



DELTA SPECIAL ECONOMIC ZONES (Free Trade Zone)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE PROPOSED DELTA STATE SPECIAL AGRO PROCESSING ZONE (SAPZ), KWALE, NDOKWA WEST LGA AND ASSOCIATED FACILITIES



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LIST OF ABBREVIATIONS & ACRONYMS

µg/m³- microgram / cubic meter

ACI- American Concrete Institute

ACs - Aggregation Centers

ADI- Area of Direct Influence

AfDB - African Development Bank

AIDS- Acquired Immune Deficiency Syndrome

AII - Area of Indirect Influence

AISC- American Institute of Steel Construction

ALARP- As Low As Reasonably Practicable

ANSI- American National Standards Institute

AoA - Agreement on Agriculture

AOI - Area of Influence

APCC ???

API- America Petroleum Institute

APWH ???

ARAP- Abbreviated Resettlement Action Plan

ASHRAE- American Society of Heating, Refrigeration and Air Conditioning Engineers

ASME- American Society of Mechanical Engineers

ASTM- American Society for Testing and Materials

ATASP- 1- Agricultural Transformation Agenda Support Program Phase 1

ATCs - Agricultural Transformation Centers

ATR - African Traditional Religion

AWPA- America Wood Preservers

AWS- American Welding Society

AWWA- American Water Works Association

BCG-Bacille Calmette-Guerin

BOD- Biochemical Oxygen Demand

BS- British Standards

BSCs- Biological Safety Cabinets

CBD- Convention on Biological Diversity

CCTV- Closed Circuit Television

CCSR ???

C-ESMP- Contractors - Environmental and Social Management Plan

CFCs - Chlorofluorocarbons

CFR- Code of Federal Regulations
CH₄- Methane
CIFOR- Center for International Forestry Research
CITES- Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLO- Community Liaison Officer
Cm- Centimeter
CMAA- Crane Manufacturers Association of America
CO₂- Carbon dioxide
CoC ???
COD-Chemical Oxygen Demand
CR - Critically Endangered
CSO-Civil Society Organizations
dB- decibel
DBH-Diameter at Breast Height
DO- Dissolved Oxygen
DPT- Diphtheria-Pertussis-Tetanus Vaccine
DS- Derived Savanna
DSEPA- Delta State Environmental Protection Agency
DSMEnv. - Delta State Ministry of Environment
DSMANR- Delta State Ministry of Agriculture and Natural Resources
DSMH - Delta State Ministry of Health
DSMLSHUP- Delta State Ministry of Land Survey Housing and Urban Planning
DSMT - Delta State Ministry of Transport
DSWMB-Delta State Waste Management Board
DTC - Direct Town Cleaning
E- East
E&S- Environmental and Social
EC - Electrical Conductivity
EIA - Environmental Impact Assessment
EMP- Environmental Management Plan
EMS- Environmental Management Systems
EMSP- Environmental Management Support Programme
EPC- Engineering, Procurement and Construction
ESA - Environmental and Social Assessments
ESAPs - Environmental and Social Assessment Procedures

ESIA - Environmental and Social Impact Assessment
ESM- Environmental and Social Management
ESMF- Environmental and Social Management Framework
ESMP - Environmental and Social Management Plan
ESMS- Environmental and Social Management System
EWPs- Elevating Work Platforms
F- Female
FAO- Food and Agriculture Organization of the United Nations
FEPA- Federal Environmental Protection Agency
FGDs- Focus Group Discussions
FGM- Female Genital Mutilation
FGN - Federal Government of Nigeria
FI- Financial Intermediaries
FMARD - Federal Ministry of Agriculture and Rural Development
FMEv.- Federal Ministry of Environment
FRAP- Full Resettlement Action Plan
ft- feet
G- Grams
GDP- Gross Domestic Product
GEMIS- Global Emission Model of Integrated Systems
GHGs- Green House Gases
GRE- Glass Reinforced Epoxy
GSM- Global System for Mobile Communication
GW- Groundwater
HBFCs- Halogenated Hydro Bromo Fluorocarbons
HC- Hydrocarbon
HEI- Heat Exchange Institute
HIV - Human Immunodeficiency Virus
HS- Health and Safety
HSE- Health, Safety, and Environment
HSTP ???
HUB- Hydrocarbon Utilizing Bacteria
HUF- Hydrocarbon Utilizing Fungi
IBC- International Building Code
IEC- International Electro-technical Commission

IEEE- Institute of Electrical and Electronics Engineers
IESIA - Integrated Environmental and Social Impact Assessment
IFAD- International Fund for Agricultural Development
IFC- International Finance Corporation
IPPC - International Plant Protection Convention
IRC- International Rice Commission
ISA- Institute Society of America
ISO - International Organization for Standardization
ISQG- Australian Interim Sediment Quality Guideline FGDs-
ISS - Integrated Safeguards Systems
ISTS- Integrated Safeguards Tracking System
IT - Information Technology
ITU-R - International Telecommunication Union - Radio Sector
ITU-T- International Telecommunication Union - Telecommunication Sector
IUCN- International Union for Conservation of Nature
JCB ???
JIT - 'Just in time principles'
Kg- kilogram
KII- Key Informant Interviews
KIP- Kwale Industrial Park
KLD - Kilo Litre per Day
Km- kilometer
Kv- Kilovolt
KVA- kilovolt-ampere
LAN - Local Area Network
LC- Least Concern
LCD- Liquid Crystal Display
LFN- Laws of the Federation of Nigeria
LRF- Livelihood Restoration Framework
LRP- Livelihood Restoration Plan
M - Moisture content
M- metre
m²- Square metre
m³/h- cubic metres per hour
MCNL- Mifor Consult Nigeria Limited

MET- Meteorology
mg/kg- Milligrams per kilogram
mg/l- milligram per litre
MGW - **M**egawatt
mm- millimeter
MoU- memorandum of understanding
MT- **M**etric tons
MTCO₂- **M**etric tons of CO₂
N- North
N₂O- nitrous oxide
NACE- National Association of Corrosion Engineers
NAFDAC- National Agency for Food and Drug Administration and Control
NAIC- Nigerian Agricultural Insurance Corporation
NALDA- National Agricultural Land Development Authority
NBC- Nigerian Building Code
NBS- National Bureau of Statistics
NCOs ??
ND - Not Detected
NE- **N**ot **E**valuated
NEC- National Electrical Code
NEEDS- National Economic Empowerment and Development Strategy
NEMA- National Electrical Manufacturer's Association
NE-**N**orth-**E**ast
NEPZA- Nigeria Export Processing Zone Authority
NERC- Nigeria Electricity Regulatory Commission
NESC- National Electric Safety Code
NFPA- National Fire Protection Association
NGO- Non-governmental Organizations
NH₃ . Ammonia
NIDs- National Immunization **D**ays
NIS ???
NNBC- Nigeria National Building Code
NO₂- Nitrogen Dioxide
NOSDRA- National Oil Spill Detection and Response Agency
NQ- **N**oise **Q**uality

NT- Near Threatened
NW-North-West
OB3- Obiafu-Obriskom-Oben Gas Pipeline
OHS- Occupational Health and Safety
OPV- Oral Polio Vaccine
OS- Operational Safeguards
OSHA- Occupational Safety and Health Administration
OVC- Orphans and Vulnerable Children
PACs- Project Affected Communities
PAGA- Public Address and General Alarm System
PAPs- Project Affected Persons
PBX- Private Branch Exchange
PCI- Precast Concrete Institute
PEA - Public EA Agency
PFIC - Prior, Free, Informed and Consented
PHC- Primary Health Centre
PHCN- Power Holding Company of Nigeria
PIE- Project Implementation Entity
PIU - Project Implementation Unit
PM- particulate matter
PPAS- Plan, Policy, Analysis & Statistics
PPE- Personal Protective Equipment
Ppm- Parts per million
PSD- Particle Size Distribution
PVC- Polyvinyl Chloride
QHSE- Quality, Health, Safety & Environment
RAAMP- Rural Access and Agricultural Marketing Project
RAP - Resettlement Action Plan
S - Silt
SAPZs - Special Agro-Industrial Processing Zones
SCEG- South Carolina Electric and Gas
SD- Sediment
SF - Secondary Forest
SHE-Safety, Health & Environment
SHME ???

SIEP- Senior Intelligence Executive Professional
SJI- Steel Joist Institute
SNSC- Safeguards and Compliance Department
SO₂- Sulfur dioxide
SoI- Sphere of Influence
SON- Standard Organization of Nigeria
SP- Sampling Point
SPM- Suspended Particulate Matter
SS- Soil Sample
SSPC- Steel Structures Painting Council
SSS - Social Safeguards Specialist
STDs- Sexually Transmitted Diseases
STIs- Sexually Transmissible Infections
SW- South-West
SW- Surface Water
TDS- Total Dissolved Solids
THB- Total Heterotrophic Bacteria
TEIH ???
THC - Environmental Management Plan
THF- Total Heterotrophic Fungi
ToR - Terms of Reference
TPM- Total Particulate Matter
TSS-Total Suspended Solids
UBC- Uniform Building Code
UHF - Ultra -High Frequency
UPVC- Unplasticized Polyvinyl Chloride
USA- United States of America
USEPA- United State Environmental Protection Agency
VCT - Vinyl Composition Tile
VG- Vegetation
VHF - Very High Frequency
VSAT - Very Small Aperture Terminal
VU - Vulnerable
WAN- Wide Area Network
WASD- Women Affairs and Social Development

WBS - Works Breakdown Structure

WBS- World Bank Standards

WC- Water Closet

WHO- World Health Organization

WTO- World Trade Organization

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EXECUTIVE SUMMARY

ES 1 Overview of the project

Delta State Special Economic Zones is the project proponent. The Zone is tasked with the responsibility of all agricultural export activities in the state and has the mandate, along with the State Ministry of Agriculture, to facilitate the production, processing and export of sufficient food for the teeming population of the state through direct assistance to farmers in the area of agricultural mechanization. The project involves establishment of the Delta SAPZ cluster in Kwale, Ndokwa West Local Government Area, and associated infrastructures across all federal constituencies of Delta State with Agro produce processing, storage, quality assurance laboratory and cold chain services as core business activities. The project, expected to last for fifty (50) years is centred on 5.71586N, 6.39506E; 5.68537N, 6.39575E; 5.68495N, 6.35413E; 5.71600N, 6.36089E and can be accessed via the Asaba-Ughelli-Warri expressway. The project aims to offer a state-of-the-art infrastructures and services comparable with International Best Practices. The Associated infrastructures hereafter referred to as Agricultural Transformation centres (ATCs) and Aggregation Centres (ACs) will aggregate the raw materials from the proximate communities to feed the Kwale processing hub. CBN-Anchor borrower's farms and locations in Uwheru community (Delta Central), Uzere community (Delta South), Ugbodu community (Aniocha North and South/Oshimili North and South), Umunede community (Ika North East/Ika South), Susakamsusa of Amai and Umuebu communities (Ndokwa East, Ndokwa West/Ukwuani), Otor-Udu community (Ughelli North and South/Udu), Deghele community (Okpe/Sapele /Uvwie), Iyede community (Isoko North and South), Koko community (Warri North/Warri South/Warri South West), Oghareki community (Ethiope East/Ethiope West), Bulu-Angiama community (Bomadi/Patani), Okpokunu community (Burutu) will serve as Agricultural Transformation Centres and Aggregation Centres. This SAPZ Project covers the establishment of;

- Industrial shed
- Arterial Roads
- Drainage System
- Power Station & Electric Supply Lines
- Street Lighting
- Green Area and
- Water Supply
- Agricultural Transformation Centers (ATCs)
- Aggregation Centers (ACs)

ES 1.2 Legal and Administrative Framework for Implementation of the Project

National Environmental & Social Policies

The following are the national environmental and social policies related to the proposed project.

- National Policy on the Environment (1988)
- EIA Act Cap E12 LFN 2004
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2007
- National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991
- National Environmental (Sanitation and Wastes Control) Regulations, 2009
- National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991
- National Environmental (Noise Standards and Control) Regulations, 2009
- National Environmental (Surface & Groundwater Quality Control) Regulations 2011
- Land Use Act CAP L5 LFN 2004
- Forest Law CAP LFN 1994
- Endanger Species (Control of International Trade and Traffic) Act CAP HI LFN 2016
- Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004
- National Environmental (Ozone Layer Protection) Regulations, 2009
- Water Resources ACT, CAP W2, LFN 2004
- National Environmental (Soil Erosion and Flood Control) Regulations, 2011
- Factories Act (CAP F1), 2004
- Employee Compensation Act, 2010
- Nigerian Urban and Regional Planning Act CAP 138 LFN 2004
- EIA Procedural Guidelines, 1995
- Natural Resources Act CAP 268 LFN 1990

The following are the national **Agricultural Policies and Legal Provisions** related to the proposed project.

- National Agricultural Land Development Authority (NALDA) Act, 1992
- National Agricultural Seeds Act Cap. N5 Vol. 10 LFN 2004
- National Crop Varieties and Livestock Breeds (Registration, etc.) Act Cap. N27
- The Agricultural Credit Guarantee Scheme Fund Act, 1977
- Agricultural Research Council of Nigeria Act Cap. A12 LFN 2004
- Agricultural (Control of Importation) Act Cap. A13 LFN 2004
- Nigerian Agricultural Insurance Corporation (NAIC) Act Cap. N89 LFN, 2004
- Agricultural and Rural Management Training Institute Act (Cap A10 LFN 2004)
- National Economic Empowerment and Development Strategy (NEEDS)
- The Food and Nutrition Policy
- The National Plan of Action for Food and Nutrition in Nigeria
- The New Nigerian Agricultural Policy 2001-2013
- The National Agricultural Development Fund

Nigerian Gender-Related Policies

The following are the Nigerian gender-based policies related to the proposed project.

- The Gender Policy Framework in Nigeria
- National Gender Policy, 2006

Nigerian Institutional Provisions and Arrangement

The following are the Nigerian Institutional provisions and arrangements related to this project.

- Federal Ministry of Environment
- National Environmental Standards and Regulations Enforcement Agency (NESREA)
- Federal Ministry of Agriculture and Rural Development (FMARD)

State Laws

- Delta State Ministry of Agriculture and Natural Resources
- Delta State Ministry of Water Resources
- Delta State Ministry of Environment
- Delta State Ecology Law 2006
- Delta State Forestry Law Cap 59 1976
- Delta State Consolidated Revenue Law 2009
- Delta State Waste Management Law 2004
- Delta State Climate Change Policy 2010

LGAs Bye-Laws on Environment

The project would trigger all the environmental and waste management by-laws of the Ndokwa West LGA.

International Conventions and Agreements applicable to the sector

Apart from the National Laws, Acts and Regulations, Nigeria is signatory or party to several International Environmental Conventions and Treaties relevant to agriculture. A list of some of the relevant International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria are;

- Convention on Conservation of Migratory Species of Wild Animals 1979
- African Convention on the Conservation of Nature and Nature Resource 1968
- Agreement on Agriculture (AoA) 1995
- Food and Agriculture Organization of the United Nations (FAO) 1945
- International Rice Commission (IRC) 1948
- International Fund for Agricultural Development (IFAD) 1977
- International Plant Protection Convention (IPPC) 1951
- Convention on Biological Diversity (CBD) 1988
- World Trade Organization (WTO) 1995

- United Nations Framework Convention on Climate Change 1994
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal 1989
- Montreal Protocol on Substance that Depletes the Ozone Layer 1987
- Vienna Convention on the Ozone Layer 1985
- Convention on the Protection of the World Cultural and Natural Heritage (World Heritage Convention) 1975
- Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES) 1973
- Paris Agreement 2015

The African Development Bank (AfDB) Integrated Safeguards System (ISS)

The ISS consists of four interrelated components as summarised in Figure ES-1

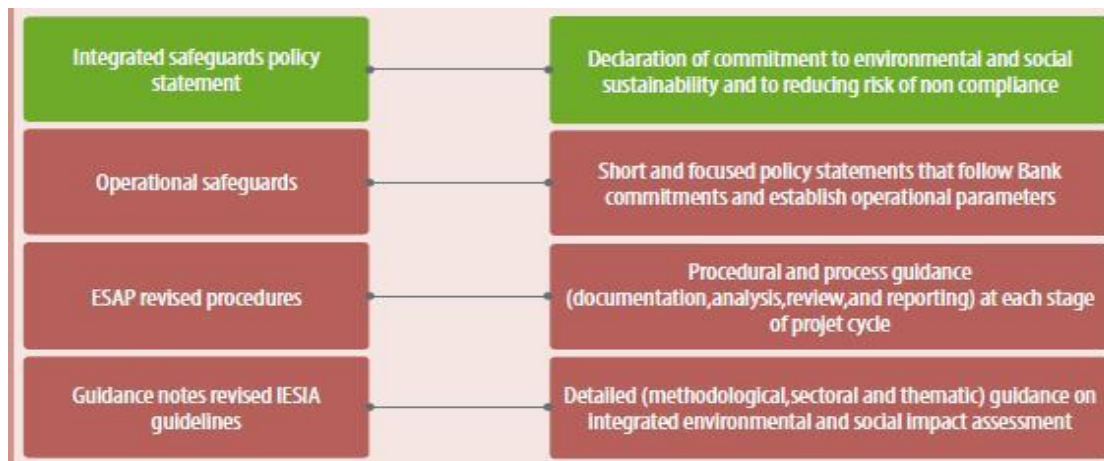


Figure ES-1: Structure of the AfDB ISS

Institutional and Administrative Framework

Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the **TCN** and the contractors. These include the following;

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Environment
- Federal Ministry of Finance
- Delta State Ministry of Agriculture and Natural Resources (Proponent)
- AfDB Project Implementation Unit (PIU)
- Delta State Ministry of Environment
- Delta Ministry of Water Resources
- Delta State Bureau for Lands and Survey
- Delta State Waste Management Authority
- Local Government Authority (LGA)

- The Customary District Councils head of the affected LGA
- Village Chiefs of Affected Communities

ES-1.3 Project Justification

ES- 1.3.1 Need for the Project

Suppose agricultural production continues to expand as expected, and fiscal policies are not in place to manage the growth of the downstream processing and trading industries. In that case, the result will be reduced prices at the farm and in the primary market. Thus the initial growth will not be sustainable, and the confidence of farmers will be lost. Therefore, growth and expansion have to be managed to comply with prevailing industrial opportunities, which requires thoughtful planning by governments. The establishment of the Delta State Agro-Industrial Processing Park (SAPZs) Hub is one of such contingency planning by the State.

ES-1.3.2 Benefits of the Proposed Project

The benefits of this project for the people of Delta State in particular and the economy of Nigeria, in general, are numerous.

The following few are worth mentioning;

- ✓ boost farmers income, reduce poverty, create clusters of economic growth, and increase tax revenue through value additions.
- ✓ encourage longer-term private sector investment, thereby assuring the sustainability of industrial development, through Government's intervention in creating and maintaining enabling environments
- ✓ stimulate private-public partnership
- ✓ increase food and nutritional security, create new/green jobs, and thereby reduce rural-urban migration through enhancement of productivity at the farm level
- ✓ promote private sector investment in climate-smart and green technologies, enabled by investment in public goods, policy interventions and the provision of pertinent support services and skills development
- ✓ reduce the low levels of post-harvest loss/deterioration of agricultural produce and increasing net profits to farmers
- ✓ guarantee availability of feedstock for sustainable input supply to agro-processing plants
- ✓ General improvement of the standard of living for the populace.

Envisaged Project Sustainability

The general sustainability principles (technical, economic, environmental and social) that guided the project's design include the following.

- Technical Sustainability
- Economic Sustainability

- Environmental Sustainability
- Social Sustainability

Project Options

- Do-Nothing Option
- Delayed Project Option
- Project Implementation Option

ES 1.4 Project Alternatives

The options and alternatives considered for the proposed project are presented in the Table ES-1.

Table ES-1: Options and alternatives considered for proposed project

Alternatives	Options Considered	Selected Alternatives
Industry Type	Solid mineral processing Agro-processing.	Agro-processing Industry
	Logistic and haulage Packaging and storage. Agricultural extension services Research and Development Cold Chain Dam Input distribution platform Service centre Food quality control Feeder road	Logistic and haulage Packaging and storage. Research and Development Cold Chain Input distribution platform Service centre Food quality control Agricultural extension services
	Cocoa (cassava, plantain, yam, oil palm, fish farming, pineapple, piggery, vegetables and rice)	Industrial Cassava, Rice, plantain, yam, oil palm, fish farming, pineapple, piggery and vegetables
Water supply	Groundwater Surface water State water board Private water supply	Groundwater and State water board Private water supply
Power source	National grid; Coal Gas power plant	A gas-powered plant backed up by the National grid power supply.
Drainage	Point drainage Channel drainage	Channel drainage
Sewage disposal	On-site disposals systems Sewage lagoons Sewage pre-treatment plant	Sewage pre-treatment plant.
ATC/AC locations	Per LGA Per Senatorial District	Per Federal Constituency

Alternatives	Options Considered	Selected Alternatives
	Per Federal Constituency	
Alterenative site	(A) Agbor (Ika South LGA) (B) Issele Uku (Aniocha LGA) (C) Kwale (Ndokwa West LGA)	Kwale (Ndokwa West LGA)

ES 1.5 Project Schedule

Table ES-2: Project schedule for the PPA and Associated Infrastructure project

S/N	Description	Duration (months)	2 nd Qtr. 2021	3 rd Qtr. 2021	1 st Qtr. 2022	2 nd Qtr. 2022	3 rd Qtr. 2022	1 st Qtr. 2023	2 nd Qtr. 2023	3 rd Qtr. 2023	1 st Qtr. 2024	1 st Qtr. 2073	2 nd Qtr 2073
Preconstruction Phase													
1	Feasibility studies	3											
2	EIA studies and approval	16											
3	EPC Contract award Process	1											
4	Check survey of EPC Contractors	1											
5	Detailed design of the facility	1											
6	Mobilisation of construction materials to the site	15 days											

	Construction Phase													
7	Construction of facility and Associated utilities	8												
	Operation Phase													
8	Facility operation	600												
	Decommissioning Phase													
9	Demobilisation of facility	4												
10	Decommissioning	One day												

ES 1.6 Description of the project site and Valued Environmental and Social Components

Figure ES-2 shows the index map of the proposed Kwale Processing facility. It shows that the project area located at Ndokwa West Local Government Area, Delta State, Nigeria. The Project's direct impacts outside of the footprint area include the biophysical and socio-economic impacts. It is expected that all direct biophysical impacts resulting from construction and operation of the agro-processing industrial park will be limited within the 1.5km² base radius. The processing centre is drained by the Ase Creek. The Proposed Processing Area (PPA) and the Associated Infrastructures falls within the tropical region of Southern Nigeria. The region exhibits two major seasons, longer wet and shorter dry seasons. The annual rainfall averages 2,768 mm. The relative humidity is usually high throughout the year (about 75%), reaching a maximum during the wet season when values above 90% are recorded. The proposed processing area (PPA) is characterized by two habitats. Secondary Forest (SF) with some patches of ephemeral (dried-up) freshwater swamps constituting about 63% of the proposed project site and Derived Savanna (DS) accounting for the remainder 37%. The project area is within the Sombreiro-Warri Deltaic plain deposits and freshwater swamp. There are no protected areas in the project area.

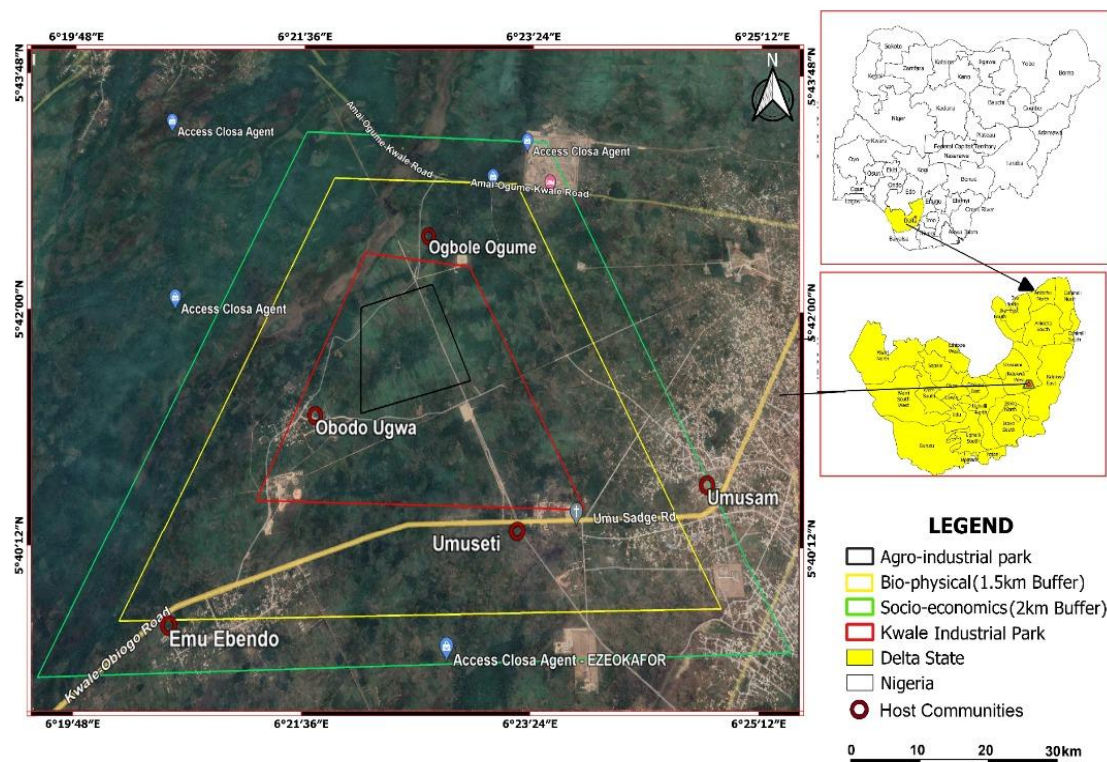


Figure ES-2: Map of the Proposed Processing Area

ES 1.6.1 Land Cover

The Land take for the proposed processing area (PPA) is 200 ha of the 1000 hectares for the Industrial Park. The remaining hectares will be used for future projects to be sited in the industrial park.

ES 1.6.2 Baseline condition of Bio-Physical Environment

All soil and groundwater baseline physico chemical parameters measured revealed results within FMEnv. regulatory limit. Soil, air and noise quality samples were obtained from ten (10) sampling points each while samples for groundwater, surface water and sediment quality were obtained from three (3) sampling points each. Soil, air and noise qualities were sampled at the same location (see table 4.4). Groundwater samples were gotten from boreholes in Obodoogwa, Utagba and Emu-Ebendo and surface water samples were obtained from Obodoogwa pond (one sampling point) and Ase creek (two sampling points). The project area is drained by the Ase Creek (289.6m away from the project area). The creek is approximately 292 km.

Results obtained for noise showed an elevated noise level above the daytime threshold limit stipulated for the various environments (school, hospital, residential and farmlands) for all the sections. However, these results were within the general noise level of prolonged exposure.

Air quality on the other hand revealed values within FMEnv regulatory limits except for NO₂ and SO₂ across all sampling points.

Analysis of water samples showed parameters within FMEnv. and WHO 2011 safe limits for the sustenance of aquatic lives. However, turbidity, COD, BOD, Nitrate and Phosphate concentrations were above regulatory limits. The high values obtained for these parameters implies episodes of anthropogenic activities in form of deposition of domestic wastes, as well as infiltration from surface runoffs leading to eutrophication

The sediment samples' results establish a similar trend as that of the surface water, thus exhibiting similar discharges and sources and all physico chemical parameters analyzed in the sediment were all within Interim Sediment Quality Guidelines (ISQG) and Federal Ministry of Environment (FMEnv) threshold values.

Data obtained for fisheries studies were based on combination of methods: direct observation of fishermen's catch in their canoe and nets at the fishing grounds and consultation in the field with the fishermen. The Kwale market was also visited to ascertain the types of fish sold. Samples of fishes observed were identified using flashcards, checklists, photographs and scientific identification keys. A total of 19 species of fish were collected and reviewed and they include

Eutropius niloticus, *Auchenoglanis occidentalis*, *Protopterus annectens*, *Hemichromis fasciatus*, *Heterotis niloticus*, *Parachelon grandisquamis*, *Sardinella madarensis*, *Penaeus notialis*. None of the species is listed in the IUCN list of threatened species.

Flora studies revealed a total of 33 plant species in the project area. One species (*Khaya senegalensis*) is threatened in the area and is categorized as Vulnerable in the IUCN List of Threatened Species. *Chromolaena odorata* and *Ageratum conyzoides* were invasive and also alien in the study area while *Astystasia gangetica* was listed as Invasive.

With respect to fauna diversity, a total of fourteen (14) avian species were sighted, five (5) mammalian species, seven (7) amphibian species and nine (9) reptilian species. None of the fauna species were in the IUCN list of threatened species.

ES 1.7 Project Impacts

The following are the key project impacts:

- Pollution/nuisance levels= SO₂, NO₂ and VOC levels in air, BOD, COD, and DO levels in surface water
- Noise = Elevated noise levels across all sampling points
- Surface water physico-chemical parameters above WHO/FMEnv regulatory limits = BOD, COD, Phosphate, Turbidity, Nitrate and DO
- Invasive species = *Astystasia gangetica*
- Alien/invasive species= *Chromolaena odorata* and *Ageratum conyzoides*
- Threatened species= *Khaya senegalensis*
- Estimated amount of greenhouse gas to be generated by project activity= 6.22827797MTCO₂ Equivalence is estimated to be emitted from project activities

ES 1.8 Social Environment

Ethnic groups

The study observed the three (3) major ethnic groups namely Ukwuani, Enuani/Ika/Ibo and Isoko/Urhobo (see table 4.36) among the respondents. As in almost all studies, the aboriginal folkloric entity, the Ukwuani people, dominated other tribal groupings in the project area.

Religion

The ESIA study revealed Christianity, African Traditional Religion (ATR) and Islam as the main religions of the respondent population. Christianity was the most practised across all the respondent communities/persons, followed by ATR and Islam faith.

Occupation

The host community's economic life revolves mainly around farming and trading, and the other livelihood activities among the respondents include artisans, firewood trading, food vending, and processing (see table 4.45).

Educational Attainment

A respondent population of 37.2% attained secondary school education compared to 40.2% that attended tertiary institutions implying a high literacy level (Table 4.38) for the study area. Similarly, the study correlated a linear relationship between respondents with no formal education to possession of artisanal skills as most non-tertiary graduates engage in non-white collar jobs.

Consultation

The consultations took place on the 4th of March, 2022. Details of the consultations held with various stakeholders of the project are presented in chapter five of the main report.

ES 1.9 Environmental and social management plan (ESMP)

The specific measures addressing each significant/moderate impact are:

Air Quality

- Maintain and operate all vehicles and equipment engines in accordance with manufacturers' recommendations
- Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt
- Cover properly loose materials and keep top layers moist
- Speed limits on-site of 15kph on unhardened roads and surfaces
- Location of stationary generators to facilitate dispersion
- Restriction of vegetation clearing to only the required area

Surface Water, Groundwater and Soil

- Regular checking and maintenance of all vehicles and equipment to minimize the risk of fuel or lubricant leakages
- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques
- Install oil/water separators and silt traps before effluent, leaves the site
- Herbicides should not be used for vegetation clearing
- Avoid vegetation clearing along stream shores and on steep slopes

Biodiversity

- Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads
- Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control

- Retention of native species where possible within the project area.

ES 1.9.1 Management measures for STD - HIV and awareness programs

The Contractor will develop a policy and management plan to reduce the transmission of STIs, including HIV/AIDS. This strategy will:

- Make provision for awareness, counseling and testing for all Project personnel, including voluntary testing for STDs and HIV/AIDS as part of any health screening program (workers will not be denied employment or discriminated against in any way based on their HIV status);
- Provide guidance and counseling to workers with HIV/AIDS to access treatment through existing health facilities or NGO campaigns or programs;
- Ensure that all Project personnel are given specific HIV and STD prevention training;
- Undertake information, education and communication campaigns around safe sexual practices and transmission of STDs and
- HIV/AIDS as well as condom distribution at stopping locations on key transport routes targeting commercial sex workers and truck drivers;
- Support public health or NGO initiatives to reduce STD transmission including working through schools, women's and youth groups;
- The Contractor will provide non-local workers with a schedule and transportation that avoids limiting off-time activities at nearby communities;
- Conduct community awareness campaigns in communities around the project area.

ES 1.9.2 Management measures of employees-communities relationship

The contractor with the supervision of the PIU will ensure:

- Respect for local residents and customs;
- Non-Discrimination (for example on the basis of family status, ethnicity, race, gender, religion, language, marital status, birth, age, disability, or political conviction);
- Compliance with applicable laws, rules, and regulations of the jurisdiction;
- Zero tolerance of bribery or corruption;
- Zero tolerance of illegal activities by Contractor personnel, including prostitution, illegal sale or purchase of alcohol, sale, purchase or consumption of drugs, illegal gambling or fighting;
- Policy and sanctions against alcohol and drugs policy during working time or at times that will affect the ability to work;
- A program for drug and alcohol abuse prevention and random testing that is equivalent in scope and objectives to the policies prescribed in the code of conduct;
- Policy including sanctions against sexual harassment (for example to prohibit use of language or behavior, in particular towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate);
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment, preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment).

ES 1.9.3 Gender equity and gender-based-violence (GBV)

The PIU and the Contractor will work together to continuously assess risks and identify and implement prevention, response and referral processes with respect to any cases involving Sexual Exploitation and Abuse/Gender Based Violence (SEA/GBV). This will focus on:

- i. Training of PIU and Contractor personnel,
- ii. Community and worker awareness,
- iii. Making available safe and confidential channels of communication and complaints, and
- iv. A referral system and mechanism for survivors of GBV/SEA;

PIU will develop and implement a GBV/SEA prevention and response framework that will address the following elements:

How the project will put in place the necessary protocols and mechanisms to address the SEA/GBV risks;

- How to address any GBV incidents that may arise
- A policy against GBV/SEA including a CoC and agreed sanctions, these will be provided by the contractor and consultants as part of the Contractor ESMP. Have all employees of contractors (including sub-contractors), supervision consultants and other consultants with a footprint on the ground in the project area sign CoCs;
- For purposes of the construction and operational phases of the project, develop an induction program, including a CoC, for all workers directly related to the project.

ES 1.9.3.1 Specific arrangements and management strategies for GBV risks

Awareness Raising Strategy, which describe show workers, local communities and Project personnel will be sensitized to SEA/GBV risks, and the worker's responsibilities under the CoC;

Referral Pathway: Identification of qualified GBV service providers (NGOs) and setting up a referral pathway so GBV survivors will be referred, and the services will be available (health, legal, psychosocial, safety planning, etc.)

Establish a SEA/GBV Accountability and Response Framework, to be finalized within put from the contractor

The SEA/GBV Accountability and Response Framework will include;

- Allegation Procedures: How the project will provide information to employees and the community on how to report cases of SEA/GBV, CoC breaches to the GRM;

- SEA/GBV Allegation Procedures to report SEA/GBV issues to service providers, and internally for case accountability procedures which will clearly lay out confidentiality requirements for dealing with cases;
- Mechanisms to hold accountable alleged perpetrators associated to the Project;
- Disciplinary action for violation of the CoC by workers. It is essential that such actions be determined and carried out in a manner that is consistent with local labor legislation and applicable industrial agreements.

ES 1.9.4 FME_{env} Environmental monitoring matrix

Table ES-3 is an example of the monitoring adopted for the project.

Table ES-3: Sample ESMP Matrix used for the project

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation enhancement measures	post-mitigation or Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO ₂ , CO, NO _x , CO ₂ , PM)	Affected communities in area of influence	Minor	Use good international standard practice: Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators to be located to facilitate dispersion	Negligible	EPC Contractor	AfDB-PIU	FME _{env} and DSM _{env}

ES 1.9.5 Key ESMP implementation indicators

The following are some of the key ESMP indicators

- Concentration of NO₂, SO₂ exceeds regulatory limit during periodic monitoring
- Number of accidental spills
- Noise level

ES 1.9.6 Institutional Framework for Implementation of the ESMP

The key roles and responsibilities for the implementation of the ESMP are presented as follows.

- DSMANR will have principal responsibility for all measures outlined in the ESMP for the construction phase.
- The HSE department of DMEnv shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations the operations. Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.
- The PIU shall hire and manage contractors, a witness NGO shall be accredited to monitor and evaluate the implementation of the ESMP to a certain extent. EPC contractors are responsible for implementation of the ESMP.
- PIU is responsible for the overall project planning and execution, including preparation of bidding documents, hiring of project management consultants, EPC contractors and supervision of the works
- The HSE department of DSMANR shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations the operations
- The Federal Ministry of Environment (FMEnv) has the responsibility for the implementation of the EIA Act 86 of 1992. Furthermore, the Delta State Ministry for Environment and the affected LGA have certain oversight roles, which they perform under coordination of the FMEnv

Responsibilities in the implementation and monitoring of the ESMP are shared between multiple stakeholders, including regulatory and concerned agencies, the AfDB-PIU, the DSMANR and the contractors.

ES 1.9.7 Estimated overall budget

Table ES-4 presents the summarized annual estimated ESMP budget. The total budget for implementing the ESMP is xxxxxxxx

Table ES-4: Estimated annual overall budget for ESMP

Construction phase					Operation phase			
Component	Cost Estimates/year (NGN)	Frequency	Annual Estimates	Annual Estimates (USD)	Cost Estimates/year (NGN)	Frequency	Annual Estimates	Annual Estimates (USD)
Air quality	750,000	Monthly	9,000,000		350,000	Bi-Annually	700,000	
Noise & vibration	750,000	Monthly	9,000,000	20,816.34	800,000	Bi-Annually	1,600,000	3,700.68
Soils integrity	100,000	Quarterly	400,000	925.17	1,200,000	Bi-Annually	2,400,000	5,613.6
Water quality	800,000	Twice a year	1,600,000	3,700.68	-	-	-	
Vegetation integrity and Fauna protection	200,000	Once during vegetation removal in the project site	200,000	462.59	-	-	-	
Visual amenities and Land planning and use	200,000	Quarterly	800,000	1,850.34	-	-	-	
Stakeholder relations Management	2,500,000	Quarterly	10,000,000	23,129.27	2,500,000	As need arises	-	5,782.32
Grievance redress mechanism	550,000	Quarterly	2,200,000	5,088.44	1,200,000	As need arises	-	2,775.51

Construction phase					Operation phase			
Component	Cost Estimates/year (NGN)	Frequency	Annual Estimates	Annual Estimates (USD)	Cost Estimates/year (NGN)	Frequency	Annual Estimates	Annual Estimates (USD)
Health, Safety and Security	200,000	Quarterly	800,000	1,850.34	380,000	Bi-Annually	760,000	1,757.82
Employment and economy	1,200,000	Quarterly	4,800,000	11,102.05	500,000	As need arises	-	1,156.46

ACKNOWLEDGEMENT

We extend our special thanks to Delta State Ministry of Agriculture and Rural Development (the Proponent) for contracting Mifor Consult Nigeria Limited (MCNL) and LongHall Consulting to prepare this ESIA study for their proposed Delta State Special Agro-Processing Zone and Associated Infrastructure project. Our Special thanks also goes to the African Development Bank (AfDB). We further register our gratitude to the various stakeholders consulted during public stakeholder consultation for their invaluable contribution, support and cooperation. Their input contributed enormously towards successful completion of this ESIA study report.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

With a population of approximately 210 million people, Nigeria accounts for about 50% of West Africa's population and is Africa's most (and the world's 7th) populous country (World Bank; World meter (2021)). The country's agricultural economy is characterized by low yield, high post-harvest losses, slow technological innovation, and significant deficits in support systems such as infrastructure, productivity-enhancing inputs, financial backing, commercial orientation, and effective related policies. Nigeria's new agricultural investment framework seeks to stimulate private sector investments to drive a market-led agricultural transformation to address these issues. The inventiveness to establish the Special Agro-Industrial Processing Zones (SAPZs) to boost the rapid development of modern agro- processing capacity in Delta state is one of such programs. The program is an integrated developmental initiative designed to concentrate agro-processing activities within high agricultural potential areas to boost productivity and integrate production, processing, and marketing of selected commodities.

With financing to be provided by the African Development Bank (AfDB) and the state government, the Federal Government of Nigeria, through the Agricultural Transformation Agenda Support Program Phase 1 (ATASP-1) seeks to establish Special Agro-Industrial Processing Zones in the country. The project also involves identifying value chain ancillary sub-components to be driven and anchored principally by private sector including the establishment of ATCs and ACs. The sub-components would primarily serve the proposed main components.

In line with the EIA Act Cap E12, LFN 2004, AfDB operational Safeguards and alignment with the project's Environmental and Social Management Framework (ESMF), this type of project shall undergo an environmental and social impact assessment. This Environmental and Social Impact Assessment (ESIA) has therefore been prepared for the proposed processing area and associated infrastructure, and will aim to, among others:

1. Identify potential and significant adverse environmental and social impacts of the proposed activities and recommend means of mitigating them to acceptable levels, where they cannot be completely avoided/ eliminated.
2. Consider the capacity of existing institutions to manage the predicted ecological and social issues and implement an Environmental and Social Management Plan (ESMP) for this purpose.

3. Comply with the Federal Government of Nigeria (FGN) Environmental Impact Assessment (EIA) Law and the Federal Ministry of Environment Guidelines.
4. Comply with the Environmental and Social Policies of the African Development Bank (AfDB). The AfDB has various instruments for addressing the environmental and social impacts of projects. The development of the proposed project will trigger all the five AfDB Operational Safeguards Policies, including:
 - i. OS 1: Environmental and social assessment;
 - ii. OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and compensation;
 - iii. OS 3: Biodiversity and Ecosystem Services;
 - iv. OS 4: Pollution Prevention and Control Greenhouse Gases, Hazardous Materials, Resource Efficiency; and
 - v. OS 5: Labour Conditions; Health and Safety.

In light of the above, the Delta State Government commissioned Mifor Consult Nigeria Limited, Calabar, an Environmental Consultancy firm, to conduct the ESIA study.

1.1.2 The Proponent

Delta State Ministry of Agriculture and Natural Resources is the project proponent. The ministry is tasked with the responsibility of all agricultural activities in the state and has the mandate to facilitate the production of sufficient food for the teeming population of the state through direct assistance to farmers in the area of agricultural mechanization and is also responsible for formulating policies, programmes and monitoring the implementation of the following policy objectives.

- Attainment of self-sufficiency in the essential food products for enhanced food security.
- Increase production of Agricultural raw material to meet the growing demand in the agro-allied industries.
- Increased production of exportable products to attract foreign exchange earnings for the nation at large.
- Modernization of agricultural production processing, storage and distribution through the infusion of improved technological packages and management so that agriculture can be more expensive to the demands of other sectors of the economy.
- Creates more agricultural and rural employment opportunities and improve the living standards of farmers and rural dwellers through enhanced income.
- Protection and improvement of land resources through appropriate farming systems.

- Establish appropriate support institutions to facilitate the integrated development and realization of the State's agricultural potentials. Table 1.1 provides the contact details of the proponent.

Table 1.1: Proponents Contact Details

Project Proponent	Delta State Government/ Ministry of Agriculture and Natural Resources
Address	Office of the Chief of Staff/ Government House, Asaba.
Contact Person	Rt Hon. Festus Agas/ Ben Agamah
Contact Email	festusagas@gmail.com/ bengamah@yahoo.com

1.1.3 Purpose of the ESIA Report

The purpose of the ESIA is to assess the potential biophysical and social impacts of the project, and prepare a detailed Environmental and Social Management Plan (ESMP). The ESIA will establish modalities of implementing the ESMP under Nigeria Environmental policies and laws and the AfDB Integrated Safeguards Systems (ISS).

1.1.4 Objectives of the ESIA

The ESIA study aims to ensure compliance with national and AfDB operational safeguards. The objectives include to:

- Establish baseline biophysical and social environment within the project area of influence;
- Identify and analyze alternatives to the proposed projects, including sites, technology, layout, etc.;
- Identify and assess the anticipated potential environmental and social impacts of the proposed project;
- Propose cost-effective mitigation measures across all phases of the project life cycle.
- Identify any future environmental and social issues and concerns which may affect the project development;
- Prepare and cost an implementable Environmental and Social Management Plan (ESMP) detailing mitigation measures and institutional roles and responsibilities.
- Develop environmental management plans for residual impacts above Minor categorization.
- Recommend an environmental management program for the rehabilitation of the scheme, including compliance, monitoring, auditing and contingency planning.
- Provide the basis for co-operation and consultation with regulatory and non-regulatory

authorities and the public.

- Assist project design and planning by identifying those aspects of location, construction and operations, which may cause adverse environmental, social, health and economic effects;
- Carry out consultations with relevant stakeholders, including potential project-affected persons, to obtain their views and suggestions regarding the environmental and social impacts of the proposed project. The outcome of the consultations will be reflected in this ESIA report and will be incorporated into the project design as appropriate; and
- Provide an opportunity for Interested and Affected persons to be engaged/ involved in the disclosure process.

1.1.5 Scope of the Study

The study will be divided into four major parts to ensure adequate coverage and ease of potential impact evaluations:

1. Legal and Administrative framework
2. Project and process description
3. State of the bio-physical and socio-economic issues.
4. Impact Assessment, mitigation and environmental and social management plans

1.1.6 The Project Justification

Over the years, the agricultural economic history of the country has been characterized by low yield, high postharvest losses, slow technological innovation, and significant deficits in support systems such as infrastructure, productivity-enhancing inputs, financial backing, commercial orientation, and effective related policies. With Nigeria's new agricultural investment framework, this project seeks to stimulate private sector investments to drive a market-led agrarian transformation. The initiative to develop the Special Agro-Industrial Processing Zones (SAPZs) is aimed at boosting the country's rapid development of modern agro-processing capacity. The project is an integrated developmental initiative designed to concentrate agro-processing activities within high agricultural potential areas to increase productivity and integrate production, processing, and marketing of selected commodities.

1.1.7 Summary of the Key Activities Undertaken in Line with the EIA Procedures in Nigeria

Table 1.2 outlines regulatory requirements undertaken, and to be undertaken within the Nigerian Regulatory framework.

Table 1.2: ESIA Process in Nigeria

ESIA Step	Description	Status	Remark
ESIA registration	This step initiates the ESIA process providing draft terms of reference, letter of Introduction from the client and a covering letter	This step has been satisfied	See Annexure 1
Authority Visit	This step provides the regulatory authorities (FMEnv, affected state and LGAs Environment Ministries and Departments respectively) opportunity to appraise the proposed project	This step has been satisfied	See Annexure 2
Scoping	The ESMF report was mooted as an alternative to Scoping exercise, hence sampling was permitted. On further considerations by FMEnv, a Scoping exercise was approved. Subsequently, a Scoping workshop was conducted after the field sampling exercise.	This step has been satisfied	See Annexure 3
Project Categorization	Steps 2 and the Scoping Report document provides the regulatory Ministry with the project overview, environmental settings and stakeholder concerns/perception to be factored into the categorization process	Official Terms of Reference was issued	See Annexure 3
Data Gathering Exercise	Data gathering exercise was conducted with active involvements of FMEnv., State, LGAs and the Ministry's officials	This was conducted from March 3 rd and 8 th 2022	See Annexure 4
Submission of Draft ESIA report	FMEnv. Specified copies of draft ESIA report to be submitted	TBD	Not yet satisfied
Public Disclosure	This step provides avenue for the ESIA findings to be made available to the wider public over a 21-working days period	TBD	Not yet satisfied
Panel Review	This step subjects the ESIA report to experts' evaluation, assessment and evaluate of stakeholders observations	TBD	Not yet satisfied
Submission of Final ESIA report	On receipt of comments from FMEnv and incorporation, a final report is developed and submitted to FMEnv within a specified time frame.	TBD	Not yet satisfied
Issuance of Approval or disapproval Certificate	This conveys the approval to the client	TBD	Not yet satisfied

1.2 Legal and Regulatory Framework

The amended 1999 constitution of Nigeria, as the national legal order, recognises the importance of improving and protecting the environment and makes provision for it in the following relevant sections:

Section 20, makes it an objective of the Nigerian State to improve and protect Nigeria's air, land, water, forest, and wildlife.

Section 12 establishes that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria.

Sections 33 and 34, which guarantee fundamental human rights to life and human dignity, respectively, have also been argued to be linked to the need for a healthy and safe environment to give these rights effect.

This Chapter provides the Nigerian administrative framework and describes the relevant Nigerian legislation and industry standards that the Project will follow. Specifically, this chapter provides a summary of:

- Nigerian administrative and legislative organization;
- National environmental and social legislation deemed applicable to the Project;
- National Climate Change Policy
- Nigeria Nationally Determined Contribution (NDC)
- National Waste Management Policy
- United Nations Framework Convention on Climate Change (UNFCCC)
- Other international conventions to which Nigeria is a signatory; and
- International standards and guidelines to which the Project will be aligned.
- Abandonment Guidelines 1995
- NAFDAC Act Cap N1, 2004
- Water Resources Act CAP W2 LFN 2004
- Public Health Law Cap 103 LFN 1990
- National Policy on Occupational Safety and Health, 2016
- Nigerian Agricultural Policy 2000
- Delta State Climate Change Policy 2010
- Consumer Protection Council Act (CPCA)
- Food and Agriculture Organization of the United Nations (FAO)

- Electric Power Sector Reform Act (EPSC) 2005;
- Fire and Rescue Service Act 2004;
- National Guidelines for Environmental Audit 2011;
- National Guidelines on Registration of Environmentally Friendly products 1999;
- National Guidelines for Environmental Audit 1999; as well as
- National Guidelines on Environmental Management System 1999, etc.
- The most recent United Nations Framework Convention on Climate Change – COP 25 of Madrid – Spain, December 2019.

1.2.1 National Environmental & Social Policies and Legal Provisions

1.2.1.1 EIA Act Cap E12 LFN 2004

The EIA Act No. 86 of 1992, now codified as, EIA Act Cap E12 LFN, 2004, is the principal legislative instrument relating to activities that may affect the environment or, to a significant extent, affect the environment. The Act sets the goals and objectives of EIA and procedures, including the minimum requirements for EIA conduct of public or private projects. The Act makes EIA mandatory for all major development projects likely to have adverse impacts on the environment and gives specific powers to FMEnv. to facilitate the environmental assessment of projects in Nigeria.

FMEnv. categorises mandatory study activities into three: **Category 3** activities have beneficial impacts on the environment; **Category 2** activities, unless within the Environmentally Sensitive Area, full ESIA is not mandatory; while **Category 1** activities require full and compulsory ESIA. Projects are pre-listed into these categories based on the type and whether they would involve physical interference with the environment. Either the listing or the result of an Initial Environmental Evaluation (IEE) is used to determine projects requiring full ESIA.

1.2.1.2 National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2007

The Act established a body known as NESREA to be the enforcement Agency for environmental standards, regulations, rules, laws, policies and guidelines in Nigeria except for Oil and Gas Industry which is handled by NOSDRA. The Act empowers the agency to have responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general, and environmental technology, including coordination and liaison with relevant stakeholders within and outside

Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

1.2.1.3 National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991

These Regulations address the handling and management of solid, radioactive and (infectious) hazardous waste. They define the objectives of management of solid and hazardous waste, the functions of appropriate Government agencies and obligations of industries. The Regulations mandate all industries to inform FMEnv of all toxic, hazardous, and radioactive substances they keep on their premises or discharge during their production processes. Schedule 12 and 13 of the Regulations provide a comprehensive list of all waste deemed hazardous and dangerous.

1.2.1.4 National Environmental (Sanitation and Wastes Control) Regulations, 2009

The Regulations provide the legal framework for adopting sustainable and environmentally friendly practices in sanitation and control of solid wastes, hazardous wastes and effluent discharges to minimise pollution. **Part 3** of the Regulations states that all owners or occupiers of premises shall provide waste receptacles for storage before collection by licensed waste managers. Besides, the Regulations make it mandatory for facilities that generate waste to reduce, reuse, recycle and ensure safe disposal to minimise pollution. The Regulations also spell out the roles and responsibilities of State and Local Government Authorities.

1.2.1.5 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991

The Regulations prohibit industry or facility from releasing hazardous or toxic substances into the air, surface/groundwater of Nigeria's ecosystems beyond the permissible limits of FEPA (now FMEnv). The Regulations further charge any industry or facility to:

- Establish and maintain a pollution monitoring unit within their premises;
- Set up a machinery for combating pollution hazard and maintain equipment in the event of an emergency.
- Have a stock of pollution response equipment which shall be readily accessible and available to combat pollution hazards in the event of accidental discharges.
- Ensure on-site pollution control; and
- Assign the responsibility for pollution control to a person or body accredited by the FMEnv. Section 5 of the Regulations mandate industries or facilities to submit to the nearest office of FMEnv a list of chemicals used in the manufacture of its products, details of stored chemicals and storage conditions and where these chemicals were obtained, bought or sold.

1.2.1.6 National Environmental (Noise Standards and Control) Regulations, 2009

The purpose of these Regulations is to ensure the maintenance of a healthy environment for all people in Nigeria, the tranquility of their surroundings and their psychological well-being by regulating noise levels. The Regulations prescribe the maximum permissible noise levels on a facility or activity to which a person may be exposed and provide for the control of noise and mitigating measures to reduce noise.

1.2.1.7 National Environmental (Surface & Groundwater Quality Control) Regulations 2011

The purpose of these Regulations is to restore, enhance and preserve the physical, chemical and biological integrity of the nation's surface waters and to maintain existing water uses. The Regulations also seek to protect groundwater sources by regulating the discharge of hazardous wastes, fossil fuels energy and any other substances having the potential to contaminate groundwater. The Regulations also include, amongst others, the application and general provisions of water quality standards for various uses such as agriculture, industrial, aquatic life and recreation.

1.2.1.8 The Standard Organization of Nigeria (SON) Act, 2015

SON's primary responsibility is to ensure that locally manufactured products in Nigeria provide the required degree of satisfaction to consumers through compliance with government policies on standardisation and conformity assessment. The Organization ensures that goods imported into Nigeria meet the minimum requirements of Nigerian industrial standards or any other approved/domesticated international standards.

1.2.1.9 Land Use Act CAP L5 LFN 2004

The Land Use Act is the legal framework for land acquisition and resettlement in Nigeria. The Act stipulates that all land in Nigeria is to be held by State Governors in trust for the people. The administration of urban land is directly under the control and management of the Governor, whereas non-urban land is under the control and management of the Local Government Authority.

By implication, the Governor has the right to grant statutory rights of occupancy to land while the Local government has the right to grant customary rights of occupancy. At any rate, all lands irrespective of the category belong to the State. At the same time, individuals only enjoy a right of occupancy as contained in the certificate of occupancy or where the grants are "deemed". Thus, the Land Use Act is the key legislation that directly relates to resettlement and compensation in Nigeria. The Act makes it lawful for the Governor to grant statutory rights of occupancy for all purposes, grant easements appurtenant to statutory rights of occupancy, and

demand rent. The local government, under the Act, can enter, use and occupy for public purposes any land within its jurisdiction that does not fall within an area compulsorily acquired by the Government of the Federation or of relevant State; or subject to any laws relating to minerals or mineral oils.

In summary, the Acts gives the government the right to acquire land by revoking both statutory and customary occupancy rights for the overriding public interest. In doing so, however, the Act equally specifies that the State or Local Government should pay compensation to the current holder or occupier with equal value.

1.2.1.10 The National Policy on the Environment

The National Policy on the Environment was formulated in 1989 and last revised in 2017 to integrate environmental concerns into all sectors of the Nigerian economy (the agricultural sector inclusive) to achieve sustainable development for Nigeria. The goal of the National Policy on Environment is to achieve sustainable development and to secure an environment adequate for good health and well-being. It also conserves and uses the environment and natural resources to benefit the present and future generations. The Policy also aims to restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems.

1.2.1.11 Agenda 21 for the Nigerian Environment

Agenda 21 for the Nigerian Environment seeks to integrate environmental policy into development planning in a holistic manner at all levels of government, the private sector inclusive, and intensify the transition to sustainable development. It is also designed to address sectoral priorities, plans, policies and strategies for the major sectors of the economy while fostering regional and global partnership simultaneously.

1.2.1.12 National Climate Change Policy 2021

This policy incorporates the 2015 signed Paris Agreement and gender issues. The objective is to implement mitigation measures and promote low-carbon, high-growth economic development strengthens adaptation towards a sustainable climate-resilient development pathway. The policy is to run between 2021 and 2030.

1.2.1.13 Other Applicable E&S Legal Provisions

Table 1.3 summarises other relevant existing Nigerian laws and regulationsTable .

Table 1.3: Other Relevant Nigerian E&S Laws and Regulations

Laws and Regulations	Summary of Provisions
Forestry Law CAP 51 LFN 1994	The Forestry Law prohibits any act that may lead to the destruction of or cause injury to forest products, forest growth or forestry property in Nigeria. The law prescribes the administrative framework for the management, utilisation and protection of forestry resources in Nigeria.
Endangered Species (Control of International Trade and Traffic) Act LFN 2016.	The Act provides for the conservation and management of Nigeria's wildlife and prohibits the hunting, capture and trade of endangered species.
Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004	An Act that prohibits carrying, depositing, and dumping toxic waste on any land, territorial waters, and matters relating thereto, including penalty for offences for individuals and corporate bodies. The Act prohibits all activities relating to the purchase, importation, transit, transportation, deposit, storage or, sale of harmful wastes.
National Environmental (Ozone Layer Protection) Regulations, 2009	These provisions seek to prohibit the import, manufacture, sale and use of ozone-depleting substances and materials that contain these substances.
National Environmental (Soil Erosion and Flood Control) Regulations, 2011	The overall objective of these Regulations is to control erosion and flooding by checking all earth-disturbing activities, practices or developments for non-agricultural, commercial, industrial and residential purposes.
Factories Act (CAP F1), 2004	The Act establishes a legal framework for the registration of factories and to make adequate provisions regarding the safety of workers against occupational hazards, and impose penalties for any breach of its conditions. This Act covers all workplaces.
Employee Compensation Act, 2010	The Act provides compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at the workplace or in the course of employment. Payment of compensation by the employer is as enshrined in the accepted principle that the employer has a duty of care to protect workers'

Laws and Regulations	Summary of Provisions
	health, welfare, and safety at work.
Nigerian Urban and Regional Planning Act CAP 138 LFN 2004	The Act aims at overseeing realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. The Act establishes grounds for land development rejection.
EIA Procedural Guidelines, 1995	Provides Procedural context and guidance for the conduct of EIA, ESIA, ESHIA etc in Nigeria.
Natural Resources Conservation Act CAP 268 LFN 1990	The Natural Resources Conservation Act CAP 268 LFN 1990 is the most direct existing legislation on natural resources conservation. The Act establishes the Natural Resources Conservation Council, which is empowered to address soil, water, forestry, fisheries, and wildlife conservation by formulating and implementing policies, programmes, and projects to protect the country's natural resources.

1.2.1.14: Delta State E&S Legal Provisions

Table 1.4 provides a summary of: Delta State and the affected LGA environmental and social legislation deemed applicable to the Project;

Table 1.4 Environmental and social legislations of Delta State

LEGISLATION	DESCRIPTION
The Delta State Town and Country Planning Laws Cap 165 of 1975	This law grants the Government and its operating agencies the authority to require lands and undertake layouts and boundary adjustments of plots, if necessary, authority to grant leases and sell plots as necessary as well as preservation of trees, landmarks for amenities, authority to approve building designs and external appearance of structures; prohibition of unsuitable buildings.
Delta State Environmental Protection Agency Edict No 5 of 1997	The DSEPA is an agency under the Delta State Ministry of Environment. Although the EIA decree No 86 of 1992 is the substantive law that regulates the siting of industrial projects that impinge on environmental elements in Nigeria, with part of the project in Delta State, this edict has a role to play in the overall EIA process as a matter of law. The edict setting up the Delta State Environmental Protection Agency (DSEPA). Captioned as Edict No 5 of 1997 outlines the primary responsibilities of the agency, which is to protect and develop the general environment of Delta State.

Delta State Ecology Law, 2006	The law empowers the Delta State Ministry of Environment with the responsibility of protecting the environment in order to achieve sustainable environmental development in the State. It empowers the Ministry with the statutory responsibility of handling environmental pollution cases. It liaises with oil companies on pollution matters. It enables, the Ministry to participate in the management of oil spills in the State .It empowers the Ministry to be an integral part of the Joint Investigation team (JIV) that investigates the causes of oil spills; carrying out assessment of damage to the environment, property, health and assessment of the ecological damage to the marine and terrestrial habitat as well as vegetation and ecosystem. The law also empowers the Ministry to handle flood and erosion cases.
Delta State Forestry Law Cap 59, 1976	This law is all about the sustainable use of Delta State forests and its biodiversity which is a renewable source of wealth in the area especially for tourism, food supply, fuel and timber as well as the protection of the environment.

1.2.2 Agricultural Policies and Legal Provisions

The Legal Framework on Agricultural Practice in Nigeria includes:

1.2.2.1 National Agricultural Land Development Authority (NALDA) Act, 1992

The National Agricultural Land Development Authority Act seeks to provide strategic public support for land and development by establishing a corporate body known as the National Agricultural Land Development Authority. This Act defined "development" as the physical preparation of land for crop and livestock and includes actual stock and livestock production, storage, processing and marketing, as well as the provision of social infrastructural facilities.

1.2.2.2 National Agricultural Seeds Act Cap. N5 Vol. 10 LFN 2004

The Act seeks to regulate the development of the national seed system by establishing a council known as the National Agricultural Seed Council. This Council is responsible for the general policy guidelines and monitoring of the development of the national seed system. The Act aims to analyse and propose programmes, policies, and actions regarding seed development and the seed industry. The overall objective of the Act is to harmonise the seed industry with other agricultural input industry to meet the increasing demand of the agricultural sector.

1.2.2.3 National Crop Varieties and Livestock Breeds (Registration, etc.) Act Cap. N27

The Act seeks to provide for detailed identification of management training needs in agriculture and rural development organisation and develop and implement training programmes to meet the needs of managers in the agricultural and rural development sector of the Nigerian economy.

1.2.2.4 The Agricultural Credit Guarantee Scheme Fund Act, 1977

The Act seeks to establish a fund to make provision for and guarantee loans granted for agricultural purposes by any bank. All loans granted under the Act shall be applied for the purpose it was meant. Criminal liability is prescribed for any person (including corporations) who contravention provisions of the Act.

1.2.2.5 Agricultural Research Council of Nigeria Act Cap. A12 LFN 2004

The Agricultural Research Council of Nigeria Act provides for the establishment of a research institute by the Council. To this end, Nigeria has several agricultural institutions situated all over the country, such as the International Livestock Research Institute, the Federal University of Agriculture, Abeokuta, the National Root Crop Research Institute etc.

1.2.2.6 Agricultural (Control of Importation) Act Cap. A13 LFN 2004

The Act made provision for regulating the importation of articles to control plant diseases such as those caused by fungus, bacterium, virus or any other organism injurious to agricultural or horticultural crops and pests. The Minister of Agriculture is mandated to make regulations prohibiting, restricting or laying down conditions for the importation from any organism, goods or things, found to, or suspected to be infected with any plant disease or pest.

1.2.2.7 Nigerian Agricultural Insurance Corporation (NAIC) Act Cap. N89 LFN, 2004

The Act seeks to provide a scheme to protect the Nigerian farmer from natural hazards by introducing measures that ensure sufficient indemnity to keep the farmer in business and establish the Nigerian Agricultural Insurance Corporation. This Corporation is responsible for the implementation, management and administration of the Agricultural Insurance Scheme in Nigeria.

1.2.2.8 Agricultural and Rural Management Training Institute Act (Cap A10 LFN 2004)

This Act makes provisions for detailed identification of management training needs in agriculture and rural development organisations and the development and implementation of training programmes to meet the needs of management teams in the agricultural and rural development sector of the Nigerian economy. The policies on Agricultural Practice in Nigeria include:

- Attainment of complete self-sufficiency in all basic food products placing emphasis on those foods that takes up a good chunk of Nigerians foreign exchange.
- Increase in quantity of agricultural-related raw materials produced to make them adequate for the industrial sector and remove the need for importation of such raw materials.
- Increase in the quantity of exportable products begin produced in an attempt to increase the amount of foreign exchange
- Modernization of all aspects of agriculture
- Provision of more rural employment opportunities through agricultural towards increasing farmers income and battering the lot of rural dwellers, which equally provides employment opportunities towards reducing unemployment rate.
- Improvement and protection of arable lands useful for farming and protection of all resources under the ground.
- Establishment of all necessary institutions to cater for the needs of farmers and promote farming.
- Trainin and improvement of Capacity to Support Rural Agricultural Practices in Nigeria.

1.2.2.9 National Economic Empowerment and Development Strategy (NEEDS)

The National Economic Empowerment and Development Strategy aims at promoting growth and reducing poverty through a participatory process. It is designed to encourage private sector participation in the development of the Nigerian economy. This policy is directed at influencing improvement in the production, processing and distribution of agricultural commodities.

1.2.2.10. The Food and Nutrition Policy

Food and nutrition form an integral part of the overall national objective of improving the socio-economic well-being of Nigerians. The policy promotes a viable system for guiding and coordinating food and nutrition considerations into development plans. The Instrument also encourages habits and activities that will reduce the level of malnutrition and ensure that nutrition is used in evaluating developmental policies and promoting good indigenous food cultures and dietary habits for healthy living and development.

1.2.2.11. The National Plan of Action for Food and Nutrition in Nigeria

The policy was launched in 2004 as a flagship infrastructure for realising the rights of Nigerians to adequate nutrition and achieving the Millennium Development Goals. The Plan, which seeks to promote a partnership approach among all stakeholders, contains various activities to address the fundamental underlying and immediate causes of malnutrition.

1.2.2.12. The New Nigerian Agricultural Policy 2001-2013

The Policy document heralds a new policy direction to achieve self-sufficiency in primary food supply and the attainment of food security, promoting an increased application of modern technology to agricultural production and improving the quality of life of rural dwellers things.

1.2.2.13. The National Agricultural Development Fund

The National Agricultural Development Fund is to provide the necessary impetus for the sustainable development of the agricultural sector. It aims at supporting private and public sectors in carrying out activities that will boost agricultural and rural development, with emphasis on comprehensive agricultural research, market development, extensive delivery, long term credit, the development of rural institutions and the promotion of enterprise.

1.2.3 Nigerian Gender-Related Policies

1.2.3.1 The Gender Policy Framework in Nigeria

The 1999 Constitution, the Federal Republic of Nigeria, prohibits discrimination based on origin, sex, religion, status, ethnic or linguistic association. Successive governments have consistently demonstrated commitment to upholding and promoting gender equality and women's empowerment in varying degrees. To facilitate gender equality and women's empowerment, the FGN created favourable national legal and policy frameworks and placed institutional mechanisms in this regard.

Moreover, as a member of the United Nations, Nigeria signed and ratified the various relevant international instruments, treaties, and conventions without reservation. These instruments have always emphasised that member nations put the necessary mechanisms needed to eliminate gender discrimination and ensure equality and human dignity to all men and women.

The government of Nigeria in 2000 adopted a National Policy on Women; it was reviewed and upgraded in 2006 to become the National Gender Policy. Other key government policies with gender equality and empowerment of women frameworks include the National Economic Empowerment and Development Strategies (NEEDS) in May 2004; and the Transformation Agenda.

1.2.3.2 National Gender Policy, 2006

The overall goal of the National Gender Policy of Nigeria is to promote the welfare and rights of Nigerian women and children in all aspects of life: political, social and economic. The policy seeks to plan, coordinate, implement, monitor and evaluate the development of women in the county. In concrete terms, the National Gender Policy in Nigeria focuses on:

- Contribution towards women's empowerment and the eradication of unequal gender power relations in the workplace and economy, in trade unions and broader society;

- Encouragement of the participation, support and co-operation of men in taking shared responsibility for the elimination of sexism and redefining of oppressive gender roles;
- Increase the involvement of women in leadership and decision-making;
- Ensure that through labor legislation and collective bargaining, the particular circumstances of women are considered and that measures are promoted to eliminate discrimination based on gender;
- Ensure that there is a gender perspective in all sectors of development.

1.2.4 Nigerian Institutional Provisions, Regulatory Agencies and Arrangement

1.2.4.1 Federal Ministry of Environment

The Federal Ministry of Environment (FMEnv.), formerly known as the Federal Environmental Protection Agency (FEPA), was established in 1999 through a presidential decree. The Ministry is the statutory government institution mandated to coordinate environmental protection and natural resources conservation for sustainable development in Nigeria. Some of the other mandates of the Ministry include:

- Advising the Federal Government on national environmental policies and priorities, preservation of natural resources, sustainable development as well as scientific and technological activities affecting the environment and natural resources; and
- prescribing standards and formulating regulations on water quality, effluent limitations, air quality, atmospheric protection, ozone protection, noise control as well as the removal and control of hazardous substances.

1.2.4.2 National Environmental Standards and Regulations Enforcement Agency (NESREA)

NESREA is charged with enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria. It also has the responsibility to enforce compliance with international agreements, protocols, conventions and treaties on the environment.

1.2.4.3 Federal Ministry of Agriculture and Rural Development (FMARD)

The Federal Ministry of Agriculture and Rural Development (FMARD) is a Ministry of the Nigerian government regulating agricultural research, agriculture and natural resources. The ministry is responsible for various roles involving national goals of rural development, food security, rural income growth and job creation. The Ministry fulfils its responsibilities through its departments and parastatal. It also supervises and provides funding for research institutes such as the National Root Crops Research Institute and colleges of agriculture and forestry (Agencies (13), Agricultural Research Institutes (17) and Federal Colleges of Agricultural Education (16).

The vision of the Ministry is to grow Nigeria's agricultural sector. Specifically, the concept is to "achieve a hunger-free Nigeria through an agricultural sector that drives income growth, accelerates the achievement of food and nutritional security, generates employment and transforms Nigeria into a leading player in global food markets to grow wealth for millions of farmers".

The Federal Government primarily funds the federal Ministry of Agriculture and Rural Development (FMARD). The Ministry superintends almost fifty parastatal operating as either key departments or agencies.

The Ministry has two (2) major departments, namely Technical and Service Departments.

- i. **Technical Departments:** Agriculture (Trees and Crops), Fisheries, Livestock, Land Resources, Fertilizer, Food Reserve & Storage and Rural Development.
- ii. **Service Departments:** Finance, Human Resources, Procurement, PPAS (Plan, Policy, Analysis & Statistics) and Co-operatives.

1.2.5 Relevant States Regulatory Agencies

1.2.5.1 Delta State Ministry of Agriculture and Natural Resources

The Ministry is responsible for formulating and implementing policies, projects and programmes of the government for the development of the agricultural sector and to monitor the implementation of the following policy objectives:

- Attainment of self-sufficiency in the essential food products for enhanced food security.
- Increase production of Agricultural raw material to meet the growing demand in the agro-allied industries.
- Increase in production of exportable products to attract foreign exchange earnings for the State.
- Modernization of agricultural production, processing, storage and distribution through the infusion of improved technological packages and management so that agriculture can be more expensive to the demands of other sectors of the economy.
- Create more agricultural and rural employment opportunities and improve the living standards of farmers and rural dwellers through enhanced income.
- Protection and improvement of Agricultural Land resources and safety of the environment through appropriate farming systems.
- Establishment of formal support institutions and operation of administrative organs to facilitate the integrated development and realization of the State's agricultural potentials.
- Train and retrain and enlightened human resource stock to make agriculture a business and not a hobby.

1.2.5.2 Delta State Ministry of Water Resources

Delta State Ministry of Water Resources is responsible for attending to issues of water supply in both urban and rural areas.

The ministry undertakes the following core functions:

- early flood warning system monitoring.
- monitor pollution water resources.
- monitor abstraction of water resources.
- develop and implement policies, projects and programmes that will enable sustainable access to safe and sufficient water to meet the needs of the people.
- help to maintain fresh water ecosystem within the state.

1.2.5.3 Delta State Ministry of Environment

Delta State Ministry of Environment manages both human and industrial waste, protects and conserve the environment, and enforces laws on the environment in the state. The ministry is responsible for enforcing environmental laws and addressing ecological and environmental challenges. Core functions of the ministry include:

- developing and creating environmental policies.
- environmental protection and control.
- Public health and sanitation (monthly sanitation exercise).
- Environmental Impact Assessment (EIA).
- environmental technology including efficient implementation of research and development.
- Collaboration with private service providers, PSPs for effective waste management.
- Direct Town cleaning (DTC).
- Waste Management.
- Urban renewal.
- Beautification and greening of major streets.

1.2.6 Delta Affected LGAs Bye-Laws on Environment, Agriculture and others related to the project.

The project would trigger all the environmental and waste management bye-laws of the Ndokwa West LGA.

1.2.7 International Conventions and Agreements applicable to the sector

International agreements, also known as conventional international law, create law for the parties of the agreement. There is a multitude of international agreements relevant to agriculture. These agreements attempt to regulate how governments relate to each other on a host of issues.

Trade agreements are among the most common types of international agreements that contribute to international agricultural law.

Apart from the National Laws, Acts and Regulations, Nigeria is a signatory or party to many International Environmental Conventions and Treaties relevant to the agricultural sector. A list of some of the applicable International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria is presented in Table 1.5.

Table 1.5 Selected international agreements and conventions to which Nigeria is a signatory

S/N	Regulations	Year adopted
1	Convention on Conservation of Migratory Species of Wild Animals	1979
2	African Convention on the Conservation of Nature and Nature Resource	1968
3	Agreement on Agriculture (AoA)	1995
4	Food and Agriculture Organization of the United Nations (FAO)	1945
5	International Rice Commission (IRC)	1948
6	International Fund for Agricultural Development (IFAD)	1977
7	International Plant Protection Convention (IPPC)	1951
8	Convention on Biological Diversity (CBD)	1988
9	World Trade Organization (WTO)	1995
10	United Nations Framework Convention on Climate Change	1994
11	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal	1989
12	Montreal Protocol on Substance that Deplete the Ozone Layer	1987
13	Vienna Convention on the Ozone Layer	1985
14	Convention on the Protection of the World Cultural and Natural Heritage (world Heritage Convention)	1975
15	Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES)	1973
16	Paris Agreement	2015
17	UN Biodiversity Conference – COP 13 of Cancun-Mexico	2016
18	Nagoya Protocol	2010
19	Kyoto Protocol	2004
20	Stockholm Convention against Persistent Organic Pollutants	2004
21	Cartagena Protocol on Bio-safety	2003

1.2.8 The African Development Bank (AfDB)

1.2.8.1 Integrated Safeguards System (ISS)

The E&S safeguards of the AfDB are a cornerstone of the Bank's support for inclusive economic growth and environmental sustainability in Africa. AfDB will apply the Integrated Safeguards System for all subprojects considered under ATASP- 1. The Bank ISS is designed to promote project outcomes by protecting the environment and people from the potentially adverse impacts

of projects. The ISS requires that all the projects comply with the ISS's safeguard requirements during subprojects preparation and implementation. The safeguards aim to:

- Avoid adverse impacts of projects on the environment and affected people while maximising potential development benefits to the extent possible;
- Minimise, mitigate, and compensate for adverse impacts on the environment and affected people when avoidance is not possible; and
- Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage E&S risks.

The ISS consists of four interrelated components, as summarised in Figure 1.1Figure.

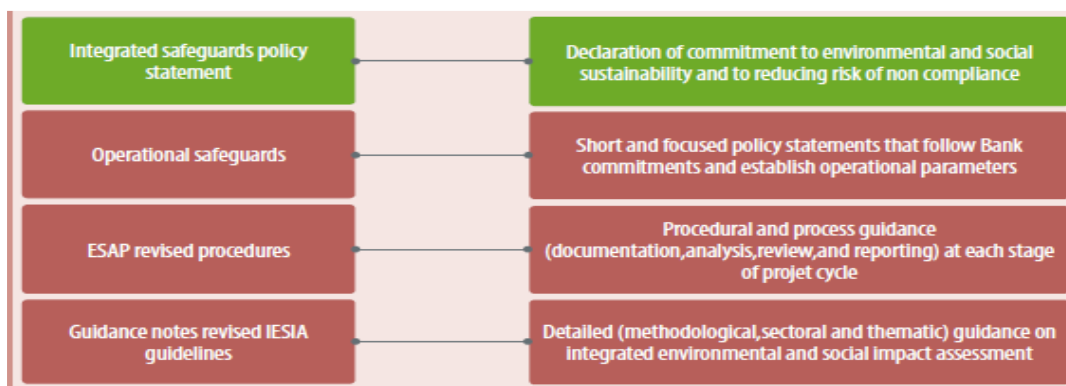


Figure 1.1: Structure of the AfDB ISS

1.2.8.2 The Integrated Safeguards Policy Statement

The Policy Statement describes the common objectives of the Bank's safeguards and lays out policy principles. It is designed to be applied to current and future lending modalities. It considers the various capacities and needs of regional member countries in both the public and private sectors. The Integrated Safeguards comprises of Policy Statement that sets out the basic tenets that guide and underpin the Bank's approach to environmental safeguards. The Bank's Integrated Safeguards Policy Statement sets out the Bank's commitments to and responsibilities for delivering the ISS: to

- ensure the systematic assessment of E&S impacts and risks;
- apply the OSs to the entire portfolio of Bank operations;
- support clients and countries with technical guidance and practical support in meeting the requirements;
- implement an adaptive and proportionate approach to E&S management measures to be agreed with clients as a condition of project financing;
- ensure that clients engage in meaningful consultations with affected groups;
- respect and promote the protection of vulnerable groups in a manner appropriate to the African context.

1.2.8.3 Operational Safeguards (OSs)

These are a set of five Operational Safeguards (OSs, see Table 1.6) requirements that Bank clients are expected to meet when addressing social and environmental impacts and risks. Bank staff use due diligence, review, and supervision to ensure that clients comply with these requirements during project preparation and implementation. Over time, the Bank may adopt additional safeguard requirements or update existing conditions to enhance effectiveness, respond to changing needs, and reflect evolving best practices.

The OSs is intended to:

- Better integrate considerations of E&S impacts into Bank operations to promote sustainability and long-term development in Africa;
- Prevent projects from adversely affecting the environment and local communities or, where prevention is not possible, minimise, mitigate and compensate for adverse effects and maximise development benefits;
- Systematically consider the impact of climate change on the sustainability of investment projects and the contribution of projects to global greenhouse gas emissions;
- Delineate the roles and responsibilities of the Bank and its borrowers or clients in implementing projects, achieving sustainable outcomes, and promoting local participation; and
- Assist regional member countries and borrowers/clients in strengthening their own safeguards systems and their capacity to manage E&S risks.

Table 1.6: AfDB Operational Safeguards OS1-5

Operational Safeguard	Description
OS 1: <i>Environmental and social assessment</i>	This overarching safeguard governs the process of determining a project's environmental and social category and the resulting social and ecological assessment requirements.
OS 2: <i>Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation</i>	This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement and incorporate a few refinements designed to improve the operational effectiveness of those requirements.
OS 3: <i>Biodiversity and Ecosystem Services</i>	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the

Operational Safeguard	Description
	commitments in the Bank's policy on integrated water resources management into operational requirements.
OS 4: <i>Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency</i>	This safeguard covers the range of critical impacts of pollution, waste, and hazardous materials for which they are aligned to international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.
OS 5: <i>Labour Conditions, Health and Safety</i>	This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonisation with most other multilateral development banks.

1.2.8.4 Environmental and Social Assessment Procedures (ESAPs)

The Bank's ESAPs details the specific procedures that the Bank and its borrowers or clients should follow to ensure that Bank operations meet the requirements of the operational safeguards (OSs) at each stage of the Bank's project cycle.

Its adoption and implementation enhance the E&S performance of the Bank's operations and improve project outcomes. The ESAPs will help to improve decision-making and project results by ensuring that Bank-financed procedures conform to the requirements laid out in the operational safeguards (OS) and are thus sustainable. The ESAP describes how the Bank and its borrowers should work together to ensure that environmental, climate change and social considerations are integrated into the project cycle from country programming to post-completion. It represents a coordination mechanism between the Bank, relevant government agencies, and private sector entities. It plays an essential role in building the project's executing agency's environmental, social and climate change management capacity. The Environmental and Social Assessment procedures apply during the entire project cycle, with differentiated tasks performed, roles and responsibilities for the Bank and its borrowers and clients.

Also, the Bank has an integrated system to ensure its E & S requirements are incorporated effectively into the whole programme cycle, i.e., Integrated Safeguards Tracking System (ISTS). The ISTS constitutes an integral part of the ESAP. Table 1.7 is a summary of the vital requirements of the ESAP during each project stage.

Table 1.7: Summary of the AfDB Project Cycle and E & S requirements

AfDB Project Cycle	Details
Country Programming Phase	<ul style="list-style-type: none"> • During country programming, the critical task is to develop and update baseline data on RMCs' E&S components, policies, programs, and capacities to better integrate E&S dimensions into lending priorities. • These are the responsibilities of the Bank's Sector Departments and Regional Departments.
Project Identification Phase	<ul style="list-style-type: none"> • At the project identification phase, the screening exercise focuses on the E&S dimensions of a project to categorise it in one out of four categories based on the potential adverse E&S impacts of the project. • The Bank and FMENnv will conduct these tasks in collaboration with the client.
Project Preparation Phase	<ul style="list-style-type: none"> • During project preparation, the scoping exercise helps define the scope of the Environmental and Social Assessments (ESA) to be completed by the Borrower based on the project category, with staff assistance from the operational departments. • The preparation of these assessments, including the development of management plans and systems, requires consultations with primary and secondary stakeholders. • Once ESAs are finalised, the review process allows operational departments to ensure that Bank's vision, policies, and guidelines were adequately considered in project design and implementation. • The clients/borrower will be in charge of preparing the required studies and plans, while the Bank will be responsible for reviewing and validating them.
Project Appraisal Phase	<ul style="list-style-type: none"> • During the appraisal phase, ESIA Summaries shall be reviewed and cleared by the Safeguards and Compliance Department (SNSC). • The procedures require the public disclosure of summaries under specified deadlines. <ul style="list-style-type: none"> ○ All Category one (1) operations shall be disclosed for 120 days before Board deliberations. ○ All category two operations shall be disclosed for 30 days before Board deliberations. • The Bank will be responsible for conducting site visits and verification activities concerning the borrowers' studies, plans, and systems.
Project Implementation Phase	<ul style="list-style-type: none"> • At the project implementation phase, the Borrowers shall ensure the implementation of E&S management plans developed to address adverse impacts while monitoring the project impacts and results. • The Bank's operational staff shall supervise the Borrowers' work and verify compliance through supervision missions and E&S audits, whenever necessary. • Audits are undertaken during the completion phase, and post evaluations shall also aim to assess the E&S sustainability of

AfDB Cycle	Project	Details
		the results.

1.2.8.5 Integrated Environmental and Social Impact Assessment (IESIA) Guidance Notes

The IESIA Guidance Notes provide technical guidance to the Bank’s borrowers or clients on standards on sector issues or on methodological approaches clients or borrowers are expected to adopt to meet OS standards. The Integrated Environmental and Social Impact Assessment (IESIA) Guidance notes provide a systematic process for addressing projects’ E&S impacts with a clear understanding of the specific sector characteristics.

The IESIA Guidelines' primary objective is to provide reference material to the staff of the Bank and clients on how to adequately consider cross-cutting themes while assessing the E&S impacts of a project. Moreover, the IESIA Guidelines can significantly assist in the project design. Many potential adverse effects can be avoided or mitigated by modifying or adding specific project components to the initial design. As well, improvements in the project design can enhance several beneficial impacts at a minimal cost. Therefore, the IESIA Guidelines regulates how to adequately consider the Bank's priority cross-cutting themes in both the preparation and assessment phases. Thus, the Bank's staff and clients should refer to the IESIA Guidelines throughout the project lifecycle.

The IESIA Guidance notes complement the guidance and formats provided in ESAP and guide clients when undertaking E&S Assessments for Bank-financed projects/programs. The Bank's Operational staff will also use it to review and clear these studies and project supervision. The provision of high-quality technical guidance is key to ensuring effective compliance, capacity and ownership of the ISS for Bank staff and borrowers alike.

The IESIA Guidance Notes are in three stand-alone volumes that guide the three essential components of:

- i. the Environmental and Social Assessment process,
- ii. specific topics and operational safeguard requirements, and
- iii. technical guidance on key sectors and subsectors that functional departments have proposed as areas where guidance is needed.

1.2.8.6 AfDB Project Categorization Process

The ESAP also includes procedural requirements such as categorising projects, disclosing and monitoring projects during implementation and operation. All projects under ATASP will be categorised and structured to meet AfDB ISS requirements. Under AfDB ISS, each subproject

will undergo E&S appraisal to determine a project funding feasibility as well as ensuring that the E&S considerations are incorporated effectively in the planning, implementation, and operation of the subprojects. Each subproject will undergo **initial E&S screening** and be categorised accordingly at the initial stage of the project cycle to determine the nature and level of E&S investigations, information disclosure and stakeholder engagement required. The categorisation shall be done according to the guidelines stipulated in the AfDB ESAPs.

Based on the categorisation, the subprojects will then be subjected to an appropriate E&S assessment and mitigation measures will be formulated to ensure E&S considerations are incorporated in the course of implementing the ATASP- 1 subproject. Table 1.8 summarises AfDB's project categorisation process (detailed in the ESAP).

Table 1.8: AfDB Project Categorization Process

AfDB Project Category	Description
Category 1	<ul style="list-style-type: none"> • Projects likely to cause significant E&S impacts. • Category 1 projects are likely to induce significant and irreversible adverse environmental and social impacts or significantly affect social or ecological components that the Bank or the borrowing country considers sensitive.
Category 2	<ul style="list-style-type: none"> • Projects likely to cause less adverse E&S impacts than Category 1. • Category 2 projects are likely to have detrimental site-specific environmental and social impacts that are less adverse than those of Category 1 projects. • Likely impacts are few, site-specific, largely reversible, and readily minimised by applying appropriate management and mitigation measures or incorporating internationally recognised design criteria and standards.
Category 3	<ul style="list-style-type: none"> • Projects with negligible adverse E&S risks • Category 3 projects do not directly or indirectly affect the environment adversely and are unlikely to induce adverse social impacts. They do not require an E&S assessment. • Beyond categorisation, no action is required. • Nonetheless, to design a Category 3 project properly, it may be necessary to carry out gender analyses, institutional analyses, or other studies on specific, critical social considerations to anticipate and manage unintended impacts on the affected communities.
Category FI	<ul style="list-style-type: none"> • Projects involving lending to financial intermediaries (FI). • Category FI projects involve lending to financial intermediaries that on-lend or invest in subprojects that may produce adverse E&S impacts. • FIs include banks, insurance, reinsurance and leasing companies, microfinance providers, private equity funds and investment funds that use the Bank's funds to lend or provide equity finance to their clients.
Subcategory	<ul style="list-style-type: none"> • The financial intermediary's portfolio is considered high risk. It

AfDB Project Category	Description
FI-A	may include subprojects with potentially significant adverse environmental, climate change, or social impacts and are equivalent to Category 1 projects.
Subcategory FI-B	<ul style="list-style-type: none"> The financial intermediary's portfolio is deemed to be medium risk. It may include subprojects with potentially limited adverse environmental, climate change, or social impacts equivalent to Category 2 projects.
Subcategory FI-C	<ul style="list-style-type: none"> The financial intermediary's portfolio is considered low risk and includes subprojects that have minimal or no adverse environmental or social impacts and that are equivalent.

1.2.9 E&S Assessment of Nigerian Policies and Legislations and AfDB Safeguards Systems

The Nigerian E&S Safeguards system (Federal Ministry of Environment EIA Guidelines) addresses most of the critical elements of E&S Safeguards except for the preparation of ESMF for projects involving multiple subprojects, indigenous peoples, and the required differentiated treatment of vulnerable groups, which are adequately addressed by the AfDB safeguard systems.

Apart from the gaps highlighted above, the main challenge facing E&S safeguarding in Nigeria is the enforcement of these policies, guidelines and legislative provisions. Institutional capacity strengthening and funding are recommended in this ESMF to support the due diligence process and consistent treatment of E&S issues across the subproject intervention areas.

To ensure E&S safeguard during subproject implementation, both the Nigerian and AfDB E&S safeguard systems need harmony. However, in divergence and gaps, the more stringent AfDB safeguard system will take precedence (Table 1.9).

Table 1.9: Comparison of Nigerian Legal Provisions and AfDB ISS specifications

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
ESMF for Projects involving multiple Subprojects. Screening	Not a national requirement EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment OS 1: Environmental and social assessment	OS 1: Environmental and social assessment OS 1: Environmental and social assessment
Scoping	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	EIA Act Cap E12 LFN 2004
Environmental and Social Impact Assessment Guideline	EIA Act Cap E12 LFN 2004 ESIA Procedural Guidelines, 1995 ESIA Sectoral	IESIA Notes ESAP Guidance	ESIA Sectoral Guidelines for production Sector, 2013 and IESIA Guidance Notes ESAP

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
	Guidelines for Production Sector, 2013		
Environmental Categorisation	EIA Procedural Guidelines, 1995 Categories I, II & III	OS 1 – Categories 1, 2,3, and FI for operations involving lending to Financial Intermediaries.	OS 1 – Categories 1, 2, 3, and FI for operations involving lending to financial Intermediaries
Environmental and Social Assessment	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: Environmental and social assessment
Environmental and Social Management Plan	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: Environmental and social assessment
Consultation and Participation	EIA Act Cap E12 LFN 2004	OS1 (include the provision of IESIA Guidance Notes on consultation)	OS1 (include the provision of IESIA Guidance Notes on consultation)
Involuntary Resettlement	-Land Use Act CAP L5 LFN 2004 – Acquisition of Land	OS2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation
Compensation	Cash compensation is generally made based upon market value. Whilst in principle there is allowance for in-kind compensation or replacement of assets, cash Compensation is common practice	OS2: Affected Persons are compensated for all their losses at full replacement cost. They can be offered a range of different compensation packages, Resettlement assistance & livelihood improvement options	OS 2: Affected Persons are compensated for all their losses at full replacement cost. They can be offered a range of different Compensation packages, resettlement assistance & livelihood improvement options
Pollution Prevention and Control	National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991; and National Environmental (Surface & Groundwater Quality Control) Regulations 2011	OS4 – Pollution prevention And control, hazardous Materials and resource Efficiency	OS4 – Pollution prevention and control, hazardous materials and resource Efficiency
Greenhouse Gases	National	OS4– Pollution	OS4 – Pollution

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
	Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991	prevention And control, hazardous materials and resource Efficiency (Special screening for GHGs is also Considered under OS 1)	prevention and control, hazardous materials and resource Efficiency (Special screening For GHGs is also considered under OS 1)
Waste and Hazardous Materials	-National Waste Management Policy -National Environmental Protection (Management Of Solid and Hazardous Wastes) Regulations, 1991 -Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004	OS4 –Pollution prevention and control, hazardous materials and resource Efficiency	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource Efficiency
Resources and Conservation	Natural Resources Conservation Act CAP 349 LFN 1990	OS3: Biodiversity and Ecosystem Services	OS3: Biodiversity and Ecosystem Services
Labour Conditions	Employee Compensation Act, 2010 Labour Act, 1990	OS5 – Labour conditions, health and safety	Employee Compensation Act, 2010 Labour Act, 1990
Health and Safety	Factories Act (CAP F1), 2004	OS5 – Labour conditions, health and safety	OS5 – Labour conditions, health and safety
Natural Habitat and Biodiversity	Forestry Law CAP 51 LFN 1994 Endangered Species (Control of International Trade and Traffic) Act 2016 Natural Resources Conservation Act CAP 349 LFN 1990	OS3- safeguard 3: Biodiversity and Ecosystem Services	OS3: Biodiversity and Ecosystem Services
Gender	National Gender Policy, 2010	Special consideration is given to the needs and rights of women. In the context of Gender vulnerability, the client must consider	There is a need for the project to consider the implications of the AfDB Gender Marker System and how to design and implement an appropriate

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
		the social and political constraints and barriers women may face.	Gender Action Plan for the subprojects
Vulnerable Groups	Some Nigerian policies address the needs of vulnerable people, such as the Gender Policy, Child Act or NEEDS framework. However, there are no specific provisions related to E&S Assessment.	OS 1: Environmental and social assessment. Special attention is given to vulnerable groups.	OS 1: Environmental and social assessment. Special attention is given to vulnerable groups.
Indigenous People	No Provision for indigenous people	OS 1: Environmental and Social Assessment	OS1: Environmental and Social Assessment
Differentiated Measures or Vulnerable Group	No provisions	Provision for Differentiated measures for inclusion	Provision for Differentiated measures for inclusion)
Environmental Monitoring	EIA Act Cap E12 LFN 2004	ESAP	ESAP
Disclosure and Access to Information	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	OS1: Environmental and social assessment

1.2.10 Comparison of Nigerian Law and AfDB OS2 Applicable to Involuntary Displacement

The primary difference between Nigerian legislation and AfDB resettlement standards is that Nigerian law concentrates on compensation for lost assets. In contrast, the AfDB Safeguards have an additional focus on livelihood enhancement (or, as a minimum, restoration). Emphasis is not only on compensation for lost assets but also on assisting people in improving (or at least restore) standards of living, incomes, and livelihoods. This includes providing access to income-earning opportunities such as agricultural production or natural resources deemed critical for subsistence.

The implementation of subprojects will follow Nigerian legislation and will also implement such additional measures as are necessary to achieve outcomes that are consistent with the AfDB Safeguards Standards. Table 1.10 summarises the broad comparison of the AfDB standards for involuntary displacement with the relevant Nigerian legislation.

Table 1.10: Comparison of Nigerian Law and principles of the AfDB OS2

Category	Nigerian Legislation	AfDB OS 2
Minimise Land and Involuntary Displacement	Explore all viable alternative project design options to ensure minimisation of impacts (Land Use Act Cap L5 LFN, 2004)	Project proponent to consider feasible alternative project designs, including re-citing and re-routing, to avoid or minimise physical or economic displacement.
Consultation and Disclosure	The Ministry of Lands usually prepares a notice of acquisition in conjunction with the survey description. This notice is then published in two newspapers (one national and one local and the government gazette	Open, inclusive and effective consultation with local communities is required. Consultation must be (Prior, Free, Informed and Consented) PFIC.
Eligibility	Under Nigerian legislation, all land rights constitute occupancy rights rather than ownership rights and accordingly, eligibility for compensation for loss of land is not provided. Anyone possessing a statutory or customary right of occupancy to affected land is entitled to compensation for unexhausted improvements made to that land. Encroachers are not recognised as an eligible group and are thus not entitled to any compensation provisions.	<p>AfDB identifies three groups of displaced people that shall be entitled to compensation or resettlement assistance for loss of land or other assets taken for project purposes:</p> <ul style="list-style-type: none"> • Those who have formal legal rights to land or other assets recognised under the country's laws concerned. • Those who may not have formal legal rights to land or other assets at the time of the census/asset survey can prove that they have a claim that would be recognised under the customary laws of the country. • Those who have no recognisable legal right or claim to the land they are occupying in the project area of influence and who do not fall into either of the two categories described above but are entitled to resettlement assistance instead of compensation for land to improve their former living standards provided that they or witnesses can demonstrate that they occupied the project area of influence for a reasonable time (at least six months) before a cut-off date established by the borrower or client and acceptable to the Bank.
Census and Asset Inventory	A survey to record the dimensions of the affected land parcels needs to be carried out. The enumeration process is asset driven and not household driven. There is no particular format that the Land Department currently uses. The method mainly comprises generic questions that are administered orally.	A census, asset inventory and comprehensive socio-economic survey are required with gender-disaggregated information.

Category	Nigerian Legislation	AfDB OS 2
Livelihood	Provisions are integrated into the 2004 Land Use Act.	Strategies to improve the livelihoods of PAPs are required.
Gender	National gender policy 2006 and National Climate Change Policy 2021	<p>Special consideration has to be paid to the needs and rights of women. In the context of gender vulnerability, the client must give careful consideration to actively facilitating consultation with both women and men in ways that are sensitive to the social and political constraints and barriers that women and men may face. The land-taking report (RAP or LRF/LRP) must include a specific protocol specifying safeguards for the quality and quantity of land allocated to women, especially widows and divorcees, to ensure their means to generate income and achieve food security.</p> <p>Specifically, applicable to resettlement, land titles at the resettlement site are to be in the name of both spouses and single heads of household, regardless of gender, if this does not conflict with the borrower or client's laws and legislation. Compensation payments to families are made to both husbands and wives when this is technically feasible and socially acceptable.</p>
Cut-off date	Though a cut-off date is not defined by Nigerian legislation, there is a six-week notice period given for land to be acquired by most projects. This notice period is not, however, a formal cut-off date.	There is a requirement to establish a cut-off date for eligibility acceptable to project financiers/lenders. The borrower or client documents the cut-off date and disseminates information about it throughout the project area of influence in a culturally appropriate and accessible manner before taking any action on clearing land or restricting local community access to land.
Timing of Compensation	Once the compensation amounts have been discussed with the affected people.	Compensation is to be made before land, and related assets are taken; and if the project is implemented in phases before project activities begin for each particular stage.
Compensation	Cash compensation is generally made based upon government rate as well as depreciation value. In principle, there is an allowance for in-kind compensation or replacement of assets; cash compensation is standard practice.	PAPs are compensated for all their losses at full replacement cost. PAPs can be offered a range of different compensation packages, resettlement assistance, and livelihood improvement options. Engagement is vital to determine the appropriate compensation packages.
Communal resources	No provisions	Page 32 of the ISS mentions compensation for the loss of communal resources.
Livelihood Assistance	No provisions	Displaced people are provided with targeted assistance to ensure that their living standards, income-earning capacity, production levels and overall means of livelihood are improved

Category	Nigerian Legislation	AfDB OS 2
		beyond pre-project levels.
Vulnerable People	Many Nigerian policies address the needs of vulnerable people, such as the Gender Policy, Child Act, or NEEDS framework. However, there are no specific provisions related to physical or economic displacement.	Special attention needs to be paid to vulnerable groups and special provisions required in the livelihood restoration process.
Grievances	Section 30 of the Land Use Act 1990 6 v: "Where there arises any dispute as to the amount of compensation calculated under the provisions of section 29, such dispute shall be referred to the appropriate Land Use and Allocation Committee."	There is a requirement to establish a culturally appropriate and accessible grievance and redress mechanism to resolve any disputes arising from the land-taking process and compensation procedures in an impartial and timely manner. PAPs must be informed about the mechanism.
Monitoring	No provisions	An independent third party is required to monitor the implementation of large-scale or complicated resettlement or livelihood restoration plans, with regular feedback from PAPs. For large scale displacement operations, quarterly reviews are recommended, and in-depth reviews of 6 months progress, consistent with the overall project scheduling, are critical.

1.2.11 Disclosure Requirements

Disclosure of information will enhance governance and accountability, specifically for the strengthening of monitoring indicators to facilitate compliance with the agreements and assess the impact on outcomes. Table 1.11 presents the disclosure duration requirements of the Nigerian FMEnv and the AfDB. Disclosure duration requirements for AfDB's Category 1 projects are more extended than the FMEnv disclosure period of 120 days. **All subprojects to be funded under ATASP- 1**, therefore, shall comply with the disclosure requirements of 120 days.

Table 1.11: Disclosure requirements of the FMEnv and AfDB

Entity	Project Type	Project Category	Disclosure documents	Disclosure Requirements*
FMEnv	Public and Private sector	Category 1, 2 & 3	ESIA	21-working days
AfDB	Public Sector	Category 1	ESM/ESMP, ARAP or FRAP	120-working days
		Category 2	ESMP	30-working days

	Private Sector	Category 1	ESM/ESMP, FRAP	60-working days
		Category 2	ESMP	30-working days

1.2.12 INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORKS AS APPLICABLE TO THE PROPOSED PROJECT

Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the Proponent and the contractors. These include the following;

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Environment
- Federal Ministry of Finance
- Delta State Ministry of Agriculture and Natural Resources (Proponent)
- AfDB Project Implementation Unit (PIU)
- Delta State Ministry of Environment
- Delta State Ministry of Lands, Survey and Urban development
- Delta State Waste Management Board
- Local Government Authority (LGA)
- The Customary District Councils head of the affected LGA
- Village Chiefs of Affected Communities

The responsibilities and roles of each of the institutions are specified in Chapter Eight.

1.2.13 ESIA PROCEDURAL GUIDELINES

ESIA is an iterative process of interacting with the public, government, stakeholders, contractors and other project planning groups. Any identified unacceptable environmental effects of the project are mitigated through feedback into the design and planning. Constant consultation amongst the ESIA project team members will ensure that all relevant information regarding the design, construction, operation, and maintenance are mutually appreciated. Baseline data for the assessment were acquired through field surveys, questionnaires/interviews, supplemented with published data (literature). These enabled the existing state of the environment to be established, and from which, using criteria set out by EIA Act No. 86 of 1992, this ESIA report was prepared. Upon production of the Draft report and subject to a public hearing, all the stakeholders' inputs shall be captured in the final report.

1.2.14 ESIA TERMS OF REFERENCE

In line with Nigeria's ESIA procedural guidelines (FEPA, 1995), a Terms of Reference (ToR) for the ESIA of the proposed project was developed, for the FMEnv's approval, at the early stages of the study based on an initial assessment of the environmental issues relating to the proposed project. The specific objectives of the ToR were to:

- Define the relevant framework of legal and administrative requirements for ESIA of the proposed project;
- Outline the general scope of the ESIA study, including the overall data requirements on the proposed project and affected environment; and.
- Define the procedures and protocols for identifying and assessing associated and potential impacts and selecting appropriate prevention, reduction, and control as well as enhancement measures for such impacts; and eventually developing an effective Environmental and Social Management Plan (ESMP) for the project. The FMEnv has issued a formal ToR (Annexure 2).

1.3 Report Structure

Table 1.12 provides the structure of the report.

Table 1.12 Structure of Report

Chapter	Content
Chapter 1	Introduction, Background information, Legal and Administrative Framework Provides a background to the proposed project and the EIA and includes information about the Proponent, the EIA consultant team and the report's main goals and structure. It also, outlines the legal framework within which the EIA has been undertaken and identifies other environmental legislation, standards and guidelines applicable to the project
Chapter 2	Project Justification and Alternatives This chapter presents project justification; the need/value and its envisaged sustainability. It also presents the various alternatives considered and those selected.
Chapter 3	Project Description This chapter provides the project description and activities
Chapter 4	Project area of influence and Description of Baseline Environment This chapter presents the project area of influence (Direct and Indirect), approach and methodology for the EIA process. It also describes the biophysical baseline of the project's areas of influence.

Chapter 5	Associated and potential Impact This chapter identifies and assesses potential Project impacts.
Chapter 6	Impact Mitigation Measures Defines relevant mitigation measures to avoid, reduce, compensate or enhance Project impacts (as applicable).
Chapter 7	Environmental and Social Management Plan Presents the Project ESMP, organizing all mitigation, management and monitoring requirements set out in the EIS into thematic management programs.
Chapter 8	Decommissioning/Abandonment Presents the steps to be taken during the decommissioning of the project and the main findings of the EIS report, and recommendations for the following phases of the project
Chapter 9	Conclusion
Chapter 10	References

CHAPTER TWO: PROJECT JUSTIFICATION

2.1 Introduction

This chapter discusses the justification for the project and the description of all alternatives considered to ensure the selection of the least environmentally and socially damaging options.

2.2 Project Justification

2.2.1 Need for the Project

With the continuous expansion in agricultural production, without appropriate fiscal policies to manage the growth of the downstream processing and trading industries, the sector is bound to suffer. This scenario will reduce prices at the farm and in the primary market. Thus, the initial growth will not be sustainable, and farmers' motivation will dwindle. Therefore, growth and expansion must be managed to comply with prevailing industrial opportunities, which requires thoughtful government planning. The proposed PPA and Associated facility is one such contingency plan by the Delta State government.

Processing agricultural materials at the source of production has many advantages. Processing adds value, reduces bulk (by lowering moisture content and other unwanted materials), removes any spoiled or sub-standard materials and helps with grading and packing according to the manufacturing processes involved, providing employment opportunities and technology transfer to the local population. Better quality materials are prepared for the market, and lower quality materials and wastes remain at the point of production. This process makes handling, storing and transporting more efficient and cost-effective. While retaining the characteristics of the original materials, processing should, where possible, also improve shelf life. This can extend the area of distribution and sales. In addition, processing and packaging should enable the product to withstand the demands of transportation and distribution better.

Despite the large and varied production base of farmers in the State and the substantial demand for many fresh and processed foods, the sales performance of the farmers remains poor due to processing facilities. Inadequate agro-processing facilities in the State result in high food losses during the production cycle and once harvested. The high cost of modern technologies, equipment and infrastructure makes it difficult for most small-scale manufacturers working in isolation to keep pace with change. Traditional working methods remain, and the manufacturer cannot meet the standards required for producing high-quality products under hygienic conditions.

The post-harvest practices in the State is also an issue. How foods/materials are collected, handled and transported requires improvement. Distribution mechanisms have to be improved to

reduce the high levels of loss that typify much of production. If the infrastructure is poor, limited roads, non-specialised transport, minimal handling care, inadequate packaging, etc. - then fresh produce will continue to deteriorate at a rate proportional to the distance, time and handling involved. Losses of the order 50 percent, for example, are possible for soft fruits when shipped in an open truck from the local communities to urban areas and other towns within the State during daylight. Losses, by comparison, are negligible for soft fruits shipped overnight by air from East Africa to Europe. The differences are due to packaging and access to experienced management and dedicated transport equipment and facilities. Good handling and marketing facilities are essential to minimise the losses. It is not sufficient to encourage the growth of processing separate from, and independent of, the service industries that provide the support, facilities, and resources essential for commercial success.

Shared facilities are a means of meeting this challenge and may provide both the critical mass and the catalyst that will enable the small-scale processor to compete. Many governments have been pursuing creating shared facilities within the framework of what has come to be called the 'Industrial Park'. The advantages of shared investment, access to technical information and tax incentives, the scale of operation and the provision of services (such as power, water and wastes disposal) are apparent, mainly when seen in retrospect and from a distance.

2.3 Benefits of the Project

The benefits of the SAPZ2 project to the people of Delta State in particular and the economy of Nigeria, in general, include:

- boost farmers' income, reduce poverty, create clusters of economic growth, and increase tax revenue through value additions.
- encourage longer-term private sector investment, thereby assuring the sustainability of industrial development, through government's intervention in creating and maintaining enabling environments
- stimulate private-public partnership
- increase food and nutritional security, create new/green jobs, and thereby reduce rural-urban migration through enhancement of productivity at the farm level
- promote private sector investment in climate-smart and green technologies, enabled by investment in public goods, policy interventions and the provision of pertinent support services and skills development
- reduce the levels of post-harvest loss/deterioration of agricultural produce and increase net profits to farmers
- guarantee availability of feedstock for sustainable input supply to agro-processing plants

- General improvement of the standard of living for the populace.

2.4 Value of the Project

The estimated value of the project is fifteen (15) million US dollars.

2.5 Envisaged Sustainability

Subsection 3.4.1-3.4.4 sets out the general sustainability principles (technical, economic, environmental and social) that guided the project's design.

2.5.1 Technical Sustainability

The proposed project is technically feasible because it is professionally designed, and the technology employed is readily available. The proposed site selection has also considered the accessibility for operation and maintenance work after commissioning. A pool of technical human resources is available in the State to drive the project. The project will be technically sustained by applying international and national best practices to implement the project.

2.5.2 Economic Sustainability

There is a considerable demand for agro and agro-allied products in Nigeria (Fig. 2.1). It shows the potential of the agro-industry towards achieving food security in Nigeria over the past years.

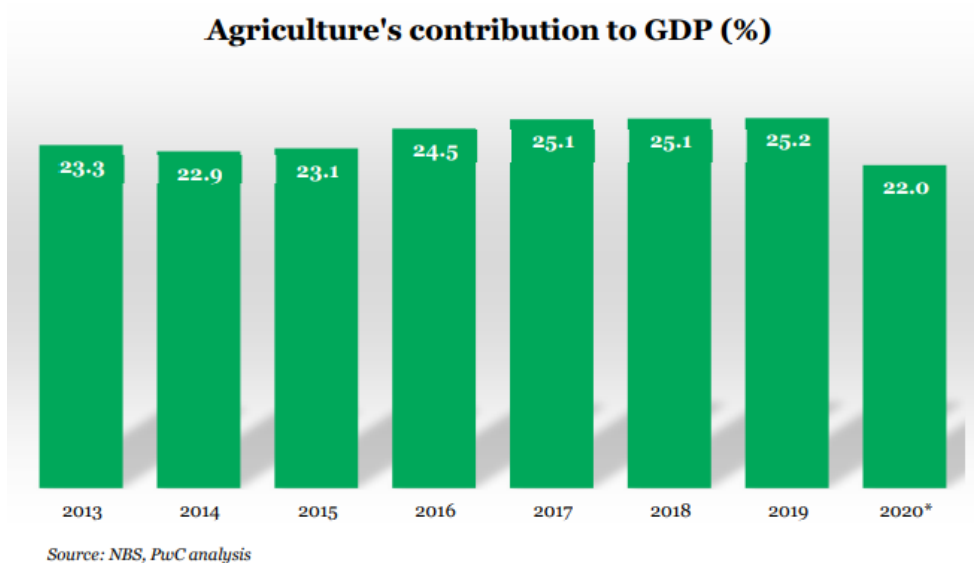


Fig. 2.1: 2-13-2020 Agro Industry Potentials of Nigeria (Federal Ministry of Agriculture and Rural Development, Bulletin 2021)

The project will be co-funded by Delta State Government and the African Development Bank (AfDB). The availability of skilled and unskilled labour force in the project area, functional organisational structure, up takers, and deployment of good industrial best practices in construction technology will make the project economically sustainable.

2.5.3 Environmental Sustainability

The project site has been carefully selected by considering sensitive ecosystems. In addition, practical mitigation measures have been proffered for the identified adverse environmental impacts of the SAPZ 2 project. The State government is fully committed to complying with the relevant national environmental laws, applicable international conventions, AfDB policies and industry best practices. Furthermore, the proponent (Delta State Ministry of Agriculture and Natural Resources) is also committed to implementing the ESMP developed to guarantee environmental sustainability. The proponent also has a whole department that handles environmental matters. The HSE department is headed by a Director who reports directly to the Permanent Secretary. A significant number of ESIAAs and ecological audits have been conducted in the past by the proponent; hence, they have the technical skills needed to manage the mitigations determined for the identified impacts of this project.

2.5.4 Social Sustainability

The project has secured the people's buy-in due to their quest for high food productivity. Also, the benefit to create job opportunities for unemployed indigenes and Nigerians would ensure social sustainability. There are no physical displacement issues in the project area.. The farmers have been fully compensated, except farmers from two communities (Umusam and Ogbole-Ogume) for their crops. In addition, the State government is committed to effective and continuous stakeholders' engagements and consultations. They are also committed to complying with applicable national social laws, relevant international conventions, industrial best practices, requirements, training and retraining the PIU team members on environmental and social management risks.

2.6 Project Options and Alternatives

2.6.1 Project Options

'Do-Nothing' Option

The 'do nothing" alternative means what the situation would be like if the project were not developed. This means that the poor food productivity, which has also been inefficient, inadequate, and unreliable, poor storage and processing facility resulting in food insecurity would remain the same. The 'Do Nothing' alternative does not seem plausible given the legitimacy of the SAPZ 2 project rationale and the benefits to be derived. Regardless of its few negative social and environmental impacts, the project will provide job opportunities during its operation phase and additional job and economic opportunities. The Do-Nothing option is **rejected** based on the following;

- Facilities would be absent for the processing and storage of agro and agro-allied products.

- There shall be a loss of potentially accruable revenue to the government
- Foreclosure of anticipated employment opportunities
- Foreclosure of expected technology transfer

Delayed Project Option

This would arise if civil unrest or public opinion is against the development or the socio-economic and cultural impacts of the project are not favourable, given available mitigation options. This would mean that all planning and development activities would be stalled until favourable conditions. This option would therefore delay the increase in food production. This option was **rejected**.

Project Implementation Option

The immediate project implementation option entails the development of the PPA and Associated Infrastructure project. This ESIA report has undertaken a detailed impact assessment to demonstrate the inherent benefits and minimise the negative impacts. This option was **accepted** because the execution of the project will boost job opportunities, peace and security, technology transfers, reduction in overdependence on the Oil & Gas sector, increased food productivity and national economic growth.

2.6.2 Analyses of Alternatives

The following alternatives were considered:

- Site / location alternatives
- Industry type alternatives
- Subcomponents alternatives
- Power alternatives
- Shed design alternatives
- Drainage alternatives
- Water supply alternatives
- Waste management alternatives

Table 2.1 presents detailed analyses of the alternative options considered for the proposed PPA project.

Table 2.1: Analysis of Project Alternatives

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
1	Industry Type.	Solid mineral processing Agro-processing.	Agro-processing Industry	<p>Several studies, including Atulegwu (2020) and report from the Delta State Government publications, revealed vast deposits of solid minerals within the state - industrial clay, silica, lignite, kaolin, tar, sand, decorative rocks, limestone; these are raw materials for industries such as brick-making, ceramics, bottle manufacturing, glass manufacturing, chemical/insulators production, chalk manufacturing and sanitary wares, decorative stone cutting and quarrying. However, the prohibition by international financial institutions in funding projects contributing to net positive carbon emissions and their reluctance in funding projects that poses significant environmental concerns coupled with the diversification agenda of the present administration makes investment in solid mineral exploitation unattractive. Hence Solid mineral processing industry for Delta State is rejected.</p> <p>The focus of the Buhari administration in agribusiness and the reality that Delta State is the 3rd largest contributing State to Nigeria's GDP makes agro-processing a priority. Also, agriculture in Delta State is the 2nd largest revenue contributor, making agro-processing a haven. Yet, the cultivatable area and yields per hectare remain primarily low. More so, more than three-quarters of these harvests are lost to poor storage, off-season and low conversion into processed products. These challenges further contribute to food insecurity in Nigeria. Therefore, the establishment of an agro-processing park is selected.</p>

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
		Logistic and haulage Packaging and storage. Agricultural extension services Research and Development Cold Chain Dam Input distribution platform Service centre Food quality control Feeder road	Logistic and haulage Packaging and storage. Research and Development Cold Chain Input distribution platform Service centre Food quality control Agricultural extension services	<p>Dams and feeder roads are essential infrastructures for agricultural production. However, their establishment in various parts of the State makes its inclusion in this ESIA study non-feasible. The State government, RAAMP and other programs are constructing dam and feeder roads in targeted agro producing areas, and including it in this project amounts to duplication. Therefore, this option is rejected.</p> <p>Nonetheless, the supplied perishable agro produce and processed goods need to be stored in a Cold Chain before and after processing; hence Cold chain option is selected.</p> <p>The need for the processed goods to be packed makes the selection of the packaging option imperative.</p> <p>The requirements that all processed goods should meet SON and NAFDAC specifications inform the selection of food quality control and Research/Development options.</p> <p>Transportation of processed goods for export and distribution requires the selection of logistics and haulage.</p> <p>The incidence of pest, continuous soil cultivation and improved farming methods makes it imperative for input distribution centres and extension services to be included in the SAPZ project. Hence input distribution centres and agricultural extension services are selected.</p>

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
		Cocoa (cassava, plantain, yam, oil palm, fish farming, pineapple, piggery, vegetables and rice)	Industrial Cassava, Rice, plantain, yam, oil palm, fish farming, pineapple, piggery and vegetables	While Delta State does not rank among the top five (5) cocoa-producing States in the country, the State, however, ranks favourably in cassava, plantain, yam, oil palm, fish farming, pineapple, piggery, vegetables and rice production (World and regional statistics, national data, maps and rankings, 2020). The absence of industries exploiting vegetable (fruit and leafy), cassava, plantain, yam, oil palm, fish farming, vegetables and rice for producing ethanol, drugs, chemicals, reagents, starch, alcoholic beverages, fertilisers, etc. in the State amidst the considerable raw material availability imposes on Delta SAPZ the inevitability of utilising these harvests. Thus the option of cocoa is rejected while (cassava, pineapple, plantain, yam, oil palm, fish farming, piggery, vegetables and rice production) is selected .
2	Water supply.	Groundwater Surface water State water board Private water supply	Groundwater and State water board Private water supply	Water supply is required for agro-processing industries, and the abstraction of water from rivers and streams are not environmentally friendly. Also, considering the relatively long distance of water bodies to the Park, the option of surface water as a water source is thus rejected . The need for water supply in the PPA assumes greater importance because of the ease of accessing the aquifer layers in the area. Moreover, the success of accessing groundwater in about 100% of drilled cases makes groundwater sources feasible, and this option is thus selected . Furthermore, groundwater supply will be complemented by supplies from the State water board agency and private water suppliers, and these options are also selected .

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
3	Power source.	National grid; Coal Gas power plant.	A gas-powered plant backed up by the National grid power supply.	<p>Coal occurs naturally in the crust, and it is an abundant source of energy for industrial activities. It can be burned directly, transformed into liquid, gas, or feedstock and can be used to produce fuel at an affordable cost. Although coal deposits exist in Delta State, it generates considerable waste, emits SO₂, Nitrogen Oxide, ash, and it is a significant contributor to global warming. This option is thus rejected.</p> <p>The proposition to power the Park with Gas would result in a cleaner environment and a cheap energy source. Also, AfDB lends credence to projects with little likelihood of impacting climate change. Moreso, Delta State ranks first in gas production, and the project area is the highest gas province in the country. Several gas pipelines characterise the area, and this option is thus selected.</p> <p>Similarly, since the project area is connected to the National grid, it makes sense that the Park's secondary power needs are served from this source. This source is co- selected.</p>

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
4	Drainage.	Point drainage Channel drainage	Channel drainage	<p>The Channel drainage option is selected for the project because it intercepts water along the entire run of the channel. Channel drainage is typically constructed with concrete, steel, polymer or composites. The interception rate of channel drainage is more significant than point drainage, and the excavation required is usually much less deep. More so, it is more efficient, less laborious and environmentally friendly. Thus, this alternative is selected.</p> <p>Unlike the Channel drainage, the Point drainage intercepts water at gullies (points). Gullies connect to drainage pipes beneath the ground surface, and deep excavation is required to facilitate this system. More so, this drainage type requires deep trenches in the shape of planking, strutting or shoring, which are generally expensive, time-consuming and environmentally hostile. Furthermore, the need for a Permit to install drainage beneath ground level makes this option unattractive. Hence, this alternative is rejected.</p>
5	Sewage disposal	On-site disposals systems Sewage lagoons Sewage pre-treatment plant	Sewage pre-treatment plant.	<p>Sewage lagoons are oxidised to allow light, warmth and oxygen necessary for bacterial and alga growth in the water to induce sewage and effluent breakdown. Sun and wind help with the evaporation of the water and subsequently create waves that stop insects from breeding and living in the effluent. Although this disposal system's installation and operational costs are generally low compared to other technologies assessed, the system's inability to remove phosphates poses an eutrophication risk in downstream areas where flow rates in the river are slower. Also, this system requires extensive land area, which could be used for other productive</p>

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
				<p>use. Based on these challenges, this option is rejected.</p> <p>On-site Disposal system: This alternative is achieved using septic tanks and leach drains. This system treats the sewage and is disposed into leach drains as effluent in a designated area close to the facility. The sewage can be treated in a septic tank or macerator system. Nonetheless, there is the issue of slow-draining sinks and toilets, gurgling sounds in the plumbing, constant plumbing backups, strong sewage odours and stagnant water. This option is thus rejected.</p> <p>The sewage pre-treatment plant is best suitable for the Park. Though expensive, it is environmentally friendly, efficient and fast. The pre-treatment plant shall consist of pre-engineered and pre-fabricated structures with minimal construction impacts suitable for larger industrial parks. The use of sewage treatment plants is international best practice.</p>
6	ATC/AC Locations	Per LGA Per Senatorial District Per Federal Constituency	Per Federal Constituency	<p>The ‘‘Per LGA’’ option was rejected because some LGAs do not have communities hosting CBN anchor borrowers scheme. The per Senatorial District option was Rejected it does not fully reflect the various agro belts in the state. The per federal constituency option was selected to reflect the various agro producing belts of the State, to fully engage communities hosting CBN anchor borrowers schemes so as to link the produce to uptakers and to provide a sense of belonging and to avoid community issues</p>

S/N	Alternatives	Options Considered	Selected Alternatives	Justification
7	Site Alternative	(D) Agbor (Ika South LGA) (E) Issele Uku (Aniocha LGA) (F) Kwale (Ndokwa West LGA)	Makurdi	<p>Though options A and B are centralized and characterized with high population to support the proposed project, poor road infrastructures and the need for land acquisition and all the attendant concerns make their selection challenging. Thus options A and B were Rejected.</p> <p>Conversely, ease to accessibility, highly agrarian characteristics, availability of government acquired land with a well mapped out area and more so, siting the proposed project within the operational vicinity of other industrial facilities would confer economic scale on all existing industries. Thus the Kwale option is Selected.</p>

CHAPTER THREE: PROJECT DESCRIPTION

3.1 General

This chapter described the key elements and planned activities of the proposed establishment of the PPA and Associated Infrastructure (which forms the Special Agro Processing Zone) in Ndokwa West Local Government Area of Delta State. The project-affected communities are Obodo Ugwa, Emu Ebendo, Umuseti, Umusam and Ogbole Ogume respectively. Impact prediction is dependent on an excellent understanding of the project activities and scope, as presented in chapter six of this report.

3.2 Project Overview

The Delta State government has identified an opportunity to establish a cluster of Agro-processing industries in a proposed free trade zone within the Kwale Industrial area in Ndokwa West LGA and Associated Facilities in all Federal constituencies in Delta state, with Agro, produce processing, storage, logistics and haulage, quality assurance laboratory and cold chain services as core business activities. The project aims to offer state-of-the-art infrastructures and services comparable with International Best Practices. The land-take for the proposed SAPZ project is 200ha out of which 1000ha designated for the Industrial Park.

A break down of the allocated land area for the SAPZ project is as follows:

- Industrial area (150 hectares)
- Laboratory - 15 hectares
- Cold Chain - 5 hectares
- Truck and Car park area (10 hectares)
- Office buildings (2 hectares)
- Green belt (5 hectares)
- Buffer corridor/setback (1 hectare)
- Reserve for future planning (4 Hectares)
- Internal road network (3 hectares)

Service Area (5 hectares) which will include the following;

- Power Generation Plant
- Sewage Treatment Plant
- Forklifts Workshop
- Fire station
- Telecommunication and Information Technology (IT) infrastructure
- Security

Campsite shall not be established. PAPs within the PACs shall be engaged to do all ancillary works. The Delta State government will be responsible for employment, site development, infrastructure development and allocation of sheds and Industrial units to prospective private investors. This project covers the establishment of;

- Industrial shed
- Internal Roads
- Drainage System
- Street Lighting
- Green Area
- Water Supply

Other components of the project include the Agricultural Transformation Centers (ATCs) and Aggregation Centers which would be established at CBN-Anchor borrower's farms. The ATC and AC centres shall handle services such as Agro-produces storage, certification, distribution and training. Table 3.1 shows the conceptual spacial distribution of facilities in the ATCs and ACs of Delta-SAPZ.

Table 3.1: Conceptual Spatial Distribution of Facilities in the ATCs AND ACs of Delta-SAPZ

	SENATORIAL DISTRICTS/FED CONSTITUENCY	LOCATION FOR CENTERS	SERVICES	Qty/Capacity	CROPS/SERVICE DESCRIPTION	REQUIRED LAND TAKE (Hectare)	Coordinate
AGRICULTURAL TRANSFORMATION CENTERS, ATCS (2 No) in the 2 other Senatorial Districts. The Hub at Kwale is in Delta North.							
1	Delta Central	Uwheru, Ughelli North LGA	Agro-Product Certification Centre (APCC)	2	Laboratory certification for all agro produce value chains for consumption and export (national and international market)	0.5	Provide over time
			Haulage Services/Truck Park (HSTP)	1	Hauling of all agro produce value chain from Kwale Hub and other SAPZ in the country. Transporting agro produce from the ATC to clients such as retailers and wholesalers	2.5	
			Mini-Secondary Processing Sheds	2	Provision of Mini-secondary processing, Primary processing services (cleaning, drying, grading), and medium packaging facilities	3	
			Product Storage Structures (PSST)	4 nos. 600 tonnes/12000 bags	Warehousing all agro produce value chain from Kwale Hub and other SAPZ in the country	<u>4.</u> Total =10	
2	Delta South	Uzere, Isoko South LGA	Agro-Product Certification centre (APCC)	2	Laboratory certification for all agro produce value chains for consumption and export (national and international market)	0.5	Provide over time
			Haulage (HSTP)	1	Hauling of all agro produce value chain from Kwale Hub and other SAPZ in the country. Hauling agro produce from the ATC to clients such as retailers and wholesalers	2.5	
			Mini-Secondary	2	Provision of Mini-secondary processing, Primary	3	

			Processing Sheds		processing services (cleaning, drying, grading), and medium packaging facilities		
			Product Storage (PSST)	4 nos. 600 tonnes/12000 bags	Warehousing all agro produce value chain from Kwale Hub and other SAPZ in the country	4.	<u>Total =10</u>
AGGREGATION CENTERS, ACs (10 No) in Federal Constituencies							
1	Aniocha North and South / Oshimili North and South	Ugboodu, Aniocha North LGA	Agro-Produce Warehouse (APWH)	2 nos. 514 tonnes/10285 bags	Rice, Yam, Cassava, Maize, Oil palm, tomatoes, vegetables	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5	
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Storage of fresh perishables (e.g. Tomatoes, vegetables, etc.)	<u>0.5</u>	
2	Ika North East / Ika South	Umunedede, Ika North East LGA	Agro-Produce Warehouse (APWH)	2 nos. 514 tonnes/10285 bags	Plantain, maize, yam, vegetables, oil palm	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	

			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5	
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Tomatoes, Okra, vegetables	<u>0.5</u> <u>Total = 6</u>	
3	Ndokwa East, Ndokwa West / Ukwuani	Susakam susa of Amai and Umuebu, Ukwuani LGA	Agro-Produce Warehouse (APWH)	2 nos. 514 tonnes/10285 bags	Yam, cassava, fishery products and rice, oil palm	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5	
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh fishery products	<u>0.5</u> <u>Total = 6</u>	
4	Ughelli North and South / Udu	Otor-Udu, Udu	Agro-Produce Warehouse (APWH)	2 nos. 514 tonnes/10285 bags	Cassava, Rice, Maize, vegetables, fishery products and Oil palm	15	Provide over time

		LGA	Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	1	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	3	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	3	
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh vegetables and fishery products		
5	Okpe / Sapele / Uvwie	Deghele, Sapele LGA	Agro-Produce Warehouse (APWH)	12 nos. 514 tonnes/10285 bags	Rice, Cassava, vegetables, fishery products and Oil Palm	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5	
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675	Fresh vegetables and fishery products	<u>0.5</u>	
						<u>Total = 6</u>	

6	Isoko North and South	Iyede, Isoko North LGA		boxes			
			Agro-Produce Warehouse (APWH)	2 nos. 343 tonnes/6857 bags	Oil palm, Vegetables, Cassava, fishery products, Plantain, and Maize	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5	
Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh vegetables and fishery products	<u>0.5</u> <u>Total = 6</u>				
7	Warri North / Warri South / Warri South West	Koko, Warri North LGA	Agro-Produce Warehouse (APWH)	2 nos. 514 tonnes/10285 bags	Cassava, fishery products, plantain, and Rice	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction	2	Extension services & training on financial literacy, business development and management, productivity	0.5	

			Hall (TEIH)		improvement, market information for trading, negotiation and investment planning.		
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh fishery products	<u>0.5</u>	<u>Total = 6</u>
8	Ethiopia East / Ethiopia West	Oghareki , Ethiopia West LGA	Agro-Produce Warehouse (APWH)	2 nos. 343 tonnes/6857 bags	Oil palm, Vegetables, fishery products, Cassava and Maize	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1	
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5	
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh vegetables and fishery products	<u>0.5</u>	
9	Bomadi / Patani	Bulu-Angiama , Patani LGA	Agro-Produce Warehouse (APWH)	2 nos. 514 tonnes/10285 bags	Cassava, Oil Palm, Plantain, Rice, and fishery products	2	Provide over time
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5	
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5	
			Agro-Input	2	Seeds, fertilizer, herbicides, etc.	1	

			Distribution Shed (AIDS)					
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5		
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh fishery products	<u>0.5</u>	<u>Total = 6</u>	
10	Burutu	Okpokunu, Burutu LGA	Agro-Produce Warehouse (APWH)	2 nos. 343 tonnes/6857 bags	Cassava, Oil Palm, Plantain, Rice, and fishery products	2	Provide over time	
			Park/Shed for Haulage Services, Machinery and Equipment (SHME)	1	Transport of produce and machinery & equipment for hire: (tractors, »planters, power tillers, harvesters, trucks), and »Provision of Primary processing services: cleaning, drying, grading and proper packaging	1.5		
			Agro Microfinance Bank (AMFB)	2	Lending for Agribusinesses	0.5		
			Agro-Input Distribution Shed (AIDS)	2	Seeds, fertilizer, herbicides, etc.	1		
			Training and Extension Interaction Hall (TEIH)	2	Extension services & training on financial literacy, business development and management, productivity improvement, market information for trading, negotiation and investment planning.	0.5		
			Cold Chain Storage Room (CCSR)	2 nos. 12.5 tonnes/675 boxes	Fresh fishery products	<u>0.5</u>		<u>Total = 6</u>

- ✓ Commissioning
- ✓ Operation/maintenance
- ✓ Decommissioning/Abandonment
- ✓ Closeout

It is to be noted that the project activities cover the construction of the park and ancillary systems and not the equipping or internal installation in each shed. The latter shall be subject to a standalone ESIA study.

3.5 Infrastructure Development

3.5.1 Site Preparation

The cutting and filling method will be used for site preparation. Vegetal clearance shall be limited to the immediate areas required for construction. Bulldozers, tractors, JCB Dumper, and mechanical Hammer will be used for site preparation.

3.5.2 Road Development

The development of roads is an integral part of planning for an industrial park. Although the Asaba-Ughelli express road is the site Approach Road, the State government plans to develop the internal road networks as part of its commitments to the project. Details of internal road construction are provided in section 3.5.7.3.

3.5.3 Project layout and design

The project shall be executed in phases.

- Phase one (1) shall involve service areas and last for two months.
- Phase two (2) shall involve the construction of industrial sheds and administrative offices. The duration is six months.

There shall be no interval between phase one and phase two. The schematic layout of the sheds and the service areas are presented in Figures 3.2 and 3.3.

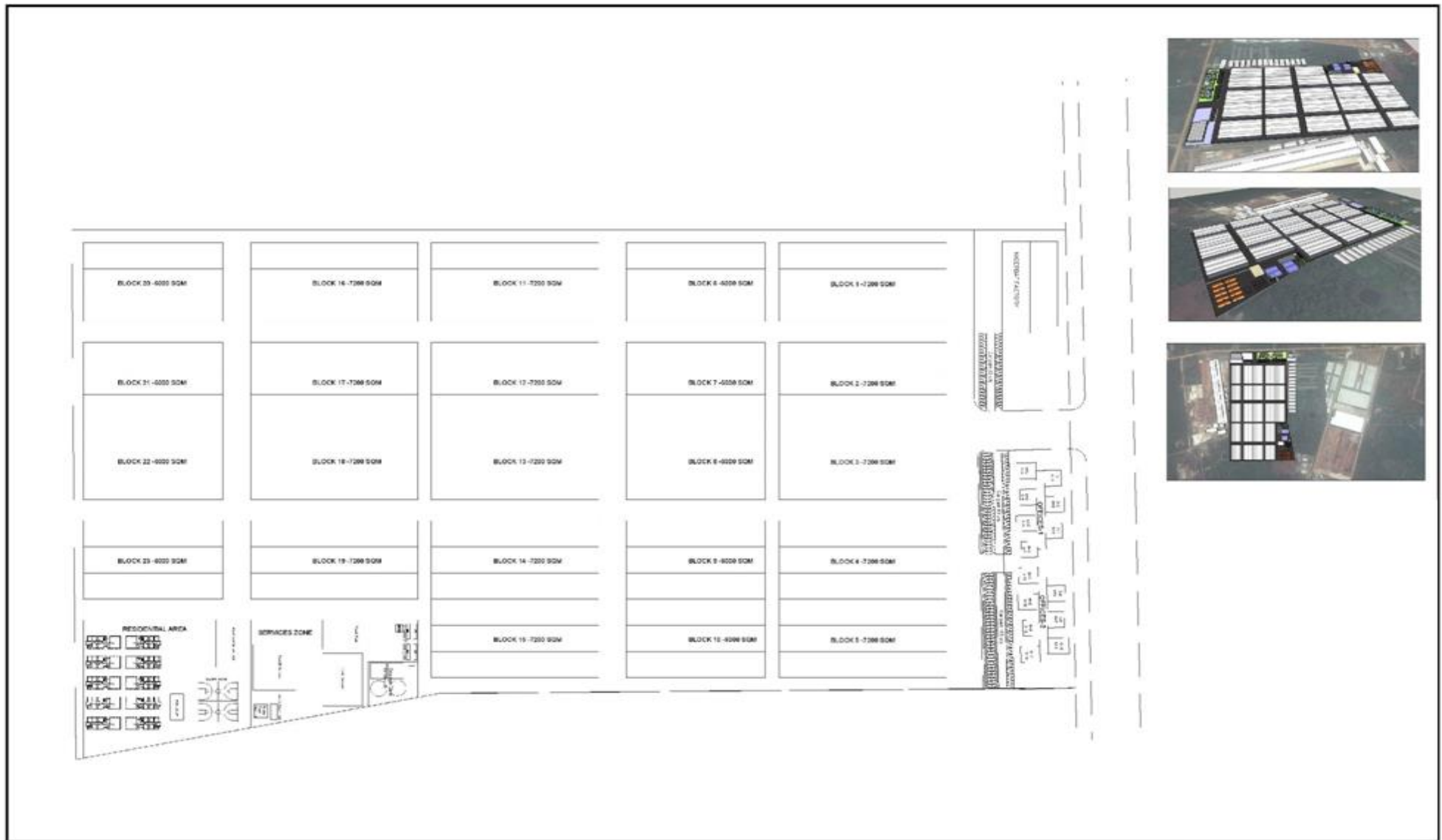


Figure 3.2: Layout of planned industrial sheds

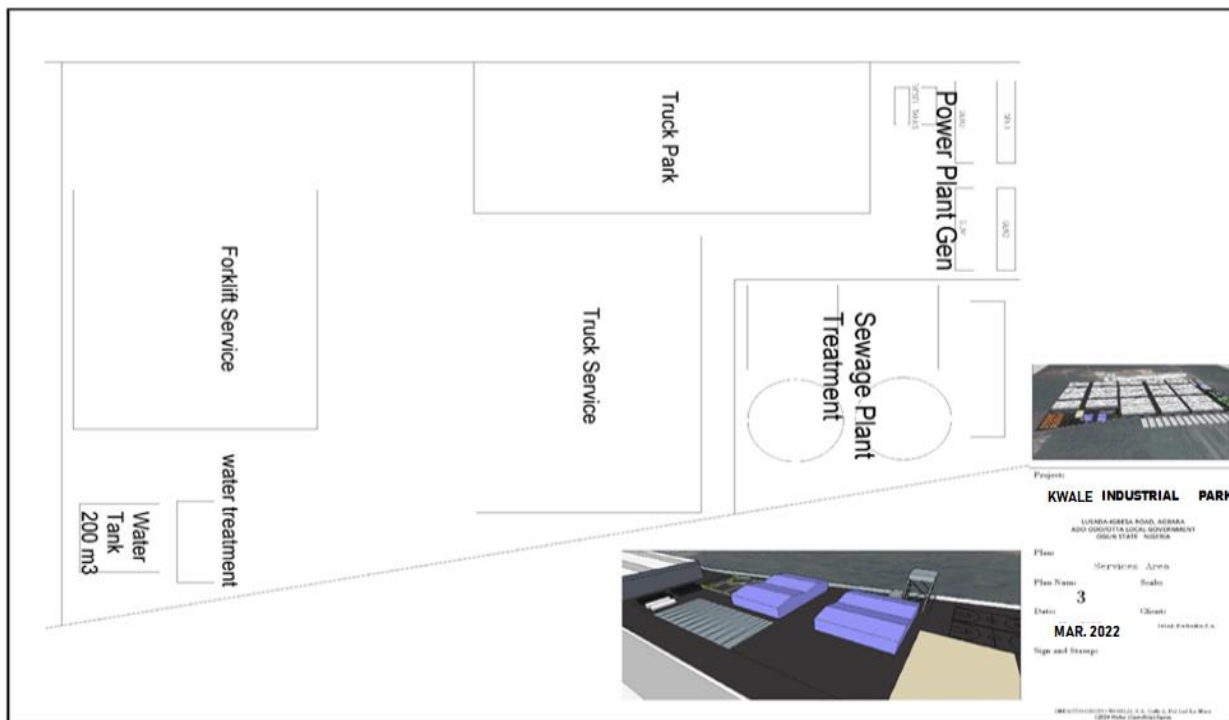


Figure 3.3: Layout of the service area

3.5.4 Applicable Standards

The applicable engineering standards for the proposed project are;

Table 3.2 Nigerian Standards/Organisations

FMEnv	Federal Ministry of Environment
PHCN	Power Holding Company of Nigeria
NBC	Nigerian Building Code
NERC	Nigeria Electricity Regulatory Commission
NEPZA	Nigeria Export Processing Zone Authority

Table 3.3 International Standards/Organisations

BS	British Standards
IEC	International Electro-technical Commission
IBC	International Building Code
WBS	World Bank Standards
AfDB	African Development Bank Standards

Table 3.4 US Standards

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
API	American Petroleum Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CMAA	Crane Manufacturers Association of America

HEI	Heat Exchange Institute
IEEE	Institute of Electrical and Electronics Engineers
ISA	Institute Society of America
NACE	National Association of Corrosion Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NESC	National Electric Safety Code
OSHA	Occupational Safety and Health Administration
PCI	Precast Concrete Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code

3.5.5 Shed Design

The design of the 180 - sheds took into cognisance the following criteria;

- Proposed factory site
- 100% flexibility in expansion
- Single-storey access requirement
- Size of equipment to be housed
- Drainage requirement
- Waste treatment, food safety and hygiene conditions.

The design also considered no ingress of dirt, rodents/insects and suitable weatherproofing materials to protect production and finished materials from contamination.

The design entailed erecting a steel frame and then laying bricks to fill between the steel frameworks with cladding as an external finish. The steel frame is proposed as a portal frame or lattice beam supported on a column.

In areas with high sided steel frames, the wall would be reinforced with wind bracing, as high sided steel frames can be unstable during high winds. Roofs of steel-framed buildings are

usually supported on steel purling. The roof shall be constructed with a single apex since multiple apex roofs are notorious for leaking.

Hygienic conditions of raw and finished products were factored into the design of the factory walls, floors and ceilings.

The use of cladding is proposed for the walling as grouting is less demanding on this surface than on tiles which are also susceptible to cleaning chemicals and crevice production.

Cladding sheets would be joined using suitable mastic or rubberised sealants. The sheets to be used include stainless steel, polyester, aluminium glass, reinforced plastics and Polyvinyl Chloride (PVC) laminates. The use of metal protectors is planned at wall corners to prevent chipping.

Since foam-filled panels are major fire risks, partitioning walls are constructed from mineral wool and rock wool.

Walling, flooring, and ceiling materials are proposed to be adaptable to foaming, fogging, scrub-down, and cleaning techniques. The project is planned to adjust to 'Just in time principles' (JIT), utilising the packaging sheds nearby to supply raw materials. All Construction materials for sheds will be sourced locally (from local vendors).

CEILING DESIGNS

Solid ceilings are to be used over suspended ones (false). This is due to the inherent risk of dust, dirt, insect and vermin associated with the latter design. Lay-in panels and metal-forced panels are proposed for ceiling finishes, allowing sufficient strength to enable one to walk on them.

FLOORS

The surface coatings on floors need to be robust since significant wear can result from the movement of heavy items, cleaning and forklift trucks. The floor is designed to be suitable for food products, ingredients and equipment, durable, free-draining, cleanable and hygienic, low cost, adaptable and repairable if damaged.

Thick ceramic tiles are proposed, though expensive but durable and effective over epoxy coating concrete and PVC vinyl. Around pillars and supports, tiles or flooring would be curved to allow ease of cleaning. Tank legs are best mounted on concrete plinths for the same reason.

Doorways require rising to prevent material washing or blowing into the clean area.

3.5.6 Design for Laboratory facility

A specialised shed will also be constructed for laboratories. The laboratories shall be used for agro-product certification and quality assurance. Several scientific tests and analyses of agro and agro-allied products will be conducted before exporting. The design of the laboratory shall be according to health and safety guidelines for best practices.

These health and safety guidelines shall be incorporated, as appropriate, in facility-specific construction documents to ensure that health and safety protection is engineered into the design of any new or renovated facility and at the time of construction of the facilities.

The laboratory shall be designed for easy cleaning and decontamination. Carpets or rugs shall not be used. Spaces assigned between benches, cabinets, and equipment shall be accessible for cleaning. All Construction materials for laboratories will be sourced locally (from local vendors).

Laboratory Furniture and Equipment

Furniture and cabinets/counters shall be as vertically flush as possible. Knee-hole space shall be provided for waste containers to allow better movement in the laboratory and increase safety. The planned laboratory furniture shall be capable of supporting anticipated loads and uses.

Casework

Laboratory casework shall be easily cleanable, and finishes should be compatible with materials used for cleaning and disinfection. Fixed casework and countertops shall be sealed to walls and floors to minimise the harbourage of pests and provide a cleanable joint. Traditional chemical-resistant plastic laminates may be appropriate for some applications. Epoxy resin will apply to most applications in cases where corrosive chemicals are used or

where sinks or heavy water usage occurs. Stainless steel shall be used for all glassware wash areas, cold rooms, and other areas as necessary based on usage.

Chemical Fume Hoods

All containment devices shall be located in the laboratory to avoid entrapment, blocking of egress, or safety hazards to the lab occupant. Fume hoods shall be located away from areas that produce air currents or turbulence, such as high traffic areas, air supply diffusers, doors, and operable windows. Fume hoods shall also be labelled to identify the fan or ventilation system where they are connected.

Autoclaves

A method for decontaminating all laboratory wastes shall be available in the facility. Autoclave space shall be finished with epoxy coatings and shall not have a suspended, acoustical ceiling. This area shall be thoroughly caulked and sealed to promote cleanliness and reduce pest harbourage. The space shall have adequate exhaust capacity to remove heat, steam, and odours generated by using the autoclave(s).

Gas Cylinders

If gas cylinders are to be placed in the lab, they should be adequately secured to a vertical surface or counter out of the way of traffic in the space.

Biological Safety Cabinets (BSCs)

BSCs shall be connected to the laboratory exhaust system by either a thimble (canopy) connection or a direct (hard) connection to allow 100% of the filtered exhaust air to be discharged out of the laboratory. The expense for installation and maintenance of a total-exhaust BSC is much higher. It, therefore, shall only be selected and installed when justified based on the specific type of research being conducted in the lab. BSCs shall be located away from doors, windows that can be opened, and heavily travelled laboratory areas. This will help to minimise air pattern disruption in the cabinet.

Architectural finishes

Floor and Base Materials

Floor materials shall be non-absorbent, skid-proof and resistant to the adverse effects of acids, solvents, and detergents. Materials such as vinyl composition tile (VCT) or rubber tile should be installed.

Walls

Wall surfaces shall be free from cracks, unsealed penetrations, and imperfect junctions with ceiling and floors.

Ceiling

Fire code requires laboratories to maintain an 18-inch ceiling clearance between sprinkler heads and materials stored in the lab to ensure that sprinklers can adequately disperse water without being blocked by storage materials near the ceiling. When storing lab supplies, all laboratory shelving units shall be installed far enough below the ceiling to maintain the required 18-inch ceiling clearance.

Windows and Window Treatment

Windows shall be non-operable and shall be sealed and caulked. Window systems that use energy-efficient glass shall be used.

Doors

Vision panels are recommended for all laboratory doors. If larger equipment is used, wider/higher doors should be considered. Laboratory doors should be recessed and swing outward in the direction of egress. Door assemblies should comply with all appropriate codes.

Equipment Pathway

The potential routing or pathway for the addition or relocation of heavy equipment shall be reviewed and identified during the design phase.

Hazard Communication Signage

The laboratory shall have a signage holder for displaying hazard communication information at the entrance door.

Plumbing

Sinks

Automated sinks shall be installed near the exit door.

Emergency Showers and Eyewash Stations

At least one emergency shower and eyewash station shall be installed. These emergency showers and eyewash stations shall be tapped into the laboratory water supply.

Electrical Lighting

Laboratory research requires high-quality lighting for close work in terms of brightness and uniformity. Fixtures shall be positioned to provide uniform, shadow-free and glare-free illumination of the laboratory benchtop. General lighting for laboratories shall be fluorescent fixtures.

Alarm and Monitoring Systems

The increasing sophistication and fine control of laboratory instruments and the unique quality of many experiments demand closely monitored and alarm systems connected to individual pieces of equipment or temperature-controlled rooms.

3.5.7 Design for administrative block

3.5.7.1 Relevant codes and standard

Relevant codes and standards to be used in the construction of the residential houses are;

- ✓ NNBC (2006) section 7.1.1.4 Building design requirements for apartment houses
- ✓ BS 8004 Foundations
- ✓ BS 8110 Structural use of concrete, Parts 1, 2 & 3.
- ✓ BS 63399 Design loading for buildings
- ✓ BS 5896 Specification for high tensile steel wire strand for the pre-stressing of concrete
- ✓ BS 5075 Concrete admixture
- ✓ BS 4483 Steel fabric for the reinforcement of concrete
- ✓ BS 4482 Hard drawn mild steel wire for the reinforcement of concrete

- ✓ BS 4466 Specification for bending dimensions and scheduling of reinforcement concretes
- ✓ BS 4461 Specification for cold-worked steel bars for the reinforcement of concrete
- ✓ BS 4449 Specification for hot rolled steel bars for the reinforcement of concrete
- ✓ BS 1881 Methods of testing concrete

3.5.8 Construction of common and service facilities

Cable galleries and internal drainage are common areas to all the sheds and thus have the same design.

3.5.8.1 Cable Galleries

Major installations comprising many cables shall be installed. A cable gallery shall allow enough space for technicians to move and work within. The 1m x 1m cable gallery shall be routed along masonry walls comprising as few bends as possible. The sheds are proposed to be equipped with a fire detection system and emergency lighting.

3.5.8.2 Internal Drainage

Foul water drains shall be of companion flange. A thick methyl methacrylate filling will be constructed around gutters. This channel will be at least 30 cm wide and deep. An open drainage system with drainage grilles and culverts linked to a conduit shall take wastewater to the sewage treatment plant. No floor gully is placed in cold rooms to avoid air reflux from the central drainage system. Drainage valves shall also be installed at all the low points.

3.5.8.3 Internal Road Network

A broader road network is already present in the project area. An internal road network shall be established within the Park.

It will be a single carriageway which will include the following;

- Asphaltic Wearing Course
- Binder Course
- Crushed Sub-base
- Lateritic Sub-base

Seven feeder single-lane internal road networks would then be constructed to connect all processing facilities and service areas. The lengths of these roads are between 200m – 1500m.

Road Safety Criteria for Junctions Design

The main objective of junction design is to increase convenience, comfort and safety while at the same time enhancing the efficient movement of all road users (motor vehicles, buses, trucks, bicycles, and pedestrians). Junctions are intended to operate where vehicles often must share space with other vehicles and pedestrians. Negotiating a connection requires many simultaneous or closely spaced decisions, such as selecting the proper lane; manoeuvring to get into the appropriate position; need to decelerate, stop, or accelerate; and selection of a safe gap. The following essential areas were considered in the design: junction angle; coordination of the vertical profiles of the intersecting roads; coordination of horizontal and vertical alignment for junctions on curves; improvement of operation, safety, and capacity through channelisation; and drainage requirements for safe operation. Poor integration of these two elements often results in a junction that is less safe and uncomfortable to use.

Junctions

Junctions, at-grade or grade-separated, are locations of high accident concentration, and accidents occur more at junctions. Consequently, special attention was paid to determining the type and shape of junctions, and detailed designs would be produced before construction.

3.5.9 Truck Workshop

Table 3.5 outlines the basic criteria considered in the truck workshop design.

Table 3.5: Basic criteria considered in truck workshop design

Element for consideration	Specific Focus Area
Sight Distance	<ul style="list-style-type: none">✓ Stopping Sight Distance✓ Decision Sight Distance✓ Passing Sight Distance✓ RR-Highway Grade x-ing Sight Distance✓ Intersection Sight Distance
Horizontal Alignment	<ul style="list-style-type: none">✓ Curve Radius✓ Superelevation✓ Intersection and Channelisation

	<ul style="list-style-type: none"> ✓ Pavement Widening
Vertical Alignment	<ul style="list-style-type: none"> ✓ Critical Length of Grade ✓ Downgrades
Cross- Section Elements	<ul style="list-style-type: none"> ✓ Lane Width ✓ Shoulder Width and Composition ✓ Side slopes and Drainage Features ✓ Pavement Cross-slope Breaks ✓ Vertical Clearance ✓ Traffic Barrier ✓ Passive Signs ✓ Curbs ✓ Acceleration Lanes

The design specifications are;

- Workshop: 10 bays (2 bays with pits)
- Installation type: Pre-fabricated drop-in pit in 2 bays
- Pit length: 23m each
- EWs in each pit (4 × EWP)
- Platform floor: Steel plate

Workshop with two pit bays each pit with two independent EWPs

Independent EWPs allows the platforms to be different heights while working on two trunks over the pit

3.5.10 External Drainage

The external drainage system will solely cater to the surface runoff within the project area by gravity flow. Covered foul drains will be used for the proposed system. This will reduce unauthorised garbage disposal into the gutters and prolong service life of the drains. Drains will be maintained to ensure proper flow. Maintenance would include inspection, de-silting, repairing any damaged drains and monitoring solid waste disposal. The following highlights

how the drainage system would be constructed. All drains to be built are proposed along the roads;

- Drainage type would be closed box drain with reinforced concrete construction;
- The proposed minimum gradient would be 1:1000;
- All secondary drains are expected to discharge to the primary drains;
- Primary drains are proposed to discharge stormwater to the nearest Ase Creek (A tributary of the Forcados River, about 289.6m away from the project area and approximately 292 km by length). The primary drains will be an open system made of concrete and reinforced iron (0.5m deep and 0.3m wide).
- The maximum primary drain width would be 2.5 m, but the depth varies from 1.4 m to 2.5 m; and
- The maximum secondary drain width would be 1.5m, but the depth ranges from 0.6m to 2.0m.
- The estimated monthly volume of drains is 450,000 litres

It should be noted that the values presented here are estimates.

All foul drains within the project area will be channelled to the sewage treatment plant (50 KLD capacity) before being discharged into the existing central drainage system established for the Park. Discharge is estimated to occur twice a week.

3.5.11 Sewage Treatment Plant

Three modular Sewage Treatment Plants of 50 KLD capacity will be provided to fasten, removing contaminants from wastewater. A by-product of sewage treatment is usually a semi-solid waste or slurry, called sewage sludge. After that, pre-treated wastes shall be fed to the existing sewage treatment plant (200 KLD capacity) established by the Park.

3.6 Telecommunication Network

A communication system comprising telephones, fax machines, wireless sets, computers, etc. and a public address system will be provided at all areas in the facility. Businesses and industries are becoming heavily reliant on fast, reliable, secure telecommunication networks. Providing world-class telecommunication services will thus be a factor in attracting investors, leading tenants and customers to the Park. Local telecom operators would provide global System for Mobile Communication (GSM) infrastructure. The land portion will be reserved

for one telecom exchange, and cable corridors will be reserved for cabling. The following Telecommunication Systems will be considered during the construction phase:

- Telecom Tower;
- Local Area Network (LAN)/ Wide Area Network (WAN);
- Public Telephone/GSM Network;
- Microwave/ Very Small Aperture Terminal (VSAT) Systems as applicable;
- Closed Circuit Television (CCTV) System;
- Gatehouse and Access Control System;

During Operation/completion of construction, telecommunication Infrastructure and facilities shall include:

- Public Address and General Alarm (PAGA) System
- Telecom Tower
- LAN/WAN Network
- Public Telephone/GSM Network
- Microwave/VSAT Systems as applicable
- CCTV System
- Gatehouse and Access Control System
- Ultra-High Frequency (UHF)/ Very High Frequency (VHF) Operations Radio System

All works undertaken in the facility and all equipment supplied shall conform to the latest issues of the relevant codes and standards from the following organisations:

- International Telecommunication Union - Telecommunication Sector (ITU-T).
- International Telecommunication Union - Radio Sector (ITU-R).
- International Organization for Standardization (ISO).
- All relevant International Electro-technical Commission (IEC) standards applicable to telecoms equipment and systems.
- National Fire Protection Association

Communication systems comprising telephones, fax machines, wireless sets, computers, public address systems shall be provided. These aspects are summarily described below;

Telecom Exchange System: An electronic (digital) automatic PBX exchange will be provided for the SAPZ. A telephone system in open and high sound areas will provide adequate weather and soundproof arrangements.

Radio Communications: The efficiency of SAPZ operations depends on a speedy flow of information between persons involved in activities at any point within the Park. A radio communications system will be developed to handle the flow of information which passes between the personnel engaged in the following operations:

- Park services and maintenance
- Access control
- Health Safety Environment and Security
- Quay crane and mobile equipment operations
- Control office
- Park and Port Terminal engineering services
- Operations management
- Supervision
- Port Security

3.7 Power Supply

The primary power for the Hub will be sourced from the Okpai Independent gas power plant, which is about 22km from the proposed industrial park. The power plant has 1000MW capacity (only half of these is currently in use). This shall be complemented by power supply from the National grid. An estimated 15MW of power is envisaged to run the PPAs (this value is estimated since there are little of no information available on the type of equipment to be used by third party industries that would rent the industrial sheds). Room will be provided for upgrade. Two (2) 2500 kV diesel generators shall be used for the eight monthly construction period.

Underground cables which offer better reliability and aesthetics may be used for commercial and residential areas; overhead lines which cost less and enable plug and play are proposed for the industrial areas.

Cancells shall be pre-laid for commercial and residential areas to provide stand-alone outdoor package switchboards at every plot. Future SAPZ investors and occupants will pick up the connection points. Cables would be laid below side tables for easy access without disturbing

the traffic. They would generally be buried directly without pipes except at crossings 200mm diameter, where UPVC pipes would be laid in single rows and hunched in concrete. This provision would facilitate cable pulling.

3.8 Street Lighting

Efficient and adequate street lighting is essential for security and road safety at night. Good street lighting will illuminate streets and sidewalks in the Park.

Lighting types/specifications being proposed are as follows:

Major road:

- The average lux level would be 15 lux;
- Uniformity factor to be 0.33 or better;
- 12-meter poles with 400 Watt or 250-Watt high-pressure sodium lamps

Minor roads:

- The average lux level would be 22 lux;
- Uniformity factor to be 0.5 or better.

3.9 Water Supply

The planned infrastructure in terms of water supply is expected to be adequate to cater for its water requirements. It is scheduled that groundwater or stored water in overhead tanks will be deployed for cooling and other water requirements. Groundwater shall be the source of water supply to the infrastructure.

Water Storage Tanks

Four Boreholes and storage tanks capable of holding about 500,000 litres of water are planned on a land take of 1,028 m². This is the overall capacity of the distribution reservoir when all the facilities are in place. One of the storage tanks will be reserved for firefighting. However, this distribution tank capacity is considered to adequately serve the population that will be resident in facilities for the next ten years.

The preferred tank shall be a 650 m³ overhead steel (hot-pressed mild steel plates of external type connection 4 ft x 4 ft, galvanised finish, stays, cleats, bolts, washers, nuts, sealant) tank of Braithwaite type or approved equivalent on a 15-metre-high steel-framed tower. These shall include all inlet, outlet and overflow pipework, valves, internal and caged external

ladders, perimeter tank surrounding the platform, level indicator, access maintenance hole, rest platform, screened vent, lightning protection and ancillaries.

Pipes, Fittings Supply and Installation

The works shall include supplying and laying PVC pipes of standard socket/spigot type. It shall consist of excavating a trench in all kinds of soil and to any depth, providing and joining all pipe materials all may be directed by the Engineer.

3.9.1 Water Requirement

Water requirements (Table 3.6) for the project will be met through the boreholes within the boundary premises.

Table 3.6 Water Requirement

S/No	Utility	Cum/day
1	Domestic	15
2	Fire fighting	23
3	WorkShop/ Vehicle Maintenance shed	6
4	Hazardous waste treatment, Recycling, etc	100
8	Green belt	105
	Total	249

3.10 Fire Fighting

The Park shall have a fire service station located to fight fire outbreaks within its premises. Smoke detectors and fire alarm systems shall be configured for every building. Firefighters shall be employed and trained. The primary responsibility of the firefighter is to respond to an incident within a minimum amount of time that will allow them to protect and save lives properties and contain the fire outbreaks.

The following facilities will be installed to provide an effective fire protection/ fighting system in the project area.

- A firewater grid system;
- Sprinkler systems;
- Inergen/ Argonite installations;
- Carbon dioxide extinguishing systems;

- Portable firefighting equipment and fire/ smoke stopping system; and
- Fire station for housing fire engines, ancillary equipment and supplies.

Firewater System

Firewater will be used to extinguish fires involving common combustible materials. The system shall consist of a storage tank, pumps and a piping network for discharging water to all Plant parts.

Fire Fighting Pumping System will be designed according to National Fire Protection Association (NFPA) standard, USA. The firefighting Pumping System will supply firewater from the storage tank to the extinguishing system.

The discharge pressure of the pumps shall be such that the header pressure is not less than 8.0 barg. The firewater pumps shall be equipped with auto-starting and manual starting facilities initiated by a push button. The pushbuttons will be placed at the following locations:

- Firewater pump house for local starting;
- Utility control room for remote starting; and
- Manual “FIRE” call points installed at strategic locations.

The firewater pumps shall take suction from a dedicated fire water tank with at least four (4) hours fire water supply at full pump discharge flow to meet the maximum fire water demand. A backup water supply shall be provided from the raw water tanks to enable the fire water tank to be taken out for inspection/ maintenance. The water shall be fresh from the borehole and free from silt and debris, and saline water shall not be used. The firewater tank shall be a surface cone-roof structure fabricated with carbon steel and shall be kept full of water with the header pressure maintained by jockey pumps.

Firewater piping system

As necessary, the firewater piping shall be laid out in a loop system with sectional isolation valves provided at all crossovers and elsewhere. This is to permit the isolation of firewater system components without compromising the safety of other Park installations.

The fire water supply lines shall not be smaller than 45 cm. Material for constructing pipelines shall be carbon steel given the high cost of Glass Reinforced Epoxy (GRE) pipe. The lines shall favour the least hazardous side of the road to facilitate access to fire hydrants.

Firewater lines around process equipment and large machinery shall generally be on the side of the road remote from them.

Hydrants

All hydrants shall have two 2^{1/2}-inch hose connections. Each hose connection shall be capable of passing 55 m³/h of water. Hydrants shall be located adjacent to risks to provide the requisite amount of water for the specific risk. The average distance between fire hydrants shall be 45 m to 90m. Wherever practicable, the distance between a hydrant and a building or structure to be protected shall be at least 15 m.

The hydrants shall be provided and suitably located to supply firewater for cooling and spaced to permit coverage of any section of the industrial zone. One hose stream shall be provided for each 900 m² of service area containing combustible material. The hydrants to be used shall be fabricated from carbon steel materials with a 150 mm riser, a weld cap, and two 2 1/2-inch valve hose connections. Also, the hose threads shall be interchangeable with those used by the local fire brigade or other firefighting institutions.

Water Sprinklers

Water sprinklers shall be installed within facilities except for the electrical panel room. Sprinkler system shall be automated and be adequately distributed in conference halls, laboratories, maintenance workshops, restaurants, hotels and other buildings where combustible material may be present. Installation of sprinkler systems in buildings shall be by NFPA codes.

An automatic water spray system will be installed. Automatically controlled systems are of two types; the wet and the dry pipe systems. The wet pipe system shall consist of spray heads attached to water pipes and permanently connected to a water supply. The water shall be discharged immediately through spray heads opened by fire. On the other hand, the dry pipe system shall consist of spray heads attached to pipes containing air under pressure, which would permit water to enter the system through a deluge valve. The water shall be discharged through spray heads opened by fire.

Inergen/ Argonite Fire Protection System

Inergen and Argonite are relatively inexpensive and readily available fire extinguishing agents used to extinguish electrical fires in enclosed spaces. They shall be installed particularly for use in generator enclosures and control cubicles. Inergen and Argonite also offer the advantages of inert atmosphere with minimum risk to personnel, high efficiency, compact storage containers and pipework, no cold shocks to delicate apparatus, no residue left after discharge, indefinite storage life, non-conductor of electricity. They can be used safely on electrical and electronic devices.

Hose Stations and Hose Reel Stations

The diesel oil pump house shall provide service water stations, fuel gas arrival and metering facilities, diesel oil truck unloading bay, diesel tanks, laboratory and maintenance workshops.

However, buildings shall be provided with fixed hose reel stations. The number of hose reel stations on each floor shall be sufficient to permit the coverage of any portion of the floor with a 6 m water stream from a nozzle attached to 20 m of 1 1/2" fire hose. The nozzles shall have an 1 1/2" tip.

Fire and Gas Detection, Control and Alarm Facilities

Fire detection, control and alarm facilities shall cover the entire industrial zone. Alarm triggers shall be installed within every building and a minimum of one per floor. Smoke detectors and heat sensors shall also be distributed to enable early detection of fire incidents.

3.11 Other Activities

Other project activities will be discussed under the following subheadings:

- ✓ Mobilisation or preconstruction phase,
- ✓ Construction phase,
- ✓ Operation/Maintenance Phase and
- ✓ Decommissioning phase

The proposed project shall involve the construction of sheds and service facilities.

3.11.1 Mobilisation or preconstruction phase

This phase entails mobilising the labour force, equipment and establishment of construction offices and acquiring various permits as required by the law. Other activities during this

phase include topographical survey, geotechnical investigation, identification of sources of construction materials, storage and material preparation.

Duration

The duration of this phase will be two (2) weeks.

Types, Quantities, and Sources of material requirements during the project's preconstruction phase are shown in Table 3.7.

Table 3.7: Types, Quantities and Sources of Materials for Preconstruction Phase

Requirements	Type	Source	Estimated Quantity Required	
Raw Materials	Coarse aggregates	From the nearby existing commercial quarries	68,000m ³	
	Hardcore	Same as coarse aggregates	68,000 m ³	
	Fine aggregates	From commercial suppliers	110,000 m ³	
	Water	Groundwater	80,000 litres	
	Cement	Local cement depot	80,000 tons	
	Reinforcement bar	reinforcements are readily available in local iron and steel stores	58,000 tons	
	Timber	Local vendors around the project area	100 000 m	
Energy	Electricity	Electricity Distribution Company and generators	2500 kV	
	Fuel	Local Vending Stations	800,000 litres	
Workforce	Skilled	Contractor	M	F
			40	20
	Un skilled	Locals in the project area	80	40
TOTAL			120	60
Equipment	Dump trucks	Contractor	20	
	Graders	Contractor	10	

	Dozers	Contractor	25
	Water Boozers	Contractor	10
	Vibrators	Contractor	15
	Excavators	Contractor	25

Source: MCNL, 2022

Transportation

Materials (fine and coarse aggregates) will be transported to the construction sites by trucks. Water boozers will move water while other materials like cement, timber and reinforcement bars will be transported by Lorries to the construction site.

Storage

Some of the materials supplied will be used directly after delivery. Cement and reinforcement bars will be held in dedicated storage rooms. Timber will be used directly in the required areas, and hence, there will be no stockpiling of wood onsite. Fuel/oils will be stored in drums, which shall be kept in bunds (well-paved areas. These are measures to curtail the impacts on spillage leading to soil and even water contamination in the area).

3.11.2 Construction phase

The major construction activities include;

- ✓ Mobilisation of plants, equipment and personnel
- ✓ Transportation of materials and personel to work site
- ✓ Clearing the immediate site required for construction
- ✓ Stonework and earthwork
- ✓ Construction of sheds and service facilities
- ✓ Construction of drainages and internal road network
- ✓ The landscaping of areas covered by the project and establishment of vegetation for functional and aesthetic purposes.
- ✓ Construction of the waste-treatment plant

Duration

The duration of this phase will be eight (8) months.

Types, Quantities and sources of project requirements during the construction phase are shown in Table 3.8.

Table 3.8: Types, Quantity and sources of project requirements during the construction phase

Requirements	Type	Source	Estimated Quantity Required	
Raw Materials	Coarse Aggregates	From the nearby existing commercial quarries and vendors	864,000 m ³	
	Hardcore	Same as coarse aggregates	250,000 m ³	
	Sand	From nearby vendors and markets	504,000 m ³	
	Water	Groundwater	5,000,000 litres	
	Cement	Reinforcements are readily available in iron and steel stores	553,846 tons	
	Reinforcement bar	Local vendors around the project area	568,420 m	
Energy	Electricity	Electricity from the national grid and diesel-fuelled generators	6220 kV	
	Fuel	Local Vending Stations	3624.9 litres	
Workforce	Skilled	Contractor	M	F
			52	20
	Un skilled	Local in the project area	575	145
		TOTAL	627	165
Equipment	Dump trucks	Contractor	4	
	Excavator	Contractor	2	
	Shovel loading M/C	Contractor	2	
	Bulldozer	Contractor	1	
	Wheel loader	Contractor	1	
	Diesel Tanker	Contractor	3	
	Grader	Contractor	1	

	Mobile Maintenance Van/Pick-up Jeep	Contractor	1
	Ambulance	Contractor	1
	Water boozers	Contractor	1
	Jeeps	Contractor	3
	44MGW Generator	Contractor	1

Source: MCNL, 2022

Transportation and storage

The exact methods for transporting and storing materials discussed in the preconstruction phase shall be adopted.

3.11.3 Operation/Maintenance Phase

The actual usage of the facilities is expected to commence after the construction works. The design period is 50 years. However, within the period, the Delta state government will carry out routine maintenance of the shared facilities, including roads, electricity, water facilities, sewage treatment plant, etc.

Other activities may include management, monitoring and evaluation

Duration

The duration of this phase will be throughout the fifty (50) years span of the project.

Types, Quantities and sources of project requirements during the operational phase are shown in Table 3.9.

Table 3.9: Types, quantities and sources of project requirements during the operational/Maintenance phase

Requirements	Type	Source	Estimated Quantity
			Calculate not to exceed
Raw Materials	Coarse aggregate		25,000m ³
	Fine aggregate		50,000 m ³
	Water		2,000000 litres

	Cement	Same as in Table 4.8	40 tons	
Energy	Electricity (national grid)		Average of 300 kVA/day	
	Electricity (Okpai Independent Gas power plant)		5.30 gallons per day	
Workforce	Skilled		Male	Female
		14	6	
	Un skilled	24	26	

Source: MCNL, 2022

Transportation and storage

The exact methods for transporting and storing materials discussed in the preconstruction phase shall be adopted.

3.11.4 Decommissioning phase

Activities include:

The demobilisation of structures shall be conducted before proper restoration of the site. Other activities include dismantling the sheds, service facilities and other structures nearer to the original condition clearance of all sorts of wastes, including used oil, sewage and solid wastes (plastics, wood, metal and papers). All wastes shall be deposited at authorised dumpsites and contracts terminated.

A decommissioning plan shall be prepared by the proponent and shared with the environmental safeguards ministry prior to actual decommissioning activities.

Duration

Decommissioning stage will last for four (4) months.

Types, quantities and sources of project requirements during the demobilisation phase are shown in Table 3.10

Table 3.10: Types, quantities and sources of project requirements during the Demobilisation Phase

Requirement	Type	Source	Quantity Required	
Workforce	Skilled	Contractor	M	F
			360	140
	Un skilled	Locals in the project area	2980	2550
		Total	3340	2690
Equipment	Bulldozer	Contractor	5	
	Motor Grader	Contractor	5	
	Roller Compactor	Contractor	2	
	Plate Compactor	Contractor	2	
	Tippers	Contractor	10	

Source: MCNL, 2022

3.12 Emission Estimation

The amount of dust (from preconstruction and construction activities), noise (emission from bulldozer, diesel tanker, excavator, wheel loader, ambulance, dump truck, grader and generator) and noxious gases (from diesel tanker, excavator, wheel loader, ambulance, dump truck, generator and grader), expected to be produced from each activity and equipment were quantified as shown in the succeeding sections.

3.12.1 Dust Emission Estimation

Three types of particulate matter, based on the size of particles (TPM, PM (10), PM (2.5)), were quantified for some activities and equipment that could potentially generate dust. The dust emission was estimated as follows:

Preconstruction and Construction phases

The particulate matter could be potentially generated during the construction and developmental stage of the proposed project activities.

The quantity of dust estimated during these phases is 1×10^6 m tones. The expected emission rate of particulate matter is obtained using the formula:

$$\text{TPM} = 2.6 (s)1.2$$

$$(m)1.3$$

$$PM(10) = 0.45(s^{1.5})$$

$$(m^{1.4}) \times 0.15$$

$$PM(2.5) = 2.6(s)^{1.2}$$

$$(m^{1.3}) \times 0.105$$

Where

S = silt content

M = moisture content

A monthly projected particulate emission using the formula above is shown as:

$$TPM = 0.101E + 01$$

$$PM(10) = 0.187E + 01$$

$$PM(2.5) = 0.975E + 01$$

3.12.2 GHG Emissions Estimation

3.12.2.1 Estimated GHG Emission Rate during the Construction Phase of the Project

3.12.2.1.1 Estimation of GHG Emissions for mobile equipment

Overview: Total emissions of GHGs from project equipment and vehicles were determined using the SCEG tool version 5.1 of the US Environmental Protection Agency. Mobile sources like owned or leased cars and heavy-duty vehicles generate emissions by burning fuel. Mileage or fuel use was estimated based on vehicle fuel economy from www.fueleconomy.gov since other data sources are not readily available.

Fuel usage and mileage are reported the same for hybrid vehicles as for conventional vehicles such as Pickup and Vans are classified as "Light Trucks", Trucks (Diesel heavy dump truck, water truck) weighing more than 8,500lb are classified as "Heavy- Duty Trucks". In contrast, non-highway vehicles (graders, cranes, excavators, and concrete batching plants) used in construction are classified as "Construction Equipment while Tractor /Trailer is termed Diesel Agricultural Equipment. Table 3.11 presents the details of equipment and vehicles required to construct the Proposed Processing Area.

Table 3.11: The expected diesel consumption -fired equipment for the proposed PPA

Equipment	Capacity/Specification	Number	Status
Dump trucks	40T Rigid body dumpers	4	Diesel Heavy Dump Truck
Diesel Tanker	-	3	
Excavator	Cat 340 Hydraulic rammer (breaker) and one with front shovel	2	Diesel construction equipment
Shovel loading M/C	Cat 966	2	
Bulldozer	CAT D7R	1	
Wheel loader	5 -6 m3 bucket,430 HP	1	
Grader	280 HP	1	
Water boozers	-	1	Diesel light trucks duty trucks
Mobile Maintenance Van/Pick-up Jeep		1	Passenger Car
Ambulance	-	1	
Jeeps (HiLux)??	-	3	
44MGW Generator			

* These assumptions are based on our current knowledge

Source: MCNL, 2022

The construction phase is expected to last for eight (8) months, after which operation shall commence. Table 3.12 presents the estimated GHG anticipated emissions from construction activities.

Table 3.12 Details of estimated GHG to be emitted during the construction phase.

Equipment Category	Number	Average fuel economy (mileage/g)	Fuel usage (gal)	Mileage	CH ₄ (g)	N ₂ O (g)	CO ₂ (kg)
Diesel	6	17.1	21,546.	781.2	12281.27	5601.9	0.531865

Construction Equip.			0				21
Diesel Light-Duty Trucks	7	7.2	4536.0	1953.0	1.9	3.0	
Diesel Passenger Cars	5	23.3	10485.0	1952.5	1.0	2.0	
Total	16		36,567.0	4,686.7	12,284.2	5,606.9	0.74568177

In all, 482.5kg (0.53186521) metric tons of CO₂ are estimated to be emitted during the construction phase of the proposed project. This also includes 12,284.2g (0.00122842 metric tons) of Methane and 5,606.9 g (0.0056069 metric tons) of Nitrous oxide. When this was extrapolated, taking into consideration the global warming potential of nitrous oxide (32) and Methane (28), results indicated that an estimated total of 0.74568177 CO₂ equivalent emissions (metric tons) of CO₂ could be emitted as a result of activities during the construction phase.

3.12.2.1.2 Emission GHG Estimation for Diesel Generators (Stationary source) during the construction phase

The following factors were taken into consideration while estimating the total GHG emissions from stationary sources during the operation phase;

- The construction phase will last for eight months (224 working days)
- The capacity of the diesel-electric generators is 30 KVA
- The facility shall utilise alternative power (diesel generators) for at most 6 hours a day

The average heating value is the USA's Environment Protection Agency, <https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf> of diesel (uncontrolled levels) was assumed to be 19,300 Btu/lb with a density of 7.1 lb/gallon or 0.00322051 metric tons of CO₂ per gallon. It is also considered that a 30 KVA generator on half load uses about 3.6 litres (0.95 gallons) of diesel in an hour (<https://www.ablesales.com.au/source/DieselGeneratorFuelConsumptionChartinLitres.pdf>).

- *8 hours (estimated running hours/day for generators) × 224 working days = 1792 (total working hours for diesel generators during operation phase)
- *0.95 gallons (average fuel consumption rate per hour) × 1008 (total working hours for diesel generators during operation phase) = 1702.4 gallons (for eight months construction phase)

- *If 1 gallon of diesel emits 0.00322051 metric tons of CO₂ (<https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf>) then 1702.4 gallons will emit metric tons of CO₂

The estimated emissions from diesel generators throughout the construction phase are about 5.4825962 metric tons of CO₂

The estimated emissions from diesel generators throughout the operation phase are about **287.286** metric tons of CO₂

Table 3.13 outlines the gross total carbon footprint (expressed in MT CO₂ equivalence) resulting from the proposed Special Agro-Processing Zone project.

Table 3.13: Total MTCO₂ Equivalence

GHG supply Component		
Project Phases	MTCO ₂ Equivalence	
Construction	Mobile sources	0.74568177
	Stationary sources	5.4825962
Net MTCO ₂ Equivalence	6.22827797	

A total of 6.22827797 MTCO₂ Equivalence is emitted from project activities. This data will be factored in preparing the Green House Gas Management Plan.

3.12.3 Noise Environment

Activities during construction will cause increased noise level from various sources. These noise sources will include:

- ✓ Vehicular Movement and
- ✓ Noise from equipment and machine use.

The generated noise will be added to the background noise level. The sound pressure level generated by a noise source, as expected, decreases with increasing distance from the source due to wave divergence. The following equation can give noise attenuation in all directions over horizontal space:

$$\text{Sound level dB (A)} = L_w - 20 \log_{10} R - 8$$

Where L_w = Sound level of source dB (A) and

R = Source distance (m)

A standard mathematical model for sound wave propagation is used to estimate noise dispersion from the source point by considering 95 dB(A) as the resultant noise level generated from the proposed project activity and output (see Figure 3.4).

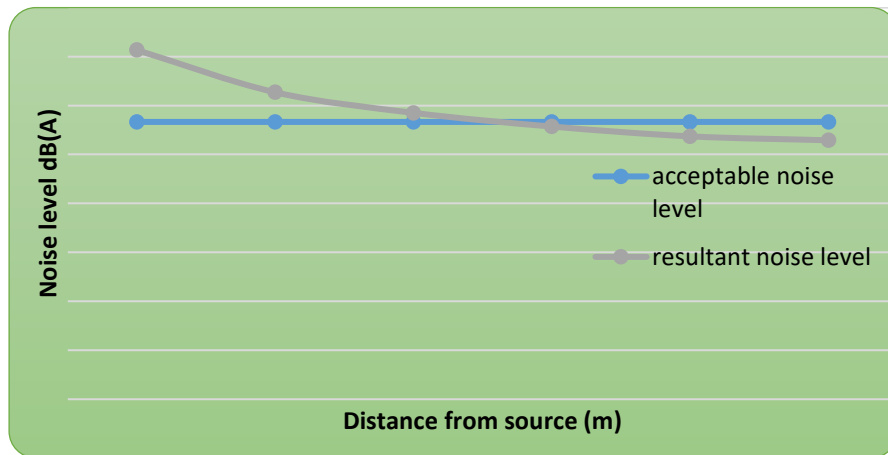


Fig 3.4: Noise modelling for the proposed project

Source: MCNL, 2022

From the result shown in Figure 3.4, it is clear that noise to be generated (modelling was done using Sound Plan software) by the proposed project activities will average 65 dB (A) at a distance of 150 m from the machine's construction phase. When this modelled noise value was superimposed on the average noise level of 48.1 dB (A) obtained from the existing environment, the resulting value of 113.1 dB (A) exceeded the regulatory limit of 90 dB (A) as prescribed by WHO/FMEnv for an 8hr duration. This will result in adverse noise impact addressed in chapters 5&6 of this report.

3.13 Waste Streams

Wastes generating sources identified across all project phases are as follows:

Stage I: Site Preparation

Activities in the site preparation stage will include clearing the project site of any physical constraints to ensure smooth access to the land for construction. Wastes expected at this stage are topsoil and vegetal matter.

Stage II: Construction

Activities at this stage include all civil and construction works, excavation, construction and installation of facilities. Wastes expected during construction include constructions debris, domestic waste, pieces of metal, spent oil and packaging materials.

Stage III: Operations

Operations in the Park will include production, movement of goods and services, vehicular/human movement, maintenance and recreation. The wastes expected from these activities include trash, spent oil, hazardous and non-hazardous chemicals, dyes, wastewater from finishing processes, suspended packaging materials (plastics, polythene, paper, cardboard, metal, etc.), kitchen waste and other in-organic materials from the various operational activities.

Stage IV: Decommissioning

The activities to be carried out in this stage include demolition of sheds and other ancillary structures, Removal of structures and un-installation of equipment. Waste materials obtainable from these activities are dust, removal debris, domestic waste, asphalt waste, concrete blocks, loose soil, off-cuts (wire, wood) and metal pieces.

Table 3.14 presents the waste inventory for the proposed project

Table 3.14: Waste Inventory

Stage	Activity	Type of waste generated	Nature of waste
Site preparation	land preparation Construction administrative block Disposal of waste	Topsoils, vegetal matter, Gaseous emissions aluminium, and metal scraps	98% of the wastes are organic and can be easily disposed of.
Construction	- construction of sheds and service facilities Construction of internal road network, Construction of drainages and residential quarters - disposal of waste	- Loose soil, overburden - Construction debris, - Plastics, rubber, tins, cardboard, zinc, nails etc. - domestic waste Gaseous emissions - metal scraps	Organic and inorganic materials
Operations	Production; movement of goods and services, vehicular/human activity, maintenance	Parking materials (paper, plastics, polythene etc.) Food remnants, Gaseous emissions Rubber, plugs, filters, engine	Organic, in-organic and metals

	recreation disposal of waste	oil, grease etc. Sanitary waste Spent oil and filters Mineral acid Polyvinyl alcohol Faecal waste Suspended solids Wastewater effluents	
Demobilisation	Removal of structures Rehabilitation Buyback activities	- Loose soil - Removal debris - Off-cuts (wood, wires etc.) - Plastics, rubber, tins, cardboard, zinc, nails etc. - Asphalt waste - metal scraps	Organic and inorganic materials

Source: MCNL, 2022

3.13.1 Quantification of Waste and Treatment

Waste streams to be generated across the project's life cycle are projected.

3.13.1.1 Waste Quantification during Preconstruction

Three types of wastes are expected from the Preconstruction stage:

- Vegetal waste from felled trees;
- Overburden spoil; and
- Others (wastes) = (water sachet, water bottles, snack wraps, nylons and plastics, scraps, concrete debris, textiles, glass etc.).

It is assumed that each person (preconstruction worker) will eat and drink at least once during the preconstruction phase, which will occur during the two weeks (12 days) estimated period. Details of the estimated quantity of waste expected to be generated during the preconstruction phase generate wastes as presented in Table 3.15.

Table 3.15: Waste Quantification

Vegetal Waste		Overburden Spoil		Other Wastes		
Parameter	Estimated Qty	Parameter	Estimated tons/km ²	Parameter	Estimated tons	Mass of a single waste (g)
Number woody plants recorded (40 Ft and above)	54	Topsoil removal per km ²	2.0	Total No of persons	180 (from the labour force)	
Average Height of woody plant (Ft)	13	Land take of the cleared area	(0.02km ²)	Duration	Two weeks	
The average circumference of a woody plant (inch)	3		2.0 x 002	Total pure water sachet from workers	180 ×12 (number of days) = 2160 pieces	3 x 2160 = 6480
Tree to ton Conversion Standard	1000 tonnes = 1820m ³		0.04	Total bottled water container from workers	2160 pieces	18.9 x 2160 = 40824
Estimated	2106 m ³	Total Estimated	0.04	Total snack wrappers from	2160 pieces	5 x 2160

Tonnes from trees to be felled	=1157 tonnes	topsoil removal (tons)		workers		=10800
Total of the cleared portion of the project site	1275.53 tons	0.04 tons		Total weight of polythene and packaging materials, water bottle, water sachet, snack wraps and nylons (tons)	58104g = 0.058104 tons	
Grand Total (Tons)	1275.628 tons					

The logs shall be disposed to the registered local wood vendors free of Charge for Reuse.

3.13.1.2 Construction Phase Waste Quantification

Waste streams quantification projected for the project's construction phase are predicated on some assumptions.

- 200ha (0.02 km²) of land is estimated to be cleared
- Estimated duration = 8 months

It is assumed that each person(s) will eat and drink at least once a day throughout this phase (Table 3.16)

Table 3.16: Waste Quantification and Disposal Details for Construction Phase

Overburden spoil		Other wastes			Disposal party	Disposal methods/use	Disposal (Action Party)
Parameter	Estimated tons/km ²	Parameter	Estimated tons	Mass (kg)	<i>Delta State Waste Management Board (DSWMB)</i>	Reuse, Recycle	<i>DSWMB</i>
Topsoil removal per km ²	0.5	Total No of persons working onsite	729 (number of the labour force from)				
Total land taken cleared for project activity.	0.02	Total pure water sachet for each worker on site	729 (number of workers) × 216 days in 8 months of construction phase) = 157,464 pieces	315			
Total Estimated topsoil removal	0.01	Total pure water sachet for each worker on site	157,464 pieces	315			
		Total bottled water container from workers	157,464 pieces	1,260			

		Total snack wrappers from workers	157,464 pieces	787			
		Total Weight of waste (tons)	2.362				
Grand Total (tons)	2.372						

3.13.1.3 Decommissioning Phase Waste Categorization

The demolition of temporary structures will generate solid wastes such as timber, iron sheets and spent oils. Timber and iron sheets will be sold to locals in the project area for reuse, while the consumed oils will be drained out and sent to authorised dumpsites. The 50 years duration of the project makes it difficult to quantify. However, a similar waste volume projected for the construction phase is expected at the decommissioning phase. Table 3.17 outlines the expected Waste stream from the decommissioning process.

Table 3.17 Waste Stream from Decommissioning Process

Project Phase	Type of waste	Form of Waste	Source of Waste	Disposal company	Disposal method/use	Disposal (Action Party)
Non Hazardous wastes						
Decommissioning	Solid waste (Non – degradable)	Demolished concrete, tins, metals, glasses, plastics, soil	Building, service areas and industrial sheds	DSWMB	<ul style="list-style-type: none"> The proponent shall obtain reusable members Topsoil will be used for backfilling foundation and pits Tins, glasses, plastics will be sold to licensed local recycling companies 	Scrap buyers/ reuse location
	Hazardous wastes					
	Liquid waste	Spent oils	Services areas, Industrial sheds	DSWMB	<ul style="list-style-type: none"> Spent oils shall be drained out before delivery to DSWMB Approved contractors. 	DSWMB approved waste management contractor

3.14 Project Schedule

Table 3.18 outlines the timeline for the start-up and completion of the project.

Table 3.18: Project schedule for the PPA and Associated Infrastructure project

S/N	Description	Duration (months)	2 nd Qtr. 2021	3 rd Qtr. 2021	1 st Qtr. 2022	2 nd Qtr. 2022	3 rd Qtr. 2022	1 st Qtr. 2023	2 nd Qtr. 2023	3 rd Qtr. 2023	1 st Qtr. 2024	1 st Qtr. 2073	2 nd Qtr 2073
Preconstruction Phase													
1	Feasibility studies	3											
2	EIA studies and approval	16											
3	EPC Contract award Process	1											
4	Check survey of EPC Contractors	1											
5	Detailed design of the facility	1											
6	Mobilisation of construction	15 days											

	materials to the site													
Construction Phase														
7	Construction of facility and Associated utilities	8												
Operation Phase														
8	Facility operation	600												
Decommissioning Phase														
9	Demobilisation of facility	4												
10	Decommissioning	One day												

3.15 Decommissioning

The project has a life span of 50 years. Decommissioning activities will be implemented in compliance with applicable regulations. The activities that would be involved during the decommissioning include the following:

- Decommission and site-clean – up
- Disposal of waste generated
- Site

review

and

reclamation

The decommissioning plan after the life cycle of the PPA shall include conflicts and grievances resolution, especially among workers and project host communities during the project implementation. This is intended to ensure the seamless acquisition of the project area in future development.

CHAPTER 4: PROJECT AREA OF INFLUENCE AND DESCRIPTION OF THE BASELINE ENVIRONMENT

4.1 General Considerations

Project Area of Influence (AOI) is the geographic area likely to be affected by the project and unexpected developments induced by the project. Therefore, determining the AoI requires informed but subjective judgement, based on available information and the knowledge of previous and similar project impacts, combined with empirical findings.

The ESIA Regulations require an Area of Direct Influence (ADI) and Indirect Influence (AII).

4.2 Area of Direct Influence (ADI)

The Project's ADI is made up of two components:

- The 200ha footprint area, i.e., the space occupied by the Project's infrastructure; and
- The area where direct impacts from the construction and operational activities will be felt.

The footprint includes the area occupied by the facilities within the SAPZ. All project activities shall be contained within the footprint area.

The Project's direct impact outside of the footprint area includes the biophysical and socioeconomic impacts. Therefore, the Project's ADI is delineated as follows:

- **Biophysical environment:** it is expected that all direct biophysical impacts resulting from Project construction and operation will be limited to a 1.5 km² radius. This dimension would accommodate temporary access, machinery movement, etc.
- **Socioeconomic environment:** Direct socioeconomic impacts are mainly felt by the persons residing or working within a 1.5km² radius of the project footprint. Fig 4.1 provides a graphical illustration of the Areas of Influence.

4.3 Area of Indirect Influence (AII)

The Project's AII is the geographic area where indirect impacts are likely to be felt. In other words, where secondary effects resulting from direct ones are felt

The Project AII is estimated to cover a further 0.5km² away from the ADI. Summarily put, the project AII is a 2km² radius from the 200ha.

Biophysical impacts are unexpected within the AII. However, indirect socioeconomic effects include job creation opportunities, workforce mobilization and areas of informal commercial activities, etc.

Table 4.1 provides the communities within the biophysical and socioeconomic components of the project.

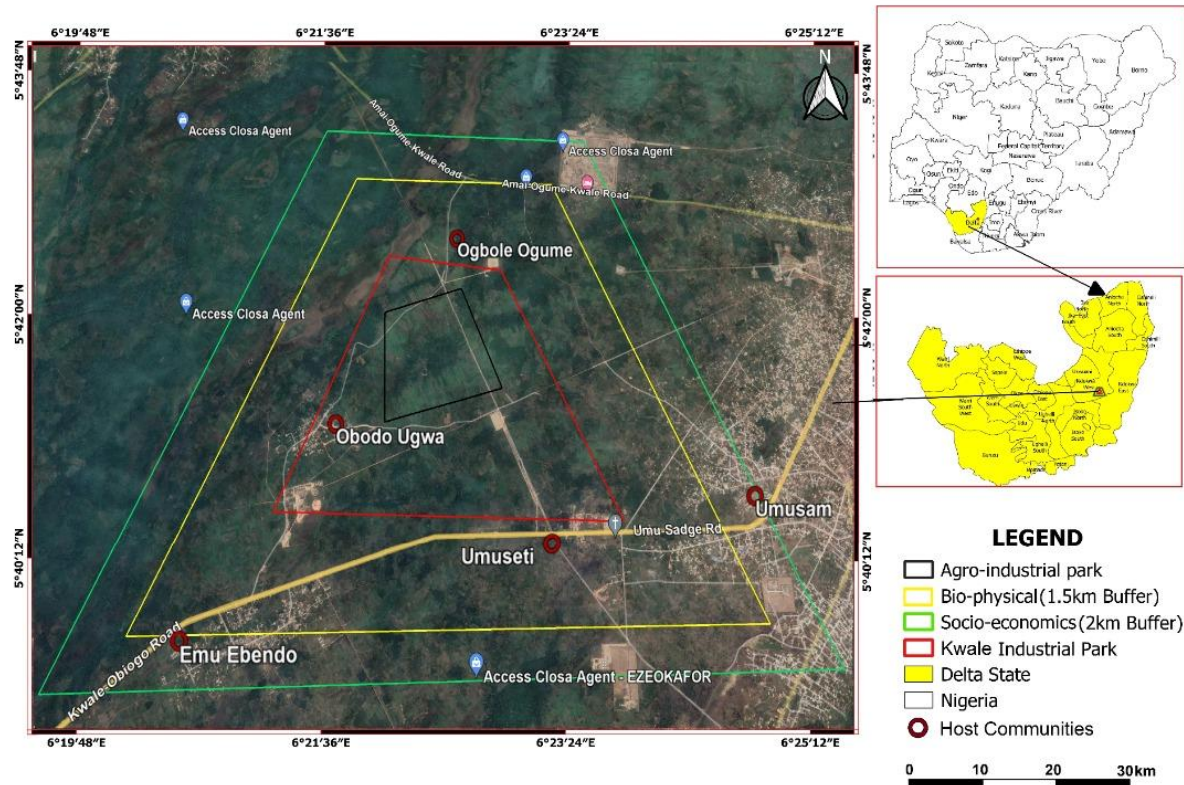


Fig 4.1: Sphere of Influence for the project

Expected indirect socioeconomic effects include job creation opportunities, workforce mobilization and areas of informal commercial activities, etc.

Table 4.1 provides the communities within the biophysical and socioeconomic components of the project.

Table 4.1: Communities within the Sphere of Influence

S/N	Communities in the Area of Direct influence	Communities within the area of indirect influence
1.	Obodougwa	Umusam
2.	OgboleOgume	Emu- ebendo
3.	Umuseti	

4.4 Identification of the study area

The proposed PPA is cited within the Kwale Industrial Park in Ndokwa West LGA of Delta State, South-South of Nigeria. Chapter four of this report provides details of the biophysical and socioeconomic conditions of the project location.

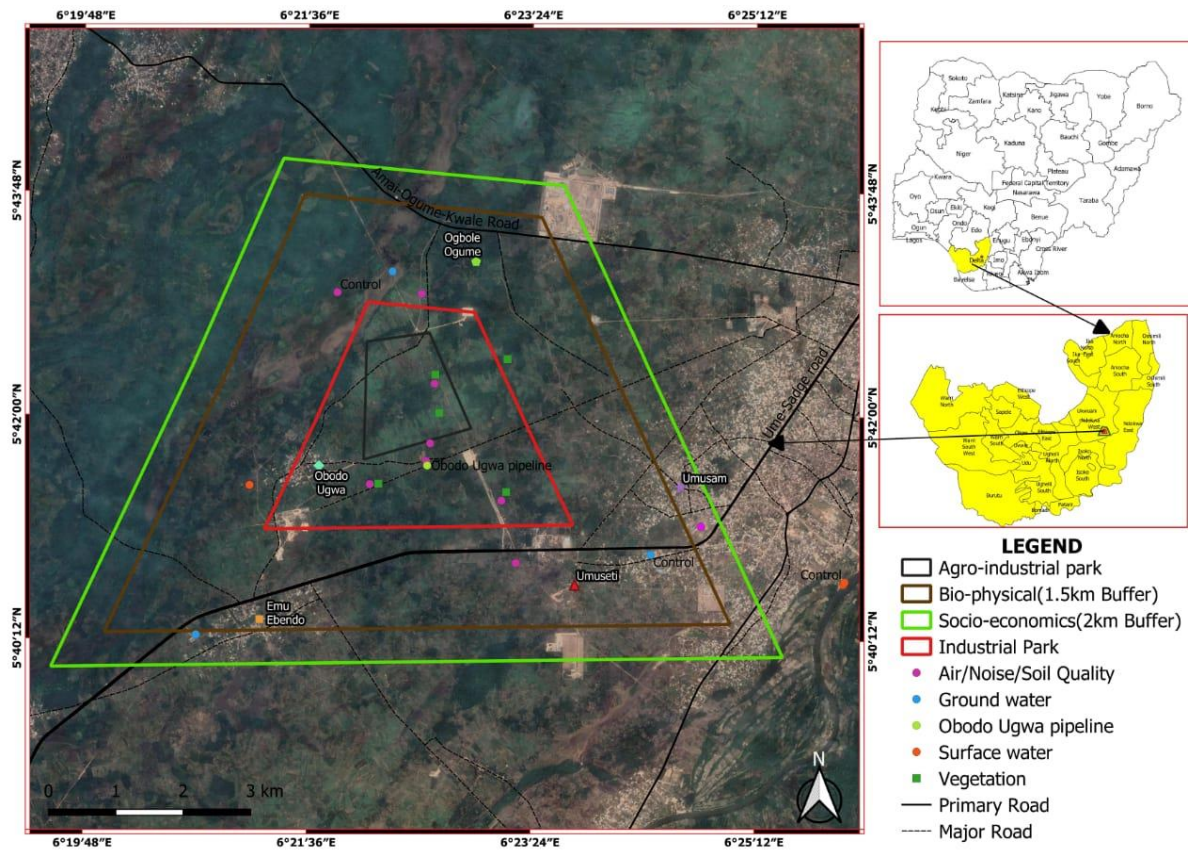


Figure 4.2: ESIA Study Area

The 200ha proposed site is a government-acquired land situated in the 1000ha proposed industrial park. It comprises patches of derived savanna vegetation, and cultivated farmlands. The area records significant levels of rainfall between June and September, with the highest in July. There are no protected areas in the project area, and the closest is Kwale forest reserve (45.3km), and Orashi forest reserve (91.5km) from the project area.

The site overlooks the Asaba-Ughelli expressway. The road conditions and network around the project site are excellent, with moderate traffic volumes. There are petroleum pipelines and an Energia company Flow station within the study area. There are no reports of kidnapping. The telecommunication networks available in the project area are MTN, Glo, 9-mobile, and Airtel.

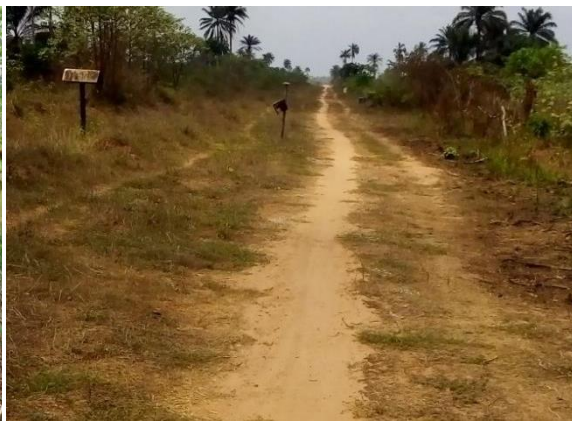


Plate 4.1: Site and surroundings of the Study Area

4.5 Overall data collection methodology

The summary of baseline conditions is based on information sourced from literature works (see relevant sections) as well as findings from a one-season (dry) field sampling program supplemented by secondary data from approved ESIA report (KIP ESIA Report, 2021, wet season), results of laboratory analyses of samples obtained and socio-economic and health surveys specific to this ESIA. The data acquired will enhance environmental management decisions and future monitoring of changes, if any.

A combination of data from existing literature, KIP ESIA Report, 2021 (wet season secondary data) and field sampling campaign (dry season) was used to inform the preparation of the baseline chapter for various environmental and social components, following the approved ToR by the FMEnv for this project.

Field studies and data collection for characterization of the baseline conditions of the proposed project area biophysical and socioeconomic conditions covered:

- climate and meteorology
- air quality and noise levels
- geology/hydrogeology
- surface and groundwater
- soil and sediment
- vegetation & fauna wildlife
- hydrobiology, fisheries and
- socioeconomics/health impact, demography and community characteristics

The acquisition of data involved field data gathering, measurements and collection of representative samples used to establish baseline environmental conditions 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. This approach assured that the required data and samples were collected under agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel. Elements of this approach include:

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

- designing and developing field sampling strategies to meet work scope and regulatory requirements;
- pre-mobilization activities (assembling of the field team, sampling equipment/materials calibrations/checks, review of work plans and schedule with the team, and job hazard analysis);
- mobilization to the field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; laboratory checks for the collected samples analysis, chain of custody and
- Scoping workshop, Stakeholder Engagement and Regulatory Ministry witnessing of data gathering.
- Demobilization from the field; transfer of sample custody to the Mifor Consult laboratory, Calabar for analyses.

Desktop studies involved acquiring relevant background information on the environment study area. Materials consulted included approved reports on previous environmental surveys in the area, publications, textbooks, articles, maps, etc., on the area and similar environments. The list of materials consulted is specified in relevant sections.

To effectively characterize the ecology and meteorology of the study area and determine seasonal variations of specific environmentally related parameters, a one (dry) season field data-gathering exercise was performed between 3rd and 8th March 2022.

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

- ambient air quality and noise level of the study area;
- physicochemical and microbiological characteristics of the soil within the study area;
- physicochemical and biological characterization of 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;
- the socio-economic and health status of the host and impacted community.

Table 4.2 summarises the information on the physical parameters sampled for the project and that of the secondary data (KIP ESIA Report, 2021), including dates of exercise and number of samples.

Table 4.2 Data summary on the various parameters sampled for the project and that of the secondary data

	Secondary Report – Wet Season data (23 rd -30 th October 2019). KIP ESIA Report, 2021		Dry season (Baseline report for current study, primary data)
Environmental Component	Number of samples		Number of samples
Climate and meteorology	Not specified	Nine sample stations and three control point stations	Ten (Nine stations and one control point station)
Air quality and noise levels		Nine sample stations and three control points.	Ten (Nine stations and one control point station)
Soil		Thirteen transects (Five sampling locations)	Ten (Nine stations and 1 control station)
Groundwater		Four boreholes and eight community well	3
Surface water, Sediment, Hydrobiology		Six sample stations and three controls.	3 (Two, upstream and downstream of Ase Creek and one at Ogbogwe pond)

4.6 Physical Environment

4.6.1 Climatic Condition of the Study Region

The project area falls within the tropical region of Southern Nigeria. The region exhibits two major seasons, longer wet and shorter dry seasons. The wet season usually begins in March and ends in October, and the South West Trade Wind causes it. The dry season usually lasts for about four months, from November to February and is characteristically marked by Harmattan wind between December and February. The annual rainfall averages 2,768 mm. The relative humidity is usually high throughout the year (about 75%), reaching a maximum during the wet season when values above 90% are recorded.

The key factors that influence temperature in the area are the sun's movement, wind speed and direction, and land configuration. The temperature in the region is generally high all year round and usually range between 27-30°C between June and December and can rise to 32-40°C between January and April, with the last few months of the dry season marked by intense heat. A general assessment of the sunshine hours for the southern region revealed that the lowest sunshine hours of approximately 3.5 hours per day are recorded at the peak of the wet season (July and August), while the brightest months occur in November, where average sunshine hours of up to 7.5 hours.

The south-westerly wind prevails during the wet season (July- October), accounting for about 33% of annual wind and the southerly winds dominating from March to June and the beginning of the dry season in November about 50% of annual winds. The north-easterly wind predominates between December and January and amounts to about 16% of the annual winds. The monthly mean wind speed varies from 3.4 to 4.6 m/s. Wind speed is greatest in August and September. Table 5.3 presents the climatic data for Delta state between 1991 and 2021 (NiMet 2022).

Table 4.3: Climatic data for Delta State (1991-2021)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Comment
Rainfall (mm)	17.82	55.16	108.6	134.86	198.3	286.36	391.24	373.36	384.71	266.46	65.05	9.82	As in other States in Nigeria, Delta is influenced by two seasonal periods, namely the dry and wet seasons. The dry season is characterized by the Tropical Continental Air Mass (North-East Trade Wind) which blows across the Sahara Desert. Delta state records significant levels of rainfall between June and September, with the highest in July. The mean rainfall range is 9.82mm to 391.24 mm.
Temperature range (°C)	30	31	30.5	29.5	28.5	26.5	25.5	25.5	26	27	28.5	29.5	The temperature range is between 25.5°C and 31.0°C. This variance in temperature is particularly striking between areas of different altitudes, and this contrast is clearer in the dry season than in the wet season.
Mean Relative Humidity (%)	52	61	69	74	80	87	88	89	86	76	55		The relative humidity of Delta ranged from 52% during January to as high as 89% in August.

Wind speed (m/s)	9.45	10.80	11.4	11.35	9.70	7.60	8.60	7.86	7.25	7.15	8.60	8.65	Wind speed is greatest in March as against October with the least.
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Source: NIMET 2022

*Figures presented on the table are monthly averages

4.6.2 Micro Climatic Conditions (Meteorology Measurements) of the Study Area

Climate encompasses the statistics of temperature, humidity, wind, rainfall and other meteorological elements in a given region over a long period (say 30-35 years). However, measurements of these climatic elements could be carried out in a smaller area over a shorter period. These are known as microclimatic measurements. In this study, temperature, Wind speed and direction were measured at nine (9) points plus one (1) control point. Specific locations for measurements were selected with consideration for concentrations of human receptors such as residential areas, commercial areas, hospitals, churches, schools and farmlands.

The temperature, wind speed, wind direction were measured with Ambient Weather WM-4. This equipment was calibrated and held at arm's length towards the direction of the prevailing wind. The values of the weather elements were then read off directly from the machine.

Table 4.4 showed that all microclimatic data obtained in the field conformed favourably to secondary data (KIP ESIA Report, 2021). Expectedly, they will be an increase in air temperature during the construction and operation phases due to heat generated from the equipment on site. This phenomenon was factored in the ESMP designed for the proposed project (Chapter 7) and proffering mitigation measures in Chapter six.

Table 4.4: Result of On-Site Meteorological Measurement

Sampling Code	Long (E)	Lat (N)	TIME	Wind speed (Kmph)		Temp . (°C)	Altitude (m)	Wind direction
				min	max			
MET1	6.376012	5.693448	1:24pm	0.4	5.5	31.7	41.99	NE
MET2	6.376388	5.696328	2:35 pm	0.24	2.6	40.6	61.02	NW
MET3	6.369373	5.690808	3:00pm	0.36	6.2	40.1	44.95	NW
MET4	6.386677	5.689534	3:25pm	0.2	5.6	38.6	78.28	NE
MET5	6.376960	5.704894	3:54 pm	0.4	8.5	40.5	84.32	NW
MET6	6.412732	5.685298	8:47 am	1.1	3.5	37.3	53.81	NW
MET7	6.387938	5.680304	9:52 am	1.21	4.0	37.8	50.52	SW
MET8	6.352221	5.690625	11:20 am	0.52	8.7	37.9	67.26	NW
MET9	6.375189	5.716365	1:30 pm	1.5	3.5	38.5	80.71	NW

MET10	6.363885	5.716527	2:30 pm	1.2	5.6	39.4	82.34	NE
	Minimum detection limit			0.1		20		-

Source: MCNL Survey, 2022

The meteorology readings revealed that the topography of the study area is slightly undulating while the wind blows in all directions except to the South-east. Shi 2019 revealed that chimneys and air outlets in industries should be situated against the flow of wind direction to minimize dispersion rate. Also, the highest average wind speed in the study area blows on the Northwesterly axis. The findings also revealed that daytime, altitude and habitat type influences wind speed and direction. The wind speeds recorded in this study can disperse gaseous effluents, smokes, twigs, sand, flags, light to moderate waste and increase runoff, susceptibility (Met matters 2022).

4.6.2.1 Ambient Air Quality

Air generally contains water vapour, gases, and particulate matter in small but variable quantities (Oguntoyinbo and Derek, 1987). Air pollution is the presence in the atmosphere of one or more contaminants in such quantities, characteristics, duration as to make them actually or potentially damaging to human, plant, or animal life or property, or which unreasonably interfere with the comfortable enjoyment of life and property.

In this study, atmospheric gases were measured with an Aeroqual aerocet531 gas analyzer. The equipment was calibrated to 0.001 minimum detection limits and held at arm's length towards the direction of the prevailing wind. The concentration of NO₂, SO₂, CO₂, NH₃ and SPM (2.5 & 10.0 µm) was read off directly from the machine screen. Air quality data were collected simultaneously and at the same sampling points with meteorological measurements (Table 5.2).

The result is presented in Table 4.5. Particular attention was paid to the Greenhouse gases (GHG) like CO₂, NO₂ and SO₂.

Table 4.5 Ambient Air Quality measured in the Study Area.

Sampling points	Time	Air quality								Coordinates	
		Particulate ($\mu\text{g}/\text{m}^3$)		Gaseous (ppm)						Long (E)	Lat (N)
		PM10	PM 2.5	SO ₂	CO ₂	NO ₂	NH ₃	O ₃	NO		
SP1	1:24pm	25.5	20.0	2.03	380.52	0.94	0.67	22.9	0.16	6.376012	5.693448
SP2	2:35 pm	46.8	22.1	1.49	362.14	0.58	0.67	29.3	0.11	6.376388	5.696328
SP3	3:00pm	22.5	16.9	0.64	367.17	0.58	0.58	26.8	0.11	6.369373	5.690808
SP4	3:25pm	34.6	20.4	1.86	387.19	0.54	0.93	32.7	0.07	6.386677	5.689534
SP5	3:54 pm	34.3	18.7	1.86	387.26	0.54	0.93	34.7	0.07	6.376960	5.704894
SP6	8:47 am	14.8	12.9	1.68	340.46	1.01	0.78	16.8	0.00	6.412732	5.685298
SP7	9:52 am	8.4	10.8	0.66	330.45	0.75	0.83	13.5	0.00	6.387938	5.680304
SP8	11:20 am	10.1	14.2	1.21	353.84	1.48	0.79	9.84	0.01	6.352221	5.690625
SP9	1:30 pm	11.5	17.8	1.64	354.11	1.34	0.89	10.0	0.12	6.375189	5.716365
SP10	2:30 pm	9.5	11.3	0.7	376.21	0.3	0.47	13.4		6.363885	5.716527
KIP ESIA Report, 2021).						0.00	0.00				
FMEnv. Limits				0.002		0.05					
WHO limits				0.02		0.2					

Source: MCNL Survey, 2022.

All parameters were within regulatory limits except for SO₂ and NO₂, where concentrations were above the WHO regulatory limit across all sampling stations. The increase may be attributed to the burning of fossil fuels, gas flaring by the Ebendo flow station, emissions from cars, trucks and buses, and off-road equipment in the study area. NO₂ interact with water, oxygen and other chemicals in the atmosphere to form acid rain. Acid rain harms sensitive ecosystems such as lakes and forests. A high concentration of NO₂ in the air can

irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms.

The SPM emission is expected to increase slightly in the area when the project commences, and this will be factored into the air management plan in Chapter seven of this report. Plate 4.2 presents an air quality sampling activity.



Plate 4.2: Sampling activity for air/noise measurement

4.6.2.2 Noise Quality

Measurement

Noise is a periodic fluctuation of air pressure causing unwanted sound. Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (SIEP, 1995). Also, disturbance to wildlife is significant, especially during breeding seasons or when rare species are present. In this study, the ambient noise level was measured simultaneously for the same sampling stations established for meteorology and air quality measurements. A calibrated handheld Pulsar Sound Level Meter held at arm's length towards the prevailing wind's direction measured the sound level. The noise level was read off the screen after about 2 minutes of the display.

Table 4.6 shows the result of noise level measurement in the study area.

Table 4.6: Noise Measurements in the Study Areas

SAMPLING CODE	Noise dB(A)	LAF (dBA)	LMIN. (dBA)	LMAX. (dBA)
NQ1	56.8	68.7	28.33	55.6
NQ2	63.8	65.9	31.08	55.7
NQ3	59.5	76.2	31.16	59.2
NQ4	50.2	59.4	29.82	62.2
NQ5	64.2	55.1	28.72	69.7
NQ6	53.5	65.0	27.71	61.5
NQ7	62.5	60.4	28.76	40.9
NQ8	69.5	64.2	35.22	57.7
NQ9	59.4	52.0	22.60	57.5
NQ10	51.7	54.2	29.55	58.3
Mean	59.11	62.11	29.295	57.83
Secondary data (KIP ESIA Report, 2021)	30.40-48.40	32.40-63.40	32.40-63.40	48.40-80.30
WHO/FMEnv Regulatory daily limit for Noise				
General Noise Level limit	- 105 dB(A) per hour or 90dB(A) per Day for prolonged exposure			
School	45 dB(A) for day and 35 dB(A) for night			
Hospital	30 dB(A) for Day and Night			
Residential	45 dB(A) for Day and 35 dB(A) for Nighttime			
Farmlands	40 dB(A) for Day and 45 dB(A) for Night			

Source: MCNL survey, 2022

As presented in Table 4.6, the results indicated an elevated noise level above the daytime threshold stipulated for the various environments (school, hospital, residential and farmlands)

across the sampled points. Vehicular traffic, neighbourhood activities, construction and public works are the possible causes of elevated noise levels in the study area during the Day. However, these results were within the general noise level of short exposure of 105dB (A) or that of prolonged exposure of 90dB (A).

The baseline noise data is comparably higher than that of the secondary data. Noise-producing activities, time and day of measurement, seasonality, and the measurement site distances from the Asaba-Ughelli expressway, in particular, could have accounted for the elevated noise level. The ambient noise level is expected to rise slightly in the area when the project commences, and this will be factored into the noise management plan in Chapter seven of the report.

4.6.3 Geology

Sedimentary rocks predominantly underlie Delta State with the following stratigraphic units underlying most of the region: the Benin Formation, the Ogwashi - Asaba Formation, the Bende-Ameki Formation, Imo Shale Formation, Nsukka Formation and Ajali Formation (Akaolisa and Selema, 2009; Nwosu *et al.*, 2010). The Benin Formation is overlain by lateritic overburden and underlain by the Ogwashi - Asaba Formation, which the Ameki Formation of Eocene underlies to Oligocene age (Mbonu *et al.*, 1991). The Benin Formation consists of coarse-grained gravelly sandstones with minor intercalations of shales and clay. The mostly coarse-grained sand units, pebbly and poorly sorted, contain lenses of fine-grained sands (Onyeaguocha, 1980).

The Ogwashi-Asaba Formation comprises a variable succession of clays, sands and grits with seams of lignite. The Ameki Formation consists of greenish-grey clayey sandstones, shale sand mudstones, and inter-bedded limestone. This Formation, in turn, overlies the impervious Imo Shale group characterized by lateral and vertical variations in lithology.

The project area is within the Sombreiro-Warri Deltaic plain deposits and freshwater swamp (Figure 4.3).

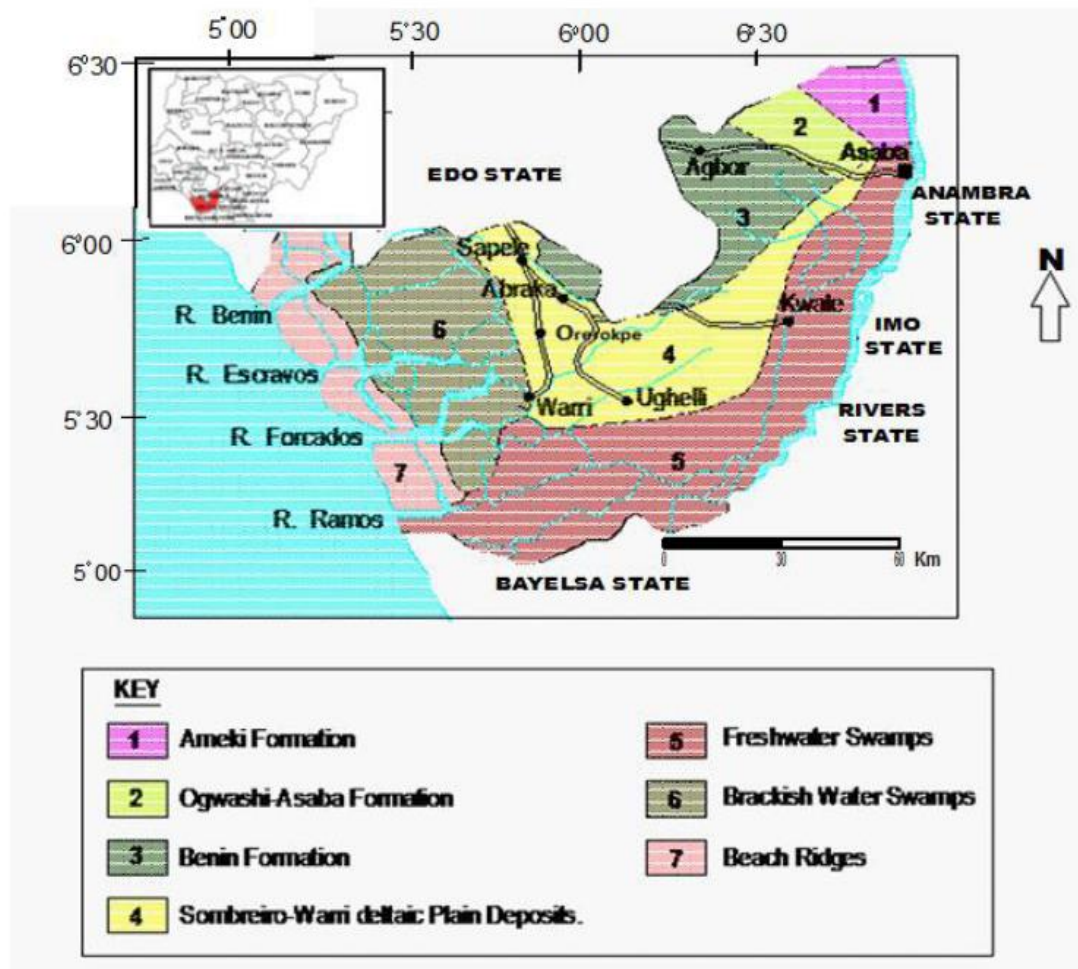


Figure 4.3: Geological Map of Delta State

Source: Orji and Egboka (2015)

4.6.4 Pedology

According to FAO soil taxonomy legends, there are thirteen (13) major soil types in Nigeria, all influenced by the climatic and vegetation zones of the country. This is expected because the degree of available moisture in the soil is an essential factor in soil reactions, fertility, and productivity. In general, the soils are divided into four main groups. These are:

- ✧ the ferruginous tropical soils on crystalline acid rocks which occupy about two-fifths of the area to the south, south-west and south-east;
- ✧ the brown soils and latosols of the northern half;
- ✧ the brown and reddish-brown soils in the northeastern corner; and
- ✧ the juvenile and hydromorphic soils, along with the alluvial channel complexes.

The soils largely reflect the influence of parent materials. Intensive use of the soils and the addition of manure and chemical fertilizers have altered their profile, texture, structure and

chemical characteristics. The project area is within the alluvial soil zone of the country (Figure 4.4).

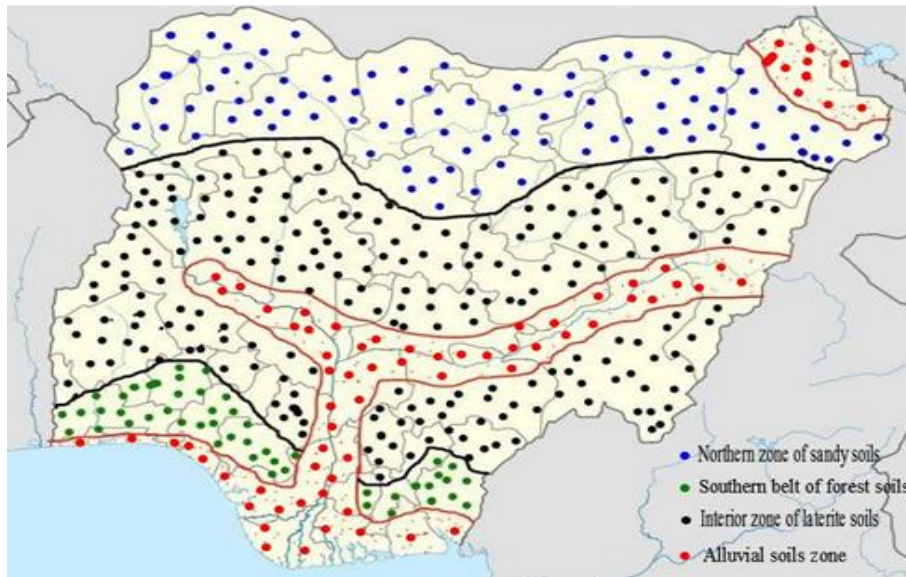


Fig 4.4: Soil zones and types in Nigeria

Source: Agriculture Nigeria, ND, 2006

The project area is made up of majorly alluvial soil.

4.6.5 Soil Quality

Soil resource is of vital importance for the survival and welfare of the people. One of the most severe and widespread problems facing the agricultural industry is the degradation of soil quality due to changes and alterations to various physical and chemical parameters. Soil is a complex natural material made of disintegrated rocks and decayed organic material which provides nutrients, moisture, and support for land plants.

This soil is a vital component of the environment. Several activities from the project construction may negatively impact the soil. These include; Potential erosion from vegetal clearing and creation of foundations for the industrial park; soil pollution and contamination from accidental oil & fuel leak from construction machinery and vehicles for the transport of construction materials equipment. More so, construction workers' disposal of solid wastes may contaminate the soil. Though most of these impacts are short term, the effects may be severe. However, mitigations measures have been proffered for these impacts, and they are well documented in chapter seven of this report

4.6.5.1 Methodology

The soil sampling locations were distributed in grids already marked out and geo-referenced. The grids considered the various land-use systems and natural features, such as forest areas, farmlands, uplands, lowlands and watercourses. Soil sampling was carried out in the same stations established for air and noise quality.

Soil samples were collected at the ten (10) preplanned sampling stations (Plate 4.3). At each sampling station, soil depth; 0-15 cm and 15-30 cm for topsoil and subsoil levels respectively. For physical and nutrient elements analyses, soil samples were sub-sampled and appropriately labelled using masking tape and indelible ink to indicate sample location and soil depth level. Samples for hydrocarbon contents analyses were collected into amber glass bottles and labelled appropriately using masking tape and indelible ink.

The samples were analysed for physicochemical, heavy metals and microbial parameters (Tables 4.7 and 4.8)



Plate 4.3: Soil sampling exercise

4.6.5.2 Physicochemical characteristics of the study soils

Table 4.7 shows the physicochemical characteristic of soils in the study area.

Table 4.7 Soil physicochemical characteristics

Parameters	0-15cm										15-30cm										Secondary data (KIP ESIA Report, 2021)	FAO 2012 limit (* Coren 2016)	WH O/F ME NV Limits (US DA 2017)	
	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10				
pH	5.17	5.42	5.76	5.95	5.56	5.59	5.15	5.20	5.31	6.21	5.85	5.61	6.22	6.10	5.96	6.43	5.73	6.87	6.90	7.0	3.80-5.91	5-8.0	5.0-8.0	
Elect. Conductivity (µS/cm)	87.76	92.14	84.68	84.03	77.15	90.83	86.35	90.83	88.17	87.92	186.6	168.8	115.8	128.8	193.0	175.9	151.2	133.3	184.1	185.0	20.00-433.00			
Moisture Content (%)	22.5	18.0	18.0	23.73	17.9	18.0	22.5	21.09	18.0	23.12	24.7	18.0	18.0	24.4	18.0	17.08	18.0	17.91	18.0	24.9				
PSD (%)	Clay	4.00	1.00	3.50	3.20	2.20	3.3	2.8	3.6	2.3	3.5	10.6	11.2	12.5	9.2	17.2	14.9	21.0	17.6	18.2	11.7	1.00-30.00		
	Silt	12.7	9.90	4.70	11.4	10.2	9.8	17.3	11.3	8.8	17.2	16.7	19.9	16.7	18.4	33.6	28.9	28.6	28.3	31.3	30.9	0.00-41.00		
	Sand	83.3	89.1	91.8	85.4	87.6	86.9	79.9	85.1	88.9	79.3	72.7	68.9	70.8	72.4	49.2	56.2	50.4	54.1	50.5	57.4	57.00-89.00		
Soil textural class	Loamy Sand	Sandy	Sandy	Loamy Sand	Sandy	Sandy	Loamy Sand	Loamy Sand	Sandy	Loamy Sand	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy				

	d			d			d	d																
Ext. Nitrate (mg/kg)	26.07	36.16	25.82	25.29	35.54	25.73	25.67	34.61	25.93	24.90	24.05	23.31	24.46	24.60	23.27	23.81	24.34	24.58	23.90	24.12	0.41-3.27	500	500	
Ext. Sulphate (mg/kg)	22.59	22.48	23.04	23.65	22.42	22.55	21.21	24.94	2.30	22.26	21.65	21.60	22.78	22.08	22.17	22.18	19.91	22.72	22.09	21.2	2.70-192.09	500		
Ext. Phosphate (mg/kg)	10.4	10.8	7.7	7.58	10.66	7.72	7.70	10.4	7.77	7.47	7.22	6.99	7.34	7.4	6.98	7.14	7.37	7.37	7.17	7.23		5	5	
Potassium (mg/kg)	0.12	0.25	0.65	0.42	0.24	1.05	0.9	0.12	0.3	0.15	0.09	0.06	0.41	0.21	0.15	0.74	0.34	0.08	0.22	0.13				
Calcium (mg/kg)	5.32	4.32	6.36	6.35	4.39	4.96	5.64	6.30	5.71	6.10	5.35	3.90	5.34	4.60	6.66	4.37	3.85	5.64	6.93	4.20	24.27-220.72			
Magnesium (mg/kg)	0.65	0.80	0.84	0.85	0.52	0.54	0.69	0.92	0.61	0.64	0.91	0.82	0.65	0.94	0.82	0.66	1.00	0.61	1.00	0.92	9.95-57.15			
THC (mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				
Total chromium (mg/kg)	0.59	0.68	0.89	0.68	0.83	0.69	0.85	0.73	0.77	0.85	1.65	1.28	1.05	1.42	0.81	1.38	1.43	1.72	1.32	1.47	2.97-13.86			
Total iron (mg/kg)	104.53	76.74	95.69	78.31	92.94	82.79	126.7	85.77	98.11	90.21	118.4	116.1	110.60	119.1	105.3	125.4	119.2	104.4	114.7	112.3	18.79-107.76	120	30,000	
Copper (mg/kg)	4.97	4.12	5.26	5.69	6.43	6.44	4.34	5.92	6.93	6.8	7.06	8.77	8.59	6.80	8.69	8.91	8.80	9.42	6.4	6.22	0.01-0.34	36	36	
Lead (mg/kg)	0.16	0.24	0.22	0.20	0.22	0.23	0.28	0.17	0.18	0.19	0.11	0.11	0.24	0.18	0.25	0.18	0.09	0.16	0.17	0.21	0.00-1.56	85	85	
Manganese (mg/kg)	6.02	4.67	5.24	5.99	6.41	6.23	6.08	6.46	6.76	6.79	7.37	7.62	8.36	8.39	6.76	7.51	7.17	8.69	6.82	6.85	0.61-11.49			
Nickel (mg/kg)	0.76	0.83	0.89	0.59	0.67	0.80	0.60	0.70	0.81	0.70	0.76	1.19	1.07	1.00	0.77	0.91	0.78	0.94	0.83	0.66	0.00-1.56	35	35	
Zinc	1.1	1.0	1.1	1.0	1.1	1.2	1.0	1.1	1.1	1.19	0.9	0.9	0.9	1.0	0.7	0.9	0.7	1.6	1.0	1.23	0.02-0.75	140	140	

(mg/kg)	2	5	1	0	6	3	9	8	5		7	7	2	1	4	2	9	4					
Arsenic (mg/kg)	0.3 4	0.2 5	0.2 9	0.2 9	0.2 0	0.2 8	0.2 8	0.2 4	0.3 3	0.25	0.3 3	0.2 2	0.2 9	0.2 8	0.4 0	0.3 7	0.3 7	0.3 0	0.2 9	0.31	0.00		
Mercury (mg/kg)	N D	N D	N D	N D	N D	N D	N D	N D	N D	ND	N D	N D	N D	N D	N D	N D	N D	N D	N D	ND	0.00		
Vanadium (mg/kg)	0.2 1	0.1 8	0.1 8	0.2 1	0.2 7	0.2 7	0.2 3	0.2 6	0.2 2	0.25	0.2 1	0.2 8	0.2 6	0.2 7	0.2 8	0.3 0	0.2 8	0.2 5	0.2 1	0.19	0.00-0.25	0.5	
Cadmium (mg/kg)	0.3 1	0.7 2	0.7 4	0.4 0	0.6 4	0.7 5	0.5 8	0.4 3	0.6 1	0.58	0.5 4	0.4 0	0.4 8	0.7 2	0.5 4	0.5 9	0.4 9	0.8 6	0.6 6	0.57	0.02-0.08		
Boron (mg/kg)	1.3 4	1.6 8	1.5 3	1.7 5	0.9 1	1.4 7	1.6 1	0.8 6	1.3 7	1.40	1.5 5	0.8 3	0.8 6	1.6 4	2.2 3	1.6 4	1.0 9	1.4 9	1.4 2	1.39			

Results from PSD analysis have shown that the soil texture in the project area is predominantly sandy to sandy loam. This justifies the slightly acidic values recorded as the pH of sandy soils are known to be between 5.8 and 6.3. This further attests to the fertility of the soil. The predominance of sandy soils (in both top and subsoil) in any project area requires soil compaction before construction (Balachowski and Kurek, 2014). It also implies moderate leaching capacity, and as a result, spills can easily percolate. Thus, this will be factored into impacts, mitigation and the project ESMP. All soil physicochemical parameters were within FAO threshold values except for phosphate values which were high across all sampling points, and total iron content, which exceeded the limit in one point (SS7) only. This could be due to the excessive use of inorganic fertiliser and manures in the surrounding farmlands (Schulte, 2004). The moderately wet classifications of the moisture content reinforce the less consolidated nature of the study area.

4.6.5.3 Soil Microbiology

The two groups of microorganisms studied from the sampled soils are fungi and bacteria, the essential organic matter decomposers in the soil. Bacteria and fungi (microbes) count provide information on the ongoing biochemical activities in soil. Microbial counts under normal circumstances increase with an increase in the soil organic matter. About 1g of fertile soil should contain 1×10^6 to 1×10^8 Cfu/g bacteria and fungi (Odu *et al.*, 1985).

The soil samples were contained in sterile glass bottles were subsequently triturated and homogenised. To evaluate the microbial population, the samples were placed in contact with 0.35% NaCl solution (physiological saline) and shaken vigorously for 30 minutes to release or extract the Protists present in the samples. The samples suspensions were serially diluted before being used to estimate microbial densities. Microbial counts under normal circumstances increase with an increase in soil organic matter.

RESULT

Table 4.8 indicated surprisingly more fungi diversities (eight species) but more bacteria counts. Also, the subsoils are more diverse microbiologically than their corresponding topsoils but with lesser counts, and some sites are more diverse than others. Only two bacteria genera (*Pseudomonas* and *Bacillus*) among the eight could utilise hydrocarbon products as growth substrates against four among the seven fungi genera.

Although reports with higher fungi diversities than bacteria are rare (Navratilova *et al.* 2019), their preference for plant-based substrates (Makipaa *et al.* 2017) as growth media possibly

indicates an abundance of logs litters, sawdust, wood splinters, and tree stumps in the study area. This assertion further implies significant logging activities, the establishment of tree gaps, soil erosion and the inevitable introduction of foreign materials, including alien species.

The recording of *Escherichia spin* top and subsoils of sampling site 2 and 5 and *Klebsiella sp* species only in the top and subsoils of sampling site 3 suggest a history of localised sewage sludge enrichment or an open defecation practice; the presence of these species stemming from faecal enrichment may be owed to fallowed farm clusters as evident in the area during field studies. Apart from this site, species found in the topsoils and subsoils of all other sampled sites were uniform suggesting uniformity in substrates composition over time.

A few hydrocarbon-degrading bacteria and fungi species further strengthen the earlier position of hydrocarbon in the study area. The degradation efficiency of these microbes may have contributed to the Non-Detection status recorded in the physicochemical section.

Table 4.8 shows the result of the microbial assay in the soil samples.

Table 4.8: Soil Microbial Result

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
SS1	Topsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Escherichia sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	5.12x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Escherichia sp</i>	4.25x10 ⁵	<i>Mucor sp</i> <i>Fusarium sp</i> <i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Candida sp</i>	3.00x10 ³	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i> <i>Penicillium sp</i>	2.50x10 ²
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	4.40x10 ⁵	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Micrococcus sp</i> <i>Enterobacter sp</i>	3.40x10 ⁴	<i>Mucor sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i>	2.50x10 ³	<i>Mucor sp</i> <i>Penicillium sp</i>	2.00x10 ²
SS2	Topsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i>	7.30x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Proteus sp</i>	6.70x10 ⁵	<i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i>	5.15x10 ³	<i>Mucor sp</i> <i>Candida sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i>	3.10x10 ²

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Proteus sp</i>							
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Actinomyces sp</i> <i>Micrococcus sp</i> <i>Proteus sp</i>	6.30x10 ⁵	<i>Pseudomonas sp</i> <i>Actinomyces sp</i> <i>Bacillus sp</i> <i>Proteus sp</i>	5.70x10 ⁴	<i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Fusarium sp</i>	4.62x10 ³	<i>Aspergillus sp</i> <i>Mucor sp</i> <i>Fusarium sp</i>	2.09x10 ²
SS3	Topsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Flavobacterium sp</i> <i>Klebsiella sp</i>	7.20x10 ⁶	<i>Pseudomonas sp</i> <i>Flavobacterium sp</i> <i>Klebsiella sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i>	6.45x10 ⁶	<i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>	5.00x10 ⁴	<i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>	4.00x10 ³
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Staphylococcus sp</i>	6.20x10 ⁵	<i>Pseudomonas sp</i> <i>Klebsiella sp</i> <i>Micrococcus sp</i>	5.20x10 ⁵	<i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Mucor sp</i>	4.70x10 ³	<i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i>	3.00x10 ¹

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Flavobacterium sp</i> <i>Klebsiella sp</i>		<i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Flavobacterium sp</i>		<i>Candida sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>		<i>Trichoderma sp</i>	
SS4	Topsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Escherichia sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	5.12x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Escherichia sp</i>	4.25x10 ⁵	<i>Mucor sp</i> <i>Fusarium sp</i> <i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Candida sp</i>	3.00x10 ³	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i> <i>Penicillium sp</i>	2.50x10 ²
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	4.40x10 ⁵	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Micrococcus sp</i> <i>Enterobacter sp</i>	3.40x10 ⁴	<i>Mucor sp</i> <i>Penicillium sp</i> <i>Candida sp</i>	2.50x10 ³	<i>Mucor sp</i> <i>Penicillium sp</i>	2.00x10 ²
SS 5	Topsoil	<i>Pseudomonas sp</i>	7.20x10 ⁶	<i>Pseudomonas sp</i>	6.45x10 ⁶	<i>Aspergillus sp</i>	5.00x10 ⁴	<i>Aspergillus sp</i>	4.00x10 ³

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Flavobacterium sp</i> <i>Klebsiella sp</i>		<i>Flavobacterium sp</i> <i>Klebsiella sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i>		<i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>		<i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>	
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Staphylococcus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Flavobacterium sp</i> <i>Klebsiella sp</i>	6.20x10 ⁵	<i>Pseudomonas sp</i> <i>Klebsiella sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Flavobacterium sp</i>	5.20x10 ⁵	<i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>	4.70x10 ³	<i>Mucor sp</i> <i>Candida sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i> <i>Trichoderma sp</i>	3.00x10 ¹
SS 6	Topsoil	<i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Pseudomonas sp</i>	8.48x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i>	7.81x10 ⁵	<i>Mucor sp</i> <i>Fusarium sp</i> <i>Aspergillus sp</i>	3.00x10 ³	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i>	2.50x10 ²

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i>		<i>Micrococcus sp</i> <i>Actinomyces sp</i>		<i>Penicillium sp</i> <i>Candida sp</i>		<i>Penicillium sp</i>	
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Actinomyces sp</i> <i>Micrococcus sp</i> <i>Enterobacter sp</i>	8.30x10 ⁵	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i> <i>Actinomyces sp</i>	7.40x10 ⁴	<i>Mucor sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i>	2.50x10 ³	<i>Mucor sp</i> <i>Penicillium sp</i>	2.00x10 ²
SS 7	Top soil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Proteus sp</i>	7.30x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Proteus sp</i>	6.70x10 ⁵	<i>Aspergillus sp</i> <i>Mucor sp</i> <i>Rhizopus sp</i>	2.50x10 ³	<i>Aspergillus sp</i> <i>Mucor sp</i> <i>Rhizopus sp</i>	2.04x10 ³
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Actinomyces sp</i>	6.30x10 ⁵	<i>Pseudomonas sp</i> <i>Actinomyces sp</i> <i>Bacillus sp</i>	5.70x10 ⁴	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Rhizopus sp</i>	1.15x10 ³	<i>Mucor sp</i> <i>Rhizopus sp</i>	1.12x10 ³

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Micrococcus sp</i> <i>Proteus sp</i>		<i>Proteus sp</i>					
SS 8	Topsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Escherichia sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	5.12x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Escherichia sp</i>	4.25x10 ⁵	<i>Mucor sp</i> <i>Fusarium sp</i> <i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Candida sp</i> <i>Rhizopus sp</i>	3.00x10 ³	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i> <i>Penicillium sp</i> <i>Rhizopus sp</i>	2.50x10 ²
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	4.40x10 ⁵	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Micrococcus sp</i> <i>Enterobacter sp</i>	3.40x10 ⁴	<i>Mucor sp</i> <i>Penicillium sp</i> <i>Mucor sp</i> <i>Candida sp</i> <i>Rhizopus sp</i>	2.50x10 ³	<i>Mucor sp</i> <i>Penicillium sp</i> <i>Rhizopus sp</i>	2.00x10 ²
SS 9	Topsoil	<i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Pseudomonas sp</i>	8.48x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i>	7.81x10 ⁵	<i>Aspergillus sp</i> <i>Mucor sp</i> <i>Rhizopus sp</i>	2.50x10 ⁴	<i>Aspergillus sp</i> <i>Mucor sp</i>	1.15x10 ³

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Bacillus sp</i> <i>Proteus sp</i> <i>Enterobacter sp</i>		<i>Micrococcus sp</i> <i>Actinomyces sp</i>					
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i> <i>Actinomyces sp</i> <i>Micrococcus sp</i> <i>Enterobacter sp</i>	8.30x10 ⁵	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Enterobacter sp</i> <i>Actinomyces sp</i>	7.40x10 ⁴	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Rhizopus sp</i>	1.15x10 ³	<i>Mucor sp</i>	1.10x10 ³
SS 10	Topsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Proteus sp</i>	7.30x10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Actinomyces sp</i> <i>Escherichia sp</i> <i>Proteus sp</i>	6.70x10 ⁵	<i>Mucor sp</i> <i>Fusarium sp</i> <i>Aspergillus sp</i> <i>Penicillium sp</i> <i>Candida sp</i>	3.00x10 ³	<i>Mucor sp</i> <i>Aspergillus sp</i> <i>Fusarium sp</i> <i>Penicillium sp</i>	2.50x10 ²
	Subsoil	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Actinomyces sp</i>	6.30x10 ⁵	<i>Pseudomonas sp</i> <i>Actinomyces sp</i> <i>Bacillus sp</i>	5.70x10 ⁴	<i>Mucor sp</i> <i>Penicillium sp</i> <i>Mucor sp</i>	2.50x10 ³	<i>Mucor sp</i> <i>Penicillium sp</i>	2.00x10 ²

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		<i>Micrococcus sp</i> <i>Proteus sp</i>		<i>Proteus sp</i>		<i>Candida sp</i>			

Microbes, including bacteria and fungi, are known to grow on waste media called substrates. The microbial data presented in Table 4.9 suggest possible substrates or waste streams in the study area. Table 4.9 listed domestic refuse, agro waste, herds presence, wood/plant waste river deposits, industrial waste weathered rock deposits and sewage as indicator substrates for the soil microbes assayed in this study. All species observed in this study was reported in the NEPZA 2019 document.

Table 4.9: Microbial–Waste Substrate Matrix

Species	Broad-spectrum media nutrients	Possible Substrate in Project Area
<i>Bacillus sp</i>	Nitrogen, carbohydrate	Meat, Groundnut, bread
<i>Pseudomonas sp</i>	vitamins, carbohydrates, nitrogen, and salts	Egg, bean and meat
<i>Micrococcus sp</i>	vitamins, carbohydrates, nitrogen, and salts	Rice, corn and bread
<i>Escherichia sp</i>	Sodium, chlorine, nitrogen	Meat, Groundnut, bread
<i>Klebsiella sp</i>	Nitrogen, carbon and sodium, ammonium phosphate	Egg, bean and meat
<i>Proteus sp</i>	Nitrogen, vitamins, lactose	Meat, Groundnut, bread Egg, bean and meat
<i>Serratia sp</i>	Sodium, chlorine, nitrogen	Rice, corn and bread
<i>Staphylococcus sp</i>	vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut, bread
<i>Enterobacter sp</i>	Sodium, chlorine, nitrogen	Meat, Groundnut, bread Egg, bean and meat
<i>Actinomyces sp</i>	sodium salt, nitrogen	Meat, Groundnut, bread
<i>Flavobacterium sp</i>	Proteoseptone, Yeast extract, Dextrose, Soluble starch, phosphate, sulfate and Sodium	Meat, fish, cheddar cheese
<i>Mucor sp</i>	Magnesium Sulfate, Monopotassium	Meat, Groundnut, bread Egg,
<i>Trichoderma sp</i>	Phosphate, Peptone, glucose, Sodium, potassium, iron, calcium	bean and meat
<i>Fusarium sp</i>	Sodium, potassium, iron, calcium,	Rice, beans and soya bean

<i>Rhizopus sp</i>	glucose	Yam, potatoes, Sugarcane, corn and wheat straw
<i>Candida sp</i>		
<i>Aspergillus sp</i>		
<i>Penicillium sp</i>		

Soil microbial diversity of the study area was generally uniform, indicating a similar substrate. All microbial species assayed in the soil samples are important in nutrient recycling. Details of the composition, abundance and broad-spectrum media nutrients of the microbial species assayed in the various samples suggest a stable ecosystem.

Indicator species such as *Escherichia sp* which were present in only the top soils of SS8, SS7, SS4 and SS2 indicate recent fecal contamination in the aforementioned areas. However, their presence in both top and sub soils of SS3 and SS5 suggest prolonged disposal of fecal matter in these areas. The frequency of *Pseudomonas sp* and *Bacillus sp* across all sampling stations possibly indicates vitamins as the dominating substrate as the species thrives more on vitamin-based substrates. Other possible substrates include; sodium, potassium, iron, calcium, and glucose. Relatively, the occurrence of *Mucor sp* and *Aspergillus sp* in all sampling sites could be owed to the availability of high vegetal waste as they are good decomposers of vegetal waste. The presence of similar fungal species in the top soils of SS3 (Obodougwa) and SS5 (Ogboleogume) indicates that quantities of the waste stream generated at these points are fairly uniform which implies negligible human migration into the area in recent times.

4.6.6 Groundwater Quality

4.6.6.1 Sampling Methodology

Water samples were collected from three (3) existing boreholes at Obodoogwa, Utagba, Emu-Ebendo within the project SoI. Plastic bottles were used for the collection and kept in a cooler loaded with ice blocks, while samples meant for heavy metal analysis were preserved by adding concentrated nitric acid (5 ml to 1 L of water). Parameters like pH, temperature, Total Dissolved Solids (TDS), electrical conductivity (EC) and dissolved oxygen were measured in *in-situ* with the aid of pH-conductivity-TDS meter (COMBO HI model 98130).

4.6.6.2: Result of groundwater quality

The results recorded for each physicochemical parameter were benchmarked with those from the Secondary data (KIP ESIA Report, 2021) and WHO/FMEnv regulatory limit, where one exists. Plate 4.4 shows groundwater sampling activity.



Plate 4.4: Groundwater sampling at Obodoogwa

Table 4.10 shows the geographical location of the boreholes sampled and the result for the physicochemical parameters measured.

Table: 4.10: Groundwater quality of the project area

Parameters	GW1	GW2	GW3	Secondary data (KIP ESIA Report, 2021)	NIS standard
	5.719342N, 6.371260E	5.670562N, 6.345103E	5.681495N, 6.405990E		
General appearance	Clear	Clear	Clear		Clear
pH @ 21.2oC	6.7	6.9	7.2	6.16-7.94	6.5-9.2
Temperature (oC)	27.2	25.3	23.6		40 °C
Turbidity (NTU)	1.12	1.37	1.92	1.00-61.00	5
TDS (mg/l)	28.2	25.3	33.1	39.00-227.00	

TSS (mg/l)		142	89	112	2.00-51.00	
Conductivity (µS/cm)		1567	1006	1233	39-453.00	2500
Total Hardness (mg/l)		7.48	9.83	10.3		
THC		ND	ND	ND		0.05
PCB (ng/m3)		ND	ND	ND		
Mineral Oil (mg/l)		<1.00	<1.00	<1.00	3.25-30.82	
BOD (mg/l)		1.27	1.32	1.46		10
COD (mg/l)		3.42	2.33	4.05	32.00-224.00	
Chloride (mg/l)		120	184	189	10.60-70.90	
Total Alkalinity (mg/l)		<1.00	<1.00	<1.00	34.00-106.00	
Nutrients	Nitrate (mg/l)	1.92	1.87	1.63	0.19-7.23	50
	Phosphate (mg/l)	0.24	0.29	0.26		
	Sulphate (mg/l)	0.28	0.29	0.22	1.39-43.98	100
Reactive Silica (mg/l)		6.1	9.6	7.4	14.28-118.40	
Cyanide (mg/l)		<0.01	<0.01	<0.01		
Ammonium (mg/l)		<0.02	<0.02	<0.02	0.63-14.82	
Aluminum (mg/l)		<0.10	<0.10	<0.10	3.42-5.88	
Calcium (mg/l)		75	83	88	22.25-81.79	
Magnesium (mg/l)		1.5	0.4	0.22	2.21-38.68	
Sodium (mg/l)		36	45	47	8.54-37.46	
Potassium		0.29	0.3	0.35	2.21-38.68	10
	Arsenic (mg/l)	<0.001	<0.001	<0.001	0.00	
	Total Mercury (mg/l)	<0.0002	<0.0002	<0.0002	0.00	
	Selenium (mg/l)	<0.001	<0.001	<0.001		
	Lead (mg/l)	<0.01	<0.01	<0.01	0.02-0.23	0.05
	Zinc (mg/l)	<0.05	0.12	0.11	0.09-0.49	
	Total Iron (mg/l)	0.28	0.15	<0.05	0.68-5.77	1.0

Heavy Metals	Copper (mg/l)	<0.05	<0.05	<0.05	0.02-0.08	1.0
	Manganese (mg/l)	<0.10	<0.10	<0.10	0.12-0.62	
	Cadmium (mg/l)	<0.002	<0.002	<0.002	0.07-0.32	
	Total Chromium (mg/l)	<0.01	<0.01	<0.01	0.49-5.08	
	Cobalt	0.02	0.02	0.02	0.00-0.10	
	Vanadium	ND	ND	ND	0.02-0.09	
Total Coliform (Cfu/100ml)	0	0	0		0	
Faecal Coliform (Cfu/100ml)	0	0	0		0	
E-coli (Cfu/100ml)	0	0	0		0	
Faecal Streptococci (Cfu/100ml)	0	0	0		0	
Total Plate Count (Cfu/ml)	0	0	0		0	

Source: MCNL Survey, 2022. ND = Not Detected

As shown in Table 4.10, all the physicochemical parameters analysed in the groundwater samples were within ISO threshold values the result compared well with the secondary data.

The microbiology analyses showed the absence of microbes in the water samples, hence fit for drinking.

4.6.7 Hydrology and surface drainage of the project area

The project area is drained by the Ase Creek (289.6m away from the project area). The creek is approximately 292 km. Ase Creek is a tributary of the Forcados River, the western branch of River Niger in the Niger Delta region of Southern Nigeria. Ase Creek marks the geological boundary of the Somberairo-Warri formation and the meander belts of the upper deltaic plains of the Niger Delta (Arimoro, *et al*, 2007). The Creek flows through the freshwater swamp and swampy forests of the Niger Delta region of Nigeria and such settlements as Asaba-Ase, Ase, Ivrogbo, Ibredeni, Awah, Ibrede, Igbuku, Ashaka, Umusedeli, Kwale, Osemele, Obetim-Uno, Iselegu and Obikwele, among others. The inhabitants of these settlements depend on the water from the Creek for domestic purposes, recreational purposes,

and transportation, industrial and agricultural purposes. (Idodo Umeh, 2002). Plate 4.4 shows the water body.



Plate 4.4: Ase Creek (5.677577N, 6.431805E)

4.6.8 Surface water quality of the study area

4.6.8.1 Sampling Methods

Two (2) surface water samples were collected from the Ase creek (plate 4.5) and another from the Obodoogwa pond, using a non-isokinetic water sampler. This involved immersion of the laboratory cleaned sample bottle below the water body's surface. The exercise also involved salinity, temperature, turbidity, pH, dissolved oxygen, and conductivity in situ. Water samples were collected for laboratory analyses using. 2-litre plastic bottle for water samples for physicochemical analysis; 2-litre plastic bottle for water samples for heavy metal analysis; 1-litre plastic bottle for water samples for microbiological analysis; and 1-litre glass bottle with Teflon seal cap for water samples to be analysed for hydrocarbon content (oil and grease, etc.).

All water samples were preserved in iced coolers on-site before transferring to the laboratory (Mifor Consult laboratory, Calabar).



Plate 4.5: Surface water sampling at the Ase creek

4.6.8.2 Surface water Physico-chemical parameters

Table 4.11 presents the physicochemical parameters assessed in samples obtained from surface water bodies within the proposed project areas.

Table 4.11: Summarised Surface Water Physico-chemical Characteristics

PARAMETERS	SAMPLE STATIONS AND COORDINATE			Secondary data (KIP ESIA Report, 2021)	WHO (2011) limits for the sustenance of Aquatic Lives
	SW1	SW2	SW3		
	5.677577N, 6.431805E	5.677867N, 6.431996E	5.690625N, 6.352221E		
Colour	Clear	Cloudy	Clear		
Odour	Nil	Nil	Nil		Odourless
pH	5.7	5.9	6.8	5.05-6.24	4.8-8.5
Temperature (oC)	26.8	25.3	28.3		22 – 40
Conductivity (µS/cm)	2150	3380	3170	16.00-34.00	980
Salinity (g/l)	0.97	1.03	0.99	0.01	
DO (mg/l)	5.2	5.3	7.5	3.00-6.10	4 – 9

Turbidity (NTU)	13.33	26.82	24.3	2.00-13.00	≤5
Total Dissolved Solids (mg/l)	1505	2366	2219	8.00-17.00	
Total Suspended Solids (TSS)	16	16	20	1.00-7.00	
Oil & Grease (mg/l)	7	5	10	2.12-18.52	
BOD (mg/l)	18	20	23	1.94-5.3	≤10
COD (mg/l)	54	60	69	32.00-96.00	40
Chloride (mg/l)	73.40	70.18	75.31	5.50-14.20	
Nitrate (mg/l)	73	64	78	0.07-0.96	50
Phosphate (mg/l)	6.18	3.16	2.62		0.5
Sulphate (mg/l)	150	212	187	2.33-11.48	250
Phenol (µg/l)	0.03	0.03	0.03		
Magnesium (mg/l)	8.6	19.4	13.5	2.21-3.65	
Potassium (mg/l)	4.21	1.96	2.72	3.47-6.56	
Sodium (mg/l)	3.57	6.72	10.35	9.25-13.23	
Calcium (mg/l)	5.71	3.68	6.34	12.67-22.70	
Chromium (mg/l)	0.27	0.27	0.27	1.20-2.28	
Manganese (mg/l)	<0.10	<0.10	<0.10	0.15-0.48	100
Lead (mg/l)	<0.20	<0.20	<0.20	0.02-0.05	1.0
Zinc (mg/l)	<0.20	<0.20	<0.20	0.10-0.18	5000
Copper (mg/l)	<0.20	<0.20	<0.20	0.03-0.04	0.5
Total Iron (mg/l)	0.53	1.62	2.51	1.75-3.02	300
Nickel (mg/l)	1.30	1.35	1.03	0.01-0.02	88
Silver (mg/l)	<0.10	<0.10	<0.10	0.01-0.02	

Cobalt (mg/l)	<0.01	<0.01	<0.01	0.00-0.03	
Cadmium (mg/l)	<0.01	<0.01	<0.01	0.07-0.08	0.03

Source: MCNL Survey, 2022

As shown in Table 4.11, all physicochemical parameters analysed in the water samples were within threshold values, except for turbidity, COD, BOD₅, Nitrate and Phosphate. These high values indicate an elevated pollution level as the water body is used for multi-purposes, including washing, bathing, cooking, etc. COD, for instance, increases as the concentration of organic material increases suggesting susceptibility to oxidation. Water with high BOD typically contains high decaying plant matter, human waste, or industrial effluent.

Also; poor agricultural practices, runoff from urban areas and lawns leaking septic systems or discharges from sewage treatment plants, very tiny inorganic and organic matter, algae, dissolved coloured organic compounds and plankton and other microscopic organisms often increase turbidity levels in surface water (Ebigwai, *et al.*, 2014).

These runoffs (enhanced by the undulating altitudinal gradients) results in the addition of nitrates to the water bodies, as evident in the result. On the other hand, high nitrates trigger plant growth, algal bloom leading to elevated BOD levels. Sustaining the existing high organic wasteload activities may deplete the dissolved oxygen levels to an anoxic level sooner.

High particulate matter concentrations affect light penetration, ecological productivity, recreational values, and habitat quality. Also, increased turbidity can harm fish and other aquatic life habitat areas. Particles also provide attachment places for other pollutants, notably metals and bacteria. The surface water acidity across the sampled points corroborate the high terrestrial depositional inputs and artisanal activities in the water bodies. The PPA project activities will impact the surface water quality during the project's life cycle and hence, factored into the ESMP.

4.6.8.3 Surface Water Microbiology

Surface water microbiology studies were conducted to reveal the quality of water bodies in the project area to infer the possible waste streams used as growth substrates.

The occurrence of eight (8) bacteria species (Table 4.12) attests to the heterogeneous nutrient inputs into the water bodies. Besides the considerable species diversities, the significant

bacteria and fungi counts indicate river bodies under a rich supply of diverse organic waste load.

The densities and taxa of microorganisms in the sampled water bodies are presented in Table 4.12, while the Substrate matrix for the sampled species is shown in Table 4.13.

Table 4.12: Surface Water Microbiology Result

	Total Heterotrophic Bacteria (THB)	Count (Cfu/ml)	Hydrocarbon utilising Bacteria (HUB)	Count (Cfu/ml)	Total Heterotrophic Fungi (THF)	Count (Cfu/ml)	Hydrocarb on Utilizing Fungi (HUF)	Count (Cfu/ml)
SW1	<i>Staphylococcus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Pseudomonas sp</i> <i>Bacillus sp</i> , <i>Escherichia sp</i> , <i>Flavobacterium sp</i> ,	5.03 x 10 ⁶	<i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Pseudomonas sp</i> <i>Bacillus sp</i> , <i>Escherichia sp</i> , <i>Flavobacterium sp</i> ,	4.74 x 10 ⁴	<i>Aspergillus sp</i> <i>Rhodotorula sp</i> <i>Penicillium sp</i>	4.56 x 10 ³	<i>Aspergillus sp</i> <i>Rhodotorula sp</i>	3.71 x 10 ³
SW2	<i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Pseudomonas sp</i> <i>Bacillus sp</i> , <i>Escherichia sp</i> <i>Flavobacterium sp</i> ,	7.01 x 10 ⁶	<i>Pseudomonas sp</i> <i>Bacillus sp</i> , <i>Flavobacterium sp</i> , <i>Escherichia sp</i>	6.62 x 10 ⁵	<i>Rhodotorula sp</i> , <i>Penicillium sp</i> , <i>Fusarium sp</i>	4.42 x 10 ⁴	<i>Penicillium sp</i> , <i>Fusarium sp</i>	3.10 x 10 ³

SW3	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Streptococcus sp</i> <i>Flavobacterium sp</i>	5.80 x 10 ⁴	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Streptococcus sp</i>	4.33 x 10 ³	<i>Aspergillus sp</i> <i>Candida sp</i>	3.07 x 10 ³	<i>Candida sp</i>	2.03 x 10 ³
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Source: MCNL Survey, 2022

Table 4.13 Substrate matrix for Surface water microbial species

Species	Broad-spectrum of growth media	Examples of local foods as a possible growth medium
<i>Bacillus sp</i>	Nitrogenous substance	Meat, Groundnut, bread
<i>Pseudomonas sp</i>	Vitamins, carbohydrates, nitrogen, and salts	Egg, bean and meat
<i>Micrococcus sp</i>	Nutrient agar	Rice, corn and bread
<i>Proteus sp</i>	Nitrogen, vitamins, lactose	Starch
<i>Flavobacterium sp</i>	Proteosepeptone, Yeast, Dextrose, Soluble starch, phosphate, Magnesium Sodium	Meat, fish, cheddar cheese
<i>Staphylococcus sp</i>	Vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut and Bread
<i>Streptococcus sp</i>	vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut and Bread
<i>Escherichia sp</i>	vitamins, carbohydrates, nitrogen, and salts	Meat, fish, cheddar cheese
<i>Actinomyces sp</i>	vitamins, carbohydrates, nitrogen, and salts	Meat, fish, cheddar cheese
<i>Candida sp</i>	Sodium, potassium, iron, calcium, glucose	Rice, beans and soya bean Yam, potatoes, Sugarcane, corn and wheat straw

The presence of faecal contamination indicator species such as *Escherichia sp* in SW1 and SW2 suggests polluted water bodies. However, the samples were devoid of water-borne pathogens such as *Giardia lamblia* and *Vibrio cholera*. Details of the composition, abundance and broad-spectrum media nutrients of the microbial species assayed in the various samples suggest contamination by food waste and runoff from fertiliser-laden agricultural lands (Nitrogen

source). All microbial species assayed in this study had been reported to play key ecological roles in various water systems, especially nutrient recycling.

4.6.9 Sediment Quality

4.6.9.1 Sampling methodology

Sediment samples were obtained alongside the surface water sample. The sample was obtained with the aid of Eckman grab. The grab is made up of stainless steel consisting of two jaws that automatically close when lowered into the river. On reaching the bottom of the water body, sediment is trapped in the jaws and is gradually pulled back to the surface. A single grab bite was collected per station. The sediment (1 - 2cm) was collected in a stainless steel basin and homogenised and sub sampled to analyse for physicochemical parameters and Total Hydrocarbon Content (THC). The residual sediment was washed and collected in a plastic container for macrobenthos analyses, while any residual sediment was thrown back into the water.

Samples for physicochemical analyses were collected in polythene bags and stored for analysis. In-situ measurements such as pH and temperature were carried out on sediment samples. The sediment samples for microbial analyses were collected in sterile plastic containers and stored in coolers containing ice blocks. After each sampling, the grab samples were washed thoroughly to remove any adhering particles from the previous sampling.

4.6.9.2 Sediment Physico-Chemical parameters

Several physicochemical parameters were conducted for recovered sediment samples from water bodies in the study area. Some of the parameters include pH, oil and grease, Total Hydrocarbon (THC), nitrates, phosphates, sulphate, chloride and about ten (10) species for heavy metals. Similarly, some of the parameters' regulatory limits and ranges (where they exist) were used as the benchmark for determining existing status. Also, the baseline study results were compared with those reported for contiguous areas.

Table 4.14 shows the result of physicochemical parameters analysed in the sediment samples of the water bodies.

Table 4.14 physicochemical characteristics of the studied sediment

PARAMETERS	SAMPLING STATIONS AND COORDINATES			Secondary data (KIP ESIA Report, 2021)	International Sediment Quality Guidelines (ISQG) Limits Aquatic lives
	SD1	SD2	SD3		
	5.677577N, 6.431805E	5.677867N, 6.431996E	5.690625N, 6.352221E		
pH	7.73	8.61	7.81	4.10-4.47	6.5-9.0
Oil and Grease (mg/kg)	<1.00	<1.00	<1.00	8.56-308.52	
THC (mg/kg)	<5.00	<5.00	<5.00		
Chloride (mg/l)	76.92	70.05	73.45	7.00-19.00	
Ext. nitrate(mg/kg)	0.16	0.16	0.16	0.61 - 0.94	
Ext. phosphate (mg/kg)	2.93	0.93	2.54		
Ext. sulphate (mg/kg)	0.84	1.80	1.53	14.29 - 76.23	
Chromium (mg/kg)	0.24	0.24	0.22	1.05-3.95	
Lead(mg/kg)	0.07	0.10	0.07	0.09-0.64	35
Zinc(mg/kg)	1.78	1.82	1.37	0.37-0.72	150
Copper(mg/kg)	4.09	3.20	4.38	0.03-0.06	28
Total iron	1.25	0.68	1.50	10.89-46.50	300

(mg/kg)					
Nickel (mg/kg)	0.76	0.87	0.82	0.05-0.12	
Cobalt (mg/kg)	<0.01	<0.01	<0.01	0.04-1.04	
Cadmium (mg/kg)	<0.01	<0.01	<0.01	0.05-0.06	
Vanadium (mg/kg)	<5.00	<5.00	<5.00	0.06-0.21	
Manganese (mg/kg)	0.991	1.31	1.331	0.68-1.27	

The result (Table 4.14) shows that the physicochemical parameters analysed in the sediment samples were within ISQG and FMEnv threshold values.

4.6.9.3 Sediment microbiology

Table 4.15 is the result of the microbiology of the recovered sediments, while Table 4.16 presents the possible substrate matrix for the microbial species observed in the sampled sediments.

Table 4.15: Microorganisms isolated from the studied sediments

	Total Heterotrophic Bacteria (THB)	Count (Cfu/ml)	Hydrocarbon utilising Bacteria (HUB)	Count (Cfu/ml)	Total Heterotrophic Fungi (THF)	Count (Cfu/ml)	Hydrocarbon Utilizing Fungi (HUF)	Count (Cfu/ml)
SD1	<i>Staphylococcus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i> <i>Pseudomonas sp</i> <i>Bacillus sp</i>	4.63 x 10 ³	<i>Micrococcus sp</i> <i>Actinomyces</i> <i>Bacillus sp</i>	3.18 x 10 ²	<i>Aspergillus sp</i> <i>Rhodotorula sp</i> <i>Penicillium sp</i>	2.42 x 10 ²	<i>Rhodotorula sp</i> <i>Penicillium sp</i>	2.11 x 10 ²
SD2	<i>Actinomyces sp</i> <i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Proteus sp</i>	3.61 x 10 ⁴	<i>Bacillus sp</i> <i>Pseudomonas sp</i> <i>Proteus sp</i>	3.08 x 10 ³	<i>Rhodotorula sp</i> , <i>Penicillium sp</i> , <i>Fusarium sp</i>	2.38 x 10 ³	<i>Rhodotorula sp</i> <i>Fusarium sp</i>	1.85 x 10 ³
SD3	<i>Pseudomonas sp</i> <i>Bacillus sp</i> <i>Staphylococcus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	3.41 x 10 ⁴	<i>Bacillus sp</i> <i>Staphylococcus sp</i> <i>Micrococcus sp</i> <i>Actinomyces sp</i>	2.14 x 10 ³	<i>Aspergillus sp</i> <i>Candida sp</i> <i>Penicillium sp</i>	3.03 x 10 ²	<i>Aspergillus sp</i> <i>Candida sp</i>	2.22 x 10 ²

	<i>Proteus sp</i>							
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Source:

MCNL

Survey,

2022

Table 4.16: Possible species- substrate matrix for Sediment samples

Species	Broad-spectrum of growth media	Examples of local foods as a possible growth medium
<i>Bacillus sp</i>	Nitrogenous substance	Meat, Groundnut, bread
<i>Pseudomonas sp</i>	vitamins, carbohydrates, nitrogen, and salts	Egg, bean and meat
<i>Micrococcus sp</i>	Nutrient agar	Rice, corn and bread
<i>Proteus sp</i>	Nitrogen, vitamins, lactose	Starch, fufu
<i>Actinomyces sp</i>	Proteoseptone, Yeast, Dextrose, Soluble starch, phosphate, Magnesium Sodium	Meat, Groundnut, bread
<i>Staphylococcus sp</i>	Vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut and Bread
<i>Streptococcus sp</i>	Vitamins, Carbohydrates, Nitrogen, And Salts	
<i>Aspergillus sp</i>	vitamins, carbohydrates, salts and nitrogenous substance	Rice, beans and soya bean, yam, potatoes, Sugarcane, corn and wheat straw
<i>Candida sp</i>		
<i>Penicillium sp</i>		
<i>Fusarium sp</i>		
<i>Mucor sp</i>	Nutrient agar, vitamins and carbohydrates	Starch, fufu
<i>Rhodotorula sp</i>		

Source: MCNL, 2022.

The microbial composition of sediments is similar to those observed in the surface water samples, except for the absence of faecal contamination indicators. The presence of *Escherichia sp.* in the surface water and subsequent absence in the sediment suggest an upsurge in open defecation practice, presumably from influx of artisanal workers to new construction sites or onset of farming activities.

Apart from faecal waste, the microbial composition in the sediment samples (Table 4.16) generally indicated contamination, especially from food and wood sources.

4.6.10 Plankton studies

4.6.10.1 Phytoplankton

Ecological sensitivity of the phytoplankton taxa was reviewed for the twelve (12) species which comprises mainly of diatoms and dinoflagellate in Table 4.17. Phytoplankton sample collection was done by lowering the plankton net just below the water surface and dragging (horizontally) on the waterway at about 1.5 knots per hour for 5 minutes. The phytoplankton samples were collected in clearly labeled containers and preserved in Lugol's iodine solution.

Table 4.17: Reviewed ecological significance of Phytoplankton taxa

Species	Division	Optimum ecological conditions	Mode of nutrition	REMARK
<i>Asterionella japonica</i>	Diatom		Phototropic	Found in both marine and freshwater environment, their diversity and count indicated an abundance of dissolved carbon sourced from discharged organic matter with which they carry out photosynthesis. When blooming and overpopulating, they can suffocate an entire area of oxygen.
<i>Ceratium tripos</i>	Dinoflagellate	Temp: 20-34 ⁰ c Salinity: 13-35	mixotrophic,	Found in both freshwater and marine environment, their diversity and count indicated an abundance of carbon sourced from discharged organic matter. Formation of toxins, changes in water quality, and reduced Dissolved Oxygen (Anoxic) conditions, leading to fish poisoning, has been reported. Biomagnification and shellfish poisoning were reported up the food chain to man.[1]
<i>Chaetoceros atlanticus</i>	Diatom	Temp: -2-29 ⁰ c	Phototropic	Found in marine/ freshwater environments, it serves as an essential food source within the water column

		Salinity: 18-37		and is a major carbon contributor to the benthic environment (Booth et al., 2002). Also, it has been reported to contribute about 91% of total phytoplankton cells, serving as an essential primary producer and contributing to oxygen production (Booth et al., 2002). Due to its high growth rates and high lipid concentrations, research has been conducted to use it as a biofuel potentially. [4]
<i>Cyclotella sp</i>	Diatom	NA	heterotrophic	Found in marine/ freshwater environments, but can also be found in brackish habitats as well. They thrive in a wide range of salinities, at high nutrient levels, and under small-scale turbulence [5] [6][7] and can be used as an early indicator of water quality deterioration. [8] [6] [7] they have also been used in the pale of flood studies to identify historical floods in an attempt to enhance predictive models for extreme flood events [9].
<i>Dinophysis sp</i>	Dinoflagellate		Mixotrophic	Found in the upper region of aquatic environments, they produce diarrhetic shellfish poisoning (DSP) toxins and pectenotoxins (PTXs) and pose a significant concern to public health and the aquaculture industry. [10] They also produce okadaic acid, dinophysistoxins, and pectenotoxins, which inhibit protein phosphatase and causes diarrhoea.[11]
<i>Eucampian zodiacus</i>	Diatom	Temp: -2-29 ⁰ c Salinity: 25-36	Saprotrophic	They are found in marine/ freshwater environments and are good indicators of water pollution. It has become known as the predominant organism causing the bleaching of aqua-cultured nori seaweed

				(Pyroplaquezation), and its blooms cause exhaustion of nutrients in water columns. [12]
<i>Melosira moniliformis</i>	Diatom	Temp: -1-25 ⁰ c Salinity: 23-36	Phototropic	Littoral dwelling <i>Melosira</i> species are freshwater pollution indicators [13]. Their diversity and counts across the sampling stations indicate huge petroleum hydrocarbon contents. [14] In extreme cases, depletion of Dissolve oxygen and Biological Oxygen Demand has been reported [15]. Their presence in the study area serves as breeding and spawning grounds for fishery resources since fish larvae depend on <i>Melosira</i> for metamorphic development [18]. They are a component of most foreign fish feeds (Sigler and Sigler 1986) [19]. <i>Melosira</i> is a biomarker [20] of the aquatic environments and undergoes chelation with lead (Pb) [21]; hence has biosorption properties [22]. Bloom of <i>Melosira</i> has been reported in wastewater rich in Carbontriles, Manganese and Nickel [23]. They are utilized as a food source for fish fries.[24][25]
<i>Melosira sp</i>	Diatom	Temp: 0-26 ⁰ c Salinity: 9-30	Phototropic	
<i>Odontella sp</i>	Diatom	Temp: 2-12 ⁰ c Salinity; 27-35 pH: 8.2-8.7	Heterotrophic	Consumption of this neretic dwelling species confer immunities and antioxidants properties on fishes [26] and serves as a rich source of Eicosapentaenoic acid- EPA[27]. Their environment of occurrence serves as a spawning and recruitment grounds for crabs, oysters, and other fishery resources [28]
<i>Oscillatoria limnetica</i>	Cyanobacteria	NA	Chemotrophic	<i>Odontella sp</i> a species of fresh water cyanobacteria is also a consortium of microalgae involved in the degradation of solid and liquid waste [29][30] reported urea, ammonium chloride and silica-based

				media as excellent growth media capable of stimulating exponential growth.
<i>Peridiniumcinctum</i>	Dinoflagellate	NA	Heterotrophic	They are found in marine/ freshwater environments. The sediment seedbeds of hypnozygotes may enable occasional blooms (population increases) of Peridinium, which are known to impart a brownish discoloration to the water.[31]
<i>Skeletonema costatum</i>	Diatom	Temp: 25 ⁰ c Salinity: 18-25	Phototropic	This marine/ freshwater species causes water discoloration [32], produces reactive aldehydes that negatively impact hatching copepods [33] and produce toxic chemicals, blocking important biochemical pathways in algae.[34]

NA- Not Available *FOOTNOTE

(1) Bienfang et al., (2012), (2) Booth et al.,(2002) (3) Booth et al.,(2002) (4) Spaulding and Edlund, (2008), (5) Jackson et al., 1987, (6) Weckstrom and Juggins, (2006) (7) Yang et al., 2005 (8) Collins et al., 1997, (9) Juggins, (2006), (10) Yang et al., (2005), (11) Mediolli and Brooks, (2003), (12) Egmond et al., (1993), (13) Reguera et al., (2012), (14) Ferris, et al., (2016), (15) Onyema, (2013), (16) Dombrowski et al., (2017), (17) Onyema (2013), (18) Murawski et al.,2000, (19) Siglerand Sigler (1986), (20) Harvey et al.,(2004), (21) Jackson and Morgan, (1978), (22) Al-Degs et al., (200), (23) Khraisheh et al., (2004), (24) Brown, (2002), (25) Guedes and Malcata, (2012), (26) Xia et al., (2014), (27) Vazhappilly and Chen (1998), (28) Boonyubol, (1984), (29) Sheppard, (2019), (30) Keerthi et al., (2013), (31) Lee, (2008), (32) Kraberg et al., (2010), (33) Miralto et al., (1999), (34) Andreae and Klumpp 1979

4.6.10.2 Zooplankton

Ecological sensitivity of the Zooplankton taxa was reviewed for the eight (8) species comprising the dominant Copepoda, Mollusca and one member each of Annelida, Arthropoda, Chaetognatha, Branchiopoda and Protohordata, in Table 4.18

Table 4.18: Reviewed ecological significance of Zooplankton taxa

SPECIES	Order/Phylum	Optimum pH, Temperature (0C) & Salinity(ppm) Ranges	Food/Feeding Habits	REMARK
<i>Polychaete larvae</i>	Annelida	pH =6.6 – 8.1 (7.4) Temp – 15 -30 (26.2) Salinity – 0.2- 25	invertebrate and phytoplankton	The euryecious ability of this species, as revealed by the reviewed physicochemical parameters, is evident in their presence in all aquatic environments [1]. Their proficiency in turning over nutrients from bottom sediments to epilimnion layers alters physicochemical parameters and influences trophic levels, migration, and sites for breeding grounds [2]. Though the species is eurythermal, larvae development is inhibited at a temperature above 26.2 ⁰ C [3]
<i>Meta-nauplius larvae</i>	Arthropoda	pH- 7–8.2 (6.37) Temp 25.6- 29.8 (27.9) Salinity 0.1- 28 (0.2)	Bacteria, Algae, rotifers, crustacean larvae and shrimps.	This larvae metaphase into <i>Nematoscelisdifficilis</i> (a species of Krill). Their diurnal vertical migration tendencies, broadcast spawning nature (since larva and not female was observed) coupled with their ecosystem services (plastic degradation, food and fish baits, main preys of predatory fishes, livestock

				fodder, human delicacies and source of 'Krill Oil' -used as therapy for blood lipid and heart health [4], imposes species protection burden since they are negatively impacted and vulnerable to predation and wastewater discharges. Abrupt changes in pH, temperature and salinity have been reported in inactivating and prolonging metamorphosis beyond four weeks [5].
<i>Sagitta enflata</i>	<u>Chaetognatha</u>	pH 5.5 – 7.3 (6.46) Temp 26.5 – 29.0 (28.0) Salinity 0.1-15 (0.30)	Copepods, organic detritus, bacteria or algae	The egg fecundity and number laid by this oligotrophic and copiotroph species, found across all spectrums of the aquatic habitat, are gravely impacted by wastewater discharges, habitats alterations, seasonal variations and abrupt changes in environmental conditions [6]. The population of <i>S. enflata</i> is reduced with low temperatures. Hatching difficulties [7] and predation by Copepods, including <i>Oithona</i> spp censored in this study, are major threats. Temperature interferes with their hatching.
<i>Parasagitta setosa</i>	Aphragmophora	pH 5.5 – 7.3 (6.20) Temp 26.5 – 29.0 (27.4) Salinity -0.15 – 15 (0.42)	Copepods and phytoplanktons	Their preference for the neretic zones of the water bodies is indicative of their inclination for warm and photic conditions that determine their daily vertical migration pattern. The introduction of alien biotic and wastewater discharges induces mortalities [8] due to changes in temperature, dissolved oxygen and pH.

<i>Oikopleura fuiformis</i>	Chordata	pH 5.78- 7.2 (6.37) Temp 25.7 – 28.6 (27.9) Salinity: 0.01 – 20 (0.4)	Planktons	This Neretic species, acting as a bridge between energy flow between producers and consumers and influenced by seasonal variations, produces bio illuminant light researched for street lightening. [9] Their high growth rate, grazing impact and daily vertical influx of organic matter make them excellent carbon recycling candidates. Their consumption of organic particulate matter is vital as they help water purification and removal of waste loads. Mucus houses formed daily to act as nutrient sources to benthos aggregates nutrients and containment of pollutants and sites of heterotrophic bacterial production[10]
<i>Eucalanus elongatus</i>	Copepoda	pH 7.5 and 8.5 (8.0) Temp 24–30 (27) Salinity 0.15 – 35 (0.9)	organic detritus, bacteria or algae	Copepods constitute the largest zooplankton populations [11] in any aquatic system since they are both Euryhaline and eurythermal. Their presence also directly correlates with high productivity, indicating an increased deposition of waste loads. Numerous studies [12] has shown a strong relationship between larval fish survival and copepod abundance and diversity. Copepods are a major component of excellent fish feed [13]. In natural waters, they act as micro predators of fish, fish parasites, intermediate hosts of fish parasites, and hosts and vectors of human diseases [14].
<i>Oithona sp</i>		pH -7.5 and 8.5 (7.9) Temp 24–30 (25.3) Salinity 0.15 – 35 (0.2)	Feeds on organic detritus, bacteria or algae	

<i>Lamellibranch larvae</i>	Mollusca	pH -7.8 – 8.3 (7.9) Temp -12- 26 (27.9) Salinity – 0.05-25 (1.6)	Feeds on plant detritus, bacteria and algae that characterize sediment surface	Lamellibranch larvae is a new water pollution indicator species [15]. Temperature and wastewater discharges, altering optimum physicochemical conditions, represents the most negative significant impact on larva metamorphosis into adulthood [16].
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*Values in bracket are personalized to the species

FOOTNOTE

(1) Ebigwai et al., (2014), (2). Bhaud et al, (1990), (3) Thorson (1966), (4) Guerrero et al., (1994), (5)Tou et al (2007) (6) Dawson et al (2018), (7) Frederiksen et al, (2006), (8) Ban (1994), (9) Atashgahi et al (2015), (10) Sato M, et al., (2008), (11) Alldredge, (2005), (12) Merrix et al, (2013), (13) Beaugrand G. (2003), (14) Choi et al, (1995), (15) Hennes et al, (1995), (16) Vaquer-Sunyer et al, (2011),

A total of twelve (12) phytoplankton species and eight (8) zooplankton species were counted in three water samples collected. This includes 231 phytoplankton and 219 zooplankton counts.

Ebigwai et al., 2014, noted similar species compositions and total counts in tropical freshwater environments. The diversity and abundance of plankton species in the study area could be attributed to favourable environmental conditions such as adequate temperature and nutrient availability (Nowrouzi and Valavi, 2011). The result revealed a high abundance of phytoplankton species with a percentage count of 59, while zooplankton accounted for 41% species diversity.

This result conforms to other literature reviews (Wiafe and Frid, 2001), indicating a high and short regeneration rate of phytoplanktons, even as they serve as an inevitable food source for the zooplankton. Diatoms are said to be ubiquitous in an aquatic ecosystem, hence their high abundance. The prevalence of some planktonic species like diatoms – *Odontella spp*, and *Melosira spp* suggest the water quality of the Ase River since they serve as indicators of water quality degradation in freshwater systems. (Valentine, 2002; Lee, 2012)

Though, some harmful algae species were observed, especially among the groups- Dinoflagellates and Diatoms. Their concentrations in the water were too low to cause any form of toxicity or discolourations within the environments (Ezra and Nwankwo 2001, Adriana and Henrik 2000).

The phytoplankton species recorded in the study area was low as compared to the secondary data (KIP ESIA Report, 2021) recording a total number of 26 phytoplankton species, having chlorophyta as its dominant specie. This could be attributed to the factors influencing phytoplankton growth rate such as, water temperature, salinity, water depth and the kinds of predators grazing on them.

The zooplankton species recorded in the study area was low as compared to the secondary data (KIP ESIA Report, 2021) recording a total number of 23 species, having cladocerans, as its dominant specie. In natural environments, a higher proportion of cladocerans relative to other zooplankton is generally related to oligotrophic and mesotrophic conditions (Sendacz et al., 1985; Imoobe and Adeyinka, 2009).

4.6.10.3 Macro benthos

Comparative qualitative and quantitative results on macro benthos survey and analysis among the sampling stations showed relative variations in species diversity and abundance values (Appendix 6). Total species diversity (taxa) of 3 and abundance value of 6 were recorded during the study period. This could be attributable to variations in the adaptability of species of benthos to the nature of water current and the nature of sediment type, preferred food species, and physicochemical parameters of the water (Raman and Ganapati 1983, Lawson 1977 and Snelgrove 1999).

Out of the observed total benthos species abundance of 6 observed in all the sampled stations, station-SW2 had the highest total abundance value (3) of benthos, representing (60%) of the total benthos. In contrast, one benthos species occurred in stations SW 3. The highest abundance observed in station SW2 could be as a result of the high adaptability of organisms in this area to sediment type, an abundance of preferred food species in the form of plankton and detritus and more favourable physicochemical parameters (UNESCO Report 1981, UNEP 1982 and 1989, Kobina and Mike 2001).

Prevalent benthic invertebrates species observed among the stations are *Nereis sp* and *Pachymelania sp*. These species had been noted to have high pollution tolerant index, possibly indicating high enrichment of the sampled stations. These organisms are also more adaptable to peculiar prevailing environmental conditions in terms of the nature of sediment, very low temperature, salinity, low dissolved oxygen, and high pressure. They are more physiologically equipped with haemoglobin, which can saturate oxygen at very low concentrations. Timorthy et al. (2001) noted that macro benthos has an active role in biotic and abiotic interactions characterizing aquatic ecosystems. Benthic invertebrate cycle nutrients and influence microbial production of greenhouse gases, toxic gases and nitrogen. Benthos species transforms organic detritus to dissolved nutrients taken up by macrophytes and algae, enhancing primary productivity. Widespread ecotoxicity at the benthos level will propagate up through the food web and disrupt nutrient cycles.

Environmental sensitivity of the proposed project on the offshore pelagic ecosystem (phytoplankton, zooplankton and fish) and benthic ecology indicated relative stabilities in the sampled stations based on the variations in the observed indicator species.

Ecosystem health around the proposed project can therefore be sustained.

4.6.11 Fishery Resources

4.6.11.1 Background

Traditionally, fish has been one of the primary food sources for riverine communities. The study of fish composition was conducted for Ase creek. A summarized inventory of key fish species in the project area is presented in Table 4.19.

Fishing is a year-round activity pursued more vigorously in the wet and early dry seasons. Economically fish provides an essential source of food and income, and fishing has an important social and cultural position in the communities that form part of the study area. The survey was aimed at the identification of: present types of fisheries in the area, main locations of each variety of fishery resources, fishing methods and gear currently in use, present fish species in the area and their values, the pattern of fish movement and migration in the area, trophic category of fishes and ecological preferences.

This report is prepared to document the Fisheries' Environmental Impact Assessment (EIA) in and around the study area.

4.6.11.2 Methodology

Information gathering involved a combination of direct observation of fishers' activity in their canoe (Plate 4.6), nets and other fishing gears at the fishing grounds, and consultations with fisherfolks onsite and off-site. The Kwale market was also visited to ascertain the types of fish sold. Samples of fishes observed were identified using flashcards, checklists, photographs and scientific identification keys. All the data gathered were documented for use in the ESIA report.

4.6.11.3 Result

Generally, fishing activities are well known and a past practice among inhabitants of the study area. The type of fishing here is mainly artisanal, in terms of scale, where the catch is usually for family consumption with little for sale. Fishing gears commonly used in the region include hook

and line, hand pole, fence, seine nets, cast nets, gill nets, bamboo traps, lift-nets, long line and basket traps (Emmanuel, Awojide, 2016). Fish catch per unit effort is reasonable, especially for the more abundant fish species. However, fish capture techniques used in the study area included canoe netting, seining, and trapping. Setlines were deployed overnight in suitable deepwater locations on the river. The typical fishing craft is the traditional dug-out canoe or half plank-constructed canoe. Fishing gears commonly used in fish exploitation include traps, set gillnet and cast nets. The set gill net with mesh size ranging between 30 and 120 mm are bottom set and used in the open water and Creeks. However, some anglers use selective and non-selective gears, which indiscriminately catch juveniles and could deplete the stock and reduce the sustainable yield. The fishing crafts are non-motorized canoes driven with paddles and sails for the shrimps and other shellfishes. Each craft is about 6.7m long, with a maximum of (3) three fishers. Fisherfolk uses three gears to exploit the fishery: beach seine, push net (active) and trap (passive).

Fish processing within the study area is traditional. Traditional smoking kilns or earthen ovens are often used to smoke fish. The smoked fish is consumed within the family unit or sold at the local markets directly to wholesale buyers.



Plate 4.6: Fishing activities at Umuseti and Ase creek

Detailed information on baseline data and reviewed physicochemical parameters per fish species is presented (Table 4.19)

Table 4.19: Fishery Inventory in the study area

S/N	Biological Name	Common Name	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
1	<i>*Chrysichthys nigrodigitatus</i>	Bagrid catfish	Omnivore	Adult and juvenile	Highly commercial	Mollusks & Benthos (Oronsaye & Nakpodia 2005; Offem et al. 2008)	River banks	6.7 - 9.7 28.2 - 38.7 0.73 - 11.8 0.4 - 5.2	The capturing of more juvenile individuals for sales poses a threat. Wastewater from laundry activities and watershed actions either destroys or inactivate (Thornton et al., 2001) the eggs on the banks.
2	<i>**Synodontis nigrita</i>	Catfish	Omnivore	Adult and juvenile	Highly commercial	Plankton, invertebrates and plants (Olojo et al., 2003)	Inside water body	6.9 - 8.0 20.0 - 36.5 1.45 - 6.75	Spawning executed beneath the water body is safe. Nevertheless, the invasion of fish prey such as sharks is detrimental to the fish species.
3	<i>*Oreochromis</i>	Nile	Omnivore	Juvenile	Highly	Zooplankton,	Rivers,	5.5 - 8.0	Water pollution

	<i>niloticus</i>	Tilapia	Herbivore	Adult	commercial	zoobenthos, aufwuchs & phytoplankton	canals, streams, lakes.	8.0 - 42.0 1.0 - 6.5 6.0– 36.0	increases the livelihood of disease or death among fish (Osman & El-Khateeb, 2016), causing a shortage of animal protein in markets and economic loss.
4	* <i>Gymnarchus niloticus</i>	Freshwater rat-tail	Carnivorous	Adult and juvenile	Highly commercial	Zooplankton, dipteran insect larvae & copepods	Water deep; shallow and grassy floodplains	6.5-8.0 24.0 - 34.0 5.0 - 7.2 0.5 – 28	In mass spawning, mating is not controlled, and a small number of breeding individuals may account for a large proportion. However, adult species prey on their young due to its trophic category.
5	* <i>Tilapia zillii</i>	Redbelly Tilapia	Herbivore Carnivorous	Adult Juvenile	Moderately commercial	Zooplankton & arthropod species with a chitin content	Inside river	6.0 – 9.0 20 – 32 6.1 - 7.6 29 – 45	The aggressive interactive nature of this species may alter the composition of fish communities. More so, being a voracious herbivore may negatively impact plant density, decreasing abundance and changing the composition of native plants (Kour et al.,

									2014). This can negatively affect native organisms that depend on such plants for spawning, protection or foraging (Kour et al., 2014).
6	** <i>Gnathonemus petersii</i>	Elephant nose fish	Carnivore	Adult	Moderately commercial	Bloodworms and aquatic invertebrates	Water bottom	6.8-7.2 22.0 - 28.0 0.8- 5.5	The carnivorous nature of this species makes it a threat to other smaller fish species.
7	** <i>Hydrocynus forskahlii</i>	Elongate Tigerfish	Piscivore	Juvenile	Highly commercial	Zooplankton & other invertebrates	Near the bottom of an inhabited water body	6.5-8.0 22.2-27.8	Incessant roaming of juveniles individuals in the shallow waters would bring about a reduction in the colony of the species as it increases the number of fish caught.
				Adult	Highly commercial	Tilapia fry			
8	<i>Acanthurus monroviae</i>	Monrovia doctor fish	Herbivore	Adult	Highly commercial	Zooplankton, phytoplankton and detritus	Rivers, canals, streams	8.1-8.4 22.2-25.6	Extreme temperatures have a significant influence on the reproductive capacity of this species, affecting the maturity process, spawning, and the survival of offspring (Raquel et al., 2016).

9	<i>Schilbe mystus</i>	African Butter Catfish	Omnivore	Adult	Moderately commercial	Fish, insects, crustaceans, ostracods, snails, diatoms, algae, plant roots, seeds and fruits.	Tributaries of rivers and streams	NA 23oc-27oc NA NA 4m-69m	This fish is of commercial importance in many parts of Africa as an important food fish. It faces the threats of water pollution, drought, and water depletion (Azeroual, 2010). The species is in severe decline due to overfishing and exploitation and is assessed regionally as Vulnerable.
10	** <i>Sardinella madarensis</i>	Flat sardinella	Omnivore	Adult and juvenile	Highly commercial	Small planktonic invertebrates, phytoplankton and fish larvae.	The surface of estuaries and lagoons	NA <24 NA 0-0.5 0-80	This species is stenohaline (Tsikliras & Antonopoulou, 2006); hence an increase in salinity reduces the population. Its population is declining due to overexploitation, with the average size of fish in the catch decreasing. The IUCN status is 'Vulnerable' (Tous et al., 2015).
11	<i>Pomadasys jubelini</i>	Sompat grunt	Carnivore	Adult	Moderately commercial	Fish, crustaceans, molluscs and	Brackish water, lagoons and	NA 20-30	Adult species prey on their young individuals; a process

						worms.	estuaries, freshwaters	NA NA 20-50	that negatively impacts their population (Koslow & Davison, 2019)
12	** <i>Parachelon grandisquamis</i>	Large scaled mullet	Piscivore	Adult	Moderately commercial	Mainly fishes	Shallow coastal waters, estuaries and brackish lagoon	NA 25-30 NA 30-35 0-10m	The high rate of catch observed during field expedition may represent the primary threat to this species in the study area
13	<i>Clarias gariepinus</i>	Sharp tooth Catfish	Omnivore	Adult	HC	Insects (adult and larvae), worms, gastropods, crustaceans, small fish, aquatic plants and debris, water birds, living and dead animal matter.	Freshwater lakes, rivers, swamps and floodplains	NA 24-30 NA NA NA	This is an aggressive invasive species. Its high fecundity, flexible phenotype, rapid growth, wide habitat preferences, tolerance to extreme water conditions and the ability to subsist on a wide variety of prey can devastate indigenous fish and aquatic invertebrate populations (Bruton, 1986). Because of the abundance of this species and its lack of mobility on land and in water, it is preyed upon

									widely by Man, leopards, crocodiles, and birds (Skelton 1993).
14	<i>*Heterotis niloticus</i>	Bony Tongue	Omnivore	Adult and juvenile	HC	Invertebrates, copepods, ostracods and chironomids.	Freshwater rivers, streams, floodplains, lakes and swamps	5.4 15-30 0.4-4.51 NA 0.42	Due to general environmental degradation, including oil spillages, pollution and destruction of mangrove swamps, this species has lost an estimated 60% of its previous breeding and nursery habitat in Nigeria (Adite, 2012). Bake and Sadiku (2005) recorded a decline of the species, which indicates that the species is threatened locally
15	<i>Lates niloticus</i>	Nile Perch	Predator (piscivore)	Adult and juvenile	Highly commercial	Fish (including its species), crustaceans, insects, juveniles feed on zooplankton.	Channels, ponds, rivers, lakes and irrigation canals; adults inhabit deep water, while juveniles are	NA NA NA NA 10-60	L. niloticus has been listed among the 100 "World's Worst" invaders (ISSG, 2009). Due to their feeding habit, their presence leads to the decline or disappearance of other species.

							found in shallow water.		
16	<i>*Hemichromis fasciatus</i>	Banded Jewfish/five-spot cichlid	Carnivore	Adult	Moderately commercial	Shrimps. Small fishes and insects.	Littoral riverine and permanent floodplain lagoons with clear water.	NA 23-25 NA NA NA	Its adaptability to a wide range of habitats makes it common in the study area. However, the predatory nature of the species may mount pressure on other smaller species in the habitat.
17	<i>Protopterus annectens</i>	African Lungfish	Carnivore	Adult and juvenile	Moderately commercial	Mollusks, crabs, prawns and small fishes.	Freshwater buried within riverbeds.	NA 25-30 NA NA NA	<i>P. annectens</i> has been assessed as Least Concern because it has an extensive range, and there are no known widespread threats to the species.
18	<i>*Auchenoglanis occidentalis</i>	Giraffe Catfish	Omnivore	Adult and juvenile	Highly commercial	Plankton, molluscs, seeds and detritus	Lakes, large rivers, shallow water with a muddy bottom.	6.5-7.8 21-25 NA NA NA	This species is threatened by the loss of flood plains and vegetated marshes around rivers and lakes due to agriculture extension and overfishing. Also, dams, water pollution (agriculture, domestic and commercial/

									industrial), groundwater extraction, and drought pose possible threats to this species.
19	<i>Eutropius niloticus</i>	Schilbe	Omnivore	Juvenile	Moderately commercial	Insects, fish,	Freshwater, large rivers, lakes.		E. niloticus serves as food for other fishes, and overfishing of this species has led to its decline.

Species marked * = Sighted; ** = market; unmarked = review and interview: NA = not available

During construction and operations, glass or plastic bottles, water sachets and food wrappings would be transported through surface runoff as sediments into the ponds feeding the Ase creek. Construction materials have been reported to alter the baseline conditions of an environment (Lee & Duffield, 2002). Plates 4.7 – 4.9 shows some fish resources in the project area



Plate 4.7: Oreochromis niloticus



Plate 4.8: Chrysichthys nigrodigitatus



Plate 4.9: Heterotis niloticus

Source: MCNL, 2022

4.6.11.4 Fishery Socioeconomics

Fisheries Survey Socio-Economics: There is no secluded location for anglers as they live among other people of various trades and occupations in the study area. The majority of the Fishermen were of the Ukwani and Isoko ethnic groups. The educational qualification of these people ranged from non-formal education to secondary education. The age structure of the anglers was mainly in the range of 25 to 60 years old.

Male members in the study area head 95% of the households. Female-headed households comprise about 5% of the community households. Most of the fisherfolks in this area are monogamous, with very few having two or more wives. It is estimated that the average household (hh) size is 5-6 people per household, suggesting a high population growth or influx. Most of the anglers do not have any source of finance other than the money that accrues to them from the sale of their fish. At this time of the year, a fisherman makes about N3, 000 to N8, 000 for the sale of fish per day, depending on the total catch. The most typical fish processing and preservation method is smoke-drying in the study area. Storage of processed fish is mainly done at an artisanal level by women in this community whose main economic activities are fish processing, distribution and marketing. The educational qualification of these people ranged from non-formal education to secondary education for traditional storage operators. Immediately after landing, fishes are thoroughly washed with either clean water or saltwater to remove dirt and microorganisms on the surface. This cools the fishes whose temperature might have been raised due to ambient conditions and slows the rate of deterioration.

4.7 Terrestrial Biodiversity

4.7.1 General overview

There are nine distinct ecological zones in Nigeria which can be streamlined into five, namely (i) Sahel Savanna, (ii) Sudan Savanna, (iii) Derived/guinea Savanna, (iv) Swamp Forest (v) Tropical rainforest (Figure 4.5).

Delta state is covered by tropical forest, secondary forest, derived savanna and freshwater swamp. In addition to these habitats, Delta state is home to mangrove habitats also. The areas are currently experiencing seasonal and episodic flooding regimes.

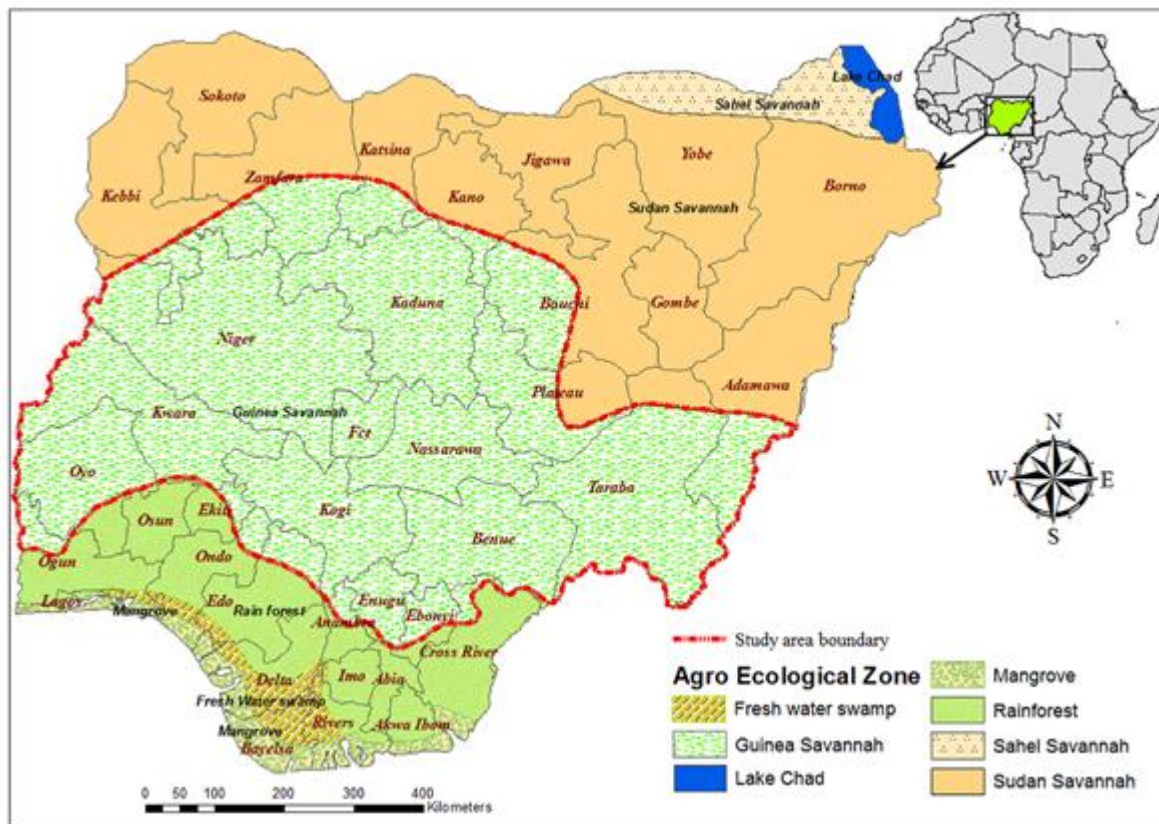


Figure 4.5: Different Vegetation Belt of Nigeria

Source: Iloeje, 2001

4.7.2 Vegetation/Flora

4.7.2.1 Sampling parameters and methods

For floral sampling, a specific and standard methodology (See Table 4.20) was adopted. Some of the floristic parameters to be determined, as shown in Table 4.20, include specific and family information (life forms, diversity richness, alien species inventory and indigenous uses. Five sampling points were delineated using plant species physiognomic conditions and habitat types (Table 4.21). A three-line transect measuring 200×100 m and separated by 1m from each other was used. All the species within the transects were manually enumerated. Habitat type and species information, including species name, family, common name, DBH, and growth habit, were determined by expert taxonomists and ecologists. Also, IUCN 2022 was used in computing the IUCN status of the censured plant species, while Odugbemi (2006) was used to identify the presence of alien or invasive among the censured species.

Table 4.20: Biodiversity Survey Methods and Procedures

Flora		
Sampling Parameter	Sampling Method	Sampling Analytical Method
Habitat type	Aerial observation, Use of transects and quadrats around Project area	Field ecological characters used for habitat delineation include canopy cover, presence of indicator species, litterfall and soil moisture content.
Species and family identification		Field botanical characters used for identification include flowers, fruits, leaves, slash, exudates, and sometimes smell. Field guides include Letouzey 1986, Hutchinson and Dalziel 1963, 1972. Hawthorne 1993, Souane 1985, White and Abernethy 1997, Akobundu and Okezie 1998, Arbonnier 2006, Nyannanyo 2006 and Ebigwai 2012.
Species richness		Species richness was evaluated by counting the number of species identified in each Whittaker transects.

Species Diversity Indices		$H = -\sum P_i \ln P_i$, Where H = Shannon's index, $\ln = \log$. $E = EQ = -\sum P_i \ln P_i / \ln S$; Where EQ = equitability, S = total number of species (Begon, et al 1986).
Species Abundance		The abundance of species was evaluated by counting the number of individuals in each Whittaker transect (Gauch, 1982).
Species frequency		number of transects the species occurred total number of transects sampled
Indigenous uses	Ethno botanical questionnaires	The various indigenous uses and most used plant species were recorded.
Alien & invasive species	IUCN & Literatures and absence of local names	The presence of alien and invasive species was compiled based on the list of exotic/invasive plant species in Nigeria (Odugbemi, 2006).
Conservation status	IUCN Red List of 2022	$\frac{\text{Number of threatened species} \times 100}{\text{Total number of species}}$
Protected species	IUCN database 2022 and CITES ACT 2016	-

Table 4.21 presents the sampling coordinates of the vegetation study.

Table 4.21: Sampling Coordinates

Sampling ID	Long (E)	Lat (N)	Habitat type
VG 1	6.386542	5.707359	
	6.386504	5.707920	
	6.386861	5.707915	

	6.386871	5.707181	Secondary forest
VG 2	6.377388	5.700365	
	6.377621	5.700789	
	6.377801	5.700252	
	6.377346	5.700091	
VG 3	6.369373	5.690808	
	6.369564	5.690773	
	6.369358	5.691067	
	6.369566	5.691054	
VG 4	6.386677	5.689534	Derived savannah with surrounding farmlands
	6.386939	5.689577	
	6.386664	5.690180	
	6.386227	5.690083	
VG 5	6.376960	5.704894	
	6.376647	5.705719	
	6.377267	5.705989	
	6.377472	5.705412	

4.7.2.2 Result of flora studies

4.7.2.2.1 Habitat Types

Habitat study was evaluated in this project to influence decisions on preconstruction and construction activities that may be selectively conducted in specific areas. The study area consisted of two habitats. Secondary Forest (SF) with some patches of ephemeral (dried-up) freshwater swamps constituting about 63% of the proposed project site and Derived Savanna (DS) accounting for the remainder 37%. Plate 4.10 presents sampling evidence of the two habitats.



Secondary forest



Derived Savanna

Plate 4.10 Overview of Habitat types in the Study area

4.7.2.2.2 Species Richness and density

Richness is the total number of species censored in a defined area. It is often used as a criterion for ecosystem disturbance or stability. On the other hand, density refers to species per given area. A total of 33 species were inventoried in the study area. A comprehensive list of the censored flora is shown in Table 4.22.

Table 4.22: Species Richness in the project area

S/N	Species	Common Name	Local Names (Anioma/i bo)	Habit	DBH (cm)		Family	IUCN	1	2	3	4	5
					SF	DS			SF			DS	
1.	<i>Ageratum conyzoides</i>	Goat Weed	Agadi-Isi-Awo-Ocha	H	7	9	Asteraceae	LC	3	2		2	2
2.	<i>Albizia adianthifolia</i>	Flat Crown <i>Albiza</i> <i>a</i>	Avu	T	14	12	Fabaceae	LC	3	2	3	3	1
3.	<i>Alchornea cordifolia</i>	Christmas Bush	Egbu	T	10	12	Euphorbiaceae	LC	1	3	4	2	
4.	<i>Alchornea laxiflora</i>	Venda Bead-String	Ububo	S	11	13	Euphorbiaceae	LC	4	5	7	9	6
5.	<i>Alstonia boonei</i>	Stool Wood	Egbu	T	12	22	Apocynaceae	LC	5	4			2
6.	<i>Andropogon tectorum</i>	Beard Grass	Ikpo	S	1	2	Poaceae	NE	3	1	2	3	6
7.	<i>Anthocleista volgelii</i>	Cabbage Tree		T		28	Loganiaceae	LC				8	4
8.	<i>Aspilia africana</i>	Haemorrhage		H	6	9	Asteraceae	LC	10	11	15	12	10

		Plant											
9.	<i>Asystasia gangetica</i> (invasive)	Chinese Violet.		H	8	5	Asteraceae	NE	12	10	8	9	5
10.	<i>Axonopus compressus</i>	Carpet Grass		H	2	1	Poaceae	LC	10	14	8	10	8
11.	<i>Azadirachta indica</i>	Neem Tree	AkunShorop	T	34	-	Meliaceae	LC		4	1		
12.	<i>Bambusa vulgaris</i>	Bamboo	Atosi	T	13	11	Poaceae	NE	15	12	10	15	13
13.	<i>Baphianitida</i>	Camwood	Ufie	S	6	5	Fabaceae	LC	2	4	6		5
14.	<i>Calopogonium muconoides</i>	Calopo		C	5		Fabaceae	NE	6	5	3		
15.	<i>Chromolaena odorata</i>	Siam Weed	Awolowo	H	3	1	Asteraceae	LC	8	10	9	7	5
16.	<i>Cleistopholis patens</i>	Salt-And-Oil' Tree	Ojo	T	14	-	Annonaceae	LC	-	3	1		
17.	<i>Elaeis guineensis</i>	African Oil Palm	Mkpuruaku	T	35	43	Arecaceae	LC	20	9	10	20	12
18.	<i>Ficus exasperate</i>	Sand Paper Tree	Anwerenwa	T	14	10	Moraceae	LC		12	10	5	4
19.	<i>Ficus sur</i>	Broom Cluster	Akankoro	T	13	-	Moraceae	LC	5	4			

		Fig											
20.	<i>Hevea brasiliensis</i>	Rubber Tree	Ròbà	T	24	-	Euphorbiaceae	LC	50	6	8		
21.	<i>Ceiba pentandra</i>	Chinese Spinach		H	-	42	Convolvulaceae	LC				9	
22.	<i>Irvingia gabonensis</i>	Bush Mango	Ogbono	T	28	21	Irvingiaceae	NT	9	3		1	4
23.	<i>Khaya ivorensis</i>	Lagos Mahogany	Ono	T	20	32	Meliaceae	VU		5	7		
24.	<i>Milicia excelsa</i>	Iroko	Oje	T	14	11	Moraceae	NT		3	4		
25.	<i>Mitragyna ledermannii</i>	Mabog		T	12	10	Rubiaceae	NT	6	4	3		1
26.	<i>Musanga cecropioides</i>	Umbrella Tree	òNrù	T	15	12	Urticaceae	LC	5	2	9	1	
27.	<i>Panicum maximum</i>	Guinea Grass	OkeÀchàl à	H	3	2	Poaceae		15	8	10	23	40
28.	<i>Parkia biglobosa</i>	African Locust Bean	DawaDawa	T	30	-	Fabaceae	LC	1		2		
29.	<i>Pentaclethra macrophylla</i>	African Oil Bean	Ugba	T	-	27	Fabaceae	LC				8	6
30.	<i>Pterocarpus santalimoides</i>	Small-Leaved Bloodwood	Nturaphia Rukpa	T	13	-	Fabaceae	LC	2	5	2		
31.	<i>Raphia hookeri</i>	Raphia Palm		T	-	12	Arecaceae	LC				9	10

32.	<i>Spondias mombin</i>	Yellow Mombin/ Hog Plum	Ijikara	T	15	-	Anacardiaceae	LC	15	8	10		
33.	<i>Urena lobata</i>	Caesarweed/ Congo Jute	Odoazezo	T		13	Malvaceae	LC					7

Source: MCNL 2022

The about 2:1 ratio in species richness obtained for the Secondary Forest and Derived savanna habitats, respectively, suggest sites with a higher likelihood of harbouring species with diverse indigenous uses. However, the species diversity in the land occurs where human and material resources need to be committed during bush clearing, suggesting the amount of vegetal waste to be generated. On species richness, transect two (2) recorded the highest species richness with a species abundance of twenty-seven (27), while transect four (4) recorded the lowest species richness with an abundance of nineteen (19). The relatively higher species density recorded in transect 2 (SF) compared to others could be attributed to the presence of a conducive environment for species proliferation.

4.7.2.2.3 Diversity indices

Shannon Wiener index and evenness index were used to evaluate species diversity for the study area. Sensitive habitats usually have a Shannon wiener index of at least 2 (Ebigwai and Akomaye, 2014; Aisling et al., 2018). A 3.06 and 0.92 Values were observed for Shannon and Equitability indices, respectively, for the SF, while 2.74 and 0.87 were obtained for the DS.

This indicates relatively higher species diversity and somewhat partial distribution of the species in the project area. However, an abundance of each species has to be considered in determining the project impact.

4.7.2.2.4 Species abundance

This is the number of individual plants in a given area. It is used to determine the number of plants in a given area; hence it provides information on vegetal waste expected from clearing a unit area of vegetation. In this study, 837 individuals were censused in the entire sampled transects (530 from secondary forest habitat and 307 from the derived savanna habitat). This information would determine the expected plant biomass from vegetation clearing per sampled transect.

4.7.2.2.5 Community structure

This is the vegetation canopy formed by plants in a given area. It informs the level of anthropogenic influence in natural habitats. In this study, average species Diameter at Breast Height (DBH) and height in the project area were used to determine the vegetation structure of the study area. The Diameter at Breast Height (DBH) study showed that a more significant

proportion of the censured species (70 %) had their DBH below 20 cm. on the other hand, over 60 % of the species had heights below 25m.

This result implies that the highest proportion of species with DBH less than 20 cm was censured in the project area. This, in turn, suggests an anthropogenic disturbance of the area as it is evident in the cultivated farmlands censured in the project area.

Though a greater proportion of the censured species over (66%) was within the woody canopy, they were dominated by samplings. This implies a habitat undergoing recuperation development after anthropogenic impacts.

This result implies that vegetation clearance will yield the least biomass volume; hence lesser vegetal wastes will be generated.

This information helps in vegetal waste quantification per acre as shown below:

Vegetal wastes = N (12 x 18)

Where N= number of individuals whose species average height was ≥ 12 m and an average DBH ≥ 18 m).

A total of 12 species, amounting to 234 individuals, satisfies the stated criteria in the entire study area.

Therefore, the waste stream from clearing an acre plot in the study area is $234(12 \times 18) / 3$ (No. of sampled plots in acre) = 16,848 tons.

However, none of the species censured within the proposed factory footprint and the area marked for clearing (transect 1) satisfies the stated criteria. Hence, vegetal waste from clearing would be negligible.

4.7.2.2.6 Alien and Invasive species

Alien species are plant resources that are inadvertently introduced into an area, while invasive species may or may not be alien except that they may out-compete other species and establish dominance. A review of the alien species database for Nigeria showed that two (2) of these species (*Ageratum conyzoides* and *Chromolaena odorata*) are invasive and alien in the study area. At the same time, *Astystasia gangetica* was censured as invasive, and all the species were censured in both habitats of the project area. These alien/invasive species in the study

area signify a disturbed ecosystem with fertile loci for proliferation. Hence, it triggered the need to develop an alien and invasive species management plan.



Chromolaena odorata



Ageratum conyzoides (Invasive, Alien)



Astystasia gangetica (Invasive)

Plate 4.11: pictures of the alien and Invasive species encountered in the study area

4.7.2.2.7 IUCN Status

The IUCN status of the plant resources of the studied area was evaluated using the IUCN Red list 2021 version three criterion. The result showed that *Khaya ivorensis* is of conservation interest, and the species is vulnerable in the IUCN Red List of Threatened Species (Version 2021). The species is currently exploited for Fuelwood, timber and wrapping leaf in the project area. Plate 4.12 shows pictorial images of the threatened species.



Plate 4.12: Threatened species in the study area (*Khaya ivorensis*)

Table 4.23 provides a reviewed data of the threatened species

Table 4.23: Threats and Conservation Actions of the Threatened Plant Taxa of the Study Area

Species	Common name	2021 IUCN Conservation status	Threats	Habitats and locations surveyed
<i>Khaya ivorensis</i>	African mahogany or Lagos mahogany	Vulnerable A1cd ver 2.3	Unsustainable harvest of timber; Deforestation and associated habitat degradation	Secondary forest

Center for International Forestry Research (CIFOR, 2022), IUCN, (2021)

4.7.2.2.8 Habitats of higher ecological integrity

Important flora resources censused in this study were mapped as shown in Table 4.24. Criteria adopted for the mapping are plant species with high indigenous uses, invasive and alien species, and those categorized under any of the threatened classes.

Table 4.24: Ecologically sensitive species and their locations

Category	Species	Ecosystem Services			Transect sampled
		Medicine	Food	Raw Materials	

Species with high indigenous uses	<i>Albizia adantifolia</i>	√	√	√	All five transects
	<i>Alstonia congensis</i>			√	1, 2 & 5
	<i>Bambusa vulgaris</i>			√	All five transects
	<i>Elaeis guineensis</i>		√	√	All five transects
	<i>Mitragyna ledermannii</i>			√	All transects except 4
	<i>Spondias mombin</i>	√	√	√	1, 2 & 3
Vulnerable (VU)	<i>Khaya ivorensis</i>				2&3
Alien Species	<i>Chromolaena odorata</i>				All five transects
Invasive Species	<i>Ageratum conyzoides</i> , <i>Chromolaena odorata</i> and <i>Astystasia gangetica</i>				All transects except for <i>Ageratum conyzoides</i> which was absent in transect 3

Source: MCNL, 2022

4.7.2.2.9 Indigenous Uses of Plant Resources in the Study Area

The indigenous uses of the various plant resources censused in the study area were evaluated via interviews.

Table 4.25 provides information on the various indigenous uses of the flora resources inventoried

Table 4.25: percentage summary of Indigenous Uses of Censored Species

Indigenous Services	% of species used	Some representative species

Food, vegetables, nuts, fruits and seeds	15	<i>Elaeis guineensis</i> , <i>Spondias mombin</i> , <i>Musanga cecropioides</i> , <i>Hevea brasiliensis</i> , <i>Bambusa vulgaris</i>
Fuelwood and charcoal	12	<i>Musanga cecropioides</i> , <i>Albizia adiantifolia</i> , <i>Mitragyna ledermannii</i> , <i>Milicia excelsa</i>
Medicinal	33	<i>Albizia adiantifolia</i> , <i>Alchornea cordifolia</i> , <i>Anthocleista volgelii</i> , <i>Musanga cecropioides</i> , <i>Mitragyna ledermannii</i> , <i>Milicia excelsa</i> , <i>Elaeis guineensis</i> , <i>Chromolaena odorata</i> , <i>Baphia nitida</i> , <i>Azadirachta indica</i> , <i>Aspilia africana</i>
Fodders	9	<i>Spondias mombin</i> , <i>Alchornea cordifolia</i> , <i>Bambusa vulgaris</i>
Fibre	12	<i>Bambusa vulgaris</i> , <i>Elaeis guineensis</i> , <i>Musanga cecropioides</i> , <i>Milicia excelsa</i>
Tannin	3	<i>Alstonia volgelii</i>
Sundry products	6	<i>Elaeis guineensis</i> , <i>Bambusa vulgaris</i>
Wrapping leaves	9	<i>Mitragyna ledermannii</i> , <i>Alchornea cordifolia</i> , <i>Anthocleista volgelii</i>
Wattles	6	<i>Elaeis guineensis</i>
Pole	9	<i>Bambusa vulgaris</i> , <i>Mitragyna ledermannii</i> , <i>Milicia excelsa</i>
Green manure and soil reclamation/erosion control and shade from the	15	<i>Albizia adiantifolia</i> , <i>Alstonia boonei</i> , <i>Spondias mombin</i> , <i>Musanga</i>

sun		<i>cecropioides, Chromolaena odorata</i>
Roof Trusses(Roof rafters) and Purloins	12	<i>Bambusa vulgaris, Elaeis guineensis, Musanga cecropioides, Milicia excelsa</i>
Frames for doors and windows and Stairs	12	<i>Albizia adiantifolia, Mitragyna ledermannii , Bambusa vulgaris, Milicia excelsa</i>

Source: MCNL, 2022

Seventeen (17) species representing about 3.3 %, have indigenous uses. *Elaeis guineensis*, *Bambusa vulgaris*, *Albizia adantifolia*, *Mitragyna ledermannii*, *Albizia adantifolia*, *Spondias mombin*, and *Milicia excelsa* were the most used plant species in the study area as a result of the wide range of products they offer. This include; Medicine, fuelwood, raw material (wood for construction of the bridge, houses and electric pole, etc.). The inventory of some species in one plot with reduced individuals is a worrying sign of over-harvesting. Plate 4.12 shows some of the indigenous uses.



(a) Timber



(b) Fuel wood



(c) Building construction

(d) fencing of farm land using bamboo

Plate 4.12 (a-d) Products from plant taxa censored.

Fauna Studies (Wildlife)

4.7.3.1 Study Methodology

Direct sight

Diurnal expeditions to recognize evidence of fauna wildlife presence was undertaken. Formal transect surveys of Herpetofauna, Aves fauna and Mammalia fauna were conducted simultaneously, using transects already established for flora sampling (Table 4.22). The transect was walked slowly and all fauna encountered were carefully observed. Pictures of the trapped and the sighted fauna were taken and identified to the lowest possible taxa by specialists.

In addition, small mammals were systematically surveyed by setting small Elliot traps, baited with rolled oats with a peanut butter and honey mixture. Trapped individuals were marked on the ears to identify subsequent recaptures and then released. Pictures of the trapped and the sighted mammals were taken where possible and identified to the lowest possible taxa specialist.

Also, small birds were systematically surveyed by setting small caging traps, baited with ripe fruits, seeds and grains. Trapped individuals were marked on the ears to identify subsequent recaptures and then released. The trapped and sighted birds were snapped where possible and identified to the lowest possible taxa specialist.

Appropriate field data sheets were employed to capture information like species list with scientific, common names, local names and abundance.

Indirect observations

The recorded evidence was represented by direct (collections and observations) and indirect (tracks, footprints, scats/ faeces, feeding activity, tracks, holes/diggings or scratching and carcass). Local land users were also interviewed about fauna they had seen or hunted in the area, and these were identified from pictures in Powell (1993). The local names were recorded. Other information gathered from the locals includes habitat history, faunal distribution pattern, seasonal migration, harvesting methods and threats to biodiversity in the study area.

Conservation Statuses

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2021-3. IUCN categories rank the relative risk of individual taxa becoming extinct in the wild based on standardized criteria.

Fauna studies were conducted and reported for the Mammalian, Avian and Herpetofauna taxa.

4.7.3.2 Mammals

Mammals perform provisional, cultural, regulatory and supporting services to humanity. Censored mammal species in the study area (See Plate 4.13) were evaluated for their local names, preferred microhabitat, mating behaviours, movement behaviour, food sources, IUCN status and possible threats (Table 4.26)



Rattus norvegicus



Chaerephon nigeriae



Chaerephon pumilus



Herpestes auropunctatus



Civettictis civetta



Xerus erythropus



Hystrix cristata



C. mitis



Paraxerus poensis



Cephaloophus niaer



Bushbuck – *Tragelaphus scriptus*



Thyromys swinderianus



Manis tetradactyla



Myosciurus pumilio



Cricetomys gambianus



C. Rufilatus

Plate 4.13: Directly and indirectly censored mammal species of the study area

Table 4.26: Assessment of censored mammalian species to Environmental Variables

Species	Brief description	Remarks
<i>Cercopithecus mona</i>	Treetops and branches are their preferred microhabitat and breeding ground which occurs nocturnally. Mona monkey, also called <i>Erue/Ewuo</i> */ <i>Ogi</i> ***, leaps on trees via lianas or ropes in local languages. They are omnivorous, feeding on leaves, fruits, tubers and insects. All six (6) individuals were sighted in the freshwater swamp habitat. They are categorized as Least Concern by IUCN 2022. In Nigeria, they are classed in the second schedule of the CITES Act 2016.	The clearing of trees with liana signifies a considerable risk to arboreal fauna (Yanoviak and Schnitzer, 2013). Yorzinski and Hermann (2016) correlated low birth rate and restlessness among nocturnal species to nighttime noise associated with production activities.
<i>Cercopithecus erythrogastrus</i>	Commonly called White-throated guenon and <i>Ukpii/Erue</i> */ <i>Dosuwe</i> ***in the local language, the species exhibit the same characteristics as Mona Monkey. The presence of large trees caused by inaccessible terrains could be why all seven individuals were sighted in the freshwater swamp habitat and no one in the Derived Savanna habitat where tree DBH was averagely less than 40cm. They are categorized as Vulnerable by IUCN 2022. In Nigeria, they are classed in the first schedule of the CITES Act 2016.	Diversities of nuts and palms in the wild are owed partly to the dispersal efficiencies of this species (Chapman and Dunham 2018).
<i>Tragelaphus scriptus</i>	Commonly called Bushbuck and <i>Ele</i> */ <i>Elili</i> *** in the local language, the species preferred microhabitat choice of mountain base or river course is due to food sources (Smits 1986). They jump in dense thickets on motion and stand all through as resting behaviour. Breeding is usually a year out but mostly during wet seasons. They are categorized as Least Concern by IUCN (20222). In Nigeria, they are classed in the second schedule of the CITES Act 2016	East 1999, and Wilson, 2001 linked ecosystem conversion, degradation and species mortality (predation, low birth rate, hunting for trade and consumption & poaching) as stressor factors.
<i>Cephalopus</i>	In local languages, the blue duiker called <i>Uyo/Ngbeda</i> */ <i>Bebri</i> *** shares the same behavioural	

<i>monticola</i>	patterns as <i>Tragelaphus scriptus</i> . They are categorized as Least Concern by IUCN (2022). In Nigeria, they are classed in the second schedule of the CITES Act 2016	
<i>Philantomba maxwelli</i>	Maxwell's duiker, locally known as <i>Orua/Mgbada**/Mgbata***</i> in local languages, prefers areas with a fresh and dense growth of shrubs and other plants. It inhabits the warm, moist lowland forests prevalent in western African countries, including Nigeria. The habitat also includes forest fringes, secondary, scrub and farmlands. They are herbivores, breeding once per year and in the dry season. A single individual was sighted in freshwater swamp habitat. Maxwell's duiker is listed as Least Concern, though with increasing population decline (IUCN, 2022). In Nigeria, they are classed in the first schedule of the CITES Act 2016	While most of its original habitats has been modified or destroyed by the spread of agricultural settlement, it adapts to secondary vegetation and farm bush. Its major threats are extensive hunting for game and expansion of settlements. They are among the most hunted ungulates in much of their range but show considerable resilience to hunting pressure, better than other duikers (Nett and Newing, 2013). However, they are not resilient to intensive poaching
<i>Neotragus batesi</i>	In local languages, Bate's dwarf antelopes, known locally as <i>Uyo*/Mgbada**/Otoobra***</i> , are small antelope whose typical habitat is humid lowland forest favours dense undergrowth. It also inhabits plantations, secondary forests, cleared areas and areas around human habitations. They are herbivores feeding on leaves, buds, shoots, fungus, and limited amounts of grasses and herbs. They also eat human food crops, such as peanuts, in areas where humans have intruded into their natural habitats. They are often caught in snares surrounding agricultural fields. Mating occurs throughout the year, with peaks in the late dry and early wet seasons. Although Bates's pygmy antelope are not endangered (Least Concern by IUCN), they are facing habitat loss due to human expansion). In Nigeria, they are classed in the first schedule of the CITES Act 2016	

<i>Vulpes pallida</i>	Pale fox, locally called <i>Olugbewoin</i> ***, dwells in shallow burrows. The habitat is sandy or stony arid terrain, and the pale fox migratory pattern is induced by drought and food availability (Sillero-Zubiri&Wacher, 2012). They are carnivores that venture out at dusk and forage for food, including rodents, reptiles and insects. It can retain water from its food and go almost entirely without drinking. Before the rainy season, they breed in underground burrows, having 3-6 young. The IUCN has rated its conservation status as "least concern". In Nigeria, they are classed in the second schedule of the CITES Act 2016	Road kills, in addition to ecosystem conversion, fragmentation and disturbance, was reported by (IUCN 2022)
<i>Procolobus verus</i>	Olive colobus monkeys locally known as <i>Erlu/Ugusu*/Akin</i> *** are arboreal and are restricted to rainforest habitats. They prefer the dense understory of the forest, often near water. They feed mainly on young leaves. These monkeys are highly selective feeders, but they will also eat seeds, flowers, and petioles seasonally. When young foliage is available, they ignore mature leaves. These colobines are reported to be polygynous, having a gestation period of 5 to 6 months, with no specific breeding season. Females reproduce about every two years and usually bear only one young at a time. Females reach sexual maturity around 3 to 4 years old, males around 5 to 6 years old (Flannery, 2000). Although this species is not of particular conservation concern (Least Concern), in Nigeria, they are classed in the first schedule of the CITES Act 2016	Major threats to their habitats, food source and breeding grounds include conversion of forest habitats to annual and non-perennial farmlands, quarrying and mining, hunting & trapping, logging & wood harvesting, wildfire/bush burning and military drills (CILSS 2016)
<i>Hystrix cristata</i>	Crested porcupine, known locally as <i>Awawa/Egboe*/Wanbo**/Gbamanema</i> ***, is a terrestrial mammal; they seldom climb trees but can swim. They are nocturnal and monogamous, taking care	Despite its protection under CITES 2016, interviews revealed that it is hunted by trapping for consumption or

	<p>of the young for a long time and small family groups consist of the adult pair and young of various ages. Usually, female crested porcupines have one litter every year. On average, one or two very well developed young are born in a burrow chamber traditionally lined with grass after a 66-day gestation period. For the most part, the crested porcupine is herbivorous, eating roots, bulbs, and leaves, but occasionally they consume insects, small vertebrates, and carrion. The five individuals were sighted in freshwater swamp habitat. They are categorized as Least Concern by IUCN (2022). In Nigeria, they are classed in the second schedule of the CITES Act 2016</p>	<p>by baits as pest control measures. Its role in warding off attacks from evil forces was also mentioned.</p>
<p><i>Atherurus africanus</i></p>	<p>The African brush-tailed porcupine, locally called <i>Evue /Ebi**/Ikri***</i>, spends its days hidden in caves, crevices, or fallen trees. They prefer naturally occurring caves and do not usually burrow out their own. <i>A. africanus</i> can be found in forests, river forests, island forests and areas of high elevations. They are strictly nocturnal, coming out to roam only when it is entirely dark. These animals will not leave their den on nights when the moon is too bright. <i>Atherurus africanus</i> is primarily herbivorous, but they occasionally have been observed feeding on carcasses. There is no clearly defined breeding period, and up to two litters are possible each year. Females typically give birth to one, sometimes two, young per litter. They have a very long gestation period, ranging from 100-110 days. These animals do not seem to be decreasing in numbers or threatened with extinction. This may partly be due to their ability to leave their habitat and relocate to a new one if resources become permanently scarce. One individual each was sighted in</p>	<p>This nocturnal and solitary forager has the same Remarks as <i>Hystrix cristata</i></p>

	<p>the freshwater swamp and derived savannah habitats. The species is categorized as Least Concern (IUCN, 2022). It is also not protected under CITES Act, 2016</p>	
<p><i>Manis gigantea</i></p>	<p>Giant pangolins with local names, including <i>Arhigbe/Akimbo</i>**/<i>Opukuda</i>***, are found in forests and savannas and seek shelter under piles of debris or burrows. They are restricted to these environments because of food supply (ants and termites) (Challender and Hywood, 2012). In the wild, giant pangolins are timid, nocturnal, solitary species spending their days concealed and asleep in their burrows. Even though they are found in and around forests, giant pangolins never climb trees. Giant pangolins are typically solitary until the mating season, which occurs from May to July during the dry season. Males will mate with many females and are usually more susceptible to captive breeding (Pietersen <i>et al.</i>, 2014). Under the IUCN List, <i>M. gigantea</i> was previously classified as Near Threatened but is now classified as Vulnerable with declining population numbers continuing. In Nigeria, they are classed in the first schedule of the CITES Act 2016</p>	<p>Hunting and poaching are the primary threats to Giant Pangolin. The species is subject to widespread exploitation for bushmeat and use in traditional medicine and is regularly recorded in bushmeat markets (Excellence <i>et al.</i> 2018). In 2015, 100 live animals were exported from Nigeria to China for use in captive breeding, according to the CITES trade data (Challender and Waterman 2017)</p>
<p><i>Chaerephon nigeriae</i>*</p>	<p>Nigerian free-tailed bat, known locally as <i>Ottor/Mbroso</i>**/<i>Avuvo</i>***, is nocturnal and feeds on insects. It spends the day roosting in groups of about ten to fifteen adults, typically in hollow trees or under the bark. Breeding occurs around the beginning of the rainy season, with young born between June and August (Willis <i>et al.</i>, 2002.). Twenty-six (26) individuals were sighted in freshwater habitat and two (2) in derived savannah. The species is categorized as Least Concern (IUCN, 2022). It is also not protected under CITES Act</p>	<p>The ability of the species to exploit buildings as roosts, and its association with cleared rainforest, suggests that it is relatively resistant to anthropogenic impacts (Willis <i>et al.</i>, 2002)</p>

	2016	
<i>Chaerephon pumilus*</i>	<p>Little free-tailed bat with local names <i>Ottor/Mbroso**/Avuvo***</i>, is found in various habitats, including savannah and disturbed rainforests. Naturally, they roost in hollows and crevices of trees and in the crowns of some types of palm trees, where large colonies can find safety.</p> <p>They are nocturnal, leaving their roosts at dusk to begin hunting. These bats hunt by themselves and return to their roosts after feeding. They are very social and make a lot of noise before leaving the roost to hunt. Migration has not been reported in this species (Aspetberger <i>et al.</i>, 2004). Juvenile little free-tailed bats have been known to have milk and remains of large cockroaches in their stomachs. Adults are purely insectivorous, and they eat a wide variety of soft-bodied insects. Little free-tailed bat populations are large, widespread, and do not seem to be rapidly declining.</p> <p>Seven (7) individuals were sighted in Freshwater swamp and one (1) in Derived savanna.</p> <p>They are considered "least concern" by the IUCN. It is also not protected under CITES Act 2016</p>	<p>The ability of the species to exploit buildings as roosts, and its association with cleared rainforest, suggests that it is relatively resistant to anthropogenic impacts (Willis <i>et al.</i>, 2002)</p>
<i>Nandinia binotata</i>	<p>The African palm civet locally known as <i>Awu**/Atong***</i> is a nocturnal, largely arboreal mammal that spends most of the time on large branches, among lianas in the canopy of trees. It eats fruits, insects, rodents, lizards, frogs and carrion. Females give birth April-January, after a gestation period of 2–3 months. A litter consists of up to four young. While she has suckling young, the female's mammary glands produce an orange-yellow liquid that discolours her abdomen and the young civets' fur. This probably discourages males</p>	<p>This species is undergoing some localized declines because of habitat loss, hunting and pest control (IUCN,2022; Van Rompaey <i>et al.</i>,2012)</p>

	<p>from mating with nursing females. Two (2) individuals were sighted in freshwater swamp habitat. This species is categorized as Least Concern by IUCN (2022). In Nigeria, they are classed in the first schedule of the CITES Act 2016</p>	
<p><i>Cricetomys gambianus</i>*</p>	<p>Northern giant pouched rat, locally known as <i>Eruke/Ngele</i>**/<i>Owutumogulu</i>***, inhabit hollow trees and rock outcropping. They use screeching as the primary form of communication and value hoarding food. This species feeds on tubers, fruits & leaves, molluscs and insects, birthing in hollow trees around May - July. They spend the day roosting in hollow trees or under the bark. Eight (8) individuals were sighted in freshwater swamp habitat. IUCN has categorized this species as Least Concern. It is also not protected under CITES Act 2016</p>	<p>Its presence indicates nearby farmlands and residential settlements with abundant waste stocks.</p>
<p><i>Heliosciurus rufobrachium</i>*</p>	<p>Red-legged sun squirrel, also known locally as <i>Ovra/Osan</i>**/<i>Itubele</i>***, inhabits upper/ middle storeys of large trees.</p> <p>They make nests underground to protect their young and feed on fruits, seeds, and insects. Their young ones are birthed in the nest or underground around May - July. They roost in holes, trunks and branches. Twenty (20) individuals were sighted in freshwater swamp habitats. The species is categorized as Least concerned (IUCN 2022). It is also not protected under CITES Act 2016</p>	<p>Habitat conversion, degradation, and disturbance limits access to food, mates and breeding grounds (Baille, Hilton-Taylor and Stuart, 2004; Kingdon, 1989).</p>
<p><i>Potamochoerus porcus</i></p>	<p><i>Etsi/Eziimohia</i>**/<i>Obe</i>***, Red river hogs inhabit primary and secondary forests, thickets in savannahs, swamps, and steppes. They also congregate around human villages. These species are social animals and mark paths by scraping tree trunks. They are omnivorous and generalists in terms of food preference. The breeding</p>	

	<p>season lasts from September to April. Their conservation status by IUCN is Least Concern. In Nigeria, they are classed in the second schedule of the CITES Act 2016</p>	
<p><i>Civettictis civetta</i></p>	<p>African civet, known locally as <i>Era/Idiabale**/Odiabale***</i>, is primarily nocturnal and spends the day sleeping in dense vegetation but wakes up at sunset. It is a solitary mammal with a unique colouration. They are omnivorous; mate from October to November, and produce offspring between January and February. Their conservation status is Least Concern. In Nigeria, they are classed in the second schedule of the CITES Act 2016</p>	
<p><i>Thryonomys swinderianus*</i></p>	<p>Cane rats, locally called <i>Olo/Odhokpa**</i>, live in small groups led by a single male. They are nocturnal and make nests from grasses or burrow underground. Individuals of the species may live over four years. If frightened, they grunt and run towards the water. Six (6) individuals were sighted in freshwater swamp habitat and one (1) in derived savannah. The conservation status is Least Concern (IUCN 2022). The species is also not protected under the CITES Act 2016</p>	
<p><i>Potamochoerus larvatus</i></p>	<p>Bush pigs, locally known as <i>Eezi*</i>, inhabit various habitats. These species are sedentary and protect their territories vigorously. They are predominantly nocturnal; they commonly communicate by grunting, with infrequent squeals and roars. They make a long, resonant growl when threatened. They also have exceptional hearing and sense of smell but poor eyesight. Bush pigs can also adapt to human-influenced habitats because they eat agricultural food crops (Kingdon, 1997). They have a polygynous mating system wherein a male exclude other males from access to a group of females. Most births</p>	

	occur between September and November in sheltered nests or hollow ground. The species is classed as Least Concern (IUCN 2022). It is also not protected under the CITES Act 2016.	
<i>Aterix albiventris</i>	The African pygmy hedgehog is a solitary animal known locally as <i>Ebinta</i> ****. As a nocturnal creature, it constantly moves, covering up to several miles in one night. Although they are not territorial, individuals keep their distance from other African pygmy hedgehogs. <i>Aterix albiventris</i> is omnivorous but primarily insectivorous. African pygmy hedgehogs are opportunistic feeders with an extremely high tolerance to toxins. They have been known to eat scorpions and small poisonous snakes with no ill effects (MacNamara 1998). They typically mate in rainy, warm seasons, when food is plentiful. Their conservation status is Least Concern, and it is also not protected under the CITES Act 2016.	
<i>Lepus capensis</i>	Cape hare, locally known as <i>Uze</i> ****, is found in savannahs and forests. They are euryecous. Their diet includes herbaceous plants, cereals, berries, vegetables, and some fungi, such as mushrooms. This species of hare also eats some of its faecal droppings laid during the night and digests them a second time to obtain essential nutrients from the material as it passes through the alimentary canal a second time (Peltonen, 2000; Vaughan and Czaplewski, 2000). Mating occurs from January to June, with the young born from March to October. Gestation lasts 42 days, and the doe raises 2 to 4 litters of 1 to 6 leverets per year. Mating activities are very lively during the mating season in the late morning or early afternoon. These animals are not currently a conservation concern, and it is also not protected under	

	the CITES Act 2016.	
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Ukwani/Anioma(); Isoko/Urhobo (**); Ijaw(***); Igbo (****)

**N/B: Species with asterisk (*) attached to their zoological names are direct evidences while those without are indirect

4.7.3.3 Avifauna

The avian study is vital to assess the potential environmental impacts of the proposed project on birds species. The project area is an important bird area, housing several avian species that offer the ecosystem provisional, regulatory and supporting services. They also help plant reproduction through pollination or seed dispersal, decomposition, and excision of degradable and some non-degradable wastes. (Table 4.27) presents the local names, bird behaviour, preferred habitat, nesting and breeding sites, altitudes and possible threats of censored species. The global conservation statuses of all species were obtained from the IUCN Red List of Threatened Species, while the Endangered species Act 2016 was used in compiling their national conservation status.

Table 4.27: Assessment of censored avian species to Environmental Variables

S/N	Species	Brief Description	Remarks
1.	<i>Pteronetta hartlaubii</i>	Hartlaub's Duck, locally called - obgwuma/obogwu*/ikpukpuyeke prefers tropical forests, especially around rivers and swampy areas. Nests containing laid eggs are placed in the burrowed ground close to water bodies. Breeding usually occurs in the wet season (Carboneras and Kirwan, 2020). The nine (9) individuals were sighted either resting or flying at 50m in the Freshwater swamp habitat—the species as Least Concern (LC) by IUCN (2022). In Nigeria, it is classed in the first schedule of the CITES Act 2016.	Breeding sites, food sources and spawning grounds are affected by habitat loss due to forest destruction (Arnoldo, 2000).
2.	<i>Lamprotornis purpureiceps</i>	Commonly called Purple-headed starling. Locally called-kpakpando*. The generalist species prefers tropical forests. Breeding is usually in tree cavities, abandoned nests and sometimes artificial structures during wet seasons (Craig and Feare,	This non-migratory species is in decline owing to ongoing habitat destruction and fragmentation. (IUCN,

		2020). All seven (7) individuals were sighted either resting or flying at an average altitude of 125m in the Freshwater swamp habitat. The species is categorized as LC by IUCN (2022). This species is not protected under CITES Act 2016	2022-1)
3.	<i>Polyboroides typus</i>	African harrier hawk, locally known as egbe*/oso**is a migratory species. The species prefer natural woodland, tree plantations (mostly <i>Elaeis guineensis</i>) (Verdoorn and Roth 2000). Breeding is usually in stick nests on treetops. Sixteen (16) individuals were sighted in Freshwater swamp habitat and three (3) in Derived savanna. The individuals were either feeding or flying at an average altitude of 166m. The species is categorized as LC by IUCN (2022) and not protected under the CITES Act 2016	The degradation of palm growing habitats does affect the breeding and abundance of this species. (Verdoorn and Roth 2000)
4.	<i>Milvus migrans</i>	Black kites, locally called nkwo*/Egodi** are resident birds of tropical forests areas. It nests in trees and cliffs and even electricity pylons. This opportunistic feeder preys upon small mammals, frogs, lizards, and insects (Ferguson-Lees and Christie 2001). Twenty-six (26) individuals were sighted in Freshwater swamp habitat and two (2) in Derived savanna either resting or flying at an average altitude of 160m. The species is categorized as LC by IUCN (2022) and not protected under the CITES Act 2016	Despite being possibly the most common raptor globally, the population has declined due to poisoning, water pollution, and over-use of pesticides. Urban environments and agricultural improvements are causing regional declines (Ferguson-Lees and Christie 2001).

5.	<i>Necrosyrtes monachus</i>	Locally known as udele*/uguru** the hooded vulture typically scavenges on carcasses. This bird species has shown more than 85% losses in population over the last 50 years (Ogada et al. 2011). All three (3) individuals were sighted in Freshwater swamp habitat, either resting or flying at an average altitude of 275m. The IUCN has rated its conservation status as "critically endangered" (IUCN 2022). This species is not protected in Nigeria under the CITES Act 2016	Species decline due to indiscriminate poisoning, trade, hunting and persecution, and habitat loss and degradation (Ogada et al. 2011).
6.	<i>Treron calvus</i>	The African green fruit pigeon, locally called Inekuku** is a Resident bird of rainforest and degraded environment including human settlements. They feed on exotic fruits or carrion on occasion. The species usually nests in a weak platform of sticks constructed in tree forks (Owolabi et al., 2018). Two (2) individuals were sighted resting in Freshwater swamp habitat at an average altitude of 123m. It is categorized as LC by IUCN (2022). The species is also not protected in Nigeria under the CITES Act 2016	Though relatively abundant and highly adaptive, these species have been reported to be impacted by forest loss (Owolabi et al., 2018).
7.	<i>Aquila africana</i>	Cassin's hawk-eagle locally known Ugoegbe*/is a resident bird of wooded hills occurring in primary lowland rainforests, secondary forests and even plantations where many large trees have been left (Ferguson-Lees and Christie 2001). It nests about 3 feet (almost 1 metre) in diameter in the forks of a large tree. Its diet consists of birds and squirrels. Its presence was obtained via indirect pieces of evidence. The species is categorized as LC (IUCN	The population is suspected to decline due to ongoing habitat destruction (Ferguson-Lees and Christie 2001).

		2022) and is not protected in Nigeria under the CITES Act 2016	
8.	<i>Cypsiurus parvus</i>	The African palm swift, commonly called in nkwungwangwa*/omuedi** is known for its association with palm trees (Chantler and Kirwan, 2020). Their breeding nests are usually situated on or near palm trees. All seven (7) individuals were sighted feeding and flying at 150m in the Freshwater swamp habitat. The species is categorized as LC (IUCN 2022), and it is not protected in Nigeria under the CITES Act 2016	Same as <i>Polyboroides typus</i> .
9.	<i>Bubulcus ibis</i>	Cattle egret locally called Leke-leke* in Anioma language are bioindicators of pollution. They prefer tropical forests. Breeding is usually in colony nests, often found around water bodies. The nest is a platform of sticks in trees or shrubs, and it feeds on a wide range of prey, mainly insects (Jones and Safi, 2011). Twelve (12) individuals were sighted in Freshwater swamp habitat and seven (7) in Derived savanna. The individuals were either feeding or flying at an average of 50m. The species is LC (IUCN, 2022), and it is not protected in Nigeria under the CITES Act 2016	The presence of the species suggests the occurrence of other mammals (Jones and Safi, 2011). It is also an indicator of polluted environments (Kowalska et al., 2018)
10.	<i>Gymnobucco calvus</i>	Commonly known as Naked-faced barbet, it is a resident species of forests habitats. They usually breed in nests on treetops. They nest in tree branches. (delHoyo et al. 2020). Twenty-seven (27) individuals were sighted in Freshwater swamp habitats, either resting or flying at an	The population is suspected to be in decline owing to the loss of suitable nesting and roosting trees (del Hoyo et al. 2020).

		average altitude of 112m. The species is LC (IUCN, 2020). It is also not protected in Nigeria under the CITES Act 2016	
11.	<i>Tockus fasciatus</i>	It is commonly known as the African pied hornbill. It is locally known as apiapia*, owoye**. It is a public resident breeder, mainly forest habitat. The female lays up to four white eggs in a tree hole. They are omnivores and this conspicuous and gregarious bird. Three (3) individuals were sighted in Freshwater swamp habitat and two (2) in Derived savanna. All were flying during censusing at an average altitude of 133m. The species is LC (IUCN, 2022). It is also not protected in Nigeria under the CITES Act 2016	Breeding sites are affected by habitat loss due to forest destruction (Alroy, 2017).
12.	<i>Cisticola anonymus</i>	Commonly called Chattering cisticola, these non-migratory insectivorous species prefer a wide range of habitats, including grasslands, mountain slopes or human-modified habitats. Nesting is discreetly in the grasses (Ryan, 2020). Eleven (11) individuals were sighted in Freshwater swamp habitat resting or flying at an average altitude of 89m. The species is categorized as LC (IUCN, 2022), and it is not protected in Nigeria under the CITES Act 2016	Nest destruction due to vegetal clearance is prevalent in disturbed habitats (Jones et al., 2011).
13.	<i>Streptopelia semitorquata</i>	Red-eyed dove, locally called Nduru*/Erure** is a common species majorly found in forests near rivers. They are not particularly gregarious and often feeds alone or in pairs. Seven (7) individuals were sighted in Freshwater swamp habitat and one	The population is suspected to be increasing owing to afforestation and water conservation programs

		(1) in Derived savanna. The individuals were either feeding, resting or flying at an average altitude of 101m. The species is categorized as LC by IUCN (2022) and are not protected in Nigeria under the CITES Act 2016	(del Hoyo et al. 1997).
14.	<i>Fraseria ocreata</i>	Three (3) African forest flycatcher (locally known as Nwanza/Akian in Ogba/Biseni languages) individuals were sighted in the freshwater swamp habitat, while two (2) were spotted in the derived savanna. Their diet consists almost entirely of insects, including winged termites, moths, beetles and caterpillars (Taylor, 2020). The individuals were sighted foraging close to the ground at a 50m average altitude. It is categorized as Least Concern by IUCN (2022) and not a protected species in Nigeria under the CITES Act 2016.	The use of insecticides and the shrinking of stagnant water bodies have been shown to affect the feeding and breeding cycles of this species (Taylor, 2020)

(Ukwani/Anioma(*); Isoko/Urhobo (**). Ijaw(***) except otherwise stated× = censured via indirect evidence(s)

4.7.3.5 Herpetofauna

The reptilian and amphibian taxa study is imperative for this project to provide informed data to guide policy decisions on occupational health hazards, pest control strategies, developmental actions or substances that could expose them to attack. Their study is also imperative to provide conservation decisions since they serve several ecosystem functions, including the prey-predation relationship. Table 4.28 outlined preferred microhabitat, breeding grounds, conservation status, and diets for each species (sighted and non-sighted).

Table 4.28: Description of censored species

Species	Brief Description	Remarks
<i>Bitis arietans</i>	African Puff Adder is called ‘Ogbu’ in the Ijaw language. Their preferred habitat is a dry ground of savannah, while major diets comprise birds, mammals, amphibians, other reptiles and insects (Miller <i>et al.</i> , 2015). They colonize ground burrows dug by mammals as spawning grounds. Two individuals were sighted at the derived savannah habitat. It is not Evaluated (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	Reports of occupational hazards associated with burrows occupied by this venomous species and its juveniles have been shown (Akani <i>et al.</i> , 2013). Dry or moist grounds with toads are vulnerable sites of <i>Bitis</i> .
<i>Chamealeo africanus</i>	Chameleon is locally called ‘Iwewe’ in the Ijaw language. Their preferred habitats are trees, ground, or bushes, while their primary food source is insects (Crabtree, 1999). They burrow, forming their nest in the soil. This species is evaluated as Least Concern (IUCN 2022). In Nigeria, it is protected in the second schedule by the CITES Act 2016	Eggs of <i>Chameleo africanus</i> laid on soil is threatened by bush clearing, wildfire, habitat modification and flooding (Böhme, 1994). Vogrin et al. 2017 attributed predation, illegal collection for the pet trade, and roadkill as some threats.
<i>Panaspis togoensis</i>	Togo skink is locally known as ‘Oworube’ in the Ukwani language. Their preferred habitats are Forest and Savannah, and their primary diet is larger invertebrates and other small insects. Five individuals were sighted across the two habitats. The species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	Loss of forest habitat due to agricultural and urban expansion is the main threat to this species. Land-use change in Nigeria for smallholdings and urban demand for wood fuel (FAO 2009) constitute a potent threat.
<i>Osteolaemus tetraspis</i>	The species are commonly known as West African dwarf crocodile and ‘Edare’, ‘Anumini” in Isoko	Hide hunting, poaching, live animal trade, consumption and habitat

	<p>and Ukwani languages. It is a revered (See Socio-economic section) animal in most Ukwani communities. Their preferred habitat is a Freshwater swamp. They are Opportunistic predators with varied diets, including reptiles, amphibians, birds and small mammals (Pauwels <i>et al.</i> 2007). Mothers build mound nests of fallen leaves and rotting vegetation about 17 meters from the water and 1-2 meters above the waterline. Three individuals were sighted in the swamp habitat. This species is categorized as Vulnerable (IUCN 2022). In Nigeria, it is protected in the first schedule by the CITES Act 2016</p>	<p>modifications are major threats. Food sources, such as crustaceans, amphibians and fishes, are negatively impacted by the discharge of industrial wastewater (Jemerigbe and Oyase, 2016).</p>
<i>Naja nigricollis</i>	<p>Black-necked spitting cobra locally called ‘Obi’ in Isoko. They are found in the savannah habitat and have small mammals, birds, and lizards as their primary diet (Shine et al., 2006). The species does not have specific breeding ground, and it is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.</p>	<p>Same Remarks as in <i>Bitis arietans</i>.</p>
<i>Python sebae</i>	<p>African Rock Python called ‘Ogbo’ in Isoko dwells in savannah and swamp habitats. Their primary diet comprises birds, Mammals, Reptiles and Fish (Areste and Cebrian, 2003). They colonize tree burrows, animal burrows, termite mounds, or caves as spawning grounds. The species is categorized as LC (IUCN 20 0). In Nigeria, it is protected in the first schedule by the CITES Act 2016</p>	<p>Their submerging ability (Mccurley, 2003) and preference for hollows in trees (Areste and Cebrian 2003), which abunds in the study area, make contact with it possible. The preferential temperature range of about 30-32⁰C (See Climatic data) and their predation on livestock and farm pests (Luiselli <i>et al.</i>, 2001) makes their presence possible. Prey hunting at twilight</p>

		(Spawls <i>et al.</i> 2002) makes journey management imperative. The species is venerated in the nearby Isoko culture (information supplied).
<i>Iguana iguana</i>	The species resides in the freshwater swamp and derived savanna habitats. Its primary food sources are leaves, fruit and flowers. Occasionally, they eat eggs, snails, and leaf dwelling insects (Alberts et al., 2014). They make ground burrows for their breeding. The species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	This species has been reported as excellent dispersal agent of seeds (Burgos-Rodríguez et al 2016). Their excreta contain germinable seeds of rare, invasive and threatened species (Moura et al. 2014; Valido and Olesen 2009). During the interview, habitat degradation by developmental projects and harvesting for human use were significant threats.
<i>Kinixys homeana</i>	Home's hinge-back tortoise is locally called 'Ikagi' in the Ijaw language. Their preferred habitat is the Derived savannah, while major diets include: snails, slugs, millipedes as well as fallen fruits, grasses and plants (Luiselli et al., 2006). They lay their eggs on the ground, covered in leaves. The species is categorized as Vulnerable (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	<i>K. homeana</i> is currently experiencing a severe decline in much of its range, due mainly to habitat loss (through agricultural and industrial expansion and deforestation) and intensive harvesting for subsistence and traditional medicine ("ju-ju") by local people in desperately poor economic conditions, as well as for international pet trade (Luiselli et al., 2006). Although <i>K. homeana</i> is still found in nearly all the forest-zone protected areas in Nigeria, hunting is still rampant (Luiselli (2003). Protected area populations are not free of

		exploitation.
<i>Kinixys erosa</i>	Forest hinge-back tortoise is locally called ‘Ikagi’ in the Ijaw language. Their preferred habitat is the Derived savannah, and their major diets are fallen fruits, leaves, fungi, mushrooms, and vegetables (Fritz and Havas, 2007). The species is categorized as Data Deficient (IUCN 2022). In Nigeria, it is protected in the first schedule by the CITES Act 2016.	<i>K. erosa</i> is hunted locally for bushmeat, and its range has retreated due to the clearance of its habitat (Tortoise & Freshwater Turtle Specialist Group). The forest hinge-back tortoise is considered threatened due to habitat destruction (Fritz and Havas 2007).
AMPHIBIANS		
Species	Brief Description	Remark
<i>Hoplobatrachus occipitalis</i>	African groove-crowned frog locally called ‘Owokpoye’ in the Ijaw language. Their preferred habitat is savanna. They mainly feed on coleopterans, caterpillars, spiders, vegetal fragments, fishes, larvae, crabs, ants, grasshoppers, locusts, dragonflies, frogs, molluscs, lizards, mice, butterflies, wasps (Mady-Goma, 2012). Eggs are deposited and attached to structures on the ground. Twenty-four individuals were sighted across the two habitats. The species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	<i>Hoplobatrachus occipitalis</i> constitutes a source of animal proteins and income to men (Neveu, 2004; Nzigidahera, 2006). Temperature is vital for the growth of <i>H. occipitalis</i> since values above 28 °C enhance average growth but is inhibited at values below 25 °C (Morin, 2008). Mosquito larvae constitute a major diet of <i>H. occipitalis</i> tadpoles (DDC, 2010) and are hence used to control malaria parasites.
<i>Leptopelis Viridis</i>	The species, commonly known as Savannah tree frog, is locally called ‘Ekere in the Ijaw language. Their preferred habitat is dry savanna ah. Major diets are crabs, ants, grasshoppers, locusts, dragonflies, frogs and molluscs (Akani <i>et al.</i> ,	<i>Leptopelis viridis</i> is ubiquitous and easily adaptable. There is no significant natural threat (IUCN SSC, 2013). However, habitat alterations, modifications, and biological resource

	2004). Copulation takes place in ephemeral ponds while eggs are not deposited in water but in burrows on the ground near the pond (Vitt, & Caldwell, 2014). <i>Thirteen (13)</i> individuals were sighted across the two habitats. This species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	<i>use destroys spawning grounds and reduces food sources</i> (Clark and Flynn 2000).
<i>Ptychadena bibroni</i>	Commonly called Broad banded grass frog and ‘Opiopio’, ‘Agedain the Ijaw language. Their preferred habitat is mainly savannah and intermittent freshwater marshes. They primarily feed on spiders and Orthopterans (Bell, 2012). Breeding takes place on the surface of stagnant waters. Seven individuals were sighted across the two habits. It is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	Previous studies on the food and feeding habits of <i>Ptychadena</i> species has revealed that they are generalist feeders with an active foraging behaviour (Rödel, 2000; Enabulele and Imasuen, 2012). The larvae of <i>P. bibroni</i> are mainly detritivores (Getz, 2011), and biological resource use is their main anthropogenic threat (Getz, 2011).
<i>Rana clamitans</i>	Green frog locally called Uworo in ‘Ogba’ and ‘Burda’ in ‘Bisei’. Their preferred habitat is savanna and freshwater swamp. They are primarily carnivores feeding on insects and other invertebrates from land and water (Jenssen, 1967). Breeding occurs in various habitats, such as swamps, ponds, marshes, bogs and slow-moving streams. Two individuals were sighted in the savanna habitat. This species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	It has been reported that both tadpoles and adults require aquatic sites with enough oxygen/dissolved oxygen (Oldfield and Moriarty, 1994). Roček, 2000 and Karen, 2008 report that all stages of the life history of green frogs have several predators.
<i>Ptychadena</i>	South African sharp-nosed frog locally called	<i>P. oxyrhynchus</i> prefers open landscapes

<i>oxyrhynchus</i>	‘Ikerebe’ in the Ijaw language. Their preferred habitat is dry, moist savannah and alternating freshwater marshes. Major diets include a variety of arthropods, mainly orthoptera and Arachnida (Bell, 2012). Breeding occurs in shallow water. One individual was sighted in the swamp habitat. This species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	(Rödel, 2000) and disturbed areas when in forests (Lawson, 1993). <i>P. oxyrhynchus</i> is a generalist feeder (Eniang <i>et al.</i> , 2003) and therefore adaptable to changing conditions.
<i>Sclerophrys maculata</i>	Commonly known as Hallowell's toad. Their preferred habitats are savannah and freshwater marshes, while major diets are beetles, ants, grasshoppers, termites and odonates (Aho, 1990). They breed in small and shallow inlets and puddles. Four individuals were sighted in the savanna habitat. It is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	The permeable skin makes it a potential bioindicator of chemical pollution (Venturmo <i>et al.</i> , 2003). Threats discussed for <i>Limnonectes malesianus</i> also applies.
<i>Hyperolius viridiflavus</i>	The African reed frog prefers Freshwater habitat. They are insectivores, and their free-living tadpole eats algae (Bubac, 2009). Breeding takes place on vegetation under the water in ponds, lakes and slow-moving streams. Two individuals were sighted in the savannah habitat. This species is categorized as LC (IUCN 2022). In Nigeria, it is not protected in the CITES Act 2016.	The species is a part of the international pet trade (SchiØtz <i>et al.</i> , 2004). It is a predator of insects (Channing, 2001). It also preys on dragonfly larvae and beetle larvae (Grafe and Lisenmair 1989). Predation of the tadpoles by water snakes (Bubac, 2009) is indicative of reptilian presence in the flooded forest.

(Ukwani/Anioma(*); Isoko/Urhobo (**). Ijaw(***))

4.8 Social Environment

4.8.1 Political context

The Federal Republic of Nigeria comprises 36 States and a Federal Capital Territory. Nigeria became an independent state in 1960 and a republic in 1963. It started with three regions, namely Eastern, Northern and Western, until a fourth, the Mid-West region, was created in 1963. Nigeria experienced the first military coup in 1966 and a thirty-month civil war from 1967 to 1970. The military government created 12 states from the four regions in 1967. Between 1967 and 1996, the 12 states were further divided into 19, then 21 and finally 36 states. Delta State was created in 1991 out of the then Bendel State. Delta State currently has 25 LGAs, including Ndokwa West. Ndokwa West LGA, as in all others in the State, is run by an elected Executive Chairman and elected Counselors. The Chairman appoints a cabinet to assist in performing the executive functions of the Local Government.

Table 4.29: Administrative structure of Nigeria and the project affected area

System of Government					
Nigeria operates Three-tier arms of government. Federal, State and Local Government Area. She runs a Presidential System of Government.					
Federal Arm	Executive - Implementation of laws, maintaining law and order, and initiating bills into parliament. A President heads it.				
	Legislature- Nigeria operates a bicameral (Senate and House of Representatives) legislature. They make laws, approve the annual budget, ratify treaties negotiated by the executive and conduct oversight functions on government activities. Senate President heads the senate, and a Speaker presides the House of Representatives.				
	<table border="1"> <tr> <td>Senatorial District</td> <td>House of Representative</td> </tr> <tr> <td>There are 109 senatorial districts in Nigeria. The project area is represented by a senator representing the Delta North Senatorial district.</td> <td>There are 360 House members in the national assembly. Delta State has ten members. The project is located in Kwale (Ndokwa/Ukwani Federal Constituency) and other communities in all federal constituencies for associated facilities.</td> </tr> </table>	Senatorial District	House of Representative	There are 109 senatorial districts in Nigeria. The project area is represented by a senator representing the Delta North Senatorial district.	There are 360 House members in the national assembly. Delta State has ten members. The project is located in Kwale (Ndokwa/Ukwani Federal Constituency) and other communities in all federal constituencies for associated facilities.
	Senatorial District	House of Representative			
There are 109 senatorial districts in Nigeria. The project area is represented by a senator representing the Delta North Senatorial district.	There are 360 House members in the national assembly. Delta State has ten members. The project is located in Kwale (Ndokwa/Ukwani Federal Constituency) and other communities in all federal constituencies for associated facilities.				
Judiciary - The supreme court, appeal court, federal courts, Industrial court, customary courts of appeal and magistrate court. They Interpret laws that protect the right of individuals, and a Chief Justice heads it.					
State Arm of Government	Executive- There are 36 states in Nigeria and the Federal Capital Territory, and an elected Governor heads the executive arm of the state government. The proposed project is located in Delta State.				

	Legislature - Each State operates a unicameral system headed by a Speaker.
	Judiciary - There are the State High court, customary courts, and Magistrate Courts. The head of the state judiciary arm is the Chief Judge.
Local Government Arm of Government	Executive- A Chairman heads the executive arm, and this arm performs similar functions to that of the President and Governor at the Federal and State levels, respectively.
	Legislature - The legislature is formed by at least ten wards in each LGA, and they make bye-laws for the LGA, and the Leader of the House heads it. Each Local Government is represented at the State House of Assembly by an elected member of the Local Government.
	Community: The traditional administration in the area is headed by a head referred to as Okpalauku and his cabinet, which comprises the Chiefs and Elders-in-Council (the Okwa's and the Nnootu's). The administration also recognises the Women Leader and the Youth Chairman, who administer justice to the women and youth folk and regularly report to the community head.
Emu Ebendo, ObodoUgwa, Ogbole-Ogume, Umusam and Umu-Seti, communities	The traditional administration in Utagba Chiefdom is headed by the eldest Okpaluku and other Okpalaku serving as Cabinet members. The administration also recognises the Women Leader and the Youth Chairman, who administer justice to the women and youth folk and regularly report to the Okpaluku.

4.8.2. Demography

Table 4.30: Socio Environment of the Project Area concerning Delta state and Nigeria.

	General statistics in Nigeria	Delta State	Ndokwa West LGA
Total population (2006 Census)	140,431,790	4,112,445	149,325
Projected population (2022 based on an exponential growth rate of 3.2%)	219,803,838	6,436,798	272,772
Total Area of Land	923,763km ²	17,698km ²	816km ²
Population Density	198.6/km ²	17,108 km ²	255.1 persons/km ²
Population Distribution			
Men	71,345,488	2,069,309	98,310
Women	69,086,302	2,043,136	101,426
Children (age 0-14)	41.8%	31.8%	67,446
15-29	25.4%	26.0%	99,798
30-44	18.0%	21.9%	
Elderly (>65)	3.2%	4.45%	7,029
Population (2010)	159,538,079	4,112,445	
Literacy rates	59.6	69.9%	
infant mortality level	64.8/1000 live births	0.00648%	
life expectancy	55 years	49Years	
Youth Literacy in any Language	Female	72.8	90.4
	Male		85.4
	Female	53.8	74.5
	Male		90.4

Source: National Population Commission of Nigeria, 2012

4.8.3 Community and Household Consultation

Community consultation is an inclusive and culturally appropriate process that involves sharing information and knowledge, seeking to understand the concerns of other project affected persons and building relationships based on collaboration. It allows the community to understand the project's risks, impacts, and opportunities to achieve positive outcomes. It

involves information dissemination and interaction/dialogues with the host community of the proposed project.




4.8.4 History and Culture of the Communities

The Okpaluku-in council of Umuseti, Obodougwa and Emu- ebendo provided their socio-cultural history (Table 4.31) to the study team. At the same time, we relied on unauthorised personal information supplied by Mr Sunny Onyia (an Onuabor man born in Utagba and residing in Ashaka) for those of the Umusam and Ogbole-ogume communities. Although Ogboleogume converged in huge numbers (Plate 4.14) to welcome the study team, they declined to provide household, FGD and KII to the field crew unless the portion of land contributed by each donor community to the proposed KIP project is publicised and signing of the resultant MoU. Similarly, the Umusam community was invited to the Scoping Workshop, but they declined attendance. Upon inquisition, the field team was informed that the community has yet to buy into the KIP project vision, and they are also suspicious of the proposed SAPZ project. Upon further persuasion, they opted that the study team come back after one month for further consultations.



Plate 4.14: Stakeholders at Ogboleogume community who declined socioeconomic consultation

Table 4.31: Host communities' socio-cultural history

Parameters	Emu-ebendo	Ogbole-ogume	Obodougwa	Umusam	Umuseti	Remarks
Demography		-				
Origin	Member of the Emu clan	Member of the Ogume clan	Member of the Ogume clan	Member of the Utabga clan		
Migration	Bini (Benin)	Edo State	Edo state	Utagba- uno	Utagba- uno	
No of families	The Okoligwe family, the Ogbolum family and Umuodio family	The Umuagbu family, The Amanta family and The Ezelu family	Twenty-two (22) families. According to their ranks, the first 3 are Umuolege, Umuoyitossai and Umundufi	Four major families (Umu-agbor, Umu-adabam, Umu-okole, and Umu-oluem)	Eighteen (18) major families. The first 3 are the Umuogwe, the Onwunalu and the Ozegbenzei families	These families have subs, and each controls community resources mainly from agriculture and royalties from companies operating in their domain
Traditional governance system	The communities are headed by the Okpalauku (traditional ruler) and his council (Okwa, Nootu, Onowu and Onotu-uku).					
GRM	Household  Family  Okpaluku-in council  Clan council					

Festivals	The Emu- ebendo festival is an annual celebration held in the community	The Ndukuogume, Olise, Ikenge, Eguugani and Ukpabor festivals. Each festival lasts nine (9) days.	Oji festival, Nduku festival, Ikenge festival, Onodu festival and Okparabor festival.	The Eze-nmor festival (which lasts two weeks), the Ifijioku festival (which lasts one day) and the Ossai-nsukwa festival (observed twice a year).	The Ukpabor festival, Iseh festival (yam festival), Igba festival (Heroes festival) and Ikenge festival	The Nduku and Oji festivals are celebrated after crop harvest, and the Onotu festival signifies a coming of age ceremony in the community. Similar festivities are part of the Ogboleogume culture—all last for nine (9) days.
Shrines	The sacred Aboshi tree	Ikpo, Isu-elishi, Isu-Nduku, Isu-orji and Isu-ndife (where no one can enter with a cutlass).	Elishishrine	Sacred places at Umusam include Nkpulukpu bush, where entry is not allowed on Eke day and Ipo, where only men are permitted to		Employees in all phases of the project shall be sensitised to the locations of these sacred places to avoid them.

				enter.		
Land ownership systems	The major land ownership systems in the communities are inheritance, purchase, and lease.					
Taboos	The community forbids mainly the consumption of cocoyam in soups, snails and Iguanas. Sexual intimacy in the bush is also prohibited.	The community forbids the consumption and killing of snails, snakes and most especially tortoises. Sexual intimacy in the bush is also prohibited.	Consumption of iguana, tortoise and snail. Also, sexual intimacy in the bush is strictly prohibited.	Sexual intimacy in the bush and consumption of tortoises, snails, sheep and crocodiles is prohibited.	Consumption and physical contact with alligators, snakes and snails, killing alligators, committing suicide, and sexual intimacy in the bush are prohibited in the communities.	This section is for contractors' and employees' guidance to prevent cultural overlap and conflict across all project phases.
Major occupation	Farming, trading and public service					The overarching farming and trading occupation partly justify the choice of Kwale for the PPA.
Potential conflict	Borderland disputes	Land delineation and desecration	Perceived "divide and rule tactics."	Distrust of the proposed SAPZ	Agitation for employment/contracts	The project proponent should be careful not to

sources	Land ownership disputes	Land ownership disputes	Borderland disputes	project	Land ownership disputes	aggravate these conflict sources.
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Plate 4.15: Stakeholder consultations at Umuseti community



Plate 4.16: Stakeholder consultations at Emu Ebendo community



Plate 4.17: Stakeholder consultations at Obodougwa community

Selected representatives (mainly chiefs and respected community) members of the communities handle intercommunity conflicts across the host communities. The Utagba-in Council and LGA council serve the roles of Appeal in dispute resolution of mainly civil cases in Ndokwa land. Instituting a court case is the last resort. Criminal cases are referred to the government law enforcement agents in all communities. However, the community members have formed themselves into vigilante groups to complement the security architecture provided by the State.

Nonetheless, potential sources of conflict include

- Non-recognition of the communities as critical stakeholders
- Perceived intimidation of the community
- Ineffective communication channels

The study observed that the host communities have lingering land ownership issues amongst themselves, which is a potential red flag for the project.

4.8.5 Socioeconomic Sampling Approach

Key Informant Interview (KII), Focus Group Discussion (FGD) and Household Questionnaires were used to harvest the socioeconomic data of the people.

The KII was organized with the chiefs and elders of Umuseti, Obodougwa and Emu- Ebendo communities at their respective town halls. FGD meetings were held with representatives from youths, women, traders/business owners, famers/hunters and fisherfolks in the three consenting communities.

The household questionnaires were administered on a Household basis. The questionnaires were administered to 1478 willing homesteads representing 42.1% of the estimated households (3511). The respondent provided the estimated households per community to support the random estimation count done by the study team. The people were assisted (mainly in pidgin and local dialects) in responding to the questionnaires. A total of 1106 questionnaires were retrieved, representing a success rate of 74.8%. Some homes and persons who declined are sceptical and unhappy that the project is agriculturally inclined against their preference for an oil and gas venture.

Table 4.32: Socio-Economic Sampling Protocols

Tools	Relevance	Communities	Estimated Number of Household	Number issued questionnaires	Retrieved questionnaires	Date of Interview	Venue
Household questionnaires	To obtain the host community's socioeconomic profile	Obodougwa	865	516	371	5 th March	The Okpalaku's palaces and homes of respondents
		Umuseti	1350	512	377	6 th March	
		Emu- ebendo	1296	450	358	6 th March	
		Total	3511	1478	1106 (74.8%)		

Source: MCNL, 2022

4.8.6 Age demography and Gender of household head

Table 4.33: Respondent by age and gender

Community	Age bracket (years)						NBS 2012	Household head	NBS, 2012
	Gender	0-18	19-39	40 – 64	Above 65	Total	Nigeria (Delta)		
Obodougwa	Male	17.1	21.7	10.6	2.9	52.3	(0-18) = 47.2 (19-39) =39.2% (40-64) =10.9% (65 and above) =2.6%.	72.7	(Headed by Male) = 76.6%
	Female	6.5	25.3	14.7	1.2	47.7		27.3	
Umuseti	Male	15.3	25.2	14.2	3.1	57.8		76.9	(Headed by Female) =23.4%
	Female	6.5	22.0	10.0	3.7	42.2		23.1	
Emu-ebendo	Male	16.0	21.5	10.0	3.4	50.9		74.1	
	Female	15.3	19.8	9.7	4.3	49.1		25.9	

Source: MCNL 2021

Persons within the age bracket of 15-44 years formed the bulk population (45%) while those within 0-14 years were the least (25%) represented in the respondent communities. This finding presents, at the least, readily available unskilled labour forces that could participate actively in the various activities across all phases of the project. (See Chapter 4 for workforce requirement of the project).

Similarly, the Annual Abstract of Statistics 2012 position that persons within the age bracket (0-18) form the bulk of the Nigerian population agrees with this study's respondent population. Igwe (2019) attributed urban pull factors as a determining criterion in age bracket configuration in Delta State.

Information on the gender of household heads in the project area revealed a 4:1 ratio for male to female heads of households respectively. The 76.9% male headed household is less than the Nigerian average of 85.7% but competes favorably with 76.6% for South-South states. This implies lesser female house heads in the project area compared to the 23.4 % South-South average. This partly confirmed the premium the people attaches to the marital institutions and the reliability of the NBS data. Nonetheless, the interview declining population of about 72%. aged between 32 and 50, may have influenced the obtained data.

4.8.6.1 Marital Status of Head of Household

The findings that about 95.3% of respondents are or once married (existing marriages, widowed or divorced) inform the PAC's sacred importance to the family union. The study also observed that 72.8% of any failed marriages occurred within the first ten (10) years, lending credence to a counselling need for young couples as a divorce antidote (See ESMP section for concurrence). Table 4.34 provides data on the marital status of household heads.

Table 4.34: Marital Status and Nature of Marriages in the Project Area

Community	% Marital Status of Household Heads				NBS 2012	Nature of Marriages of heads of Household		Ashavar& Agada, 2013
	Single	Married	Divorced	Widowed		Monogamy	Polygamy	
					Nigeria			Delta
Obodougwa	12.8	64.1	5.1	17.9	Married (50.0%)	85.0	15.0	Polygamy
Umuseti	8.1	80.8	2.0	9.1	Single (46.4%)	80.0	20.0	28.0%,
Emu-ebendo	6.8	79.7	1.7	11.9	Widowed (1.97%)	75.2	25.8	Monogamy

					Divorced (1.58%)			72.0%
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MCNL, 2022

The marital status of respondents of 82% (64.1% marital and 17.9% widowed) recorded in the project area is more than the Nigerian average and the South-South average of 77.4% and 65.7%, respectively. The respondent populations have more widows than widowers. The median age bracket of the Single respondent population across all the PACs was about 29.2. The majority of them were of the male gender, while the females were primarily students, apprentices and single mothers.

Furthermore, it was observed that 66.5 % of the respondents in the project area practice monogamous marriages, above the Nigerian and South-South averages of 60.7 and 57.7%, respectively. This is in tandem with the predominant Christian Faith among the respondents and Delta State, in general (Esiri 2021).

4.8.6.2 Household Size

The average household size of about eight among the respondents (Table 4.35) is above the 6 recorded by NBS 2012 for Delta State.

Table 4.35 Household Size of Respondents

Communities	Average household Size	Number of Households
Obodougwa	8	371
Umuseti	7	377
Emu-ebendo	8	358

Source: MCNL, 2022

The study observed a strong correlation coefficient of 0.89 between households sizes above six and couples with non-tertiary education. Also, the study reveals the premium the people attaches to extended family ties as about 89% of the respondent homes comprises the couple, children, siblings and either of their parent. Ejechi and Esiri 2021 corroborated this position also. Mrs Ossai and Chiekwene lamented the toll this family structure type poses on a household's economic, social and private lives.

4.8.6.3 Ethnic Composition

The study observed four (4) main ethnic groups (Table 4.36) among the respondents. As in almost all studies, the aboriginal folkloric entity, the Ukwuani people, dominated other tribal groupings in the project area.

Table 4.36 Ethnicity of the respondent population in the Project Area

Communities	Ukwuani	Enuani/Ika/Ibo	Isoko/Urhobo	Others
Obodougwa	20.3	11.5	0.9	1.1
Umuseti	22.6	16.9	0.8	1.1
Emu- ebendo	13.5	9.7	0.6	1.0

Source: MCNL, 2022

Similarly, other Delta ethnic and linguistic groups complemented the Ukwuani's population to about 98%. The higher percentage of Delta Northerners and Isoko/Urhobo people is linked to their proximity to the proposed project's location. Yorubas, Ijaws and the Binis make up less than 2% of the respondent population.

4.8.6.4 Religion

This ESIA study revealed Christianity, African Traditional Religion (ATR) and Islam as the main religions of the respondent population. Christianity was the most practised across all the respondent communities/persons, accounting for approximately 74.6 %. ATR followed, with 25.2 %, while about 0.09 % were adherents of the Islamic Faith (Fig 4.6).

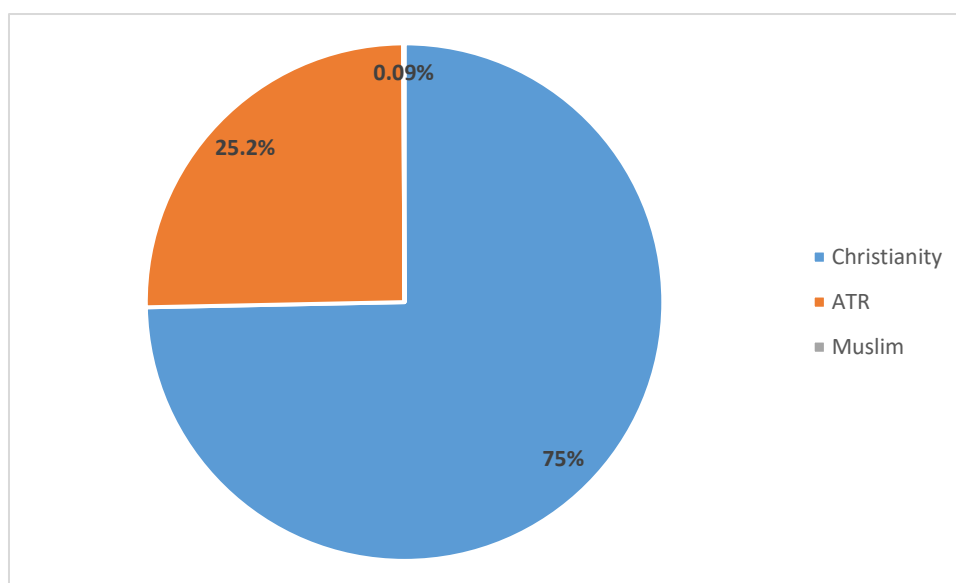


Fig. 4.6: Main religious groups in the project area

None of the indigenous Ukwani respondents was an adherent of the Muslim faith; instead, they were settlers. Similarly, about 5.9% of the respondents practiced ATR exclusively while the remainder practiced it alongside the Christian Faith. The adherents of these various religions observe one festival or the other. For example, Nduku and Oji festivals are notable African traditional festivals in the project area. The Islamic and Christianity adherents in the area observe the worldwide traditional Muslim and Christian festivals, respectively. The followers of a particular faith use the festivities to seek divined favour, prosperity, bumper harvest, peace, security, long lives, and good health for the communities. Adherents of other religions solidarise with their friends of the other Faiths during their festivals and revel in the off-work day the festivity affords.

4.8.7 Existing Infrastructures

Ground truthing, information from questionnaires, and responses during FGDs revealed that seven functional schools within the project sphere of influence (Kindly note that it may not be exhaustive of each host community). Table 4.37 shows the names, categories and ownership of these schools.

Table 4.37: Education facilities within the project sphere of influence

S/N	Name of school	Category	Ownership
1	Ebendo secondary school, Emu Ebendo	Secondary	Public
2	Ebendo primary school, Emu Ebendo	Primary	Public
3	Ogbole primary school, Ogbole-Ogume	Primary	Public
4	Ogbole secondary school, Ogbole-Ogume	Secondary	Public
5	Obodogwa Secondary school, Obodougwaogume	Secondary	Public
6	Obodogwa Primary school, Obodougwaogume	Primary	Public
7	UtagbaOgbe Technical College, Umusam	Tertiary	Public

Source: MCNL, 2022

From the Table, all educational facilities within the project area are publicly owned, with affordable tuition fees. About 60% of the schools have basic water supply and toilet facilities.

However, the respondents reported insufficient teaching staff and instruction materials. In addition, public tertiary institutions (Utagba Ogbe Technical College, Umusam) and skill acquisition centres are available in the project area, improving adults' literacy levels and enhancing the availability of a middle-level workforce for the proposed project.

4.8.7.1 Educational Attainment

A respondent population of 37.2% attained secondary school education compared to 40.2% that attended tertiary institutions implying a high literacy level (Table 4.38) for the study area. Similarly, the study correlated a linear relationship between respondents with no formal education to possession of artisanal skills as most non-tertiary graduates engage in non-white collar jobs.

Table 4.38: % of Respondent's Educational Status and facilities in the Project Area

Communities	No formal education	Primary	Secondary	CoE and polytechnic	University Degree
Umuseti	2.3	4.7	12.0	7.0	5
Obodougwa	2.1	4.7	14.2	8.7	11
Emu- ebendo	2.5	6.3	11.0	5.5	3
% total	6.9	15.7	37.2	21.2	19

MCNL 2022

Obodougwa community has the highest respondent literacy level of 39.1%. The high literacy level in the project area is exemplified by about 77.4% of the respondent population having secondary school or tertiary. Umuseti community has neither primary nor secondary school, thus majority of the respondents access formal education from neighboring communities. This imposes a burden as movement mostly by footpath or major roads exposes pupils to potential road accidents and reptile attacks. The UtagbaOgbe Technical College is the only technical institution within the project community. Most of the graduates who responded to the questionnaires were schooled in one of the University of Science and Technology, Ozoro, Delta State University, Abraka or Delta State Polytechnic, Ogwashi-uku. Those with no formal education or primary education summed up at 22.6%. Plate 4.18 are pictures of some schools in the project area.



Plate 4.18: Some schools within the project sphere of influence

4.8.7.2 Access to Potable Water

Access to portable water encompasses the sources of water for domestic, and other purposes. The PAC's potable water access is obtained chiefly via private boreholes (Table 4.39) complemented by the communally owned borehole.

Table 4.39: Percentage access of respondents to Water Sources across the Project Area

Community	Communal borehole	Surface water/Rain	Private well/borehole
Obodougwa	86	0	14
Umuseti	67	0	33
Emu-ebendo	76	0	24

Source: MCNL Survey, 2022

The respondents depend either on community or privately-owned boreholes for their water needs. The percentage of respondents with privately owned boreholes aligns closely with housing type, household construction materials, income levels, occupation and educational status. None of the respondents depends solely on surface water or rain for their needs. Plate 4.19 shows boreholes in the project area.



Plate 4.19: Boreholes in the project-affected communities

The 76.3% average of respondents having access to a portable water source is higher than the average Nigerian and Delta State average of 67.3 and 62.7 respectively (NBS 2012). The smaller sampling size and the semi-urban nature of the PACs may have accounted for this deviation. Nonetheless, Obisesana and Ozabor 2016 recorded similar percentages of portable water access in Owah-Abbi, Ukwani LGA, Delta State.

4.8.7.3 Households' Main Source of Energy

Kerosene stove, firewood and gas cooker was the most used energy source for cooking. Generally, over 65% of the project area households use kerosene for cooking their meals. Some respondent families' exclusive dependence on firewood for cooking speaks to its availability, overexploitation and low economic status (These findings were factored into the Impact section). The limited use of electricity-powered devices for cooking is expected in semi-urban and rural communities with epileptic power supply. In addition, electricity was the least patronized energy source in the project area used for cooking.

Table 4.40: Household Main Source of Energy for cooking and lighting

Cooking					Lighting					
Community	Gas Cooker	Electric Cooker	Paraffin/kerosene	Firewood (biomass)	PHCN	Solar	lamp	Candles	Generators	Torchlight
Obodougwa	7	2	27	26	40	0	21	2	28	16
Umuseti	6	4	33	19	32	0	19	3	23	8
Emu-ebendo	9	3	29	22	38	0	27	1	32	12

Source: MCNL Survey, 2022

Petrol-powered generators and electricity from the national grid are the primary lighting sources among the respondent populations. Fifteen (1.35%) respondent households do not have PHCN connections or private generators in their homes. Twelve of these households are female-headed (widows and single mothers) and aged between 65 and 78. Their houses are constructed primarily with either thatches, or mud. About three of them lives in unroofed buildings. These persons do not own any inherited land and do not have access to credit facilities. They are vulnerable in every sense of the term. Their names and pictures (withheld) based on request were documented, and their plight was factored into the abridged livelihood restoration program in Chapter Seven. Other less frequently used energy sources for lighting are lamps and torchlight. Conversely, solar and candles are rarely used as energy sources.

4.8.7.4 Household Construction Materials

Roofing, walling and flooring house materials were also studied. These parameters are an indirect index of the life quality of the respondent's populations.

4.8.7.4.1 Roofing materials

Iron sheets, asbestos and aluminium accounted for about 87% of the roofing materials. The least used roofing material is thatch, accounting for about 4%. (Table 4.41)

Table 4.41: % of Roofing Materials used by Respondents

Material	Corrugated Iron Sheets	Asbestos	Aluminium roofing	Unroofed building	Thatch
Obodougwa	14	7	6	3	5
Umuseti	17	8	6	1	5
Emu- ebendo	10	7	5	3	3

Source: MCNL, 2022

Some of the respondent population living in thatched or unroofed buildings belonged to those without PHCN or generator connections; some had illegal connections. BEDC 2021 Bulletin attributed illegal connections and structures on Right of Ways as challenges requiring sensitization campaigns in Delta and Edo States. An awareness campaign was also factored into the ESMP design. The low percentage of buildings under construction in the area is indicative of the prevailing harsh economic situation of the area and country. The data do not reveal any structure constructed with Bamboo/reed roofing.



Plate 4.20: Roofing materials in the project area

4.8.7.4.2 Walling Materials

Results of household walling materials (Table 4.42) revealed that mud and concrete were the walling material in the study area as revealed by the respondents.

Table 4.42: Walling materials of respondent houses in the project area

Walling Material Type	Obodougwa	Umuseti	Emu-ebendo	Total (%)
Mud	12.1	6.5	6	24.6
Concrete (blocks)	20.0	30.5	16.6	67.1
Thatch	1.2	3.5	3.6	8.3
Bamboo	0	0	0	0.00

Source: MCNL Survey, 2022

The relationship among respondents (67.1%) living in walled houses constructed of concrete, mud or thatch speaks to the varied social classes of the respondents and the semi to peri-urban nature of the project area. About 75% of respondents living in mud houses are subsistence farmers with low income and poor education backgrounds. These findings were in line with Chameera *et al.*, 2016 but differed positively from the NBS 2012 (26.7) for Nigeria and Delta State (7.1)



Plate 4.21: Walling materials in the project area

4.8.7.4.3 Flooring Material

Table 5.43 shows the results of flooring material from the study. Earth/sand/dirt/straw, smooth cement and ceramic tiles are the flooring materials used by the respondents (Table 4.43). The ratio of 1: 1.33 between respondents living in homes constructed of smooth cement and ceramic tiles attests to many persons within the upper-lower to lower-middle-class strata in the project area. The 13.9% of respondents living in earth/sand/dirt/straw homes mirror the data for lack of access to potable water and those living in unroofed or thatched houses. It speaks to the number of vulnerable persons in the PACs

Table 4.43: Flooring materials of respondent houses in the project area

Material type	Obodougwa	Umuseti	Emu- ebendo	(%)
Earth/sand/dirt/straw	5.6	5.2	3.1	13.9
Ceramic Tiles	11	12.6	13.3	36.9
Smooth Cement	16.8	15	17.4	49.2

MCNL, Survey 2022

The study also correlated income levels, educational status and lifetime exposure to types of flooring materials used by respondents. The obtained data mirrors the NBS data for semi-urban areas in Nigeria, and the data also agrees with the reports of Terzi and Pauline, 2008.

4.8.7.5 Household Waste Management

4.8.7.5.1 Refuse disposal

The respondents in the project area get rid of their solid wastes by two means: open dumping and burning. Figure 4.7 shows the proportion of respondents in the two categories.

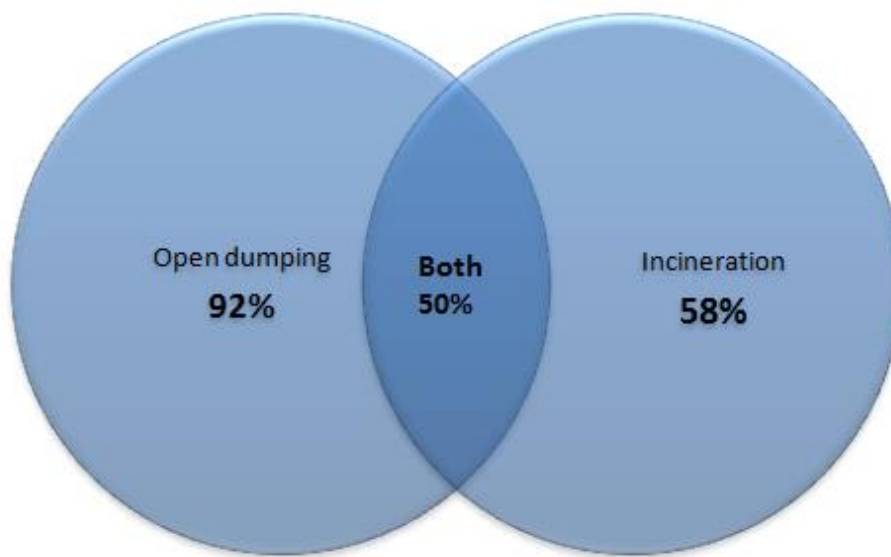


Figure 4.7: Refuse disposal methods by households

The prevalent refuse disposal method in the area is open dumping (92%). This indicates the unavailability of refuse disposing companies and if any exist, their inefficiency. This is followed by refuse incineration (58%) though some households practice both methods (50%). The high percentage of respondents practising the Open dumping system could have influenced the prevalence of environmental/public health diseases (See Health section) in the area and some mammalian, herpetofauna and raptors (see Biodiversity section) species censored in this study. Similarly, a percentage of 58 respondents incinerating their wastes speaks to an impending deterioration of air quality and a pointer to respiratory susceptibility. This finding also influenced the factoring of an awareness campaign into the ESMP design.

4.8.7.5.2 Sewage disposal

Water closet (WC), pit latrine and open defecation (Figure 4.8) are the three sewage disposal practices revealed for the study area.

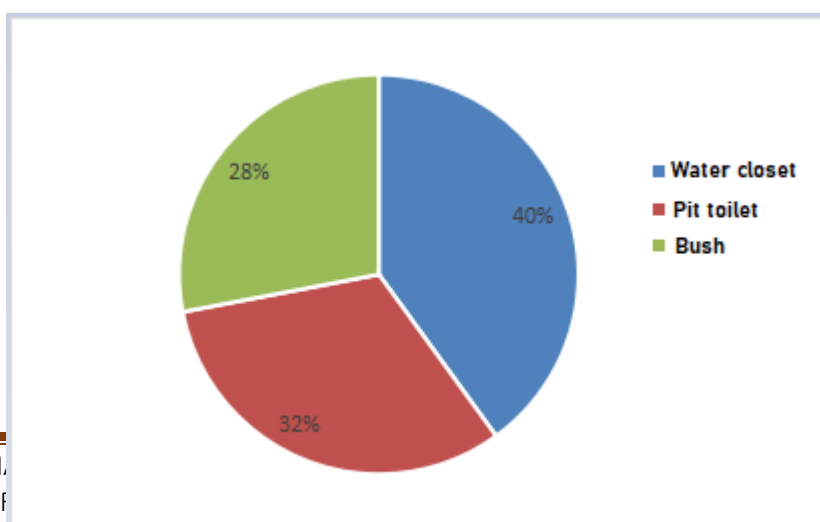


Figure 4.8: Sewage disposal methods by households

About 2:3 of the respondents use water closets and other sewage disposal methods. This data correlates linearly with housing construction materials (Table 4.41), social status, and to a lesser degree, educational backgrounds and, surprisingly, religious belief systems as about 75% of the ATR adherent respondents use either pit or bush. The greater percentage of respondents using WC resides in Umuseti, perhaps because it is a component of urbanised Kwale town. Vera and Christin, 2021 correlated open defecation practices to rural areas. The relatively high level of open defecation practice in the area may partly justify the presence of *E. coli* in the soil (see section 4.4.5.3).

4.8.7.6 Household Facilities

Several facilities were surveyed among households within the project's sphere of influence. These include power generators, televisions, cars/trucks and refrigerators. Table 4.44 provides the household facilities used by the respondent populations in the project area.

Table 4.44: % Household Facilities among Respondents

Facilities	Power generator	Gas/Kerosene stove	Refrigerator	Television	Radio/cassette/music system	Car/Truck	Motorcycle	Bicycle	House in town	Land in town
Obodougwa	8	17	4	10	20	7	17	10	2	10
Umuseti	13	22	15	22	30	10	10	4	5	14
Emu-ebendo	9	20	8	11	18	6	15	12	3	11

**N/B the percentage may exceed 100% as some respondents may possess more than one household facility

Source: MCNL, 2022

The finding that 30% of the respondents own a functional power generating set speaks to the erratic power supply in the area. It partly justifies the high deterioration of agro produce with short shelf life, as reported by the respondents. Regrettably, the use of these power generating sets to augment power supply from the national grid adversely (Greenhouse gases, noise, potential soil contamination, etc.) impacts the environment (this was factored in the project ESMP). The peoples' affinity for information is evident in the high usage of radio and television in the area.

Motorcycles and bicycles are the primary means of transportation among the respondents. The lower average percentage (14) of respondents who own lands and houses in town invariably speaks to the respondents' lower-level social cadre, implying the need for livelihood restoration/enhancement measures in the ESMP. More persons owning a kerosene/gas stove, motorcycle and generating sets reveal the people's reliance on DPK and PMS than AGO and LPG products.

Generally, the semi-urban nature of the Umuseti community within the Kwale metropolis could have accounted for an increased presence of household facilities than the other two communities.

4.8.8 Economics and Livelihoods of Households

4.8.8.1 Occupation

The host community's economic life revolves mainly around farming and trading, and the other livelihood activities among the respondents include artisans, firewood trading, food vending, and processing. Table 4.45 shows the percentage occupational distribution of the people.

Table 4.45: %Occupational distribution of respondents in the study area

Occupation	Aquaculture	Pastoralist	Self-employed	Private employee	Public employee	Farming and trading
Obodougwa	1.3	1.2	9	1.8	4.9	17
Umuseti	3.5	0.8	11	3	6.4	8
Emu- ebendo	1.2	0	8	4.2	3.7	15
Total (%)	6	2	28	9	15	40

Source: MCNL, 2022

The majority of the respondents in the project area depend on farm produce for their livelihood. The higher percentage of working respondents in Umuseti compared to the other two communities affirms the urbanised status of the community over the other two communities. The absence of a pastoralist respondent in Emu Ebendo may indicate either fewer numbers or daily diurnal movements out of the community. The open vegetation nature in the community enhanced by extensive farmlands may be preventing the herd's fertile loci for grazing. Conversely, the proximity of Ase creek to Umuseti may have influenced the prevalence of earthen ponds in aquaculture compared to the other communities.

4.8.8.2 Household Income levels

The income-generating activities of the people in the project area include crop farming, trading, artisanship, livestock rearing, civil service and self-employment. About 54% of the respondents in the area earn below N500, 000 per annum. In comparison, 46% earn above it, implying a respondent population (earning at the most, 2.8 USD per day) within the low-income strata of the society. The high percentage of income earners above 500,000 in Umuseti is probably owed to their urbanised area and the high number of businessmen and women in the community compared to the other two communities. Ismail, 2010 correlated

higher literacy levels and communities with diverse educational facilities to a proportionate higher income earner. Also, the respondents' greater percentage of low-income earners practice subsistent farming and blame aggregators, lack of storage facilities, inadequate credit facilities, and electricity load-sharing as limiting causal factors. Figure 4.9 presents the average daily income of the respondents in USD.

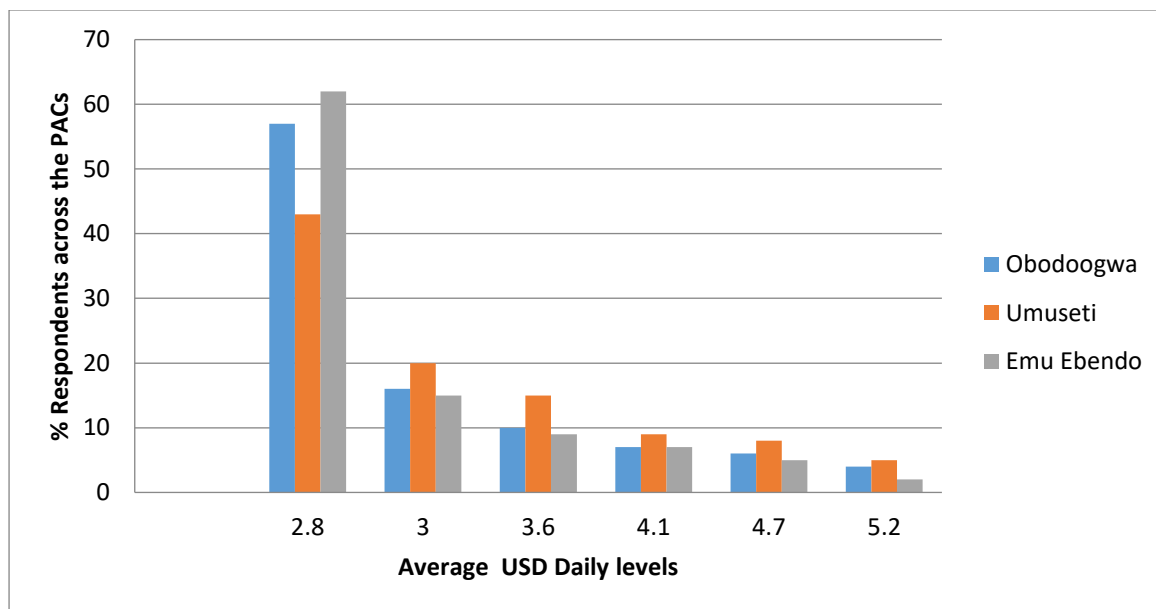


Fig. 4.9: Average daily income of the respondents in USD.

4.8.8.3 Constraints to Livelihood of Respondents

Table 4.46 presents constraints to livelihood in the project area.

Table 4.46: Constraints to Livelihood Activities in the project area

Constraints	Communities			Total	Rank
	Obodougwa	Umuseti	Emu-ebendo		
Insufficient land	0.3	0.23	0.27	0.8	11th
Poor Quality land	0.42	0.43	0.38	1.23	6th
Flooding	0.23	0.41	0.33	0.97	9th
Low water quality	0.4	0.45	0.44	1.29	4th
Lack of inputs	0.42	0.35	0.33	1.1	7th

Lack of capital	0.60	0.47	0.53	1.6	1st
Drying of River Ase	0.32	0.33	0.33	0.98	8th
Lack of storage facilities	0.45	0.62	0.45	1.52	2nd
Low processing capacity/power supply	0.42	0.48	0.38	1.28	5th
Inadequate extension	0.27	0.42	0.26	0.95	10th
Poor marketing channel	0.48	0.40	0.49	1.37	3rd

Source: MCNL 2022

Respondent household heads blame constraints on livelihood on mainly access to funds, lack of storage facilities and poor marketing channels. Others include; poor roads, absence of extension services, flooding, power supply, etc. These findings are unexpected in agrarian communities; however, they are consistent with NBS data 2012. These problems justify prioritising a SAPZ project over other alternatives in the area.

4.8.8.4 Access to the Project Site

Plate 4.22 presents some roads in the project area



a. Umuseti road b. Umusam road c. Emu- ebendo road d. Obodougwa road

Plate 4.22 a- d: Access roads to the project site

Transport facilities used in the area include motorcycles, light-duty vehicles, etc. (Table 4.43), with motorcycles the foremost. The communities are interlinked and served by minor paved or unpaved roads (Fig 4.22), including the dual carriage Asaba-Ughelli expressway.

4.8.8.5 Communication Facilities

The people in the project area have access to mobile communication through fixed wireless lines provided by communication service providers like MTN, GLO, AIRTEL and 9MOBILE. There are no postal services in the area, but the inhabitants obtain news via radio, television and other digital devices.



Plate 4.23: Telecom masts observed in the project area

4.8.8.6 Health

This section presents the baseline health data based on information generated from sampled groups in the study area. Data obtained were subsequently compared with state and National data and available averages.

4.8.8.6.1 Health Facilities

There are two functional health centres (Utagba- Uno Primary healthcare centre and Primary healthcare centre, OgboleOgume). Likewise, there are two defunct health facilities located in Obodougwa and Ogbole-Ogume (Plate 4.24). The grossly inadequate health facility poses grave concerns to the health status of people, as exemplified by the prevalence of Malaria, Fever, Upper Respiratory Tract Infection, Typhoid fever, Diarrhoea/vomiting and Eye ailments. The inadequacies in quality health care delivery and its absence in some other communities blossoms inevitably herbal homes and healers.



a. Functional health facility at Ogboleogume



b. Non-functional health facility at Obodougwa



c. Non-functional health facility at Ogbole-Ogume

Plate 4.24 a-c: Health facilities in the project area

4.8.8.6.2 Prevalence of Diseases in the Study Area

This study was conducted via a visit to the primary health facility, Ogboleogume community. It was revealed that the most prevalent diseases affecting all age groups in the project/study area are Malaria Fever (32.8%), Upper Respiratory Tract Infection (21.8%), and Typhoid Fever (11.7%), Diarrhoea/vomiting (10.5%) and Eye problems (7.5%). Other common ailments include Worm Infestation, Diabetes Mellitus, Lower Respiratory Tract Infection, and Arthritis. The prevalence of these diseases points to breeding grounds for the disease-carrying vectors. Recall that indiscriminate refuse disposal is prevalent in the area (Section 4.8.7.5.1; Fig 4.6), which serves as proliferation grounds for these vectors,

indicating a non-hygienic environment. This baseline data was factored into impact mitigation.

4.8.8.6.3 Traditional Medical Practice

The practise of traditional medicine is common in the area. Their practices involve herbs, body charms, body massaging and scarification. The services offered by these practices are shrouded in secrecy. Traditional birth attendants are popular. About 67% of respondents claimed they have either visited or are still visiting herbal homes for medical recipes and treatments such as that of Madam Chiekwene (Plate 4.25). The high patronage of traditional medicines could be attributed to inadequate medical centres.



Plate 4.25: Interview with a traditional medicine practitioner in Obodougwa community

4.8.8.6.4 Sexual Activities and Knowledge of Sexually Transmissible Infections (STI)

Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) have become a very important public health concern in Nigeria. However, there are no data on sexual practices, knowledge and beliefs about HIV/AIDS and other Sexually Transmissible Infections (STIs) in the study area. Therefore, several questions were included in this study to ascertain their awareness of these health problems. Both men and women were asked about their sexual practices. They were also asked about what they believed was the mode of transmission of HIV and where they sought treatment for STIs. Condom use and availability were also reported. Expectedly, the respondents did not disclose information on the number of sexual partners they keep.

4.8.8.6.5 Condom Availability and Use

Condoms serve as an excellent barrier to the transmission of HIV and other sexually transmissible infections. Respondents were asked about condom use. The data presented is

limited to those who have had sexual intercourse. Condoms were readily available in over 90% of the chemist stores. However, the average number used weekly could not be accurately verified. A survey across the project area indicated that overall, less than 30% of males and 35% of females aged above 15 years had never used a condom before, while over 20% of males and 30% of females claimed they used condoms only occasionally, mainly either for prevention of pregnancy or STI. Only less than 10% of sexually active males and 2% of females use a condom (i.e. during every episode of sexual intimacy).

4.8.8.6 Immunisation Status in Children

The proportion of children under five years old immunised against DPT, BCG, OPV, and Measles was 75%. This figure was above the national target of 70%. This is owed partly to the non-hygienic environment and dominant diseases in the area. Oral Polio Vaccine (OPV) was the most commonly received vaccine in the project community. This may partly be due to the OPV given during the National immunisation days (NIDs) set aside by the Federal Ministry of Health through the National Programme on Immunization every year. Each child below five years is expected to receive two drops of OPV during each round of NID. The poor record of immunisation indicates the poor routine immunisation practice.

4.8.8.7 Land planning and uses

Land ownership in the project area is either by community or family. However, under the Public Lands Acquisition Law, the state government may acquire land compulsorily for the public purpose from individual landowners subject to the payment of compensation to such landowners. Grazing activities are also practised in Obodougwa and Umuseti by the Fulani pastorals.

The residential areas and the surrounding sub-places consist primarily of single-unit residential homes surrounded by farmlands.

4.8.8.9 Cultural Heritage Resources

Several heritage sites in the project-affected communities, including a marked sacred grove. The sites (Plate 4.24) are at a minimum of about 65m from the project area, and table 4.47 presents the location of these sites.



Plate 4.26: Cultural Heritage sites in the project area

CHAPTER FIVE: ASSOCIATED AND POTENTIAL IMPACT

5.0 Introduction

This chapter provides information on the assessment of potential environmental and socio-economic deterioration of baseline conditions arising from the proposed project. It also presents the approach adopted for the mitigation of identified impacts. The chapter also outlines the approach for predicting any residual consequences after the application of mitigation measures. The short-term (preconstruction, construction and decommissioning phases) and the long-term (operational phase) were considered. Provision of the assessment methodology used in evaluating impact significance, considering the impact magnitude and sensitivity of receptors and resources affected, is also outlined.

Table 5.1 as part of the impact assessment process, presents the primary project activities (source of potential impacts) considered and the environmental and social aspects and receptors assessed for potential effects during the construction and operational phase of PPA and Associated Infrastructure project.

Table 5.1 Indicative project activities and environmental/social receptors assessed.

Aspect	Phases	Activities
Indicative project activities	Pre- Construction Phase	Land acquisition Consultation with PAPs, Vegetation clearance, Project planning, layout and design Transportation of men & materials
	Construction Phase	Transportation of men & construction materials, Establishment of a construction yard; Preparation of building foundations; Assembly of machinery and equipment for construction; Use of natural resources (water, energy sources); Construction of sheds, offices and other ancillary facilities; Construction of internal access roads; Construction of parking areas; Construction of wastewater treatment facilities Disposal of waste materials from construction activities and wastewater; Non-routine events (e.g. spills, traffic, accidents, occupational health & safety incidents).
	Operation Phase	Operation of the facility; Routine maintenance of the project area's shared facility Monitoring by relevant authorities

Aspect	Phases	Activities
	Decommissioning Phase	Building/Facility dismantling Dismantling of building Foundation Transportation/Waste management Restoration of the sites
Environmental indicators, resources or receptors considered in the impact assessment	Construction, Operations and Decommissioning	<p>Biophysical Environment:</p> <ul style="list-style-type: none"> • Air quality; • Noise, vibration; • Soils and geology; • Water resources; • Terrestrial and aquatic ecology. <p>Human Environment</p> <ul style="list-style-type: none"> • Visual amenities; • Community-level impacts; • Community health, safety and security; • Labour and working conditions; • Infrastructure; • Employment and economy; and • Cultural Heritage • Grievance Redress and Conflict Resolution • Gender Based Issues

For each of the above-mentioned environmental and socio-economic component, the associated potential impacts of project activities are identified and the significance of the impacts assessed.

Tables 5.6 to 5.36 presents the summary of all potential impacts with their significance

5.1 Impact Assessment Methodology

This section describes the overall approach used for the assessment of impacts. Topic-specific methodologies are described under each section of the impact assessment.

In general, the assessment of impacts will pass through an interactive process involving the following four key elements:

- Prediction of potential impacts and their magnitude (i.e., the consequences of the proposed project on the natural and social environment);
- Evaluation of the importance (or significance) of impacts taking the sensitivity of the environmental resources or human receptors into account;

- Development of mitigation measures to avoid, reduce or manage the impacts or enhancement measures to increase positive impacts; and assess significant residual impacts after applying mitigation and enhancement measures.
- Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are as low as reasonably practicable for the project.

5.2 Definition of Impact Terminologies

Nature/Type of impacts

There are several ways that impacts may be described and quantified. Table 5.2 provides definitions of terms used in this section.

Table 5.2: Definition of impacts

1	<p>NATURE OF IMPACT: An impact is essentially any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity.</p> <p>Negative – an impact that represents an adverse change from the baseline or introduces a new undesirable factor.</p> <p>Positive – an impact that represents an improvement to the baseline or introduces a new desirable factor.</p>
2	<p>TYPE OF IMPACT:</p> <p>Direct (or primary) – impacts that result from the direct interaction between planned project activity and the receiving environment.</p> <p>Secondary – impacts that result from the primary interaction between the Project and its environment because of subsequent interactions within the environment.</p> <p>Indirect – impacts that result from other activities that are encouraged to happen because of the Project.</p> <p>Cumulative-impact consists of an impact that is created as a result of the combination of the project evaluated in the EIA together with other projects</p>

	causing related impacts.
3	<p>TEMPORAL SCALE OF IMPACT:</p> <p>Temporary - impacts are predicted to be of short duration, reversible and intermittent/occasional. The receptor will return to a previous state when the impact ceases or after a period of recovery.</p> <p>Short-term - impacts that are predicted to last only for a limited period (i.e., during construction) but will cease on completion of the activity or because of mitigation measures and natural recovery (e.g., non-local construction workforce-local community interactions).</p> <p>Long-term - Impacts that will continue for the project's life but cease when the project stops operating (i.e. 50years or when there is improvement in technology that requires replacement). These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended period.</p>
4	<p>SPATIAL SCALE OF IMPACT:</p> <p>On-site – impacts that are limited to the Project site.</p> <p>Local - impacts that affect locally significant environmental resources or are restricted to a single (local) administrative area or a single community. For this ESIA, local impacts are limited to the Project site and its area of influence.</p> <p>Regional - impacts that affect regionally significant environmental resources or are experienced at a regional scale as determined by administrative boundaries.</p> <p>National - impacts that affect nationally significant environmental resources; affect an area that is nationally important /protected, or have macro-economic consequences (i.e. Nigeria).</p> <p>International - impacts that affect internationally essential resources such as areas protected by International Conventions.</p> <p>Trans boundary - impacts that are experienced in one country as a result of activities in another.</p>

5.2.1 Magnitude of Impact

The term 'magnitude' covers all the dimensions of the predicted impact on the natural and social environment, including:

- the nature of the change (what resource or receptor is affected and how);
- the spatial extent of the area impacted, or proportion of the population or community affected;
- its temporal extent (i.e. duration, frequency, reversibility); and
- where relevant (accidental or unplanned events),
- the probability of the impact occurring.

Table 5.1 provides the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment for biophysical impacts.

For social impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or losses access to or control over socio-economic resources resulting in a positive or negative effect on their well-being (a concept combining an individual's health, prosperity, their quality of life, and their satisfaction).

5.2.2 Sensitivity of resources and receptors

Sensitivities are defined as aspects of the natural or social environment that support and sustain people and nature. Once affected, their disruption could lead to a disturbance of the stability or the integrity of that environment.

For ecological impacts, sensitivity can be assigned as low, medium or high based on the conservation importance of habitats and species. For habitats these are based on naturalness, extent, rarity, fragility, diversity and importance as a community resource.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as a stakeholder's (or groups of stakeholders') resilience or capacity to cope with sudden changes or economic shocks'. The sensitivity of a resource is based on its quality and value/importance, for example, by its local, regional, national or international designation, its importance to the local or broader community, or its economic value.

5.2.3 Likelihood

Table 6.3 explains the terms used to define the likelihood of occurrence of an impact

Table 5.3: Explanation of terms used for the likelihood of occurrence

Definition of likelihood		
High probability	Refers to a very likely impact	Refers to very frequent impacts
Medium probability	Refers to a potential impact	Refers to occasional impacts
Low probability	Refers to an improbable impact	Refers to rare impacts

5.2.4 Impact Evaluation

The third stage in the assessment procedure involved the evaluation of the impacts identified to determine their significance. This was based on the methodological framework set by (ISO) 14001 – EMS and EMSP Aspects and Impacts – Determining Significance developed by the University of Bristol in 2015. The evaluation of impact significance was based on the following clearly defined criteria:

- Environmental Legislation and Policy
- Stakeholders’ Concern and Interest
- The severity of Environmental and Social Impacts
- Magnitude/Scale of Impacts
- Frequency of Occurrence of Impacts

Table 5.4 describes the criteria and rating adopted for the impact evaluation

Table 5.4: Impact Evaluation Criteria and Ratings

Consequence			
A	Environmental legislation and corporate Policy	Is there any legislation affecting the aspect?	Score
		The impact is covered by legislation & Policy	3
		The impact is covered by legislation	2

		The impact is covered by Policy	1
		The impact is not covered by legislation or Policy	0
B	Stakeholder concern/interest	What stakeholder concern or interest does the Stakeholder raise?	Score
		The impact raises considerable global, national and local interest or would have a seriously detrimental effect on the reputation of the client	3
		The impact raises some interest and may have some detrimental effect on the reputation of the client	1
		The impact raises no interest and would have no effect on the reputation of the client	0
		The impact raises some interest and may have some positive effect on the reputation of the client.	-1
		The impact raises global, national and local interest or would have a significant positive effect on the client's reputation.	-3
C	The severity of Environmental Impact	What is the severity of environmental impacts?	Score
		The impact has a moderate detrimental effect on the environment or a scarce, non-renewable resource. Long Term/ Irreversible Impact.	3
		The impact has a moderate detrimental effect on the environment or a scarce, non-renewable resource. Impact not reversible within a year.	2
		The impact has a minor detrimental effect on the environment and on scarce, non-renewable resource. Impact reversible within a month to a year.	1
		The impact has no known effect on the environment	0
		The impact has a minor positive effect on the environment and on scarce, non-renewable resource.	-1

		The impact has a moderately positive effect on the environment and on scarce, non-renewable resource.	-2
		The impact has a significant positive effect on the environment or a scarce, non-renewable resource.	-3
D	Scale of Impacts	What is the scale of the impact?	Score
		The negative impact occurs in high or large quantities	3
		The negative impact occurs in medium quantities	2
		The negative impact occurs in low or small quantities	1
		The positive impact occurs in low or small quantities.	-1
		The positive impact occurs in medium quantities.	-2
		The positive impact occurs in high or large quantities.	-3
Z	LIKELIHOOD (Frequency of occurrence)	How frequently does the impact occur?	Score
		The impact occurs daily	5
		The impact occurs weekly	4
		The impact occurs monthly	3
		The impact occurs on an annual basis	2
		The impact is unlikely to occur	1

5.2.5 Overall Significance Ranking

Following the evaluation of each impact using the criteria highlighted in Tables 5.1 to 5.4 above, the identified environmental impacts are categorized and scored according to Table 6.5a and the equation below. $\text{Consequence (A+ B + C + D) X Likelihood (Z) = Significance evaluation score}$

Table 5.5: Significance Level Categories

Impact Significance	Score
Low Negative Significance	1 – 25
Medium Negative Significance	26 – 50

High Negative Significance	> 50
Positive Significance	< -1

ISO, 1996

5.3 Residual Impact Assessment

Impact prediction considers any mitigation, control and operational management measures that are part of the project design and project plan. A residual impact is predicted to remain once mitigation measures have been designed into the intended activity. The residual effects that may remain after applying the impact mitigation measures have also been discussed for further reduction as possible.

5.4 Potential Impacts during initial preconstruction Phase

5.4.1 Impacts on Air Quality

Table 5.6 presents the assessment of potential impacts on air quality, sources and rating criteria

Table 5.6 Impacts on Ambient Air Quality during initial preconstruction Phase

Impact Statement	Sources of Impact	Impact on Ambient Air Quality	
		Impact criteria	Rating
A1: Reduction in ambient air quality	Site preparation (land clearing)	Legislature	3
		Stakeholder concern	3
A2: Contribution to global warming	Transport of materials to the site	Severity	2
		Scale	2
		Frequency	4
		Overall rating	40
		Impact Significance	Medium

A1: Vehicles transporting men and materials will generate PM, SO₂, CO, NO_x, CO₂ emissions. This activity is expected to add to baseline concentrations. This impact is rated Medium, and the implementation of mitigation measures will reduce the effect to a minor level.

A2: Vegetal removal during site clearance shall contribute to global warming as a sink for carbon sequestration will be lost. During transport, the operation of the vehicles and machine will also result in the emission of greenhouse gases such as methane and CO. This impact is rated Medium, and the implementation of mitigation measures shall reduce the impact to a minor level.

5.4.2 Impacts on Ambient Noise Level

Table 5.7 presents the assessment of the potential impact on noise, sources and rating criteria

Table 5.7 Assessment of impacts on ambient Noise quality during Initial Preconstruction Phase

Impact Statement	Sources of Impact	Impact on Noise	
		Impact criteria	Rating
NQ1: Increase in ambient noise level and Vibrations	Noise and vibration result from construction activities such as heavy machinery, concrete mixing plants, stone crushing, etc. Presence of workers on site Transport of materials to the site	Legislature	3
		Stakeholder concern	1
		Severity	2
		Scale	1
		Frequency	4
		Overall rating	35
		Impact Significance	Medium

The baseline noise levels were above the regulatory limit for schools, residential areas and churches; the project shall add to the baseline noise level during this phase, the impact is rated Medium. However, implementing mitigation measures shall reduce the impact to a **minor** level.

5.4.3 Impacts on Soil and Geology

Table 5.8 outlines the summary of the potential impact on soil and geology, sources and rating criteria

Table 5.8 Soil and Geology Impacts during Pre- construction Phase

Impact Statement	Sources of Impact	Impact on Soil and geology	
		Impact criteria	Rating
SQ1: Change in soil structure SQ2: Exposure of soil to erosion	Land clearing Transport of men and materials to the site Excavation, compaction, grading and disposal of waste	Legislature	2
		Stakeholder concern	1
		Severity	3
		Scale	1
		Frequency	5
		Overall rating	35
		Impact Significance	Medium

Impact Description

S1: land clearing, transportation of materials to the site shall likely cause a change in the soil structure, making it more compacted. This impact is rated Medium according to the criteria in Table 5.8

S2: Clearing of vegetation shall render soils vulnerable to both wind and water erosion. This impact is also rated Medium.

Implementation of mitigation measures will reduce both impacts to **Minor**.

5.4.4 Impacts on Water resources

Table 5.9 presents the potential impact on water resources, sources and rating criteria

Table 5.9 Impacts on Water Resources during Preconstruction Phase

Impact Statement	Sources of Impact	Impact on water resources	
		Impact criteria	Rating
W1: Potential surface and groundwater contamination	Operation and maintenance of pre-construction equipment/machines Vegetation clearance	Legislature	3
		Stakeholder concern	3
		Severity	3
W2: Potential groundwater contamination	Movement of vehicles in conveying men and materials	Scale	2
		Frequency	5
W3: Sedimentation of Streams and Rivers	Oil spills from equipment/machines	Overall rating	55
		Impact Significance	High

Impact Description

W1: Baseline surface water turbidity, COD, BOD, Nitrate and Phosphate level were above regulatory limits in all sampling points. The project activities will produce overburden which may be washed down by rain into nearby water bodies. This shall add to the baseline levels, which are currently above WHO regulatory limits

Vegetation clearing will increase the runoff rate into the Ase Creek, adding to the present turbidity levels. Also, runoff may accidentally deposit waste oil during machine/equipment repair and maintenance into the natural watercourses.

W2: Depending on the spill's magnitude, a vast accidental spill may seep into the groundwater and contaminate the water source. This shall lead to groundwater pollution; thus, rendering these waters unsafe for drinking.

W3: Clearance of existing vegetation will expose the upper layers of the soil horizon to soil erosion. The transport of eroded soil into surface water resources will impact water quality. The stockpiling of excavated earth and construction materials can result in runoff to the water bodies.

W1, W2, and W3: Overall, impacts resulting from sedimentation problems and groundwater/surface water and groundwater contamination problems are predicted to have a high significance. Implementation of mitigation actions shall reduce the impact to a medium level.

5.4.5 Impacts on Biodiversity

Table 5.10 describes the potential impact on biodiversity, sources and rating criteria

Table 5.10 Biodiversity Impacts during Preconstruction Phase

Impact Statement	Sources of Impact	Impact on biodiversity	
		Impact criteria	Rating
B1(A): Loss of threatened species and plants of important indigenous uses B1 (B): Habitat loss B1(C): Migration of fauna species as a result of noise and vibrations	(1) Vegetation clearing	Legislature	3
		Stakeholder concern	3
	(2) Transport of men & materials	Severity	2
		Scale	2
		frequency	5
		Overall rating	50
		Impact Significance	Medium

Impact description

It is estimated that a relative amount of vegetal biomass shall be cleared to establish this project. This will lead to species migration, loss of habitat and loss of Threatened flora species in the area. The baseline result showed that one flora species were of conservation interest (*Khaya*

ivorensis). Similarly, almost all the species inventoried in the study area were reviewed to offer provisioning services. However, considering the relative amount of vegetal quantity that would be cleared and the sensitivity of the habitats and the threatened plant species, implementing mitigation measures shall reduce these impacts to **minor** significance.

5.4.6 Impacts on Community Infrastructure, Socio-cultural and Health Status

Table 5.11 presents the potential impact on biodiversity, sources and rating.

Table 5.11 Impacts on Community Socio-cultural and Health Status

Impact Statement	Sources of Impact	Impact on Community Socio-cultural and Health Status	
		Impact criteria	Rating
SE1 (A): Risks and tensions between incoming expatriate and local workers SE1 (B): Violation of norm and culture by incoming workers SE1 (C): Increased incidences of communicable & non-communicable diseases SE1 (D) Pressure on existing social infrastructure	(1) Employment of pre-construction workers	Legislature	3
		Stakeholder concern	1
	(2) Influx of workers and marketers	Severity	2
		Scale	1
	(3) Vegetal clearance	frequency	4
		Overall rating	28
	(4) Movement of men and materials	Impact Significance	Medium

Impact Description

SE1 (A, B, C and D): The influx of preconstruction workers and marketers into the project area may increase disease incidence rates in the area. Most of these persons may be carriers of communicable diseases, and interaction with the locals may further spread the diseases. This impact is rated medium considering the duration of this phase, and the application of the mitigation measures shall reduce the effects to minor status. On the other hand, considering the quantity and nature of materials used during construction, transporting these materials to the site will increase the burden on existing roads in the project area. This shall indirectly affect roads

not also captured in the AoI since materials will be moved from other parts of the country to the project lay down area. Material transport is likely to cause a traffic logjam. This impact is of high significance. Implementing mitigation measures shall reduce this impact to a **minor** level.

5.4.7 Impacts on Traffic and Safety

Table 5.12 outlines the potential impact on Traffic and Safety, sources and rating criteria

Table 5.12 Impacts on Traffic and Safety

Impact Statement	Sources of Impact	Impact on Traffic and Safety	
		Impact criteria	Rating
TR1 (A): Risk of Accidents to locals TR1 (B): Traffic congestion	Transportation of materials on-site and wastes offsite.	Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	4
		Overall rating	48
		Impact Significance	Medium

TR1 (A&B): Increase in traffic during material, and personnel transport in the villages and the roads could also be a source of accidents. This impact is rated medium significance due to the duration of the project phase, and implementation of mitigation measures shall reduce the result to a Minor level.

5.4.8 Impacts on Employment and opportunities

Tables 5.13 presents the potential impact on Employment and opportunities, sources and rating criteria

Table 5.13 Impacts on Employment and Opportunities

Impact Statement	Sources of Impact	Impact on the impact on employment and opportunities	
SE1 (H) Employment	Material requirement and sales Vegetal clearance Transport of construction materials Employment of workers	Impact criteria	Rating
		Legislature	
		Stakeholder concern	
		Severity	
		Scale	
		Frequency	
		Overall rating	
		Impact Significance	Positive

SE1: Employment of casual un-skilled labour would occur for short-term contracts or the entire preconstruction phase. The main jobs that will be available are the vegetal clearance, sales and requirement of materials. Supplies will include raw materials that meet standards as required for the construction of the facilities. This is a positive impact and, as such, does not require mitigation.

5.5 Construction Phase Impacts

5.5.1 Impacts on Ambient Air Quality

Table 5.14 outlines the potential impact on Ambient Air Quality, sources and rating criteria

Table 5.14 Impacts on Ambient Air Quality

Impact Statement	Sources of Impact	Impact on Ambient air quality	
AQ2 (A): Reduction in ambient air quality	Operation of construction equipment	Impact criteria	Rating
		Legislature	3

Impact Statement	Sources of Impact	Impact on Ambient air quality	
AQ2 (B): Dust emission from land preparation and vehicle movements AQ2 (C) Impact on climate change	and machine	Stakeholder concern	3
	Transportation and traffic	Severity	3
		Scale	3
	Diesel powered generators	Frequency	5
		Overall rating	60
		Impact Significance	High

AQ2 (A): The vehicle movement for the construction will result in PM, SO₂, CO, NO_x, CO₂ emissions. It is noteworthy to mention that the quantity of emissions is dependent on the vehicle type, amount and conditions. Light-duty petrol vehicles not equipped with pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration and idling cycles. Frequent cycle changes characteristic of congested urban traffic patterns thus tends to increase pollutant emissions. At higher cruise speeds, hydrocarbon and CO emissions decrease, while NO_x and CO₂ emissions increase. Emissions from diesel-fuelled vehicles include particulate matter, NO_x, SO₂, CO, and hydrocarbons, most of which occur from the exhaust. Operating at higher air-fuel ratios (about 30:1 than 15:1 characteristic of petrol-fuelled vehicles with electronic fuel injection engines), diesel-powered vehicles tend to have low HC and CO emissions, despite having considerably higher particulate emissions.

Particulates emitted from diesel vehicles/ generators consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel-fuelled vehicles, the contribution of soot to particulate emissions is between 40% and 80%. The black smoke emanating from poorly maintained diesel-fuelled vehicles/ generators is caused by oxygen deficiency during the fuel combustion or expansion phase. Particulate emissions from petrol-driven vehicles are usually negligible. When they occur, such emissions will result from unburned lubricating oil and ash-forming fuel and oil additives.

The impact of emissions arising from vehicles and equipment associated with construction activities is considered high. The application of mitigation measures shall reduce the Medium impact level.

AQ2 (B) Dust emission from land preparation and vehicle movements

The dust emissions arising from the construction activities of the Project are a result of land preparation activities and vehicular movements. Dust emissions can impact the close receptors due to the physical appearance, deposition on the roof of the residential areas and creating a nuisance for the surrounding community. Removal of material usually occurs with a bulldozer, and cleared material is stored in piles for later use or during rehabilitation procedures. Fugitive dust is generated during the clearing of material and from wind-blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be caused during the transportation of the material, usually by truck, to the stockpiles. This dust can take the form of entrainment from the vehicle itself or dust blown from the back of the trucks during transportation.

The impact is rated high. However, implementation of mitigation measures shall reduce the impact to Medium.

AQ2 (C) Impact on climate change

A series of stages are involved in estimating the climate change impact. During the construction stage, the following activity is considered for climate change impact.

The process from material production:

GHG will be emitted from the manufacturing process of construction material as well as from the diesel powered generator. However, it is an indirect impact on the project but still necessarily considered part of the project's lifecycle. The assumption used for the GHG emission calculation on this item, based on the Global Emission Model of Integrated Systems (GEMIS) database. GHG will be emitted from material production as well as energy use in construction activity. GHG emission during the construction stage is short, and temporally, the impact on climate change is considered to be high. Implementation of mitigation measures will reduce effects to a Medium level.

5.5.2 Impacts on Ambient Noise Level

Table 5.15 presents the potential impact on Ambient Noise Level, sources and rating criteria

Table 5.15: Impacts on Ambient Noise Level

Impact Statement	Sources of Impact	Impact on Ambient noise level	
		Impact criteria	Rating
NQ2: Increase in ambient noise level	Operation of construction equipment and machine	Legislature	3
		Stakeholder concern	3
	Transportation (Vehicular Movement) and traffic	Severity	3
		Scale	3
	Presence of construction workers	Frequency	5
		Overall rating	60
		Impact Significance	High

NQ 2: During the construction phase, construction activities, traffic, and the use of construction equipment and machinery are likely to lead to a temporary increase in noise levels that may disturb adjoining areas and local fauna.

The project area is noise degraded. Baseline noise levels were above recommended threshold limit for all microclimates, including hospitals, churches and schools. The project shall add to the baseline noise level. The construction activity will be undertaken during the daytime. Construction activities will be concentrated and done sequentially so that no area is prone to the long duration of noise impacts. There will be some noise generated from tractors and trucks transporting the materials and equipment, but the traffic volumes are expected to be occasional.

Considering the construction activity schedule and nature of construction, the overall noise impact on nearby sensitive receptors with embedded controls in place will be of **high** significance; however, applying mitigation measures will reduce the effect to a **medium** level.

5.5.3 Impacts on Soil and Geology

Table 5.16 presents the potential impact on Soil and Geology, sources and rating criteria

Table 5.16 Impacts on Soil and Geology

Impact Statement	Sources of Impact	Impact on Soil and Geology	
		Impact criteria	Rating
SQ2 (A): Change to soil structure (erosion and compaction) SQ2 (B): Potential contamination of soil from accidental release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminum oxide paint, etc.	General construction works	Legislature	3
	Building of internal road networks	Stakeholder concern	3
	Excavation of drainages and residential quarters	Severity	1
		Scale	1
		Frequency	5
		Overall rating	40
		Impact Significance	Medium

SQ2 (A): During the construction phase, the main activities likely to affect soil structure and quality are digging foundation pits, constructing internal access road networks, and removing vegetation (for foundation purposes). Foundations will be dug up to variable depths, depending upon the building/structure type and soil characteristics. Vehicle movement around the project area can lead to soil compaction in those areas where soils are clayey or highly saturated. This

impact is rated medium and shall be reduced to Medium if the proffered mitigation measures are implemented.

SQ2 (B): Also, Soils can be contaminated during the construction phase by accidental oil/fuel spills from heavy machinery either at storage yards or work sites. In the event of an accidental spill, the proportion of soil contamination will depend on the magnitude of these unintentional events. A significant amount of solid waste (including wood, metal scraps, office and domestic wastes, etc.) will be generated in this project phase. The methods used to handle and dispose of these wastes to be generated play an essential role in the significance of impacts expected from waste management. Waste handling and disposal have been assessed to pose a medium impact on the environment. Application of specific mitigation measures such as de-compaction of soils following construction as well as avoiding construction activities during times when soils are saturated and preventing the storage of materials within these areas as well as the implementation of an Emergency Response Plan will help manage accidental spills properly will reduce the impact to a Medium level.

5.5.4 Impacts on Water Resources

Table 5.17 presents the potential impact on Water Resources, sources and rating criteria

Table 5.17 Impacts on Water Resources

Impact Statement	Sources of Impact	Impact on Water Resources	
		Impact criteria	Rating
WQ2 (A): Potential surface contamination	Operation and maintenance of construction machines and equipment	Legislature	3
		Stakeholder concern	1
WQ2 (B): change in hydrological flow regimes of surface water	Washing of workers and construction instruments	Severity	3
		Scale	1
WQ2 (C): Potential groundwater contamination	Surface water	Frequency	5
		Overall rating	40

Impact Statement	Sources of Impact	Impact on Water Resources	
of water resources	runoffs	Impact Significance	Medium

Sources of impacts on water resources include removing vegetation, vehicle movement, and contamination from potential spills.

WQ2 (A): Vegetation removal is not planned close to the Ase Creek as it's not within the project footprint. Nonetheless, vegetal clearance can increase soil erosion, causing sediment influx into the Ase Creek, especially during rain events. This shall likely add to the baseline surface water Turbidity levels above threshold limits. Poor waste management practices are likely to affect water quality (e.g. improper waste disposal in the stream). The risk of accidental oil spills from heavy machinery during the construction phase could result in the Ase Creek contamination.

WQ2 (B): Construction of internal road networks and vehicular movement along the construction sites can result in changes in hydrological flow regimes of watercourses. Depending on the level of disturbance, watercourses can be temporarily or permanently impaired. This impact is rated Medium considering the proximity of the Ase Creek (the only available surface water source within the project area). However, mitigation measures will reduce impacts on water resources to Minor.

WQ2 (C): Depending on the spill's magnitude, a huge accidental spill may seep into aquifer layers and contaminate the water source. This Impact is rated Medium, and the application of mitigation measure shall reduce the impact to Minor.

WQ2 (D): Water to be used for construction activities shall be sourced from the borehole. The impacts are rated Medium, and implementing the mitigation measures listed above shall reduce effects to Minor status.

5.5.5 Impacts on Biodiversity

Table 5.18 presents the potential impact on Biodiversity, sources and rating criteria

Table 5.18 Impacts on Biodiversity

Impact Statement	Sources of Impact	Impact on Biodiversity during construction	
B2(A): Further migration of fauna species as a result of construction noise B2 (B): Introduction of invasive and alien species	Construction of offices, internal roads and other ancillary facilities	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	2
	Transport and traffic	Severity	2
		Scale	2
		Frequency	5
		Overall rating	45
		Impact Significance	Medium

B2 (A): During construction, there shall be faunal disturbance within the project area. Sensitive ground-dwelling animals, especially from the mammalian and reptilian taxa, will further migrate during construction. This impact is short-termed and rated **medium**. The application of mitigation measures will reduce the effects to a **minor** level.

B2 (B): The possibility of creating fertile loci for alien and invasive flora species is being introduced to the area during material transport (sand, gravel). The proliferation of invasive species can have negative impacts on local species by outcompeting native taxa. Alien invasive species have the potential to modify wildlife habitat, which can impact associated fauna populations substantially. *Chromolaena odorata*, *Ageratum conizoides* and *Astystasia gangetica* listed as invasive to Nigeria and was censored in this study. This impact is rated **medium**. The application of mitigation measures will reduce the effects to a **minor** level.

5.5.6 Impacts on Community Health and Safety

Tables 5.19 presents the potential impact on Community Health and Safety, sources and rating criteria

Table 5.19 Impacts on Community Health and Safety

Impact Statement	Sources of Impact	Impact on Community Health and Safety	
		Impact criteria	Rating
(A): Risking tensions between outside (partly possibly expatriate and local worker (B): Violation of norm and culture by outsiders, workers and marketers (C): Increase incidences of communicable & non-communicable diseases	Employment of construction workers The temporary influx of persons to the communities	Legislature	3
		Stakeholder concern	1
		Severity	2
		Scale	1
		Frequency	5
		Overall rating	35
		Impact Significance	Medium

(A), (B): Potential socio-economic impacts are expected to arise from socio-cultural conflicts between the construction workforce and natives due to differences in belief systems. This may also lead to the violation of the existing traditional norms in the project area. These impacts are rated medium as the application of mitigation measures shall reduce the impact to a minor status

(C): Construction activities can create new malaria vector (mosquito) habitats due to the establishment of small pit lakes. An influx of workers with no or partial immunity to malaria parasite (*Plasmodium* sp) increases the risk of serious illness, resulting in death. This impact, if not managed, is expected to pose a significant characteristic. The influx of workers into the project area also increases the risks of Sexually Transmitted Diseases (STDs) and could adversely impact the spread of HIV/AIDS and other communicable diseases. If left unmanaged, this impact may result in long-term health issues that may eventually lead to fatality. The impact arising from this is ranked as a medium. Application of mitigation measures would reduce the impact to a Minor level.

5.5.7 Impacts on Socio-infrastructure

Table 5.20 is an assessment of Socio-economic impacts on the existing social infrastructure of the project that is expected to occur during the construction phase.

Table 5.20 Impacts on Socio-infrastructure

Impact Statement	Sources of Impact	Impact on Socio-infrastructure	
		Impact criteria	Rating
SE2 (D): Pressure on existing social infrastructure	An influx of workers	Legislature	2
		Stakeholder concern	2
		Severity	2
		Scale	2
		frequency	5
		Overall rating	40
		Impact Significance	Medium

5.5.8 Impacts on accidents and traffic congestion

Table 5.21 is an assessment of Socio-economic impacts on road accidents, kidnappings and traffic congestion.

Table 5.21 Impacts on accidents and traffic congestion

Impact Statement	Sources of Impact	Impact on accidents, kidnappings banditry and traffic congestion	
		Impact criteria	Rating
SE2 (E): Risk of	Transportation of	Impact criteria	Rating

Impact Statement	Sources of Impact	Impact on accidents, kidnappings banditry and traffic congestion	
road Accidents and Kidnapping SE2 (F): Traffic Congestion	materials onsite	Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	High

Construction and transportation activities will increase traffic congestion, risk of injuries, hostage and kidnapping, and damage to assets.

SE2 (E): Accidents arising from road trips (transport of materials and personnel) along mobilization routes may result in injury or loss of life of personnel and school children trekking to distant schools away from their communities, damage to company assets. This impact is rated with **high** significance, and implementation of mitigation measures shall cascade the impact to a **medium** level.

Tb1 (F): Transportation of men and materials for construction shall add to a traffic load of the area. This impact is rated **high**, and implementing mitigation measures listed shall reduce the result to a **medium** level.

5.5.9 Impacts on Employment and Opportunities

Tables 5.22 outlines the potential impact on employment and opportunities, sources and rating criteria

Table 5.22 Impacts on Employment and Opportunities

Impact Statement	Sources of Impact	Impact on the impact on employment and opportunities	
SE2 (G): Supply chain opportunities for Nigerian companies and locals that can provide goods and services needed by the company SE2 (H)Employment	Material requirement Employment of workers	Impact criteria	Rating
		Legislature	
		Stakeholder concern	
		Severity	
		Scale	
		Frequency	
		Overall rating	
		Impact Significance	Positive

SE2 (G), SE2 (H): Based on the results of the socio-economic assessment, the unemployment rate in the area is high. The locals are, however, optimistic about the possibility of job availability with the project. Any available jobs will positively impact the employment and income situation at the study area and the regional and national levels. The effect is beneficial. Employment of casual un-skilled labour would occur for short-term contracts or the entire construction phase. This could result in a positive spin off during the construction phase as any level of employment in this region of moderate unemployment, and low wage levels will have a beneficial social spinoff. The impact is beneficial. During the construction phase, there will be provision for sub-contracting to local supplies. Supplies will include raw materials that meet standards as required for the construction of the facilities. Equal opportunities will be given to sub-contractors from the host communities. This is a positive impact and, as such, does not require mitigation.

5.5.10 Visual Impacts

Table 5.23 presents the potential on Visual Impacts, sources, rating criteria and mitigation measures

Table 5.23 Assessment of Visual Impacts

Impact Statement	Sources of Impact	Impact on Visual Impacts	
		Impact criteria	Rating
VI 1: Visual effects	The presence of an active construction site	Legislature	2
		Stakeholder concern	1
		Severity	1
		Scale	1
		Frequency	5
		Overall rating	25
		Impact Significance	Low

VI 1: Aesthetic impacts during the construction phase will be limited to work zones. The area already has many existing facilities, the changes in the landscape are not likely to produce significant impacts in most areas. These areas are not known to have unique landscape values. Setting up of these facilities may create visual intrusion by altering the typical landform pattern. Domestic waste might be disposed to the construction area, creating a visual nuisance. Construction waste will be disposed of at sites approved by relevant waste management. The duration of the construction activity is short term in nature, and the area's sensitivity is also medium. Thus the impact is rated **medium**.

5.5.11 Impact on workplace Health and Safety

Tables 5.24 presents the summary of the potential impacts on workplace Health and Safety, sources and rating criteria

Table 5.24 Assessment of Impacts on workplace Health and Safety

Impact Statement	Sources of Impact	Impact on Workplace Health and Safety	
HS1: Risk of workplace accidents and hazards	Construction of internal road networks	Impact criteria	Rating
		Legislature	3
	Construction of offices and other facilities	Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	High

SHE risks can arise from various construction activities such as earthworks, operation, and movement of heavy equipment and vehicles, storage of hazardous materials, traffic, waste disposal etc. The probability of an accident occurring at the project site during the phases of the development is High. This is due to the intense use of machinery and other heavy-duty equipment used primarily in the construction phase. Work-related incidents and accidents resulting from trips, falling objects at heights during construction activities are likely to occur. Fire and explosions may be described as technological hazards, which can cause severe injury or result in loss of lives and damage to properties and the environment. Flammable substances, including diesel and motor oil, may be stored or used on the project site for heavy-duty equipment. These substances are precursors for fires and explosions. Envisaged impacts from accidental explosions resulting in a fire outbreak are ranked High. The land area to be cleared will be kept to the minimum necessary to sedimentation on River Ase courses. Where practicable, structures to provide natural attenuation shall be provided. Implementation of mitigation measures is likely to reduce the impact to a medium level.

5.6: Operation Phase Impacts

Table 5.25 presents the assessment of the potential impacts on air quality, sources and rating criteria

5.6.1 Impact on Air quality

Table 5.25 Impacts on Ambient Air Quality

Impact Statement	Sources of Impact	Impact on Ambient Noise level	
		Impact criteria	Rating
Reduction in ambient air quality	Gas emission from operating machines, equipment and vehicles	Legislature	3
		Stakeholder concern	3
Dust emission from land preparation and vehicle movements	Transportation of agro products for processing as well as processed products	Severity	3
		Scale	3
Impact on climate change	The odour from untreated wastewater effluents	Frequency	5
		Overall rating	60
		Impact Significance	High
	Release of Gaseous effluents from smoke stack		

Dust generated from the movement of company vehicles, including trucks, can cause a considerable nuisance to communities along the access road, within and around the processing zone and can cause health problems, including respiratory complaints/diseases.

Emissions from vehicles, equipment and machinery could cause adverse impacts on air quality affecting the health and welfare of workers. Also, odour from untreated wastewater effluents will impact the air quality negatively. The production of greenhouse gases from the exhaust emissions of vehicles and machinery would contribute negatively to climate change. However, implementing measures will reduce the residual impact to a medium level.

5.6.2 Impact on Ambient Noise level

Table 5.26 is an assessment of the potential impacts on Ambient Noise level, sources and rating criteria

Table 5.26 Impacts on Ambient Noise level

Impact Statement	Sources of Impact	Impact on Ambient Noise level	
		Impact criteria	Rating
NQ 3: Increase in ambient Noise level	Movement of vehicles	Legislature	3
	Presence of people in the facility	Stakeholder concern	3
		Severity	3
	Noise from operating machines/equipment	Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	High

Movement of vehicles, maintenance activities, and noise from operating machines and equipment will increase noise levels, disturbing neighbouring communities. Baseline data revealed high noise level exceeding the regulatory limit for all climate environments. Noise generating operations may cause adverse health effects on workers as well. Overall, noise-related impacts during the operation phase are ranked high considering the duration of the project phase. However, with mitigation measures, the effects on noise shall be reduced to a medium level.

5.6.3 Impact on Soil and Geology

Tables 5.27 is an assessment of the potential impacts on Soil and Geology, sources and rating criteria

Table 5.27 Impacts on Soil and Geology

Impact Statement	Sources of Impact	Impact on Soil and Geology during Operation	
<p>Potential contamination of soil from accidental release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, wastewater, etc.</p> <p>Soil compaction from the movement of vehicles conveying raw materials and the finished products</p>	Maintenance of shared facilities (roads, operating machines/equipment, effluent from wastewater facilities	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	2
		Severity	3
	Movement of vehicles	Scale	2
		frequency	3
		Overall rating	30
		Impact Significance	Medium

During the operation phase, oil leaks resulting from equipment breakdown or accidental spills from machinery used for maintenance purposes could lead to soil contamination. The movement of vehicles can also lead to soil compaction. During the construction phase, the risk of soil contamination due to leaks and accidental spills cannot be wholly discarded. This impact has been ranked medium. However, the application of management measures will help reduce this risk significantly to minor status.

5.6.4 Impact on Socio-economics

Table 5.28 presents the assessment of the potential impacts on Socio-economy, sources and rating criteria

Table 5.28 Impacts on Socio-economics

Impact Statement	Sources of Impact	Impact on Socio-economy	
SE3 (A): Development of new	Processing of agro products Transportation of raw	Impact criteria	Rating
		Legislature	

infrastructures or improvement to existing ones.	materials as well as finished products	Stakeholder concern	
		Severity	
		Scale	
		frequency	
		Overall rating	
		Impact Significance	Positive

The functionality of the agro-processing facility will result in the improvement of social services infrastructure in the area and a reduced cost of providing these services. The facility will offer supplying opportunities for skilled and unskilled PACs members; hence, the impact on infrastructure during operation and maintenance is Beneficial.

5.6.5 Impact on Community/Occupational Health, Safety and Security

Tables 5.29 presents the assessment of the potential impacts on Health, Safety and security, sources and rating criteria.

Table 5.29 Impacts on Health, Safety and security

Impact Statement	Sources of Impact	Impact on Health, Safety and security	
		Impact criteria	Rating
Health issues from exposure to noise, odour from wastewater effluents, potential attack from pests as a result of breeding sites for pest proliferation	Operation of the processing facility	Legislature	3
		Stakeholder concern	3
		Severity	3

Death and injury from accidents during transport of raw materials and finished products. Impacts during maintenance of shared facilities		Scale	1
		Frequency	5
		Overall rating	50
		Impact Significance	Medium

Health issues from exposure to noise, odour from wastewater effluents, potential attack from pests as a result of breeding sites for pest proliferation, death and injury from electrocution, accidents during transport of raw materials and finished products, impacts during maintenance of shared facilities and other work-related injuries could occur, mainly as workers may not be familiar with the operational methods and machinery. Implementation of mitigation measures shall reduce the impact to a medium level.

5.6.6 Impact on Waste

Tables 5.30 presents the assessment of the potential impacts on waste, sources and rating criteria

Table 5.30 Impacts on waste

Impact Statement	Sources of Impact	Impact on waste		
		Impact criteria	Rating	
Waste generation from different operations in the processing facility	Wastewater effluents	Legislature	3	
		Stakeholder concern	1	
	Solid wastes from processing activities	Severity	1	
		Scale	2	
		Spent/used oils	Frequency	5

		Overall rating	35
		Impact Significance	Medium

Improper management of waste may result in environmental and human health hazards such as pollution and disease. Improper managing of waste oils could result in soil contamination and contamination of groundwater and surface watercourses (through seepage and surface runoff).

5.6.7 Impact on Emergency Response and Disaster Management

Tables 5.31 outlines the assessment of the potential impacts on Emergency Response and Disaster Management, sources and rating criteria

Table 5.31 Impacts on Emergency Response and Disaster Management

Impact Statement	Sources of Impact	Impact on Emergency Response and Disaster Management	
		Impact criteria	Rating
Emergency Response and Disaster Management	Loss of life, injury, damage to equipment, fire outbreaks, building collapse	Legislature	3
		Stakeholder concern	1
		Severity	2
		Scale	2
		Frequency	5
		Overall rating	40
		Impact Significance	Medium

5.6.8 Positive Operational Impacts

Tables 5.32 outlines assessment of the potential positive impacts to be derived from the project, sources and rating criteria

Table 5.32 Positive Operational Impacts

Impact Statement	Sources of Impact	Impact on Emergency Response and Disaster Management	
		Impact criteria	Rating
Boost in export of our locally processed agro-products. Increase in export duties to the federation. Employment opportunities	Operation of the Agro processing facility	Legislature	
		Stakeholder concern	
		Severity	
		Scale	
		Frequency	
		Overall rating	
		Impact Significance	Positive

5.6.9 Impacts on Water Resources

Table 5.33 presents the potential impact on Water Resources, sources and rating criteria

Table 5.33 Impacts on Water Resources

Impact Statement	Sources of Impact	Impact on Water Resources	
		Impact criteria	Rating
Potential surface contamination	Operation of the agro processing	Legislature	3

Impact Statement	Sources of Impact	Impact on Water Resources	
Change in hydrological flow regimes of surface water Potential groundwater contamination Exploitation of water resources	facility Washing of workers and instruments Surface water runoffs	Stakeholder concern	3
		Severity	3
		Scale	2
		Frequency	5
		Overall rating	55
		Impact Significance	High

Sources of impacts on water resources include runoffs and contamination from potential spills.

Depending on the spill's magnitude, a huge accidental spill may seep into aquifer layers and contaminate the water source. This Impact is rated high, and the application of mitigation measure shall reduce the impact to Medium significance.

5.7: Decommissioning Phase Impacts

The decommissioning phase refers to all the activities related to the proposed processing area when it is no longer in use. During the decommissioning phase, the demolition activities are likely to have similar impacts on the environment identified for the construction phase. These include potential consequences such as sedimentation, surface water, visual impact, air and noise pollution, risk of fires and explosions, safety and security and traffic impacts etc. Impacts arising from decommissioning activities have been ranked with significance levels of Low to High.

Proper implementation of mitigation measures will reduce the effects to a Minor significance.

5.8 Cumulative Impacts

5.8.1 Defining Cumulative Impacts

In theory, any development such as the proposed project may be taking place simultaneously as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential outcome will be cumulative. According to the Performance Standard, cumulative impacts can be defined as impacts that:

"result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process are conducted."

Generally, Cumulative Impacts are considered to be impacts that act with impacts from other projects such that:

- The sum of the impacts is greater than the parts; or
- The sum of the effects reaches a threshold level such that the impact becomes significant.

The types of cumulative impacts that may be of relevance are detailed below:

- **Accumulative:** the overall effect of different types of impacts at the same location. An example would be fugitive dust emissions, construction noise and construction traffic, impacting the local communities as a nuisance/ disturbance.
- **Interactive:** where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important) (e.g. water abstraction from a watercourse might exacerbate the consequences caused by increased sediment loading).
- **Additive or In-combination:** where impacts from the primary activity (i.e. the construction and operation of the Project) are added to impacts from third-party activities, e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future).

5.8.2 Identification of Relevant Development(s)

The cumulative impact assessment focuses on the combined effects of the Project with potential future development in the immediate area around the Project site. The cumulative assessment

impacts the potential project in view, depending on the status of other projects and the level of data available to characterize the magnitude of the impacts.

Given the paucity of available information regarding such future developments, this assessment follows a generic pattern. It focuses on critical issues and sensitivities for this project and how these might be influenced by cumulative impacts with a combination of other developments. Consultations with local and state authorities and identification of relevant and significant developments via searches of relevant documents provided invaluable assistance in this assessment. The main developments identified are cumulative impacts from other projects within 2km SoI. Table 5.34 presents the list of cumulative impacts within the project area.

Table 5.34 Impacts on Water Resources within the Project Area

S/N	Existing facilities	Activities	Probable impacts
1.	Eme-Ebendo flow station	Oil processing	Pollution of soil, noise generation and air quality deterioration.
2.	Lagos Ogbe Primary school	Academic	Noise pollution
3.	Embik solace hotel and suite	Accommodation, feeding and other services	Noise and soil quality deterioration, contribution to traffic congestion
4.	Kwale-Umu-Ebendo road	Haulage	Air, noise and soil contamination
5.	The glory of His presence global church	Worship	Air, noise and soil contamination
6.	Umusadege road	Haulage	Air, noise and soil contamination
7.	Ebendo Secondary School, Emu-Ebendo	Academic	Air, noise and soil contamination
8.	Sophitera fashion school	Sowing	Air, noise and soil contamination
9.	Energia limited	Gas processing plant	Deterioration of air, noise and soil quality

10.	Ebendo market	Buying and selling of goods and services	Deterioration of air, noise and soil quality
11.	Xenergi oilfield limited	Gas processing plant	Deterioration of air, noise and soil quality
12.	Hotel Demesa	Accommodation, feeding and other services	

CHAPTER SIX: Mitigation Measures

6.1 Introduction

As presented in Chapter 5, the proposed Agro-industrial Park and associated project can impact the various components of the biophysical, health and social environment of the project area. The identified negative impacts have been ranked variously as High, Medium and Minor. To preserve the environment, several steps have been taken to mitigate the significant, medium ranking negative impacts and enhance those impacts identified as positive. The mitigation measures proffered for the predicted impacts of the proposed project activities took cognizance of the following:

- ✧ Environmental laws and regulations in Nigeria, with emphasis on permissible limits for waste streams (FMEnv (formerly FEPA), 1991);
- ✧ Best available Technology for Sustainable Development;
- ✧ Feasibility of application of the proposed mitigation measures;
- ✧ View and concerns of stakeholders as expressed during consultations carried out during the study.

The residual effects that may remain after applying the impact mitigation measures have also been discussed for further reduction of residual impacts to as low level as possible.

6.2 Mitigation Methodology

6.2.1 Definition of Mitigation Measures

Mitigation measures are developed to avoid, reduce, remedy or compensate for any adverse impacts identified and create or enhance positive impacts such as environmental and social benefits. For this project, the mitigation hierarchy used is **Minimisation** (reduction), as the probable project impact cannot be avoided. In this context, the term “mitigation measures” includes operational controls and management actions. These measures are often established through industry standards and may include:

- changes to the design of the project during the design process (e.g., changing the development approach);
- operational plans and procedures (e.g. waste management plans)

For impacts assessed to be of Major significance, a change in design or layout is usually required to avoid or reduce these. For impacts assessed to be of Moderate significance, specific mitigation measures such as engineering controls are usually required to reduce these impacts to As Low As Reasonably Practicable (ALARP) levels. This approach takes into account the technical and financial feasibility of mitigation measures. Impacts of Minor significance are usually managed through good industry practice, operational plans and procedures and negligible impacts require no mitigation action, other than those already included in the project design.

In developing mitigation measures, the first focus is on measures that will prevent or minimize impacts through the design and management of the project rather than on reinstatement and compensation measures.

6.2.2 Assessing Residual Impacts

Impact prediction considers any mitigation, control, and operational management measure part of the project design and plan. A residual impact is the impact that is predicted to remain once mitigation measures have been designed into the intended activity. The residual impacts are described in terms of their significance following the categories identified in Chapter 5.

Social, economic and biophysical impacts are inherently and inextricably interconnected, and change in any of these domains will lead to changes in the other domains. This section looks at how the local way of life might change due to the proposed Project. Potential changes to local culture, livelihoods, health and well-being, and personal and communal property rights are examined.

Table 6.1 Mitigation Measure (Preconstruction/Construction Phase)

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
Air quality/ Climate change	<p>Localised impairment of air quality by exhaust emissions from vehicles and equipment engines (SO₂, CO, NO_x, CO₂, PM)</p> <p>Elevated dust levels in nearby communities result from the dust raised by vehicle movements, wind, and handling of dusty material.</p> <p>GHG emissions and other noxious gases that could add to climate change effects</p>	Affected communities in the area of influence	High	<ul style="list-style-type: none"> - Maintain and operate all vehicles and equipment engines under manufacturers recommendations - Restrict clearance to project footprint - Dust minimisation measures shall be implemented, including watering the construction areas, including the road surfaces before construction. - Soil stockpiles and stores of friable material will be covered to reduce the potential for fugitive emissions of dust where possible. - Vehicles carrying friable materials will be enclosed or sheeted. - Loading, unloading and handling of dusty materials will only be carried out in designated areas. - Workers would be provided with dust protection PPE. <p>Effective preventative maintenance established to ensure all construction equipment is maintained in good working order not to produce an inordinate/excessive amount of exhaust emissions.</p> <p>Construction machinery will not be allowed to remain in idle mode over extended periods.</p>	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				Use ozone-depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane, and halogenated hydro Bromo fluorocarbons (HBFCs) will not be permitted.	
Noise and vibration	Nuisance noise from construction activities	Affected communities in the area of influence Construction workers	High	<p>A detailed noise control plan for relevant work practices shall be used to during health & safety briefings with construction staffs</p> <p>Select 'low noise' equipment or methods of work</p> <p>Restrict construction activities to day-time</p> <p>Avoid dropping materials from height, where practicable.</p> <p>Avoid metal-to-metal contact on equipment.</p> <p>Activities producing excessive noise levels will be restricted to the day-time, and equipment typically producing high levels of noise will be suppressed or screened when working within a distance of some 200 m from any sensitive noise receptors (particularly along access road alignments)</p>	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>Near places of worship, construction producing nuisance level noise be minimised or rescheduled so as not to occur on a locally recognised religious day. This is particularly relevant along the access road alignment.</p> <p>Work areas will be organised and operated to restrict noise levels not to exceed recommended thresholds at the nearest sensitive receptor during everyday activities. As current noise levels in and around the project area already exceed this threshold value, the project will strive not to cause more than a 3dB increase in measured ambient levels during normal activities.</p> <p>Advance notice will be given to communities if short-term noisy construction activities occur, which could cause these levels to be exceeded.</p> <p>Measures to minimise noise during construction will include:</p> <ul style="list-style-type: none"> • locating and orientating equipment to maximise the distance and to direct noise emissions away from sensitive areas; • using buildings, earthworks and material stockpiles as noise barriers where possible, and 	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<ul style="list-style-type: none"> • turning off equipment when not in use. <p>A preventative maintenance program established for equipment and vehicles to not emit excessive noise or vibration due to inadequate maintenance or damage</p> <p>Personnel will be made aware of the importance of minimising noise and the required measures in this regard.</p>	
Soils, geology and land-use	-Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation, etc	The soil on the construction site	High	<p>Construction of foundations to be undertaken in the dry season.</p> <p>Backfill foundation pits by the excavated soils, which will resemble the order of the original soil layers.</p> <p>Protect excavated soil materials from erosion.</p> <p>Ensure that the land is physically restored (include re-vegetation where possible) before the next rainy season.</p> <p>Accidental spills from machine maintenance shall be managed</p>	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>appropriately.</p> <p>Develop project-specific waste management plan and ensure proper implementation</p> <p>Provide adequate containers for waste collection</p> <p>Periodically audit contractor activities to check the level of compliance to regulatory waste management requirements.</p> <p>Ensure engagement of government-approved waste management contractors</p> <p>Safe operating practices are enforced during construction</p> <p>Slope stability measures will be incorporated, such as benching and installing erosion protection features such as silt barriers and sedimentation ponds.</p> <p>The land area to be cleared will be kept to the minimum necessary to prevent soil disturbance outside the streams. Other surface water bodies will be protected where practicable to provide natural attenuation of flows.</p> <p>In areas of ground clearance, topsoil will be stripped and salvaged as much as possible.</p>	
				<p>Implement adequate site drainage on the construction yard to allow for the directed flow of surface water off-site. This shall include cut-off drains to</p>	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<div> <p>divert surface runoff from exposed soils or construction areas.</p> <p>Install oil/water separators and silt traps before effluent leaves the site.</p> <p>Minimise bare ground and stockpiles to avoid silt runoff.</p> <p>Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).</p> <p>Remove all water accumulation within bunds using manually controlled positive lift pumps, not gravity drains.</p> <p>Regular checking and maintenance of all plant and equipment to minimise the risk of fuel or lubricant leakages.</p> <p>Training of relevant staff in safe storage and handling practices and rapid spill response and clean-up techniques.</p> <p>Set up and apply procedure regarding dealing with contaminated soils.</p> <p>Develop and implement a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly.</p> <p>Spreadsheet underneath the tower structure before starting any painting activity.</p> </div>	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
Water resources	<p>Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater</p> <p>The exploitation of water resources (e.g. casting of foundations) sourced from nearby water bodies through tanks.</p>	Local groundwater-well, borehole and Fete River	High	<p>Groundwater shall be used for construction in place of surface water.</p> <p>Rivers and streams shall not be dammed for water abstraction.</p> <p>Accidental spills from machine maintenance shall be managed appropriately.</p> <p>Continuous training of workers on HSE protocols</p> <p>Conducting daily safety briefings</p> <p>using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas</p> <p>Refuelling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies and provided with secondary containment measures.</p> <p>The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills/leaks and take necessary measures to prevent materials from falling into the river.</p> <p>Water for construction will be sourced from project boreholes.</p> <p>Water use will be monitored and recorded to maximise the efficiency of water use and minimise waste.</p> <p>Re-use of water will be undertaken where practical and safe.</p>	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
Terrestrial ecology	<p>Vegetation loss and disturbance to habitats, fauna and flora by construction activities</p> <p>Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread and loss of grazing fields for herds.</p> <p>Loss of species that offer Provisioning Services</p>	Flora and fauna and habitat in the area of influence	Medium	<p>Restrict construction activities, including vehicle movements and material storage in the project area</p> <p>Promote the use of existing access roads for machinery and vehicle movements</p> <p>Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control.</p> <p>Workers would be advised not to be killed in the unlikely event animals are encountered but instead caught and released into a similar environment.</p> <p>Vegetation clearing will be confined to the immediate construction site.</p>	Minor
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	Medium	<p>Develop a code of behaviours for workers</p> <p>All workers to receive training on community relations and code of behaviour.</p> <p>Employ workers majorly from host communities</p> <p>Management practices aimed at eliminating disease vector breeding sites.</p> <p>Awareness/health campaigns shall include other infectious diseases such as dysentery and cholera.</p> <p>Enhance ongoing consultations with local communities (with good</p>	Minor

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>representation) to create continuous dialogue, trust and planning of community development activities.</p> <p>Co-ordinate Stakeholder Engagement of all partners of the industrial site, prepare and implement Stakeholder Engagement Plan</p> <p>Develop a health plan to address potential health issues</p> <p>Initiate /enforce corporate health awareness programs for malaria, AIDS, etc.)</p> <p>Provide site medical personnel to attend to emergencies</p> <p>Engage the services of retainer clinics to manage health issues</p> <p>Educate workforce on the prevention of malaria as well as encourage the use of mosquito nets Ensure personnel use appropriate PPE</p> <p>Prepare and implement the emergency response plan.</p> <p>Ensure availability of first aid facilities onsite</p> <p>Provide information, education and communication about safe uses of water and occupational hygiene and safety</p> <p>Ensure Environmental Management for vector control and avoidance via settlement location</p> <p>Develop and implement safe food storage and handling practices</p>	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
Employment and economy	Creation of temporary jobs for residents and Nigerian nationals with skilled trades Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Residents of affected communities, Nigerian nationals, Nigerian companies and local SMEs	Positive	Prepare a local content plan to facilitate identifying and selecting qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities	Positive
Infrastructure	An influx of outside workers may pose additional pressure on social infrastructure, like medical costs, emergency services, water supply, solid waste management.	Affected communities in the area of influence	Medium	Co-ordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. Install proper and independent facilities at the construction site for water supply, sanitation, solid, liquid waste, medical services, fire-fighting equipment etc., so that pressure on community infrastructure is limited. Funding of local community projects to compensate for impacts.	Minor
Traffic congestion	Risk of road Accidents and Kidnapping Traffic Congestion	Workers and people in the affected communities	Medium	Implement a traffic safety plan including design of access point, signalisation, speed limits, training of drivers, use of traffic guards, procedures for the transport of oversized loads (e.g., engines), Maintain a log of traffic-related incidents, sensitisation of road users and people living close to the construction site. All vehicles are certified road/water worthy before being mobilised for work activities.	Minor

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>Compliance with all roads safety transport rules, including speed limits</p> <p>Competency training and certification of drivers before mobilisation.</p> <p>Limit movement to day time only.</p> <p>Setting and enforcing speed limits of 100km/hr (major roads) 40-60km/hr (built-up areas) and 10-30km/hr (construction sites);</p> <p>Consultation and good public relation with the stakeholder communities.</p> <p>Ensure government-approved security personnel is used on transport vehicles and boats when warranted</p> <p>Co-ordinate work activities to avoid heavy traffic periods</p> <p>Use warning signs and traffic wardens/directors.</p> <p>Ensure activities causing blockages at road crossings are carried out within the shortest time practicable.</p> <p>Develop appropriate strategies to minimise the need for transportation of supplies</p> <p>Ensure compliance with all applicable laws, such as maximum load restriction and speed limits</p> <p>Community consultations and meetings on the ongoing road works and related hazards will be held.</p> <p>Active sites will be sealed off from the public using reflective tapes and</p>	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>cones; where necessary, road diversions will be created.</p> <p>Road safety initiatives will be developed and implemented, including:</p> <p>Ensuring that only qualified (licenced) drivers operate machinery;</p> <p>Enforcing speed limits and traffic control measures in appropriate locations;</p> <p>Implementing road safety signage;</p> <p>Installing speed control devices such as governors on trucks.</p>	
Visual amenities	Visual effects	Project area	Medium	<p>Restore temporal work zones after construction</p> <p>Maintain orderliness in the work area</p> <p>Proper handling (treatment and disposal) of generated waste</p>	Minor
Workplace Health and Safety	Risk of workplace accidents and hazards	Workers at the construction site	High	<p>Develop project-specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training and certifications to be followed by all workers, including subcontractors. Especially slip-trip and fall hazards and electrocution need attention.</p> <p>A local hiring office (or offices) to be set up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.</p> <p>Periodic training of staff on workplace health and safety</p>	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>Make sure all personnel are qualified and certified for their relevant works.</p> <p>Make sure approved safe work procedures are provided and complied with at all times before commencement of work.</p> <p>Ensure SHE briefings, job hazards identification and controls, before the commencement of work activities</p> <p>Use of appropriate personal protective equipment (PPE), e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site</p> <p>Limit work activities to day-time only.</p> <p>Ensure availability of first aid facilities onsite</p> <p>Ensure retainer clinics are engaged and site medical personnel are available in case of accidents.</p> <p>Maintain a medical emergency response plan so that injured or ill persons can promptly access appropriate care.</p> <p>Ensure all fuel storage tanks are kept at safe distances from work areas</p> <p>Ensure storage areas are identified with caution signs.</p> <p>Educate workforce on risks associated with storage areas and prohibit activities (such as smoking) that can ignite storage tanks</p> <p>Designate no-smoking and smoke areas</p>	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures <i>(the proponent shall ensure the execution of the underlisted mitigation measures)</i>	post-mitigation Significance
				<p>Hold SHE meetings and talks on fire hazard</p> <p>design work area to internationally acceptable standards</p> <p>The contractor will be required to submit an OHS management plan.</p> <p>Workers will be provided with all the required PPE.</p> <p>Toolbox talks will be carried out daily on safe work practices and other OHS issues.</p>	
Waste	<p>Waste generation from maintenance from:</p> <ul style="list-style-type: none"> -land preparation -construction administrative block -construction of sheds and service facilities -construction of internal road network, -construction of drainages and residential quarters -Wastewater effluents -Spent/used oils 	Project site and surrounding area	Medium	<p>Where possible, wastes will be re-used or recycled.</p> <p>Burning of waste will not be permitted.</p> <p>All personnel will be trained in the appropriate management of waste.</p> <p>All disposable waste shall be disposed accordingly</p>	Minor
Emergency Response and Disaster Management	Loss of life, injury, damage to equipment, fire outbreaks, electrocution, fallen poles, lines and conductors	Workers and people within and around the project area	Medium	<ul style="list-style-type: none"> - Implementation of Emergency Response Plan - Awareness-raising among workers - Monitoring of potential situations leading to disaster. 	Minor

6.3 Decommissioning phase mitigation measures

Mitigation measures for impacts during decommissioning will be implemented in line with practices at the time of decommissioning. However, in addition to the mitigation measures for construction impacts, the following mitigation measures have been put in place for implications arising due to decommissioning process:

- Develop and implement a decommissioning plan in line with requirements at the time of decommissioning.
- Ensure that excavated and stockpiled soil material is stored and bermed on the higher-lying areas along with the site and not in any runoff channels where it is likely to cause erosion.
- Decommissioning activities should preferably occur during the dry season months to prevent soil erosion caused by heavy rains.
- Wet all unprotected cleared areas and stockpiles with water to suppress dust pollution. Institute noise control measures (e.g. regular equipment maintenance) throughout the decommissioning phase for all applicable activities.
- Take cognizance of peak traffic times and plan the transportation of decommissioned structures and personnel to avoid obstruction of local traffic by vehicles heavy machinery/trucks.
- The decommissioning contractor will have to develop a decommissioning security plan and implement its use.
- Ensure effective waste management from the cradle to the grave for all wastes generated during and after the decommissioning period.
- Enforce proper waste management policies in line with FMEnv standards and requirements at the time of decommissioning.
- Ensure use of roadworthy vehicles and equipment as well as skilled operators and drivers

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Introduction

This chapter provides the ESMP for the PPA and Associated facilities projects. Elements of this plan will be taken forward and incorporated into a comprehensive project Environmental and Social Management System (ESMS) that will be used to deliver the Project's HSE regulatory compliance objectives and other related commitments.

This ESMP is a delivery mechanism for environmental and social mitigation and enhancement measures made in the ESIA Report. The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. Therefore, the ESMP is a management tool used to ensure that undue or reasonably avoidable adverse impacts of initial preconstruction, construction, operation and decommissioning are prevented or reduced and that the positive benefits of the Projects are enhanced (Lochner, 2005).

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the AfDB ecological and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS). The ESMP is intended to cover those activities described in Chapter four of this EIA report; this includes project activities during the initial preconstruction, construction, operation (actions on the shared facilities) and decommissioning and will be subject to thorough reviews before the commencement of activities to ensure completeness. The ESMP does not include measures for actions related to equipment and facility fabrication being done off-site. It should be noted that this provides the outline requirements for environmental management. Provision will be made to update the outline ESMP once the detailed project design is complete and adapt the ESMP to relevant project stages as part of the overall ESMS.

The ESMP details the mitigation and enhancement measures the State Ministry of Agriculture and Natural Resources has committed to implement through the Project's life and includes desired outcomes, performance indicators, targets or acceptance criteria, monitoring and timing for actions and responsibilities. Suppose during the construction and operational phase; the impact is found to be higher than initially predicted. In that case, additional mitigation measures will need to be implemented to control, reduce or prevent such impact from occurring.

Therefore, the ESMP is a dynamic document that will need to be continuously updated and amended as necessary throughout the project life cycle to ensure that any negative impacts from the Project are prevented or reduced, and positive ones are enhanced. Any significant changes will need to be discussed with the Federal Ministry of Environment and the AfDB.

7.2 Objectives of the ESMP

The ESMP is needed as an implementation guiding tool to successfully manage the project's environmental and social performance throughout its lifecycle. It integrates social and ecological management with overall project engineering, procurement, construction, and operations. The ESMP is prepared to achieve the following objectives, to:

- promote environmental and social control in the project implementation in all phases;
- ensure that all relevant stakeholders are aware of their respective responsibility - promoter, contractors, regulators and other relevant agencies;
- incorporate environmental and social management into project design and operating procedures and activities;
- serve as an action plan for social and ecological management for the project;
- provide a framework for implementing environmental and social commitments (such as mitigation measures identified in the ESIA);
- prepare and maintain project ecological and social performance records for monitoring and evaluating performance monitoring, audits and non-compliance tracking.

7.3 Institutional Framework for Implementation of the ESMP

Responsibilities in implementing and monitoring the ESMP are shared between multiple stakeholders, including regulatory and concerned agencies, the AfDB-PIU, the Ministry, and the contractors. These are represented in Figure 7.1

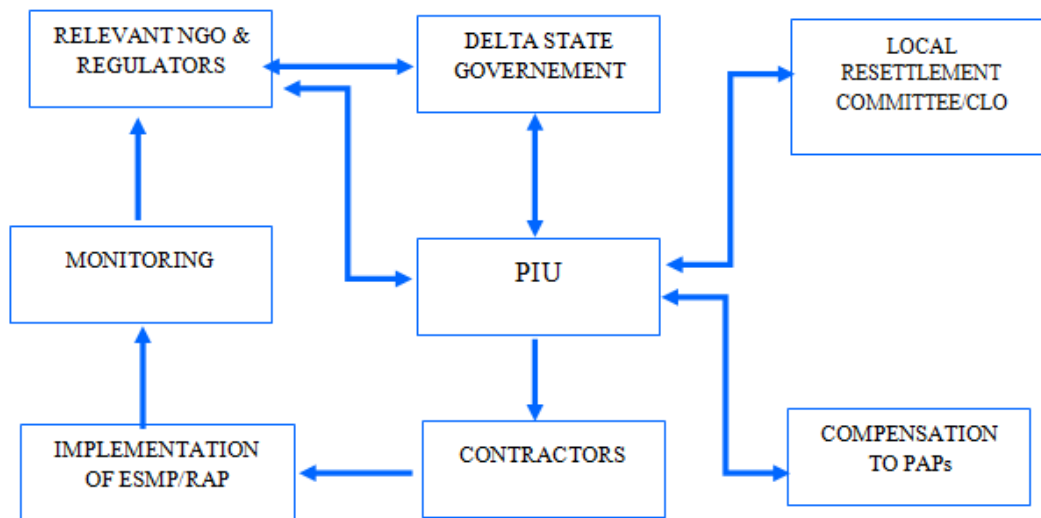


Figure 7.1 Institutional Arrangements for the implementation of ESMP for the project.

Figure 7.2 is the organogram for the Delta State Ministry of Agriculture and Natural Resources

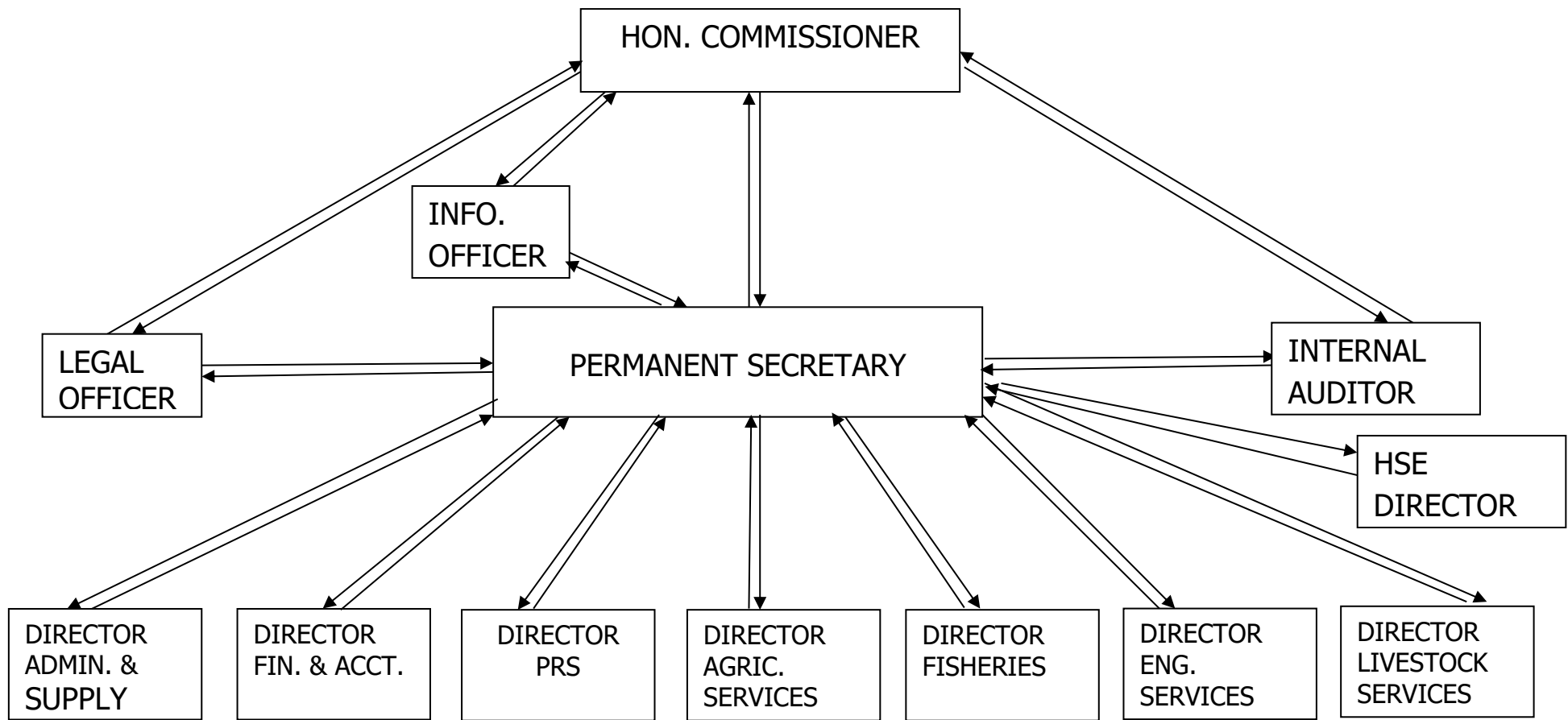


Figure 7.2 Organogram of Delta State Ministry of Agriculture and Natural Resources

Figure 7.3 presents the Organogram of the DSMANR-AfDB PIU

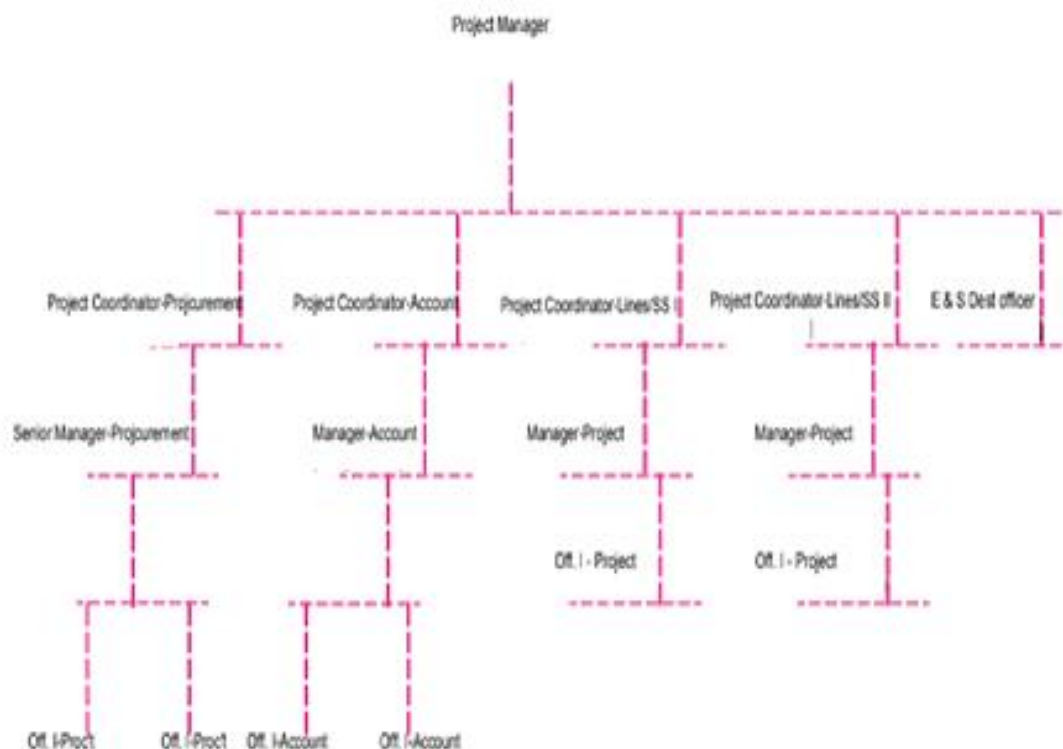


Fig 7.3: Organogram of the DSMANR-AfDB PIU (Roles are yet to be filled)

The key roles and responsibilities for the implementation of the ESMP are presented.

Overall:

- The Delta State Ministry of Agriculture and Natural Resources will have principal responsibility for all measures outlined in the ESMP for the construction phase.
- The Ministry is responsible for the implementation of the measures in the operation phase.
- Both may delegate responsibility to their contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, this is indicated in Tables 7.2 and 7.3
- Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.

The Project Implementation Unit (PIU) will manage the project.

The PIU shall hire and manage contractors; a witness NGO shall be accredited to monitor and evaluate the implementation of the ESMP to a certain extent. The contractors are responsible for the performance of the ESMP. Overall regulatory agencies at the National, State and Local Government levels are accountable for implementing ESMP.

7.3.1 Project Proponent (Delta State Ministry of Agriculture and Natural Resources)

The Ministry is the implementation agency for this project. Hence, it has the overall responsibility for its success. The Ministry Management has established the PIU for the proposed project to handle this responsibility. The PIU is headed by a Project Manager who reports to the Director, planning, research and statistics.

7.3.2 Project Implementation Unit (PIU)

The PIU set up by the Ministry-AfDB is saddled with the responsibility of project implementation. A Project Manager heads it. Members of the PIU consist of technical experts and environmental, social, and two liaison officers appointed drawn from relevant ministry departments, including HSE, Projects, procurement, planning, etc.

PIU is responsible for the overall project planning and execution, including preparing bidding documents, hiring project management consultants, EPC contractors, and supervising the works. This approach includes ensuring proper implementation of the environmental and social management measures contained in the ESMP and monitoring.

To provide additional oversight, the project PIU will retain the services of Mifor Consult Nig. Ltd. to manage the ESMP implementation. The PIU will also invite relevant NGOs to monitor and ensure the adequate performance of the ESMP.

7.3.3 The Ministry's HSE Department

The HSE department shall be responsible for ensuring the implementation of management measures during the operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulation to the operations.

7.3.4 Regulatory Agencies and Other Concerned Authorities

The Federal Ministry of Environment (FMEnv) is responsible for implementing the EIA Act 86 of 1992. Furthermore, State Ministry of Environment (Delta State) and the affected LGA

(Ndokwa West) has specific oversight roles, which they perform under the coordination of the FMEnv.

Table 7.1 presents the responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the proponent and the contractors.

Table 7.1: Project implementation unit (PIU), proponent and contractors

No	Steps/Activities	Responsibility	Collaboration	Service Provider
1.	Identification and siting of the project	PIU	<ul style="list-style-type: none"> State authorities 	Specialist Consultant
2.	<ul style="list-style-type: none"> Screening, categorization and identification of the required instrument (national EIA procedure) 	Env. safeguards specialist (ESS) and the PIU	<ul style="list-style-type: none"> beneficiary; local authority; Social Safeguards Specialist (SSS) on the PIU, FMEnv and AfDB 	Specialist Consultant
3.	Approval of the classification and the selected instrument by the Public EA Agency	PIE coordinator	<ul style="list-style-type: none"> ESS-PIU; SSS-PIU 	<ul style="list-style-type: none"> Public EA Agency (PEA-FMEnv) The Bank
4.	Preparation of the safeguard document/instrument (ESIA, Env. Audit, simple ESMP, etc.) following the national legislation/procedure (considering the Bank policies' requirements)			
	Preparation and approval of the ToRs	ESS-PIU		<ul style="list-style-type: none"> The Bank
	Preparation of the report		<ul style="list-style-type: none"> Procurement specialist (PS-PIU); SSS-PIU; Local authority 	<ul style="list-style-type: none"> Consultant
	Report validation and issuance		<ul style="list-style-type: none"> Procurement specialist (PS-PIU) 	<ul style="list-style-type: none"> Public EA Agency (PEA); The Bank

No	Steps/Activities	Responsible	Collaboration	Service Provider
	of the permit (when required)		PIU); SSS-PIU; Local authority	
	Disclosure of the document		Project Coordinator	• Media; The Bank; Supervising engineer; PEA
4.	(i) Integrating the construction phase mitigation measures and E&S clauses in the bidding document prior advertisement; (ii) ensuring that the constructor prepares his ESMP (C-ESMP), gets it approved and integrates the relevant measures in the works breakdown structure (WBS) or execution plan.	Technical staff in charge of the project (TS-PIU)	• ESS-PIU; PS-PIU	Procurement Specialist
5.	Implementation of the other safeguards measures, including environmental monitoring (when relevant) and public sensitization activities	ESS-PIU	• SSS-PIU, PS-PIU; TS-PIU; Financial Staff (FS-PIU); Local authority	• Consultant; National specialised laboratories; NGOs; State Ministries and Local Government Councils
6.	Oversight of safeguards implementation (internal)	SSES	• Monitoring and Evaluation Specialist (M&E-PIU); FS-PIU; State and Local Governments	• Control Firm (Supervisor)
	Reporting on project	Coordinat	• M&E-PIU ; ESS-	M&E specialist and

No	Steps/Activities	Responsible	Collaboration	Service Provider
	safeguards performance and disclosure	or	PIU ; SSS-PIU	Technical officer
	External oversight of the project safeguards compliance/performance.	FMEnv	• M&E-PIU ; ESS-PIU ; SSS-PIU; PS-PIU; Supervisor	Consultant
7.	Building stakeholders' capacity in safeguards management	ESS-PIU	• SSS-PIU; PS-PIU	<ul style="list-style-type: none"> • Consultant • NGOs • Other qualified public institutions • The Bank
8.	Independent evaluation of the safeguards performance (Audit)	ESS-PIU	• SSS-PIU; PS-PIU	• Consultant

*The Bank= AfDb

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

The Federal Government of Nigeria

Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the Country. It has the responsibility for ESIA implementation and approval under the EIA Act. It has developed specific guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures when the project commences. And it can issue directives to the project on specific actions related to the environment in the project area. The Ministry involves the States typically and sometimes local governments in this responsibility depending on the particular activity.

Delta State Ministry of Water Resources and Environment

The Environment department of the ministry manages both human and industrial waste, protect and conserve the environment as well as enforce laws on environment in the state.

Project Implementation Unit

Is a unit established by the proponent responsible for the end-to-end delivery of any SAPZ project in Delta State, including planning, feasibility, ESIA, engineering, procurement and construction (EPC). Furthermore, the PIU shall ensure:

- Proper implementation of the ESMP
- Supervise the EPC contractor in conjunction with the Owner Engineers in Project Department to ensure implementation of management measures.
- Implementation of community-approved projects financed through the EPC contractors.
- Production of monitoring reports to appropriate government authorities, Ministry of Agriculture and the contractor in charge of the project.

Delta State Ministry of Agriculture and Natural Resources

Delta State Ministry of Agriculture and Natural Resources is primarily responsible for planning, formulation, implementation and coordination of agricultural policies of the State. The Ministry is the implementation agency for this project. Hence, it has the overall responsibility for its success.

Delta State Environmental Protection Agency (DSEPA)

The agencies are responsible for preparing and updating periodic master plans for the development of environmental science and technology and advise the government of the financial and material required for the implementation of such programs; to establish a mechanism to predict ecological disasters; identify the problems of drainage and sewage systems and carry out measures to improve, protect and remedy their ecosystems, also protection and development of the environment and also ensuring a healthy environment.

Delta State Ministry of Trade and Investment

This ministry is responsible for creating a conducive environment for the promotion of Investment and development of Sustainable Industries and Trade, with a view to diversifying and growing the economy, creating wealth and employment, so that there is prosperity for all.

Delta State Ministry of Transport (DSMT)

The significant roles of the Ministry include;

- To formulate and implement effective policies regarding road transportation to ensure that adequate road safety measures are implemented across the State.
- To co-ordinate the creation of motor parks, identification and development of railways and river transportation.
- To ensure effective and efficient movement of goods and services that will enhance socio-economic growth throughout the states.

Delta State Ministry of Health/Women Affairs and Social Development (DSMH/WASD):

The responsibilities of the Ministries in the State are to facilitate efforts in providing micro credits to the disadvantaged women from donor agencies (UNICEF, UNFPA), strengthen the capacity of caregivers, OVC, NCOS, and CSO sensitise the women on the issues of child rights, HIV/AIDS, harmful traditional practices, initiate programs that promote the economic empowerment of women provide, decent health care delivery, in reducing maternal mortality and morbidity by collaborating with the Ministry of health and also strengthen the child's parliament through seminars exchange programmes, debates, radio/TV shows.

Delta State Ministry of Land Survey Housing and Urban Planning (DSMLSHUP)

The Ministry is vested with the authority of land administration. They are also charged with the survey of state lands, determination of land use and control, compensations, housing policies and urban development. The Ministry is also responsible for the supervision of the PIU, mapping and surveying, registration of title to lands, development and maintenance of open spaces.

Local Government Area (LGA)

The project is located at Ndokwa West LGA. This LGA is involved in the ESIA approval process. According to the national EIA requirement, the LGA will have representatives in the panel that will review the report and advise the Minister to make decisions on the project.

The Customary District Councils

The traditional head has an essential role in the project concerning mobilising the community members to support the project, grievance redress, peace and security of personnel, equipment, and facilities to be installed. Close contact and regular consultation shall be maintained with customary chiefs throughout the life of the project.

Witness NGO

To enhance transparency and trust from PACs, it is suggested that a witness NGO, recognised and credible in the project area, be retained, through a public proposal and selection process, to provide independent advice, and report on ESMP implementation and management, focusing on consultation activities, corporate social responsibilities/related activities and grievances management. This NGO could be a recognised and credible Human Right advocacy group or an NGO active in rural, environmental, social or development.

This outside look will ensure that proper procedure and stated ESMP processes are followed, that PACs grievances are well taken care of, and that PACs are treated with fairness. This model of supervision is consistent with best practice nationally and internationally. It will ensure that the process is fair and equitable with net positive benefits for the PACs. It also minimises grievances.

Contractor Environmental Manager

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU, will be responsible for daily management onsite and the respect of management measures from the ESMP. This manager will regularly report to the environment and social expert of the PIU during the entire construction period.

Contractors must hold all necessary licenses and permits before the work begins. It will occur to provide to the PIU all of the required legal documents, among which the signed agreements with owners, authorisations for borrow pits and temporary storage sites, etc.

Communities (Community Liaison Officers)

Leaders and traditional institutions of the affected communities will assist in public sensitization effort to advance the implementation of ESMP.

7.4 Communication

After the transfer of operation, the state government will maintain a formal communication procedure with the regulatory authorities and communities. The E & S Manager in the PIU is responsible for transmitting HSE issues to and from regulatory authorities whenever required. Meetings will be held, as needed, between the state government, the appropriate regulatory agency and community representatives to review ESMP implementation, health and safety issues and community relationships during implementation performance, areas of concern and emerging issues. Dealings will be transparent, and stakeholders will have access to personnel and information to address concerns raised.

The Project will develop and implement a grievance mechanism whereby community members can raise any issues of concern. Grievances may be verbal or written and usually either specific claims for damages/injury or complaints or suggestions about how the Project is being implemented. When a grievance has been brought to the Project team's attention, it will be logged and evaluated. The person or group with the grievance must present grounds for making a complaint or claiming loss to make a proper and informed evaluation.

Where a complaint or claim is considered valid, steps are required to be undertaken to rectify the issue or agree on compensation for the loss. In all cases, the decision made and the reason for the decision will be communicated to the relevant stakeholders and recorded. Where there remains disagreement on the outcome, an arbitration proceeding may be required to be overseen by a third party (e.g. government official). Local community stakeholders will be informed on how to implement the grievance procedures.

7.5 Documentation

The Ministry of Agriculture and Natural Resources for the operation phase will control HSE documentation, including management plans, associated procedures, checklists, forms, and reports. All records will be kept onsite and backed up at several off-site locations (including secure cloud storage facilities). Records will be held in both hard copy and soft copy formats. And all documents will be archived for the life of the project.

Furthermore, the document control procedure by the Ministry will describe the processes that the Project will employ for official communication of both hardcopy and electronic (through the internet) document deliverables. In addition, it will explain the requirement for electronic filing and posting and the assignment of document tracking and control numbers (including revision codes).

The E & S Manager of PIU is responsible for maintaining a master list of applicable HSE documents and ensuring that this list is communicated to the appropriate parties. The HSE Coordinator is responsible for providing notice to the affected parties of changes or revisions to documents, issuing revised copies, and checking that the information is communicated within that party's organisation appropriately.

The subcontractors will be required to develop a system for maintaining and controlling its HSE documentation and describe these systems in their respective HSE plans.

7.6 Operational Control Procedures

Each significant impact identified in the ESIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement, and record-keeping to avoid or reduce impacts. Operational controls are regularly monitored for compliance and effectiveness through a monitoring and auditing procedure described in the ESMP.

Operational control procedures will be reviewed and, where appropriate, amended to include instructions for planning and minimising impacts or reference relevant documents that address impact avoidance and mitigation.

7.6.1 Managing Changes to Project Activities

Changes in the Project may occur due to unanticipated situations. Adaptive changes may also occur during the final design, commissioning or even operations. The establishment of the project will implement a formal procedure to manage changes in the project that will apply to all project activities.

The procedure's objective is to ensure that the impact of changes on the health and safety of personnel, the environment and shared equipment are identified and assessed before changes are being implemented. The management of change procedure will ensure that:

- proposed changes have a sound technical, safety, environmental, and commercial justification;
- changes are reviewed by competent personnel, and the impact of changes is reflected in documentation, including operating procedures and drawings;
- hazards resulting from changes that alter the conditions assessed in the ESIA have been identified and evaluated, and the impact(s) of changes do not adversely affect the management of health, safety or the environment;
- changes are communicated to personnel who are provided with the necessary skills, via training, to implement changes effectively; and
- the appropriate Agriculture Ministry person(s) accepts the responsibility for the change.

As information regarding the uncertainties becomes available, the Project ESMP will be updated to include that information in subsequent revisions. Environmental and social, and engineering feasibility and cost considerations will be considered when choosing between possible alternatives.

7.6.2 Emergency Preparedness and Response

The Ministry of Agriculture and Natural Resources will prepare plans and procedures to identify the potential for and respond to environmental accidents and health and safety emergencies and prevent and mitigate potentially adverse ecological and social impacts that may be associated with them.

The Ministry will review emergency preparedness and response daily and after any accidents or emergencies to ensure that lessons learnt inform continuous improvement.

Emergency exercises will be undertaken regularly to confirm the adequacy of response strategies.

Investigations of accidents or incidents will follow formal documented procedures.

7.6.3 Checking and Corrective Actions

Checking includes inspections and monitoring and audit activities to confirm the proper implementation of checking systems and the effectiveness of mitigations. Corrective actions include response to out-of-control situations, non-compliances, and non-conformances. Measures also include those intended to improve performance.

7.6.4 Monitoring

Monitoring will be conducted to ensure compliance with regulatory requirements and evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the ESMP Tables 7.2 and 7.3

Monitoring methodologies or processes must be put in place to ensure the efficacy of the mitigation measures identified in the ESIA. Monitoring methodologies should be established to address the following:

- Alteration to the biological, chemical, physical, social and health characteristics of the recipient environment;
- Alterations in the interactions between project activities and environmental and social sensitivities, and interactions among the various sensitivities;
- Monitor the effectiveness of the mitigation and enhancement measures;
- Determination of long term and residual effects;
- Identification of Project-specific cumulative environmental and social effects, if applicable;
- The quarterly FMEnv monitoring shall be performed with the involvement of the communities. This joint monitoring will support good community relations by creating trust and involvement;
- At the construction site, inspections should be performed on human resources procedures, occupational health, safety and security risks management, emergency planning and the open water on malaria larvae; and
- The recruitment, human resources procedures, HSE training and awareness of the labour force in the construction as well as the operation phase should be monitored to know their origin in line with the local content plan and the level of knowledge and awareness on the code of conduct, STD prevention and occupational H&S measures.

The FMEnv guidelines require an environmental monitoring plan as part of an ESIA. The monitoring program aims to ensure that the negative environmental and social impacts identified in this ESIA are effectively mitigated in the construction and operation stages of the Project.

7.6.5 Auditing

Beyond the regular inspection and monitoring activities conducted, audits will be carried out by the state ministry to ensure compliance with regulatory requirements as well as their HSE standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff, and the results shall be reported to the state ministry of agriculture and natural resources to be addressed.

The audit will include a review of compliance with the requirements of the ESIA and ESMP and have, at a minimum, the following:

- completeness of HSE documentation, including planning documents and inspection records;
- conformance with monitoring requirements;
- efficacy of activities to address any non-conformance with monitoring requirements; and
- training activities and record keeping.

There will be a cycle of audits into specific areas of the project. The frequency of audits will be risk-based and will vary with the Project stage, and will depend on the results of previous audits.

A regulatory compliance audit is a mandatory requirement to be carried out by an independent accredited consultant every three years during the operation phase and the reports submitted to the Federal Ministry of Environment.

7.6.6 Corrective action

Investigating a 'near-miss or actual incident after it can be used to obtain valuable lessons and information that can be used to prevent similar or more severe occurrences in the future.

The Ministry will implement a formal non-compliance and corrective action tracking procedure to investigate the causes of and identify corrective actions to accidents or environmental or social non-compliances. This will ensure co-ordinated action from EPC Contractor and its subcontractors. The HSE coordinator will be responsible for keeping records of corrective actions and overseeing the modification of environmental or social

protection procedures or training programs to avoid repetition of non-conformances and non-compliances.

7.6.7 Reporting

Throughout the project, the proponent will keep the regulatory authorities informed of the project performance concerning HSE matters by way of written status reports and face-to-face meetings. They will prepare a report on environmental and social performance and submit it to FMEnv. The frequency of this reporting will be determined by FMEnv, in a letter of approval of the project. These reports are prepared as part of the requirements for impact mitigation monitoring carried out by FMEnv and DSMEnv.

If required, the Ministry will provide appropriate HSE-related activities, including internal inspection records, training records, and reports to the relevant authorities.

Subcontractors are also required to provide HSE performance reporting to the Ministry regularly through weekly and monthly reports. These will be used as inputs to the above.

7.7 Grievance Mechanisms

During the implementation of the ESMP, it is possible that disputes/disagreements between the project developer and the PACs will occur. There are significant challenges associated with grievance redress, especially in projects of this magnitude. A grievance procedure based on community grievance resolution channels and regulatory agencies shall be used.

7.7.1 Customary Mediation

All the communities affected by this project have internal mechanisms for resolving disputes through the customary chiefdoms. Such customary avenues should provide a first culturally appropriate grievance procedure to facilitate formal or informal grievance resolution.

The PIU shall set up a Customary Grievance Redress Committee in each community to address complaints. PAPA's complaints should first be lodged verbally or written in the grievance register through the customary chief, who in turn will invite the PIU. The PIU and the traditional leaders, and other Councils Chiefs will try to resolve the issue amicably. If the complaint cannot be resolved at this level or the plaintiff is not satisfied with the settlement proposed, the matter should be reported to the regulatory agencies.

7.7.2 Regulatory Agencies

FMEnv and DSMEnv have the statutory responsibility for oversight and monitoring the implementation of the ESMP. The agencies shall pronounce judgement on any environmental complaint or dispute reported to them based on regulatory requirements. At this stage, if the plaintiff is still not satisfied with the settlement, he/she can then proceed to the official legal procedures.

7.7.3 Courts of Law

The judicial process under applicable laws will be followed, and the law courts will pass binding judgment on the matter.

7.7.4 Grievance Resolution Procedures

The first level is the Village Chief and the PIU: The aggrieved person shall first report the matter to the Village Chief for resolution. Issues that can be resolved at this level include community quota, boundary issues, etc. The type of issues to report to the PIU for possible adjudication have perceived damage to property or means of livelihood, incorrect PAP data, infidelity to ESMP and corporate social responsibilities, etc. If the issue is not resolved at this stage, it can then be escalated to customary mediation. If still no acceptable resolution is achieved, the parties may choose to go to the regulatory agencies and, after that, to the court under the laws of the Federal Republic of Nigeria. Figure 7.3 illustrates the procedure for grievance resolution.

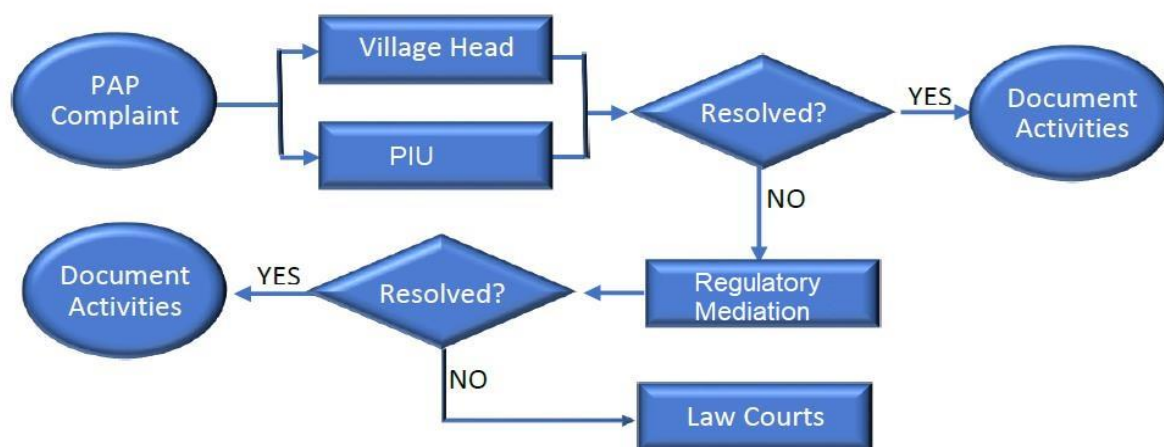


Figure 7.4: Grievance Resolution Procedures

7.8 Proposed Management Plan

The Environmental and Social mitigation/enhancement measures and the responsibilities for implementation are in Tables 7.2&7.3. The EPC contractor has responsibility for implementing the mitigation actions during the construction phase. The budget for implementation shall be included in the EPC contract as part of the overall construction cost.

The monitoring plan in Tables 7.4 and 7.5 contain details of responsibilities, parameters to be monitored. Monitoring methods and standards/targets as well as locations and monitoring frequency. The cost estimates cover costs of analyses of samples (where required), travelling expenses and regulatory costs. The budget for environmental and social monitoring during construction (Table 7.4) shall be added to the EPC contract budget. The EPC Contractor shall be required to disburse when needed, as may be directed by the Project Manager.

The budget for the monitoring during operations shall be provided by the Ministry's management in its annual budgeting process and administered directly by the appropriate authorities responsible for ensuring mitigation actions are implemented effectively. The Ministry shall adopt these measures and impose as contractual conditions on the up takers renting the sheds. Additional detailed policies and specific plans have been developed to support the implementation.

Table 7.2 Responsibilities for Implementation and Monitoring of Mitigation Measure (Preconstruction/Construction Phase)

Indicator	Potential impact	Receptor	Pre-mitigation Significance	Mitigation or enhancement measures	Post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality/ Climate change	Localised impairment of air quality by exhaust emissions from vehicles and equipment engines (SO ₂ , CO, NO _x , CO ₂ , PM) Elevated dust levels in nearby communities resulting from the dust raised	Affected communities in the area of influence	High	<ul style="list-style-type: none"> - Maintain and operate all vehicles and equipment engines under manufacturers recommendations - Restrict clearance to project footprint - Dust minimisation measures shall be implemented, including watering the construction areas, including the road surfaces before construction. - Soil stockpiles and stores of friable material will be covered to reduce the potential for fugitive emissions of dust 	Medium	EPC Contractor	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

	<p>by vehicle movements, wind, and handling of dusty material.</p> <p>GHG emissions that could add to climate change effects</p>			<p>where possible.</p> <ul style="list-style-type: none"> - Vehicles carrying friable materials will be enclosed or sheeted. - Loading, unloading and handling of dusty materials will only be carried out in designated areas. - Workers would be provided with dust protection PPE. <p>Effective preventative maintenance established to ensure all construction equipment is maintained in good working order not to produce an inordinate/excessive amount of exhaust emissions.</p> <p>Construction machinery will</p>				
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				<p>not be allowed to remain in idle mode over extended periods.</p> <p>Use of ozone-depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane, and halogenated hydro Bromo fluorocarbons (HBFCs) will not be permitted.</p>				
Noise, vibration & EMF	Nuisance noise from construction activities	Affected communities in the area of influence Construction workers	High	<p>Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings</p> <p>Select 'low noise' equipment or methods of work</p>	Medium	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

				<p>Restrict construction activities to day-time</p> <p>Avoid dropping materials from height, where practicable.</p> <p>Avoid metal-to-metal contact on equipment.</p> <p>Activities producing excessive noise levels will be restricted to the day-time, and equipment typically producing high levels of noise will be suppressed or screened when working within a distance of some 200 m from any sensitive noise receptors (particularly along access road alignments)</p> <p>Near places of worship,</p>				
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				<p>construction producing nuisance level noise be minimised or rescheduled so as not to occur on a locally recognised religious day. This is particularly relevant along the access road alignment.</p> <p>Work areas will be organised and operated to restrict noise levels not to exceed recommended thresholds at the nearest sensitive receptor during everyday activities. As current noise levels in and around the project area already exceed this threshold value, the project will strive not to cause more than a 3dB increase in measured ambient levels during normal activities.</p>				
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				<p>Advance notice will be given to communities if short-term noisy construction activities occur, which could cause these levels to be exceeded.</p> <p>Measures to minimise noise during construction will include:</p> <ul style="list-style-type: none"> • locating and orientating equipment to maximise the distance and to direct noise emissions away from sensitive areas; • using buildings, earthworks and material stockpiles as noise barriers where possible, and 				
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				<ul style="list-style-type: none"> • turning off equipment when not in use. <p>A preventative maintenance program established for equipment and vehicles to not emit excessive noise or vibration due to inadequate maintenance or damage</p> <p>Personnel will be made aware of the importance of minimising noise and the required measures in this regard.</p>				
Soils, geology and land-use	-Change to soil structure (erosion and compaction) as a result of excavation and	The soil on the construction site	Medium	<p>Construction of foundations to be undertaken in the dry season.</p> <p>Backfill foundation pits by the excavated soils, which will</p>	Minor	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

	backfilling and removal of vegetation, etc			<p>resemble the order of the original soil layers.</p> <p>Protect excavated soil materials from erosion.</p> <p>Ensure that the land is physically restored (include re-vegetation where possible) before the next rainy season.</p> <p>Accidental spills from machine maintenance shall be managed appropriately.</p> <p>Develop project-specific waste management plan and ensure proper implementation</p> <p>Provide adequate containers for waste collection</p>				
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				<p>Periodically audit contractor activities to check the level of compliance to regulatory waste management requirements.</p> <p>Ensure engagement of government-approved waste management contractors</p> <p>Safe operating practices are enforced during construction</p> <p>Slope stability measures will be incorporated, such as benching and installing erosion protection features such as silt barriers and sedimentation ponds.</p> <p>The land area to be cleared will be kept to the minimum</p>				
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				<p>necessary to prevent soil disturbance outside the streams. Other surface water bodies will be protected where practicable to provide natural attenuation of flows.</p> <p>In areas of ground clearance, topsoil will be stripped and salvaged as much as possible.</p>				
				<p>Implement adequate site drainage on the construction yard to allow for the directed flow of surface water off-site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas.</p> <p>Install oil/water separators and</p>				

				<p>silt traps before effluent leaves the site.</p> <p>Minimise bare ground and stockpiles to avoid silt runoff.</p> <p>Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).</p> <p>Remove all water accumulation within bunds using manually controlled positive lift pumps, not gravity drains.</p> <p>Regular checking and maintenance of all plant and equipment to minimise the risk of fuel or lubricant leakages.</p>				
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				<p>Training of relevant staff in safe storage and handling practices and rapid spill response and clean-up techniques.</p> <p>Set up and apply procedure regarding dealing with contaminated soils.</p> <p>Develop and implement a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly.</p> <p>Spreadsheet underneath the tower structure before starting any painting activity.</p>				
Water resources	Potential surface and groundwater	Local groundwater	Medium	Groundwater shall be used for construction in place of surface	Minor	EPC Contract	AfDB -PIU	FMENV, DSMEnv and

	<p>contamination from accidental spills and improper disposal of waste and wastewater</p> <p>The exploitation of water resources (e.g. casting of foundations) sourced from nearby water bodies through tanks.</p>	<p>r-well, borehole and Ase River</p>		<p>water.</p> <p>Rivers and streams shall not be dammed for water abstraction.</p> <p>Accidental spills from machine maintenance shall be managed appropriately.</p> <p>Continuous training of workers on HSE protocols</p> <p>Refuelling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies and provided with secondary containment measures.</p>		<p>or</p>		<p>Ndokwa West LGA Council</p>
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				<p>The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills/leaks and take necessary measures to prevent materials from falling into the river.</p> <p>Water for construction will be sourced from project boreholes.</p> <p>Water use will be monitored and recorded to maximise the efficiency of water use and minimise waste.</p> <p>Re-use of water will be undertaken where practical and safe.</p>				
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Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread and loss of grazing fields for herds. Loss of species	Flora and fauna and habitat in the area of influence	Medium	<p>Restrict construction activities, including vehicle movements and material storage in the project area</p> <p>Promote the use of existing access roads for machinery and vehicle movements</p> <p>Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control.</p> <p>Workers would be advised not to be killed in the unlikely event animals are encountered but instead caught and released into a similar environment.</p>	Minor			
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	that offer Provisioning Services			Vegetation clearing will be confined to the immediate construction site.				
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	Medium	Develop a code of behaviours for workers All workers to receive training on community relations and code of behaviour. Employ workers majorly from host communities	Minor	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

				<p>Management practices aimed at eliminating disease vector breeding sites.</p> <p>Awareness/health campaigns shall include other infectious diseases such as dysentery and cholera.</p> <p>Enhance ongoing consultations with local communities (with good representation) to create continuous dialogue, trust and planning of community development activities.</p> <p>Co-ordinate Stakeholder Engagement of all partners of the Agro processing site, prepare and implement Stakeholder Engagement Plan</p>				
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				<p>Develop a health plan to address potential health issues</p> <p>Initiate /enforce corporate health awareness programs for malaria, AIDS, etc.)</p> <p>Provide site medical personnel to attend to emergencies</p> <p>Engage the services of retainer clinics to manage health issues</p> <p>Educate workforce on the prevention of malaria as well as encourage the use of mosquito nets Ensure personnel use appropriate PPE</p> <p>Prepare and implement the</p>				
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				<p>emergency response plan.</p> <p>Ensure availability of first aid facilities onsite</p> <p>Provide information, education and communication about safe uses of water and occupational hygiene and safety</p> <p>Ensure Environmental Management for vector control and avoidance via settlement location</p> <p>Develop and implement safe food storage and handling practices</p>				
Employment and economy	Creation of temporary jobs for residents	Residents of affected communities	Positive	Prepare a local content plan to facilitate identifying and selecting qualified local and	Positive	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa

	and Nigerian nationals with skilled trades Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	s, Nigerian nationals, Nigerian companies and local SMEs		Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities				West LGA Council
Infrastructure	An influx of outside workers may pose additional pressure on social infrastructure, like medical costs, emergency	Affected communities in the area of influence	Medium	Co-ordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. Install proper and independent facilities at the construction site for water supply, sanitation, solid, liquid waste,	Minor	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

	services, water supply, solid waste management.			<p>medical services, fire-fighting equipment etc., so that pressure on community infrastructure is limited.</p> <p>Funding of local community projects to compensate for impacts.</p>				
Traffic congestion	<p>Risk of road Accidents and Kidnapping</p> <p>Traffic Congestion</p>	Workers and people in the affected communities	High	<p>Implement a traffic safety plan including design of access point, signalisation, speed limits, training of drivers, use of traffic guards, procedures for the transport of oversized loads (e.g., engines),</p> <p>Maintain a log of traffic-related incidents, sensitisation of road users and people living close to the construction site.</p>	Medium	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

				<p>All vehicles are certified road/water worthy before being mobilised for work activities.</p> <p>Compliance with all roads safety transport rules, including speed limits</p> <p>Competency training and certification of drivers before mobilisation.</p> <p>Limit movement to day time only.</p> <p>Setting and enforcing speed limits of 100km/hr (major roads) 40-60km/hr (built-up areas) and 10-30km/hr (construction sites);</p>				
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				<p>Consultation and good public relation with the stakeholder communities.</p> <p>Ensure government-approved security personnel is used on transport vehicles and boats when warranted</p> <p>Co-ordinate work activities to avoid heavy traffic periods</p> <p>Use warning signs and traffic wardens/directors.</p> <p>Ensure activities causing blockages at road crossings are carried out within the shortest time practicable.</p> <p>Develop appropriate strategies</p>				
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				<p>to minimise the need for transportation of supplies</p> <p>Ensure compliance with all applicable laws, such as maximum load restriction and speed limits</p> <p>Community consultations and meetings on the ongoing road works and related hazards will be held.</p> <p>Active sites will be sealed off from the public using reflective tapes and cones; where necessary, road diversions will be created.</p> <p>Road safety initiatives will be developed and implemented,</p>				
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				<p>including:</p> <p>Ensuring that only qualified (licenced) drivers operate vehicles, equipment and machineries;</p> <p>Enforcing speed limits and traffic control measures in appropriate locations;</p> <p>Implementing road safety signage;</p> <p>Installing speed control devices such as governors on trucks.</p>				
Visual amenities	Visual effects	Project area	Low	<p>Restore temporal work zones after construction</p> <p>Maintain orderliness in the work area</p> <p>Proper handling (treatment and disposal) of generated waste</p>	Negligible	EPC Contract or	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council

Workplace Health and Safety	Risk of workplace accidents and hazards	Workers at the construction site	High	<p>Develop project-specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training and certifications to be followed by all workers, including subcontractors. Especially slip-trip and fall hazards and electrocution need attention.</p> <p>A local hiring office (or offices) to be set up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.</p> <p>Periodic training of staff on workplace health and safety</p>	Medium	EPC Contractor	AfDB -PIU	FMENV, DSMEnv and Ndokwa West LGA Council
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				<p>Make sure all personnel are qualified and certified for their relevant works.</p> <p>Make sure approved safe work procedures are provided and complied with at all times before commencement of work.</p> <p>Ensure SHE briefings, job hazards identification and controls, before the commencement of work activities</p> <p>Use of appropriate personal protective equipment (PPE), e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site</p>				
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				<p>Limit work activities to day-time only.</p> <p>Ensure availability of first aid facilities onsite</p> <p>Ensure retainer clinics are engaged and site medical personnel are available in case of accidents.</p> <p>Maintain a medical emergency response plan so that injured or ill persons can promptly access appropriate care.</p> <p>Ensure all fuel storage tanks are kept at safe distances from work areas</p>				
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				<p>Ensure storage areas are identified with caution signs.</p> <p>Educate workforce on risks associated with storage areas and prohibit activities(such as smoking) that can ignite storage tanks</p> <p>Designate no-smoking and smoke areas</p> <p>Hold SHE meetings and talks on fire hazard</p> <p>design work area to internationally acceptable standards</p> <p>The contractor will be required to submit an OHS management plan.</p>				
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				<p>Workers will be provided with all the required PPE.</p> <p>Toolbox talks will be carried out daily on safe work practices and other OHS issues.</p>				
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Table 7.3 Responsibilities for Implementation and Monitoring of Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Exposure to emissions from vehicles (PM10, NO ₂ /NO _x , SO _x), Gaseous release from processing machines	Workers on-site, communities within the PPA's AOI	High	Dust minimisation measures shall be implemented, including watering of the access road. Speed limits will be	Medium	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA Council

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	<p>Odour from wastewater effluents and agro-processing processes</p> <p>Elevated dust levels in nearby communities as a result of dust raised by vehicle movements, wind, and handling of dusty material</p>			<p>implemented and enforced.</p> <p>Proper treatment of wastewater before releasing to the environment</p> <p>Effective preventative maintenance established to ensure all vehicles and machinery are maintained in good working order and do not adversely impact air quality due to inadequate care or damage.</p> <p>There are long term plans in place to implement renewable</p>				

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				energy generation options to reduce or eliminate dependence on fossil fuel generators; and Use ozone-depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane, and halogenated hydro Bromo fluorocarbons (HBFCs) shall not be permitted.				

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Noise and vibration	Noise from: processing activities emanating from the rented sheds; processing equipment; workers, sellers, vehicular movements, etc.	Affected communities	High	<p>Provision of noise protection PPE for use in noisy areas of the facility.</p> <p>Noisy machinery (e.g. generators) will be housed/ screened where possible to contain the sound to a limited area.</p> <p>Workers in noisy areas will not be allowed to work for more than 8hours at a time in the noisy environment.</p> <p>The use of PPE shall be fully</p>	Medium	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA Council

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				ensured				
Soils, geology and land-use	Potential contamination of soil from accidental release of hazardous or contaminating material, as well as from discharge of untreated wastewater effluents Compaction due to vehicular movement in conveying raw materials and finished products to	Soils around the Agro Processing Zone	Medium	Appropriate flow diversion and erosion control structures, i.e. earth embankments, shall be put in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc. Ensure safe operating practices are enforced during	Minor	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA Council

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	and from the Agro-processing facility, respectively.			<p>maintenance</p> <p>Implementation of the project-specific spill and Emergency Response Plan</p> <p>Ensure hydrocarbon/chemical spill containment and prevention measures and equipment are functional and effective on-site and for equipment and vehicles</p> <p>Double handling to be avoided where possible</p> <p>When a transfer has to take place, ensure it is effected inlined and secured areas</p>				

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				where containment is possible Educate personnel on hydrocarbon and chemical handling risks/hazards through SHE briefings/toolbox meetings				
Socioeconomics	Processing of agro products Transportation of raw materials as well as finished products	People within and outside the project affected communities	Positive	The impact is beneficial and shall be enhanced by sustaining the project through adequate and effective maintenance activities as well as complying with the federal government's policies and laws on agro-processing operations	Positive	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA Council

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Community/Occupational Health, Safety and Security	External safety risks of electrocutions, bush fires, shed/ building collapse, air/noise pollution, pest infestations resulting from processing activities, and work-related injuries occurring, particularly as workers may not be familiar with the operational methods and machinery.	Affected communities	Moderate	<ul style="list-style-type: none"> - Workers will be provided with all the required PPE. - Worker induction, followed by regular training on operational and safety issues, will be conducted throughout employment - Toolbox talks will be carried out daily on safe work practices and other OHS issues. - First aid facilities will be available in all work areas - Medical facilities will be available to all workers. <p>Ensure environmental</p>	Minor	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA Council

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				cleanliness of the agro-processing sheds				
Impact on economy and livelihood	Improved production of food and agro/agro-allied products	State/National level	Positive	Beneficial impacts and shall be enhanced by sustaining the project through adequate and effective maintenance activities as well as complying with the federal government's policies and laws on Special Agro-Processing operation	Positive	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA Council
Waste generation from different operations	Release of wastewater effluents Generation of solid wastes from processing activities	The PPAs and its surroundings	Medium	Waste bins will be provided in all facility areas to dispose of the various types of wastes generated by the project. These bins will be marked to	Minor	Prospective private investors	Delta State Government	FMENV, DSMEnv and Ndokwa West LGA

Indicator	Potential impact	Receptor	Significance (pre- mitigation)	Mitigation or enhancement measures	Significance (post- mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
in the processing facility	Spent/used oils			<p>facilitate waste segregation for collection, transportation and disposal.</p> <p>Separation of domestic and hazardous waste at the source shall be strictly enforced.</p> <p>Where possible, wastes will be reused or recycled.</p> <p>Burning of waste will not be permitted.</p> <p>All personnel will be trained in the appropriate management of waste</p>				Council

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				<p>according to the WMP.</p> <p>Wastewater effluents shall be appropriately treated before releasing them into the environment.</p> <p>Waste oils generated by the project (vehicles and machinery) will be collected and stored in sealed containers and arrangements made with companies who can use them in their operations or manage their disposal.</p>				
Emergency	Loss of life, injury, damage	In the PPA	Medium	-Implementation	of Minor	Prospective	Delta State	FMENV,

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Emergency Response and Disaster Management	to equipment, fire outbreaks, building collapse	facility		Emergency Response Plan - Awareness-raising among workers - Monitoring of potential situations leading to disaster.		private investors	Government	DSMEnv and Ndokwa West LGA Council

Table 7.4: Environmental and Social Monitoring Plan during Construction Phase

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN)
Air quality	SO ₂ , NO _x , CO ₂ , CO, VOC, PM	Visual inspection of construction sites, access roads; verification of equipment and machinery Ambient air quality measurements	Avoid significant degradation of baseline conditions. WHO and national ambient air quality standards, FMEnv standards	Project area and the surrounding environment	Monthly	AfDB - PIU	750,000
Noise & vibration	Noise Levels	Noise level measurements	Avoid significant degradation of baseline conditions. WHO and FMEnv noise standards	Project area and the surrounding environment	Monthly	AfDB - PIU	750,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN)
Soils integrity	Visual signs of contamination Status of drainages, bund walls, stockpiles, etc	Visual inspection of the construction site	Avoid the use of erosive processes or control them Reduce soil compaction Avoid soil profile structure destruction Avoid any soil contaminations	Soils in and around the SAPZ project area	Quarterly	AfDB - PIU	100,000
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Avoid significant degradation of baseline conditions. FMENV soil quality standards	Soils in and around the SAPZ project area	Quarterly	AfDB - PIU	
Water quality	Water Physico-chemical and	Analysis of surface and groundwater	Avoid significant degradation of baseline	Ase River	Twice a	AfDB -	

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN)
	microbiological -pH, temperature, TSS, turbidity, phosphorus, metals, sulphate, BOD, COD, coliform, fungi, etc.	samples Visual detection of pollution signs (presence of oil, waste, etc.)	conditions WHO and FMEnv water quality standards		year	PIU	800,000
Aquatic ecology	Same as water quality Fish catch yield	Visual inspection of rivers and streams Interview with fishermen	Avoid equipment and vehicle movements in rivers and streams.				

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN)
Vegetation integrity and Fauna protection	Vegetation cover Pictorial comparison (before and after) Fauna species, age, number of individuals sighted	Visual inspection of project sites and access roads	Avoid significant degradation outside the project footprint. Protection of flora species with conservation status Avoid habitat loss and disturbances for local fauna	Flora and Fauna community in the project area and surrounding areas	Once during vegetal clearance	AfDB - PIU	200,000
Visual amenities Land planning and use	Orderliness and cleanliness of sites disturbance outside project	Visual inspection of construction sites and access roads	Good housekeeping practice Site clearance activities to be restricted to the minimum required area. Provision of the predefined	Project site	Quarterly	AfDB - PIU	200,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN)
	footprint		route, barriers or boundary markings to prevent the incursion of machinery and workers into restricted areas				
Stakeholder relations Management	No complaints/concerns received Status of grievance resolutions	Interview affected communities Stakeholder meetings Inspection of complaints/grievance logbook	Grievances are resolved effectively Complaints and issues are addressed timely	Neighboring communities	Quarterly	AfDB - PIU	2,500,000
Grievance redress mechanism	No complaints/concerns received Status of grievance	Interview affected communities Stakeholder meetings Inspection of	Grievances are resolved effectively Complaints and issues are addressed timely	Neighboring communities	Quarterly	AfDB - PIU	550, 000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN)
	resolutions	complaints/grievance logbook					
Health, Safety and Security	Incidences	Inspection and review of incidence log	ILO requirements and Factories Act minimum labour standards	Construction site	Quarterly	AfDB - PIU	200,000
Employment and economy	Proportion of employees from the local communities materials procured from community members made in Nigeria materials used	Inspect employee records Random interview with workers on site Inspection of procurement records Interview with suppliers and vendors	Semi-skilled and non-skilled labour employed from the PACs Materials available in the communities are used Made in Nigeria products are utilised, except where not available	Construction site	Quarterly	AfDB - PIU	1,200,000

Table 7.5 Environmental and Social Monitoring Plan during Operations Phase

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Air quality	SO ₂ , NO _x , CO ₂ , CO, VOC, PM,	Visual inspection of substations and access roads; verification of equipment and machinery records Ambient air quality measurements	Avoid significant degradation of baseline conditions. WHO and national ambient air quality standards (FMEnv)	Project area	Bi-Annually	DSMEnv-HSE Dept	350,000
Noise quality	Noise Levels	Noise level measurements	Avoid significant degradation of baseline conditions. WHO and FMEnv noise standards	Project area	Bi-Annually	DSMEnv-HSE Dept	800,000
Soils	Visual signs of	Visual inspection of substation	Avoid the use of erosive	Soils in and around the	Bi-	DSMEnv-	1,200,0

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
integrity	contamination Status of drainages, bund walls, stockpiles, etc	sites and access roads	processes or control them Reduce soil compaction Avoid soil profile structure destruction Avoid any soil contaminations	project area	Annually	HSE Dept	00
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Avoid significant degradation of baseline conditions. FMEnv soil quality standards	Soils in and around the project area	Bi-Annually	DSMEnv-HSE Dept	
Stakeholder	Number of complaints/	Interview neighbouring communities	Grievances are resolved effectively	Neighboring communities	As need arises	DSMEnv-HSE Dept	2,500,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
relations Management	concerns received Status of grievance resolutions	Stakeholder meetings Inspection of complaints/grievance logbook	Complaints and issues are addressed timely			Dept	
Grievance Redress Mechanism	Number of complaints/ concerns received Status of grievance resolutions	Interview neighbouring communities Stakeholder meetings Inspection of complaints/grievance logbook	Grievances are resolved effectively Complaints and issues are addressed timely	Neighboring communities	As need arises	DSMEnv-HSE Dept	1,200,000
Health, Safety and Security	Incidences	Inspection and review of incidence log	No health incidents	Project area	Bi-Annually	DSMEnv-HSE Dept	380,000
Employment	Proportion of	Inspect employee records	Semi-skilled and non-	Project area	As need	DSMEnv-	500,00

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
ent and economy	employees from the local communities materials procured from community members made in Nigeria materials used	Random interview with workers Inspection of procurement records Interview with suppliers and vendors	skilled labour employed from the PACs Made in Nigeria products are utilised, except where not available ILO requirements and Factories Act minimum labour standards		arises	HSE Dept	0
Total Cost Estimate							

7.9 Management Sub-Plans/Programs

The ESIA study trigger development of specific management plans to wit;

- Air Quality Management Plan (AQMP)
- Waste Management Plan (WMP)
- Community Health and Safety Management Plan (CHSMP)
- Traffic/journey Management Plan (TMP)
- Construction management plan (CMP)

A Resettlement Action Plan (RAP) shall be conducted by the proponent upon confirmation that the project will result in Project Affected Persons (PAPs).

Each plan outlines developmental and implementable procedures as part of the overarching ESMS developed and implemented by the Ministry of Agriculture and Natural Resources, Delta State and the Contractor, as applicable.

Furthermore, the Contractor is required to develop and implement the following Construction triggered Management Plan:

- Soil and Erosion Management Plan;
- Update the Traffic Management Plan;
- Training and Skill Transfer Program;
- Worker's Health and Safety Management Plan;
- Rehabilitation and Re-vegetation Plan;
- Environmental and Social Code of Conduct;
- Contractors' GRM for Communities and Workers;
- Method Statements, including, but not limited to: erosion control, water crossing, work in heights, and others that the ESCMM may require

The Contractor will draft these specific management plans based on the requirements presented in this ESMP and submitted to the Ministry of Agriculture and Natural Resources for approval in consultation with AfDB before activity kick-off.

7.9.1 Air Quality and Climate Change Adaptive Management Program

Justification and Objectives

Generation of particulate matter and emission of GHG is expected across all phases of the project. When superimposed on the ambient condition, baseline levels above regulatory limits for some microenvironment are likely. This plan is aimed at controlling GHG emissions and PM generation across all the project phases. The 50year operational period before decommissioning makes it untenable to have included decommissioning in the Plan.

Legal Framework

Legislative safeguards for air quality in Nigeria are enshrined in FEPA 1999 and FMEnv 2004 document on regulatory limits.

Actions and Implementation Schedule

Tables 7.6 provide applicable control and actionable mitigation measures during the pre-construction, construction and operation phases to reduce GHG and PMs' emission footprint. It also provides in-built design systems to achieve emission reduction. Implementation of the spelt-out mitigation measures shall address GHG emissions and PM generation concerns.

Table 7.6: Air quality and climate change adaptation management program – actions, description and implementation schedule

Control and Mitigation Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	Movement of men and machinery shall be planned to avoid residential areas, hospitals and schools as	Preconstruction/ Construction phases	Contractor	HSE Dept DSMEnv

Control emissions of dust and pollutant gases	practicably possible			
	Schedule maintenance of machinery shall be strictly adhered to avoid the release of avoidable noxious gases. Scheduled daily equipment working hours, operator's training program and weekly safety briefings shall be factored in the internal monitoring system.	During the construction and operation phase	Contractor and uptakers	HSE Dept DSMEnv
	Minimisations of hauling distances by sourcing construction materials nearby as much as possible. An allowable 0.2- 0.4 m space is left unloaded for any construction materials carrying trucks.			
	Enforcement of speed limits where necessary.			
	Trucks carrying dusty materials needed to be adequately covered;			
	Stockpiles of granular materials need to be waterproofed, protected or sprinkled with water constantly.			
	Water use as dust suppressants shall be employed in every	Whenever need	Contractor	HSE Dept DSMEnv

	work front with unpaved surfaces twice per week in wet seasons and daily during dry seasons.	arises		
	The construction laydown area shall be sprinkled with water twice a week during wet seasons and daily during dry seasons.		Contractor	HSE Dept DSMEnv

Follow-up Monitoring on Mitigation effectiveness and Grievance Receipt

Air quality monitoring actions shall be developed in less than 1km to residential areas and 2km to hospitals and schools. Parameters to be measures are CO, CO₂, SOX, NOX and CH₄. A bi-weekly frequency monitoring is planned during construction and quarterly during the operation phase.

FMEnv Air sampling methods adopted in Chapter 6 (Result Interpretation)

Table 7.7 summarises the follow-up and monitoring actions and the implementation schedule.

Table 7.7 Air quality management program - follow-up and monitoring actions, description and implementation schedule

Follow-up or Monitoring Action	Description	Implementation schedule
Periodic air quality monitoring	Air quality monitoring stations shall be established at the defined threshold distances near three sensitive receptors, Homes, schools and hospitals.	Bi-weekly during construction and quarterly during operation

Air quality monitoring in response to complaints	<p>If complaints from the local population regarding air quality are registered,</p> <p>(i) Corrective actions for simple complaints such as the need for an additional or more frequent watering program for dust control, traffic speed issues shall be implemented ASAP and</p> <p>(ii) Air quality monitoring will be undertaken near the affected sensitive receptors to verify the ambient air quality levels and define additional mitigation if required.</p>	When necessary
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Corrective Actions

If the air quality values recorded exceed FMEnv regulatory limits, or if complaints from the local communities are lodged, causal factors for such elevated concentrations shall be identified and corrected. High concentrations typically result from failure to adhere to any or some of the mitigation measures listed in Tables 7.2 and 7.3.

In the event of non-compliance, additional mitigation measures shall be defined on a case by case basis ranging from a warning, verifiable shreds of evidence of vehicle having been serviced and increase frequency of training and safety briefings.

A monitoring campaign will be undertaken in areas where non-compliances were recorded to verify the resolution of the issue.

Reporting

Performance Indicators

Table 7.8 lists the performance indicators to be monitored for the Air Quality Management Program:

Table 7.8 Performance indicators for Air Quality Management Program

Indicator	Target	Trend
Number of TPM exceeded during periodic monitoring	<10% of monitored sites with recorded elevated concentrations above FMEnv standard	% of recorded TPM concentrations above FMEnv regulatory limits decreases bi-weekly
Concentrations of SOX, CO, CO ₂ , CH ₄ exceeds FMEnv regulatory limit during periodic monitoring	<10% of monitored sites should exceed FMEnv regulatory limits	% of recorded measured gases decreases bi-weekly
Number of community complaints regarding air quality	1 complaint per month per near sensitive receptor	Number of complaints decreases bi-weekly
Number of verification monitoring	Equal to the number of complaints	NA

Indicator	Target	Trend
campaigns in response to complaints		
Number of additional air quality mitigation measures undertaken in response to complaints	Equal to or greater than the number of complaints	NA

Note NA. – Not Applicable.

The performance indicators results shall be compiled quarterly

Reports

Table 7.9 summarises the documental records that will be kept to control the execution of this specific environmental management program. These documents will be prepared, archived and maintained by the PIU.

Table 7.9– Record Documents for the Air Quality Management Program

Document Title	Document Type	Frequency of Record or Report
Record of periodic air quality monitoring	Record	Quarterly
Record of air quality associated community complaints	Record	On occurrence
Record of air quality monitoring in response to complaints and mitigation responses	Record	On occurrence
Performance Report	Report	Quarterly

7.9.2 Waste Management Plan

Objectives

The purpose of this plan is to guide personnel and Contractors on the management of miscellaneous hazardous and non-hazardous waste generated during the Life of the project, particularly during construction and operation phases.

The waste management approach focuses on implementing the three "R"s (Reduce, Reuse and Recycle) as the Federal Ministry of Environment defines. Waste management comprises the collection, conditioning, transportation and deposition at a legally designated final place.

Adequate waste management is essential to prevent soil and water resources contamination. It is also vital to maintain workers and indigenes' community and occupational health by avoiding the proliferation of pests and diseases.

The present program considers the Nigerian and AfDB/Delta State Ministry of Agric EHS General Guidelines.

Scope and Responsibilities

These procedures apply to those units and their personnel involved in the management of hazardous and non-hazardous wastes. The Waste Management Plan applies to all pre-construction, construction and operation activities.

The responsibility for implementing the proposed waste management actions and procedures falls with the various contractors involved in the project's construction phase, which will need to use the guidelines provided in this plan to develop specific waste management procedures applicable to their activities. The Delta State Ministry of Agriculture is responsible for auditing the Contractors' activities to ensure that best practice waste management procedures are being followed.

Availability of Waste Disposal Facilities

The development of this plan and its upgrade by the Contractor took/shall consider the availability of waste facilities in Delta State.

Waste management in the project area is the responsibility of the Waste Management and Sanitation Board in Delta and the State Environmental Protection Agency. No public landfills exist in the Project area, rather many municipal waste sites.

Waste Management Actions

Table 7.10 below summarises the proposed waste management actions.

Table 7.10 – Waste management actions

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Prepare waste inventory	<p>Prepare an inventory of any hazardous and non-hazardous waste</p> <p>Classify the waste;</p> <p>Define sources, volumes and indicate the appropriate final destination for each type of waste, considering the region's specifications in question regarding the availability of waste treatment and disposal facilities.</p>	Pre-construction phase	Contractor	PIU

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Reduce waste production	<p>Working sites must be kept clean, neat and tidy at all times;</p> <p>Avoid leaving garbage unattended to avoid attracting pests and nocturnal carnivores;</p> <p>Implement daily cleaning routines to minimise waste;</p> <p>Promote the recycling and recovery of waste in coordination with municipal authorities</p> <p>Use materials that can be reused easily;</p> <p>List and estimate the volume of waste that can be reused, recycled or re-processed (example, wood scraps, soils, none used materials);</p> <p>Ensure that the quantities of materials on site are as accurate as possible to avoid surpluses resulting in waste.</p>	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv
Non-hazardous waste segregation	Provide specific colour coded containers of appropriate sizes (according to the expected waste volume) to place waste in different working areas. The segregation will be carried out as close as possible to the place of production. These shall	During construction and	Contractor and Delta State waste	PIU,

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	<p>ensure adequate hygiene and sealing conditions;</p> <p>Strictly prohibit littering with plastic or other wastes by all project personnel;</p> <p>Provide different containers for each type of waste that can be reused, recycled or re-processed. Containers will be identified according to their categorisation and classification;</p> <p>Waste segregation must be carried out accordingly, ensuring that waste does not exceed the top of containers;</p> <p>The containers must be constructed of an appropriate material to prevent leakage, clean and permanently closed;</p> <p>All produced waste will be sorted according to its type. Workers will initially do waste segregation;</p> <p>Produced waste will be removed daily and temporarily stored in Temporary Storage Facilities until transported to the final destination.</p>	<p>operation phases</p>	<p>management Agency</p>	<p>FMEnv</p>

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Temporary storage facilities for non-hazardous waste	<p>Non-hazardous waste must be temporarily stored, before the final destination, at only one designated area. This area must be duly delimited and signed ("Waste Storage Area"). The area should have a firm waterproof base protected from the ingress of stormwater from surrounding areas. It must also have an effective drainage system to an impervious spillage collection area, where any spillage can be recovered and suitably treated. This area must be restricted and should not be accessible to unauthorised persons. The containers should not be easily corrodible but rodent-resistant, insect-resistant and have handles at the sides and tight-fitting overlapping covers.</p> <p>Inert waste may be stored in the open without the need for a waterproofing floor in a designated and delimited area;</p> <p>Location of waste Temporary Storage Facilities must be at least 50m from watercourses and ground depressions;</p> <p>Maintain a good organisation of space and cleaning of waste storage areas;</p> <p>Waste materials that can be reused by the community, such as removed soil and</p>	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	stones, cut wood and other building materials, could be made available for pick up in an orderly fashion and with proper safety arrangements.			
	<p>Before transport, an FMEnv certified laboratory shall confirm it to be non-hazardous. If approved as non-hazardous, a waste manifest detailing content, volume, the generating company should be produced in duplicate and a copy handed to the driver. The transport of waste must be carried out in an appropriate vehicle, capable of containing the trash, and in good operating condition. These vehicles must be easily washable;</p> <p>Transfer operations of waste containers must be carried out safely: without compromising its segregation, and without causing leaks or spills and originating dust;</p> <p>The final destination and transport of waste are the responsibility of the Contractor;</p> <p>The final destination and transport of waste must be agreed upon and authorised by the State waste management authorities. The necessary licenses must be obtained;</p>	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Non-hazardous waste final destination	<p>Prohibit the burial or dump of any type of waste in an unauthorised location</p> <p>Use accredited waste vendors from affected states</p> <p>Prohibit waste incineration;</p> <p>Non-hazardous waste will be removed weekly;</p> <p>PIU and the Contractor will agree on and document the final disposal site for the waste, ensuring that it meets FMEnv, the Delta States and AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS) requirements, and will keep records of the delivery of the waste at such facilities.</p>			
Hazardous waste segregation	<p>Provide containers for the segregation of hazardous waste, ensuring that waste does not exceed the top of containers and have an appropriate size. Containers will be made of appropriate material so that their content does not damage them or permit toxic substances formation. They shall ensure adequate hygiene and sealing;</p> <p>Provide different colour coded containers for each type of hazardous waste to be produced.</p>	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	<p>Hazardous waste will not be mixed with other types of waste;</p> <p>Containers will be placed on wooden pallets or plastic pails;</p> <p>Maintain containers clean and permanently closed;</p> <p>All produced waste will be sorted and placed in the corresponding container.</p>			
<p>Temporary Storage Facilities for Hazardous waste</p>	<p>Hazardous waste will not be stored at the work fronts and must be transported daily to Temporary Storage Facilities built for this purpose or hired through a certified service provider;</p> <p>Hazardous waste must be temporarily stored, before the final destination, at only one designated area. This area must be duly delimited and signed ("Hazardous Waste Storage Area") as restricted access. The area must be roofed, adequately ventilated and have an impervious surface floor;</p> <p>Location of the Waste Temporary Storage Facilities must be away (100 m) from watercourses and ground depressions;</p> <p>No smoking will be allowed in the vicinity of a hazardous waste storage area. Place</p>	<p>During construction and operation phases</p>	<p>Contractor and Delta State waste management Agency</p>	<p>PIU, FMEnv</p>

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	<p>appropriate symbolic signage (No smoking, No naked light and danger);</p> <p>Provide extinguishers near the waste storage areas;</p> <p>Maintain a good organisation of space and cleaning of waste storage areas.</p>			
Transport of Hazardous Waste	<p>The transporting vehicle/medium within the generation site must be waterproof and of high mechanical stability. The vehicle must display the hazard sign, the remedial measures/first aid sign during accidental discharge, telephone number of contact person(s) to be boldly inscribed on the vehicle.</p> <p>The transport of hazardous waste within the facilities up to the storage location will be made, resorting to appropriate equipment or vehicles capable of containing the waste and in good operating conditions. These vehicles must be easily washable.</p> <p>The transport vehicle will be dully identified with signs for the transportation of hazardous material;</p> <p>Hazardous waste must be transported (internal transportation) in containers. The transport must have steel clamps for securing the containers and guarantee safe</p>	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
	<p>transport;</p> <p>Hazardous waste transport can be evacuated from the designated site by entities licensed by appropriate authorities.</p> <p>When the hazardous waste is collected, a manifest, in four copies, will be completed, indicating the quantities, quality and destination of the collected waste; one copy is kept by the waste generating entity, another copy is maintained by the waste transporting entity, the third copy is kept by the entity receiving the product and the fourth copy is sent to the Delta State Environmental Protection Agency (DSEPA).</p> <p>Provide the workers responsible for handling hazardous waste with adequate PPE (workwear, gloves, boots, and masks).</p>			
Hazardous Waste Final Destination	The final disposal of hazardous waste will be made at an infrastructure licensed by DSEPA for storage, treatment or final disposal of hazardous waste. Whenever possible, enforcement of the buyback policy with the suppliers should be invoked.	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Workers training	<p>Workers must be briefed on the behavioural aspect of waste reduction. The use of disposable products (such as plates or plastic or paper cups, products with excessive packaging) will be limited as much as possible, and the use of reusable products will be promoted;</p> <p>Workers must be trained on the classification, correct sorting and handling of waste;</p> <p>Workers responsible for hazardous waste handling must be trained on the classification, correct sorting, handling and transport of hazardous waste. Workers must be briefed on the use of personal protection equipment.</p>	During construction and operation phases	Contractor and Delta State waste management Agency	PIU, FMEnv

Follow-up Actions

Table 7.11 summarises the follow-up or systematic or periodic verification actions proposed for waste management.

Table 7.11 – Waste Management Follow-up Actions

Follow-up or verification action	Description
Inspection of the waste storage areas	Perform daily visual inspections of the hazardous and non-hazardous waste storage areas to verify if the existing containers are adequate to the volume of waste produced and the correct waste sorting and conditioning is being carried out. Also, ensure zero spill processes is continually in place and that any accidental spill is promptly contained and clean-up operations instituted immediately. Verify the integrity of the containers and other environmental control systems/equipment.
Inspection of working areas	Perform daily visual assessment of work areas for organisational sanctity and site cleanliness
Verification of final disposal sites	Undertake annual due diligence visits to the final disposal sites to confirm that final elimination is in compliant with applicable Delta State Ministry of Agriculture and Natural Resources, FMEnv and AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS)

Remedial Actions

Table 7.12 summarises the corrective actions and their implementation schedule.

Table 7.12 – Waste Management Plan - corrective actions, description and implementation schedule

Corrective Actions	Description	Implementation Schedule
Spill mitigation actions	Removal of substances accumulated in the spill containment trays sinks; Repair or change the damaged container that leaks.	When applicable
Response to complaints	In response to workers or community complaints about odours or pest's proliferation, increase waste collection frequency.	When applicable
Corrective action for improper waste storage	Provide or increase the quantities of proper containers in the storage areas where waste increases are evident. Increase the frequency of waste collection.	When applicable
Corrective action for littering and illegal dumping	Increase awareness about waste management.	When applicable

Performance and Reporting

Table 7.13 lists the performance indicators to be monitored for the Waste Management Plan.

Table 7.13 – Performance indicators for Waste Management Plan

Indicator	Target	Trend
Weekly volume of waste produced, by type (hazardous and non-hazardous)	Volumes will be recorded. No target is applicable (as volumes will depend on activity).	Volume of waste per workday decreases quarterly (showing efforts to reduce waste production)
Weekly volume of waste transported to final deposition	Equal to the weekly volume of waste produced.	NA
Number of improper waste management procedures detected	< 5 per quarter	Number of events decreases quarterly
Number of adopted corrective actions in response to detection of improper waste management procedures	Equal to the number of improper waste management procedures detected	NA.

Note NA. – Not Applicable.

The performance indicator results will be determined weekly and compiled in quarterly reports, as indicated in the following section.

Reports

The following table summarises the documental records that will be kept to control the execution of the waste management plan. These documents will be prepared, archived, and maintained by the contractor to document the plan's implementation results.

Table 7.14 – Record documents for the Waste Management Plan

Document Title	Document Type	Frequency of Record or Report
Weekly volume of waste produced, by type	Record	Weekly
Weekly volume of waste by category transported to final deposition	Record	Weekly
Weekly volume of waste recycled or reused	Record	Monthly
Record improper waste management procedures detected and remediation actions undertaken	Record	Weekly
Performance Report	Report	Quarterly

7.9.3 Community Health and Safety and Gender Management Plan

Objectives

The construction and operation of the project could increase community health and safety hazards due to increased light, noise and dust emissions, increased traffic, workforce mobilisation, population influx and security personnel. Management of these risks will require implementing the mitigation measures proposed in chapter seven of this report regarding these issues, compiled in this Community Health and Safety Management Plan.

Scope and Responsibilities

Together with the state ministry of agriculture, PIU is responsible for implementing all mitigation and management measures. Note that much of the mitigation will involve strong participation of the Contractor through the development of additional management plans and the management of day to day activities in the park, as detailed here. However, the PIU and the state ministry will continuously guide and supervise the Contractor in all issues related to engagement with communities and minimise impacts on their health and safety.

Proposed Actions and Implementation Schedule

Table 7.15 presents the main actions for implementing the Community Health and Safety and Gender Management Plan.

Table 7.15 – Community Health and Safety and Gender Management Plan actions, description and implementation schedule

Actions	Description	Implementation Schedule	Responsibility	Supervision
<p>Minimise hazard risk to communities from Project traffic</p>	<p>The Contractor will develop, and submit for PIU and FMEnv approval, an updated Traffic Management Plan detailing the management procedures and mitigation measures to minimise traffic-related hazard risks to communities. The Plan will include the mitigation provided hereunder:</p> <p>The movement of vehicles shall be limited to pre-approved routes. These will be defined to avoid crossing residential areas, schools or hospitals whenever feasible;</p> <p>Speed limits not exceeding 30 km/h will be set for heavy vehicles moving in unavoidable sensitive receptors (schools, hospitals and homes) and 60km/h on paved roads. Drivers shall be trained onset speed limits and safe driving.</p> <p>Install temporary official traffic signs on local roads around the work fronts before and during the execution of the works together with local transit authorities;</p> <p>Consult with community on traffic restrictions and schedule, provide alternative connectivity where needed, and conduct regular driver and community traffic safety awareness programs;</p>	<p>Across all project phases</p>	<p>Contractor and Ministry of Agric-HSE Dept</p>	<p>PIU, FMEnv</p>

	<p>Use operated traffic control in vital sensitive areas and crossings, especially near any places where people in general and children in particular congregate;</p> <p>Manage traffic and machinery to avoid accidents involving domestic animals and cattle. Provide for animal crossings and access to watering sites, if needed.</p> <p>Reroute traffic or limit access if required, in coordination with communities and local authorities.</p>			
<p>Minimise noise nuisance on communities</p>	<p>Noisy activities, especially during construction activities, will be limited to the daytime period (between 08:00 and 05:00) and working weekdays, avoiding working during the night-time and on weekends, whenever near residential areas;</p> <p>The contractor will avoid placing fixed equipment in proximity to sensitive receptors;</p> <p>Use of portable screens during construction where possible;</p> <p>if noise complaints are received from local communities in the morning or evening periods, despite compliance with the previous measures, and</p>	<p>Across all project phases</p>	<p>Contractor and Ministry of Agric-HSE Dept</p>	<p>PIU, FMEnv</p>

	if the ensuing investigation confirms the noise impact, effect further reduction in work schedule. In such cases, the work schedule will be defined in a participatory manner, through consultation with affected communities;			
Ensure good practices in labour management and minimise risks of social conflicts with the workforce	<p>The Contractor will develop and implement a Local Recruitment and Working Conditions Plan, which will include the following principles:</p> <p>Create mechanisms to ensure that the recruitment and hiring procedures are conducted in a transparent and just manner, are co-ordinated with the community leaders and LGA Administration, maximise local employment, including women and young workers and transfer technical skills to the local labour force;</p> <p>Forbid workers from hunting or buying bush meat. Inform workers of these restrictions in the induction sessions and enforce and monitor them appropriately.</p> <p>Give priority to hire local workers, provided applicants have the necessary skills;</p> <p>Employment opportunities will be adequately advertised so as not to limit application opportunities;</p> <p>The process of contracting staff will be transparent and follow pre-established and acceptable criteria. It shall follow a co-ordinated procedure with local leaders that aim to maximise opportunities for the</p>	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv

	<p>local workforce;</p> <p>Avoid hiring at the gate – establish local and regional recruitment centres and provide pick up points for applicants from communities;</p> <p>Ensure respect for local labour laws and worker rights, and together with the labour policy, Health and Safety Management Plan, ensure safe and fair working conditions;</p> <p>Develop and implement a worker’s grievance management system.</p>			
<p>Minimise risks of social conflicts with workforce</p>	<p>Policy and sanctions against violence or exploitation, including of a sexual nature (for example, the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favours or other forms of humiliating, degrading or exploitative behaviour);</p> <p>Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behaviour with children, limiting interactions with children, and ensuring their safety in project areas);</p> <p>Policy and sanctions against sexual relations with anyone under the age of 18 (except if married before employment);</p> <p>Description of disciplinary measures for infringement of the code and</p>	<p>Across all project phases</p>	<p>Contractor and Ministry of Agric-HSE Dept</p>	<p>PIU, FMEnv</p>

	<p>company rules. If workers are found to be in contravention of the CoC, which the Contractor will explain to them and require them to sign at the commencement of their contract, workers must face proportionate disciplinary procedures;</p> <p>Failure to keep by these standards will be stated in the contracts as grounds for contract termination. Inform all hired workers of these restrictions and the possible consequences of breaking them.</p> <p>The Contractor will further be expected to:</p> <p>Publicise the CoC in settlements potentially around the project area. This will help ensure that the residents are aware of behaviours expected of construction staffers;</p> <p>Provide schedule and transportation that allows workers to visit their families or to have leisure time at reasonable intervals.</p> <p>The Contractor will require its subcontractors to subscribe and adhere to this code and diligently supervise its implementation at all levels, including engaging the community in confidentially and actively identifying any inappropriate behaviour.</p>			
GBV/SEA prevention and response	<p>PIU, Contractor and the state ministry will work together to assess risks, identify and implement prevention continuously, response and referral processes involving Sexual Exploitation and Abuse / Gender-Based Violence (SEA/GBV). The prevention mechanisms will focus on:</p>	<p>Across all project phases</p>	<p>Contractor and Ministry of Agric-HSE Dept</p>	<p>PIU, FMEnv</p>

framework	<p>training of PIU, Contractor and the ministry of agriculture personnel, (ii) community and worker awareness, (iii) making available safe and confidential channels of communication and complaints, and (iv) a referral system and mechanism for survivors of GBV/SEA;</p> <p>PIU, together with the State Ministry of Agriculture, will develop and implement a GBV/SEA prevention and response framework that will address the following elements:</p> <p>How the project will put in place the necessary protocols and mechanisms to address the SEA/GBV risks;</p> <p>How to handle any GBV incidents that may arise;</p>			
	<p>A policy against GBV/SEA, including a CoC and agreed sanctions. The contractor and consultants will provide these as part of the Contractor ESMP. Have all employees of contractors (including sub-contractors), supervision consultants and other consultants with a footprint on the ground in the project area sign CoCs;</p> <p>For purposes of the construction and operational phases of the project, develop an induction program, including a CoC, for all workers directly related to the project.</p> <p>Specific arrangements for the project by which GBV risks will be addressed, including:</p> <p>Awareness Raising Strategy, which describes how workers, local</p>			

<p>GBV/SEA prevention and response framework</p>	<p>communities and Project personnel will be sensitised to SEA/GBV risks, and the worker's responsibilities under the CoC;</p> <p>Referral Pathway: Identification of qualified GBV service providers (NGOs) and setting up a referral pathway so GBV survivors will be referred, and the services will be available (health, legal, psychosocial, safety planning, etc.);</p> <p>Establish a SEA/GBV Accountability and Response Framework, to be finalised with input from the contractor, which will include at a minimum:</p> <p>Allegation Procedures: How the project will provide information to employees and the community on how to report cases of SEA/GBV, CoC breaches to the GRM;</p> <p>SEA/GBV Allegation Procedures to report SEA/GBV issues to service providers and internally for case accountability procedures which will lay out confidentiality requirements for dealing with cases;</p> <p>Mechanisms to hold accountable alleged perpetrators associated with the Project;</p> <p>Disciplinary action for violation of the CoC by workers. Such measures must be determined and carried out in a manner that is consistent with local labour legislation and applicable agreements;</p> <p>The supervision consultant ToR and the training plan will include</p>	<p>Across all project phases</p>	<p>Contractor and Ministry of Agric-HSE Dept</p>	<p>PIU, FMEnv</p>
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	<p>provisions to promote monitoring and reporting on the implementation and effectiveness of the SEA/GBV Action Plan to prevent and mitigate SEA/GBV risks associated with the project;</p> <p>Reporting on the Framework implementation will be done monthly.</p>			
Security Management response	<p>Together with the state ministry of agriculture, the contractor will develop a Security Management Plan detailing the security arrangements to be deployed at the SAPZ project. This plan will be compliant with AfDB operational safeguards (see chapter 2)</p>	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv
Minimise community security hazards due to interaction with security personnel	<p>This plan will include mandatory training for all security personnel, in what regards human rights, proportionate force use and adherence to contractor's code of conduct;</p> <p>Nigeria Security and Civil Defence Corps (NSCDC) will supply security; PIU will make an effort to engage with the authorities so that any engagement with the communities complies with the Voluntary Principles on Security and Human Rights.</p>	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv

7.9.4 Traffic Management Program

Justification and Objectives

The Project is expected to generate relatively high volumes of traffic across all phases of the project. Therefore, it is essential to ensure that traffic is managed to facilitate efficiency and provide the safety of personnel and the local community. The vehicular traffic generated as a result of the Project requires management on the site itself and insofar as traffic impacts may be experienced along with local road networks and urban/residential areas. The outline TMP has also been prepared for identifying appropriate and safe methods of access for traffic to the Proposed Processing Areas and Associated Facilities.

Objectives of TMP

The objectives of this outline TMP are to:

- Outline minimum road safety measures to be undertaken at site access/exit locations, during the works and including approaches to such access/egress locations;
- Demonstrate to the developer, contractor and supplier the need to adhere to the relevant guidance documentation for such works; and
- Provide the basis for preparing a final TMP by the contractor appointed to carry out the works.

The PIU shall ensure that the contractor manages the construction activities as spelt out under this outline TMP. The contractor will prepare a final TMP that complies fully with the outline TMP.

Objectives and measures are also included for the management, design and construction of the project to control the traffic impacts insofar as it may affect the environment, residents and the public in the area.

The final TMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which the PIU requires.

Traffic Management Signage

The contractor shall undertake consultation with the relevant authorities to identify and agree on signage requirements. Such signage shall be installed before works commencing on site.

Proposed signage may include warning signs to warn road users of the works access/exit locations and the presence of construction traffic. All signage shall be provided under the Nigerian Highway Code Part 2, Section B - road signs, signals, and markings

In summary, the contractor will be required to ensure that the following elements are implemented:

- Consultation with the relevant authorities to identify and agree to signage requirements;
- Provision of temporary signage indicating site access route and locations for contractors and associated suppliers; and
- Provision of general information signage to inform road users and local communities of the nature and locations of the works, including project contact details.

PROGRAMMING

To reduce impacts on local communities and residents adjacent to the proposed sites, it is suggested that:

- The contractor will be required to liaise with other construction projects and the local authorities to co-ordinate deliveries.
- The contractor, alongside the private investors during the operation phase, will be required to schedule deliveries in such a way that contrasting activities do not run concurrently, e.g. avoiding pouring of concrete on the same day as material deliveries to reduce the possibility of numbers of construction delivery vehicles arriving at project site location simultaneously, resulting in a build-up of traffic on the Asaba-Ughelli-Warri road network during the construction phase.
- The contractor will be required to schedule deliveries to and from the proposed SAPZ project area such that traffic volume on the existing road is kept to a minimum.
- The contractor shall develop a construction phase programme of works in liaison with the relevant local authorities, explicitly considering potential scheduled road repair

works. In particular, works should be programmed where possible such that any road repair works factors the traffic plan.

- Heavy Duty trucks deliveries to the project area will be suspended on the days of any major traditional festivals or market days that can cause more significant than usual traffic volumes.
- The contractor will be required to interact with local community members to ensure that deliveries will not conflict with sensitive events.
- Heavy Duty Trucks (HDT) deliveries will avoid passing schools at opening and closing times where it is reasonably practicable.
- Construction activities will be undertaken during daylight hours for all construction stages. It is not anticipated that construction works will be carried out between 6 pm and 6 am.

LICENSING

The PIU and contractor shall ensure that:

- All Project vehicles comply with relevant traffic and transport licensing requirements (such as licensing requirements relating to the transportation of oversized loads or hazardous materials, including hazardous waste).
- All vehicular drivers used during the Project shall have the requisite licenses to operate any vehicle (or machinery) operated by them on the Site or any public roads.
- All Project vehicles shall have valid roadworthy certificates and licenses.

Routing and direction of traffic and site access

The movement of all vehicles to and from the SAPZ project area shall be along designated Federal roads, state roads and site access roads. Most materials for the construction works shall be transported to the major towns in the area. In contrast, pre-fabricated steels will be transported by road from Port-Harcourt to Warri, by train from Warri to Ajaokuta, then through the Asaba- Ughelli- Warri road to the PPAs. The contractor and PIU shall determine the most appropriate route for large Project vehicles (such as HDT, Light Duty Trucks and

buses) transporting equipment, materials and employees (along public roads) to and from the SAPZ facility in consultation with the FRSC, local road traffic authorities and the local community. A copy of the approved routes must be maintained on Site together with this Plan (A responsibility of the Contractor and his Site Manager).

Any anticipated or scheduled traffic delays occasioned by Project vehicles (such as abnormal loads, i.e. the transformers) shall be co-ordinated with FRSC and local traffic authorities in advance.

RECOMMENDED TRAFFIC MANAGEMENT SPEED LIMITS

Adherence to posted / legal speed limits will be emphasised to all staff/suppliers and contractors during induction training.

Drivers of construction vehicles / HDTs will be advised that vehicular movements in sensitive locations, such as local community areas, shall be restricted to 60 km/h. A speed limit of 30 km/h shall be implemented for construction traffic in sensitive areas such as school locations. Such recommended speed limits will only apply to construction traffic and shall not apply to general traffic. It is not proposed to signpost such speed limits in the interest of clarity for local road users.

ROAD CLEANING

The works contract requires that the contractor carry out sweeping road operations to remove any project-related dirt and material deposited on the road network by construction/delivery vehicles. Road Sweepers will dispose of the generated material to the licensed municipal waste facility around the site.

VEHICLE CLEANING

The works contract shall require that the main contractor provide wheel washing facilities and any other necessary measures to remove mud and organic material from vehicles exiting tower construction sites. In addition, the cleaning of delivery trucks such as concrete delivery trucks shall be carried out at the laydown area.

ROAD CONDITION

The extent of the heavy vehicle traffic movements and the nature of the load may create problems of:

- Fugitive losses from wheels, trailers or tailgates; and
- Localized areas of sub grade and wearing surface failure.

The contractors shall ensure that:

- Loads of materials leaving each site will be evaluated and covered if considered necessary to minimize potential dust impacts during transportation.
- The transportation contractor shall take all reasonable measures while transporting the waste or any other materials likely to cause fugitive losses from a vehicle during transportation to and from the site, including but not limited to: (i) Covering of all waste or material with suitably secured tarpaulin/ covers to prevent loss; and (ii) utilization of enclosed units to prevent loss.

The roads forming part of the haul routes will be monitored visually throughout the construction period.

In addition, the contractor shall, in conjunction with the PIU:

Undertake additional inspections and reviews of the roads forming the haul routes one month before the construction phase to record the condition of these roads at that particular time.

Such surveys shall comprise, as a minimum, a review of video footage taken at that time, which shall confirm the condition of the road corridor immediately before the commencement of construction. This shall include video footage of the road wearing course, the appearance and condition of boundary treatments and the condition of any overhead services that will be crossed. Visual inspections and photographic surveys will be undertaken of bridges and culverts that are along the haul roads.

Where requested by the local authority before the commencement of construction operations, pavement condition surveys will also be carried along roads forming part of the haul route.

These will record the baseline structural condition of the road being surveyed immediately before construction.

Throughout the project life cycle, ongoing visual inspections and monitoring of the haul roads will be undertaken to ensure any damage caused by construction traffic is recorded and that the relevant local authority is notified. Arrangements will be made to repair any such damage to an appropriate standard promptly such that any disruption is minimised.

Upon completion of the construction of the proposed development, the surveys carried out at the pre-construction phase shall be repeated, and a comparison of the pre and post-construction surveys carried out as well as for the operation phase. Where such comparative assessments identify a section of road as having been damaged or deteriorated due to construction/operation traffic, the road will be repaired to the pre-construction standard or better by the State Government.

ROAD CLOSURES

During the works, it is not envisaged that road closures will be required. In areas where existing carriageways are narrow, it is envisaged that Traffic Management measures such as temporary traffic lights will be utilised to facilitate traffic.

However, it is envisaged that temporary road closures will be required at guarding locations for removal following construction. These closures will be short, with road closure times and appropriate measures to be agreed upon with the FRSC and other relevant stakeholders before removing guarding. It is envisaged that road closures will be undertaken between 6 pm -6 am when traffic volumes are at their lowest, subject to agreement with the FRSC and other relevant stakeholders.

ENFORCEMENT OF TRAFFIC MANAGEMENT PLAN

All project staff, private investors and material suppliers will be required to adhere to the final TMP. As outlined above, the principal contractor shall agree and implement monitoring measures to confirm the effectiveness of the TMP, and compliance will be monitored by the resident engineer on behalf of the Delta State Ministry of Agriculture and Natural resources. Regular inspections/spot checks will also be carried out to ensure that all project staff, private investors and material suppliers follow the agreed measures adopted in the TMP.

DETAILS OF WORKING HOURS AND DAYS

Construction of the proposed development is envisaged to be undertaken during daylight hours for all construction stages. It is not anticipated that construction works will be carried out on Bank Holidays or in hours of darkness.

PEDESTRIAN AND PASSENGER SAFETY

All construction personnel transported to and from the Site shall be safely accommodated in appropriate passenger vehicles. No employee shall be transported on the back of open trucks. The Contractor's Construction Safety Officer shall ensure that this requirement is adhered to at all times.

All vehicles transporting employees shall be appropriately maintained and shall not carry more passengers than the number of persons for whom seating accommodation is provided.

Assembly points for local construction workers embarking passenger vehicles shall be located a safe distance from areas/routes of high vehicle traffic. Those residing in hotels shall be picked up daily from their various hotels. Roads and areas used by construction vehicles shall, as far as possible, be avoided by all personnel. Designated pedestrian routes shall be demarcated where appropriate.

Vehicle and pedestrian safety shall be emphasized in the Safety Induction Training required to be provided by the Contractor. All employees, construction personnel and private investors shall be trained and informed as to the dangers and risks posed by construction and other traffic; such training shall also include appropriate precautionary measures required to be

undertaken to facilitate safe and efficient traffic management (e.g. checking for traffic before crossing roadways and utilising designated pedestrian routes). Drivers shall be adequately trained to recognise and avoid road hazards, vehicle maintenance, and safety requirements.

EMERGENCY PROCEDURES DURING CONSTRUCTION

The contractor shall ensure that unobstructed access is provided to all emergency vehicles along all routes and site accesses.

The contractor shall provide the contractor's personnel responsible for construction traffic management to the local authorities and emergency services agencies.

In the case of an emergency, the following procedure shall be followed:

- Emergency Services will be contacted immediately by dialing the emergency contact line provided;
- The caller will give exact details of the emergency/incident to the emergency line operator to allow them to assess the situation and respond adequately;
- The emergency will then be reported to the Site Team Supervisors and the Safety Officer;
- All construction/operation traffic shall be notified of the incident (where such occurs off-site);
- Where required, appointed site first aiders will attend the emergency immediately; and
- The Safety Officer will ensure that the emergency services are en route.

COMMUNICATION

The contractor shall ensure that close communication with the relevant local authorities and the emergency services shall be maintained throughout the construction phase. Such communications shall include:

- Submissions of proposed traffic management measures for comment and approval;
- Ongoing reporting relating to the condition of the road network and updates to construction programming; and

- Information relating to local and community events could conflict with proposed traffic management measures and construction traffic to implement alternative measures to avoid such conflicts.

The contractor shall also ensure that the local community is informed of proposed traffic management measures before their implementation. Such information shall be disseminated by sensitisation and delivering leaflets/flyers to houses in the affected areas. Sensitisation shall be done in local, pidgin and English languages. The flyers shall contain contact information for public members to obtain additional information and provide other knowledge such as local events, traditional festivals, and religious celebrations, which may conflict with proposed traffic management measures.

Construction and Operation Methodologies

The contractor shall consider the construction methodology as detailed in chapter four of this report to prepare the final TMP.

- The contractor shall provide detailed traffic management arrangements for all construction stages and submit them for approval to the relevant local authorities and the FRSC.
- The contractor shall submit for approval to the state ministry of Agriculture and the Local Authority, as part of their final TMP, details concerning construction/operation staff vehicle pooling and parking.
- This Traffic Management Plan (TMP) will form part of the construction contract and is designed to reduce possible impacts during the construction of the PPA.
- The outline TMP shall be used by the appointed contractor as a basis for the preparation of a final TMP and shall detail, at a minimum, the items described in this outline TMP and any subsequent requirements of the FRSC and local authorities.
- The ministry of agriculture's PIU shall ensure that the contractor manages the construction activities under this outline TMP and shall ensure that any planning conditions are incorporated into the final TMP prepared by the appointed works contractor.

7.9.5 Construction management Plan (CMP)

Justification and Objectives

Unsustainable construction activities will have adverse health, social and environmental effects. It may eventually halt the project implementation processes. This plan, therefore, outlines the ministry's approach to managing the execution of the proposed project. The Plan covers site establishment, logistics and the process of managing the overall local environment. It seeks to ensure that the works cause the minimum practicable disruption to residents, including achieving a safe working and living environment. The Plan shall enable contractors to understand the nature of the scope of their works and the various construction activities associated with the development.

This Plan will be used as the template for developing the construction phase health and safety plan, in tandem with the construction method statement. Many of the matters identified will be developed in more detail and dealt with at the appropriate construction stage by detailed site-based method statements. Method statements will be prepared and agreed upon for all major site operations before the commencement of relevant works. This is mainly for the groundwork excavation and structural works.

Communication

The ministry of agriculture seeks to maintain good relationships with the project community. Such relations are significantly assisted by good communication and by keeping the host community and appropriate third parties regularly informed of site activities likely impacts adjoining residents. The contractors and the management team will be receptive to all reasonable concerns of the local community. They will demonstrate a considerate and professional approach to maintain a well-balanced relationship with the local public during project execution.

Notices shall be posted on the site hoarding to keep locals advised of anticipated events, the works' general progress, and any requirements for any abnormal works. Appropriate signage and information boards will be displayed on the hoarding.

Considerate Constructors Scheme

In selecting the appropriate constructors, the ministry shall assess their project track record and management procedures to ensure the capability to deliver a project safely and with minimum practicable disruption and inconvenience to the environment and residents. The appointed constructor will be registered and comply with the requirements of the Considerate Constructors Scheme for the duration of the project. The works will be carried out under the Considerate Constructors Scheme and in such a way as to minimise the impact on the local environment and amenities.

Throughout the works, the constructors will be required to provide relevant method statements and risk assessments. Benchmarking against relevant Key Performance Indicators (KPI) will be used to monitor the constructor's performance against the qualities in this plan. A contact board will be displayed outside the site providing contact details. This will include names and telephone numbers of key construction staff so that the general public can make contact should they have cause to do so.

A complaints/contact book will be kept on-site, which will be used to record details of any complaints. This will include the name of the person making the complaint, the date, time and nature of the complaint and the action necessary to resolve the complaint. The constructor and the site manager will regularly review the complaints book to ensure that any complaints are dealt with and resolved promptly.

Site Establishment

The space available within the proposed site will be utilised to store construction materials and security post, which will enable the execution of the project development. An on-site borehole will be used for all construction water demands, while the contractors will provide on-site power. Access will be maintained for the duration of the works via the front entrance from Asaba- Ughelli- Warri Road. A parking lot will be created on-site to accommodate delivery Lorries and to restrict parking along the road.

A mobile concrete pump may be positioned on-site during large volume concrete works, and the parking bays on the site shall be suspended for these specific activities. All necessary permits and licenses will be obtained at the appropriate time from the Federal Ministry of Works (FMW) and Delta state Ministry of Works (DSMW). During the excavation for

foundations, the excavation spoil will be borrowed to skips on the road. During bulk excavation for shed buildings, there may be a continuous transfer of excavation spoil to muck away Lorries.

Construction work

As part of the CMP, construction work on-site will be carefully managed to minimise disruption to workers' baseline social and environmental condition and incidence. All activities on site will be undertaken with appropriate regard paid to:

Working Hours

Working hours will be 07.00 – 17.00 Monday to Saturday only, under the National Building Code of Nigeria (NBCN) most recent Construction Practice –2006. There shall be no work on Sundays and public holidays.

Fire and Emergency Procedures

Contact names and telephone numbers will be made available in 'out of hours' emergencies relating to the site. This information will be displayed on the hoarding. The constructor shall implement procedures to protect the area from fire. The site manager shall assess the degree of fire risk and formulate a Site Fire Safety Plan, which will be updated as necessary as the works progress and will also include the following:

- Hot Work Permit regime.
- Installation of the site fire-fighting equipment, e.g. establishing fire points and installing and maintaining fire extinguishers etc.
- Evacuation alarm.
- Material storage and waste control.
- Fire Brigade access.

Security

All site personnel will have to sign in on arrival and sign out before leaving the site. This will be incorporated into the Site Rules and included as part of the site induction process.

The front hoarding will be regularly inspected to ensure that it remains secure. All hoardings will remain closed when the site is not operational. The access gate to the site will be controlled to only allow access for authorised personnel.

Health and Safety

A Construction Health and Safety Plan will be prepared for the works under the Construction Design and Management (CDM) regulations, 2015. Risk Assessments will be developed and agreed upon. Subcontractors' detailed method statements will also be produced, and safe work methods established for each element of the works.

Site inductions will be held for all new site personnel to establish the site rules and enforce safety procedures. All site personnel will be required to read the emergency procedures when signing in for the first time and sign to the effect that they have read the procedures. These will include any relevant communal issues.

Scaffolding

As already noted, scaffolding will be required for the construction of the storehouse. Scaffolding will be used to provide workers with a safe temporary work platform. It will be planned, erected, inspected and tagged by competent persons. It will be regularly reviewed to ensure no risks to safety and compliance with HSE regulations' requirements.

Good Housekeeping

The site will be kept in a clean and safe condition. The following practices shall be maintained:

- The areas adjacent to the site will be regularly inspected and any site rubbish removed.
- The adjacent road and pavement will be kept clean.
- The perimeter hoarding will be repainted from time to time and will be kept in a neat and tidy condition.
- Any graffiti will be quickly removed from the hoardings.
- Offloading will generally be direct from vehicles onto the site.

- Materials will not be stored on public footpaths or roads.
- Waste and rubbish will be regularly removed from the site and not allowed to accumulate to cause a safety or fire hazard.
- Welfare facilities will be provided within site to discourage operatives from frequenting the interface between the site and public areas.

Environmental Matters

The selected constructor shall operate an environmental policy in which supports the following values to:

- Conduct their activities with proper regard to the protection of the environment.
- Comply with all relevant regulatory and legislative requirements and codes of practice.
- Communicate with local communities to ensure the work causes the minimum disturbance and disruption.
- Ensure that staff has a good understanding of the environmental impacts of construction work and minimize these impacts.
- Ensure their suppliers and sub-constructors apply similar standards to their work.
- During the early stages of the project, the constructor shall carry out the following activities will be carried out to deal with environmental management:
 - ✓ Prepare a Project Environmental Plan.
 - ✓ Prepare and consult with the client and statutory authorities to obtain relevant approved licenses and consents.
 - ✓ Prepare a Site Waste Management Plan and consult with supply chain partners and the design team to design out or minimize waste.

Waste and Material Management

A site waste management plan has been drafted (see Section 7.9.2).

Dust, Noise and Vibration

Detailed AQMP has been proposed in Section 8.9.1. But as per a matter of good practice in construction, the following practicable mitigate shall be observed:

Dust

- ✓ Adjacent road surfaces will be frequently swept clean;
- ✓ All loads delivered to or collected from the site will be covered where appropriate;
- ✓ All road vehicles will be requested to comply with set emission standards;
- ✓ Skips will be securely covered
- ✓ The air quality within the site will be continually monitored.

Noise and Vibration

- ✓ The constructor shall take reasonable steps to minimize any noise disruption to adjacent residence and fauna habitats.
- ✓ Operatives working in noisy areas will be monitored to ensure they are wearing the necessary protective equipment and not exceeding their permitted exposure periods.
- ✓ An electrically operated plant will be used where practical.
- ✓ Try to ensure all plant used on the site is effectively silenced.
- ✓ No externally audible radios or other audio equipment will be allowed on site.

7.9.6 Biodiversity Management Program

7.9.6.1 Justification and Objectives

The construction and operation of the proposed Project will result in some biodiversity impacts, on vegetation and wildlife, particularly *Khaya ivorensis* (Vulnerable). Alien/invasive species (*Ageratum conyzoides* and *Chromolaena odorata*) were also censored. Monitoring and management actions for these biodiversity components are required, so as to continuously evaluate the Project's impacts and the efficacy of the proposed mitigation. The PIU will prepare a Biodiversity Management Program (BMP). The BMP will establish baseline values for the managed/monitored activities, implementation schedule, and responsibility for carrying out the monitoring and corrective actions, supervision responsibilities, budget estimates, and source of funding.

7.9.6.2 Monitoring and Management Actions and Implementation Schedule

Table 7.19 lists:

- ✧ The scope of the BMP, which includes: (a) invasive species; (b) deforestation rate in forest habitats and wildlife poaching activities, biodiversity monitoring and management actions; and (c) IUCN threatened species monitoring
- ✧ Brief description of the actions to be implemented;
- ✧ Implementation schedule;
- ✧ Responsibilities for implementation of management and monitoring program; and
- ✧ Supervising agency(ies)

For each activity in Table 7.16, the BMP will identify:

- ✧ Baseline values (including direct and indirect/induced impacts);
- ✧ Monitoring indicators (including direct impact of the infrastructure constructed, as well as indirect/induced impacts of the area of influence, access roads, and other ancillary infrastructure);
- ✧ List of potential remedial actions and their triggers;
- ✧ Estimated costs / indicative budget; and
- ✧ Source of funding.

Details on the monitoring methodology are provided in the following section.

Table 7.16 – Biodiversity monitoring and management actions, description and implementation schedule

Monitoring and Management Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Invasive flora species monitoring and management	Monitor the presence and proliferation of invasive flora species (including but not limited to <i>Ageratum conyzoides</i> and <i>Chromolaena odorata</i>) around the project area, access road, lay down areas, lay down area and borrow pit areas. Use cultural practices to remove invasive/alien species if observed.	Once in every three months during construction and twice per year during the first five years of operation	Contractor (during the construction phase) Operational manager (during the operation phase) to be carried out by Independent Biodiversity Consultant financed by SAPZ project	HSE dept.
IUCN flora species monitoring and management	Monitor the population and regeneration potential of the threatened species (including but not limited to <i>Khaya ivorensis</i>) at the secondary forest habitat If the population of these species appears to be below baseline value	Once in every three months for the first ten years after construction phase	Operational manager (operation) to be carried out by Independent Biodiversity Consultant financed by SAPZ project	HSE dept.
IUCN and migratory fauna species monitoring	Monitor the population and movement of the migratory species	Once in every three months for	Operational manager (operation) to be carried	HSE dept.

and management		the first ten years after construction phase	out by Independent Biodiversity Consultant financed by SAPZ project	
Deforestation rate and the extent of wildlife poaching monitoring and management –including remedial actions of impacts on secondary forest habitat, on both flora and fauna	<p>Establish the baseline for present deforestation rates and wildlife poaching activities prior to the start of clearing;</p> <p>Monitor the direct and indirect / induced impacts on natural and critical natural habitat. Establish deforestation and poaching monitoring and development of corrective actions;</p> <p>Register the presence of people and/or structures in and near the project area and the actions taken by local authorities to prevent illegal logging, poaching or encroachment. These impacts should be accessed through ground monitoring, as possibly via GIS mapping.</p> <p>If activities with significant negative impacts are observed, on natural and/or critical habitat on flora and fauna, mitigation measures such as targeted protection,</p>	<p>Once in every three months during construction and during the first five years of operation</p> <p>Biannually during the next 5 years of operation.</p>	<p>Contractor, site manager (construction)</p> <p>Operational manager (operation) to be carried out by Independent Biodiversity Monitoring and Management Consultant financed by SAPZ project</p>	HSE dept.

	reforestation and anti-poaching programs shall be developed and enforced			
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7.9.6.3 Code of Conduct

The BMP shall specify or cross-reference all the biodiversity-related environmental rules that all contractors and project workers will be expected to follow, along with the required induction training prior to beginning work and the penalties for non-compliance.

7.9.6.4 Implementation Arrangements

For each planned activity, the BMP will indicate (i) expected implementation schedule (during construction and operation); (ii) institutional responsibilities for implementation (PIU, FMEnv, Contractor, and/or collaborating governmental entity or NGO); and

(iii) Indicative budget and expected source of funds for each key BMP activity during construction and operation (funding would be from the SAPZ project).

7.9.6.5 Monitoring Methodology

Invasive Species

The invasive flora species monitoring plan will start with the construction phase and at that time patches or individuals of invasive flora species as indicated in the baseline, will be identified and geo-referenced. The identified patches/individuals will be removed and disposed properly to avoid introduction into nearby farms. Growth will be monitored monthly during construction and twice per year during operation phases (at least during the first 5 years), or until no patches are detected.

If new locations of flora invasive species are detected along the access roads or lay down areas during maintenance, those will be monitored, and removed or controlled as well.

The expansion of the monitored invasive species will be evaluated and if needed and new measures to control them will be proposed.

Threatened Species

The threatened species monitoring plan will start after the construction phase. There is potential for deforestation of secondary forest habitats by locals on site clearance and Access Road opening, especially for fuel wood as indicated in the baseline. The HSE department shall organize sensitization programs in the project area on the adverse impacts of logging threatened species. Monitoring shall be carried out every three months to assess the regeneration potential

of the secondary forest habitats. If in five year, the population of the IUCN species decreases from the baseline population, the HSE shall cause replanting to be carried out on those habitats.

Induced Impacts

The following actions will be developed as part of the BMP:

- ✧ Establishment of a baseline for present deforestation rates and wildlife poaching activities within 500 m on site via ground-trotting, and possibly using GIS models
- ✧ In case monitoring of the BMP observed significant negative impacts, HSE department will re-vegetate or put in place targeted species manage, solve or reduce these problems, rather than only continue to watch them. The problems areas will be referenced via GPS;
- ✧ Minimizing Facility and Access Road Induced Impacts. Besides providing options for reforestation or targeted protection of natural habitats and increased poaching, the BMP shall seek to prevent and minimize such impacts in the first place. Effective strategies for doing this should include, as feasible, (i) Restrict clearing only to project footprint (ii) Avoid clearing riparian habitats as practically possible

7.9.6.6 Corrective Actions

Table 7.17 presents the main remedial actions.

Table 7.17 – Corrective actions, description and implementation schedule

Corrective Actions	Description	Implementation Schedule
Act on expansion of invasive flora species	If invasive Area of Occurrence (AoO) and/or Extent of Occurrence (EOO) are observed to be increasing and threatening native species and habitats, actions to control and remove these patches will be implemented after being properly evaluated.	Whenever necessary
Clearing of IUCN species	If the baseline population of these species reduces, replanting programs shall be initiated	Whenever necessary

Act on high levels of impacts on natural habitat, flora and fauna	If deforestation and poaching in post opening up of the project area doubles the initial rate prior to commencement of pre-construction/construction, reforestation and targeted protection measures need be instituted.	Whenever necessary
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7.9.6.7 Performance and Reporting

Table 7.18 lists the performance indicators to be monitored:

Table 7.18 – Performance indicators for Biodiversity Management Program

Indicator	Target	Trend
Number and extent of invasive flora species patches	Zero increase from pre-project conditions.	Number of invasive flora decreases between successive monitoring periods.
Clearing and migration of IUCN threatened plant and fauna species	Population of threatened plant species are stable or increase the baseline	Population of the species continues to flourish with high regeneration and recruitment potentials

The performance indicators results will be determined and compiled in quarterly reports, as indicated in the following section.

7.9.6.8 Reports

Table 7.19 summarizes the records that will be kept, to control the execution of this monitoring and management program.

Table 7.19– Record Documents for the Biodiversity Management Program

Document Title	Document Type	Frequency of Report
Invasive species monitoring report	Report	Bi-annually (twice per year)
IUCN flora species	Report	Quarterly
Baseline Report. Monitoring Report and Management Report of impacts on natural and critical natural habitat, on both flora and fauna (deforestation rates and wildlife poaching activities)	Report	Bi-annually

CHAPTER EIGHT: DECOMMISSIONING AND ABANDONMENT PLAN

8.1 Decommissioning/Abandonment

8.1.1 Decommissioning/Closure

Most development projects have useful lives, beyond which they are no longer economically viable either as a result of competing technology or irredeemable unforeseen circumstances. Upon the completion of useful life cycle, there is a need to abandon and/or decommission such projects. Planning abandonment activities in advance is the key to a safe, environmentally friendly, and efficient decommissioning/abandonment programme in accordance with the Nigerian regulatory requirements. Furthermore, removal must be carried out with due regard for protection of the immediate environment.

Therefore, adequate plans will be put in place to decommission the project in a cost-effective and environmentally-friendly manner.

8.1.2 Plan Structure

A decommissioning plan incorporating the reclamation plan shall be submitted to Federal Ministry of Environment before the cessation of the processing zone operations. The Decommissioning Plan shall:

- ◆ Nominate the end use(s) of all lands affected by the project
- ◆ Nominate the end use(s) of all buildings, houses and other infrastructure components;
- ◆ Describe the steps to make the area safe;
- ◆ Describe the type and duration of post decommissioning monitoring.

The fate of each of the project infrastructure listed will be dependent upon the nominated end land uses, which will be agreed with the local communities and the federal government agencies. These items will then be set out in detail within the final decommissioning plan to be presented to the Federal Ministry of Environment before the cessation of the project operations (if and when it becomes necessary).

8.1.3 Reporting

A Post Decommissioning Report shall be prepared as required by statutory regulations and submitted to regulators. The report will provide the following details.

- ◆ Overview of decommissioned facilities.
- ◆ Details of methods used for decommissioning.
- ◆ Nature of decommissioning (whole or partial).
- ◆ Records of consultation meetings.
- ◆ Details of recyclable/reusable facility components.
- ◆ Decontaminated facilities.
- ◆ Decommissioning schedule.
- ◆ State of the surrounding environment.
- ◆ Waste Management Plan.
- ◆ Plans for restoration/remediation where necessary.

CHAPTER NINE: CONCLUSION

The Environmental and Social Impact Assessment (ESIA) of the proposed SAPZ has been carried out in line with statutory requirements for environmental management in Nigeria and as such ensures that potential environmental, social and health impacts of the project are fully appraised. This ESIA report has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost-effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. A management plan that would be effective throughout the projects life cycle has also been put in place to assure environmental sustainability of the project.

The environmental baseline condition of the project area which was carried out based on a one season (wet) data, supplemented with dry season secondary data (KIP ESIA Report, 2021) showed that the physical, chemical and biological characteristics as well as meteorological, climatic and hydrological characteristics were generally consistent with previous studies carried out within the environment with some few exceptions. Also documented were unique assemblages of wild flora and fauna species with abundances that relate to the nutrients and chemical composition of the ecosystems.

The identified adverse impacts of the proposed project include potential; air and noise pollution, soil, sediment, groundwater water and surface water contamination from accidental discharges of effluent, workplace accidents, traffic, community conflict, migratory and raptor avian species, IUCN plant species. Consequently, cost-effective mitigation/ amelioration measures have been designed to ensure that these impacts are prevented, reduced or controlled to as low as reasonably practicable in order to ensure conservation of biodiversity in the area and enhance continual compliance with environmental standards and requirements in Nigeria. It is understood that the project will result in substantial social and economic benefit for Nigeria. The EMP developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation.

Socioeconomic consultations with the project host communities and other relevant stake holders were also carried out and shall continue throughout the life cycle of the project. It is therefore hoped that all data/evidence contained in this report is sufficient in the development of an

environmental impact statement (EIS), and afterward in the acquiring of necessary permits for commencement of the project.

Conclusively, the Project Implementing Entity (PIU), and any institution participating in the implementation, will not issue a Request for Proposal (RFP) of any activity subject to Environmental and Social Impact Assessment (ESIA), without the insertion of the construction phase's Environmental and Social Management Plan (ESMP). It will also not authorize the works to commence before the contractor's ESMP (C-ESMP) has been approved and integrated into the overall planning of the works.

REFERENCES

ANNEXES

- List of the professionals and the organizations having contributed to the preparation of the ESIA Report.
- List of consulted documents, including project-related reports
- Baseline data referred to in the report

Record of consultation meetings with primary and secondary stakeholders