.	Within 7 days of exposure
Rain Event Protocol	Cease land clearing 24 hrs before heavy rainfall forecasts; inspect all erosion controls post event.	As needed

Operational and Long-term Control Measures

To ensure sustained flood and erosion risk mitigation, CR-SAPZ commits to the following operational and long-term control measures as part of its environmental stewardship obligations:

- Routine Cleaning of Drainage Networks: CR-SPAZ shall implement quarterly maintenance program involving the de-silting and debris removal from all site drainage channels, culverts, and retention ponds to ensure unimpeded water flow and prevent localized flooding.
- Periodic Vegetation Maintenance: CRSAPZ will undertake routine rimming of grass cover and replacement of dead plants on slopes and erosion-prone areas to maintain effective ground cover and enhance slope integrity throughout the project lifecycle.
- Storm Event Monitoring: CR-SPAZ shall Install automatic rain gauges to monitor precipitation; Any storm event exceeding 50mm/hour will trigger an inspection protocol within 24 hours to assess erosion control systems and initiate immediate corrective actions where needed.

- Community Early Warning System: CR-SPAZ in collaboration with Cross River State Emergency Management Agency (SEMA), to deploy flood early-warning mechanisms, including sirens and alert systems, to safeguard vulnerable downstream communities.
- Emergency preparedness and Response: CRSAPZ is committed to maintaining a comprehensive emergency preparedness framework and these measures should be well established and effectively maintained. All emergency protocols shall be reviewed bi-annually, updated based on site conditions, and kept fully operational to ensure rapid and effective response to extreme weather events.

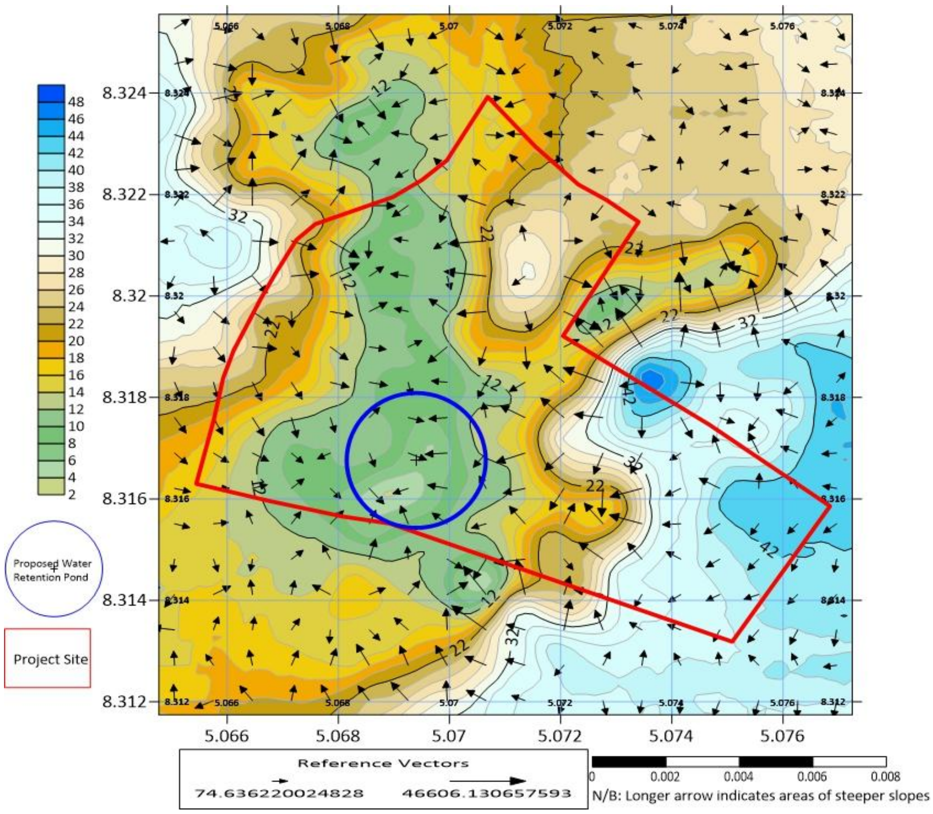


Figure FE 3: Vector flow map

Institutional Roles and Responsibilities

Successful implementation of the flood control plan depends on well-defined roles and coordination among stakeholders to ensure accountability, compliance, and effective delivery.

Table FE 2: Institutional Roles and Responsibilities

Role	Responsible Entity	Key Functions
FECP Oversight	CR-SAPZ PIU	Oversight, supervision, and review of the flood plan implementation
Execution	DBO Contractor	On-ground implementation of all flood/erosion works.
Monitoring	Environmental Consultant	Routine inspection, performance review, and reporting.

Supervision / Regulation	Cross River State Ministry of Environment / NESREA	Ensure standards and regulatory compliance and enforcement

Monitoring and Evaluation Framework

This framework defines key indicators, methods, and responsibilities for monitoring flood and erosion control efforts, enabling timely risk detection and informed decision-making throughout the project.

Table FE 3: Monitoring and Evaluation Framework

Indicator	Method	Frequency	Responsible Unit
Drainage capacity and flow	Flow rate measurement and ponding observations	Quarterly	Site Engineer
Siltation in retention basins	Sediment depth gauges and visual inspections	Monthly	E&S Unit
Gully formation hotspots	Geotagged photographic surveys	Biannually	Environmental Consultant
Rainfall events above design	Rain gauge logs and hydrological alerts	Event-based	Safety/Climate Officer

Conclusion

The FECP for the AIH at Adiabo represents a strategic commitment by CR-SAPZ to proactively mitigate the environmental vulnerabilities inherent to the project area. By integrating both engineered (grey) infrastructure and ecosystem-based (green) solutions, the plan offers a balanced, adaptive, and resilient framework for managing flood and erosion risks. CR-SAPZ reaffirms its responsibility as the project proponent to ensure full implementation, monitoring, and continual improvement of all prescribed control measures. This includes maintaining functional drainage systems, enforcing vegetation restoration, and institutionalizing early warning and emergency response protocols in partnership with state and local agencies.

Beyond compliance, this plan reinforces CR-SAPZ’s long-term vision of environmental stewardship, climate-smart infrastructure development, and community protection. Through consistent execution, stakeholder engagement, and transparent oversight, the FECP will safeguard lives, livelihoods, and physical assets, while also strengthening the ecological integrity and sustainability of the broader Adiabo landscape.

G. Climate Change Management Plan (CCMP)

Climate change poses growing risks to infrastructure, ecosystems, and vulnerable communities, particularly in flood-prone, agriculturally active zones. Adiabo community, situated in Odukpani Local Government Area of Cross River State, lies near the Calabar-River Estuary within the humid tropical rainforest zone. Characterized by low-lying terrain, annual rainfall that exceed 4,000 mm, prolonged high humidity >80% and increasing unpredictability in seasonal patterns, the area is highly susceptible to climate-related impacts such as flooding, erosion, and ecosystem degradation.

As plans progress for the development of a proposed Agro-Industrial Hub in the region, it is imperative to integrate robust climate resilience measures into the design, construction, and operational phases of the project. If left unaddressed, climate related disruptions such as intensified precipitation, rising temperatures, sea level encroachment, and greenhouse gas (GHG) emissions could compromise agro-processing activities, reduce crop yields, elevate maintenance costs, and threaten the long-term viability of the Hub. In addition, local deforestation, biomass combustion also contributes to localized GHG emissions and air quality degradation.

This Climate Change Management Plan (CCMP) outlines proactive strategies framework for mitigation, adaptation, monitoring and evaluation, and institutional capacity building in line with Nigeria's Nationally Determined Contributions (NDCs), the National Adaptation Plan (NAP), and global frameworks such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs). Through this plan, the Agro-Industrial Hub in Adiabo is envisioned not only centre for economic transformation, but also as a model for climate resilient, community-driven development in the Niger Delta and beyond.

Aim of CCMP

The primary aim of this plan is to:

Ensure that the Agro-Industrial Hub in Adiabo becomes a climate-resilient economic catalyst balancing industrial growth with environmental stewardship, and serving as a replicable model for low-carbon, climate smart development to areas with similar ecological zones.

Objectives OF CCMP

The objectives of the CCMP are to:

- To mainstream climate risk analysis and adaptation planning across all stages of project design, development, construction, and operational management.
- To identify, reduce, and monitor greenhouse gas (GHG) emissions associated with construction activities, agro-processing operation, land use changes and energy consumption.
- Build climate resilience into infrastructure, agricultural inputs, water systems, and supply chains, ensuring continuity and resilience under future climate scenarios
- To align project implementation with Nigeria's national climate strategies, including the NDCs and the Roadmap to Net-Zero (2050–2070), while contributing to international climate targets.
- To promote sustainable land management practices, reduce deforestation, and improve local air quality through low-emission technologies and regenerative environmental actions.
- To establish robust monitoring and evaluation systems for tracking climate impacts, policy effectiveness, and adaptive progress over time.

Climate Risk Assessment Summary

The proposed Agro-Industrial Hub (AIH) in Adiabo, Odukpani LGA, Cross River State, lies within the humid tropics of southern Nigeria. Based on meteorological baseline data sourced from climate records, the project area experiences the following climatic parameters:

- Annual Rainfall: Approximately 3,134 mm
- Mean Daily Temperature: 27.4 °C, with an annual mean of 25.46 ± 2.7°C
- Relative Humidity: Peaks at 79.4%

Average Wind Speed: Ranges from 0.40 to 1.50 m/s. These figures confirm the presence of a tropical monsoon (Am) climate under the Köppen-Geiger classification. Such climatic conditions present significant implications for the project's design, construction, and operational phases.

Key Climate-Related Risks and Implications

- **High rainfall and Flood Susceptibility:** The substantial annual rainfall and seasonal intensity heighten the risk of flash floods and waterlogging, particularly in low-lying areas of the project site. Uncontrolled runoff could damage infrastructure, disrupt operations, and increase sedimentation in surrounding ecosystems. Heat stress and Worker Safety: Ambient temperatures exceeding 38°C could impact worker health, energy demand, and equipment performance.
- **Greenhouse Gas Emissions (GHG):** The projected use of diesel-powered generators, agro-processing machinery, and transport logistics is estimated to produce cumulative GHG emissions of approximately: 321.60 tonnes CO_2e, equivalent to 164,082 m^3 of emissions annually (based on Tier 1 IPCC default emission factors for diesel combustion). This emission profile contributes directly to climate change and will require mitigation through energy efficiency measures and renewable alternatives. Agricultural Vulnerability: Rising temperatures, high humidity, and prolonged wet seasons can increased pest and disease outbreaks that may reduce productivity in agricultural inputs.

Climate Change Mitigation Measures

To support a resilient, sustainable, and low-carbon AIH in Adiabo, CR-SAPZ/DBOC will implement an integrated CCMP). Aligned with national and international standards, the plan ensures climate responsiveness, emissions reduction, and environmental stewardship across all project phases.

Energy Efficiency and Low-carbon Technology

- **Renewable Energy Integration:** Install solar photovoltaic (PV) systems for administrative buildings and perimeter lighting. This will reduce dependence on fossil fuels and stabilize energy costs. Introduce a phased rollout of hybrid solar-diesel will be adopted to ensure smooth transition from conventional diesel-based energy systems. The long-term goal is to fully decommission diesel reliance within five years of operation.

- **Energy-efficient Buildings:**

▪ All new buildings shall be constructed in line with green building standards. Passive ventilation designs will be complemented with high-albedo reflective roofing and thermal insulation materials to cut down cooling demand by up to 30%.
▪ Install energy management systems including motion-sensor LED lighting and programmable smart meters to monitor, track, and optimize energy consumption patterns in real time.

Sustainable Transport and Logistics

▪ CR-SAPZ/DBOC shall exclusively prioritize low-emission vehicles for inter-facility transport. This decision is intended to cut direct transportation emissions and reduce operational costs linked to fuel usage.
▪ Encourage the use of biofuels- compatible transporters or electric forklifts within the processing zone and storage areas, replacing internal combustion engine models with more climate-conscious alternatives. .

- Establish a centralized logistics hub to facilitate cargo consolidation, route optimization and scheduling. This will significantly reduce truck movements, idling time and associated GHG emissions.

GHG Inventory and Reduction Strategy

- CR-SAPZ/DBOC shall baseline greenhouse gas inventory during mobilization using IPCC 2006-Guidelines and national templates. The inventory will cover Scope 1 (on-site fuel combustion), Scope 2 (electricity), and Scope 3 (indirect emissions).
- CR-SAPZ shall commit to achieving a 10–20% reduction in emissions intensity over the first five years of operations through continuous improvement in energy efficiency, process optimization, and material selection. To address residual and unavoidable emissions the project will implement carbon sink initiatives (Ecosystem-based Adaptation) that is localized offset schemes such as agroforestry expansion and wetlands preservation, which serve as natural carbon sinks.

Climate Change Adaptation Measures

Infrastructure Resilience

- CR-SAPZ/DBOC shall elevate essential facilities above 100-year floodplain levels using reinforced foundations and geotechnical stabilization.
- Build climate-smart drainage infrastructure such as oversized culverts, sediment traps, and bioswales to handle extreme rainfall and minimize flood risk.
- Integrate redundant water supply systems (e.g., boreholes, rainwater harvesting tanks, and emergency storage reservoirs) to ensure continuous availability of potable and process water.

Ecosystem-based Adaptation

- Establish and maintain natural buffer zones measuring 10–30 meters along riparian corridors and erosion-prone slopes. These zones will be stabilized with deep-rooted vegetation to prevent run-off and sedimentation.
- Undertake a structured afforestation activities using a blend of indigenous, drought and flood-tolerant tree species., such *as Gmelina arborea (Gmelina), Terminalia catappa (Tropical almond), Acacia mangium* (Black wattle).
- Introduce agroforestry and integrated land management in farming operations such as combining trees, crops, and livestock in synergistic spatial arrangements to enhance carbon sequestration and reduce erosion.

Water Resource Management

- Promote rainwater harvesting system with rooftop collection systems exceeding 50 square meters and storage tanks. Harvested water will be used for cleaning, irrigation, and non-potable industrial applications.
- Install drip irrigation infrastructure over traditional flooding or sprinkler systems for on-site agricultural components to minimize water loss and enhance yield-per-drop for field crops and horticulture.
- Use automated soil moisture sensors coupled with irrigation control valves on all demonstrated farms to monitor and minimize over-irrigation, also to optimize water usage.

Climate-Smart Agriculture (CSA)

- Collaborate with research institutions to test improved climate-resilient crop varieties
- Implement Integrated Pest Management (IPM) strategies to reduce chemical use to shifting climate regimes and ecological dynamics. Biological controls, pheromone traps, and organic foliar sprays will be introduced progressively.
- Organize and rain smallholder farmers quarterly on climate-smart agronomic practices including minimum tillage, organic mulching, contour farming and cover cropping.

Capacity Building and Policy Integration

Governance Framework

CR SAZP shall appoint a qualified Climate and Sustainability Officer to ensure the delivery, monitoring, and continuous improvement of CCMP strategies. Integrate CCMP into the Environmental and Social Management System (ESMS) protocols, and all procurement policies to ensure adherence across the project value chain.

Training and Awareness

- Conduct semi-annually capacity-building workshops for the stakeholders including project staff, local government representatives, and farmer groups on climate risk, adaptation, and GHG. Each session will include participatory risk mapping, scenario modelling, and GHG literacy.
- Customized toolkits will be developed and distributed, containing infographics, climate alerts, and behavioural guidance in both English and relevant local dialects to ensure inclusive knowledge dissemination.

Monitoring, Reporting and Evaluation (MRE)

To ensure the effectiveness and accountability of the CCMP, a MRE framework has been established. This framework is designed to track progress, measure impact, and ensure alignment with both national and international policy directives.

The MRE strategy incorporates clearly defined indicators, measurable targets, responsible units, and standardized tools. It is structured to support adaptive management, improve transparency, and inform decision-making at the local and state levels. The plan will undergo periodic reviews to integrate new scientific data, policy changes, and stakeholder feedback.

Indicators and Performance Metrics

Indicator	Target	Frequency	Responsible Unit
% reduction in GHG emissions (Scope 1 & 2)	10% over 5 years (Baseline 2024)	Annually	Climate Change Officer
Number of renewable energy systems installed such as Solar, biomass.	Minimum 3 systems by 2027	Biannually	Engineering and Energy Transition Team

Indicator	Target	Frequency	Responsible Unit
% of total renewable energy consumption from clean sources	At least 0% by 2027	Annually	Utility Supervisor
Area of land preserved (ha) + Number of trees to be planted.	36 hectares preserved, 1,098 stands to be planted	Biannually	E&S Unit
Climate adaptation compliance rating (Composite index)	≥ 90% compliance with planned adaptation actions	Annual audit (via 3rd-party audit)	External Auditor
Number of climate resilience workshops held	≥2 workshops per year	Semi-annually	Capacity Building & Training Desk
% of critical infrastructure climate-risk assessed	100% of key assets	Annual review	Infrastructure Resilience Committee

Tools and Mechanisms

- GHG Inventory Tool: Adopt standardized African Development Bank (AfDB) and Intergovernmental Panel on Climate Change (IPCC) spreadsheet calculators tools to track emissions from energy use, waste, and transport
- Climate Risk Index: Create a geo-coded local index to assess exposure, sensitivity, and adaptive capacity at the community level, using variables such as elevation, rainfall variability, and land use. and track vulnerability.
- Early Warning Systems: Collaborate with the Nigeria Meteorological Agency (NiMet) and National Emergency Management Agency (NEMA) to disseminate location-specific alerts for extreme weather events such as floods, droughts, and other related climate issues.
- Annual Climate Scorecard: Publish a performance dashboard showing progress across key indicators, shared with local communities and development partners to promote transparency.

Conclusion

The CCMP for the proposed AIH in Adiabo represents a decisive step toward embedding climate resilience, sustainability, and low-carbon development into Nigeria's agricultural industrialization agenda. By aligning with national priorities, this plan positions the Adiabo Hub not only as an economic driver but as a benchmark for climate-smart development across similar ecological zones. Through targeted mitigation measures, such as renewable energy deployment, energy-efficient infrastructure, sustainable logistics, and greenhouse gas (GHG) reduction strategies, the project will significantly curb its environmental footprint. Simultaneously, robust adaptation frameworks, including ecosystem-based interventions, water resource optimization, and climate-smart agricultural practices, will safeguard livelihoods, protect biodiversity, and ensure operational continuity under future climate conditions.

Institutional mechanisms, including continuous capacity building, integrated governance, stakeholder engagement, and a transparent monitoring, reporting, and evaluation framework, will ensure that climate action remains accountable, adaptive, and inclusive throughout the project lifecycle.

H. Cultural Heritage Management Plan (CHMP)

The Agro-Industrial Hubs (AIHs) at Adiabo, Odukpani Local Government Area in Cross Rivers State under the Cross River Special Agricultural Processing Zones (CR-SAPZ) program designed to stimulate agricultural processing, value addition, and rural economic growth. However, large-scale land-based projects like this carry the risk of adverse impacts on tangible and intangible cultural heritage resources, which are essential to community identity, spiritual well-being, and social cohesion. The CHMP provides a structured approach to:

- Identify, evaluate, and document cultural heritage within the Project Area of Influence (PAI).
- Mitigate potential impacts from land acquisition, site clearing, infrastructure construction, and project operations.
- Engage meaningfully with stakeholders, including custodians of cultural knowledge and spiritual leaders.
- Establish operational procedures, particularly for "chance finds" of archaeological, historical, or sacred significance.
- Integrate respect for cultural heritage into project design, workforce conduct, and community relations.

The CHMP complements the ESIA findings and ensures compliance with AfDB Operational Safeguard 8 (Cultural Heritage), Nigerian legal requirements, and global best practices.

Objectives of the CHMP

This CHMP seeks to:

1. **Preserve Tangible Heritage:** Prevent damage, destruction, or loss of physical cultural resources such as shrines, burial sites, sacred groves, artifacts, and monuments within the project area.
2. **Respect Intangible Heritage:** Protect spiritual practices, oral traditions, festivals, traditional knowledge systems, and community rituals integral to local identity.
3. **Promote Informed Consent:** Ensure free, prior, and informed consultations with affected communities regarding cultural heritage risks and mitigation options.
4. **Establish Robust Procedures:** Implement field-ready Chance Finds Protocols to safeguard cultural resources discovered unexpectedly during project activities.
5. **Foster Sustainable Coexistence:** Encourage community participation in heritage management while enabling the project to proceed responsibly.
6. **Comply with Regulatory Standards:** Fulfil obligations under Nigerian law, AfDB safeguards, and international conventions on cultural heritage protection.

Legal And Policy Framework

The CHMP is developed in accordance with:

Nigerian Legal Provisions

- **National Commission for Museums and Monuments (NCMM) Act, CAP N19 LFN 2004:** Establishes legal protection for antiquities, historical sites, and cultural property. Mandates NCMM oversight for significant cultural resources.
- **Nigerian Constitution (1999, as amended):** Guarantees the protection of cultural rights, including the right to enjoy, develop, and preserve cultural heritage.

- **Land Use Act (CAP L5, LFN 2004):** Regulates land acquisition, acknowledging customary ownership and traditional land uses, which may be linked to cultural heritage.
- **State and Local Government Regulations:** Cross River State and Odukpani LGA traditional leadership structures play a central role in identifying, protecting, and managing community heritage.

International Standards

- **AfDB Operational Safeguard 8 (OS8-Cultural Heritage):** Requires clients to avoid or minimize impacts on cultural heritage and engage with communities, ensuring respect for spiritual, cultural, and historical values.
- **UNESCO Convention for the Protection of the World Cultural and Natural Heritage (1972):** Promotes safeguarding globally and nationally significant cultural resources.
- **ILO Convention 169 (Indigenous and Tribal Peoples, where applicable):** Provides for cultural rights and protection of indigenous heritage, though Nigeria has not ratified this, its principles guide best practice.
- **United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP):** Recognizes rights to cultural identity, heritage preservation, and participation in heritage-related decisions.

Cultural Heritage Context of the Project Area

Cross River State is renowned for its rich, diverse cultural heritage, including:

- **Tangible Heritage:**
  - Sacred forests and groves associated with deities or ancestral spirits.
  - Shrines, altars, and religious structures.
  - Burial sites and ancestral graveyards.
  - Historic landmarks, artefacts, and objects of archaeological value.
- **Intangible Heritage:**
  - Traditional festivals, rites of passage, and spiritual ceremonies.
  - Oral histories and folklore passed through generations.
  - Indigenous knowledge systems related to agriculture, ecology, and health.
  - Traditional authority structures, such as councils of elders and cultural custodians.

Preliminary consultations with community leaders and the ESIA scoping process indicate:

- Local communities observe strict cultural protocols regarding sacred sites such as Efe Ekpe.
- There are likely undocumented cultural resources within or near the project footprint.
- Festivals and religious events can influence project schedules due to community participation.

Cultural Heritage Management Measures

Baseline Identification and Documentation

The assessment of the cultural heritage of the project area shows that:

- The cultural heritage of the study communities is linked to language, dress and food, festivals and dances.
- The communities have various similarities in the way they dress, foods they eat and ways they conduct their marriages.
- Indigenous languages spoken in the communities are some of their cultural heritages.

- Among all the communities, land is considered a major socio-cultural asset and a heritage that must be bequeathed to succeeding generations.
- The communities have deities, shrines and sacred places which they have maintained, for example, the Efe Ekpe. These deities, shrines, sacred places and traditional worship are important aspects of the people's cultural heritage.

Avoidance, Protection, and Buffer Zones

- Design project layout to avoid physical disturbance of identified cultural heritage resources.
- Where avoidance is impossible, implement protective buffers (e.g., fencing, signage, no-go zones) as agreed with communities.
- Respect traditional access routes and practices associated with sacred sites.
- Seek NCMM and community approval for any necessary relocation or modification of cultural features (only as a last resort).

Chance Finds Procedure

If unexpected cultural heritage is discovered during excavation, earthworks, or other activities:

1. **Immediate Action:**
   - Suspend work in the discovery area.
   - Secure the site to prevent damage or unauthorized access.
2. **Notification:**
   - Inform CR-SAPZ management, cultural monitors, NCMM, and local authorities.
3. **Assessment:**
   - Qualified cultural heritage experts assess the find's significance.
4. **Decision-Making:**
   - Determine appropriate actions (preservation, relocation, further study) in consultation with stakeholders.
5. **Documentation:**
   - Record the find, including photographs, descriptions, GPS coordinates.
6. **Work Resumption:**
   - Resume activities only after formal clearance by authorities and cultural leaders.

Community Engagement and Participation

- Establish continuous dialogue with host communities regarding cultural heritage management.
- Form a Cultural Heritage Committee with representatives from:
  - Traditional authorities and custodians.
  - Youth, women, and vulnerable groups.
  - CR-SAPZ community liaison officers.
- Consult on all heritage-related decisions, including avoidance measures, access restrictions, and potential relocation of cultural features.
- Provide feedback on project activities and incorporate cultural knowledge into project operations where appropriate.

Intangible Heritage Promotion

- Avoid scheduling construction or disruptive activities during key community festivals or spiritual events.

- Encourage workers and contractors to respect local customs, attire, language, and spiritual practices.
- Explore opportunities to support cultural revitalization, such as documenting oral traditions or sponsoring community heritage initiatives.

Roles And Responsibilities

Stakeholder	Responsibilities
CR-SAPZ Management	Overall CHMP oversight, resource allocation, regulatory compliance
Contractors/Subcontractors	Implement Chance Finds Protocols, comply with cultural protection measures
Community Relations Team	Facilitate consultations, maintain cultural respect among workforce
NCMM and State Heritage Agencies	Provide technical guidance, legal oversight, and approvals
Community Cultural Leaders	Identify cultural resources, guide protection measures, and mediate decisions

Monitoring, Evaluation, And Reporting

Monitoring Activities

- Routine inspections of known heritage sites to ensure protection measures remain effective.
- Regular workforce briefings on cultural sensitivity and respect protocols.
- Inclusion of cultural heritage indicators in broader environmental and social monitoring frameworks.

Evaluation

- Mid-project and end-of-phase audits to assess:
    - Effectiveness of avoidance and protection measures.
    - Implementation of Chance Finds Procedures.
    - Community satisfaction with heritage management efforts.

Reporting

- Monthly internal reports detailing:
    - Heritage incidents or grievances.
    - Community consultations conducted.
    - Heritage-related training sessions.
- Formal notifications to NCMM and stakeholders in case of significant discoveries or incidents.

Grievance Redress for Cultural Heritage Issues

- Dedicated grievance channels for cultural heritage concerns, accessible to all community members.
- Confidential reporting options to encourage open feedback.
- Grievance resolution process:
    - Acknowledgement of receipt within 3 days.
    - Investigation and community dialogue within 14 days.
    - Resolution communicated promptly to complainants.
- Escalation mechanisms for unresolved grievances, involving traditional leaders, CR-SAPZ management, and authorities.

Capacity Building and Training

- Mandatory cultural sensitivity training for all project staff and contractors.
- Specialized sessions for field workers on recognizing cultural resources and respecting community customs.
- Inclusion of community representatives in training where relevant.
- Continuous learning approach, with refresher courses and updated protocols based on evolving project context.

Conclusion

The AIH project acknowledges the fundamental importance of preserving cultural heritage for the well-being of host communities. Through this CHMP, the project commits to:

- Safeguarding both tangible and intangible cultural resources.
- Promoting respectful engagement with cultural leaders and custodians.
- Aligning with legal requirements, AfDB OS8, and global best practice.
- Fostering sustainable coexistence between development objectives and cultural heritage preservation.

I. Livelihood Restoration and Enhancement Plan (LREP)

The Agro-Industrial Hub (AIH) project at Adiabo, Odukpani LGA is designed to drive agricultural processing, job creation, and rural economic development under the Special Agro-Industrial Processing Zones (SAPZ) programme. The AIH is expected to generate long-term benefits, however, land acquisition and construction may temporarily or permanently affect the livelihoods of individuals and households in the project area. This Livelihood Restoration and Enhancement Plan (LR&EP) is designed to ensure that project-affected persons (PAPs), particularly those whose livelihoods are adversely impacted by land acquisition and other project activities associated with the development of the AIH, are supported to restore or improve their livelihoods and standards of living.

Objectives of the LREP

This LREP is prepared to meet the following objectives:

- To restore affected livelihoods to pre-project levels or better.
- To enhance income-generation opportunities for host communities.
- To provide targeted support to vulnerable groups.
- To improve the resilience and adaptive capacity of affected households.
- To ensure sustainable livelihood development aligned with the SAPZ's agro-industrial focus.
- To facilitate inclusive economic participation and social cohesion
- To align with lender standards (AfDB ISS) and Nigerian legal framework.
- To integrate sustainable development goals (SDGs 1, 2, 5, and 8).

Project Context and Scope of Impact

- **Project Location:** Adiabo, Odupani LGA, Cross River State
- **Land Requirement:** Approximately 130 hectares for AIH infrastructure
- **Potential Impacts:** Displacement of farmlands, economic trees, informal businesses, fishing zones, and temporary employment loss

- **Primary Livelihoods Affected:** Subsistence farming, fishing, trading, and informal artisanal activities

Legal and Policy Framework

The LR&EP is developed in compliance with:

- Nigerian Land Use Act (1978)
- AfDB OS5 – Involuntary Resettlement
- SAPZ Programme Implementation Manual

Socioeconomic Baseline

Affected Communities:

- Adiabo Ikot Mbo Otu
- Adiabo Esine Ufot
- Other contiguous villages

Livelihood Sources:

- Rain-fed farming on cassava, yam, maize, vegetables, plantain, bananas, oil palm etc.
- Majority of the PAPs are subsistence or small-scale farmers
- Some engage in artisanal processing.
- Fishing and aquaculture
- Sand mining and sales
- Small-scale palm oil processing
- Petty trading and local crafts
- Artisanal works
- Civil/public service employment
- High dependence on natural resources, low access to credit, and limited mechanization

Vulnerable Groups:

- Female-headed households
- Unemployed Youths and elderly without income
- Households with no land titles
- People living with disabilities.

Livelihood Restoration Strategies

Land-Based Livelihood Restoration

- Provision of alternative farmland (where feasible)
- Provision of access to irrigation schemes.
- Soil improvement assistance (organic composting, fertilizers).
- Capacity in climate-smart agriculture and regenerative practices
- Establishment of demonstration farms and cooperative farming models.
- Formation of farmer cooperatives
- Development and integration of farmers into out-grower schemes to provide raw materials to the AIH

Livelihood Impacts from The AIH Project

Impact Type	Description
Land Take	Loss of farmland and economic crops
Restriction of Access	Disruption to fishing areas, forest resources, and cultural sites
Employment Disruption	Interruption of trading and informal sector employment
Disruption of fishing activities	Encroachment on fishing zones near project area
Loss of income	From farming, fishing, and micro-enterprises
Loss of access	To forest resources and seasonal harvest areas
Temporary job displacement	During land preparation and civil works

Livelihood Assessment Matrix

Livelihood Type	**No. of Affected HHs**	**Key Vulnerabilities**	**Restoration Measures**	**Enhancement Measures**
Rainfed Farming	500	Loss of land and produce	Land-for-land, inputs, extension services	Outgrower schemes, Agro-industrial processing clusters
Fishing	115	Equipment loss, access blocked	Replacement boats/nets, aquaculture training	Cold chain, fish marketing cooperatives
Petty Trading	60	Income shock, market loss	Business kits, financial literacy	Linkages to AIH canteens, retail supply chains
Artisanship	25	Loss of customer base	Toolkits, marketing skills	In-hub service contracts (carpentry, welding, repairs)
Youth (unemployed)	80	Lack of skills, job access	Apprenticeship, vocational training	Digital marketing, e-commerce for agro-products
Women (cross-cutting)	180	Financial exclusion, labor load	Formation of women's groups, access to credit	Gender-responsive agribusiness training

Fisheries and Aquaculture Livelihood Support

- Provision of fishponds and fingerlings.
- Training on aquaculture (e.g., catfish farming) fish feed formulation and disease management.
- Provision of fishing nets, boats, etc.
- Training in aquaculture (e.g., catfish farming) aligned with the hub's agro-industrial value chains
- Provision of cold storage and market access support.

Agricultural Input Support

- Subsidized seed distribution (maize, cassava, yam, rice, etc.).
- Provision of tools and farming equipment.
- Linkages with agro-dealers and extension officers.

Skills Development and Vocational Training

- Training in agri-business, poultry, piggery, aquaculture, and food processing etc.
- Short-term vocational training in tailoring, welding, carpentry, mechanics, and solar installation.
- Entrepreneurship development for youth and women.
- Apprenticeship placement and certification
- Employment facilitation in AIH construction and operations

Financial Support and Microcredit

- Start-up capital support or revolving loan schemes.
- Partnerships with microfinance institutions (MFIs) and cooperatives.
- Access to financial literacy programs.

Support for Small and Medium Enterprises (SMEs)

- Business advisory services for traders and service providers.
- Inclusion in AIH value chain contracts (transport, supply, catering).
- Micro-grants and business start-up kits
- Training in business management, value addition, and financial literacy
- Linkages to AIH markets and supply chains

Gender and Youth Mainstreaming

- Targeted training for women on agribusiness and cooperative formation.
- Provision of childcare support during capacity building sessions.
- Youth incubation programs linked to the AIH.

Employment Opportunities

- Prioritization of PAPs in AIH job recruitment
- Labour-intensive public works (roadside planting, community sanitation) for transitional support

Special Measures for Vulnerable Groups

- Targeted support for women, female-headed households, youth, and persons with disabilities
- Tailored livelihood packages (e.g., home-based processing, tailoring, etc.)
- Formation of women's cooperatives and youth agribusiness groups

Vulnerable Groups Support Strategy

- **Tailored Support:** Home-based enterprises, flexible training schedules
- **Dedicated Quotas:** In all training and financial programs

- **Support Services:** Childcare provisions, psychosocial counselling
- **Monitoring:** Gender- and vulnerability-sensitive M&E framework

Livelihood Enhancement Initiatives

- Community resource centres for information, training, and ICT use.
- Agro-industrial processing cooperatives and women-led market linkages.
- Out grower schemes and guaranteed off-take arrangements.
- Renewable energy support (solar dryers, solar water pumps).
- Public-private partnerships for agricultural mechanization.

Implementation Framework

Stakeholder	Role
Cross River State Government	Policy oversight, land administration, budget support
AIH Project Implementers	Execution, monitoring, and reporting
Community-Based Organizations	Mobilization, grievance redress, feedback loops
NGOs and CSOs	Technical support, capacity building, independent monitoring
Odukpani LGA	Coordination, local logistics, youth and women engagement

Monitoring and Evaluation Framework

Indicator	Target	Frequency
% of households with restored farmland	100% of displaced farming households	Quarterly
Number of individuals trained	500+ in Year 1	Biannual
Number of new micro-enterprises supported	At least 200 within first 2 years	Annual
% of income restored (compared to baseline)	100% within 18 months	Biannual
Number of women/youths trained	Minimum 40% of total beneficiaries	Quarterly

Risks And Mitigation Measures

Risk	Mitigation Measure	Risk Rating
Inadequate funding or delays	Secure lender funds and include LREP in main project budget	High
Lack of community participation	Continuous sensitization and local partnership	Medium

Elite capture of benefits	Transparent selection criteria, independent monitoring	High
Gender-based exclusion	Gender-specific programming and quotas	Medium
Sustainability of enterprises	Mentorship, market linkages, business training	Medium

Grievance Redress Mechanism (GRM)

- Multi-tier GRM at village, LGA, and project levels.
- Complaints register at community centres and local government offices.
- Independent oversight by civil society organizations.
- Toll-free line and grievance response team.