ABIA STATE MINISTRY OF AGRICULTURE AND NATURAL RESOURCES

UMUAHIA

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

OF

ABIA STATE SPECIAL AGRO PROCESSING ZONE

(SAPZ PROJECT)

Draft Report

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LIST OF ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
BMP-	Biodiversity Management Program
BOD	Biochemical Oxygen Demand
CBOs	Community Based Organizations
CESMP	Contractor Environmental and Social Management Plan
CHS	Community Health and Safety
CITES	Convention on International Trade in Endangered Species
CMS	Conservation of Migratory Species
CLO	Community Liaison Officer
CO	Carbon monoxide
CO_2	Carbon dioxide
CoC	Code of Conduct
COD	Chemical Oxygen Demand
CSO	Civil Society Organization
dB	Decibels
DBH	Diameter at Breast Height
DHS	Demographic Health Survey
EA	Environmental Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESS	Environmental and Social Safeguards

FDRD	Federal Department of Rural Development
FMARD	Federal Ministry of Agriculture and Rural Development
FMEnv	Federal Ministry of Environment
FGN	Federal Government of Nigeria
FPMU	Federal Project Management Unit
GBV	Gender Based Violence
GIS	Geographic Information System
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
HIV	Human Immunodeficiency Virus
IEE	Initial Environmental Examination
ISO	International Organization for Standardization
ISS	Integrated Safeguards Standards
IUCN	International Union for the Conservation of Nature
LC	Least Concern
IDA	International Development Association
LFN	Legal Framework of Nigeria
LGA	Local Government Authority
LGAs	Local Government Areas
IPV	Intimate Partner Violence
LPZ	Livestock Processing Zone
MDAs	Ministries, Departments and Agencies
MEnv	Ministry of Environment
NEEDS	National Economic Empowerment and Development Strategy
NESREA	National Environmental Standards and Regulations Enforcement Agency

NGO	Non-Governmental Organization
NPC	National Population Commission
OHS	Occupational Health and Safety
OP	Operational Policy (of African Development bank)
PAPs	Project Affected Persons
RAPs	Resettlement Action Plans
RoW	Right of Way
RPF	Resettlement Policy Framework
SEA	Sexual Exploitation and Abuse
SPMU	State Project Monitoring unit
SPIU	State Project Implementation Unit
SO_4^{2-}	Sulphate ion
SS	Suspended Solids
SPM	Suspended Particulate Matter
TDS	Total Dissolved Solid
TOR	Terms of Reference
TSS	Total Suspended Solid
µg/l	Microgram per liter
µS	Micro Siemen
TA	Technical Assistance
ToR	Terms of Reference
VAC	Violence Against Children
WB	World Bank
WHO	World Health Organization

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ACKNOWLEDGMENT

Epic-Agro Consults Ltd wishes to acknowledge and thank the Abia State Ministry of Agriculture and Natural Resources, Ministry of Environment, the host communities, NGOs, CBOs and other concerned stakeholders and persons for their cooperation, assistance and support during the conduct of this study. Profound appreciation goes to those who provided aid in technical and project planning matters to produce the Environmental and Social Impact Assessment report for Abia Special Agro Processing Zone, Abia State, Nigeria.

EXECUTIVE SUMMARY

ES-1.0 INTRODUCTION

The Government of the Federal Republic of Nigeria through the Federal Ministry of Agriculture and Natural resources with assistance from the African Development Bank (AfDB) seeks to increase value addition to some staple agricultural products in Nigeria through the Special Agro– Industrial Processing Zones (Program)

-The Proponent: The proponent is the Abia State government through the Ministry of Agriculture and Natural Resources**.**

-Project Location: The project will be located in three local government areas in Abia state. Owaza Ukwa West will host the SAPZ hub, the other two LGAs , Bende and Ikwuano will be the Agricultural Transformation Centres (ATCs).

-Regulatory framework: Federal Ministry of Environment (FMEnv) is the sole regulatory body empowered to regulate the conduct of ESIA studies in Nigeria, they derive their power from the EIA Act of 2004. In carrying out the ESIA studies, a number of national/local and international environmental and social laws, guidelines and regulations that guide developmental projects shall be applied. Most importantly the African Development Bank integrated safeguard polices shall be strictly adhered to, which include OS. 1: Environmental and social assessment, OS. 2: Involuntary Resettlement: Land Acquisition, Population Displacement and compensation, OS. 3: Biodiversity and Ecosystem Services, OS. 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials, Resource Efficiency, OS. 5: Labour Conditions; Health and Safety.

ES-2.0 PROJECT JUSTIFICATION

Need and benefits of the project

The essence of this proposed project is to bridge the gap of the ever- growing demands of staple food in Nigeria, aside the economic benefits that shall be earned by both the local community and the country at large. Other benefits will include

- Improvement in crop production
- Capacity `building for local farmers
- Employment opportunities
- General improvement in the livelihood of the adjoining communities

- Envisaged Sustainability of the Project

The project is evaluated based on the four principles of project sustainability which are Technical, Environmental, Economical, and Social Sustainability.

Technical sustainability: The proposed project is technically feasible because, it is professionally designed, and the technology employed is readily available. The proposed project site is very accessible to other states and within 3km radius of Port Harcourt Airport and a sea port for patronage.

Economic Sustainability:

There is a huge demand for agricultural products like Cocoa, maize, rice and palm oil and demand for processed cereals for livestock feeds in southeast and Nigeria in general. In the short term, the project will be funded by development partners. However, in the medium to long term after operation, the return on investment would be guaranteed. The availability of skilled and unskilled labor force in the project area, functional organizational structure of the agricultural zone, presence of up takers and deployment of good industrial best practices in the agro processing technology is expected to make the project economical sustainable.

Environmental Sustainability:

The project site has been carefully selected by considering sensitive ecosystems and to avoid built-up areas as much as possible. In addition, practical mitigation measures have been proffered for the identified environmental impacts of the Agro processing project and Abia SAPZ is fully committed to comply with the relevant applicable national environmental laws, applicable international conventions and AfDB environmental and social safeguard requirements**.**

Social Sustainability

One of the benefits of this project is to enhance the socioeconomic activities of the people and also to create job opportunities for unemployed indigenes. This would enhance the socio-economic activities of the communities thereby supporting the sustainability.

-PROJECT ALTERNATIVES

Alternatives are defined as different means of meeting the general purpose and requirements of the project, which may include alternatives to:

- Mode of cropping system
- Irrigation
- Power supply
- Sources of water;
- Waste management; and
- No option

Cropping system option : Mono cropping is considered as the preferred option due to the large expanse of land and ease of mechanization

•**Irrigation option**: Drip irrigation is preferred as it is water efficient and can be installed in any type of landscape.

Power supply Option: Solar energy installations (Option 2) such as solar powered pumps are preferred for the pump irrigation.

Waste Management Option: composting is a better option as it is ecofriendly and could be used to improve soil quality on farms. It will also keep waste away from landfill, which already have limited space.

No option: This option is not preferable because Non implementation of the project will continue to deprive project communities of access to economic opportunities and food security associated with agriculture.

Go-Ahead Option: The Go-Ahead option was chosen. This is the most favourable option considering that the project has positive impact on the people in Abia state.

ES-3.0 PROJECT DESCRIPTION

The Program has four broad components namely:(i) Support the development of enabling climate adapted infrastructure for Agro-Industrial Hubs (AIHs), (ii) Improve agricultural productivity and enterprise development to enhance agricultural value chains and job creation in the SAPZ Catchment Areas, (iii) Support Agro-Industrial Zone Policy and Institutional Development, and (iv) Program Coordination and Management.

Abia State SAPZ intends to establish Agro-industrial Hub in Owaza as part of AIIP project and Ikwuano and Bende LGAs as Agricultural transformation Centres (ATCs).

Project components

The proposed project will have three major components namely

(i) Component 1: Production Development,

(ii) Component 2: Integrated Agribusiness and Value Chain Development, and

(iii) Component 3: Project Management and Institutional Support

E.S 4.0. DESCRIPTION OF THE ENVIRONMENT

The description of the environment is based on a number of primary and secondary data sources. Primary data sources include dry season baseline fieldwork survey undertaken

on 4th -10 March 2024. Baseline surveys included soils, groundwater, surface water, and sediment, fauna and flora, air quality, and noise levels. A socioeconomic and health baseline study were also undertaken in all the villages SAPZ project will be located.

The fieldwork samples were analysed in New Concept Laboratories Ltd Located at Obinze FUTO road under the supervision of FMEnvi. Staff.

ES 4.1 Climate/ Meteorology

The project area is situated in the tropical rainforest zone of West Africa, off the Gulf of Guinea. The climatic data of the area are typical and representative of the two-season tropical climate of equatorial Africa, characterized by high annual rainfall, comparatively high temperature and relative humidity.

ES 4.2 Air Quality

The results of ambient air quality studies on site show that the concentration range of the parameters: The PM $_{2.5}$ ranges between 0.01-0.04 mg/m^3 on site, average of 0.02 mg/m^3 in the dry season. The PM 10 ranges between 0.019- 0.045 mg/m3 on site, average of 0.032mg/m^3 in the dry season. The SO_2 was not detected on site in all the stations in dry season. The value of NO_2 measured on site ranges from 0.052- 0.104 mg/m^3 on site, average of 0.078 mg/m^3 in the dry season.

ES 4.3 Noise

The Ambient noise levels around Umuololo ranged from 70-72.5 dB(A), Ariam elu elu 64.2-85.6 dB(A) and Okporoenyi in Bende ranged from 48-60.1dB(A) with average of 65.3 dB(A).

ES 4.4 Water Resources

Groundwater

All physicochemical parameters analyzed in the ground water samples were within threshold values, except for the following parameters: Colour, Total Suspended Solid, Ammonia and Phosphate concentrations above NIS threshold limits for drinking water.

The results of the base metals concentration showed that they largely reflect the non-saline nature of groundwater resources in the proposed project location as indicated by the chloride and hardness concentrations.

Surface water

The sampled surface water were Ibine stream in Bende and Imo river in Owaza Ukwa West. The mean pH of the surface water for Imo river was 5.1± 0.03 and Ibine stream 6.23±0.05 which are within the pH range of 6.50 -8.50 for surface water with aquatic life (FMEnv.). The mean temperature for the two river ranged from 27.37±0.5 ºC to 27.80±1.6 ºC. Mean acidity levels for the surface waters were Imo River: 13.5±0.6 mg/l and Ibine 12.3±1.0 mg/l and alkalinity 24.67±1.5mg/l and 4.50±1.22 mg/l respectively.

River Sediments

The pH of the sediment samples ranged from 5.20 to 5.50 with a mean of 5.43±0.18 for Ibine Bende River while Imo River ranged from 5.16 to 5.22 with mean value of 5.43±0.18. Mean concentrations of nitrate, phosphate and ammonia in the sediment for Ibine stream were 4.57±0.79 mg/kg, 29.17±11.5 and 1.46±0.834 mg/kg respectively. Also the Imo river sediments for Nitrate, Phosphate and Ammonia were 11.29± 1.06, 6.88 ±0.04 and 1.52± 0.29 respectively.

ES 4.5 Sediment microbiology

The mean Total heterotrophic bacteria count for the Ibine and Imo were $2.1x10^6$ Cfu/gm and $1.34x10^6$ Cfu/gm, respectively. Also Total Coli form count for the Ibine and Imo river were 1.0 $x10^6$ and 1.08 $x10^6$ cfu/gm. Total hydrocarbon utilizing bacteria was only detected in Imo river but no growth was observed in Ibine stream

ES 4.6: Soil study

The soil textural class of the soil samples obtained from designated locations within the SAPZ project communities was predominantly clayey except in Owaza Ukwa West LGA, with a sandy loam composition ranging from 23%- 85% %, and percentage ranges of silt and sand at 0.16- 20% and 20-78% % respectively.

The mean pH levels for the top and sub soil were 4.8±0.02 and 4.5±0.03 respectively. There was no significant difference between the pH of the topsoil (0-15cm) and the sub soil (15 – 30 cm). Top soil nitrate ranged from 0.02- 56.03 mg/kg and sub soil ranged from 0.04 to 4.74 mg/kg with of 3.5 and 2.4 mg/kg respectively.

ES 4.7 Soil Microbiology

Total heterotrophic bacteria (THB) had the highest plate counts of microorganisms in the soil samples followed by coliform bacteria, thus indicating that the proposed project area has some level of human faeces contamination**.**

ES 4.8 Aquatic Ecology

Phytoplankton

The major species of Chlorophyta recorded in Imo River and Ibine stream and their relative abundance at the three sampling points across the LGAs include *Amphora ovailis* (3.88%), *Ankistrodesmus falcatus* (2.70%) and *Coscinodiscus rothii* (2.38%). abundance) include *Eudorina sp*. (3.92%), *Tabellaria fenestrata* (3.77%), *Navicula ovalis* (3.42%), *Tabellaria nitzschoides* (3.67%) and (3.47%).

Zooplankton

A total of ninteen (19) were observed in Imo river and eleven(11) in Ibine stream in Bende in the samples. Copepoda was the dominant taxa across the two rivers sampled. The presence of these zooplanktons in a high proportion is indicative of water body experiencing environmental stress and anthropogenic impacts.

Benthos

A total of twelve (12) species were observed Imo River and nine (9) species in the Ibine Stream at Bende. A pollutant tolerant species *Lymnaea natalensis* was censored in sediments samples obtained in downstream and upstream Ibine stream Bende. Its occurrence suggests water bodies polluted by sewage, agricultural run-off and wastes.

Fish ad Fisheries

The study identified 14 fish species in Imo River belonging to 10 families while in Ibine stream Bende 10 species of fish belonging to 4 families were recorded. The taxa and families recorded in this survey are fewer as compared with the number recorded for other studies conducted on a number of rivers in Nigeria.

ES 4.9 Vegetation Study

In the study area, four distinct vegetation types were identified in Ukwa West and it includes: Riparian forest, Bush fallow, oil plantation and Farm plots. The riparian forest had the highest number of species. In Ikwuano two vegetation types were identified : farm plot and bush fallow. While in Bende three vegetation types were identified: farm plot, bush fallow and cocoa plantation. A review of the alien species data base for Nigeria showed that two (2) of these species (*Ageratum conyzoides*, and *Chromolaena odorata*) occur in the study areas. On the other hand, three (3) species (*Chromolaena odorata, Pennisetum purpureum* and *Mimosa pudica*) were invasive. The presence of these alien/invasive species in the study area signifies a disturbed ecosystem possibly from anthropogenic activities.

The IUCN status of the plant resources of studied area was evaluated using the IUCN red list version 2018 -2 criterion. Results showed that five species are of conservation concern. These are (a) *Alepidea cordifolia* (Endangered) and *Dichapetalum obanense*, *Dendrolobium umbellatum*, *Ricinidendron heudelotii* and *Lophira alata* in the Vulnerable category (VC). *Cordia dichotoma* was censored in Ukwa west and Ariam elu elu with an abundance of 4 and 5 individuals, respectively.

All the plant communities within the study area are secondary as most of the primary forest had been removed to allow for establishment of farms. The main crops grown in the study area are cassava, cocoyam, yams and corn. These serve as staples for communities within the study area.

ES-4. 10 Wildlife Study

Herpetofauna

Result showed that herpetofauna species were censored across the three habitat types in the study area.

Avian Fauna

Avian group found in the study area: *Alcedo leucgater (*White-bellied kingfisher), African march owl(*Asio capensis), Corythaeola cristata(*Blue plantain eater), *Halcyon malibica* (Blue kingfisher).

Mammals

The following mammals were observed: Maxwell's duiker (*Cephalophus maxwelli),* Common duiker(*Syvicapra grimmia)* Squerril (*Urocitellus columbianus)*

All sighted species were of Least Concern (LC) status using the IUCN Red list 2018 version two criterion

ES 4.11 SOCIOECONOMIC AND HEALTH ENVIRONMENT

Host Communities

A total three host communities in three LGAs viz Ukwa West , Bende and Ikwuano

The communities are Umuololo in Ukwa West , Okporoenyi Bende and Ariam Elu elu in Ikwuano LGA.

Location	Longitude	Latitude	Elevation	Place
Ariam elu elu	7.62249	5.34192	53	Town hall
Okporoenyi	7.599223	5.507741	51	Community hall
Umuololo	7.18476	4.96336	22	Palace of paramount ruler

ES 4.11.1 Summary of Baseline Result of the Socio-economic Environment of the Project Area

S/N	Socio-economic Information	Umuololo Community, Owaza	Ariam elu elu community Ikwuano	Okporoenyi Community Bende
1	Ethnicity	Igbo	Igbo	Igbo
2	Religion	Christianity	Christianity	Christianity
3	Estimated population	3000	2000	2,000
4	Gender Disposition	Male: 35.3% Female:34.5 % Children: 30.2%	Male: 31.4% Female: 34.9% Children: 33.7%	Male: 32.5% Female: 31.5% Children: 36.0%
5	Major Occupation	Farming, civil servant, artisans	Farming, civil servant, artisans	Farming, civil servant, artisans
6	Transportation System	Road	Road	Road
7	Electricity Source	National grid	National grid	National grid
8	Cultivated Crops	Cassava, yam, palm oil	Cassava, yam, palm oil	Cassava, yam, maize
9	Industries	Oil rigs	-	-
10	Educational Institutions	Public and private educational institutions	Public and private institutions	Public and private institutions
11	Healthcare Facility	Primary health care,	Primary health care	Primary health care
12	Common Ailments	Malaria: 80% Hepatitis: 5% Diabetes: 20%	Malaria: 80% Hepatitis: 5% Diabetes: 15%	Malaria: 80% Hepatitis: 5% Diabetes: 15%
13	Environmental Problem	Erosion, waste management	Erosion	Erosion problem, waste management
14	Toilet System	Pit toilet: 55% Bush: 15% Water closet: 30%	Pit toilet: 45% Bush: 15% Water closet: 40%	Pit toilet: 80% Bush: 10% Water closet: 10%

15	Waste Disposal	No proper waste management system	No proper waste management	No proper waste management
16	Household Fuel	Fuelwood kerosene	Fuel wood, kerosene	Fuel wood, kerosene
17	Potable Water Sources	Borehole, stream	Borehole, stream	stream
18	Average Monthly Income	1-50,000: 60% 51,000-100,000: 20% 101,000-150,000: 15% Above 150,000: 5%	1-50,000: 65% 51,000-100,000: 15% 101,000-150,000: 15% Above 150,000: 5%	1-50,000: 60% 51,000-100,000:20% 101,000-150,000 Above 150,000: 5%
19	Case of Involuntary Resettlement	None	None	None

4.11.2 Consultation

There have been consultations wih different stakeholders for the project. The consultation carried out so far are:

• Scoping Workshop was conducted by FMEnv, State Env., Host communities etc.

• Site visit by FEEnv and State Representatives

• ESIA fieldwork Study in identified host communities.

ES-5.0 POTENTIAL IMPACT

Potential and Associated Impacts

The Project activities will give rise to a range of impacts of varying magnitude and significance. The impacts for the short-term construction phase and the long-term operational phase were considered separately, where appropriate.

The assessment methodology used to assess the significance of impacts took into account impact magnitude and sensitivity of receptors and resources affected. Impacts were assessed pre-mitigation and a significance rating determined. Mitigation measures to

avoid, reduce, remediate or compensate for potential negative impacts and actions to be taken to enhance benefits were identified. Residual impacts were then assessed to As-Low-As- Reasonable-Practical (ALARP).

E.S 6.0 MITIGATION MEASURES

Mitigation Measures

A key objective of the ESIA was to develop and describe practical, appropriate and cost-effective mitigation and management measures that avoid, reduce, control, remedy or compensate for negative impacts and enhance positive benefits. The objectives of mitigation have been established through legal requirements or industry good practice standards and where standards were not available, project-specific standards have been established**.**

ES-7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

ESMP provides the means of assessing the accuracy of the predicted project impacts and the monitoring of the effectiveness of the proposed mitigation measures contained in the EIA report.

The specific measures addressing each significant/moderate impact:

Air Quality

- Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
- Regular cleaning of equipment
- Cover properly loose materials and keep top layers moist
- Speed limits on-site of 15kph on unhardened roads and surfaces
- Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, 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

- Ensure that effluent from the abattoirs and meat processing areas are treated before entering the public drainage channels.
- Rivers and streams shall not be dammed for the purpose of water abstraction
- Herbicides should not be used for vegetation clearing
- Avoid vegetation clearing along stream shores and on steep slopes

Management measures of employees-communities relationship

- 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 and 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 or within accommodation camps, or acquired from outside the camp while accommodated in the camp;
- 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.

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.

ES-8.0 Conclusion and Recommendation

The study has identified the environmental and social issues/impacts associated with the proposed project activities on the immediate environment. And, in order to minimize these impacts, appropriate mitigation, monitoring plan, implementation schedules and estimated cost for the ESMP implementation has been proffered. This ESIA has been prepared to ensure that the project is implemented in an environmentally and socially responsible manner thus promoting sustainability and project acceptability. It is therefore strongly recommended that the project be embarked upon as proposed.

CHAPTER ONE

INTRODUCTION

1.1 Project Background

The Abia state government through the State Ministry of Agriculture aims to improve food production and reduce poverty in the state. The ministry has planned to increase cassava production, establish a mega oil palm plantation and processing plant within Owaza community. The state also intends to establish cocoa, rice, soya bean and maize plantations and other sundry items at Bende Local Government area. There will be value addition on all the crops. The investment include a strategic combination of civil engineering, vegetation land management and other catchment protection measures and community led adaptive livelihood initiatives.

The Government of the Federal Republic of Nigeria through the Federal Ministry of Agriculture and Natural resources with assistance from the African Development Bank (AfDB) seeks to increase value addition to some staple agricultural products in Nigeria through the Special Agro– Industrial Processing Zones (Program). This funding support is to allow medium scale commercial farmers and their out growers to expand areas under cultivation for rice, soybean and maize. This integrated approach supports elements of growing at scale and provision of market outlets for smallholder farmers, especially women and youth.

The SAPZ program promotes increased productivity, value addition, market access and private sector investment in select agricultural value chain commodities. It prioritizes the development of agro-industrial activities and leverages existing and new private sector investments and take advantage of existing infrastructure assets. The focus is on the promotion of commodities that have a high potential to boost export revenues or

import substitution. The program is designed to enhance complementarity with existing or completed projects financed by the Bank including those in the power, transport, water and agriculture sectors

The Abia State government intends to leverage on this initiative of Federal government to increase food production in the state and increase food supply and export.

This Draft ESIA report was produced after scooping workshop, fieldwork study and laboratory analysis of the sampled components. The report documents the findings of the ESIA and include Environmental and Social Management Plan (ESMP) to implement all the mitigation measures for all significant impact of the project.

This introductory chapter presents an overview of the project, outlines the approach to undertake the ESIA. In addition, the legal and policy framework for the ESIA is also outlined in this chapter.

1.2 The Proponent

The proponent is the Abia State government through the Ministry of Agriculture and Natural Resources. The state government has just developed an Industrial Innovation Park aimed at playing an integral role in Nigeria's green energy transition to cleaner energy with active participation in the low carbon transition without compromising returns. A major component of the industrial park is to create an agricultural hub for value addition of farm produce and enhance export of agricultural commodities.

EIA Consultant: The state Ministry, has sought for immediate assessment of Environmental and Social Impact of this project on the communities in compliance with national laws and African Development Bank directives. Epic –Agro Consults Ltd has taken the responsibility to conduct the Environmental and Social Impact Assessment (ESIA) on the communities that will be affected by this project. Epic Agro is located at No. 17 Covina Cresent Suncity Estate Galadama Abuja FCT.

1.3 Project Location

The project will generally cover the tropical ecological zone of Abia state of Nigeria and be integrated in the Abia Industrial and Innovation Park(AIIP). Specifically the project will focus on the 3 local government areas of Abia state (Bende , Ikwuano and Ukwa West) that have the potential for oil palm, cocoa, maize, rice and soya production. It is also imperative to consolidate the gains of other programmes and projects that operated or are operating in these LGAs.

The communities are Umuololo Owaza in Ukwa West , Okporoenyi in Bende and Ariam elu elu in Ikwuano

Table 1.1 GPS coordinates of the Abia SAPZ project communities.

s/n	Location	Longitude	Latitude
1	Owaza	7.189096	4.964465
2	Ariam Elu elu	7.62064	5.34111
3	Okporo Enyi Community	7.599223	5.507741

1.4. Project Objectives:

The SAPZ Program goal is to increase household incomes, foster job creation in rural agricultural communities, especially for youth and women, and enhance food and nutritional security in Nigeria. The development objective is to support inclusive and sustainable agro-industrial development. The SAPZ Program interventions will seek to enhance the competitiveness of selected value chains. This will be achieved through increased productivity, aggregation and reliable supply of quality raw materials, value addition, market access and private sector investment.

The project also hope to increase production of staple food crop (particularly maize, cassava, soya rice, cocoa and oil palm), contribute to industrialization, youth

employment and food security. The project is expected to contribute to the Government's industrialization agenda, support skills development and entrepreneurship for women and youth, and build resilient food systems in the tropical ecological zone of Nigeria.

1.5 Purpose of the ESIA

The aim of Environmental and Social Impact Assessment (ESIA) is to establish the impact of the Project on the biophysical environment of the project area, socio economics and health of the communities in the project area, and propose mitigation measures necessary to carry out the project with minimum harm to the environment and the people. The specific objectives are to:

- Ensure compliance with Nigeria national environmental regulations and policies, African Develop bank and IFAD Standard industry best practice and standards;
- Establishe the baseline environmental, social and health conditions of the project area;
- Assess the potential impacts of the proposed Project on the environment;
- Proffer appropriate mitigation measures for negative impacts to be undertaken at various project phases;
- Proffer means of enhancing and sustaining beneficial impacts of the projects on the environment;
- Development of control strategies with a view to mitigating and ameliorating significant impacts;
- Identify existing and expected environmental regulations that will affect development and advise on standards limit, consents, and targets;
- Identify any environmental aspects and concerns that may in future affect development;
- Provide the basis for cooperation and consultation with stakeholders;

- ❖ Develop cost effective Environmental and Social Management Plan (ESMP) as well as provide recommendations for monitoring and management activities.

1.6. SCOPE OF WORK

1.6.1 Project Scope: The Abia State SAPZ project intends to re-establish special intervention crops such as oil palm, cassava, cocoa for local consumption and export in Owaza Ukwa West and in Bende LGA. The project will involve special agricultural processing activities with focus on value addition on the staple agricultural crops for local consumption and export purposes.

1.6.2: ESIA Scope of Work:

The scope of work for the proposed project as approved by FMEnv, consists of one season field work which was conducted from 5th March 2024 – 12th March 2024. Technical data and published studies in the project area were reviewed.

The tasks carried out include:

I. Project Registration and Screening;

II. Project Scoping Workshops;

III. Field Sampling Work;

IV. Laboratory Analysis of Field Samples;

V. Impact Study of the proposed project on the environment;

VI. Develop cost effective Environmental Management Plan (EMP);

VII. Produce ESIA Report

1.7: EIA PROCESS IN NIGERIA

The ESIA for this project was undertaken in accordance with the Environmental Impact Assessment Act CAP E12 LFN, 2004). The overall ESIA key steps as highlighted in **Figure 1.1** are listed below:

- Project Registration;
- Screening;
- Scoping;
- ESIA Execution: Baseline Data Collection and Stakeholder Engagement;
- Review of ESIA Report and Approval;
- Impact Mitigation Monitoring (IMM).

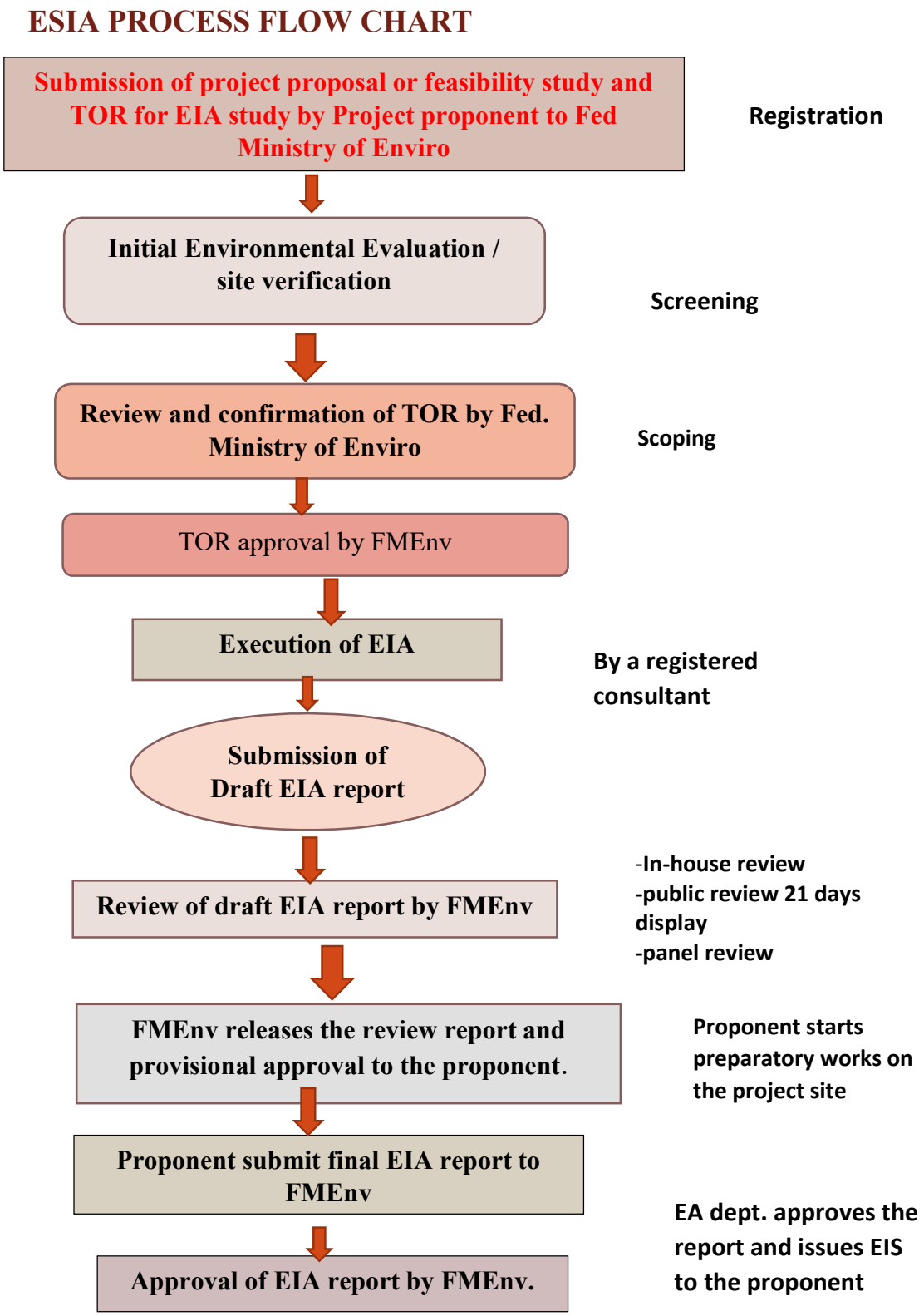

Figure 1.1 ESIA Process Flowchart Source: https://ead.gov.ng/eia-process-flowchart.

1.7.1 A brief Description of the key ESIA step:

Project Registration

Registration of the project by the proponent is the first step of the ESIA process.

The proponent will obtain ESIA Proposal form from Federal Ministry of Environment (FMEnv and submitted the form back to FMEnv after filling it with the project Scope of Work and Term of Reference (SOW/TOR).

Screening

Screening is done to determine whether a project requires an ESIA or not and the level of assessment to be carried out.

Screening is the Initial Environmental Evaluation (IEE) of the project, it included site verification of the project site by officials of FMEnv. This will enable Federal Ministry of Environment (FMEnv) for their Initial Environmental Evaluation (IEE) to determine the project's category under the ESIA study activities list.

Scoping

Scooping activities involve review and confirmation of the scope of Terms of Reference (TOR) by FMEnv. One of the main objectives of scoping is to identify the potentially significant environmental issues relating to the proposed development that should be addressed as part of the ESIA. This enables the Project Proponent to address the key issues from the outset and also allows early recognition of these issues in the design and evolution of the project.

Scoping is the stage in the Environmental Impact Assessment process that makes the general public and NGOs aware of a proposed project and allows them to air their opinions about the project. During scoping, the key issues and impacts that should be further investigated are identified. This identification is based on legislative requirements, international conventions, expert knowledge, and public involvement. The boundary and time limit of the study is also set.

1.7.2 ESIA Execution

This is the Baseline study of the project site and environment. In this stage, comprehensive study of the project site and its environment are carried out. Components studied include the physico-chemical environment (climate, meteorology, geology, soil type and distribution, groundwater characteristics, air quality, and noise levels); biological environment (location and distribution of flora and fauna wildlife characteristics); socio-economic and health conditions describing the demography, culture, heritage sites, social and health status of the people and their environment.

The ESIA is executed by a registered consultant of FMEnv under the supervision of FMEnv. The ESIA execution involves fieldwork, stakeholder engagement, laboratory analysis of samples, data analysis, impact assessments, Environmental Management Plant (EMP) and report writing.

Stakeholder Consultation: The objective of the consultation process was to present the proposed project to various stakeholders and their concern.

The following tasks were undertaken:

- identification of a preliminary list of stakeholders;
- compilation of background information document (BID) for use in communicating with stakeholders;
- meetings with a number of government departments and stakeholder groups; and
- various focus group meetings with local community members.

Impact Analysis: Here, all significant environmental, social and economic impacts of the proposed project are identified and predicted including the detailed elaboration of alternatives to the project design.

Impact Mitigation: After all, impacts have been predicted and identified, actions to reduce the level of environmental damage and to avoid the potential adverse consequences of the proposed project are recommended.

Environmental Management Plan (EMP): The range of different measures to mitigate impacts identified through the ESIA process is reported in the ESIA report within the project description and mitigation chapters. These have been brought together in a provisional EMP for the project (see Chapter 7). The plan details the specific actions that are required to implement the controls and mitigation measures that have been agreed through the ESIA process.

Report: The outputs of the above tasks are drawn together into the draft ESIA report and submitted for review, comments and approval by FMEnv. The outcome of the review will inform all the necessary corrections before re- submitting the report for final approval of the project ESIA

Review of Draft ESIA Report

ESIA report review undergoes internal review, external review, and formal public hearing. A public hearing is carried out by the stakeholders - those that will be affected by the project in one way or the other. This includes members of the community where the project is to be sited, NGOs, Local government, State Government etc.

Decision-making

At this stage, a project can be approved, rejected, or subjected to further change. A project is approved if all concerns raised during the review were addressed by the ESIA team or if all significant adverse effects have been properly mitigated.

Project Monitoring

Impact Mitigation Monitoring (IMM) is carried out during project implementation to ensure the mitigation measures proposed in the ESIA study is carried out.

1.8 POLICY, ADMINISTRATIVE AND LEGAL FRAMEWORK

Federal Ministry of Environment (FMEnv) is the sole regulatory body empowered to regulate the conduct of ESIA studies in Nigeria, they derive their power from the EIA

Act of 2004. The project activities are also regulated by several statutory guidelines and standards laws both in Nigeria and international and they are reviewed in this section.

1.8.1. National Policy

National Environmental Policy

Launched by Government in November 1989, this document prescribed guidelines for achieving sustainable development in fourteen vital sectors of the nation's economy, namely: Human Population; Land Use and Soil Conservation; Water Resources Management; Forestry, Wildlife and Protected Natural Areas; Marine and Coastal Area Resources; Sanitation and Waste Management; Toxic and Hazardous Substances; Mining and Mineral Resources; Agricultural Chemicals; Energy Production; Air Pollution; Noise in the Working Environment; Settlements; Recreational Spaces, Green Belts, Monuments, and Cultural Property.

It also contains Nigeria's commitment to ensure that the country's natural and built environment is safeguarded for the use of present and future generations. This commitment demands that efficient resource management and minimization of environmental impacts be the core requirements of all development activities.

Accordingly, this Policy seeks to promote good environmental practices through environmental awareness and education.

Some specific regulations include:

The S.I.9 is cited as National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991.

- National Environmental (Sanitation and Wastes Control) Regulations, S.I.28 of 2009,
- National Environmental (Noise Standards and Control) Regulations, S.I.35 of 2009;
- National Environmental (Surface and Groundwater Quality) Regulations, S.I.22 of 2011;
- National Environmental (Electrical/Electronic Sector) Regulations, S.I.23 of 2011;

• National Environmental (Control of Bush/Forest Fire and Open Burning) Regulations, S.I.15 of 2011; and

• National Environmental (Soil Erosion and Flood Control) Regulations, S.I.12 of 2011.

The project will have effects on biophysical and human environment, as a result it shall comply with the relevant provisions of this policy.

1.8.2 Legal Framework

The major laws of interest for this project are:

1. Environmental Impact Assessment (EIA) Act CAP E12 LFN, 2004

This Act provides the guideline for activities or development projects for which EIA is mandatory in Nigeria. Such development include crop production and Agro processing plants.

Pursuant to this act the EIA Act No 86 sets out the procedure for prior consideration of environmental issues in certain categories of public and private development projects. These categorizations are based on the environmental and social risks and impacts of a proposed project in relation to the magnitude of the risks and impacts. The proposed project has been assessed as Category I by the FMEnv based on the site visit/verification conducted by the representatives of Regulators.

Supplements to the EIA Act are Sectoral Guidelines that includes some of the following:

- ❖ Sectoral Guidelines for Waste Management Facility (FMEnv Sectoral Guidelines, 1995).
- ❖ Material Guidelines for Registration of Environmental Products and Eco-Labelling (FMEnv Sectoral Guidelines, 1995).
- ❖ National Guidelines on Waste Disposal Through Underground (FMEnv Sectoral Guidelines, 1995)
- ❖ National Guidelines on and Standards for Water Quality (FMEnv Sectoral Guidelines, 1995).

The EIA guidelines (procedural and sectoral) issued by the FMEnv derived from this Act and the project proponent shall conduct its activities for the development of this project in conformance with these guidelines.

2. Federal Ministry of Environment (FMEnv)

Set up by Presidential Directive No. Ref. No. SGF.6/S.221 of October 12, 1999 and empowered with regulation of all environmental matters protecting, enhancing and preserving the Nigerian environment, Carries out the Federal Executive Council decisions on environmental matters. Focal point and designated National Authority for the implementation of various international laws on environmental protection/conservation.

- ❖ Mandated to co-ordinate the environmental protection and conservation of natural resources for sustainable development in Nigeria some of which are:
- ➢ Monitor and enforce environmental protection measures;
- ➢ Enforce international laws, conventions, protocols and treaties on the environment;
- ➢ Prescribe standards and make regulations on air quality, water quality, pollution and effluent limitations, the atmosphere and ozone layer protection, control of toxic and hazardous substances; and
- ➢ Promote cooperation with similar bodies in other countries and international agencies connected with environmental protection.

The act establishing the Ministry places on it the responsibility of ensuring that all development and industry activity, operations and emissions are within the limits prescribed in the National Guidelines and Standards and comply with relevant regulations for environmental pollution management in Nigeria as may be released by the Ministry. To fulfil this mandate, a number of regulations/instruments have been churned out such as outlined below. Thus, in line with her mandate, the Ministry has developed far reaching legal instruments for achieving environmentally sound

management of resources and sustainable development across all major sectors of the economy.

These regulatory instruments are enforced through the activities of the following agencies:

- National Oil Spill Detection and Response Agency (NOSDRA) established under Act of 2006 as lead agency on oil spillage matters with clear mandate to administer the National Oil Spill Contingency Plan (NOSCP).
- National Environmental Standards and Regulations Enforcement Agency (NESREA) [with Gazette No. 92, Vol. 94 of 31st July, 2007 established with 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.

3. Land Use Act Cap L5, LFN 2004

The Land Use Act (Cap 202, 1990), now Cap L5 Laws of the Federation of Nigeria 2004, is the key legislation that has direct relevance to this project. Relevant sections of these laws that may relate to this project with respect to land ownership and property rights, resettlement and compensation are summarized in this section.

The Land use Act places the ownership, management and control of land in each state of the federation in the Governor. Land is therefore allocated with his authority for commercial, agricultural and other purposes. The Land use Act of 1978 as amended by Land Use Act Cap L5, LFN 2004 states that'… It is also in the public interest that the rights of all Nigerians to use and enjoy land in Nigeria and the Natural fruits thereof in sufficient quality to enable them to provide for the sustenance of themselves and their families should be assured, protected and preserved'. This implies that acts that could

result in the pollution of the land, air, and waters of Nigeria negates this decree, and is therefore unacceptable.

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

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

But the limit of such grants is 500 hectares for agricultural purposes and 5,000 for grazing except with the consent of the Governor. The local Government, under the Act is allowed to enter, use and occupy for public purposes any land within its jurisdiction that does not fall within an area compulsorily acquired by the Government of the Federation or of relevant State; or subject to any laws relating to minerals or mineral oils.

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

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

Payment of such compensation to the holder and the occupier as suggested by the Act may appear confusing as it raises the following question: Does it refer to holder in physical occupation of the land or two different parties entitled to compensation perhaps in equal shares? The correct view appears to follow from the general tenor of the Act. First, the presumption is more likely to be the owner of such unexhausted improvements. Secondly, the provision of section 6(5) of the Act, which makes compensation payable to the holder and the occupier according to their respective interests, gives a pre-emptory directive as to who shall be entitled to what.

Also, the Act provides in section 30 that where there arises any dispute as to the amount of compensation calculated in accordance with the provisions of section 29, such disputes shall be referred to the appropriate Land Use and Allocation Committee. It is clear from section 47 (2) of the Act that no further appeal will lie from the decision of such a committee. If this is so, then the provision is not only retrospective but also conflicts with the fundamental principle of natural justice, which requires that a person shall not be a judge in his own cause. The Act must, in making this provision, have proceeded on the basis that the committee is a distinct body quite different from the Governor or the Local Government. It is submitted, however, that it will be difficult to persuade the public that this is so since the members of the committee are all appointees of the Governor.

Where a right of occupancy is revoked for public purposes within the state of the Federation; or on the ground of requirement of the land for the extraction of building materials, the quantum of compensation shall be as follows:

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

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

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

Where the right of occupancy revoked is in respect of a part of a larger portion of land, compensation shall be computed in respect of the whole land for an amount equal in rent, if any, paid by the occupier during the year in which the right of occupancy was revoked less a proportionate amount calculated in relation to the area not affected by the revocation; and any interest payable shall be assessed and computed in the like manner. This project will require acquisitions of land for the expansion of plantations and farm plots. Hence, will comply with the requirements of this law.

4. The Harmful Waste (Special Criminal Provision etc.) Act 1988, CAP H1, LFN 2004

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

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

- Section 7 makes provision for the punishment accordingly, of any conniving, consenting or negligent officer where a company commits the offence.
- Section 12 defines the civil liability of any offender. He would be liable to persons who have suffered injury as a result of his offending act.

This Act is essentially a penal legislation. The offenses are committed by doing any of the acts or omissions stated in section 12 of the act. The jurisdiction of the Act is far reaching as it sought to remove any immunity conferred by diplomatic immunities and privileges Act on any person for the purpose of criminal prosecution.

The project will generate wastes including construction wastes and transformer oils at SAPZs and other harmful wastes. These wastes shall be handled, treated, and disposed of in accordance with the relevant requirements of this Act.

5. National Environmental Standards and Regulations Enforcement Agency (NESREA) Act, 2007

The Federal Government in line with Section 20 of the 1999 constitution of the Federal Republic of Nigeria established the National Environmental Standards and Regulations Enforcement Agency (NESREA) as a parastatal of the Federal Ministry of Environment.

NESREA has the mandate to enforce compliance with laws, guidelines, policies and standards on environmental matters.

Section 7 provides the Agency authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitoring and regulatory measures.

- Section 8 (1)(K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation.
- Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment.

The Act also enables the Agency to:

- Prohibit process and use of equipment or technology that undermine environmental quality;
- Conduct field follow-up of compliance with set standards and take procedures prescribed by law against any violator.

NESREA has, over the past years, provided at least 24 regulations gazette as supplementary in its Act. Some of these include:

- National Environmental (Surface and Groundwater Quality Control)

Regulations, S. I. No. 22 of 2011.

- National Environmental (Sanitation and Wastes Control) Regulations, S. I. No.28 of 2009.
- National Environmental (Ozone Layer Protection) Regulations, S. I. No. 32 of 2009.
- National Environmental (Noise Standards and Control) Régulations, S. I. No. 35 of 2009.
- The National Effluent Limitation Regulation, S1.8 of 1991 (No 42, Vol. 78, August, 1991).

This project will comply with NESREA regulations, including conducting ESIA, environmental audit every three years after commissioning, obtain permit before disposing of hazardous wastes, etc.

1.8.3 Statutory Guidelines and Standards

I. National Effluent Limitation Regulations 1991. This Act was issued in 1991. It provides national Guidelines and Standards for industrial effluents, underground water pollution, gaseous emissions, noise, air quality and hazardous wastes management for Nigeria.

II. National Environmental Protection (Pollution and Abatement in Industries and

Facilities Producing Waste) Regulations, 1991.

Provide general guidelines for the containment of pollution in industries that generate harmful wastes.

These include:

a. Regulations S.1.8, S.1.9, S.1.15 of 15 August 1991

b. National Environmental Protection (Effluent Limitation) Regulations S.I.8 (FEPA, 1991).

c. National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations – S.I.9 (FEPA, 1991).

d. National Environmental Protection (Management of Solid and Hazardous Wastes) Regulation S.I.15

III. Harmful Waste Act No. 42 of 25 November 1988; Harmful Wastes (Special Criminal Provisions etc.) The Guidelines and Standards on waste disposal provide the modus operandi for the most viable options for the disposal of harmful wastes in a tropical environment as Nigeria.

IV. Factories Act CAP 126 LFN 1990

The Act makes provision for health and safety of persons employed in places statutorily defined as factories and for which a certificate of registration is required by law. It requires that workers should be adequately protected from occupational health and safety hazards.

V. The Endangered Species Act, CAP E9, LFN 2004

This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction as a result of over exploitation.

These sections are noteworthy:

• Section 1 prohibits, except under a valid license, the hunting, capture or trade in animal species, either presently or likely, in danger of extinction.

• Section 5 defines the liability of any offender under this Act

• Section 7 provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.

The crops will be grown on natural areas that serve as wildlife habitats which will be impacted by the project. Hence, the project activities shall be carried out to comply with relevant provisions of this Act.

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

The factories Act, as contained in the Laws of the Federation of Nigeria 1990, seeks to legislate, and regulate the conduct of health and safety in the Nigerian workplaces. It was enacted in June1987 with the desire to protect the workers and other professionals against exposure to occupational hazards. The director of factories at the Federal Ministry of Employment, labor and productivity is responsible for the administration of the provisions or requirements of this Act. Section 13 allows an inspector to take emergency measures or request that emergency measures be taken by a person qualified to do so, in cases of pollution or nuisances.

This Act deals with working conditions at work sites, including construction sites, such as the type to be undertaken under the Project. Hence, the occupational health and safety requirements applicable to construction sites, as well as other work sites to be used by the project shall be subjected to the provisions of this Act.

VII. Labour Act - CAP. L1 L.F.N. 2004

This Act deals with labour issues, including payment of wages, recruitment, discipline, employee welfare, employment of women and child labour.

Sections 54 to 58 which deal with employment of women, prescribed period of absence from work for nursing mothers and allows her half an hour twice a day during her working hours to attend to the baby for a period of up to six months after she resumes work. Section 55 also exempted women from night work, except when they are employed as nurses. Sections 59-64 deal with employment of young people.

VIII. Workers' Compensation Act, 1987

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

IX. Nigeria's Industrial Policy 2021.

X. National Policy on Environment 2017.

XI. Nigerian Criminal Code Cap C38, LFN 2004.

XII. Fire and Rescue Service Act 2004.

XIII. National Guidelines for Environmental Audit 2011.

XIV. Abandonment Guidelines 1995.

XV. National Policy on Occupational Safety and Health, 2016.

XVI. The Gender Policy Framework in Nigeria.

The 1999 Constitution OF the Federal Republic of Nigeria prohibits discrimination based on places of origin, sex, religion, status, ethnic or linguistic association. Successive governments have always demonstrated commitment to upholding this and to promote gender equality and women's empowerment in varying degrees. To facilitate gender equality and women's empowerment, the FGN created favorable national legal and policy frameworks and put in place institutional mechanisms in this regard. Moreover, Nigeria, as a member of the United Nations, signed and ratified the various relevant international instruments, treaties and conventions without reservation. These instruments have always emphasized that member nations put in place the necessary mechanisms needed to eliminate gender discriminations, ensure equality and human dignity to all men and women. The government of Nigeria in 2000 adopted a National

Policy on Women, in 2006; it was reviewed and upgraded 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 of the immediate past administration who in developing the Vision 2020, had a 'Special Interest Group on Women' to oversee –the development of policy statements that engender 'sustainable human and national development built on equitable contribution of the Nigerian women, men and children'

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 in 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 participation of women in leadership and decision-making;
- Ensure that through labour legislation and collective bargaining, the particular circumstances of women are considered and that measures are promoted to eliminate discrimination on the basis of gender;
- Ensure that there is a gender perspective in all sectors of development

1.8.4. STATE LEGISLATION

The Nigerian Constitution allows States to make legislations, laws and edicts on the

Environment. These State Environmental Protection Agencies may participate in regulating the consequences of project development on the environment in their areas of jurisdiction. State Environmental Protection Agencies thus have the responsibility for environmental protection at the state level within their states. The functions of the SEPAs include:

- Routine liaison and ensuring effective harmonisation with the Federal Ministry of Environment in order to achieve the objectives of the National Policy on the Environment;
- Co-operate with other relevant National Directorates/Agencies like Nigeria Port Authority in the promotion of environmental education;
- Be responsible for monitoring compliance with waste management standards;
- Monitor the implementation of the EIA and the Environmental Audit Report (EAR) guidelines and procedures on all developments policies and projects within the State.

1. Abia State Environmental Protection Agency

Abia State Environmental Protection Agency –ASEPA is an agency charged with protecting the environment in the State. Specifically, to coordinate the waste management aspect of the Protection Agency environment, domestic and industrial pollution control and ensures Environmental Compliance to environmental laws in the State.

1.8.5. International Standards, Treaties and Conventions

Apart from the National Laws, Acts and Regulations, Nigeria is a signatory or party to many International Environmental Conventions and Treaties that are relevant to the agricultural sector. A list of some of the relevant International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria are presented in Table .1.2

Table 1.2 : Selected international agreements and conventions to which Nigeria is a signatory

s/n	Regulations	Year adopted
1	United Nations Framework Convention on Climate Change (UNFCCC)	1992
2	Basel Convention on the Control of Tran boundary Movements of Hazardous Wastes and their Disposal	1989
3	Montreal Protocol on Substance that Deplete the Ozone Layer	1987
4	Vienna Convention on the Ozone Layer	1985
5	Convention on Conservation of Migratory Species of Wild Animals	1979
6	Convention on the Protection of the World Cultural and Natural Heritage (world Heritage Convention), Paris	1975
7	Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES)	1973
8	ILO c155 and R164 2001; Management of workplace Health and Safety and Controlling Workplace hazards	
9	Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) (Signatory only)	1968
10	African Convention on the Conservation of Nature and Nature Resource	1968
11	Paris Agreement	2015

1.8.5.1 The African Development Bank (AfDB).

The E&S safeguards of the AfDB are a cornerstone of the Bank's support for inclusive economic growth and environmental sustainability in Africa. The Bank's Integrated Safeguard Systems (ISS) is designed to promote the sustainability of project outcomes

by protecting the environment, social conditions and people from the potentially adverse impacts of projects. The ISS consists of four interrelated components as summarized in Figure Fig.1.2

Integrated safeguards policy statement		**Declaration of commitment to environmental and social sustainability and to reducing risk of non compliance**
Operational safeguards		**Short and focused policy statements that follow Bank commitments and establish operational parameters**
ESAP revised procedures		**Procedural and process guidance (documentation, analysis, of project cycle**
Guidance notes revised IESIA guidelines		**Detailed (methodological, sectoral and thematic) guidance on integrated environmental and social impact assessment**

Figure 1.2 : Structure of the AfDB ISS

1.8.6 The Integrated Safeguards Policy Statement

This describes common objectives of the Bank's safeguards and lays out policy principles. It is designed to be applied to current and future lending modalities and it considers the various capacities and needs of regional member countries in both the public and private sectors. The Bank's Integrated Safeguards Policy Statement sets out

the Bank's own commitments to and responsibilities for delivering the ISS: to ensure the systematic assessment of E&S impacts and risks.

1.8.7 Operational Safeguards (OSs)

These are a set of five safeguard 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 requirements to enhance effectiveness, respond to changing needs, and reflect evolving best practices. The five OSs are presented in Table . The OSs are 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, minimize, mitigate and/or compensate for adverse effects and maximize 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 1.3: AfDB Operational Safeguards OS 1-5

Operational Safeguards	Description	Triggered/Not Triggered	Applicability to proposed project.
OS. 1: Environmental and social assessment	This overarching safeguard governs the process of determining a project's environmental and social category and the resulting	Triggered	The development and rehabilitation of agriculture infrastructures, which may pose Environmental and social risks. SAPZ risks will be managed throughout the implementation of mitigation measures prescribed in the site specific ESMPs
OS. 2: Involuntary Resettlement: Land Acquisition, Population Displacement and compensation	This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement and incorporates a few refinements designed to improve the operational effectiveness of those requirements	triggered	The project will not acquire lands since interventions will focus on only existing farmers and value chain actors. However, the project implementation could restrict locals or herders from accessing lands that are used as pasture lands.
OS. 3: Biodiversity and Ecosystem Services	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements.	Triggered	The proposed interventions will involve extraction of natural resources including use of water, soils (e.g., commercial harvesting, agriculture,
OS. 4: Pollution Prevention and	This safeguard covers the range of key impacts of pollution, waste and	Triggered	Agriculture development activities

Control, Greenhouse Gases, Hazardous Materials, Resource Efficiency	hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow		will involve the use of improved application of fertilizers and agro-chemicals, as well as result in the production of agriculture wastes. These will be managed as per measures prescribed in the ESMP
OS. 5: Labour Conditions; Health and Safety	This safeguard establishes the Bank's requirements for its borrower's or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks	Triggered	The Contractor shall comply with the Labour laws and Occupational Health and Safety Best Practice

1.8.8 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 operations conform to the requirements laid out in the operational safeguards (OS) and are thus sustainable.

1.8.9 E&S Assessment of Nigerian Policies and Legislations and AfDB Safeguard Systems

The Nigerian E&S Safeguards system addresses most of the key elements of E&S Safeguards for projects involving multiple subprojects, 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 overlapping functions of different agencies in relation to enforcement of these policies, guidelines, regulations and legislative provisions. To ensure E&S safeguard during project implementation, both the Nigerian and AfDB E&S safeguard systems will be implemented. However, in the event of divergence and gaps between the two regulations the AfDB safeguard system with the more stringent requirement will take precedence (table 2.4)

Table 1.4: Benchmarking of Nigerian Legal Provisions and AfDB ISS specifications.

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by Abia SAPZ
ESMF for Projects Involving multiple subprojects	Not a national Requirement	OS1: Environmental and social assessment	OS 1: Environmental and social assessment
Screening	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: 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	EIA Procedural Guidelines, 1995 EIA Sectoral Guidelines for	IESIA Guidance Notes ESAP	ESIA Guidance Notes ESAP

Assessment Guidelines	Power Sector, 2013		
Environmental Categorization	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 004	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 provision of IESIA Guidance Notes on consultation)	OS 1 (include provision of IESIA Guidance Notes on consultation)
Involuntary Resettlement Compensation	Land Use Act CAP L5 LFN 2004-Acquisition of Land Access Rights for Electricity Projects Regulations, 2012Cash compensation Is generally made based Upon Market value. Whilst in principle there is allowance for in-kind Compensation or Replacement of assets, Cash	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation OS 2: Affected Persons are compensated for all their losses at full replacement cost. They can be offereda range of different compensation packages, resettlement assistance & livelihood improvement options.	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation 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

	compensation is common practice		
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	Operational safeguard 4– Pollution prevention And control of, hazardous Materials and resource efficiency	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency
Greenhouse Gases	National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991	Operational safeguard 4– Pollution Prevention and control, hazardous Materials and resource Efficiency (Special screening for GHGs is also considered under OS 1)	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency (Special screening for GHGs is also considered under OS 1)
Waste and Hazardous Materials	- National Environmental Protection (Management Of Solid and Hazardous Wastes) Regulations, 1991 -Harmful Wastes (Special Criminal Provisions etc.)	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency

	Act CAP HI LFN 2004		
Resources and Conservation	Natural Resources Conservation Act CAP 349 LFN 1990	Operational safeguard 3: Biodiversity and Ecosystem Services	Operational safeguard 3: Biodiversity and Ecosystem Services
Labour Conditions	Employee Compensation Act,2010 Labour Act, 1990	Operational safeguard 5 – Labour conditions, health and safety	Employee Compensation Act,2010 Labour Act, 1990
Health and Safety	Factories Act (CAP F1), 2004	Operational safeguard 5– Labour conditions, health and safety	Operational safeguard 5 – Labour conditions, health and safety
Natural Habitat and Biodiversity	Forestry Law CAP 51 LFN 1994 Endangered Species (Control of International Trade and Traffic) Act. No. 11 of 1985. Natural Resources Conservation Act CAP 349 LFN 1990	Operational safeguard 3: Biodiversity and Ecosystem Services	Operational safeguard 3: 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 the social and political constraints and barriers that women may face	There is the need for the project consider the implications of the AfDB Gender Marker System and how to design and implement an appropriate Gender Action Plan for the sub projects

Vulnerable Groups	Some Nigerian policies address the needs of vulnerable people, such as the Gender Policy, Child Actor 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.
Differentiated Measures for 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

1.9. INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

Special Agro processing zone, AfDB, Project Implementing Unit (PIU) shall be responsible for implementation of ESMP of this ESIA in liaison with other relevant stakeholders which shall be directed by the Financier (AfDB) through SAPZ. These include the following:

1.9.1 The Federal Government of Nigeria

Section 20 of the constitution of Nigeria makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively,

can also be linked to the need for a healthy and safe environment to give these rights effect. The executive council of the federation approves all national policies including the National Policy on Environment.

1.9.2 . Federal Ministry of Environment

The Federal Ministry of Environment is responsible for implementation of the overall environmental policy of the Country. It has the responsibility for verification of the project sites during this study. The Ministry will be responsible for review and disclosure of this ESIA report and its implementation through panel review with experts, issuance of approval to next phase of project implementation, Monitoring the Impact mitigation processes during ESMP implementation by the contractor and finally certification at the end of the project cycle. The Ministry will also be responsible for Environmental Audit monitoring review and compliance enforcement, along with waste management in the operation phase and in the decommissioning phase. They will enforce waste Management in line with all the laid down Regulations and guidelines of Conventions to which each identified waste shall belong, e.g. Basel, Stockholm, and Montreal protocols, climate change, etc, as it relates to Livestock processing and other allied businesses

1.9.3 The Federal Ministry of Agriculture and Rural Development (FMARD)

The Federal Ministry of Agriculture and Rural Development (FMARD), is a Ministry of the Nigerian government that regulates agricultural research, agriculture and natural resources, forestry and veterinary research all over Nigeria through its agencies and departments such as the Federal Department of Fisheries and Federal Department of Livestock.

1.9.4 National Agricultural Land Development Authority Act

An Act of 7th May 1992 established the National Agricultural Land Development Authority to provide, among other things, strategic public support for land development.

The Nigerian Institute of Animal Science was established by the National Assembly Act No. 26 of 2007 under the Federal Ministry of Agriculture and Rural Development as a regulatory agency for Animal Science practice with powers to regulate all matters pertaining to Animal husbandry in Nigeria.

1.9.5 Federal Ministry of Science and Technology (FMS&T) Parastatals

1.9.5.1 The National Centre for Genetic resources and Biotechnology

The National Centre for Genetic Resources and Biotechnology (NACGRAB) was established in 1987 by the Federal Ministry of Science and Technology (FMS&T) to conduct research, gather data and disseminate technological information on matters relating to genetic resources conservation, utilization and biotechnology applications. The Centre, backed by Decree 33 of 1987 regulates the seed, livestock and fisheries industries.

1.9.5.2 The National Biotechnology Development Agency (NABDA) (2001).

The Agency was established under the aegis of the Federal Ministry of Science and Technology to implement the policy that is aimed at promoting, coordinating, and setting research and development priority in biotechnology for Nigeria. Part of its specific mandates is to undertake research, development and innovation, promotion and deployment of appropriate biotechnologies for increased productivity and value chain development to enhance sustainable agriculture and food security.

1.9.6 Federal Ministry of Health Parastatal

1.9.6.1 National Agency for Food and Drug Administration and Control (NAFDAC),

NAFDAC has power under its enabling law to conduct appropriate tests and ensure compliance with designated and approved standard specifications, including the investigation and inspection of facilities and raw materials used in the production of food, drugs, cosmetics, medical devices, and chemicals. It also has power, among others,

to prevent the dumping of substandard and unwholesome regulated products and unwholesome processed foods into Nigeria and determine the suitability or otherwise of medicine, drugs, food products, cosmetics, medical devices or chemicals for human and animal use.

The quality and safety of food, drugs and other regulated products consumed by Nigerian consumers (whether locally or internationally produced and whether they emanated from conventional or biotechnological processes) and protection from health risks are publicly regulated and achieved through:

- standard setting ;
- information control ;
- the imposition of criminal liability on any person who produces any food or drug that is found to be "fake," "adulterated," "counterfeit," "expired," "substandard," and "unhealthy and unwholesome" ;
- this is further complemented by another provision extending liability to those selling or offering to sell, display, aid or abet any person to sell, produce, import, manufacture, sell or distribute food or drug, medical devices, cosmetics and chemicals which are injurious to health or adjudged to be fake, adulterated, banned or fake, substandard or expired.

Nigeria adopts the food safety standards set out in the Codex Alimentarius of the FAO in the banning of importation of foods. Consistent with this standard, Nigeria continues to ban imports of all:

- bovine animal meat and edible offal (fresh, chilled, frozen).
- pork, sheep, goats and edible offal of horses, asses and mules.
- bovine spongiform encephalopathy (BSE) is the stated rationale, however, these bans apply to all countries, even those without BSE cases.

Nigeria also bans the import of live and dead poultry (with the exception of day-old chicks) and poultry meat, including fresh, frozen, and cooked poultry meat. While the stated rationale is to prevent the spread of avian influenza (AI), these bans were implemented during the 2006 AI outbreak and do not reflect current AI risk.

Foods, food additives or drugs must meet the NAFDAC safety and quality requirements under the NAFDAC Act before they may be sold or marketed in Nigeria. Although the NAFDAC Act does not distinguish between conventional and genetically modified products or processes, the Agency has several rules that would subject "more than minimally manipulated" human tissues and cellular products to the full panoply of rules governing drugs, devices or biologics

1.9.6.2 National Biosafety Management Agency Act, 2015

This Act establishes the National Biosafety Management Agency charged with the responsibility for providing regulatory framework, institutional and administrative mechanism for safety measures in the application of modern bio-technology in Nigeria with the view to preventing any adverse effect on human health, animals, plants and environment

1.9.7 Project Implementation Unit

This is a unit established by Imo state government with responsibility for the end to end delivery of all AfDB funded projects, including planning, ESIA/ESMP, feasibility and RAP, engineering, procurement of Livestock processing zone contractor, supervision of the construction. PIU is headed by a substantive Project Manager. Furthermore, the PIU shall ensure:

- The ESIA studies are conducted in line with legal requirements as well as requirements of the lender;
- Proper implementation of the ESMP;

- Supervise the EPC contractor during the implementation of ESMP in the construction stage conjunction with the Owner Engineers in Project Department to ensure implementation of management measures;
- Provision of information on activities and consultations with the PAPs;
- Maintain an inventory of the assets to be resettled and a detailed valuation of the compensations;
- Ensure proper information and participation of PAPs and affected communities;
- Management of compensation payments;
- Monitoring the resettlement work;
- Implementation of community-approved projects financed through the EPC contractors; and
- Production of monitoring reports on ESMP and Health and Safety implementations compliance all through the project cycle either Monthly or quarterly or as often as the reports are required from either the Bank or Regulators.

1.9.8 Abia State Ministry of Environment

The Abia State Ministry of Environment is responsible for implementation of the overall environmental policy of the state. It has the responsibility for verification of the project sites during this study. The Ministry will be responsible for review and disclosure of this ESIA report and its implementation through panel review with experts, issuance of approval to next phase of project implementation, Monitoring the Impact mitigation processes during ESMP implementation by the Contractor and finally certification at the end of the project cycle. The Ministry will also be responsible for Environmental Audit monitoring review and compliance enforcement, along with waste management in the operation phase and in the decommissioning phase. They will enforce waste Management in line with all the laid down Regulations and guidelines of Conventions

to which each identified waste shall belong, e.g. Basel, Stockholm, and Montreal protocols, climate change, etc, as it relates to livestock processing.

1.9.9 Abia State Ministry of Land Survey Housing and Urban Planning (ASMLSHUP)

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 issuance of the gazzetted government lands.

1.9.10. Local Government Areas (LGAs).

The Ukwa- west, Ikwuano and Bende LGAs are involved in the ESIA approval process. According to the EIA Act, the LGA will have representatives in the panel that will review the report and advise the Minister to make decisions on the project. The LGA also have roles in the administration of lands in rural areas and hence, will be involved in the resettlement process.

1.9.11 The Customary District Councils

The Eze's (traditional head of chiefdom) have important role to play in the project with respect to mobilization of 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.

CHAPTER TWO
PROJECT JUSTIFICATION

2.1 INTRODUCTION

This chapter provides information on the project in terms of the need for the project and the benefits. It also presents a number of project options and alternatives that were considered

2.2. NEED FOR THE PROJECT

The essence of this proposed project is to bridge the gap of the ever- growing demands of staple food in Nigeria, aside the economic benefits that shall be earned by both the local community and the country at large.

The value addition for agricultural products and processing is constantly changing, consumer-driven industry that provides billions of dollars and numerous jobs for the economy. The food processing industry has evolved into a large, corporate, automated industry, which utilizes the entire raw materials in some manner. Today, the majority of crops are processed in large state-of-the-art facilities that handle large volumes per day. The benefits of this project for the people of Abia State and the south East are numerous The following are few benefits.

About 1.5 million households would be direct beneficiaries along the entire agricultural value chain, including private sector agribusinesses and agro-processors, smallholder farmers, agri-preneurs and agro-dealers. The SAPZ Program (Phase I) targets the creation of a minimum of 400,000 jobs, and up to 1.6 million indirect jobs. The jobs will be created during the construction and operational phases, and include jobs created by MSMEs' along the value chain and factory jobs created by the tenant industries in the Agro Industrial Hubs. In addition, benefits will include

- Improvement in crop production
- Capacity `building for local farmers

- Employment opportunities
- General improvement in the livelihood of the adjoining communities

2.4. Envisaged sustainability

The general sustainability principles (technical, economic, environmental and social) that guided the design of the project are set out below.

2.4.1 Technical Sustainability

The proposed project is technically feasible because, it is professionally designed, and the technology employed is readily available. The proposed project site is very accessible to other states and within 3km radius of a Port Harcourt Airport and a sea port for patronage.

2.4.2 Economic Sustainability

There is a huge demand for agricultural products like Cocoa, maize, rice and palm oil and demand for processed cereals for livestock feeds in southeast and Nigeria in general. In the short term, the project will be funded by development partners. However, in the medium to long term after operation, the return on investment would be guaranteed. The availability of skilled and unskilled labor force in the project area, functional organizational structure of the agricultural zone, presence of up takers and deployment of good industrial best practices in the agro processing technology is expected to make the project economical sustainable.

2.4.3. Environmental Sustainability

The project site has been carefully selected by considering sensitive ecosystems and to avoid built-up areas as much as possible. In addition, practical mitigation measures have been proffered for the identified environmental impacts of the Agro processing project and Abia SAPZ is fully committed to comply with the relevant applicable national environmental laws, applicable international conventions and AfDB environmental and social safeguard requirements. Furthermore, Abia SAPZ is also committed to

implementing the ESMP developed to further guarantee the environmental sustainability. Abia SAPZ has full department that handles environmental matters.

The implementation of the findings and recommendations of the ESIA in the project design shall ensure the environmental sustainability of the project. The application of standard industrial practice during construction and implementation of the project shall also ensure the environmental sustainability of the project. The implementation of the standalone ESMP shall ensure continuous safeguarding of the Environmental and Social components for ensured sustainability in line with the Bank's policy.

2. 4.4 Social Sustainability

One of the benefits of this project is to enhance the socioeconomic activities of the people and also to create job opportunities for unemployed indigenes. This would enhance the socio-economic activities of the communities thereby supporting the sustainability. In addition, Abia SAPZ is committed to effective and continuous stakeholders' engagements and consultations. Abia State SAPZ is committed to comply with applicable national social laws, relevant international conventions and AfDB safeguard requirements. While AfDB is also committed to training and re training of the PIU team members on environmental and social management risks. The continuous implementation of the Bank's Environmental and Social safeguards policies throughout the various phases of the project shall also ensure the social sustainability of the project.

2. 5. PROJECT ALTERNATIVES

2.5.1 Options for consideration

The proposed project considered some feasible options in respect of their potential environmental and social impacts. These are analysed in Table 2 and include

Cropping system;

- Rice, maize Soya and cassava production systems;
- Type of irrigation;
- Power supply;

• Sources of water;

• Waste management; and

• No option

Table 2.1 : Analysis of Alternative Project Options

Option/ Method of Deployment	Potential Environmental, Social, Technological and Economic Implication		Preferred Option
Cropping system			
1.Mono-cropping	**Advantages** 1. Growing one type of crop all year round on the same land. 2. Allows large expanses of land to be cropped and harvested at the same time. 3. Easier to be mechanized. 4. Less types of equipment and machinery required	**Disadvantages** 1. Higher risk of crop failure due to pest and disease infestation or drought. 2. Higher risk of investment loss due to crop failure. 3. Higher rate of nutrient depletion due to the same nutrient requirement.	Option 1, Mono cropping is considered as the preferred option due to the large expanse of land and ease of mechanization
2. Mixed Cropping	Advantages 1. Growing of two or more crops on different portions of the same land. 2. Spreads risk of crop failure. 3. Diversifies sources of income.	Disadvantages 1. Different maturity periods of crops affect planning. 2. Different requirements of plants require different types of equipment, fertilizers and other farm inputs	
Rice, cassava, maize and soya production system			
1. Upland production	Advantages 1. Grown in rain-fed naturally well-drained soils 2. Plants have less exposure to alterations between aerobic and anaerobic environments	Disadvantages 1. It is largely for subsistence production 2. Soils are usually nutrient deficient 3. Have lower yield	Option 2, Lowland valley production is the preferred option due to its higher yields and suitability for

	3. Rice varieties are drought tolerant	4. Susceptible to weed invasion and disease	commercial production
2. Lowland valley production	Advantages 1. Fields can be flooded either by rainfall or irrigation 2. Lowland soils are usually fertile 3. Suitable for commercial production 4. Has higher yields	Disadvantages 1. Water level cannot be controlled exposing crops to serious floods or drought 2. Crops are exposed to alterations between aerobic and anaerobic environments	
Type of irrigation			
1. Surface irrigation (flood and furrow irrigation methods)	Advantages 1. Surface irrigation is one of the most common types of irrigation systems. 2. Uses the force of gravity to distribute the water, which is meant to then seep into the soil. 3. Less costly compared to other irrigation systems 4. Suitable for high water demand crops. 5. Can be used in windy conditions.	Disadvantages 1. Not suitable for crops which are sensitive to flooding.	option 3, Drip irrigation is preferred as it is water efficient and can be installed in any type of landscape
2. Sprinkler irrigation	Advantages 1. High application efficiency 2. Can be combined with fertilizer application. 3. Can be applied at areas with variable topography	Disadvantages 1. Water can be lost because of high winds or evaporation. 2. Irrigating the entire field uniformly can be difficult or tedious if the system is not properly designed 3. Water remaining on plants' leaves may promote fungal and other diseases. 4. If fertilizers are included in the	

		irrigation water, plant leaves can be burned, especially on hot, sunny days	
3. Drip Irrigation	Advantages 1. Consideration for vegetable crops, but requires pumping from laterals to storage tanks into a piped system. Can be done but needs full and multiple farmer cooperation. 2. Water is delivered at or near the root zone of plants, drop by drop. 3. In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation. 4. High efficiency of fertilizer application. 5. This method can be the most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized	Disadvantages 1. Very costly compared to other irrigation systems. 2. Requires highly skilled labour in design, installation and operation. 3. Highly sensitive to clogging.	
Power supply			
1. National grid	Advantages 1. The cost of electricity is low decreasing production cost	Disadvantages 1. Unreliable power supply from frequent power cuts	Solar energy installations (Option 2) such as solar powered pumps are preferred for the pump irrigation.
2. Solar energy installations	Advantages 1. Presents a clean and sustainable source electricity 2. Low operational costs 3. Meets the objective of Technology transfer and climate friendliness	Disadvantages 1. Expensive capital cost	
Sources of Water			
1. Groundwater	Advantages 1. Relatively reliable source all year round	Disadvantages 1. Expensive to access and abstract	Option 2, which is the use of surface water appears to be the most

	2. Seasonal variations are minimal 3. Relatively stable water quality	2. Challenges of over-exploitation to meet high demands and associated threat of land subsidence 3. May require farms of boreholes to meet demand 4. Threat of high iron and fluoride concentration in aquifers in the northern parts of the country	preferred option as it will be easier to implement water management plans
2.Surface water	Advantages 1. Easier to abstract and use	Disadvantages 5. Seasonal variations in flow 6. Vulnerable to pollution	
3.Rain harvesting	Advantages 1. Easy to trap and store	Disadvantages 1. Source is unreliable 2. Evaporation losses are high in the dry months of the year	
Waste Management Option			
1. Composting plant	Advantages 1. Improvements in soil quality. 2. Enhances the structure of the soil. 3. Eco-friendly. 4. Fully organic fertilizer. 5. Higher yields.	Disadvantages 1. Requires initial investment. 2. Efficiency depends on the amount of organic waste 3. May attract rats, snakes, and bugs. 4. Requires space 5. Unpleasant smell	**Option 1, composting is a better option as it is ecofriendly and could be used to improve soil quality on farms. It will also keep waste away from landfill, which already have limited space.**
2. Municipal Waste Dump/ landfill sites	Advantages 1. Straightforward concept to deal with waste. 2. Filled land can be reused for other community purposes. 3. Landfills can prevent environmental dumping. 4. Good for waste that is non-	Disadvantages 1. Completed landfill areas can settle and requires maintenance. 2. Requires proper planning, design, and operation. 3. Can contribute to groundwater pollution.	

	recyclable.	4. Landfills can be a breeding ground for bacteria.	
No Option			
	Advantages 1. Funds for the project implementation could be used for solving other development problems, albeit less dire	Disadvantages 1. Non implementation of the project will continue to deprive project communities of access to economic opportunities and food security associated with agriculture. Also, locals who would have been offered employment will continue environmentally unfriendly livelihood activities such as felling of trees for charcoal, game hunting leading to bushfires etc. 2. Government will lose revenue and the opportunity to leverage import substitution for economic growth	**This option is not preferable**

CHAPTER THREE
PROJECT DESCRIPTION

3.1 PROJECT BACKGROUND

The first Phase of Special Agro-Industrial Processing Zones (SAPZs) Program will be implemented in seven (7) states (Cross River, Imo, Kaduna, Kano, Kwara, Ogun, and Oyo) and the Federal Capital Territory (FCT). The Programme development objective is to support inclusive and sustainable agro-industrial development in Nigeria. The Program has four broad components namely:(i) Support the development of enabling climate adapted infrastructure for Agro-Industrial Hubs (AIHs), (ii) Improve agricultural productivity and enterprise development to enhance agricultural value chains and job creation in the SAPZ Catchment Areas, (iii) Support Agro-Industrial Zone Policy and Institutional Development, and (iv) Program Coordination and Management. The key expected outputs of the SAPZ Program (Phase I) are: development of infrastructure for eight (8) Agro-Industrial Processing Hubs (AIHs), fifteen (15)Agricultural Transformation Centers (ATCs), 2,300 ha of irrigated lands and farm to market access roads; supply of certified agricultural inputs and extension services; skills development for farmers and Micro, Small and Medium Scale Enterprises (MSMEs), an updated agro-industrial zone policy and establishment of regulatory institution/special regulatory regime. SAPZ Program (Phase I) will be implemented over five years (2022 –2026). The total cost for the SAPZ Program (Phase I) is estimated at USD 538.05 million net of taxes. The African Development Bank will provide an ADB Loan of USD 160 million (29.7% of total cost) together with an Africa Growing Together Fund (AGTF) loan of USD 50 million (9.3%).

Plate 3.1 Abia SAPZ cassava processing hub at Ikwuano LGA

Plate 3.2 Abia SAPZ oil Palm hub at Owaza Ukwa West

Plate 3.3 Cocoa process hub at Bende LGA

As part of the comprehensive strategy by the Abia State government to resolve the perennial challenges with the crop production sector, and provide incremental jobs in the state, the government has designed a strategic program intervention under Special Agro processing zone to overcome the food and nutritional deficits situation and reduce drastically the importation of basic grains and other agricultural commodities. The project will focus on food commodities where Abia state has both competitive and comparative advantage to produce, as well as create more jobs within the agriculture and related sectors. The Abia SAPZ project focuses on crop production in the state including cassava, maize, soybean, rice and oil palm processing and value addition.

The overall goal of the project is to increase production of cassava, maize, soybean, rice and Palm oil processing, thus contribute to industrialization, youth employment and food security. The project is expected to contribute to the Government's industrialization agenda, support skills development and entrepreneurship for women and youth, and build resilient food systems in the tropical areas of southern Nigeria. This would be achieved through the facilitation of private sector investment in value chains associated with crop production, improved productivity and production of feedstock made up of

rice, maize and soybean, a purposive intervention in poultry value chain. At least 500 Ha of rice, maize and soybean is expected to be put under cultivation. It is expected to increase productivity of soybean from average of 0.2 tons/ha to 2.0 tons/ha; maize from 3.5 tons/ha to 8.5tons/ha and rice from 2.0 tons/ha to 2.5 tons/ha. Increased domestic production seeks to reduce importation of these basic commodities, creating jobs for women and youth along the priority value chains.

3.2 Project components

The proposed project will have three components namely

(i) Component 1: Production Development,

(ii) Component 2: Integrated Agribusiness and Value Chain Development, and

(iii) Component 3: Project Management and Institutional Support

Component 1: Production Development:

This component aims to support farmers with interventions including land development in inland areas for rice production, following land and soil suitability surveys. It will also support land development under no-tillage systems using conservation agriculture. It will promote the use of economic trees as part of alley-cropping and promote measures to reduce bush fires. These measures will include the enforcement of community by-laws and establishment of fire belts. It will promote the use of hybrid seeds and bio-pesticides for the control of invasive pests including fall armyworm. There will be no land acquisition under this project. One key criterion for participating farmers is for them to own land under cultivation for which an expansion is required. There are no settlements/population in the inland areas where water management structures are to be developed. Activities regarding land development will therefore not cause displacement (temporal or permanent).

Sub-component 1.1 Commercial Production of Maize, Soybean and oil palm processing under Conservation Agriculture at Owaza, Ukwa West

- Production and promotion of certified hybrid maize and improved soybean seeds, in collaboration with seed companies.
- Support to land development and mechanization services.
- Training of producers, haulers, aggregators and marketers on sanitary and phytosanitary (SPS) issue relating to maize and soybeans
- Farmer mobilization and awareness creation on conservation agriculture.
- Train project staff and farmers on Integrated Crop and Pest Management (ICPM), including biological control options for the management of Fall Army Worm (FAW) and *Aspergillus* on Maize and Soybeans.
- Conduct surveillance and collect data on pests attacking the Maize and Soybeans in the project zones with specific reference to FAW.
- Support out-grower contractual arrangements
- Use of ICT for soil suitability assessment and GIS mapping of commercial farms
- Promotion of climate smart agriculture, environmental conservation best practices, including use of economic trees such as cocoa and oil palm etc.
- Community sensitization, establishment of fire belts and enforcement of community fire by-laws to deal with the impact of bush fires.
- Promote the use of Nitrogen fixing inoculants to boost soybean yield.

Sub-component 1.2: Commercial Production of Cocoa, rice and Cocoa processing under Conservation Agriculture at Okporoenyi, Bende LGA.

- Production and promotion of certified hybrid rice and improved cocoa seeds, in collaboration with seed companies.
- Support to land development and mechanization services.
- Training of producers, haulers, aggregators and marketers on sanitary and phytosanitary (SPS) issue relating to maize and soybeans

• Farmer mobilization and awareness creation on conservation agriculture.

• Train project staff and farmers on Integrated Crop and Pest Management (ICPM),

Sub-component 1.3: Commercial Production of Cassava and cassava processing under Conservation Agriculture at Ariam Eluelu Ikwuano LGA.

• Production and promotion of certified hybrid cassava and improved cassava cuttings, in collaboration with National Root Crop Research Institute (NRCRI) and other companies.

• Support to land development and mechanization services.

• Training of producers, haulers, aggregators and marketers on sanitary and phytosanitary (SPS) issue relating to maize and soybeans

• Farmer mobilization and awareness creation on conservation agriculture.

• Train project staff and farmers on Integrated Crop and Pest Management (ICPM),

Component 2: Integrated Agribusiness and Value Chain Development:

This component seeks to support actors along the value chain, particularly post-production actors. Key interventions include the promotion of quality standards for maize and soybean production, storage and processing and enhance access to market information (e.g. quantity, quality, timing and pricing).

It will support skills development for women and youth, promote entrepreneurship and mentoring programs, especially for crop production value chain. Women headed households in vulnerable communities would be supported to produce local rice to improve their income status and help meet their nutritional requirements. A detailed site-specific environmental assessment will be undertaken for each private sector operation, in compliance with the EIA Act of 1992 before any support will be extended during project implementation.

Sub-component 2.1 Value Addition and SME Development

• Promotion of quality standards for rice, maize and soybean production, storage and processing.

- Support business development, including improvements in business processes of existing commercial farmers
- Enhance access to market information (e.g. quantity, quality, timing and pricing)
- Promote the development of allied services (packaging, new distribution networks for cassava, soybean, transport services, new agro-input delivery systems, etc.
- Support to feed millers to improve feed stock and expand processing capacity
- Enhance investment facilitation and promotion to increase the number of commercial producers and processors in the South east region.

Sub-component 2.2: Youth/Women Empowerment and Nutrition

- Promote other income generating activities for women and youth, including as cocoa, rice, cassava and maize production and processing
- Support women and youth on marketing and supply of crop products to key institutions and programs including the school feeding program
- Capacity building for women and youth in small-scale commercial poultry business management and entrepreneurship, including mentorship.

3.3 PROJECT PHASES AND ACTIVITIES

The specific project activities to be implemented in the Abia SAPZ project are preparatory, construction and operation phases. The project phases are listed below, this does not however show the interdependencies of the activities.

Phase I: Pre-construction (preparatory)

- Feasibility studies
    1. Identification of potential beneficiary communities for the production of maize, soybeans, cassava oil Palm and rice
- Conduct of relevant studies, including socio-economic surveys
- Development and Implementation of Environmental and Social Management Plan (ESMP)
- Request for applications and screening of applicant farmers using the following criteria:

✓ Prospective farmers must be interested in the cultivation of soyabean, maize and rice and should operate an out-grower or an in-grower scheme.

✓ Interested farmers shall be willing to cultivate these crops under Conservation Agricultural practices.

✓ Prospective farmers should own a contiguous land of not less than 100ha suitable for production with potential to expand further.

✓ A substantial area of land should have been developed and prepared for farming by the prospective farmer.

✓ the dedicated farmland of at least 100 ha shall be made available solely for the Conservation.

Agriculture for the next five (5) years.

✓ the farm should be accessible and motorable throughout the farming season. Farms located along major roads would be an added advantage.

✓ Prospective Farmers must show an indication of access to storage facilities for inputs and harvested grain.

✓ Prospective Farmers should have access to technical services (Extension agents, Mechanization operators etc.) to support farm development and management.

• Assessment of soil suitability and GIS mapping of commercial farms using ICT.

Construction Phase

• Provision of support for land development and access to mechanization services.

• Production and promotion of certified hybrid maize and improved soyabean seeds, in collaboration with seed companies.

• Promotion of climate smart agriculture, environmental conservation best practices, including use of economic trees such cocoa, oil palm etc.

• Training and capacity building on business development, animal husbandry and health

• Enhance capacity to mobilize private sector investors in the maize-soybean-poultry industry.

Operation Phase

• Support out-grower contractual arrangements.

• Conduct surveillance and collect data on pests attacking the Maize and Soybeans in the project zones with specific reference to fall Armyworm (FAW).

• Community sensitization, Establishment of fire belts and enforcement of community fire by-laws to deal with the impact of bush fires.

• Promote the use of Nitrogen fixing inoculants to boost soybean yield

• Promotion of quality standards for rice, maize and soybean production, storage and processing

• Support business development, including improvements in business processes of existing commercial farmers

• Enhance access to market information (e.g. quantity, quality, timing and pricing)

• Support to feed millers to improve feed stock and expand processing capacity

• Enhance investment facilitation and promotion to increase the number of commercial producers and processors in the Savannah regions

• Support women and youth on marketing and supply of poultry products to key institutions and programs including the school feeding program

• Capacity building for women and youth in small-scale commercial poultry business management and entrepreneurship, including mentorship.

Fig. 3.1 Small scale Palm oil production Process.

Plate 3.4. Small scale Cocoa plantation and oil palm mill in Abia State

Plate 3.5 Cocoa nursery plot

Plate 3.6 cassava farm

Plate 3.7 Cassava Tubers

Plate 3.8 Soybean Plantation

3.3.1 Tree plant species

Trees to be planted will be site-adaptive, fast growing, and agroforestry species. The site for planting trees will be carefully selected to have the required soil depth for the tree growth. Wherever possible, a 3-5 m spacing will be maintained between trees. One of the most common errors in tree planting is that the rootball is either planted too deep or too high, both of which can cause serious problems. It is recommended that the planting hole will be 2 to 3 times wider than the diameter of the tree's rootball.

The depth of the hole shall be equivalent to the height of the rootball. After planting, the hole will be backfilled with soil dug from the planting hole, soil mixed with large amounts of organic soil amendments such as compost. The addition of an organic soil amendment may be called for if the existing soil is of poor quality, such as excessively sandy or heavy clay soils, or those consisting of undesirable fill material.

Alternatively, quality topsoil, similar in texture to the existing soil, may be brought in and used for backfill.

When planting on slopes, it will be important to set the tree so the top-most root in the ball on the uphill side is about even with the soil. The side of the root ball on the downhill side will be well above the surrounding soil. Then enough soil and mulch will be brought to the hole to cover the sides of the root ball.

When planting in rock or very compacted soil break up the substrate as best as possible to allow roots to anchor into the landscape. In fact, if this is not done, roots are likely to be very shallow and the tree may grow poorly. Drilling holes in rock below the root ball might help encourage some deep roots that could help secure the tree in windy weather.

Once the plant is properly placed in the hole, cut away and remove all rope, twine, burlap and any plastic or synthetic materials that will not decompose.

3.3.1.1 Watering

Water is a critical factor in the successful establishment of landscape plants. Excessive or insufficient water will impede the formation and/or elongation of new roots. Immediately after planting, the planted area will be watered. Depending on soil type, rootball size, weather, location etc., the rootballs of newly planted trees may need water every day, 2-3 times per week or once a week; more frequent irrigation may be needed during the dry season or in times of extended drought.

A watering schedule needs to be established, as the important thing to remember is that the rootball and planting area need water on a regular basis for the tree to become established. Newly planted trees, with their newly developing roots, must receive adequate water during the entire first growing season, right up until dormancy in the late fall, to become established. Rainfall alone may not provide the adequate, consistent moisture necessary for establishment.

3.3.2 Establishment of Crop plantation

Plant population

Accurate plant densities must be based on seed quantities per hectare and not on seed mass. Seed is sold according to weight, which makes it difficult to calculate seed requirements. The labels on the seed package are supposed to indicate the number of seeds per kilogram. This can then be used as a basis for calculating the relative quantity of seeds required.

Most planter tables that are used for calibration also use relative data and the plant population should then be regarded as estimated. The only way in which planters can be calibrated accurately is to count the number of seeds that are placed over a specific distance by the planter.

Seed size

The seed sizes of different cultivars vary considerably. They will probably vary between 5 000 and 8 000 seeds per kilogram. Some cultivars tend to produce bigger seeds more

than others, but the influence of environmental conditions during the grain-filling period have the biggest effect.

If drought or any other stress factor is experienced during the grain-filling period, the seeds will be smaller than normal. A good blossom period that leads to a lot of pods can also result in smaller seeds. The reverse can also be true. Very small seeds will not have an effect on the yield of the crop, provided the germination of the seed occurs correctly. It is not uncommon to get a large variation in seed sizes in one production unit. Planters that use volumetric seed measurement must be calibrated regularly – particularly if you change cultivars.

3.4 WASTE HANDLING/ MANAGEMENT

Wastes management is an integral part of the environmental management programs. The waste management system is result oriented and measurable. The sources of wastes from each phase of the project are identified, quantified and

disposal method will be provided in line with FMEnv/OGEPA guideline.

However, in line with regulatory requirements,Abia SAPZ has developed a waste management plan, based on the principle of the 4R's (Reduce, Reuse, Recycle, and Recovery) through process of optimization or redesign, efficient procedures and good housekeeping. Wastes generated shall be managed in the following ways

Inventorization

- Classification
- Segregation
- Wastes quantification
- Wastes tracking and
- Wastes disposalx

Waste Generation

Below is a list of envisaged project wastes and their potential sources:

- Leaves, branches, trunks, grasses from the clearing of the vegetation

• Kitchen wastes from human feeding and activities involving many workforces.

• Scrap metals – from cuttings, fittings, pylon member, nuts, bolts, and welding etc.

• Concrete waste – from foundations and plinths, including housing complex and control room construction.

• Nylons/Plastics – from human activities wrappings, water sachet, food etc.

• Oil spills from heavy duty machinery and equipment and vehicle engines, either during normal runs of old machines or maintenance work.

• Human wastes – from activities of personnel involved in the work or secondary business group.

• Operational activities – nylons, paper materials/office, human waste etc.

• PCB is a toxic substance contained in certain oils, which shall not be used in this project. Nevertheless, to control an accidental spill, provision shall be included in the project design for an API gravity oil separator as well as a bundwall or underground chamber as an integral part of transformer foundation is required to control PCB spillage.

3.4.1 Waste Disposal

Waste disposal methods will include:

• Selling metal, wood, and plastic scraps to buyers;

• Reuse of materials e.g., packages, concrete, etc;

• Dumping of remaining wastes at approved sites.

Sewage from site camps will be vacuum-sucked into septic tanked trucks and taken to the sewage treatment plant clossest to the site. Spent oils generated during changing engine oil and maintenance work will be stored in oil trench and oil sump at the plantation camps and in line with requirements of the Basel Convention. It is recommended to use mobile toilets at construction sites, and soak-a-way pits at camp sites.

3.4.2 Air emissions

Air emissions will be limited to fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles) during the construction phase of the Project.

3.4.3 Solid wastes

Solid wastes will include sludge, food wastes, paper, batteries, glass, plastic, used parts, consumable items such as filters, packing materials, and other materials. A comprehensive waste management system will be in place that allows separation of waste streams to facilitate reuse or recycling. All hazardous materials, such as oily contained rags and filters, and batteries, shall be separated and stored separately.

To reduce waste, where possible the Project will require suppliers to provide consumable items in reusable containers or packaging. All wastes will be disposed of by waste registered contractors by respective State Ministry of Environment who have been licensed by the appropriate authority.

A preliminary estimate of the categories of waste, quantities and disposal methods over the preparation and implementation phase have been compiled and is presented in Table 3.1.

Table 3.1 : categories of waste and disposal methods for SAPZ

Waste	Type of waste	Source of waste	Waste Management Practices
Site preparation/ Clearing			
Cleared vegetation	Non-Hazardous		Compost the vegetation
Top soil/organic matter	Non-Hazardous		Use for Backfilling of access road
Site Solid Waste: Office waste, Food Waste, Paper, wrappings, Plastic Bottles, Site Dirt, etc	Non-Hazardous		Periodically disposed of (weekly) through State Environmental Protection Agency
Sanitary Sewage	Hazardous		Disposed through septic tank and shall be evacuated by an accredited waste contractor for treatment.
Spent oil	Hazardous		Collect in Drums and transport to licensed disposal Agents
Scrap Metal	Non-Hazardous		Collect disposed to recycling plant
Operational Phase			
Site Solid Waste: Office waste, Food Waste, Paper, wrappings, Plastic Bottles, Site Dirt, Etc.	Non-Hazardous		Periodically disposed of (weekly) through State Environmental Protection Agency
Sanitary Sewage	Hazardous		Disposed through septic tank and shall be evacuated by an accredited waste contractor for treatment at a sewage treatment plant approved
Spent Oil	Hazardous		Collect and transport to licensed disposal Agents
Biopesticides/chemicals	hazardous		Collect and transport to licensed disposal agents.
Scrap Metal	Non-Hazardous		Collect disposed torecycling plant

3.4. PROJECT STAFFING AND SCHEDULES

Project Schedules:

The study of Abia SAPZ operations and implementation, engineering design of the proposed plants, lay out of the expansion of oil palm and cocoa plantation etc will take 7 months. The project scheduled for Site Preparation, Construction and Commissioning will take approximately 10 months.

Project staffing

About 620 staff will be employed during the Site preparation across the 3 local government areas , construction and implementation phases of the project. Total staff required for the operation is 90 personnel and estimated indirect staff from contractors, suppliers etc. is 200 personnel. The project staffing is as shown in table

Table 3.2 categories of staff for the SAPZ project

Project Phase	Skilled Staff	Unskilled Staff	Total
Study on project apprasial document (PAD)	8	8	16
ESIA	16	4	20
Engineering Design	17	3	20
Farm layout	125	6	131
Construction	216	10	226
Commisssioning	215	9	224
	Total		637

CHAPTER FOUR

DESCRIPTION OF PROJECT ENVIRONMENT

4.1 INTRODUCTION

The chapter gives a comprehensive description of the current environmental and socioeconomic baseline conditions of the project area which could potentially be affected by the proposed Abia SAPZ project in 3 LGAs. The chapter presents an overview of the aspects of the environment relating to the surrounding area in which the project will take place and which may be directly or indirectly affected by the proposed project. The study areas are, Umulolo in Owaza Ukwa West , Ariam elu elu Ikwuano LGA and Okoroenyi Bende LGA.

The description of the environment is based on a number of primary and secondary data sources. Primary data sources include dry season baseline fieldwork survey undertaken 4th -10 March 2024. Baseline surveys included soils, groundwater, surface water, and sediment, fauna and flora, air quality,and noise levels . A socioeconomic and health baseline study was also undertaken in all the villages SAPZ project will be located . Secondary data sources include recent ESIA study in the project area, various research studies and published literature including weather data, and socio-economic data.

Plate 4.1 Abia State industrial and Innovation Park

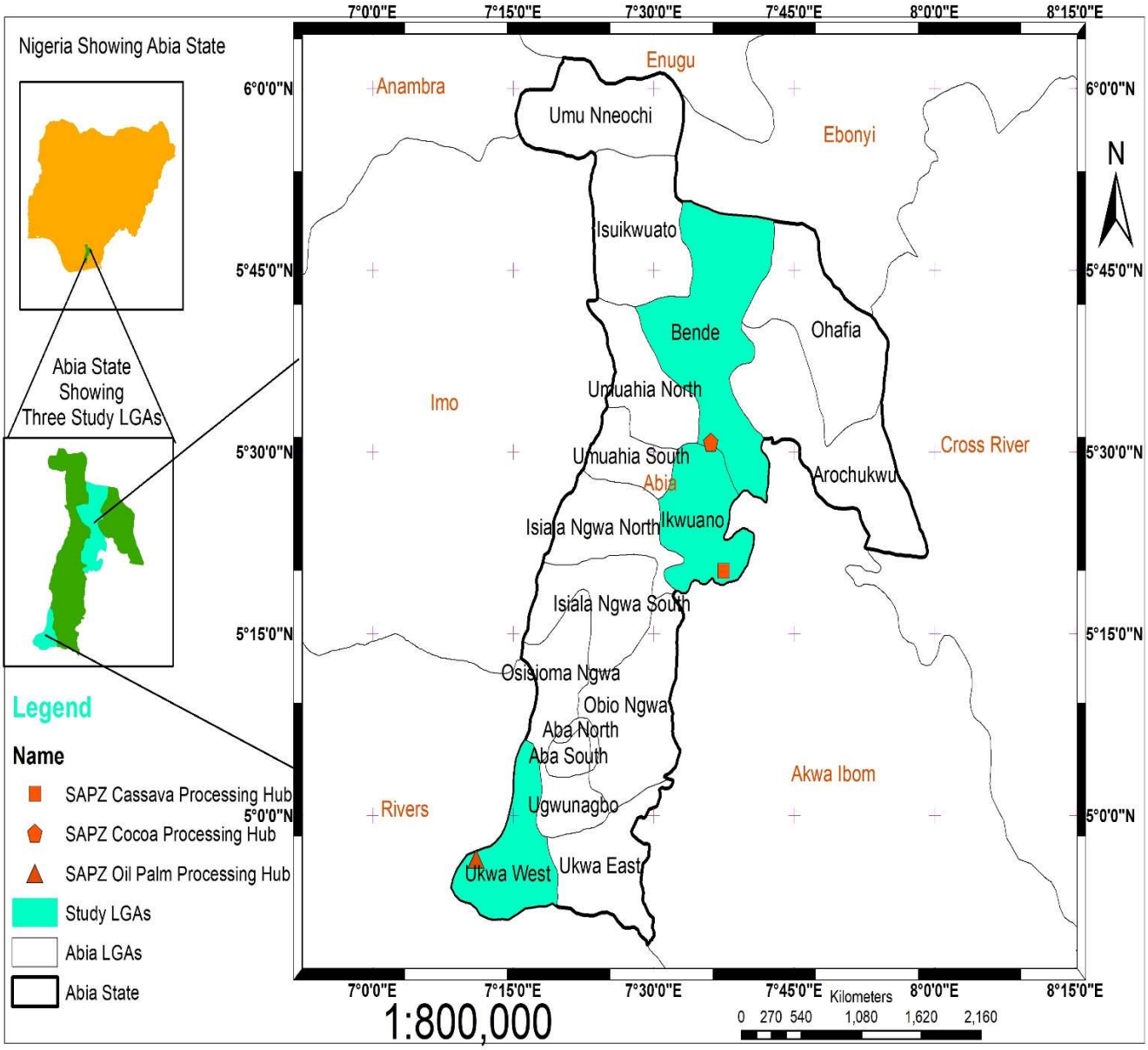

Fig. 4.1 Locational Map of the study area

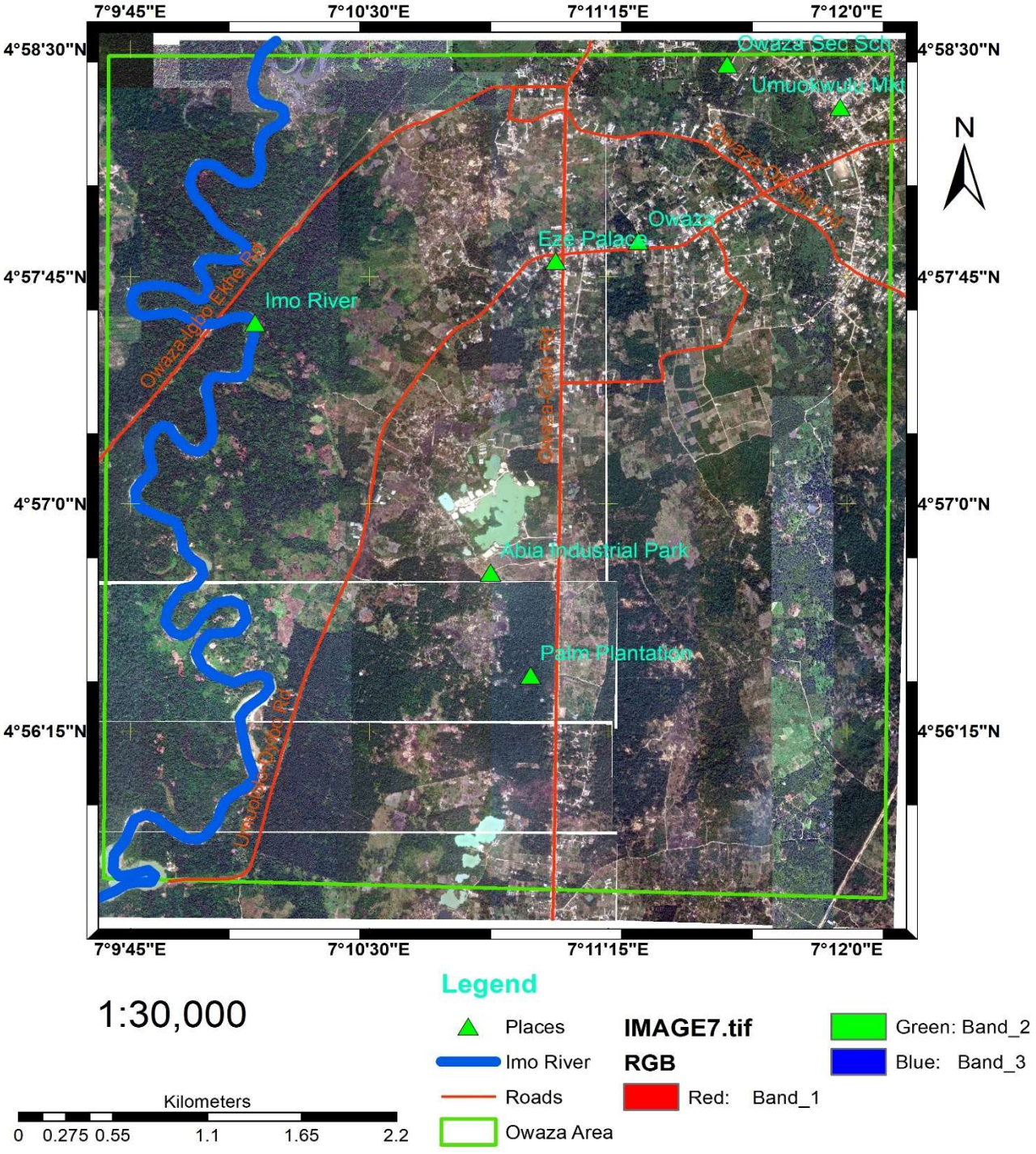

Fig 4.2 Satellite Imagery of Ukwa-West

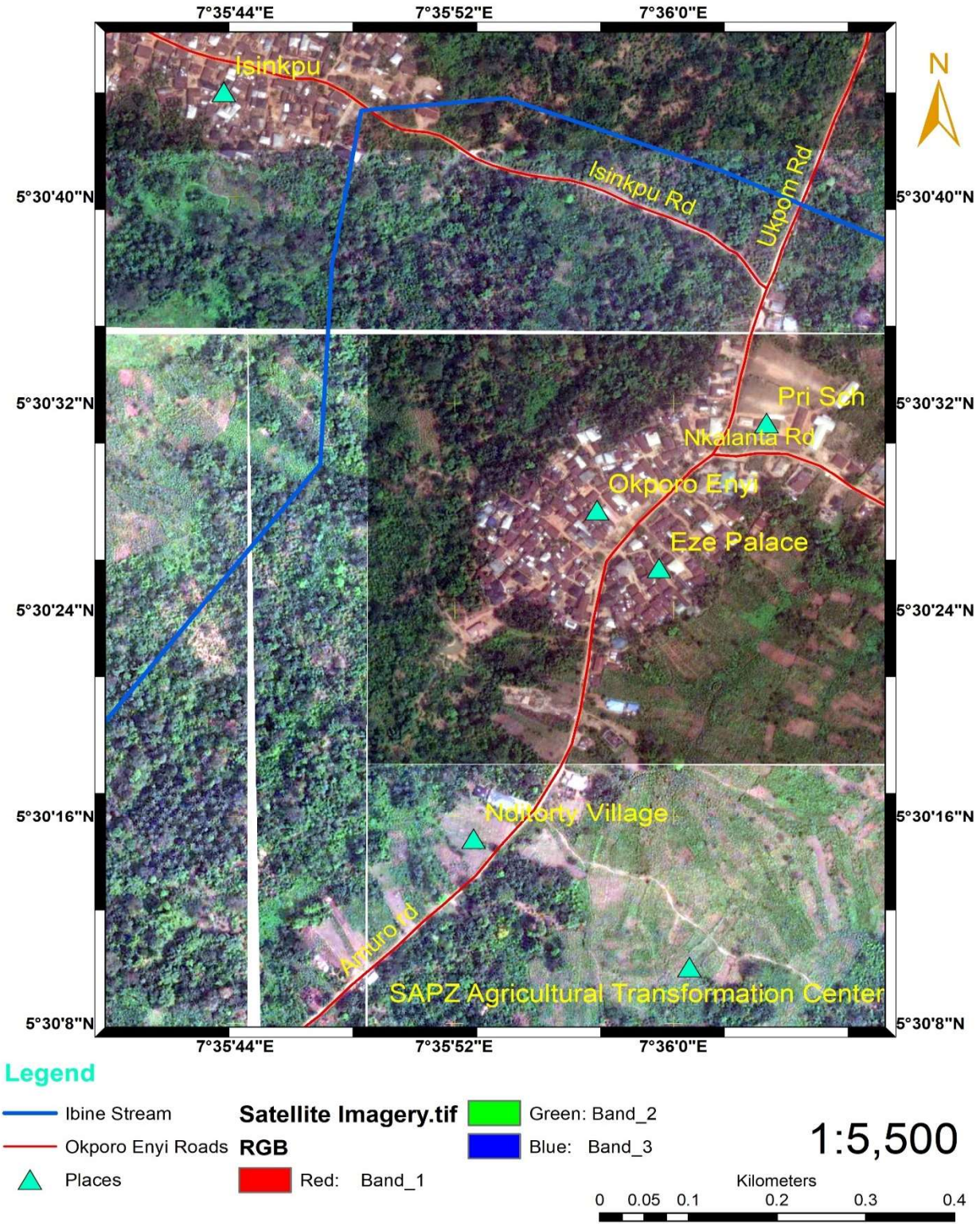

Fig. 4.3. Satellite Imagery of Okporoenyi of Bende LGA

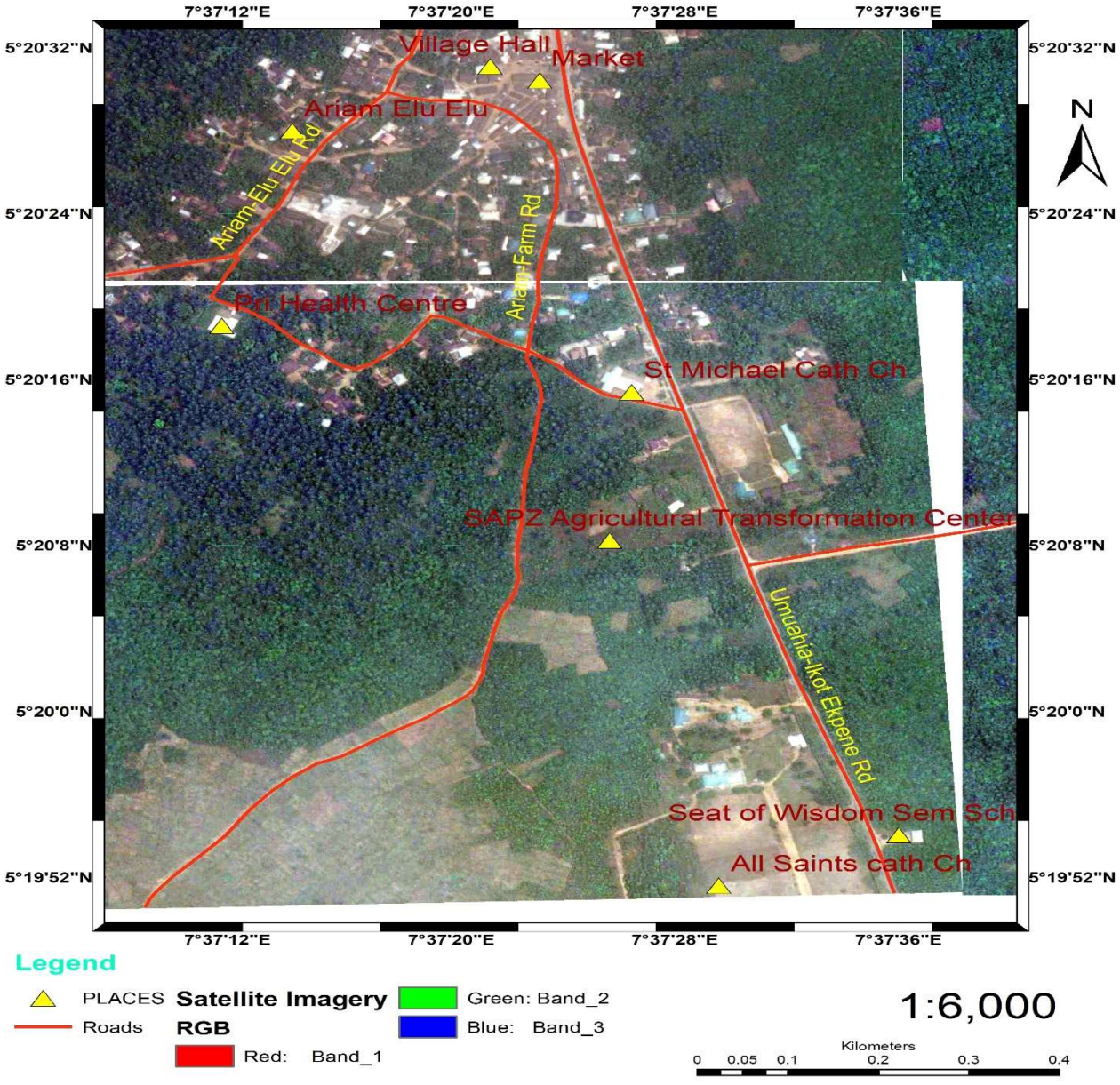

Fig. 4.4. Satellite Imagery of Ariam Elu elu of Ikwuano LGA

Table 4.1 Summary of the data used for the ESIA

Parameters	Source	Date
Insitu Metrology, Air Quality, Noise, EMF, Water, Soil and land Use, Sediment, Vegetation, Wildlife, Socioeconomics, health study, Water quality, Wildlife	Abia SAPZ	2024
Metrology: Temp, Rainfall, RH, and Wind	Nimet Data	1990 – 2021 (31yrs)

4.2 STUDY APPROACH

Field studies and data collection for characterization of the baseline conditions of the proposed project environment covered, in line with the approved TOR by the FMEnv.

- Climate and meteorology
- Air quality, noise level, vibration level and Electromagnetic field (EMF)
- Water Resources (Surface and ground water)
- Soil and sediment
- vegetation & fauna wildlife
- Hydrobiology, fisheries and
- Socio economics/health impact, demography and community characteristics

Etc

4.2.1 Scoping Workshop

Scoping Workshop and Site verification were conducted on 4th March 2024 as shown in Plate 4.1a-e under the supervision of Officers of Federal Ministry of Environments (FMEnv).

Plate 4.2a Scoping workshop with the Ariam Elu elu community

Plate 4.2 b Scoping workshop with the Ariam Elu elu community

Plate 4.2c. Scoping workshop with the Okporoenyi community

Plate 4.2d. Scoping workshop with the Umuololo Owaza community

4.2 e . Scoping workshop with the Umuololo Owaza community

Quality Assurance/Control

The following are the Quality Assurance and Quality Control undertaken to guarantee the intergrity of the data and analytical results

• Only adequately trained personnel were used for the laboratory analysis.

• The personnel were briefed on the scope of work.

• Complete adherence to written analytical work instructions available to staff involved in project execution were maintained and verified.

• Routine auditing and checking of results at every stage of analysis were implemented. Quality control solutions and mid-point standards were also introduced in every batch of samples or every set of ten samples. Analyses for which deviation of these quality control / mid-point standards which were outside 90 to 110% of expected concentration ranges were repeated.

• Equipment were adequately calibrated prior to use and checked by the supervising officer.

• Sediments were not dried before extraction takes place.

• Solvent used were those of the lowest possible boiling points. When evaporations were necessary, solvents were reduced or removed with great care at temperatures not higher than 30^0C.

• Analysis schedule indicating analysts assigned to carry out various tests were drawn up.

During benthic analysis, internal standards shall be added before extraction takes place.

• Analytical errors were controlled by duplicate analysis at pre-determined intervals, sample spiking, etc.

Materials that were 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 materialsconsulted is specified in relevant sections

4.2.2 Baseline Data Acquisition Method

The acquisition of data basically involved field data gathering, measurements and the collection of representative samples used to establish the environmental conditions of the study area. The Quality Assurance/quality Control (QA/QC) procedures covered all aspects of the study, including sample collection, handling, laboratory analyses, data

coding and manipulation, statistical analyses, presentation and communication of results. Chain of custody procedures including sample handling, transportation, logging and cross-checking in the laboratory were also implemented. All analyses were carried out in FMEnv accredited laboratory (New Concepts Environmental laboratory, FUTO road Obinze). The methods of analyses used in this study were those specified in Federal Ministry of Environment Guidelines and other internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained quality control and quality assurance was observed from sample collection on field, storage and laboratory analysis and result compilation

4.2.3 Desktop Studies

Secondary data was obtained through literature searches and approved EIA in the project area.

4.2.4. FIELD SAMPLING DESIGN

The field survey for water, hydrobiology, soil, vegetation, wildlife, socio-economic and air quality were conducted and samples taken from pre-determined sampling stations. Representative sampling was adopted to help obtain data required to describe the baseline status of the environment around the proposed Abia SAPZ sites in Ukwa West, Ikwuano and Bende LGAs. The fieldwork sampling and Socioeconomic were conducted from 4th March – 10th March 2024, though the socioeconomic studies extended beyond this date to ensure proper coverage of the area. The summary of data obtained from fieldwork is presented in Table 4.2 and the sampling map is presented

Table 4.2 . Types and Number of samples

s/n	Environmental Components	Sample Number/ Stations	Requirements
1	Surface Water	6	All parameters approved in the TOR
2	Sediment	6	All parameters approved in TOR
3	Benthic and Plankton Survey	3	
4	Biodiversity study: taxa. fish, marine mammals, endangered marine species.		
5	Groundwater Sampling	7	
6	Air quality &noise measurements	10	PM_{10}, $PM_{2.5}$, SO_2, NOx, CH_4, CO_2, H_2S CO & TVOC, noise levels in dB
7	Meteorology	10	Relative humidity, Rainfall, wind speed, dew point, and air temperature
8	Soil Sampling	12	
9	Terrestrial Flora and fauna(Vegetation and Wildlife) biodiversity study: taxa, protected areas and species identification		
10	Socio-economic Survey	Villages	
11	Terrestrial archaeological study	Project sites at Ukwa West, Bende and Ikwuano	

Source: Abia SAPZ field work ESIA study 2024

Table 4.3: Sampling Stations Coordinates

Codes	LGA	Type of sample	Coordinates		
AQSP1	Ukwa west	Air quality	N: 4.94605°	E: 7.18284^0	Elevation: 20m
AQSP2	Ukwa west	Air quality	N: 4.94315°	E: 7.17334^0	Elevation: 20m
AQCSP	Ukwa west	Air quality	N: 4.95558°	E: 7.18554^0	22m
AQSP1	Ikwuano	Air quality	N: 5.33468°	E:7.62391^0	118m
AQSP2	Ikwuano	Air quality	N: 5.3344°	E:7.62328 °	117m
AQCSP	Ikwuano	Air quality	N:5.334212°	E:7.62352^0	115m
AQSP1	Bendel	Air quality	N: 5.5045°	E:7.5988^0	118m
AQSP2	Bendel	Air quality	N: 5.50372°	E:7.59998 °	117m
AQSP3	Bendel	Air quality	N: 5.50274°	E:7.60146 °	117m
AQCSP	Bendel	Air quality	N: 551106°	E:7.60145^0	115m

Source: Abia SAPZ field work ESIA study 2024

4.3 BASELINE FIELD DATA ACQUISITION METHODS

4.3.1 Climate and Meteorology

Long-term data measurements taken at the nearest synoptic stations in Port Harcourt the same air basin as the proposed project site were obtained from the Nigerian Meteorological Agencies (NIMET). The data include temperature, rainfall pattern and distribution, relative humidity, wind direction and speed. Relevant literature materials on the area of study were collected and reviewed.

Meteorology Data obtained is subjected to the following analysis:

- Check the data obtained against the *in situ* on site to confirm data obtained is representative of the study area;
- identify extreme weather events and frequency of occurrence that may determine project setting/design and timing;

- ❖ Identify microclimates, their dynamics and their determining factors, especially as they could affect project deliveries;
- ❖ specify weather and atmospheric conditions.

4.3.2 Ambient Air Quality

The *in situ* air quality stations study was conducted at 10 stations. The parameters measured are nitrogen dioxide (NO_2), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), Volatile organic compound (VOC), Carbon monoxide (CO), and Carbon dioxide (CO_2). The quality assurance and control (QA/QC) measures employed include sampling at approximately 1.5m above ground and away from buildings. The air quality of the project area was measured using appropriate portable gas analyzers and other sampling equipment. Approximately 30 minutes was spent per station (Plate 4.2). Table 4.3 shows the sampling stations.

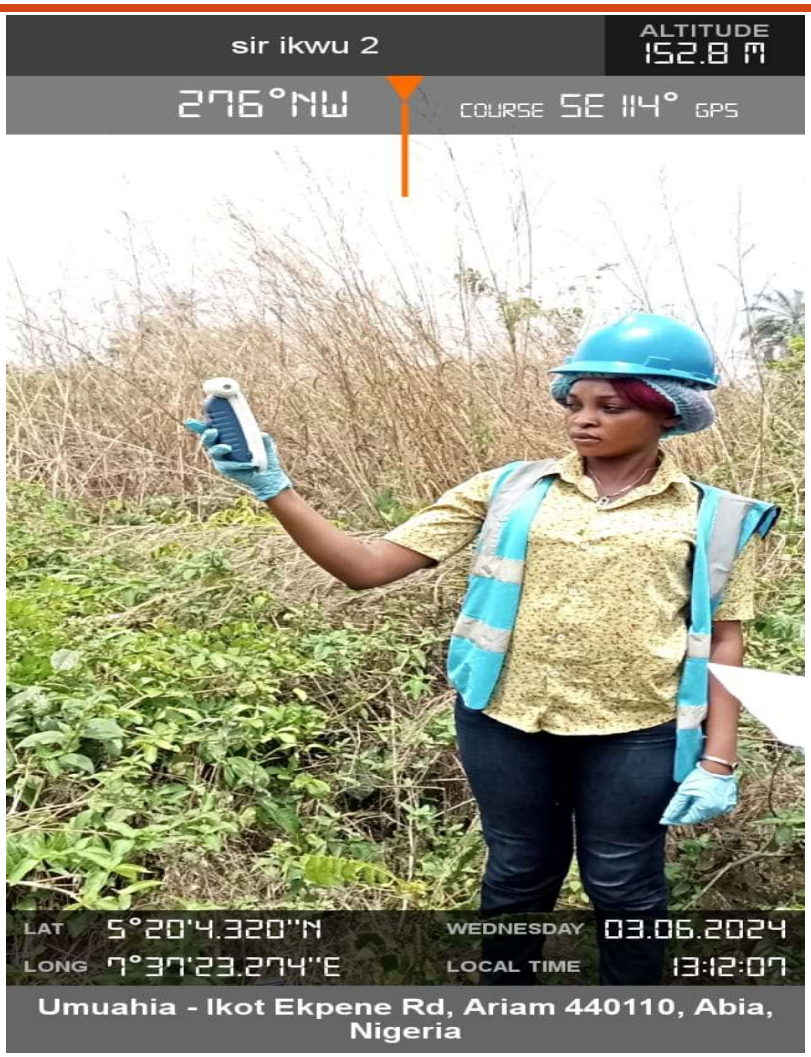

Plate 4.3a . Air quality determination

Plate 4.3b. Air quality determination

AEROQUAL 500 SERIES, AIR QUALITY MONITOR,
(INCLUDING THE SENSORS) were used for Air Quality; Noise & Meteorological Studies

4.3.3 Soil and Land-use

The land-use component of an ESIA study which is aimed at evaluating the degree to which a project will affect the main land use potentials, assesses the existing human activities relative to the human and natural elements of the proposed area. It involves the interpretation of satellite imageries in combination with the under-listed set of maps and complemented with field reconnaissance and ground-truthing during the field survey exercises:

▪ The satellite Imagery of the proposed site and surrounding villages.

Climate: Abia State enjoys an equatorial climate consisting mainly of two major seasons: Rainy season, (March-October) and Dry season (November-February) each year. The north east trade wind from Sahara Desert and the southerly humid marine air mass from the Atlantic Ocean cause the seasonal variation in the climate of Abia state. The number of sunshine hours in the state is 3600 hours per year.

Geology: There are two principal geological Formations in the state namely Bende-Ameki and the Coastal Plain Sands otherwise known as Benin Formation. The Bende-Ameki Formation of Eocene to Oligocene age consists of medium–coarse-grained white sand stones. The late Tertiary-Early Quaternary Benin Formation is the most predominant and completely overlies the Bende-Ameki Formation with a south west ward dip (Fig 4.3). The Formation is about 200m thick. The lithology is unconsolidated fine-medium-coarse-grained cross bedded sands occasionally pebbly with localized clay and shale.

Relief and Drainage: Abia state is drained by five important rivers namely: Imo, Esu, Akpoha, Igu and Aba River. The drainage is however dominated by two main rivers: the Imo River on the west and Cross-River on the east (Fig 4.5). The drainage pattern is generally dendritic with tributaries generally in a southerly direction. The dendritic drainage nature of the area signifies a homogeneous underlying material where structural control is lacking. The draining river and its tributaries are perennial, resulting in dominant rainforest plants along their banks.

Rainfall: The rainfall duration in the state can be classified into the wet and the dry seasons. Abia state enjoys a copious rainfall during rainy (monsoon) season. The mean monthly rainfall during this season is 335 mm and falls to 65 mm during the dry season. The annual rainfall is between 2000 mm and 2250 mm south of Abia and between 1250 and 2000 mm north-east of Abia.

Soil Sampling Techniques.

Following the planimetric maps of the proposed site of Abia SAPZ with soil samples station superimposed on it, soil sampling locations were identified. The identified locations were geo-referenced and preliminary investigations carried out. Site information were acquired using the field proforma for soil assessment (USDA, 2006). Soil samples were collected using soil auger (Plate 4.3) from 19 stations (Table 4.3) at depths of 0-15cm for the top-soil and 15- 30cm for the sub-soil, making a total of 38 samples. Physical properties of the soil samples were examined and recorded. The geographical coordinates of each sampling point were determined and recorded using Geographical Positioning System (GPS) – Garmin etrex.

Plate 4.4 Soil and water sampling

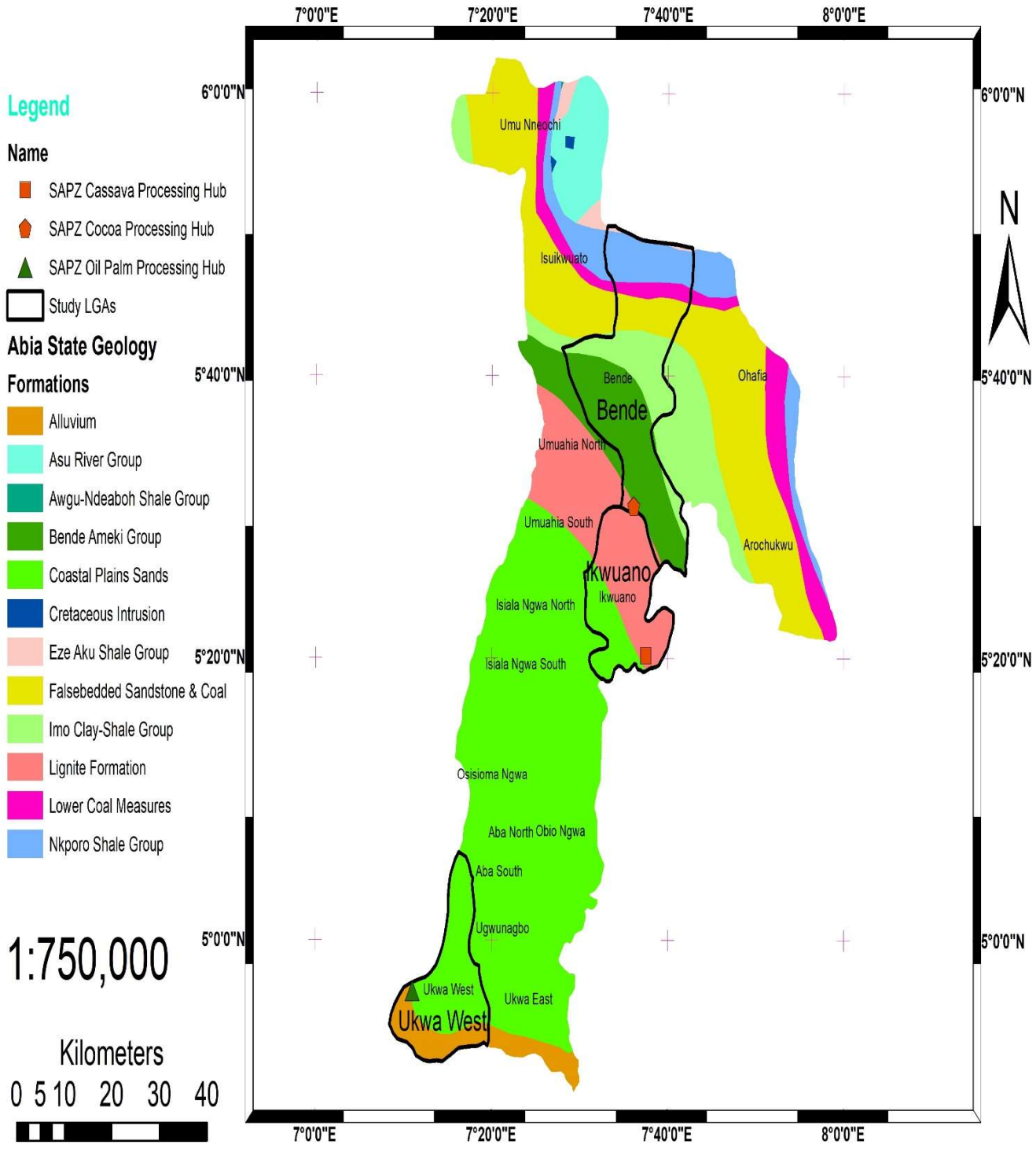

Fig 4.3 Abia state Geological formation

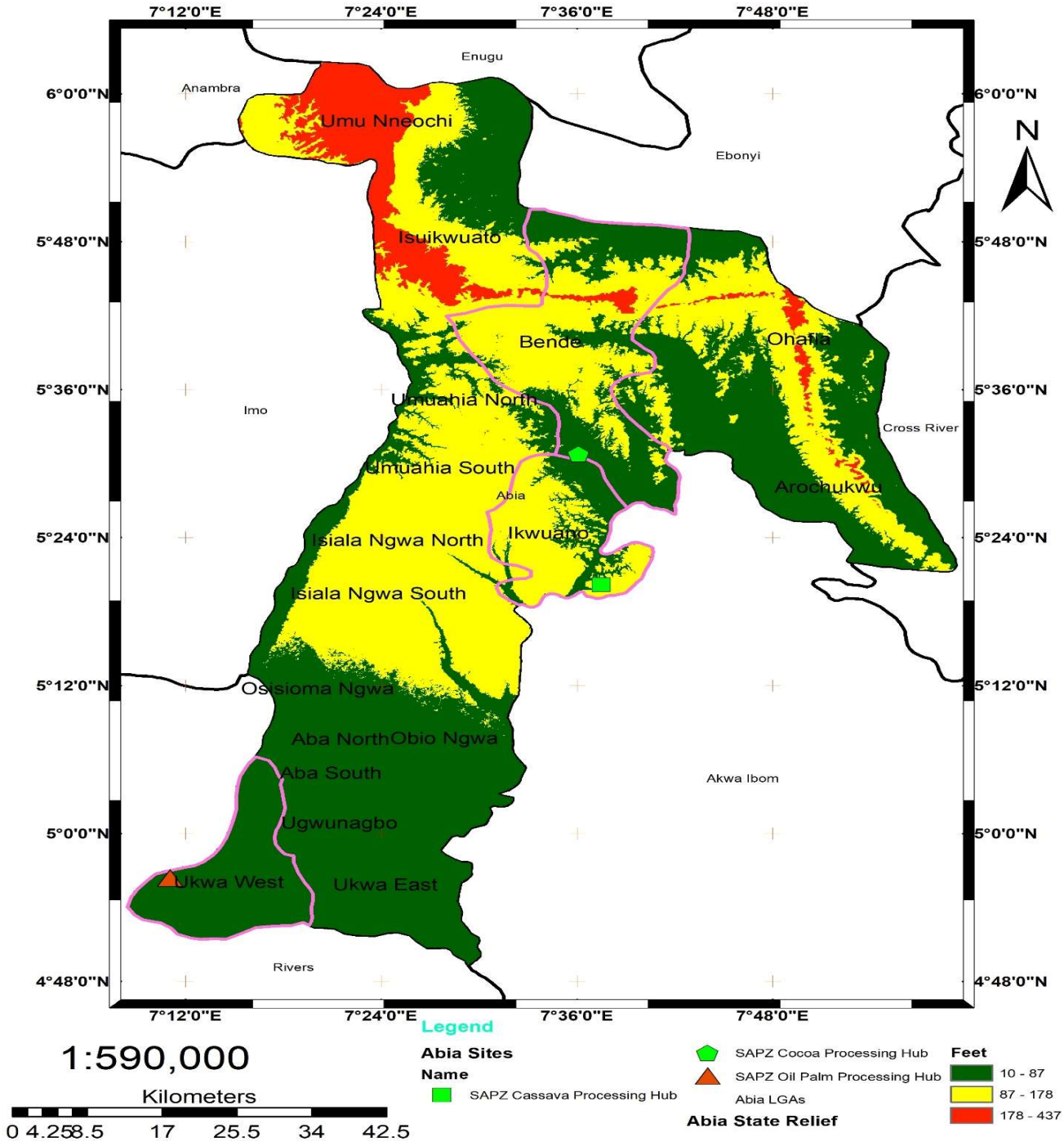

Fig. 4.4 Abia State Relief map

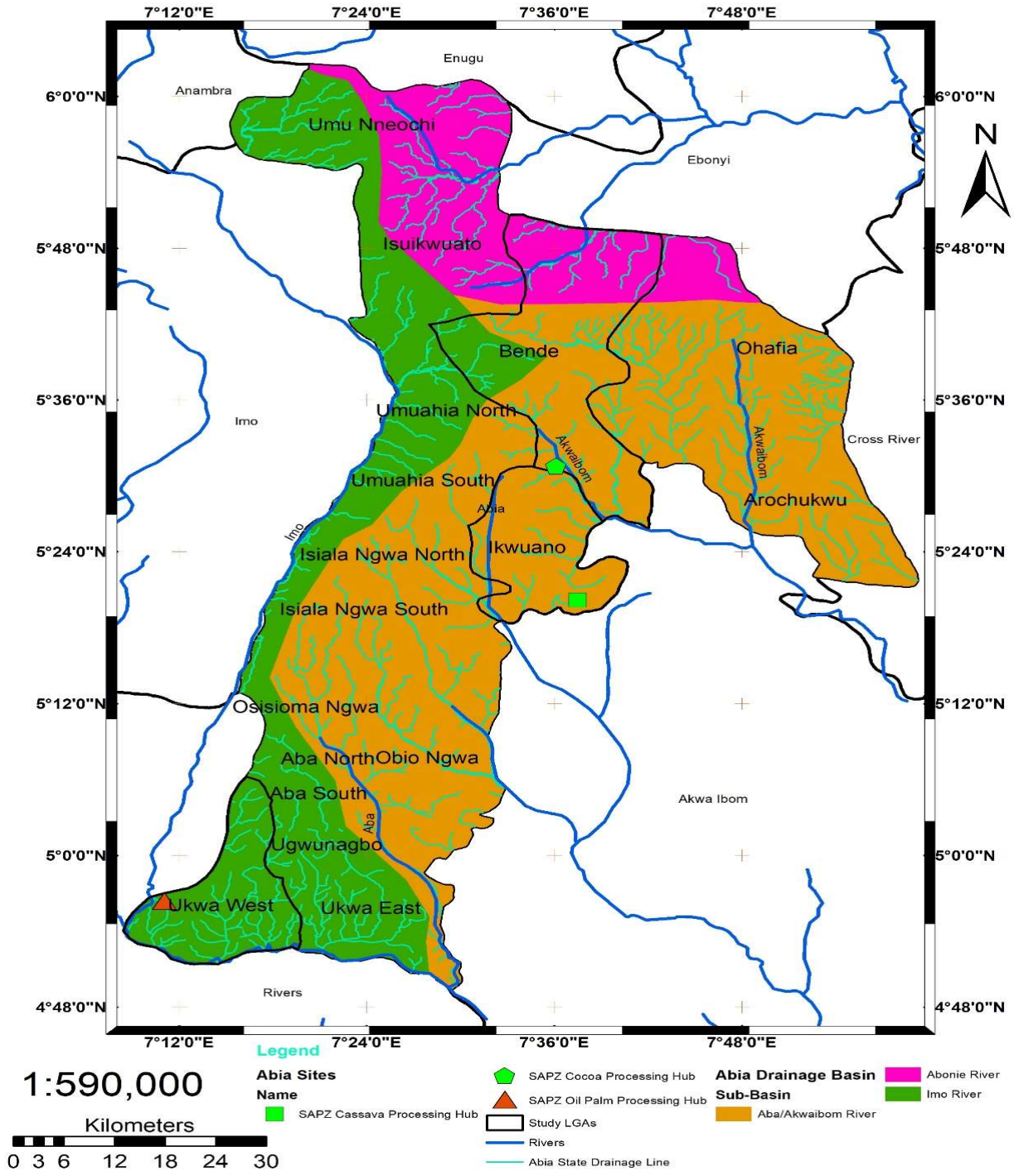

Fig 4.5 . Drainage Basin of Abia state

4.4 Water Quality

Groundwater

Two ground water samples were obtained from boreholes in the project Area (Table 4.4). While water samples for general physico-chemical analysis were collected in a 1-Litre acid pre-washed and distilled water rinsed plastic bottles, water samples for biochemical oxygen demand (BOD) and hydrocarbon analysis were collected in 250 mL amber glass bottles. The water samples for metal analysis were collected in acid pre-washed plastic bottles into which 2 mL of concentrated nitric acids had been added.

Table 4.4. Water Sample coordinates

Codes	LGA	Type of sample	Coordinates		
BWQ/OWA	Ukwa west	Borehole	N: 4.9546°	E: 7.18465°	Ele.22m
BWQ AR	Ikwuano	Borehole	N: 5.3445°	E: 7.6204°	Ele.117m
SWQ 1	Bende	Surface water	N: 5.5053°	E: 7.9970 °	50m
SWQ 2	Bende	Surface water	N: 5.5129°	E: 7.6013 °	65m
SWQ3	Bende	Surface water	N: 5.5126°	E: 7.6018 °	49m
UIRSP	Ukwa west	Surface water	N: 4.94794°	E: 7.16522 °	
MIRSP	Ukwa West	Surface water	N: 4.94022°	E: 7.16774°	
DIRSP	Ukwa West	Surface water	N: 4.93302°	E: 7.16736°	
SEDQ 1	Bende	Sediment	N: 5.5053°	E: 7.9970 °	50m
SEDQ 2	Bende	Sediment	N: 5.5129^0	E: 7.6013 °	65m
SEDQ3	Bende	Sediment	N: 5.5126°	E: 7.6018 °	49m
SEDP1	Ukwa west	Sediment	N: 4.94794°	E: 7.16522°	
SEDP2	Ukwa west	Sediment	N: 4.94022°	E: 7.16774°	
SEDP3	Ukwa west	Sediment	N: 4.93302°	E: 7.16736°	

Surface Water

Different water bodies within the project area of influence were assessed to determine their baseline conditions prior to the commencement of the project.

Parameters such as pH, temperature, conductivity, total dissolved solids and dissolved oxygen of the water samples were determined *in situ* using hand-held meters which had been calibrated prior to sampling. Water samples for microbiological analysis were collected in pre-sterilized 50 mL vials.

Samples collected were kept in ice chest and transported to the laboratory (New Concept laboratory Obinze, Owerri) for wet chemical analyses. All the samples were appropriately preserved and analyzed within their holding time. Analyses were carried out using standard operating protocols developed from national and international guidelines including the Federal Ministry of Environment, FMEnv (1991), US Environmental Protection Agency (US EPA) and APHA (2005) methodologies for water analysis.

4.4.1 Microbiology (Water, Soil and Sediment)

Water, soil and sediment samples were subjected to microbiological analysis in the laboratory for Total Heterotrophic and Total Hydrocarbon Degrading bacteria and fungi, total coliforms and faecal bacteria. Soil, water and sediment samples were collected in sterile containers and labelled according to the locations. Samples were immediately subjected to microbiological analysis on getting to the laboratory.

Determination of Total Heterotrophic Bacteria on Plate

Total heterotrophic bacteria isolated from each sample were determined by plating out 0.1ml of 10-4 dilution series of soil samples and 0.1ml of dilution 10-2 of water sample on nutrient agar and potato dextrose agar plates for bacterial and fungal enumeration. At the end of the incubation colonies were screened, counted and identified based on morphological and biochemical properties.

Determination of Total Coliform

The replicates made for coliforms on MacConkey agar plates as described above were incubated aerobically at 37^0C for 24 hours. Pinkish rose colonies indicated the presence of coliform (in the water sample. The colonies that grew on the agar were counted and noted.

Determination of Total Hydrocarbon Utilizers

Total hydrocarbon utilizers present in soil, sediment and water samples were determined using the method described by Raymond et al (1976). To achieve this, 0.1ml aliquot diluted soil, sediment and water samples were plated out by spreading technique on modified minimal salt media (Kastner et al. 1994). The medium is then autoclaved at 121^0C for 15 minutes.

4.4.2 Hydrobiology

The main influencing factor plankton diversity in Nigerian Rivers is the seasonal variation of rainfall, but biological cycles may play a significant role on chemical variables.

Biological approaches to evaluating water quality involve assessing communities of organisms. The basis for this approach is that different species have varying tolerances to environmental stressors (Kroeger et al. 1999). Fish productivity of water bodies is connected to primary production by many intermediate trophic links. The four groups of organisms that appear in The European Water Frame-work Directives WFD (Phytoplankton, Zooplankton, Fish and macrophytes), represent water ecological structure over a range of temporal and spatial scales and functional roles.

Aquatic studies conducted in the project area covered the following aspects:

- Hydrology
- Water quality - Physico-chemical and microbial characteristics
- Sediment

• Phytoplankton and zooplankton

• Macro-invertebrate sampling

• Fish fauna and fisheries.

4.3.9.1 Collection of phytoplankton and zooplankton samples

Plankton samples were collected using a 55µm mesh size plankton net lowered into the river for two minutes. These samples were collected from 2 stations in the Imo and Ibine stream. Collected samples were then concentrated, transferred into a properly labelled 250ml plastic containers with screw caps and preserved in 4% unbuffered formalin before being transferred to the laboratory for analysis.

Sediment

Sediment samples were taken by means of Van Veen grab for physico- chemical and benthos estimation from the two rivers within the project location and analysed. Sediment samples were collected at 6 locations within the surface waters assessed.

4.4.4 Sample Collection and Handling

Sample collection and handling were carried out as far as possible in accordance with FMEnv guidelines. Where the guideline cannot be followed strictly for safety or logistic reasons, other proven, scientifically acceptable methods of sample collection and handling were used. All samples collected were properly sealed and labelled. Where samples were sent to another laboratory for examination, a duplicate copy of this information was sent along with the sample to the laboratory, independent of the sample. All movements of the samples were included on the samples' record. Basic information was recorded together with results of analysis, in a register.

i. Sample Preservation

The pH, temperature, conductivity, total dissolved solid, dissolved oxygen and turbidity were determined in the field (in situ) using water instrument, while ammonia, nitrite, nitrate, were determined within 6 hours from time of sampling. Samples for delayed analyses were preserved by refrigeration, pH-adjustment and chemical pre-treatment

(heavy metals, Total Hydrocarbon) as follows: Water samples for BOD_5 determination were collected in black oxygen bottles and kept away from light source to prevent photo-oxidation and sample property deterioration.

ii Heavy metals and Hydrocarbon

Subsamples were pre-treated with nitric acid to a pH level of 2 in glass containers. All other analyses commenced on reaching the laboratory and were completed within 3 weeks of sample collection using standard analytical methods (mostly according to APHA *et al.,* 1980.

iii. Analytical Quality Control

The methods of laboratory analysis used were those specified in International Analytical Standards such as APHA for water quality. Trace metal analysis was carried out using Atomic Absorption Spectrophotometer duly calibrated using standards. Only Analytical Grade Reagents (Analar) and Chemicals were used for preparing solutions and standards. Laboratory equipment and facilities were decontaminated through proper cleaning. or guide against lack of sensitivity and calibration, analysis of 'control' (blank) and 'standard' (reference) samples was regularly carried out. All the samples were analysed by New Concept analytical laboratories Obinze Owerri.

Table 4.5: List of Methods of Chemical Analyses for water samples

Parameter	Method
pH	Potentiometric
Odour	Human Receptor
Appearance	Human Receptor
Total Dissolved Solid, mg/l	Gravimetric
Salinity, Brix %@ 20 ^{0} C	Refractometric
Total Solid, mg/l	Gravimetric
Conductivity, µS/cm	Potentiometric
Temperature, ºC	Electrode thermometer
Colour, PCU	Photometric
Turbidity, NTU	Nephelometric
Dissolved Oxygen (m/l)	Electro-membrane
Total chloride, mg/l (Cl^-)	Argentometric
Total hardness,(mg/l)	Gravimetric
Calcium Hardness, (mg/l)	Gravimetric
Magnesium Hardness (mg/l)	EDTA Titrimetric
Iron, (mg/l)	AAS
Total Suspended Solid, (mg/l)	Gravimetric
Sulphate,(mg/l)	UV Spectrophotometer
BOD (mg/l)	Incubation & Electro-membrane
COD, (mg/l)	Titrimetric
Total Alkalinity,(mg/l)	Titrimetric
Bio-carbonate, (mg/l)	Titrimetric
Calcium, (mg/l)	EDTA Titrimetri

Magnesium, (mg/l)	EDTA Titrimetric
Phosphorus, (mg/l)	Ascorbic acid
Nitrate (mg/l)	UV Spectrophotometer
Nitrite (mg/l)	Diazotization
Ammonia, (mg/l)	Phenate Spectrophotometric
Phosphate, (mg/l)	Ascorbic acid
Sodium, mg/l Na	AAS
Potassium, mg/l K+	Tetraphenylborate
All heavy metals	AAS

4.4.5 Socio-economy/Consultations

Survey Instruments: Survey instruments involves qualitative and quantitative data collection.

Household Questionnaire: A household questionnaire was designed for gathering factual socio-economic and health information in the village. A total of 400 questionnaires were administered. Respondents representing men, women and youths in the villages (Umulolo Owaza, Ariam elu elu Ikwuano and Okporoenyi Bende were interviewed in households that are carefully selected in the village.

Community Profile Questionnaire: The community profile questionnaire was used to gather the basic information about the community.

Data Collection: Houses in the village were listed and using systematic random sampling technique, houses were selected for the conduct of personal interviews. In the selected households, the consent of head of the household was sought. From the list of household members provided by the household head, one member was randomly selected for interview.

Qualitative Data: Qualitative data was collected to augment the quantitative data through Focus Group Discussion (FGD) with the Village head and other chiefs available in the community. The FGD was held at the village hall building. The FGD proceeding was tape recorded and group photographs taken.

4.5 CLIMATE AND METEOROLOGY

Data on climate and meteorology were obtained from the nearest synoptic stations of Nigerian Meteorological Agencies (NIMET) located in Port Harcout Airport, River State which is closest to the project area. The data included temperature, rainfall pattern and distribution, relative humidity, wind direction and speed.

General Climate and Meteorology of the study area

The project area is situated in the tropical rainforest zone of West Africa, off the Gulf of Guinea. The climatic data of the area are typical and representative of the two-season tropical climate of equatorial Africa, characterized by high annual rainfall, comparatively high temperature and relative humidity. In general, two seasons are characteristic of the climate in the region, namely the dry and wet seasons. The occurrence of these seasons corresponds with periods when the tropical continental and maritime air masses, and their associated winds, influence the coast of Nigeria.

4.5.1 Wind

Winds in the area are fairly consistent and sometimes very strong, especially during squalls associated with thunderstorms. It is these thunderstorms and the local 'tornadoes' accompanying them that are the dominant features of the weather in the area. They may occur throughout the year, even during the dry season, producing wind gusts of up to 100km/h (SIDS BV, 1999). Low wind velocities have been reported in the area with values within a range of 0.8 – 1.0 m/s at the Wind speeds are generally lower in the nights than during the days and vary with season, with the highest wind speed recorded at the onset of the rainy season. During the dry season, winds are distributed in all

directions, however during the rainy season, the predominant wind direction is southwest (Fig. 4.6)

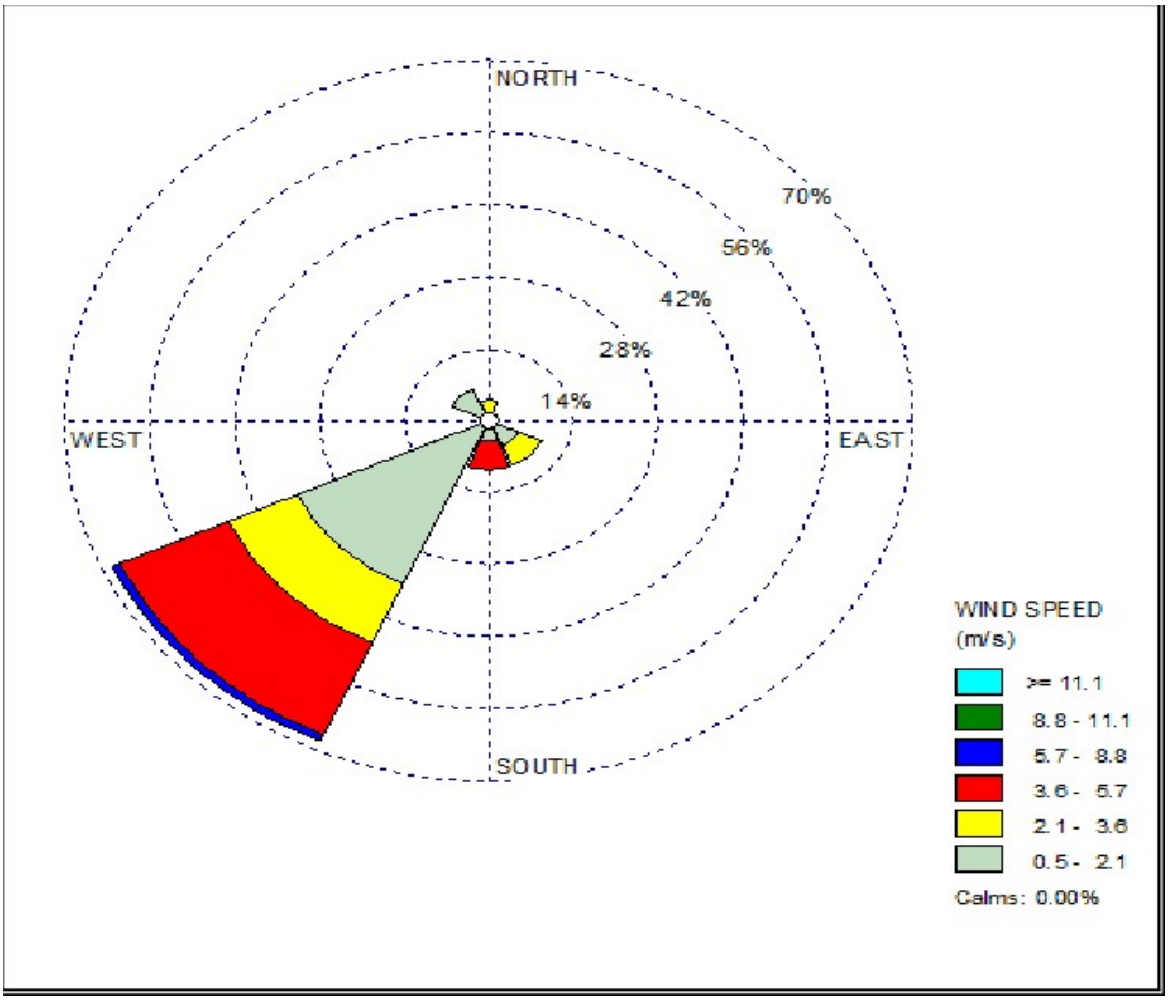

Fig. 4.6: Prevailing Wind Direction in the Proposed Project Area

4.5.2 Air Temperature

Mean maximum monthly temperatures in the proposed project area range from 28°C to 33°C, while the mean minimum monthly temperatures are in the range of 17°C to 24°C (Figure 4.7). The mean annual temperature for the area is reported to be 26°C and the hottest months are February to May with rapid changes in the air temperature during rainfall thunderstorms. Ambient temperatures could be as high as 37°C in the dry sunny

days. These ambient air temperature levels are typical of coastal tropical environments with the spatial temperature variations likely accounted for by the dynamic cloud cover during the day and time of measurement (Ayoade, 2004).

4.5.3 Rainfall

The peak of the rainy season occurs from May to July and again between September and November. The mean annual rainfall shows that the wet season exhibits heavier rains with the highest occurring in September (367.1mm) and less intense in December to February (25.9-56.5mm).

The raining season (April to November) typified by the southwest trade winds and the dry season (December to March) characterized by the northeast trade winds which bring harmattan. Rainfall is heaviest during the months of May and June. About 50% of the total rainfall occurs between April and July whilst only about 10% of the annual total falls between November and February.

Rainfall in the project area is generally high, with mean total annual rainfall of 367.1 mm (Figure 4.7). Rain falls almost all through the year with the peak in June. The site experiences a bimodal rainfall pattern with peaks in June and September. The seasonality is mainly produced by the movement of the zone of convergence between the two tropical air masses, known as Inter-tropical Convergence Zone. The project area is constantly under the influence of the moist south-westerly winds and experiences thick cloud cover and precipitation for a significant part of the year.

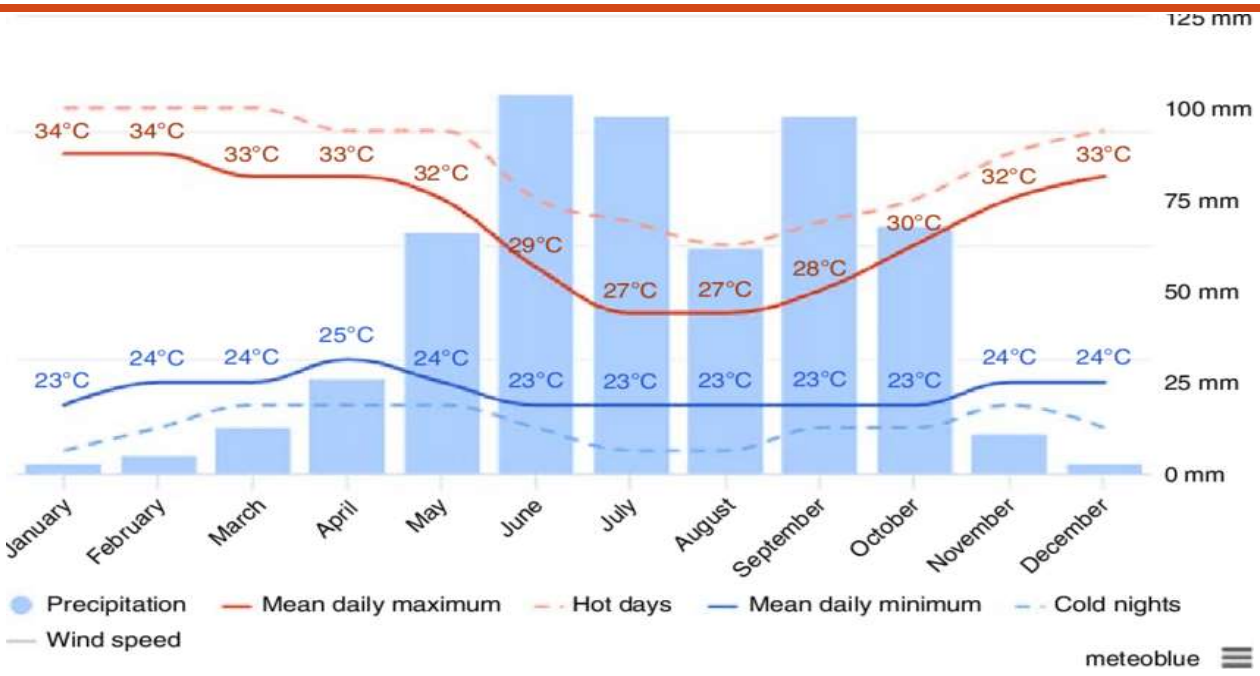

Fig. 4.7. Rainfall pattern with peaks in June and September

Atmospheric Pressure

The project area is characterized by low atmospheric pressure, ranging between 1001 and 1031hpa, with an average of 1011.5 hpa (Fig 4.8). It is lowest in the dry season between January and April and highest in August. Much like the air temperature and relative humidity, the atmospheric pressure, is subject to rapid changes during the passage of thunderstorms

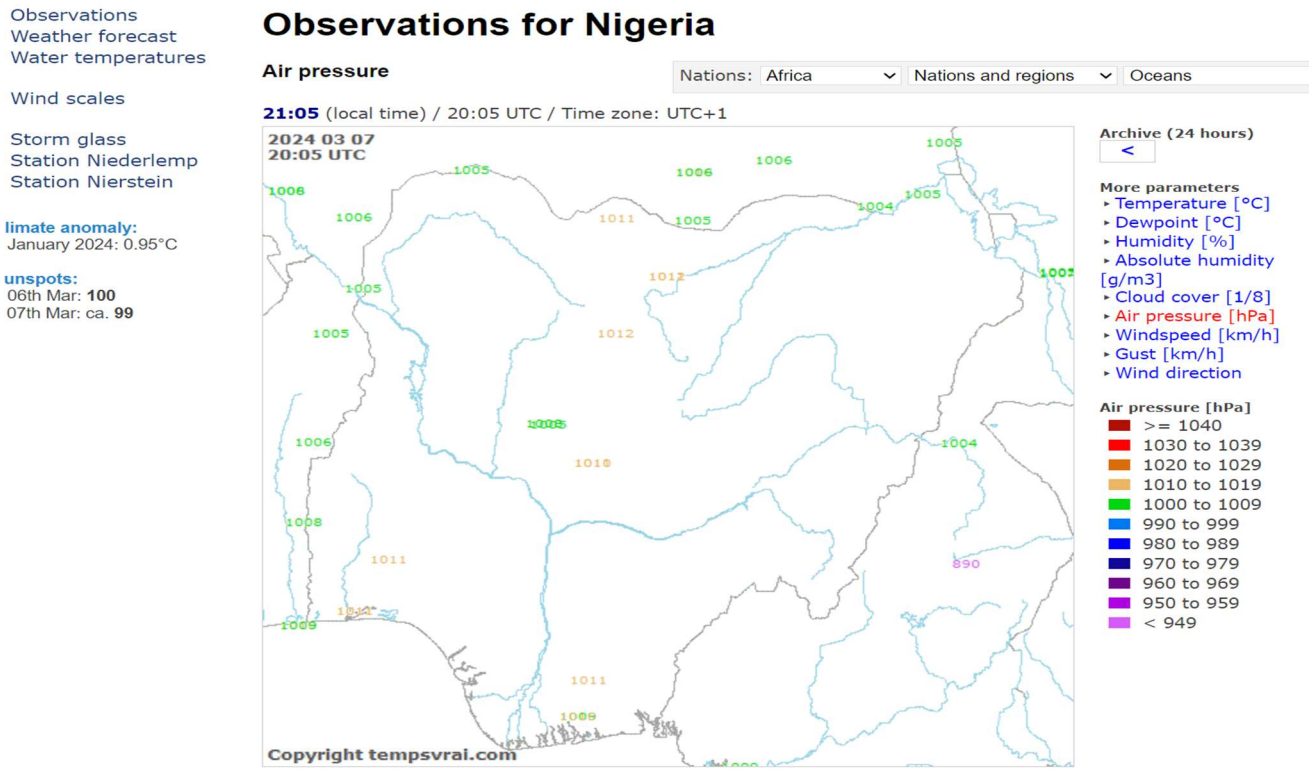

Fig. 4.8: Air pressures observed in the study area (adapted from Observations - weather.plus)

Relative Humidity

The area is characterized by a relatively high relative humidity throughout the year ranging between 60% and 80% in March and 80% - 100% in August.

Table 4.6 : Insitu Metrological Study in the Project Area

Code	Location Name	N	E	Temp °C	R. Humidity (%)	W. Speed (m/s)	Dew point, ^{0} C
AQSP1	Ukwa west	N: 4.94605°	E:7.18284^0	32.20	79.30	0.90	27.30
AQSP2	Ukwa west	N: 4.94315°	E:.17334^0	32.40	78.40	1.90	27.10
AQCSP	Ukwa west	N: 4.95558°	E: 7.18554^0	31.60	78.30	1.10	26.60
AQSP1	Ikwuano	N: 5.33468°	E:7.62391^0	36.40	61.70	2.50	26.80
AQSP2	Ikwuano	N: 5.3344°	E:7.62328 °	36.60	60.50	1.80	26.60
AQCSP	Ikwuano	N:5.334212°	E:7.62352^0	35.60	53.50	1.00	28.10
AQSP1	Bende	N: 5.5045°	E:7.5988^0	37.00	59.20	1.20	26.70
AQSP2	Bende	N: 5.50372°	E:7.59998 °	41..20	52.50	1.30	27.300
AQSP3	Bende	N: 5.50274°	E:7.60146 °	47.10	33.50	1.10	27.10
AQCSP	Bende	N: 551106°	E:7.60145^0	41.50	40.40	1.00	26.30

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4.6 AMBIENT AIR QUALITY

The Air quality parameters measured are Particulate matter (PM $_{10}$ and PM $_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), volatile organic compound (VOC), Carbon monoxide (CO), Carbon dioxide (CO_2), Ammonia (NH_3), and Methane (CH_4).

Air quality in the study area is influenced by a number of existing sources of air pollution, including transportation (cars, trucks, Bikes), heating and lighting (i.e., cooking, diesel generators, petrol generators and hydrocarbon exploration especially at Owaza in Ukwa West LGA etc.

Air Quality Result

Ambient air was sampled and analysed in situ for the common atmospheric pollutants within the proposed Abia SAPZ project locations. The results are

Presented in Table 4.7. The result of ambient air quality within the study area in the dry season shows that the concentrations of the key pollutants were below the WHO permissible limit.

Particulates

The particulates measured are PM 2.5, and PM 10 using spot check instrument average of 30 minutes. The PM 2.5 ranges between 0.01-0.04 mg/m^3 on site, average of 0.02 mg/m^3 in the dry season. The average is lower than WHO standard of 0.045mg/m^3 as shown in and Fig**. 4.9**

The PM 10 ranges between 0.019- 0.045 mg/m^3 on site, average of 0.032mg/m^3 in the dry season. The average is higher than WHO of 0.015 mg/m^3 as shown in Fig 4.9

Sulphur Dioxide

The SO_2 was not detected on site in all the stations in dry season. It is safe to say the SO_2 values are below the instrument detection limit of 0.01ppm and below WHO regulatory limit of 0.04 mg/m^3 (Table 4.7

Carbon Monoxide

The CO measures on site in the dry season was below the instrument detection limit except for the control point at Ariam Elu elu Ikwuano .

- Carbon Dioxide (CO_2)

The CO_2 measured on site ranges from 842.00 - 1059mg/m^3 on site, average of 933.9mg/m^3 in the dry season. The value is within the range of normal background level (250 – 400ppm) of CO_2.

- Hydrogen Sulphide (H_2S): The value of H_2S measured in all the stations were below instrument detection limit (0.1ppm) for the site and control stations in dry season.

- ***Nitrogen Oxides (NOx)***

The value of NO_2 measured on site ranges from 0.052- 0.104 mg/m^3 on site, average of 0.078 mg/m^3 in the dry season. The average NO_2 value is higher than the WHO standard limit of 0.025 (Table 4.7).

- Volatile Organic Compound, VOC

The value of VOC measured on site ranged from 39.00-99.00mg/m^3 and average of 72 mg/m^3 for the project sites and control stations. Other parameters were fairly detected at the project site.

Table 4.7: Results of in situ Air quality in the study area.

Code	Location Name	N	E	CO mg/m^3	CO_2 mg/m^3	O_3 mg/m^3	NO_2 mg/m^3	CH_4 mg/m^3	H_2S mg/m^3	VOC mg/m^3	SO_2, mg/m^3	NH_3, mg/m^3
AQSP1	Owaza	N: 4.94605°	E:7.18284^0	2.5	878.0	0.0	0.094	6.60	0.0	97.00	0.0	0.60
AQSP2	Umuololo	N: 4.94315°	E:.17334^0	2.00	856.00	0.0	0.104	29.00	0.0	77.0.0	0.0	0.60
AQCSP	Umuololo	N: 4.95558°	E: 7.18554^0	2.0	911.0	0.0	0.080	8.80	0.0	56.00	0.0	0.6
AQSP1	Ariam elu	N: 5.33468°	E:7.62391^0	0.0	1032	0.0	0.052	28.00	0.0	99.00	0.0	0.0
AQSP2	Ariam	N: 5.3344°	E:7.62328 °	0.0	1037.00	0.0	0.060	26.0	0.0	96.0.0	0.0	0.0
AQCSP	Ariam	N:5.334212°	E:7.62352^0	6.10	887.00	0.03	0.102	19.00	0.0	62.00	0.0	0.0
AQSP1	Bende	N: 5.5045°	E:7.5988^0	0.0	1059.00	0.05	0.091	29.00	0.0	95.00	0.0	0.01
AQSP2	Bende	N: 5.50372°	E:7.59998 °	0.0	932.00	0.01	0.095	14.00	0.0	55.00	0.0	0.0
AQSP3	Bende	N: 5.50274°	E:7.60146 °	0.0	842.00	0.06	0.100	13.00	0.0	39.00	0.0	0.40
AQCSP	Bende	N: 551106°	E:7.60145^0	3.8	905.0	0.06	0.079	14.00	0.0	40.00	0.0	0.03
		WHO 2021 AQGs		4.0	NS	0.10 - 0.15	0.025	NS	0.042	NS	0.04	0.40
		Ave.		1.82	933.9	0.42	0.078	18.7	0.0	72	0.0	0.224
		Min.		0.0	842	0.0	0.052	6.60	0.0	39.00	0.0	0.0
		Max.		6.10	1059	0.06	0.102	29.00	0.0	99.	0.0	0.6

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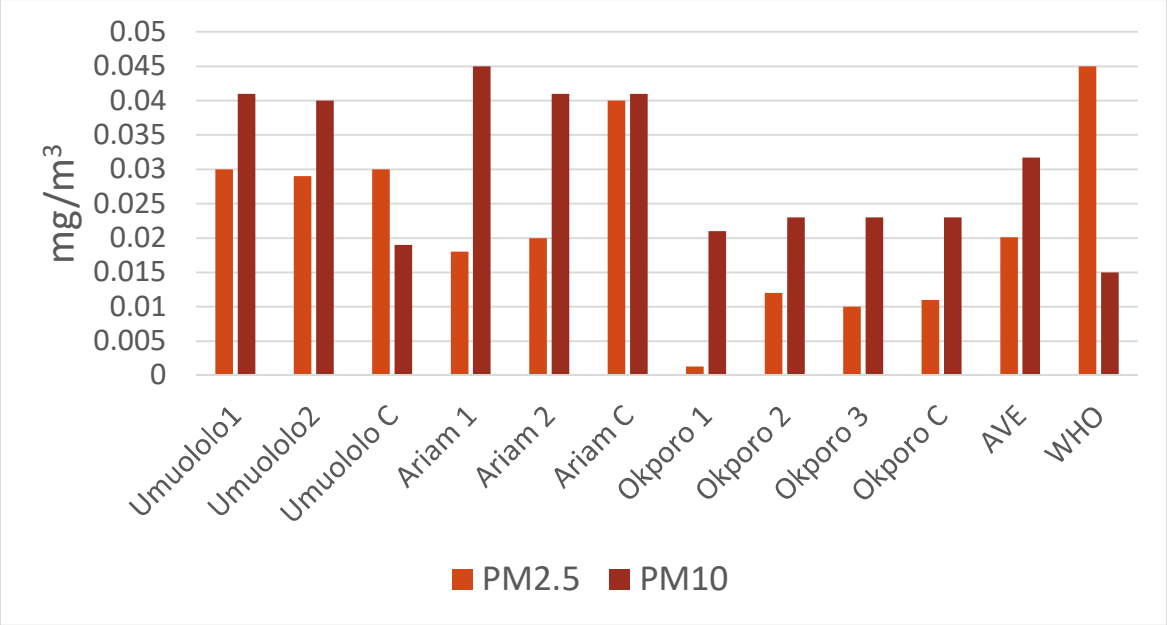

Fig 4.9 . Particulate matter concentration in the study area. Abia SAPZ ESIA 2024

Noise

Noise sources around the site include noise generated by vehicles and trucks on the tarred road, and human interactions in the communities and towns along the proposed Abia SAPZ. The nearest sensitive noise receptors are road users and occupants of buildings along the roads.

Ambient Noise Measurements

An ambient noise survey was undertaken during the dry season. Short-term (10 minutes) noise measurements were taken at Nineteen (10) points. Measurements were taken using a handheld Digital noise level meter. Measurements were taken with the meter at a height of approximately one meter above ground level and the response time set to show and read on the 'A' frequency weighting scale (weighted for human hearing perception). The results of the short-term noise surveys are summarized in Fig.4.10

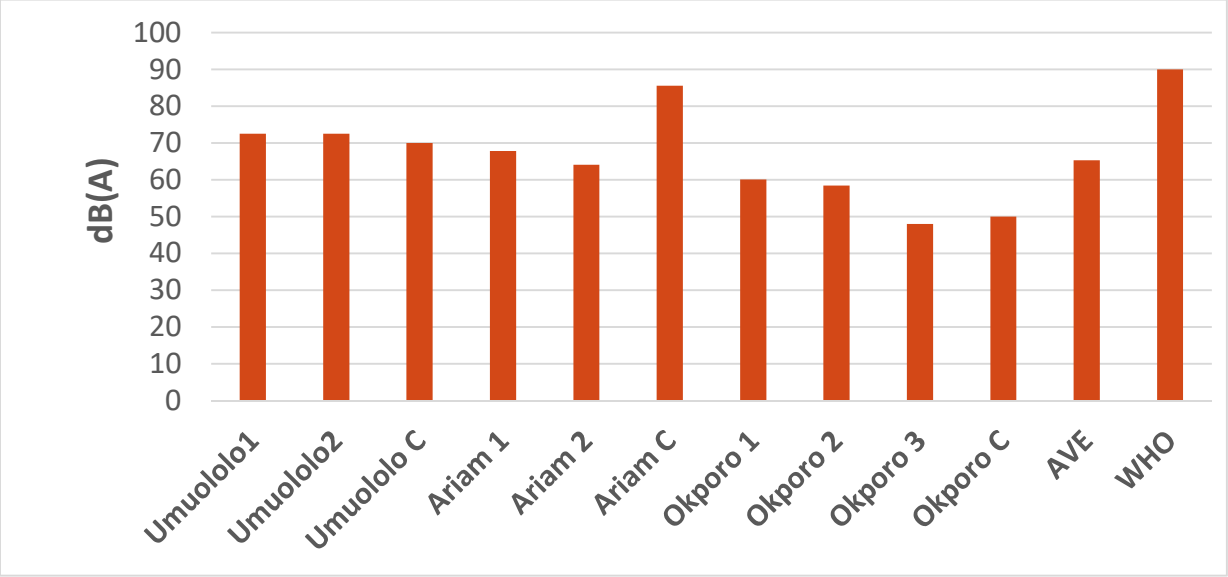

Fig 4.10. Noise measurement in the Study Areas. Abia SAPZ ESIA 2024

The Ambient noise levels around Umuololo ranged from 70-72.5 dB(A), Ariam elu elu 64.2-85.6 dB(A) and Okporoenyi in Bende ranged from 48-60.1dB(A) with average of 65.3 dB(A). These values are with W.H.O. permissible limits for community noise of 90.0 dBA for day-time standard.

4.7. Water analysis Results

Results of Groundwater resources

The physico-chemical characteristics of the ground water bodies within the proposed project areas are summarized in Table 4.8. All physicochemical parameters analyzed in the water samples were within threshold values, except for the following parameters: Colour, Total Suspended Solid, Ammonia and Phosphate concentrations above NIS threshold limits for drinking water. The results of the base metals concentration showed that they largely reflect the non-saline nature of groundwater

resources in the proposed project location as indicated by the chloride and hardness concentrations.

Table 4.8 Results of physicochemical parameters of ground water in the study area

Parameter	BWQ AR	BWQ/OWA	NIS 977:2017
pH	6.60±0.00	6.40±0.00	6.50 -8.50
Odour	Unobjectionable	Unobjectionable	Unobjectionable
Appearance	Clear	Clear	Clear
Total Dissolved Solid, mg/l	31.85±2.76	16.25±0.00	500.00
Salinity, Brix %@ 20 ^{0} C	ND	ND	0.0
Total Solid, mg/l	74.00±2.83	42.00±0.00	500-1000.00
Conductivity, µS/cm	49.00±4.24	25.00±0.00	1000.00
Temperature, ^{o}C	29.80±0.00	28.40±0.00	20.00-30.00
Colour, PCU	6.50±0.71	4.00±0.00	5.00
Turbidity, NTU	1.15±0.07	0.04±0.01	5.00
Dissolved Oxygen (m/l)	10.75±0.07	8.90±0.00	>.7.50
Total chloride, mg/l (Cl^-)	17.99±0.0	15.00±1.41	100.00
Total hardness,(mg/l)	19.43±1.83	15.54±0.00	100.00
Calcium Hardness, (mg/l)	11.66±1.83	7.77±0.00	100.00
Magnesium Hardness (mg/l)	7.77±0.00	7.77±0.00	100.00
Iron, (mg/l)	0.68±0.00	0.76±0.01	0.30
Total Suspended Solid, (mg/l)	42.15±0.07	25.75±0.00	<10.00
Sulphate,(mg/l)	1.32±0.37	2.76±0.18	100.00
BOD (mg/l)	3.10±0.00	3.80±0.14	NS
COD, (mg/l)	48.00±0.00	48.00±0.00	NS
Total Alkalinity,(mg/l)	8.00±0.00	7.00±0.00	200.00
Bio-carbonate, (mg/l)	7.99±0.00	6.99±0.00	NS
Calcium, (mg/l)	3.35±0.52	2.23±0.00	200.00

Magnesium, (mg/l)	1.89±0.00	1.89±0.00	2.00
Phosphorus, (mg/l)	28.53±0.38	20.11±0.00	NS
Nitrate (mg/l)	0.17±0.02	0.19±0.01	10.00
Nitrite (mg/l)	0.09±0.0	0.08±0.01	0.02
Ammonia, (mg/l)	0.17±0.01	0.20±0.01	0.05
Phosphate, (mg/l)	87.50±1.17	61.67±0.00	5.00
Sodium, mg/l Na	0.58±0.01	0.57±0.00	100.00
Potassium, mg/l K+	3.00±0.00	3.67±0.23	10.00

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BWQ AR= borehole at Ariam elu elu , BWQ/OWA= borehole at Owaza

EC (Electrical Conductivity)

The conductivity of water is a measure of the ability of the water to conduct electricity and indicates the levels of dissolved solutes in the water, including the presence of impurities. Clean or treated water devoid of impurities mostly has low conductivity, implying the absence of contaminant in the water since most of the dissolved ions in the water would have been removed by the treatment process. However, natural waters, including groundwater and surface water, are likely to have higher concentrations of dissolved ions leached from the surrounding rocks they are in contact with and may not be said to have been contaminated. Nevertheless, water with high dissolved solids, and consequent high conductivity, may result in the encrustation and corrosion of metallic surfaces, especially industrial equipment such as boilers, supply lines of domestic/sanitary pipes and lines etc. Electrical conductivity obtained from the study area ranged from 25 to 49 µS/cm and is below the permissible limit set NIS.

Total Dissolved Solids, Total Suspended Solids and Turbidity

Solids in water play important role in the chemical and ecological balance of the water system. They could serve as nuclei for precipitating dissolved minerals in the

water and also could dissolve into bioavailable nutrient in the liquid phase. This impact on water quality properties such as conductivity, change in water density which affects buoyancy and increase in the availability of nutrient needed to enhance some basic water reactions. Solids exist in water in two forms: total dissolved solids (TDS) and total suspended solids (TSS), with the summation of the two making up the total solids (TS). Suspended solids are solids contained in water that are not in solution, but comprising settle-able, floating, and colloidal or non-soluble solids.

The mean concentration of TDS, TS and TSS ranged from 16.25±0.0- 31.85 ±2.76mg/l, 42.0 ±0.0-74.0 ±2.83 mg/l and 25.75±0.0 – 42.15mg/l, respectively and are within NIS permissible limits except TSS.

Nutrients (NO_3^-, PO_4^{3-} and SO_4^{2-}) in groundwater

Nutrients in water consist of micro/macronutrients and essential minerals in dissolved form, required for healthy growth and sustenance of aquatic plants and animals.

Hence nutrient depletion or enrichment can have a consequential effect on aquatic systems. Nutrient required most by aquatic organisms includes nitrate (NO_3^-) and phosphate (PO_4^{3-}) which are the drivers of primary productivity in natural waters. The balance of these nutrients in water could impair the water system. In this present study the nutrients obtained in the groundwater samples ranged from Sulphate (1.32±0.32-2.76±0.18mg/l,) Nitrate (0.17±0.02-0.19±0.01mg/l) and Phosphate (61.67±0.0-87.5±1.17 mg/l). All the nutrients are within the permissible limits except phosphate.

Oxygen Parameters: (DO), (BOD) and (COD)

Dissolved oxygen (DO) in water sustains life in aquatic systems. Dissolved oxygen refers to the level of free, non-compound oxygen present in water. Oxygen dissolves in surface water due to the aerating action of winds and also introduced into the water as a by-product of aquatic plant photosynthesis.

The level of DO, most often than not, indicates the extent of pollution and safety or viability of a water source or body and depends, in part, to the chemical, physical, and biochemical activities occurring in the water. Low level of dissolved oxygen in water is a sign of contamination and is an important factor in determining water quality, pollution control and treatment. Thus, a high DO level in a community water supply is good because it makes drinking water taste better.

Biochemical oxygen demand measures the oxygen needed by organism for their oxidative process. Higher BOD indicates more oxygen is required, which is less for oxygen-demanding species to feed on and signifies lower water quality. Inversely, low BOD means less oxygen is being removed from water, so water is generally purer. COD on the other hand, is a water quality parameter used not only to determine not only the amount of biologically active substances such as bacteria, but also biologically inactive organic matter in water.

The DO, BOD and COD of the groundwater samples ranged from 8.90±0.0-10.75mg/l, 3.1±0.0-3.8±0.14mg/l, 48.0± 0.0 -48.0 ±mg/l, respectively.

Base Metals: Na, K, Mg and Ca

Presence of base metals in water greatly influences the conductivity of water and thus is crucial to the chemical equilibrium of aquatic system. The base metals concentration within the study area ranged from Na^+: 0.57±0.0-0.58±0.0mg/l, K^+ : 3.0±0.0 -3.67±0.23 mg/l , Ca^{2+} : 2.23±0.0-3.35±0.0 mg/l, Mg : 1.89±0.0 - 1.89±0.0mg/l.

Heavy Metals concentration

The presence of toxic metals in water resources, including when present above their natural or background levels, could indicate contamination from anthropogenic influences or from the surrounding geologic formation of the soil.

Concentrations of heavy metals in the groundwater samples are as shown in Table 4.9

Table 4. 9 Heavy metal concentration of groundwater samples from the study areas

Parameter	BWQ AR	BWQ/OWA	NIS 977:2017
Nickel, ,mg/l Ni	1.53±0.00	3.12±0.08	0.01
Copper, mg/l Cu	0.002±0.0	0.02±0.00	1.00
Vanadium, mg/l V	0.02±0.02	0.20±0.01	NS
Lead , mg/l Pb	ND	ND	0.01
Mercury, mg/l Hg	0.25±0.12	0.20±0.08	0.001
Zinc mg/l Zn	0.54±0.03	0.25±0.05	5.00
Aluminum, , mg/l Al^{+3}	5.00±0.64	10.91±1.28	0.02
Chromium, mg/l Cr^{+3}	0.02±0.0	0.03±0.00	0.01
Arsenic, mg/l As	0.12±0.01	0.09±0.01	0.01
Cadmium, mg/l Cd	ND	ND	0.003
Manganese, mg/l Mn	ND	ND	0.10

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The mean concentrations of heavy metal ranged from Ni (153-3.32) Mg/l and is above the permissible limits (Table 4.9). Copper ranged from 0.002-0.02 mg/l, Vanadium ranged from 0.02-0.2mg/l. However Pb+ was not detected . Mercury, Zinc , Aluminum, Cr, As and Cr were all below the permissible limit set by NIS/Federal Ministry of Environment.

Ground water Microbiology

Microorganisms subsist in water in most cases as a result of the presence of nutrients and organic substrates which they compete for. Microbial activities in the water are desirable in that they provide a mechanism of reducing nutrient and organic load in water by converting the complex molecules, in most cases to their basic components or elemental or simpler forms.

Table 4.10. Ground water microbial load in the study area.

Organism	BWQAR	BWQ/OWA
Total Heterotrophic Bacteria count , Cfu/100ml	21±0.0	38±0.0
Total Coli form count, cfu/100ml	46±0.0	49±0.0
Total Fungi Count, cfu/100ml	1	3±0
Total Hydrocarbon Degrading Bacteria count cfu/ml	NG	NG
Total hydrocarbon Degrading Fungi Count, cfu/ml	NG	NG

NG=no growth

Results of the microbial analysis of the groundwater samples are as shown in Table 4.10 There were presence of coliform bacteria in the groundwater samples ranged from 46 – 49 Cfu/100ml. Also, hydrocarbon utilizing bacteria and fungi were all absent in the samples. However heterotrophic bacteria and fungi were detected within a range of 21-38 Cfu/100ml. These bacteria are ubiquitous in the environment and are likely to be present in natural water at some varying levels, even in the absence of pollution.

4.8 Surface Water

Two surface water bodies were assessed to determine their baseline conditions before the commencement of the project Table 4.4 shows the coordinates of the sampled surface water. The two rivers are located in Ukwa west (Imo river) and Bende LGA (Ibine stream). The results of the physicochemical concentrations are presented in Table 4.11

Table 4.11: Results of Physico-chemical Parameters of Surface Water

Parameters	UIRSP	MIRSP	DIRSP	mean±std	SWQ 1	SWQ 2	SWQ3	mean±std	Fmenv
pH	4.90	5.10	5.10	5.1± 0.03	6.20	6.20	6.30	6.23±0.05	6.50 -8.50
Odour	Unobjectionable	Unobj	unobj	Unobj	Unobj	Unobj	Unobj	Unobj	-
Appearance	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	turbid	-
Total Dissolved Solid,(mg/l)	10.47	10.47	12.35	11.94±1.2	30.55	37.05	31.85	33.26±3.2	500.00
Salinity, Brix %@ 20 ^{0} C	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	
Total Solid, (mg/l)	63.00	65.00	72.82	68.43±3.7	152.0	334.00	198.00	226.33±87	500-1000.00
Conductivity, (µS/cm)	16.10	16.1	19.00	18.37±1.8	47.00	57.00	49.00	51.17±5.0	1000.00
Temperature, ^{o}C	26.9	26.90	28.00	27.37±0.5	25.80	28.90	28.80	27.80±1.6	30.00
Colour, PCU	49.0	53.00	46.0	50.57±4.9	350.00	480.00	380.00	401.7±617.8	15.00
Turbidity, NTU	65.80	66.22	61.20	64.59±2.3	141.0	68.40	96.60	103.10±32.7	10.00

Dissolved Oxygen (m/l)	13.00	13.00	11.90	12.43±0.4	14.00	9.90	12.10	11.98±1.81	>.4.00
Total chloride, mg/l (Cl^-)	14.00	14.00	15.99	15.66±1.3	16.00	21.99	21.99	19.99±4.00	250.00
Total hardness,(mg/l)	46.20	47.20	48.60	48.96±2.2	23.31	25.90	20.72	23.74±3.03	200.00
Calcium Hardness, (mg/l)	31.08	31.08	31.08	32.81±5.3	18.14	12.96	15.55	15.98±1.95	150.00
Magnesium Hardness (mg/l)	15.12	16.12	17.52	16.15±4.4	5.17	12.94	**5.17**	7.76±3.28	150.00
Iron, (mg/l)	0.06	0.07	0.08	0.08±0.02	2.61	3.24	2.56	2.81±0.33	1.00
Total Suspended Solid, (mg/l)	52.53	54.53	60.47	56.49±2.8	121.45	296.95	166.15	193.08±84.6	<10.00
Sulphate,(mg/l)	10.00	12.00	10.00	11.00±1.1	71.84	98.42	88.42	86.18±12.34	200.00-400.00
BOD (mg/l)	5.72	5.68	6.60	6.20±0.41	9.30	9.20	10.70	9.62±0.97	NS
COD, (mg/l)	56.30	56.30	58.20	58.50±2.2	112.00	64.00	80.00	5.33±29.79	NS
Total Alkalinity,(mg/l)	22.00	24.00	25.00	24.67±1.5	5.00	3.00	5.00	4.50±1.22	150.00
Acidity (mg/L)	11.2	16.2	13.12	13.5±0.6	11.6	12.4	12.8	12.3±1.0	NS
Bio-carbonate, (mg/l)	21.99	23.99	24.99	24.66±1.5	4.99	2.99	4.99	4.49±1.22	NS
Calcium, (mg/l)	8.94	8.94	8.94	9.44±1.5	5.21	3.72	4.47	4.59±0.56	200.00

Magnesium, (mg/l)	3.68	3.92	4.26	3.93±1.1	1.26	3.15	1.26	1.89±0.80	2.00
Phosphorus, (mg/l)	36.20	36.10	36.20	36.87±1.1	48.92	67.12	55.2	57.03±8.37	NS
Nitrate (mg/l)	12.22	14.30	16.80	15.49±1.8	6.39	9.91	7.57	7.96±1.60	50.00
Nitrite (mg/l)	1.06	1.04	1.08	1.11±0.08	1.03	1.34	1.16	1.17±0.15	0.20
Ammonia, (mg/l)	0.36	0.36	0.38	0.39±0.03	0.37	0.49	0.42	0.43±0.05	0.30
Phosphate (mg/l)	98.44	98.46	89.54	91.66±5.	150.00	205.83	169.17	174.86±25.6	<5.00
Sodium, (mg/l)	0.22	0.22	0.20	0.22±0.02	2.24	12.2	2.32	2.30±0.04	200.00
Potassium, mg/l	0.36	0.36	0.42	0.39±0.03	8.17	2.32	10.50	8.25±1.77	10.00

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Table 4. 12. Heavy metal concentration of surface water in the study area.

Parameters	UIRSP	MIRSP	DIRSP	mean±std	SWQ 1	SWQ 2	SWQ3	mean±std	Fmenv
Nickel (mg/l) Ni	0.05	0.07	0.06	1.56±3.65	4.35	12.24	8.00	8.18±3.58	0.02
Copper, (mg/l) Cu	0.20	0.20	0.30	0.25±0.04	0.05	0.20	0.08	0.11±0.07	1.00
Vanadium, (mg/l)V	0.16	0.15	0.08	0.14±0.05	0.25	0.32	0.02	0.16±0.12	
Lead , (mg/l) Pb	ND	0.02	0.06	0.04±0.02		BDL	BDL	BDL	0.01
Mercury, (mg/l) Hg	0.10	0.10	0.05	0.10±0.04	0.20	ND	0.18	0.20±0.03	0.001
Zinc (mg/l) Zn	0.009	0.012	1.00	0.74±0.57	1.25	3.45	2.33	2.34±0.99	
Aluminum, , (mg/l) Al^{+3}	2.85	2.90	2.40	2.54±0.26	19.09	27.27	17.27	21.36±5.10	1.00
Chromium, mg/l Cr^{+3}	0.05	0.05	0.06	0.06±0.01	0.05	0.03	0.01	0.03±0.02	0.05
Arsenic, mg/l As	0.023	0.023	0.020	0.02±0.00	0.22	0.26	0.05	0.15±0.0	0.01
Cadmium, mg/l Cd	0.003	0.003	0.003	0.01±0.00	BDL	BDL	BDL	BDL	0.003
Manganese, mg/l Mn	0.011	0.011	0.014	0.01±0.00	0.30	0.36	0.28	0.32±0.04	0.05

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4.8.1 Results of Physico-chemical properties of the surface water

The mean pH of the surface water for Imo river was 5.1± 0.03 Table 4.11) and Ibine stream 6.23±0.05 which are within the pH range of 6.50 -8.50 for water with aquatic life (FMEnv.). The mean temperature for the two river ranged from 27.37±0.5 °C to 27.80±1.6 °C. Mean acidity levels for the surface waters were Imo River: 13.5±0.6 mg/L and Ibine 12.3±1.0 mg/L and alkalinity 24.67±1.5mg/L and 4.50±1.22 mg/l respectively.

Mean total solids, total dissolved solids and total suspended solids for Imo river and Ibine stream concentrations were TS:68.43±3.7mg/l, 226.33±87mg/l , TDS: 11.94±1.2, 33.26±3.2mg/L TSS: 56.49±2.8mg/l , 193.08±84.6 respectively (Table 4.11 . These concentrations are within range of fresh waters as shown in the chlorides concentration and salinity level at mean of 15.66±1.3mg/L, 19.99±4.00 respectively. Electrical conductivity of the water ranged from18.37±1.8 µS/cm to 51.17±5.0. µS/cm and are with FMenv. Limits . Mean turbidity of the two surface water ranged from 64.59±2.3 to 103.10±32.7NTU. The turbidity in the two rivers were beyond regulatory limits.

Parameters Indicating Oxygen

Results of the oxygen indicating parameters showed that the surface sources are well oxygenated with a dissolved oxygen (DO) range of 11.98±1.81 to 12.43±0.4mg/L (Table 4.11) Imo river had the highest mean level. The DO levels suggest a remote likelihood of active anthropogenic pollution within the monitored surface waters. The DO levels were all within the prescribed limit for surface water by the Federal Ministry of Environment (FMEnv) which is a minimum of >.4.00mg/L, hence optimum for aquatic habitat.

The mean biochemical oxygen demand (BOD) and chemical oxygen demand (COD) concentrations for the two rivers were Imo: 6.20±0.41mg/l , Ibine : 9.62±0.97 and 58.50±2.2mg/l , 85.3±29.79mg/l respectively. The comparative higher COD and

BOD values observed for the surface water may be ascribed to the higher dissolved inorganic components of surface water. Also, COD levels for the surface turbid water sample are not unusual as different workers have reported varied COD levels. These comparative higher levels compared to surface water may be ascribed to the presence of microbial and other organic and inorganic constituent in Nigerian surface water.

Nutrients in the surface water

The results of the nutrients in the surface water samples are presented in Table 4.11. The concentration of the phosphate ranged from 89.54mg/l to 205.83mg/l with a mean range of 91.66±5.mg/L and 174.86±25.6 mg/l which is higher than the <5.00mg/L PO_4^{3-} enrichment threshold beyond which algal bloom will likely manifest. Mean concentrations of nitrate and sulphate were 15.49±1.8mg/l, 7.96±1.60 mg/L and 11.00±1.1 mg/l , 86.18±12.34 ,respectively.

Base Metals: Na, K, Mg and Ca

The base metals recorded from the two rivers ranged from- Na: 0.22±0.02-2.30±0.04mg/l , K: 0.39±0.03-8.25±1.77mg/l and Ca: 9.44±1.5-4.59±0.56mg/L, the values were all within regulatory limits .

Heavy metal concentration of surface water in the study area.

The heavy metal concentration of surface water is presented in Table 4.12 . The heavy metal values assessed were within FMEnv except Nickel, 1.56±3.65mg/l, 8.18±3.58mg/l, Mercury: 0.10±0.04 mg/l, 0.20±0.03 for the Imo and Ibine rivers . Aluminum: 2.54±0.26mg/l, 21.36±5.10 for Imo and Ibine respectively.

4.9 Surface Water Microbiology

Table 4.13 . Results of the surface water microbiology

Parameters	UIRSP	**MIRSP**	**DIRSP**	**mean±std**	**SWQ 1**	**SWQ 2**	**SWQ3**	**mean±std**
Total Heterotrophic Bacteria Cfu/ml	1.9 x10^6	2.3x 10^6	2.0x 10^5	203333.00±23.1	2.8x 10^5	5.1x 10^5	4 x 10^4	276,666.7±23.1
Total Coli form count, Cfu/ml	3.4 x 10^4	3.6x10^4	3.5x10^4	34983.00±12.1	2.8 x10^4	3.6x 10^4	5.0x10^4	385000.00±43.2
Total Fungi Count, cfu/ml	2.6 x 10^4	2.8 x 10^4	2.7x 10^4	26833.00±12.3	4 x 10^4	7 x 10^4	15000	38500.00±32.5
Total Hydrocarbon Degrading Bacteria count Cfu/ml	5000	5500	5200	5083.00±2.67	NG	NG	NG	-
Total hydrocarbon Degrading Fungi Count, Cfu/ml	1000	2100	1800	1733.00±23.1	NG	NG	NG	-

UIRSP=up stream of Imo river, MIRSP= Mid stream of Imo river, DIRSP= down stream of Imo river. , SWQ 1= up stream of Ibine stream, SWQ 2= mid stream, SWQ3= down stream. NG=no growth

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Results of the surface water microbiology are as shown in Table 4.13. There was presence of total coliforms bacteria in the entire surface water assessed. Coliforms presence strongly indicates contamination with faecal coliform. Total heterotrophic bacteria (THB) and total heterotrophic fungi (THF) were detected at varying levels in all the samples as these are ubiquitous microorganisms in the environment. Also hydrocarbon utilizing bacteria and fungi were also indicated.

4.10. River Sediments

Table 4.14 Results of the physicochemical properties of the river sediments.

Parameters	SEDQ 1	SEDQ 2	SEDQ3	Mean ± std	SEDP1	SEDP2	SEDP3	Mean ± std	FMEnv std
pH	5.20	5.50	5.50	5.43±0.18	5.16	5.20	5.22	5.43±0.18	6.50
Conductivity, µS/cm	157.0	148.00	147.0	150.5±04.76	130.0	136.00	140.00	136.33±3.67	100.00
Ca mg/kg	5.96	7.45	5.96	6.46±0.77	12.20	18.40	16.30	15.63±2.82	250.00
Nitrate, mg/kg	5.31	3.66	4.74	4.57±0.79	10.58	10.44	12.60	11.29±1.06	NS
Nitrite, mg/kg	0.21	0.6	0.09	0.30±0.24	0.33	0.35	0.40	0.36±0.03	NS
T. Nitrogen, %	0.25	0.47	0.17	0.30±0.13	0.32	0.38	0.38	0.37±0.03	NS
PO_4^{-3} mg/kg	42.50	27.50	17.50	29.17±11.49	6.82	6.94	6.85	6.88±0.04	>100
P mg/kg	13.86	8.97	5.71	9.51±3.74	2.22	2.26	2.23	2.24±0.02	NS
SO_4^{-2} (mg/kg)	27.89	3.95	6.58	12.81±11.64	5.60	10.54	10.0	8.61±2.58	100
T. organic C, %	10.14	10.42	10.49	10.34±0.18	2.16	3.14	3.10	2.80±0.49	<10.00
Mg mg/kg	3.78	2.52	6.30	4.20±1.7	5.22	5.00	5.18	5.13±0.10	100.00
Al mg/kg	23.64	18.18	12.73	18.34±5.31	3.21	4.62	3.88	3.90±0.63	<0.01
Na mg/kg	0.97	1.03	0.68	0.89±0.17	1.20	1.30	1.18	1.23±0.05	NS
K mg/kg	7.33	3.50	6.17	5.69±1.90	7.33	3.50	6.17	5.69±1.90	>100
Total mg/kg Cl^-	29.9	33.9	27.9	30.66±2.73	34.9	30.99	32.99	32.99±1.79	250.00
NH_3 mg/kg	1.08	1.83	1.47	1.46±0.34	1.18	1.80	1.60	1.52±0.29	NS
Pb mg/kg	ND	0.02	0.04	0.10±0.14	0.12	0.16	0.08	0.12±0.04	0.05
Cd (mg/kg)	ND	ND	ND	-	0.18	0.17	0.20	0.18±0.02	0.10

Manganese, mg/kg	0.02	0.01	0.01	0.01±0.00	0.06	0.04	0.06	0.05±0.01	4.00 – 25.00
Chromium, mg/kg	0.02	0.12	0.03	0.10±0.13	0.18	0.22	0.19	0.19±0.02	0.05
Ni mg/kg	ND	ND	ND	-	0.02	.06	0.03	0.04±0.02	<1.00
Cu mg/kg	0.01	0.02	0.02	0.02±0.01	0.10	0.26	0.18	2.16±4.82	2.00
Mercury,mg/kg	0.22	0.32	ND	0.25±0.07	ND	0.20	0.24	0.18±0.09	0.001
Zinc, mg/kg Zn	0.10	0.45	0.56	0.38±0.21	2.20	1.86	2.66	2.23±0.36	5.00
Arsenic, mg/kg As	0.10	0.15	0.19	0.15±0.03	0.06	0.10	0.16	0.11±0.05	0.05
Vanadium, mg/kg V	0.04	0.13	0.15	0.10±0.05	0.02	0.03	0.08	0.05±0.02	NS
TPH	ND	ND	ND	-	ND	ND	ND	ND	10.0
BTEX, mg/ kg	ND	ND	ND	-	ND	ND	ND	ND	NS
PAH, mg/l kg	ND	ND	ND	-	ND	ND	ND	ND	NS
Iron, mg/kg Fe	0.57	0.76	0.60	0.64±0.09	0.57	0.76	0.60	0.64±0.09	1.00
Ash content, %	71.31	43.8	69.0	60.62±14.09	68.2	66.8	68.0	67.73±0.68	NS
Moisture Content, %	27.7	52.79	31.66	557.95±10.39	40.6	38.8	38.6	39.64±1.38	NS
Total Organic matter, %	28.69	56.14	30.98	39.38±14.09	31.7	31.1	32.0	31.61±0.37	NS

Table 4.15. Results of the sediment Microbiology

Organism	SEDQ 1	SEDQ 2	SEDQ3	Mean +/-SD	SEDP1	SEDP2	SEDP3	Mean ± std	FMEnv std
Total Heterotrophic Bacteria count , Cfu/gm	2.1 $x10^6$	2.1 $x10^6$	2.2 $x10^6$	2.1$x10^6$	3.4 $x10^6$	3.0 $x10^6$	3.2 x 10^6	13,400,00	0 - 30
Total Coli form count, cfu/gm	2.3 $x10^6$	4.0 x 10^4	9.4 $x10^6$	1.0 $x10^6$	2.5 x 10^5	2.7 x 10^5	3.0 $x10^5$	1083333	0
Total Fungi Count, cfu/ml	2.0 $x10^4$	4.0 $x10^4$	8.0 $x10^4$	4.6x 10^4	3.0 x 10^3	30000	50000	36,666.7	0
Total Hydrocarbon Degrading Bacteria count cfu/gm	NG	NG	NG	-	2.0 x 10^3	3200	4200	3133.3	0
Total hydrocarbon Degrading Fungi Count, cfu/gm	NG	NG	NG	-	1000	1400	1200	1200	0

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4.10.1 Results of river sediments

pH and Conductivity

Results of the physico-chemical analysis of the sediment samples are as shown in Table 4.14. The pH of the sediment samples ranged from 5.20 to 5.50 with a mean of 5.43±0.18 for Ibine Bende River while Imo River ranged from 5.16 to 5.22 with mean value of 5.43±0.18. There was no significant difference between the values of the pH observed for the sampled sediment of the different surface waters. The mean conductivity of the surface waters were 150.5±4.76 µS/cm for Ibine river. And that of Imo River was 136.33±3.67 µS/cm within a range of 130 to 140 µS/cm. This conductivity is within the range observed by Chikwe (2020) in a study on assessment of pollution status of Imo river, south eastern Nigeria.

Total Organic Carbon and Total Organic Matter

The total organic carbon of the sediment ranged from 10.1 to 10.3% for the Ibine stream with mean value of 10.34±0.18 %. Also the organic carbon for Imo river sediment ranged from 2.16 – 3.14% with mean value of 2.8± 0.49 %. (Table 4. 14) the organic matter for the two river Ibine and Imo river were 39.38±14.09 % and 31.6± 0.37 % respectively. The organic matter level in sediment could be derived from dead plant and aquatic organism as well as hydrocarbon pollution. The concentrations observed for this assessment indicate that the surface waters' sediments were relatively not enriched.

Nutrients: Nitrate, Phosphate and Ammonia

Mean concentrations of nitrate, phosphate and ammonia in the sediment for Ibine stream were 4.57±0.79 mg/kg, 29.17±11.5 and 1.46±0.834 mg/kg respectively. Also the Imo river sediments for Nitrate, Phosphate and Ammonia were 11.29± 1.06, 6.88 ±0.04 and 1.52± 0.29 respectively.

These observed concentrations were consistent with the study of Abayomi et al. (2011) for phosphate in sediment of in some Nigerian waters and suggest a potential for sediment-water matrix nutrient exchange which is important in sustaining a thriving biological productivity. The scenario ensures a continuous replenishment of the nutrient levels in the water column of the surface water from the sediment and vice versa.

Organic Parameters in the Sediment Samples

The total petroleum hydrocarbon (TPH), Polyaromatic hydrocarbon (PAH) and BTEX were below detection limits on sediments samples from the two rivers.

Base Metals of the Sediment Samples from the two rivers

The results of the base metals, including Na^+, K^+, Mg^{2+} and Ca^{2+} are as shown in Table 4.14. The mean Na^+ level for Ibine and Imo river sediment samples were 0.89±0.17and 1.23±0.05mg/kg respectively which indicates a fair ability of the sediment to immobilize pollutants such as metals and nutrients through ion-exchange and complexation. The mean concentrations of the metals of K^+ Mg^{2+}, Ca^+ were 5.69±1.90 mg/kg, 4.20±1.7mg/kg and 6.46±0.77mg/kg, for Ibine river respectively also K^+ Mg^{2+}, Ca^+ for Imo river were 5.69±1.90 mg/kg, 5.13±0.10 mg/kg and 15.63±2.82mg/kg , respectively.

Heavy Metals

The results of the heavy metals in sediments of Ibine stream in Bende and Imo river in Ukwa west are presented in Table 4.14. All the metals analyzed were detected in Imo river sediment samples. However, Cd and Ni were below detection limit in Ibine stream sediment in Bende. Concentrations of Zn were the highest observed at the sampled locations with a mean of 2.23±0.36 mg/kg followed by Fe. Mean concentrations of the other metals were; Cr, 0.10±0.13 mg/kg; Cu, 0.02±0.01mg/kg; Hg 0.25±0.07mg/kg; Pb, 0.10±0.14 mg/kg and As, 0.15±0.03mg/kg for Ibine sediment.

4.10.2 Microbiology

The results of the microbial analysis of the sediment samples from the two rivers are presented in table 4.15. The mean Total heterotrophic bacteria count for the Ibine and Imo were $2.1x10^6$ Cfu/gm and $1.34x10^6$ Cfu/gm, respectively. Also Total Coli form count for the Ibine and Imo river were $1.0 x10^6$ and $1.08 x10^6$ cfu/gm. Total hydrocarbon utilizing bacteria was only detected in Imo river but no growth was observed in Ibine stream. Similarly total hydrocarbon utilizing bacteria was observed in Ibine stream but had growth in Imo river with mean value of 1200 Cfu/gm. Microorganisms isolated include *Bacillus spp, Mucor spp., Aspegrillus wentii* among others.

4.11: Soil Study

Field Data Gathering and Analysis

Soil samples were collected at designated locations within and around the project site for laboratory analysis. The sampling points are as shown in Table 4.16 Soil sampling was carried out at locations/points consisting standard methods for soil analysis.

Table 4.16 GPS coordinates of soil sample across the SAPZ communities

Sample Codes	GPS Coordinates	Description
TSQP1	N:5.337384^0	Top soil Ariam elu elu
SQSSSP1	E: 7.62336^0	Sub soil Ariam elu elu
TSQP2	N: 5.33633^0	Top soil Ariam
SQSSSP2	E: 7.62403^0	Sub soil
TSQP3	N: 5.33548^0	Top soil Ariam
SQSSSP3	E: 7.62336^0	Sub soil Ariam

TSQP4	N: 5.3388^0	Top soil ariam
SQSSSP4	E: 7.62294^0	Sub soil ariam
TSQP5	N: 5.33419^0	Top soil Ariam
SQSSSP5	E: 7.62451^0	Sub soil Ariam
TSQC	N: 5.34278^0	Control top soil Ariam elu elu
SQCSSS	E: 7.62279^0	Sub soil Ariam elu elu
SQSTSP1	N: 4.94604^0	Top soil Umuololo
SQSTSP1	E: 7.18049^0	Sub soil Umuololo AIIP
SQSSP1	N: 4.9464^0	Top soil umuololo
SQSTSP2	E: 7.17503^0	Sub soil umuololo
SQSSP2	N: 4.94512^0	Top soil umuololo
SQSTSP3	E: 7.17027^0	Sub soil umuololo
SQSSP3	N: 4.93673^0	Top soil umuololo
SQSTSP4	E: 7.18186^0	Subsoil umuololo
SQSSP4	N: 4.93646^0	Top soil umuololo
SQSTSP5	E: 7.17467^0	Sub soil umuololo
SQSP5	N: 4.9409^0	Top soil umuololo
SQSTSP6	E: 7.17235^0	Sub soil umuololo
SQSSP6	N: 4.94102^0	Top soil umuololo
SQSTSP7	E: 7.17922^0	Sub soil umuololo
SQSSP7	N: 4.95325^0	Control top soil
SQCSS	E: 7.18617^0	Control sub soil Umuololo
TSQ CP1	N: 5.50367^o	Top soil Okporoenyi Bende
SSQ CP1	E: 7.59847^o	Sub soil
TSQ CP2	N: 5.50205^o	Top soil okporoenyi
SSQ CP2	E: 7.59761^0	Sub soil
TSQ CP3	N: 5.50093^o	Top soil Okporoenyi
SSQ CP3	E: 7.59934^0	Sub soil
TSQ CP4	N: 5.50237^o	Top soil okporoenyi

SSQ CP4	E: 7.56009^0	Sub soil
TSQ CP5	N: 5.50424^o	Top soil okporoenyi
SSQ CP5	E: 7.60168^o	Sub soil
TSQ CP6	N: 5.50464^o	Top soil okporoenyi
SSQ CP6	E: 7.59984^0	Sub soil
TSQ CP7	N: 5.51047^o	Top soil okporoenyi Control
SSQ CONTROL	E: 7.60039^0	Sub soil control

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Table 4. 17: List of Methods of Chemical Analyses in Soil

Parameter	Method	Summary of Procedure
pH	Electrometric method (APHA 2320B)	Solutions of the soil/sediment samples were prepared in $CaCl_2$ and the pH determined electrometrically using calibrated pH meter.
Conductivity, µS/cm	Electrometric method (APHA 2510B)	Solutions of the soil/sediment samples were prepared in distilled water and the electrical conductivity determined electrometrically using a calibrated conductivity meter.
Ca, Na, K and Mg(mg/l)	Spectrophotometric Method (APHA	Samples were digested with concentrated HNO_3 and subsequently determined by Atomic Absorption Spectrophotometer (AAS
Nitrate, mg/kg	Colorimetric Method (APHA 4500-N E)	KCl extracts of the soil/sediment were used for the cadmium reduction of nitrate in the extracts to nitrite, followed by colorimetric determination.
Phosphate, mg/kg PO_4^{-3}	Colorimetric Method (APHA 4500-P E	$NaHCO_3$ extracts of the soil/sediment were used for the ascorbic acid reduction of the phosphomolybdic complex formed to give a blue colour which was determined by colorimetry.
Sulphate, mg/kg SO_4^{-2}	Turbidimetric Method (APHA 4500-SO43- - E)	Distilled water extract of the soil/sediment samples were used. The precipitation of sulphate ions in samples was carried out using $BaCl_2$ followed by colorimetric determination of its concentration.

Total organic carbon, % and Total Organic matter, %	Wet digestion/ Titrimetric Method (EPA)	Samples were oxidized with acidified dichromate solution followed by back-titration with ferrous ammonium sulphate
Heavy metals	Spectrophotometric Method (APHA)	Samples were digested with concentrated HNO_3 and subsequently determined by Atomic Absorption Spectrophotometer (AAS
TPH	Gas Chromatography, GC (APHA 5520 F)	The hydrocarbon content of the samples was extracted and determined by GC
CEC, Meq/kg	Spectrophotometric Method	The exchangeable cations of the soil/sediment samples were extracted with $BaCl_2$ and their concentrations determined in the supernatant by AAS. This was used to calculate the CEC.
Moisture Content, %	Gravimetric Method (A5TM D 2974-87)	Soil/sediment samples were heated to 105 oC in an oven, cooled in a desiccator and the weight differential used to calculate the moisture content
Microbiology	Culture Method (APHA)	Samples were cultured and colonies of heterotrophic bacteria and fungi, total faecal coliform, total hydrocarbon bacteria and fungi determined.

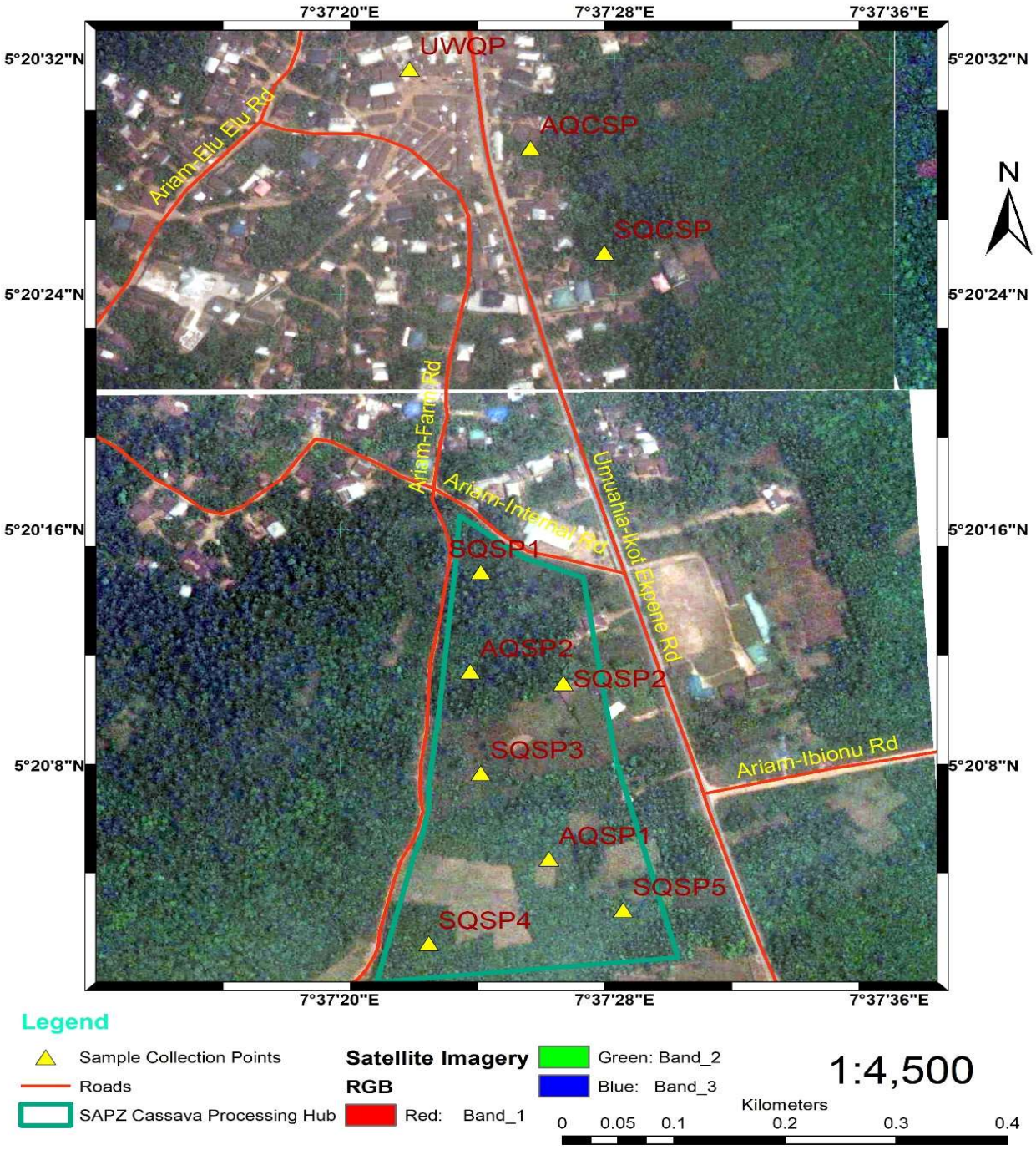

Fig. 4.11 Sampling locations at Ikwuano LGA

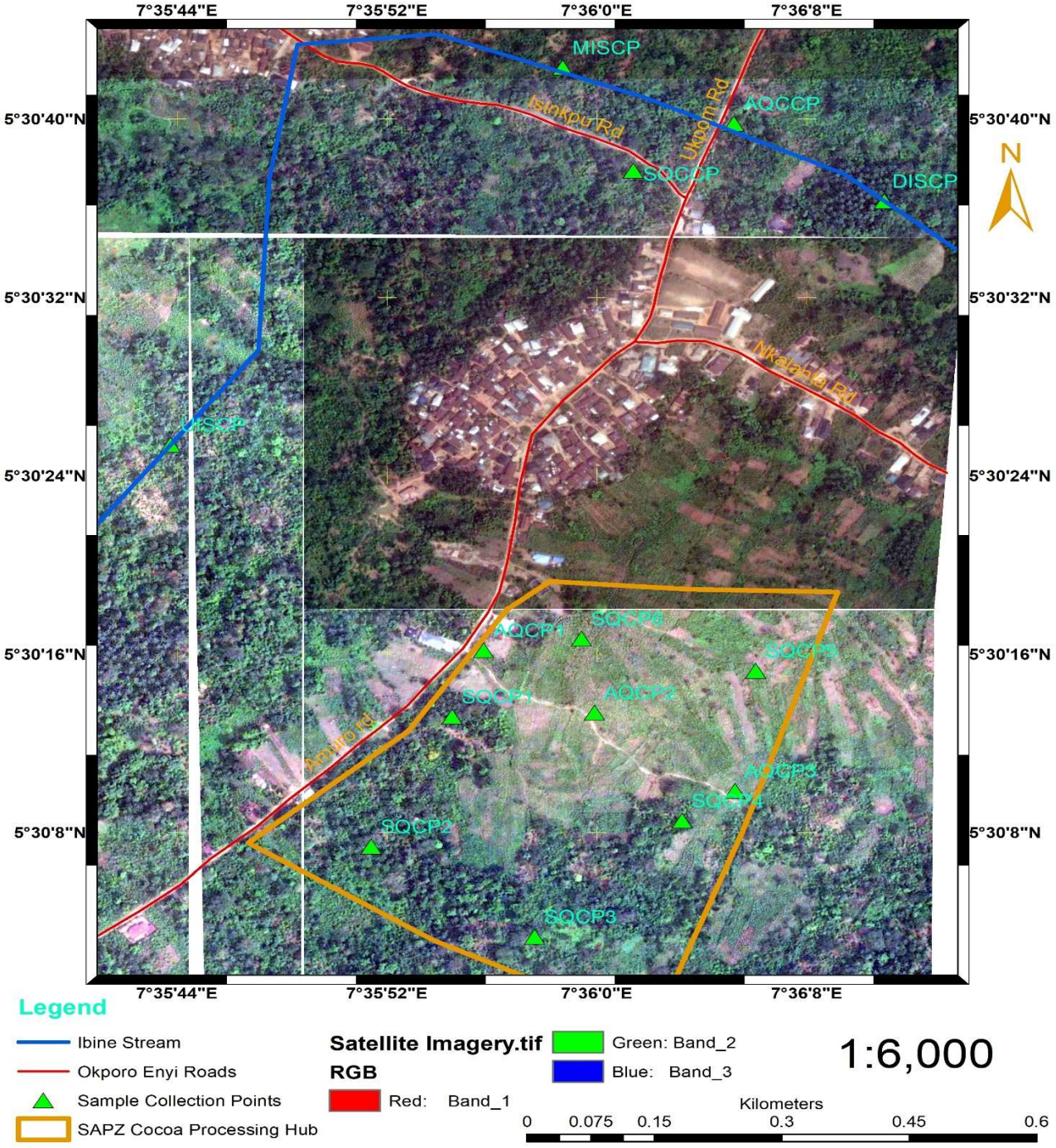

Fig. 4.12. Sampling location at Okporoenyi Bende

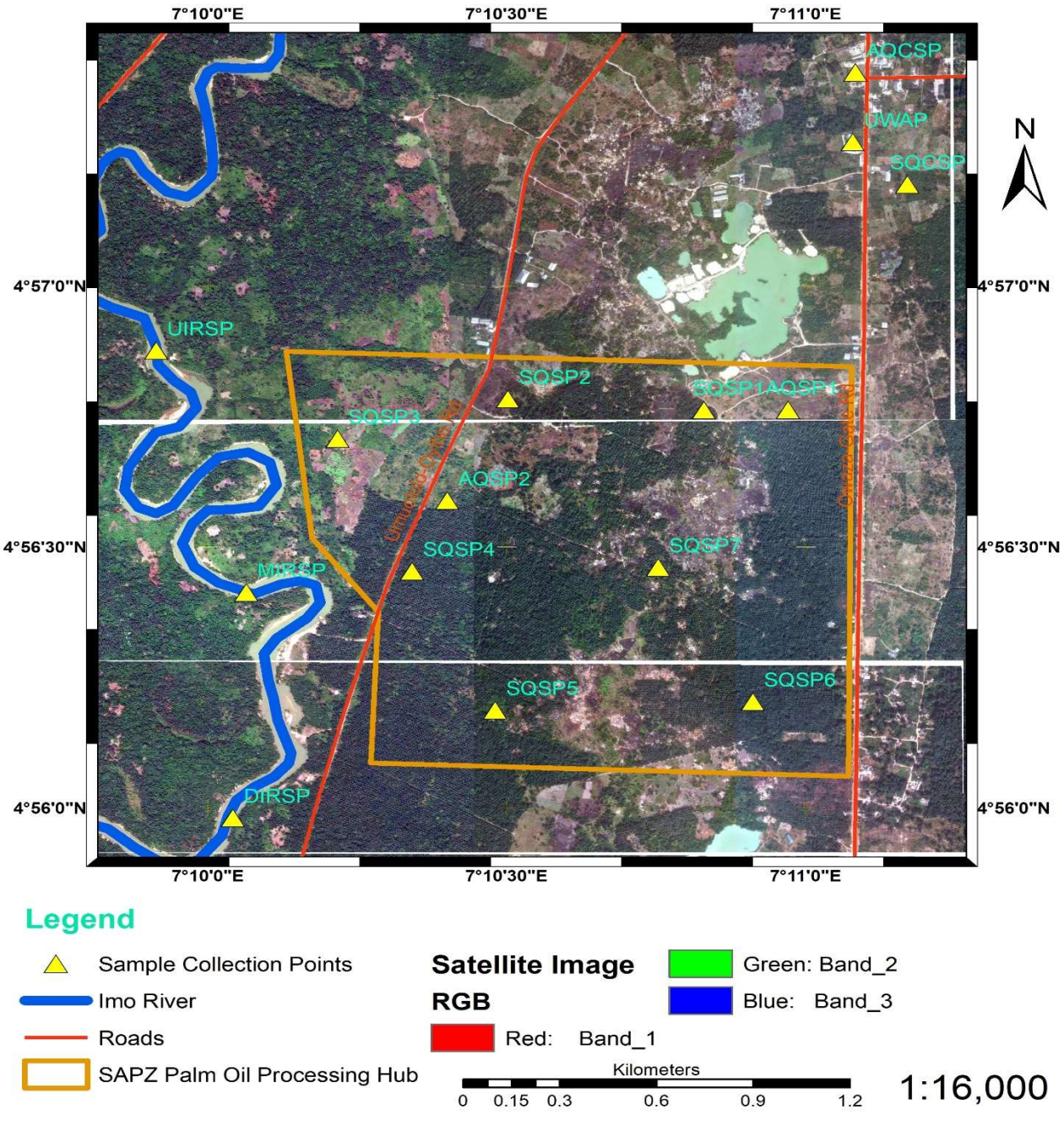

Fig. 4.13. Sampling Location at Owaza Ukwa West LGA

Table 4.18: Composition of soil in the proposed project location

Code	Soil Layer	Sand (%)	Clay (%)	Silt (%)	Texture
TSQP1	Top	65.02	33.48	0.73	Sandy clay
TSQP2	Top	72.34	26.05	0.90	Sandy clay
TSQP3	Top	65.93	33.16	0.23	Sandy clay
TSQP4	Top	65.74	32.97	1.20	Sandy clay
TSQP5	Top	65.74	32.97	1.24	Sandy clay
TSQC	Top	67.8	33.2	1,27	Sandy clay
SQSTSP1	Top	96.33	0.18	3.49	Sandy loam
SQSTSP2	Top	88.91	10.05	1.04	Sandy clay loam
SQSTSP3	Top	85.32	13.65	1.03	Sandy clay
SQSTSP4	Top	82.89	15.90	1.21	Sandy clay loam
SQSTSP5	Top	88.7	10.2	11.65	Sandy clay loam
SQSTSP6	Top	84.8	9.1	10.89	Sandy clay loam
SQSTSP7	Top	87	12.3	11.9	Sandy clay loam
SQCSTS	Top	77.11	10.3	11.2	Sandy clay loam
TSQ CP1	Top	22.68	77.11	0.21	Clay
TSQ CP2	Top	23.4	70.38	0.54	Clay
TSQ CP3	Top	27.61	67.5	0.56	clay
TSQ CP4	Top	63.52	35.20	0.74	Sandy clay loam
TSQ CP5	Top	36.76	61.58	0.82	Sandy clay
TSQ CP6	Top	32.93	64.73	1.62	clay
TSQ CP7	Top	34.2	67.3	1.56	Clay

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4.11.1 Results of Soil Analyses

Soil Composition and Texture

Soil composition influences the ease with which soil can be used for agricultural productivity and for any other productive purpose, the amount of water and air it can hold, and the rate at which liquid, including water and pollutants can percolate or drains through the soil.

The soil textural class of the soil samples obtained from designated locations within the SAPZ project communities was predominantly clayey except in Owaza Ukwa west LGA, with a sandy loam composition ranging from 23%- 85% %, and percentage ranges of silt and sand at 0.16- 20% and 20-78% % respectively (Table 4.18). The soil composition observed for the proposed project area indicates that the soil has high potential for water retention due to its higher clayey fraction.

The rich clayey fraction of the soil along the proposed project areas of influence is peculiar to heavily forested tropical ecology of Southern Nigeria. This fertile ecological characteristic of the soil is indicated by the conspicuous rich vegetation along the route of the proposed project.

pH

The pH values of both the top and sub samples were in the acidic range. While the pH of the top soil ranged from 3.8 to 6.2, those of the sub soil were in the range of 3.8 to 6.2 (Table 4.19). The mean pH levels for the top and sub soil were 4.8±0.02 and 4.5±0.03 respectively. There was no significant difference between the pH of the topsoil (0-15cm) and the sub soil (15 – 30 cm).

Table 4.19: Results of the physicochemical properties of the soil from the SAPZ project communities

Parameter	pH		Conductivity, µS/cm		Total Nitrogen, %		Total organic carbon, %		Total Organic matter, %		Moisture Content, %		CEC, Meq/kg		PAH, mg/kg	
	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	sub	Top	Sub
TSQP1	4.80	4.70	187	174.0	0.14	0.17	14.01	21.11	15.1	14.4	11.1	11.31	1.58	0.97	ND	ND
TSQP2	4.60	4.60	168	160.0	0.22	0.28	23.67	21.05	12.9	13.0	8.78	10.43	1.71	0.90	ND	ND
TSQP3	4.70	4.80	157	157.0	0.25	0.11	21.25	10.76	13.3	13.6	8.90	9.79	1.63	1.33	ND	ND
TSQP4	4.80	5.00	153	152.0	0.14	0.17	21.80	22.56	10.0	12.1	6.51	7.80	1.34	1.90	ND	ND
TSQP5	5.10	4.70	157	159.0	0.14	0.14	21.94	13.73	14.2	13.8	9.53	9.28	0.82	1.64	ND	ND
TSQC	5.00	4.70	160	159.0	0.08	0.11	15.25	6.90	10.8	12.4	7.86	9.41	0.83	1.26	ND	ND
SQSTSP1	3.80	3.80	312.	312.0	0.21	0.21	42.64	42.64	18.6	18.6	3.63	3.63	1.24	1.24	0.05	0.048
SQSTSP2	4.40	4.40	168.	168.0	0.14	0.18	22.56	22.56	8.91	8.9	5.99	5.99	1.02	1.02	0.046	0.032
SQSTSP3	4.40	4.40	168.	168.0	0.18	0.21	18.70	18.70	7.63	7.6	3.04	3.04	1.58	1.58	ND	ND
SQSTSP4	4.80	4.80	320	320.0	0.21	0.21	40.66	40.66	22.7	22.7	3.63	3.63	1.26	1.26	ND	ND
SQSTSP5	4.30	4.30	166.	166.0	0.19	0.19	18.88	18.88	7.64	7.6	4.06	4.06	1.40	1.40	ND	ND
SQSTSP6	4.60	4.60	165.	165	0.16	0.16	24.60	24.60	22	22.0	6.90	6.90	1.10	1.10	ND	ND
SQSTSP7	4.40	4.40	166.	166.0	0.18	0.18	18.70	18.70	21.9	21.9	6.28	6.28	1.55	1.55	ND	ND
SQCSTS	6.20	6.20	168.	168.0	0.18	0.18	18.22	18.22	9.49	9.49	6.62	6.62	1.70	1.70	ND	ND
TSQ CP1	5.30	5.20	161.	158.0	0.21	0.08	20.29	21.1	28.7	31.0	22.95	23.45	1.10	0.94	0.008	0.003
TSQ CP2	5.50	5.50	156.	153	0.35	0.45	25.74	24.84	30.1	37.0	22.68	24	1.69	1.36	0.002	0.001
TSQ CP3	5.20	5.10	168.	172.	0.21	0.14	24.70	25.67	24.4	26.1	16.08	16.6	1.94	1.54	ND	ND

TSQ CP4	4.80	4.80	169.	171.	0.21	0.63	23.94	21.94	30.5	30.4	21.03	21.1	1.80	1.52	0.003	0.001
TSQ CP5	5.3	5.50	181.	177.0	0.17	0.14	22.63	23.25	25.2	25.1	18.52	17.7	1.60	1.51	0.002	0.001
TSQ CP6	4.90	4.80	167.	168.0	0.17	0.34	15.66	14.84	24.1	25.6	15.5	16.71	2.15	1.85	ND	ND
TSQ CP7	5.10	5.40	160.	156	0.22	0.06	13.39	13.94	27.2	22.2	19.32	17.99	1.08	0.92	0.001	ND
Mini	3.80	3.8	153	152.	0.08	0.11	14.01	6.90	7.63	7.6	3.04	3.04	0.82	0.92	ND	ND
Max	6.2	6.2	320	320	0.35	0.63	42.64	42.64	30.5	30.4	22.95	24	2.15	1.90	0.05	0.00
Ave.	4.8± 0.02	4.5± 0.03	162± 2.3	165± 2.7	0.18± 0.03	0.25 ±0.5	26.6± 3.4	26.4± 0.3	28.4 ±1.2	28.3 ±2.5	20.3± 4.5	22.3± 0.2	1.67 ±2.4	1.7± 4.5	0.001 ±0.00 1	0.048 ±0.01
Fmenv.	6.50		100.00		NS		<10.00		NS		NS		NS		NS	

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Electrical Conductivity

Electrical conductivity is the ability of a material to conduct electricity. In soil this conduction takes place through the water filled pores of the soil (Muhammed and Alimardani, 2010). Thus, the soil's electrical conductivity (EC) is a measure of the amount of solutes in soil or ions in soil and can be correlated to the salinity of the soil.

It could also serve as an excellent indicator of nutrient availability and loss, soil texture, and available water capacity. The mean EC of the soil samples from the proposed project communities were for top soil 162±2.3 µS/cm and sub soil was 165±2.7 µS/cm.

Table 4.20: Heavy metal concentration of soil in the SAPZ project communities

Parameter	Lead, mg/kg		Cadmium, mg/kg		Arsenic, mg/kg As		Chromium, mg/kg		Nickel, mg/kg		Copper, mg/kg		Mercury, mg/kg		Zinc, mg/kg		Vanadium, mg/kg V	
	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	0.21	0.02
TSQP1	ND	ND	ND	ND	0.25	0.10	0.05	0.09	0.24	0.12	0.04	0.01	0.24	0.22	0.49	0.21	0.29	0.30
TSQP2	0.09	ND	ND	ND	0.20	0.18	0.02	0.04	ND	ND	0.02	ND	0.11	ND	0.21	0.07	0.04	0.04
TSQP3	0.01	ND	ND	ND	0.11	0.06	0.05	0.04	ND	ND	0.02	ND	0.20	0.04	ND	0.14	0.12	0.15
TSQP4	ND	0.39	ND	ND	0.27	0.20	0.03	0.04	0.12	ND	0.02	ND	0.01	0.03	0.21	0.14	0.10	0.21
TSQP5	0.21	ND	ND	ND	0.19	0.19	0.10	0.04	0.71	0.24	0.03	0.02	0.52	0.05	0.59	ND	0.01	0.19
TSQC	ND	ND	ND	ND	0.12	0.07	0.07	0.01	0.12	0.12	0.02	ND	ND	0.25	0.42	ND	0.01	0.12
SQSTSP1	ND	0.17	ND	ND	0.22	0.16	0.13	0.06	2.35	0.35	0.04	ND	0.37	ND	0.45	0.28	0.18	0.06
SQSTSP2	ND	0.09	ND	ND	0.13	0.20	0.09	0.02	1.53	0.71	0.03	0.01	0.04	0.11	0.49	0.17	0.20	029
SQSTSP3	ND	ND	ND	ND	0.18	0.26	0.09	0.02	1.06	2.71	0.02	0.01	0.20	0.28	0.28	0.28	0.20	0.40
SQSTSP4	ND	0.17	ND	0.04	0.26	0.26	0.10	0.04	2.0	1.24	0.06	0.18	0.20	ND	0.40	0.26	0.05	0.13
SQSTSP5	ND	ND	ND	ND	0.19	0.20	0.11	0.08	2.12	1.40	0.07	0.30	0.11	ND	0.26	0.19	0.2	0.20
SQSTSP6	ND	0.09	ND	0.04	0.16	0.20	0.14	0.06	1.48	0.70	0.03	0.01	0.30	0.20	0.43	0.17	0.18	021
SQSTSP7	ND	ND	ND	ND	0.18	0.18	0.14	0.08	2.59	2.64	0.05	0.01	0.45	ND	0.45	0.23	0.25	0.14
SQCSTS	ND	ND	ND	ND	0.05	0.10	0.01	0.09	2.59	ND	0.02	0.02	0.19	0.41	0.31	0.14	0.06	0.02
TSQ CP1	ND	ND	0.06	0.09	0.12	0.09	0.01	ND	0.35	9.06	0.02	0.02	ND	ND	0.28	0.17	0.12	0.16
TSQ CP2	ND	ND	ND	ND	0.15	0.20	0.03	0.08	0.12	0.24	0.02	0.01	0.09	0.09	0.17	0.21	0.10	0.10
TSQ CP3	ND	0.03	ND	ND	0.14	0.18	0.02	ND	1.18	ND	0.05	0.01	ND	ND	0.70	0.17	0.20	0.20

TSQ CP4	ND	ND	ND	ND	0.14	0.11	0.03	0.10	1.41	0.24	0.04	0.01	ND	ND	0.66	0.21	0.05	0.10
TSQ CP5	ND	ND	ND	0.15	0.17	0.16	0.05	ND	ND	1.41	ND	0.03	ND	ND	0.14	0.52	0.20	0.16
TSQ CP6	ND	ND	ND	ND	0.17	0.10	0.08	0.25	0.47	3.29	0.01	0.06	0.25	0.21	0.38	0.66	0.12	0.12
TSQ CP7	ND	ND	ND	0.02	0.14	0.11	0.15	0.12	0.47	0.35	ND	0.01	0.12	0.08	0.28	0.10	0.05	0.04
Mini	ND	ND	ND	ND	0.05	0.06	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.02
Max	0.21	0.39	0.06	0.09	0.26	0.26	0.15	0.25	2.59	9.06	0.02	0.18	0.45	0.28	0.70	0.66	0.29	0.40
Ave	0.01	0.18	0.02	0.02	0.03	0.14	0.011	0.13	1.12	3.54	0.02	0.01	0.05	0.02	0.24	0.04	0.03	0.13
Fmenv	0.05		0.10		0.05		0.05		<1.00		2.00		0.001		5.00		NS	

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Total Organic Carbon (TOC) and Total Organic Matter (TOM)

Total organic carbon (TOC) is the measure of amount of carbon (C) stored in soil organic matter (SOM). Soil organic matter could be defined as the organic component of the inorganic soil, and it consists of three primary parts including small (fresh) plant residues and small living soil organisms, decomposing (active) organic matter, and stable organic matter (humus). Soil organic matter serves as a reservoir of nutrients for crops, provides soil aggregation, increases nutrient exchange, retains moisture, reduces compaction, reduces surface crusting, and increases water infiltration into soil.

Table 4.21a. Results of soil Chemical properties in the study area

Parameter	Ca mg/kg		Nitrate, mg/kg		Nitrite, mg/kg		Phosphorus, mg/kg		Magnesium, mg/kg		Sodium , mg/kg		Potassium, mg/kg		BTEX,		$PO_4$3- Mg/kg		SO_4^{-2} mg/kg	
	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	sub	Top	Sub	top	sub
TSQP1	4.47	5.96	6.03	4.02	0.27	0.09	19.84	7.34	7.56	2.52	0.98	0.92	5.33	5.50	ND	ND	60.9	22.5	5.26	4.7
TSQP2	4.47	4.47	4.41	2.49	0.15	0.3	13.04	15.5	5.04	5.04	1.00	1.00	6.50	1.17	ND	ND	40.0	47.5	7.89	8.1
TSQP3	10.4	10.4	1.17	1.44	0.27	0.3	22.83	10.3	3.78	5.04	0.91	1.07	3.50	6.67	ND	ND	70.0	31.6	14.7	15
TSQP4	10.4	22.4	0.72	0.39	0.21	0.36	16.58	14.7	3.78	3.78	1.01	1.05	5.33	3.50	ND	ND	50.8	45	28.1	34
TSQP5	7.45	7.45	0.66	1.83	0.45	0.33	12.77	20.4	6.30	6.30	1.08	1.0	5.83	5.00	ND	ND	39.1	62	8.42	7.8
TSQC	4.47	4.47	0.12	0.93	0.45	0.24	17.66	10.3	2.52	7.56	0.82	1.00	4.17	5.00	ND	ND	54.1	31.	28.6	10
SQSTSP1	8.94	8.94	4.08	4.08	0.3	0.30	13.86	13.8	10.0	10.1	0.50	0.50	8.17	8.17	0.080	0.056	42.5	28.3	7.37	17.
SQSTSP2	4.47	4.47	4.59	4.59	0.27	0.27	16.31	16.3	5.04	5.04	0.53	0.53	4.17	4.17	0.074	0.030	50.0	45.8	17.4	2.6
SQSTSP3	5.96	5.96	4.02	4.02	0.18	0.18	46.74	46.7	7.56	7.56	0.50	0.50	4.50	4.50	ND	ND	143	40	5.26	5.8
SQSTSP4	8.14	8.14	4.06	4.06	0.3	0.3	13.71	13.7	10.3	10.3	0.58	0.58	8.22	8.22	ND	ND	42.1	28.	6.30	18
SQSTSP5	4.90	4.90	4.00	4.00	0.20	0.20	46.96	46.9	6.22	6.22	0.51	0.51	4.16	4.16	ND	ND	144.	40	6.50	5.5
SQSTSP6	5.57	5.57	4.42	4.42	0.20	0.20	18.91	18.9	6.28	6.28	0.56	0.56	4.15	4.15	ND	ND	58.0	45.	17.4	2.4
SQSTSP7	4.96	4.96	4.02	4.02	0.18	0.18	46.74	46.7	7.56	7.56	0.50	0.50	4.50	4.50	ND	ND	143.	44.0	5.26	5.0
SQCSTS	19.4	19.4	4.74	4.74	0.42	0.42	15.76	15.7	7.56	7.56	0.51	0.51	5.67	5.67	ND	ND	48.3	783	37.3	35.
TSQ CP1	17.9	14.9	0.85	1.33	0.06	0.09	18.48	21.7	6.30	3.78	0.91	0.97	3.17	66.6	0.016	0.010	56.7	66.6	20.3	12
TSQ CP2	11.9	8.94	0.11	0.29	0.06	0.12	16.58	15.8	2.52	3.78	0.81	0.96	4.33	48.3	0.011	0.010	50.8	48.2	65.8	24.
TSQ CP3	17.8	16.4	1.36	0.04	0.04	0.06	16.31	14.4	6.30	2.52	0.98	0.81	4.33	44.2	ND	ND	50	44.1	7.1	17.
TSQ CP4	16.4	11.9	1.18	1.45	0.05	0.19	25.54	59.8	3.78	3.78	0.89	0.75	5.83	183.	0.012	0.008	78	183	15	6.3
TSQ CP5	7.45	11.9	1.18	0.50	0.07	0.06	12.50	25.0	5.04	3.78	0.98	0.92	5.67	76.7	0.006	0.005	38.3	76.6	14.7	13.
TSQ CP6	23.8	13.4	0.37	0.11	0.10	0.05	21.74	23.1	7.56	2.52	0.95	0.67	3.67	70.8	ND	ND	66.6	70.	15.3	35.

CEC – Cation Exchange Capacity; PAH – Polyaromatic Hydrocarbons; BTEX – Benzene, Toluene, Ethylbenzene and

TSQ CP7	17.8	11.9	0.02	0.07	0.16	0.11	20.92	21.7	5.04	5.04	0.97	0.81	5.50	66.67	0.006	ND	64.2	66.	9.47	3.7
Mini	4.47	4.47	0.02	0.04	0.04	0.06	12.77	7.34	2.52	2.52	0.50	0.50	3.17	1.17	ND	ND	38.3	22.5	5.26	2.4
Max.	23.8	22.4	6.03	4.74	0.42	0.42	46.96	59.8	10.3	10.3	1.08	1.07	8.22	183	0.016	0.056	143	783	65.8	34
Ave.	6.8	8.9	3.5	2.4	0.02	0.23	22.5	24.3	4.6	5.43	0.56	0.78	6.4	143.	0.012	0.023	87.5	85.3	67.5	45.
Fmenv.	250.		NS		NS		NS		100.00		NS		>100		NS		>100		100	

Xylene; TPH– Total petroleum hydrocarbon content Abia SAPZ ESIA 2024

Nutrients

The availability of plant nutrient species, such as phosphorus and nitrogen, is an indication of the soil's productivity. These nutrients species, usually locked up as constituents of organic matter, are released into the soil by the decay process. Atmospheric depositions, fertilizer and runoffs from farmland and highways can also be sources of nutrient enrichment in soil. Nutrients can also be exchanged in the soil via anion exchange and retained where the soil has a net positive surface charge through surface charge attraction. Concentrations of nutrients, including NO_3^-, PO_4^{3-} and NH_4+ in the soil samples are as shown in Table 4.21. Top soil nitrate ranged from 0.02- 56.03 mg/kg and sub soil ranged from 0.04 to 4.74 mg/kg with of 3.5 and 2,4mg/kg respectively. Phosphate concentration ranged from 38.3 mg/kg top soil to 143 mg/kg while the sub soil ranged from 22.5mg/kg to 783 mg/kg. Ammonia concentration ranged from 0.18 to 0.6 mg/kg (Table 4.21) for sub soil and sub soil ranged from 0.18 to 0.72 mg/kg.

Organic Compounds

Most organic compounds in the environment, especially the highly volatile class, are called Class A pollutants due to their potent hazardous nature on human health. Presence of Organic compounds at elevated levels is often an indication of increased anthropogenic influences. PAH, Benzene, Toluene Ethylxylene and xylene (BTEX); and total petroleum hydrocarbon content (TPH) were determined in the soil of the proposed project area.

TPH and BTEX were observed in some soil samples within the proposed project communities with concentrations below detection limit of <0.001 mg/kg, to 0.056mg/kg at Owaza which seems to be around old oil exploration site Concentrations of TPH observed in the assessment were within the range of below detection level to 747 mg/kg in the top soil and below detection limit to 836 mg/kg in the sub soil. The comparative low levels of the organic compounds in some areas monitored showed that proposed project of influence has witnessed little or no anthropogenic organic pollution in recent times. However, the very high TPH concentration observed in Owaza close to the site of AIIP could be as of oil leakage during exploration activities.

Results of the Base Metals and CEC of the Soil Samples in the Study Area

Base metals in soil, such as sodium, potassium, magnesium and calcium ions, provide plants with nutrients for normal growth. They are also means by which soils obtain much needed cations through cation exchange for plant growth. The results of the cation exchange capacity (CEC) and the base metals (Na, K, Mg and Ca) are presented in Table 4.20.

The cation exchange capacity (CEC) level ranged from 0.82 to 2.15 Meq/kg for top soil and 0.92 to 1.90 Meq/kg for sub soil. The CEC mean values for top and subsoil were 1.67±2.4 and 1.7±4.5 Meq/kg , respectively.

The proposed SAPZ project sites had cultivated plots and fallow areas which mostly have CEC levels of more than 1.6 Meq/kg .

There were no significant differences in the levels of each base metal at the various sampled locations. Generally, the concentrations of the metals at the proposed SAPZ sites were not markedly different. Mean concentrations of the base metals in the top soil include Na, 5.43 ± 2.3 mg/kg; K, 6.4± 2.3 mg/kg; Ca, 6.8 ± 3.2 mg/kg; and Mg, 4.6± 0.41 mg/kg for the top soil across the sampling locations (Table 4.20). Calcium had the highest concentrations across all the sampled locations in both the top and sub soil with little differences in the observed concentrations.

Table : 4.21b Results of the soil chemical properties

Parameter	Cl^- mg/kg		NH_3 mg/kg		TPH mg/kg		Bulk Density, g/ml		Porosity		Ash content, %		Aluminium ,mg/kg Al		Manganese, mg/kg		Fe (mg/kg)	
	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub
TSQP1	32	24	0.3	0.72	0.19	1.2	1.05	1.00	0.16	0.20	84.90	85.5	26.36	14.55	ND	ND	0.65	0.61
TSQP2	26	36	0.21	0.27	ND	ND	1.11	1.05	0.12	0.10	87.03	87.01	31.82	13.64	ND	ND	0.53	0.61
TSQP3	26	32	0.24	0.18	0.07	ND	1.11	1.11	0.14	0.12	86.71	86.43	29.09	17.27	0.01	0.01	0.73	0.60
TSQP4	28	38	0.21	0.21	ND	ND	1.17	1.11	0.09	0.14	89.96	87.90	20.00	28.18	ND	ND	0.56	0.60
TSQP5	32	38	0.24	0.24	0.04	0.14	1.11	1.05	0.14	0.18	85.79	86.71	4.55	27.27	0.04	ND	0.66	0.63
TSQC	32	26	0.27	0.24	0.12	0.14	1.25	1.25	0.03	0.03	89.21	87.6	11.82	18.18	ND	ND	0.64	0.61
SQSTSP1	36	36	0.3	0.3	747	836	1.00	1.00	2.00	1.00	81.3	81.36	10.00	10.00	10.1	0.01	0.57	0.58
SQSTSP2	30	30	0.18	0.18	2.32	2.70	1.25	1.25	1.6	1.25	91.09	91.09	15.4	15.45	5.04	ND	0.65	0.81
SQSTSP3	34	34	0.21	0.21	ND	ND	1.25	1.25	1.60	1.25	92.37	92.37	26.36	26.36	7.56	ND	0.62	0.66
SQSTSP4	33	33	0.32	0.32	ND	ND	1.20	1.20	1.40	1.20	77.30	77.30	10.10	10.10	10.3	ND	0.59	0.50
SQSTSP5	35	35	0.28	0.28	ND	ND	1.24	1.24	1.60	1.24	92.36	92.36	24.10	24.10	6.22	0.21	0.60	0.64

SQSTSP6	31	31	0.19	0.19	ND	ND	1.22	1.22	1.80	1.22	78.0	78.00	15.26	15.26	6.28	ND	0.62	0.41
SQSTSP7	34	34	0.21	0.21	ND	ND	1.00	1.00	2.00	1.00	78.0	78.06	26.36	26.36	7.56	0.03	0.57	0.68
SQCSTS	32	32	0.24	0.24	ND	ND	1.18	1.18	1.69	1.18	90.51	90.51	20.00	20.00	7.56	ND	0.63	0.63
TSQ CP1	28	27.9	0.33	0.40	2.75	1.31	0.91	0.83	0.07	0.13	71.31	68.96	7.27	6.36	ND	ND	0.65	0.72
TSQ CP2	30	27.9	0.60	0.49	1.59	ND	0.91	0.87	0.07	0.10	69.87	62.9	32.73	22.7	ND	0.01	0.77	0.94
TSQ CP3	34	25.9	0.46	0.48	ND	ND	0.91	0.91	0.07	0.07	75.61	73.8	29.09	23.64	0.01	0.02	0.70	0.65
TSQ CP4	34	33.9	0.33	0.19	0.14	ND	0.87	0.83	0.10	0.13	69.46	69.6	28.18	26.36	ND	ND	0.71	0.77
TSQ CP5	30	31.8	0.37	0.31	0.14	0.16	0.91	0.83	0.07	0.13	74.84	74.9	27.27	24.55	ND	ND	1.03	0.65
TSQ CP6	26	27.9	0.55	0.51	ND	0.16	0.91	0.91	0.07	0.07	75.93	74.0	30.00	34.55	ND	ND	0.52	0.67
TSQ CP7	29.9	29.9	0.33	0.31	0.72	0.49	0.91	1.00	0.07	0.01	72.8	77.8	6.36	7.27	ND	0.05	0.61	0.10
Mini	26	24	0.18	0.18	ND	ND	0.87	0.83	0.03	0.01	69.87	62.9	4.55	6.36	ND	ND	0.52	0.10
Max	36	33.9	0.60	0.72	747	836	1.25	1.25	2.00	1.25	92.37	92.37	32.73	34.55	10.3	0.05	1.03	0.94
Ave.	28.3	28.7	0.48	0.51	634	564	0.82	0.78	1.43	0.74	68.3	74.3	27.4	28.5	3.6	0.03	0.55	0.54
FMEnv	250		NS		10.0		NS		NS		NS		<0.01		4.00– 25.00		1.00	

Heavy Metal

Heavy metals may be present naturally in some soil samples as a result of the original composition of the parent weathered rock which formed the soil, or due to anthropogenic contamination of the soil. Exposure to heavy metal contamination remains one of the major concerns of environmental pollution due to their debilitating health effects, especially in humans. Heavy metal pollution may occur naturally through releases from metal containing ores or anthropogenically from numerous metal containing products of everyday use to levels higher than the background limits of the metals in the soil and also at levels beyond the threshold limits set by regulatory authorities.

The soil of the proposed project route was analyzed for the presence of heavy metals and the results obtained are presented in Table 4.20 Mean concentrations of the metals analyzed in the top soil were Pb: 0.01±0.012mg/kg, Cd: 0.02mg/kg, Cr: 0.011mg/kg, As: 0.03mg/kg ,Ni: 1.12mg/kg and Cu: 0.02mg/kg. The concentrations were all within regulatory limits for arable soil.

While Iron (Fe) concentration ranged from 0.52-1.03 mg/kg for top soil and sub soil from 0.94 - 0.54 mg/kg a mean of 0.55±0.03 and 0.54± 0.24mg/kg for top and sub soils respectively. Hg was recorded in some locations of the study area with concentration from below detection limit to 0.45 mg/kg for top soil and below detection limits to 0.28 mg/kg with of 0.05 mg/kg and 0.02 mg/kg for top and sub soils respectively. The concentrations of the metals in the sub soil shared similar trends to those observed for the top soil.

Soil Microbiology

Table 4.22 Results of soil Microbiology

Code	THB $x10^6$ Cfu/gm	TCC $X10^4$ Cfu/gm	TFC $X10^4$ Cfu/gm	THDB $X10^3$ Cfu/gm	THDF $X10^4$ Cfu/gm	Species Of Microorganisms Isolated
TSQ CP1 TS	1700000	20000	20000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.*
SSQ CP1 SS	70000	70000	30000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
TSQ CP2 TS	180000	NG	90000	NG	10000	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SSQ CP2 SS	90000	80000	30000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergilluswentii; Norcadia spp.; Corynbacterium*
TSQ CP3 TS	230000	40000	90000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SSQ CP3 SS	1900000	40000	70000	NG	NG	*Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp*
TSQ CP4 TS	120000	20000	80000	NG	20000	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SSQ CP4 SS	60000	20000	70000	NG	NG	*Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*

TSQ CP5 TS	110000	1600000	90000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SSQ CP5 SS	1100000	160000	40000	NG	NG	*Micrococcus spp.; Fusarium spp; Aspergilluswentii; Norcadia spp.; Corynbacterium.*
TSQ CP6 TS	30000	NG	70000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergilluswentii; Norcadia spp.; Corynbacterium*
SSQ CP6 SS	3300000	10000	90000	NG	NG	Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.;
TSQ CP7 TS	120000	20000	20000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SSQ CTL SS	1300000	20000	60000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
TSQP1 TS	1200000	5200000	1600000	NG	NG	Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.
SQSSSP1 SS	1200000	2800000	40000	NG	NG	*Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
TSQP2 TS	1600000	6100000	20000	NG	NG	*Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSSSP2 SS	4100000	9800000	30000	NG	NG	Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.;
TSQP3 TS	7400000	6200000	1500000	NG	NG	Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.
SQSSSP3 SS	70000	7900000	220000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.*
TSQP4 TS	3600000	30000	70000	NG	NG	*acillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*

SQSSSP4 SS	5200000	4300000	10000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
TSQP5 TS	1300000	40000	20000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQSSSP5 SS	1700000	110000	40000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
TSQC TS	70000	2400000	40000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQCSSS SS	1600000	30000	20000	NG	NG	*Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSTSP1 TS	4600000	107000000	11000	2000	1000	*Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSSP1 SS	7200000	5300000	20000	NG	30000	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSTSP2 TS	1900000	2000000	14000	1000	1000	Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergilluswentii; Norcadia spp.; Corynbacterium
SQSSP2 SS	8800000	7100000	50000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSTSP3 TS	4300000	7100000	40000	NG	1000	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSSP3 SS	2900000	20000	30000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*

SQSTSP4 TS	2000000	1600000	12000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium*
SQSSP4 SS	7000000	5200000	20000	NG	20000	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQSTSP5 TS	1900000	2000000	14000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQSP5 SS	2900000	20000	30000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQSTSP6 TS	4200000	6100000	50000	NG	2000	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergilluswentii; Norcadia spp.; Corynbacterium.*
SQSSP6 SS	8500000	7000000	40000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQSTSP7 TS	1100000	6200000	50000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQSSP7 SS	2900000	20000	30000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucor spp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQCSTS TS	1900000	2000000	14000	NG	NG	*Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergillus wentii; Norcadia spp.; Corynbacterium.*
SQCSS SS	180000	1100000	40000	NG	NG	*Bacillus spp; Pseudomonas aeruginosa; Aspergillus fumigates; Mucorspp; Penicillium spp; Micrococcus spp.; Fusarium spp; Aspergilluswentii; Norcadia spp.; Corynbacterium.*

THB= total heterotrophic Bacteria, TCC= Total coliform count, TFC= total fungi count , THDB= Total Hydrocarbon Degrading Bacteria count, THDF= Total hydrocarbon Degrading Fungi. Abia SAPZ ESIA 2024

Soil microbiology

The two groups of microorganisms usually studied in environmental media are fungi and bacteria, which remains the most important organic matter decomposers in the soil. Soil microorganisms play an essential role in decomposing organic matter, cycling nutrients and fertilizing the soil. These microorganisms are heterotrophic, highly aerobic and mobile in soil. Bacteria and fungi (microbes) count provide information on the level of ongoing biochemical activities in soil. Microbial counts under normal circumstances increase with an increase in soil organic matter.

Results of the microbial analyses showed the presence of both heterotrophic and hydrocarbon utilizing bacteria and fungi in the top and sub soil (Table 4.22). Total heterotrophic bacteria (THB) had the highest plate counts of microorganisms in the soil samples followed by coliform bacteria, thus indicating that the proposed project area has some level of human faeces contamination.

4. 12 TERRESTRIAL ECOLOGY

4.12.1 Vegetation Study:

There are various vegetation zones in Nigeria, all determined by the prevailing climatic conditions across different parts of the country. These zones have varying annual rainfall, temperature, atmospheric pressure, and predominant vegetation. Some of the zones are significantly larger than others, with some being more human-friendly than others. There are seven distinct ecological zones in Nigeria which can be streamlined into five, namely

(i) Sahel/Sudan Savanna, (ii) Guinea Savanna, (iii) Derived Savanna, (iv) Lowland rainforest/ montane forest and (v) Freshwater swamp forest/mangrove forest and coastal vegetation.

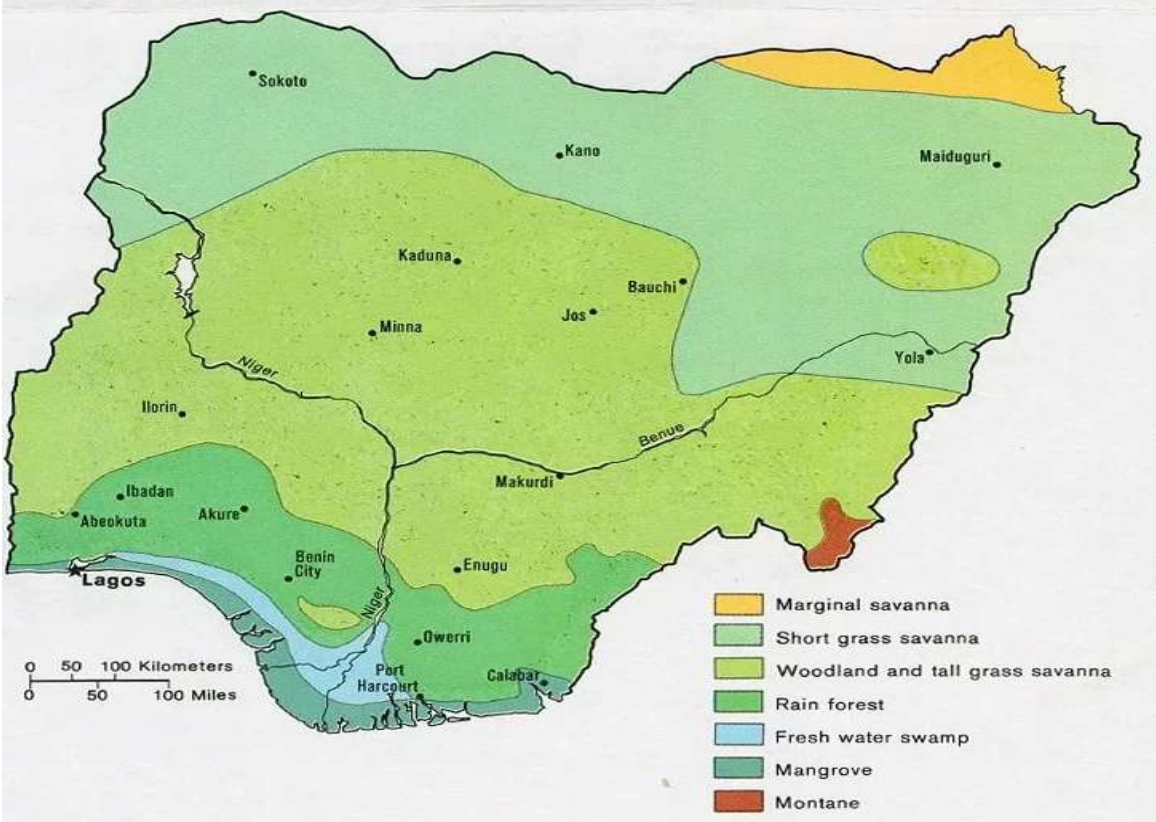

Fig.4.14. Map Showing Different Vegetation Belts of Nigeria.

4.12.2 Methodology

Specific and standard methodology were adopted for specific floral taxon for which baseline information were obtained. Some of the floristic parameters determined are as shown in Table 4.22 which include specific and family information (life forms, species diversity, species richness, alien species inventory and indigenous uses). In this study three (3) Transect were randomly established at each sampling station to ensure adequate coverage of the project area of influence. Each transect was 200m long and sampling quadrats were established every 50 m. At each quadrat floral diversity and density of key economic and medicinal species were determined. The sampling of quadrats were 10 m x10 m and 25 m x 25m for trees and 1 m x 1 m for herbaceous plants. Additional 'walk through' transects were established east and

west of the main site to provide observation for a general description of the area's vegetation. In addition to the walk-through observation points, the study covered 18 vegetation sampling stations.

Plant species were identified to family, generic and species levels either in the field or herbarium. Species touching or overshadowing the line transect were manually enumerated and converted to the Blanquet scale. Species type, habitat type, DBH, growth habit and interviews on indigenous uses and local names of species were conducted. Also, the IUCN data base of alien invasive and IUCN 2018 version 2 standards was used in computing IUCN status. Table 4.22 summarizes the methodology used in this study.

Table 4.23: Summary of the Methods used in the Vegetation study

Flora		
Activity	Method	Remarks
Species identification / family diversity	Use of quadrat ($10m^2$),Transect (200m x 200m)	Field botanical characters used for identification include flowers, fruits, leaves, slash, exudates, and sometimes smell. Field guides include Letouzey 1986, Hutchinson and Dailziel, 1963, Hawthorne1993, Souane 1985, Akobundu and Agyakwa, 1998, Arbonnier 2004, Nyannanyo 2006.
Species diversity		$H= -\Sigma P_i \ln P_i$, Where H = Shannon's index, ln = log. $E= EQ = -\Sigma P_i \ln P_i$ / lnS; Where EQ = equitability, S = total number of species (Begon, et al 1986))
Species richness/ abundance		Abundance of species was evaluated by counting the number of individuals of a species in each Whittaker transects. Family abundance was

		evaluated by counting the number of individuals of species belonging to a family (Gauch, 1982).
Species density		Number of plant species recorded Total number of plots censured
Species frequency		Number of plots in which species/family is recorded x 100 Total number of plots censured
Indigenous uses of species	Ethno botanical questionnaires	The various indigenous uses of the recorded plant species were compiled in addition to plant species with the most diverse uses
Alien and invasive species	IUCN & Literatures and absence of local names	The occurrence of exotic species was compiled based on literature searches and absence of local names (Odugbemi 2006)
Conservation status	IUCN Red List of 2018	Number of threatened species x 100
		Total number of species
Protected species	IUCN database 2018 and CITES ACT 2016	-

4.12.3 Baseline Characterization

Owaza Ukwa West

In the study area, three distinct vegetation types were identified and it includes: **Riparian forest**, **Oil Palm plantation and Farm plots**. The Riparian forest was characterized by plants that have morphological and physiological adaptations to water-logging (Hogan and Wilbridge, 2007). Common vegetation constituting the Riparian forest include: *Ficus benghalensis* L. *Raphia hookeri*, *Terminalia superba*, *Diospyros mespiliformis*, *Nauclea diderrichii*, *Baillonella toxisperma*. Furthermore, the oil palm plantation was characterized by light loving, fast growing

species such as *Elaeis guineensis, Albizia zygia, Pennisetum purpureum,* and *Cenchrus purpureus*. All the plant communities within the study area are secondary as most of the primary forest had been removed to allow for establishment of farms. The main crops grown in the farm plots are cassava, melon and maize. These serve as staples for communities within the study area. Synopsis on the vegetation characteristics in the study area is discussed in this subsection.

Ariam Elu Elu Ikwuano LGA.

In the study area, two distinct vegetation types were identified and it includes: Bush fallow and Farm plots**.** The Bush fallow was characterized by light loving, fast growing species such as *Chromoleana odorata, Albizia zygia, Pennisetum purpureum, Cenchrus purpureus and Spondias mombin*. Weeds were also abundant in the Bush fallow and abandoned farms. All the plant communities within the study area are secondary as most of the primary forest had been removed to allow for establishment of farms.

The main crops grown in the farm plots are cassava, melon and maize. These serve as staples for communities within the study area. Synopsis on the vegetation characteristics in the study area is discussed in this subsection.

Plate 4.5 : The vegetation type at Ariam elu elu.

Okporoenyi, Bende LGA

In this study area the main vegetation type identified were Cocoa plantation, Bush fallow and farm plots. The cocoa plantation was characterized by typical tropical trees such as shrubs. Examples are *Theobroma cacao, Itea virginica, Axonopus compressus (Sw.) P Beauv, Chrysopogon aciculatus (Retz.) Trin., Commelina erecta L., Amaranthus hybridus L., Ageratum conyzoides L.*

The bush fallow was characterized by light loving trees like, *Asystasia gangetica* (L.) T. Anders, *Pennisetum purpureum, Cenchrus purpureus*, *Emilia praetermissa, Chromoleana odorata, Ipomoea carica, Leptocholoa chinensis, Momordica charantia L. Panicum maximum Jacq.. Paspalum scrobiculatum* L. *Ludwigia polycarpa* L. All the plant communities within the study area are secondary as most of the primary forest had been removed to allow for establishment of farms. The main crops grown in the farm plots are cassava, melon and maize. These serve as staples for communities within the study area.

4.12.4 Species Richness

This is the total number of species censored in the entire sampling locations. It is often used as a criterion for ecosystem disturbance or stability. A total of fifty six (106) species were censored in the study area. A comprehensive list of the censored flora including those for each habitat is shown in the Appendix while the summarized result is presented in Table 4.24

Table 4.24 Plant species richness per habitat

Location	Sampling points	Habitat type	Species richness	Species richness per transect			
				1	2	3	4
Owaza Ukwa west	AOW 01	Riparian forest	55	23			35
	AOW 04	Bush fallow	35		24	33	
	AOW 05	Farm plot	23		15		14
	AOW 09	Oil palm plantation	35	20		12	
	AOW 10	Oil palm plantation	32	24		10	
Ariam Ikwuano	AAI 01	Bush fallow	37		15		30
	AAI02	Farm plot	28	32		31	
	AAI03	Bush fallow	46		23		38
	AAI04	Farm plot	25	20		12	
Bende	ABE01	Cocoa plantation	34		24		10
	ABE03	Cocoa plantation	25	24		25	
	ABE04	Bush fallow	36		35		13
	ABE05	Bush fallow	43	15		30	
	ABE06	Farm plot	22		24		32

Abia SAPZ ESIA 2024

From table 4.24 , the Riparian forest had the highest number of species, followed by the Bush fallow, plantation plots and farm plots which recorded average species richness of 40, 35 and 26 respectively. The challenging access to the riparian may be responsible for the higher species richness observed. The observed wildfire and intense grazing activities at the bush fallow and farm plots would have contributed significantly to the recorded sparse species.

4.12.5 Species Density

Density refers to the number of species per given area. In this study, species density is used to evaluate number of plant species in a sampling plot. This in turn helps in vegetal waste quantification as shown below: Tree to Ton Conversion Standard (inch ft) = 24 trees at 40 ft x 7 inch (where 24= number of tree species in one ton with an average height of 40ft and an average DBH of 7inch). No tree satisfies the stated criteria and hence vegetal waste from project site clearing is negligible.

4.12.6: Shannon and Evenness Indices

Shannon Wiener Index and evenness index were used to evaluate species diversity for the habitats. The Bush fallow with a Shannon index of 2.54 was more diverse than the Riparian with 2.14. This is indicative of more species biomass in the habitat than the others.

4.12.7 Species Growth Habit

Species Growth Habit is the form in which a species exists. The censored species had about two-third woody (Tree and shrubs) and one-quarter, non woody (ferns, grasses, climbers and herbs). The relatively high proportion of non- woody species as well as woody species with low DBH is indicative of habitats under disturbances.

4.12.8 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. International Union for the Conservation of Natural Resources (IUCN) listed about 24 plant species that are alien to Nigeria, while the global invasive database listed the occurrence of 29 invasive floras in Nigeria. A review of the alien species data base for Nigeria showed that two (2) of these species (*Ageratum conyzoides*, and *Chromolaena odorata*) occur in the study areas. On the other hand, three (3) species (*Chromolaena odorata, Pennisetum purpureum* and *Mimosa pudica*) were invasive. The presence of these alien/invasive species in the study area signifies a disturbed ecosystem possibly from anthropogenic activities. Plates 1 and 2 are pictures of some these species

(a) Plate 1. *Chromolaena odorata*

(b) *Mimosa pudica*

Plate 4.6. Alien species (a-b)

(a) *Ageratum conyzoides*

(b) Pennisetum purpureum

Plate 4.7 (a-b): Invasive species of the study area

4.13 IUCN Status

The IUCN status of the plant resources of studied area was evaluated using the IUCN red list version 2018 -2 criterion. Results showed that five species are of conservation concern. These are (a) *Alepidea cordifolia* (Endangered) and *Dichapetalum obanense*, *Dendrolobium umbellatum*, *Ricinidendron heudelotii* and *Lophira alata* in the Vulnerable category (VC). *Cordia dichotoma* was censored in Ukwa west and Ariam elu elu with an abundance of 4 and 5 individuals, respectively. Interestingly most of these species are under protection in Gele Gele forest reserve, Omo forest reserve and Olokemeji forest reserves. Plate 4.6 (a-b) shows pictorial images of these threatened species.

(a)Alepidea cordifolia

(b) Dendrolobium umbellatum (L.) Benth

Plate 4.8 (A-b): Pictures of Threatened Species in the Study Area

4.13.1 Habitats of higher ecological integrity

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

Table: 4.25 : Ecologically sensitive plant species and their locations in the study area.

Category	Species	Locations/Habitats			
Species with high indigenous uses	*Elaeis guinnensis*	BF	RF	FP	Palm & cocoa plantation
		✓	✓	✓	✓
	Parkia filicoidea Welw. ex Oliv	✓	✓	✓	
	Lophira alata	✓	✓	✓	✓
	Pentaclethra macrophylla	✓	✓		

	Bambusa vulgaris	✓	✓		
	Irvingia gabonensis	✓		✓	✓
	Spondia sp	✓		✓	✓
	Theobroma cacao	✓		✓	✓
	Gmelina aborea	✓		✓	✓
Threatened flora species	*Afzelia africana* (VU)	✓	✓		
	Dalbergia latifolia (VU)	✓		✓	✓
	Lophira alata (VU)	✓		✓	✓
	Ricinodendron heudelotii (VU)	✓	✓		
	Alepidea cordifolia	✓	✓		
Alien species	*Ageratum conizoides*		✓	✓	✓
	Chromolaena odorata	✓		✓	✓
Invasive Species	*Mimosa pudica*	✓		✓	✓
	Chromolaena odorata	✓	✓	✓	✓
	Dalbergia sissoo		✓	✓	✓

BF=Bush fallow, RF= Riparian forest, FP=Farm Plot.

4.14 Indigenous uses of Plant Resources in the Study Area

The indigenous uses of the various plant resources censored in the study area were evaluated via interviews as shown in Plate 4.7a-e

(a) Palm tree

(b) Palm fruit

(c) Cocoa tree

(d) African locust bean tree

(e) Fuel wood

Plate 4.9 (a-e) Some of the Plant resources censored in the study area.

Fifteen (15) species representing about 20.5% have indigenous uses. *Gmelina aborea, Theobroma cacao, Elaeis guineensis, Pentaclethra macrophylla, Lophira alata and Bambusa vulgari* are the most used plant species in the study area as a result of the wide range of products they offer. This include; Medicine, fuel wood, raw material (wood for construction of bridge, houses and electric pole, etc). On the other hand, *Ageratum conyzoides, Alchornea cordifoia, Annona muricata, Anthoclesista djalonensis and Musanga cecropioides* were less use due to the limited number of products they offer. The inventory of some species in one plot with

reduced individuals is a worrying sign of over harvesting. Plate 4(a-d) shows some of the indigenous uses.

Table 4.26 : Plant Species and Their Indigenous Uses

s/n	Scientific name	Uses	Number of uses
1	*Annona muricate*	Fuelwood, Prevention of Soil Erosion	2
2	*Anthoclesista djalonensis*	Fuelwood and Wattles	2
3	*Ageratum conyzoides*	Fodder	1
4	*Albizia zygia*	Medicinal, Gum & Adhesives, Tannin, Wattles	4
5	*Azadirashta indica*	Fuelwood, Medicinal and Fence	3
6	*Ceiba pentandra*	Medicinal, Fruits & Seeds and Frames for Doors & Windows	4
7	*Elaeis guineesis*	Medicinal, Nuts, Sweeteners, Beverages & Drinks, Shade from Sun and Roof Trusses (Roof Rafters & Purloins)	4
8	*Harungana madagascariesis*	Medicinal, Chewing Sticks	2
9	*Gmelina aborea*	Fuelwood, Charcoal, Medicinal, Chewing Sticks Fodder, Fence, Wattles, Poles, Green Manure & Soil Reclamation Shade from Sun, Prevention from Soil Erosion, Frame for Doors and Windows	5
10	*Lophira alata*	Fuelwood, Medicinal, Roof Trusses (Roof Rafters & Purloins), Frame or Doors & Windows, Stairs	4
11	*Pentaclethra macrophylla*	Fuelwood, Charcoal, Medicinal, Spices, Flavouring & Thickeners, Green Manure& Soil Reclamation Shade from Sun	3
12	*Mitragyna stipulosa*	Fuelwood, Frame for Doors & Windows, Stairs	4
13	*Dialium guineese*	Fuelwood, Medicinal and Chewing Sticks	3

14	*Bambusa vulgaris*	Fuelwood, Chewing Sticks, Fence and Wattles	5
15	*Mangifera indica*	Fuel wood, fruit juice, medicinal	3
16	*Theobroma cacao,*	Fuelwood, medicinal, raw material	3
17	*Parkia filicoidea Welw. ex Oliv*	Medicinal, raw material	2

4. 15 Wildlife Study

Sample stations were allocated to cover the different sub-habitats within the project location. The sampling point distance also took into cognizance guideline requirements to allow for effective coverage of the sampling site. Sampling was done across all vegetation strata.

Transects were used for wildlife assessment within and across the proposed proposed project sites. The basis for the allocation of the sampling stations was random though with a bias to cover different landscape, water bodies etc. in the project area. At each sampling station, the relevant ecological parameters such as wildlife and their habitats, were documented. Farmers/hunters were also interviewed to elicit relevant information about wildlife associated practices in the area such as hunted animals, sacred animals, common animals and animal sighting trends. The sampling locations are the same with the vegetation and Soil samples.

4. 15 .1 : Herpetofauna

Study Methodology

Direct observations

Diurnal and nocturnal field observations to recognize evidence of herpetofauna species presence were undertaken. Formal transect surveys of reptiles and amphibians were conducted simultaneously, following the transects already established for flora. Transects were walked slowly and all reptiles and amphibians encountered carefully observed. The sighted herpetofauna were snapped where

possible and identified to the lowest possible taxa by specialist. Appropriate field data sheets were employed to capture information like species list with scientific, common and local names and abundance

Indirect observations

The recorded evidence was represented both by direct (collections and observations) and indirect (tracks, footprints, scats/faeces, feeding activity, tracks, holes/diggings or scratching and carcass, habitats and dwelling places, vocals and call outs etc.). Local land users were also interviewed about herpetofauna they had seen or hunted in the area, and these were identified from pictures. A summarized sampling protocols is provided in the table 4.26 .

Table 4.27: Summary of methods used for the herpetofauna groups

Herpetofauna group	Survey Technique	Survey Effort per Vegetation Community
Reptiles		
Diurnal searches	Habitat searches	0.1 ha search for one-person per hour for 2 days per site
Nocturnal searches	Spotlight searches	Walking rate of 400 metre per hour per person on 2 nights
Specific habitats	Diurnal + nocturnal Searches	One-person hour diurnal + Oneperson hour per 0.1
Pitfall trapping		
Amphibians		
Diurnal searches	Systematic searches	0.1 ha search for one-person hour per habitat
Nocturnal searches	Spotlight searches	30 mins on two separate nights

Conservation Status

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2018-2. The IUCN categories rank the relative risk of individual taxa becoming extinct in the wild based on a set of standardized criteria.

4.15.2 Result

Herpetofauna

Result showed that herpetofauna species were censored across the three habitat types in the study area. Table 4.27 presents the the herpetofuna groups in the study area.

Table 4.28: Herpetofauna Checklist

Taxa	Species	Conservation status			Habitat censored						Lit. reviewed
		Endangered Act 2016	IUCN	Endemism	BF	RF	FP	plantations	Breeding	Feeding	Threats/Conservation Actions12
Amphibians	*Hoplobatrachus occipitalis*	Not listed	Least concern(LC)	No	3	2	2	3	Late Feb March	Insects, algae, leaves, fish	Not under threat
	Hyperolius Concolor	Not listed	LC	No	2		2	2	Feb -Apri		
	Hyperolius Fasciatus	Not listed	LC	No	1		3	2	Feb-Apri		
Reptilia	*Agama Boensis*	Not listed	LC	No	6	6	1	2	April-may	Fish aves, amphibians,	Legislation and enlightenment

	Holaspis Guentheri	Not listed	LC	No	1	1	1	1	Oct. Dec	Amphibans and fish	Biological resource use and Agricultural Activities. In situ conservation in reserves

Bush fallow= BF, Riparian forest == RF, farm plot= FP

From the field data, Bush fallow has highest Herpetofauna. This indicates the relative preference for this habitat by herpetofauna in the study area. This could be attributed to the availability of food, breeding grounds, vegetative cover and the fertile environment provided by this habitat in the area. In terms of species abundance, reptilian group recorded a remarkable lower attendance with 2 individuals. Reptiles are biological predators of amphibians; hence, the lower abundance of the former promotes habitat proliferation by the later. Also, reptiles are hunted by man and predatory birds, which might possibly, be responsible for their low diversity and abundance in the study area.

4.16 Avian Fauna

Study Methodology

Methodology for birds' survey

The survey provided information on:

• Estimation of number/density of birds regularly present or resident within the study area before its construction;

• Patterns of bird movements in the vicinity of the line route before construction;

• Presence, abundance and use of habitats from endemic and threatened species inside the proposed project site.

• Identification of breeding/wintering grounds if present

• To meet these objectives, three inventory methods were used. These methods are described herein. Counting stations along transect in order to estimate the number and density of birds, birds were sampled using counting stations along each transect visited. The distance in between each counting station may vary according to habitat patches, size but were of 250 m minimally. The number of counting stations were determined depending on the number of different habitats to inventory and field accesses. However, a minimum of two counting stations were made along each

transect. Counting stations were maximised during early morning when singing bird activity is at its maximum. The counting stations were located preferably in homogenous habitat patches. Additional points were also placed in rare habitats. At each point count, ornithologists at a site and wait still for one minute to let the birds settle down, in case they had been disturbed. The observer then make a fifteen-minute count, noting all birds seen or heard at the station and the distance from the observer to the bird in the following distance classes: 0-50m, 50-75m, 75-100m, >100m. In the first 5-minutes period, observer noted all bird seen or heard.

General information taken were

- station name
- observer name
- date
- time (start and end)
- temperature (°C)
- cloud (%) precipitation (rain, fog etc.)
- wind speed (Beaufort scale)
- wind direction
- observation conditions
- Finally, general notes on the inventoried habitats were taken, as well as pictures

Observation Stations - Migratory Survey

The observation stations were located where the field of view is optimal or open areas. When weather conditions are not appropriate for viewing the targeted species (e.g.rainfall , fog), inventories will be postponed until weather conditions improve. The field crew will note observations at each station for 60 minutes. Binoculars will be used by the observers to identify birds (raptors, waterfowl and other aquatic birds, passerine, others). The surveys will be done between 8 a.m. and 4 p.m. to maximize the observations, as migrating raptors travel more frequently at this time of the day.

The field crew will log all birds observed and the travel characteristics of each individual. The observations were compiled on a field datasheet.

Conservation Status

The global conservation status of all species were obtained from the IUCN Red List of Threatened Species Version 2 (2018) while Endangered species Act 2016 was used in compiling the national status.

Checklists of some of the Avian group found in the study area are listed in Table 4.28

Table: 4.29: Birds Checklist

Scientific name	Common name	Status			
		Normal	Threatened	Endangered	Extinct
Alcedo leucgater	White-bellied kingfisher	✓			
Ardea cinerea	Grey heron		✓		
Asio capensis	African march owl	✓			
Corythaeola cristata	Blue plantain eater	✓			
Tauraco macrorhynchus	Verreaus's touraco	✓			
Halcyon malibica	Blue kingfisher	✓			
Bubulcus ibis	Cattle egret	✓			
Casmerodius albus	Great white egret	✓			

Species of Conservation Interest

Analysis for the conservation status of the species censored in the project area was conducted using the IUCN 2018-2 Red List of Threatened species. None of the sighted species censored in the study area were of conservation interest as all were categorised as Least Concern (LC).

Table 4.30: Mammals checklist

Scientific name	Common name	Status			
		Normal	Threatened	Endangered	Extinct
Cephalophus maxwelli	Maxwell's duiker	✓			
Hypsinatus monstrosus	Hammer-headed bat	✓			
Phinolophus sp.	House bat	✓			
Syvicapra grimmia	Common duiker	✓			
Tragelaphus scriptus	Sitatunga	✓			
Atherurus africanus	African brush-tailed porcupine		✓		
Urocitellus columbianus	Squerril	✓			
Perodicticus potto	softly-softly		✓		

4.16.1 IUCN status

All sighted species were of Least Concern (LC) status using the IUCN Red list 2018 version two criterion. However, two non sighted species *Crocidura nigeriae* and *Perodicticus potto* are classed in Nigeria Endangered Species Act 2006. as absolutely prohibited and under license respectively. The major threat for the two species is hunting. Also, no endemic species was recorded.

Habitat of high value

Bush fallow and Riparian forest habitats are priority habitats to the mammalian taxon. There was no species of conservation interest according to IUCN in the study area. However, 2 species were of conservation interest. These are *Atherurus*

africanus (absolutely prohibited) and *Perodicticus potto* (license). Both species were found in Bush fallow. Therefore, conservation of this habitat is imperative.

4.17 AQUATIC ECOLOGY

4.17.1 Benthic Macro Fauna sampling Methodology

Benthos were obtained by washing residual sediment samples through a 0.5 mm-mesh sieve using water obtained from the river at the site. This was carried in a manner so as not to destroy the integrity of the benthic organisms. The benthos samples obtained were placed in a plastic container and preserved in 20% buffered formal saline solution and stored in the ice coolers. After each sampling, the Eckman Grab was washed thoroughly with water from the river to remove remaining particles from previous sampling.

Benthos Analysis

Macro invertebrates were identified to the lowest practical identification level—typically genus or species. If an animal was a member of one of the "minor" taxonomic groups, identifications might only be to that higher taxonomic level.

Additionally, if an organism was damaged or a juvenile, identifications to the genus or species level could not always be made. Benthic vertebrates were identified by means of identification keys provided by Pennak (1978), APHA/AWWA/WEF/ (1992)

4.17.2 Zooplankton Sampling

Zooplankton As part of the procedures taken to determine the type and nature of small living organisms surviving on the surface of the water, a zooplankton sampling exercise was conducted. Zooplankton samples were collected by pulling plankton net of mesh size of 0.063 mm vertically on the surface of the river. A weight (Iron rod) was attached to the cord holding the net, lowered into the water and then pulled back to the surface for collection of samples. After each tow, zooplankton were collected using labeled wide mouth plastic containers and preserved with 10 %

buffered formalin, the net was thoroughly washed so that particles adhering to the net was washed into the collecting bottle for analysis.

Zooplankton Analysis:

In the laboratory, zooplankton samples were concentrated to about 50ml by gravity over 24 hours. They were further concentrated to about 5mls by centrifugation. Triplicate sub-samples were taken from each concentrate and transferred to Sedgwick Rafter slides for identification and enumeration. Zooplankton samples were identified with the aid of key provided by Iltis (1998). This was done using a light microscope and a magnification of 25-100 x. Zooplanktonic organisms were identified using keys provided by Rey and Pourriot (1980).

4.17.3 Phytoplankton Sampling:

Phytoplankton was collected using plankton net with a mesh size of 55µ to which a vial was attached at the bottom end. To achieve the objective, the net was first lowered to a depth of 0.2m and slowly towed vertically for about 2 minutes on the River. A horizontal tow was achieved by lowering the net to a depth of about 0.2m and towed at 2 knots/hr for two minutes. The contents of the vial attached at the bottom of the plankton net was emptied into plastic vials and preserved in 4% formalin.

Phytoplankton Analysis

In the laboratory, phytoplankton samples were concentrated to about 50ml by gravity over 24 hours. They were further concentrated to about 5mls by centrifugation. Triplicate sub-samples were taken from each concentrate and transferred to Sedgwick Rafter slides for identification and enumeration.

Phytoplankton samples were identified with the aid of key provided by Whitford and Schumacher (1973), Whitford and Schumacher (1973).

Phytoplankton Community Structure Analysis:

The following diversity indices were used for biological data analysis for both zooplankton and phytoplankton.

(i) Species Richness Index (d): The Species Richness Index (d) according to

The Shannon diversity index (*H*) is index that is commonly used to characterize species diversity in a community. Shannon's index accounts for both abundance and evenness of the species present. The proportion of species *i* relative to the total number of species (p_i) is calculated, and then multiplied by the natural logarithm of this proportion ($\ln p_i$). The resulting product is summed across species, and multiplied by -1:

Shannon index $H' = -\Sigma^{s}_{i} p_i \ln p_i$,

Where:

H= Shannon's diversity index

S = total number of species in the community (richness)

Pi = proportion of *S* made up of the *i*th species

4.17.4 Phytoplankton

The checklist of the phytoplankton families/species in aquatic systems within the proposed Owaza Industrial processing park and the Cocoa processing hub at Bende LGA are presented in table 4.30 while the detailed species richness are found in the appendix . These data show that five major families of phytoplankton were recorded. These are Baccilariophyta, Chlorophyta, Dinophyta and Euglenophyta and this composition is in conformity with observations made by Nwankwo et. al. (2008), Akoma and Opute (2010), Izunobi, et al. (2022). Chlorophyta were the dominant phytoplankton division and constituted 41.45% within Imo River. The dominance of this division of phytoplankton has been reported in literature (Akoma and Opute 2010, Dike and Adedolapo, 2012; Izunobi, et al., 2022).

The major species of Chlorophyta recorded in Imo River and their relative abundance at the three sampling points across the LGAs include *Amphora ovailis* (3.88%), *Ankistrodesmus falcatus* (2.70%) and *Coscinodiscus rothii* (2.38%). abundance) include *Eudorina sp.* (3.92%), *Tabellaria fenestrata* (3.77%), *Navicula ovalis* (3.42%), *Tabellaria nitzschoides* (3.67%) and (3.47%).

Table 4.31 : Phytoplankton Assemblage across all Sampling Stations

Location	Species	Group	Family	UIRSP	MIRSP	DIRSP
Imo river	*Melosira sp*	Diatom	Melosiraceae	12		
	Surirella nobilis	Diatom	Bacillariophyceae		21	
	Coscinodiscus eccentricus	Diatom	Coscinodiscaceae	11		12
	Micrasterias denticulate	Green algae	Chlorophyceae		14	
	Eudorina sp.	Green algae	Chlorophyceae	9		21
	Ankistrodesmus falcatus	Green algae	Chlorophyceae	21		9
	Scenedesmus sp.	Green algae	Chlorophyceae		21	
	Ulothrix sp	Green algae	Chlorophyceae	13		14
	Tetraspora sp	Green algae	Chlorophyceae	14	10	
	Ulothrix sp.	Green algae	Euglenophyceae	7		21
	Oscillatoria limnetica	Blue-green algae	Oscillatoriaceae		21	
	Anabaena	Blue-green algae	Nostocaceae	12		13
	Peridinium cinctum	Dinoflagellate	Dinophyceae		12	11
	Navicula ovalis	Blue-green algae	Chlorophyceae	12	23	
	Pleurosigma elongatum	Diatom	Naviculaceae	11		12
	Scenedesmus sp.	Green algae	Chlorophyceae		13	14
	Tabellaria fenestrata	Blue-green algae		12	13	
	Amphora ovailis	Blue-green algae	Dinophyceae		23	14
	Tetraspora sp	Green algae	Chlorophyceae	12	9	12
	Total abundance			146	167	153
	Total number of species			12	11	11
	Shannon index			2.24	1.99	2.15
	Evenness			0.71	0.52	0.41
	Coscinodiscus	Diatom	Bacillariophyceae	23	21	

Ibine stream Bende LGA	*eccentricus*					
	Oscillatoria limnetica	Blue-green algae	Oscillatoriaceae		15	18
	Melosira sp	Diatom	Melosiraceae	21	21	
	Volvox sp.	Algae	Green algae	15	21	15
	Centritractus dubius	Dinoflagellate	Xanthophyceae	18	25	
	Phacus caudatus	Green algae	Euglenophyceae	12		25
	Cosmarium sp	Green algae	Chlorophyceae	14	21	11
	Nitzschia obtustata	Diatom	Bacillariophyceae	24		23
	Amphora sp	Green algae	Green algae	21		23
	Scenedesmus sp	Green algae	Chlorophyceae	25	11	9
	Tabellaria fenestrata	Green algae	Bacillariophyceae	11	21	
	Navicula ovalis	Diatom	Bacillariophyceae		11	20
	Nitzschia linearis	Diatom	Bacillariophyceae	12	13	21
	Total abundance			206	180	165
	Total number of species			11	10	9
	Shannon index			2.21	1.89	1.78
	Evenness			0.72	0.82	0.78

UIRSP= up stream, MIRSP= mid stream, DIRSP= down stream

4.17.5: Zooplanktons Results

A total of ninteen (19) were observed in Imo river and eleven(11) in Ibine stream in Bende in the samples (Table 4.31). Copepoda was the dominant taxa across the two rivers sampled. The presence of these zooplanktons in a high proportion is indicative of water body experiencing environmental stress and anthropogenic impacts. The identified zooplankton fauna were categorized into protozoa, rotifers, cladocera, copepods, insect larvae and fish larvae.

Table 4.32: Zooplankton Assemblage across All Sampling Stations

Location	Species	Phylum/	Group/Class	UIRSP	MIRSP	DIRSP
Imo river	*Euchlanis sp.*	Rotifer	Monogononta	10	2	9
	Brachionus falcutus	Rotifer	Monogononta		3	
	Moina micrura	Arthropoda	Cladocera	2		3
	Kurzia longirostris	Arthropoda	Cladocera		2	3
	Nauplius larvae	Arthropoda	Copepoda	5		2
	Bryocamptus birsteini	Arthropoda	Copepoda		3	
	Gastropod larvae	Mollusca	Gastropoda	2		2
	Diaphanosoma excisum	Rotifer	Monogononta	6	2	
	Labidocera acutifrons	Arthropoda	Copepoda		9	
	Oithona setigera	Arthropoda	Copepoda		2	
	Keratella quadrata	Rotifer	Monogononta	1		2
	Ilyocryptus verrucose	Arthropoda	Cladocera	2		1
	Brachionus calyciflorus	Rotifer	Monogononta		9	
	Lepadella patella	Rotifer	Monogononta	2		1
	Eurytemora sp	Arthropoda	Copepoda		2	
	Polychaete larvae	Annelida	Polychaeta	1		9
	Euchaeta norvegica	Arthropoda	Copepoda		8	1
	Eucyclops serrutalus	Arthropoda	Copepoda	1		
	Eucalanus elongatus	Arthropoda	Copepoda		2	

	Total abundance			33	44	33
	Total number of species			10	11	10
	Shannon index			2.02	1.72	1.56
	Evenness					
Ibine Stream Bende	**Species**	**Phylum/**	**Group/Class**	**UIRSP**	**MIRSP**	**DIRSP**
	Kurzia longirostris	Arthropoda	Cladocera	9		8
	Nauplius larvae	Arthropoda	Copepoda	9		9
	Bryocamptus birsteini	Arthropoda	Copepoda		2	
	Gastropod larvae	Mollusca	Gastropoda	1		8
	Diaphanosoma excisum	Rotifer	Monogononta	5		
	Labidocera acutifrons	Arthropoda	Copepoda		9	2
	Oithona setigera	Arthropoda	Copepoda	1		1
	Keratella quadrata	Rotifer	Monogononta		7	
	Euchaeta norvegica	Arthropoda	Cladocera	1		2
	Eucyclops serrutalus	Arthropoda	Monogononta	2	9	
	Eucalanus elongatus	Arthropoda	Monogononta	9	1	
	Total abundance			45	28	30
	Total number of species			8	5	6
	Shannon index			1.81	1.23	1.32
	Evenness			0.28	0.3	0.43

Table 4.33: Benthos Assemblages across All Sampling Stations

Location	Species	Group/Class	Family	UIRSP	MIRSP	DIRSP
Imo river	*Bulinus globosus*	Gastropoda	Planorbidae	1		
	Nais communis	Oligochaeta	Naididae		1	
	Macrobrachium sp	Decapoda	Palaemonidae			1
	Chironomus sp	Diptera	Chironomidae		2	
	Lymnaea natalensis	Gastropoda	Lymnaeidae			2
	Canthyporus sp	Coleoptera	Dystiscidae	2		1
	Dero digitata	Oligochaeta	Naididae		1	
	Cryptochironomus sp	Diptera	Chironomidae	1		
	Melanoides tuberculates	Gastropoda	Thiaridae			1
	Pseudocloeon glaucum	Ephemeroptera	Baetidae	1		3
	Biomphalaria pfeifera	Gastropoda	Planorbidae		1	
	Bulinus globosus	Gastropoda	Planorbidae	1		1
	Total number of individuals			6	5	9
	Total number of species			5	4	6
	Shannon index			1.82	1.64	1.85
	Evenness			0.32	0.34	0.41
Ibine stream Bende	**Species**	**Phylum/**	**Group/Class**	**UIRSP**	**MIRSP**	**DIRSP**

	Macrobrachium sp	Decapoda	Palaemonidae	2	1	
	Chironomus sp	Diptera	Chironomidae			3
	Lymnaea natalensis	Gastropoda	Lymnaeidae	3		1
	Canthyporus sp	Coleoptera	Dystiscidae		1	
	Dero digitata	Oligochaeta	Naididae			2
	Cryptochironomus sp	Diptera	Chironomidae	1		1
	Melanoides tuberculates	Gastropoda	Thiaridae	1		1
	Pseudocloeon glaucum	Ephemeroptera	Baetidae		1	
	Biomphalaria pfeifera	Ephemeroptera	Baetidae		1	
	Total number of individuals			7	4	8
	Total number of species			4	4	5
	Shannon index			1.72	1.53	1.56
	Evenness			0.42	0.34	0.45

The results of the benthic study is presented in Table.4.32. A total of twelve (12) species were observed Imo River and nine (9) species in the Ibine Stream at Bende. A pollutant tolerant species *Lymnaea natalensis* was censored in sediments samples obtained in downstream (Imo River) and upstream Ibine stream Bende. Its occurrence suggests water bodies polluted by sewage, agricultural run-off and wastes. All other samples were devoid of pollution indicator species.

4.17.6 Fish ad Fisheries

Fishing activity was low during the study in Imo River, and Ibine stream. Records in this study were solely dependent on collection of anglers (hobbyists) at the scene of sampling. Fish fauna was relatively few and may be due to the fact that the duration was not long enough for a more exhaustive survey. Additional information was obtained via market survey and professional observation in situ as well as interviews from fisherman and the local vendors. Pictorial evidence of these fishes from the study area is further presented in plate 4.8

Table: 4.33 shows that in Imo River 14 species of fish belonging to 10 families were recorded while in Ibine stream Bende 10 species of fish belonging to 4 families were recorded. The taxa and families recorded in this survey are fewer as compared with the number recorded for other studies conducted on a number of rivers in Nigeria. The fish species recorded in this survey in previous literature reports (Adaka et.al. 2015). IUCN 2019 version revealed that none of the species is threatened

Table 4.34: Checklist of Fish composition in the Study Areas

s/n	Family/Species	Common Name	Imo River	Ibine Stream	2018 IUCN ranking
1	*Chrysicthys nigrodigitatus*	Bagrid catfish	✓	✓	Least Concern
2	*Ctenopoma kingsleyae*	Leaf fish	✓		
3	*Oreochromis niloticus*	Nile tilapia	✓	✓	
4	*Hydrocynus forskahlii*	Elongate tiger fish	✓		
5	*Phago loricatus*	African pike Characin	✓		
6	*Electrophorus electricus*	Electric eel		✓	
7	*Tilapia galilaeus*	Cichlid	✓		
8	*Pellonula afzellusi*	Clupeid	✓		

9	*Clarias lazera*	African catfish	✓	✓	
10	*Lates niloticus*	Niger/Nile Perch		✓	
*11	*Gymnarchus niloticus*	Freshwater rat-tail	✓		
*12	*Heterotis niloticus*	Heterotis	✓	✓	
13	*Polypterus anectens*	Bichirs		✓	
14	*Calamoichthys calabricus*		✓	✓	
15	*Clarias gariepinus*	Asa	✓	✓	
16	*Labeo coubie*	African carp	✓	✓	

*Species 11-12 are additional species reported present but in literature for this geographic range.

(a)Phago loricatus

(b) Oreochromis niloticus

(c) Chrysicthys nigrodigitatus

Plate 4.10 (a-c). Some Fish Species of the study Area

4.18 SOCIO-ECONOMICS AND HEALTH ASSESSMENT

4.18.1 Objective and Scope of this Socio-Economic Impact Assessment (SIA)

This Socio-Economic Impact Assessment (SIA) aims at providing information to the policy makers, regulatory and corporate bodies, project proponents and the general public, the potential impact (beneficial and adverse) of the Abia State SAPZ project on socio-economic and health status of the beneficiary communities in the three Local government Areas. The potential impacts associated with the proposed project as it concerns the socio-economic and health was obtained from the consultations with the project stakeholders, and analyses of various socio-economic qualitative and quantitative data. The specific objective are as follows

- ✓ To describe the demographic features of the beneficiary communities in the three selected LGAs

- ✓ To determine the existing socio-cultural practices of these beneficiary communities in the three selected LGAs
- ✓ determine the economic position and poverty status of the people in the beneficiary communities in the selected 3 beneficiary LGAs
- ✓ analyze the health status of the people in the beneficiary communities within the selected LGAs

4.18.2 Political context in Nigeria.

Nigeria is a Federal Republic made up of 36 States and a Federal Capital Territory. Nigeria became an independent state in 1960 and a republic in 1963. It started off with three regions namely Eastern, Northern and Western regions 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. Imo State was created in 1976 out of the then East-Central State. Abia state was created in 1991 out of Imo State. Old Anambra State was created in 1976 from part of East-Central State, and its capital was Enugu. In 1991 a re-organisation divided Anambra into two states, Anambra and Enugu.

Country location and Administrative structure

Nigeria is a country in West Africa. It is situated between the Sahel to the north and the Gulf of Guinea to the south in the Atlantic Ocean. It covers an area of 923,769 square kilometres (356,669 sq mi), and with a population of over 230 million, it is the most populous country in Africa, and the world's sixth-most populous country. Nigeria lies between latitudes 4° and 14° north of the equator and longitudes 3° and 15° east of the Greenwich meridian on the west coast of Africa. It covers a total area of 923,766 square kilometers consisting of 910,768 square kilometres of land and 13,000 square kilometres of water with the coast line stretching up to 853 kilometres.

The entire country is divided into 36 states and Federal Capital Territory. These are further sub-divided into 770 local government areas which form the third tier of government while the central and state governments form the first and second tier respectively. The third tier consists of the Local Government Areas. The country practices a presidential system of government consisting three arms of government: the executive, the legislature and the judiciary (Nigerian 1999 Constitution). The executive consists of both elected and appointed members, while members of legislature, both at federal and state levels are elected. This pattern is similar to what obtains at the Local Government level, except that there is no third arm (the judiciary) at the LGA level.

Another major difference between the central government structure and that of the state is the presence of two legislative chambers at the center (i.e. the Senate and the House of Representatives), while the states have just one. The LGA administration is run by an elected Executive Chairman and appointees of the Chairman representing the executive arm of local government administration.

There is also the legislature made up of Counselors elected from the wards in the LGA. The Chairman is the chief security officer of the LGA and the office is important in the operations of the proposed project.

The communities have a well-defined hierarchical political structure with traditional leadership (Eze) and community Heads. The traditional authority structures are similar in all the communities.

Executive - Implementation of laws, maintenance of law and order, initiates bill into parliament. It is headed by a President

Legislature- Nigeria operates a bicameral (Senate and House of Representatives) legislature. They make laws, approves annual budget, ratification of treaty negotiated by the executive and conduct oversight functions on government

activities. The senate is headed by Senate President and the House of Representative is headed by a Speaker.

Judiciary - There is the Supreme Court, appeal court, federal courts, Industrial court, customary courts of appeal and magistrate court. They Interprets laws, protects the right of individuals. It is headed by a Chief Justice

In the States: We have the executive, the Legislature and the Judiciary, the executive arm is headed by the executive Governor and the Legislature is headed by the Speaker of the House of Assemble.

Judiciary -There is the State High court, customary courts, and Magistrate courts. The head of the state judiciary arm is the Chief Judge.

In the Local Government Administration: Legislature - The legislature is formed by at least ten wards in each LGA. They make bye laws for the LGA. It is headed by a Speaker.

Community and Household Consultation

Community consultation is an inclusive and culturally appropriate process which involves engaging the people, sharing information and knowledge, seeking to understand their concerns on the proposed project and building relationships based on collaboration. It allows the community to understand the risks, impacts and opportunities of the project in order to achieve positive outcomes. It involves information dissemination and interaction/dialogues with the host communities of the proposed project.

Conflict Resolution

Civil cases in the communities are arbitrated by the Chiefs-in-Council, Elders-in-Council, religious leaders, traditional priests, age grade, women groups or family heads. On the other hand, inter-communal conflicts are resolved by the representatives (Chiefs) of the communities involved. If it cannot be resolved at that level, the case is taken to the Paramount ruler for adjudication. Criminal cases are

referred to the government law enforcement agents. Also the communities have organized themselves into vigilante groups to compliment the security architecture provided by the State.

With respect to the project, predicted sources of conflicts include:

- Non-recognition of communities as critical stakeholders
- Border land disputes
- Agitation for employment/contracts
- Issue of non -payment of compensation when the land was acquired
- Perceived intimidation of the communities
- Perceived "divide and rule tactics"
- Ineffective communication channels.

This study did not find any specific current issue that could conceivably lead to full blown conflicts with the Abia SAPZ. However, agitation remains for issues such as economic displacement, loss of land and livelihood, impact of the project on community health and compensation. The SAPZ shall build on the existing cordial relationship between her and these communities through enhanced continuous engagement and payment of compensation. It is however canvassed that the SAPZ should carefully study the existing conflict resolution strategies in these communities for adoption since conflicts are better resolved at this level for sustained peace rather than adjudication in the court of law.

Abia State

Abia state was created in 1991 out of Imo State. Abia State is made up of seventeen (17) Local Government Areas. Abia State occupies about 6,320 square kilometres, it is bounded on the north and northeast by the states of Enugu, and Ebonyi. Imo State to the west, Cross River State and Akwa Ibom State to the east and south east respectively, and Rivers State to the south. The Igbo people, who are one of the

indigenous peoples of the South-eastern part of Nigeria, make up 95% of the population.

The population of Abia State is over 3,720,000 as of 2016. Geographically, the state is divided between the Niger Delta swamp forests in the far south and the drier Cross–Niger transition forests with some savanna in the rest of the State. Other important geographical features are the Imo and Aba Rivers which flow along the Abia's western and southern borders, respectively. Crude oil and gas production is a prominent activity, as it contributes over 39% of the State's GDP. Alaoji Power plant located near Aba Town in Abia State. The industrial Centre of the state is in Aba, with textile manufacturing, pharmaceuticals, soap, plastics, cement, footwear, and cosmetics.

4.18.3 Methodology of Study

(i) Survey Design, Survey Instrument and Sampling Procedures

The study is carried out in the three Local government Areas: Ukwa West, Ikwuano and Bende in Abia State.

The communities within the Abia SAPZ project were selected and a sample of the aggregate population of the host communities for the proposed SAPZs with other communities close to them was used for the study. To give every social group of a beneficiary community, a fair chance of being selected, probability proportional to size (PPS) allocation option was adopted. The men, women and youths population size as contained in the group list were used to draw the sample.

$$Pi = \frac{xi}{\sum_{i=1}^{n} xi}$$

Where;

Pi = Sample of each social group to be selected

n = Population of the sub group

Xi = Total sample

A proportion of 20% of the total registered people in each sub group was used to draw a total sample of people comprising of men, women and youth as shown in Table 4.34 below. A simple random sampling technique was used to draw 230 respondents from the population and administered with a well-structured questionnaire but only 202 valid questionnaires of the total returned set were found useful for the analysis. Information elicited include: the demographic, socio-cultural and economic activities of the people. A qualitative data collection from the host communities on the proposed SAPZs was also done using a Focus Group Discussion (FGD).

Table 4:35: Sample Selection across the 3 Local government areas

LGAs	Communities	Registered Population	Sample drawn	Sample used
Ukwa West	Umuololo	930	86	72
Ikwuano	Ariam eluelu	600	76	68
Bende	Okporoenyi	500	68	62
	Total	8600	230	202

ii. Data Analysis:

The focus group discussion was recorded, transcribed and the content analyzed in line with the research objectives. Descriptive statistical tools such as frequency counts, mean and charts were used to analyze the quantitative data obtained. Some variable are not mutually exclusive, thus multiple responses was introduced in getting responses is such cases. Poverty index was obtained using the poverty headcount index otherwise known as poverty depth as contained in Foster-Greer Thorbeck (FGT) model. The index is spread across some social groups and occupation of the respondents across the communities in Southeast.

The model adopted the mean per-capita monthly expenditures on food consumption, consumption expenditure on services offered to households, consumption expenditure on utilities which include fuel, energy, water, etc. and depreciation cost on household durable proxy by the monthly maintenance cost on household assets. The per-capita mean Monthly Consumption expenditure is expressed as:

$$\text{MMPCE} = \frac{Total\ Household\ Consumption\ Expenditure}{Total\ Hosehold\ Size}$$

Poverty threshold (Poverty line) according to Foster-Greer Thorbeck is expressed as 2/3 mean per-capita household expenditure. The poverty line or threshold (Z) is the minimum level of income or expenditure deemed necessary to achieve adequate standard of living in a given society. There is no standard poverty line but most studies adopted the two-third mean per capita household consumption expenditure (MPCE) as an absolute standard for poverty line (Ehirm et al., 2017). Data were analyzed from a simple software package: statistical Package for Social Sciences (SPSS) and excel.

4.18. 4 Socioeconomic Baseline

Host Communities

The Abia SAPZ project is hosted by three communities located in three local government areas. They are Umuololo (Ukwa West), Ariam Eluelu (Ikwuano) and Okporoenyi (Bende). All the communities affected by the proposed project is listed below in table 4.35 with their GPS coordinates.

Table 4.36: GPS coordinates of the SAPZ communities in Abia

Location	Longitude	Latitude	Elevation	Place
Ariam elu elu	7.62249	5.34192	53	Town hall
Okporoenyi	7.599223	5.507741	51	Community hall
Umuololo	7.18476	4.96336	22	Palace of paramount ruler

4.18.5 Demographic Characteristics

Livelihood Parameters

The life expectancy of the Southeast ranges from 52.7 years in Abia State to 56 years in Anambra state. Imo State has only 53.9 years life expectancy. Child mortality is very high in Imo state giving the report presented in Table 4.35 above. In every 1000 births, there is an infant mortality of 132 while Abia has 65 infants dying per 1000 birth. Anambra registered the least with only 35 deaths at infant per 1000 births.

Table 4.37: Livelihood Parameters of Abia State Nigeria

Livelihood	Abia State			
	Ukwa-west	Ikwuano	Bende	Ugwunegbo
Population (census 2006)	127,200	175,078	280,500	85,371
Population density [2022]	519.4/km²	621.8/ km²	474.8/km²	1,035/km²
Land area	244.9 km²	281.6 km²	590.8 km²	108km²
youth Literacy any language {%}	92	95.1	92	95
Female	43,218	85,980 (49.1%)	96,946	42,570

Male	44,149	89,098 (50.9%)	95,675	42,801
Child Mortality {1:1000}	65/1000			
Life expectance {Years}	52.7			

Source : NBS

4.18. 6 Socio-cultural Organization

The socio cultural distribution in the three LGAs are presented in the Table 4.37. From the results farmers association was the most predominant social organization across the all the communities. Also Umuololo community presented the highest proportion of Village men (86%) and women associations (84%) compared to other communities. A strong male and youth organization is an indication of proper protection of the infrastructural facilities in an area (Ajaero et al., 2018). The youth will see the project as their property and will do anything to protect it.

Plate. 4. 11 : Sociocultural activities in Ariam Elu elu community

Table 4.38: Social organizational profile of the selected communities

Socio-cultural	Umuololo	Ariam elu elu	Okporoenyi
Farmers cooperatives Asso	46(92)	44(97.8)	45(88.2)
Age Grades	30(60)	32(71.1)	34(66.7)
Village Men Assoc	43(86)	30(66.7)	32(62.7)
Village Women Assoc	42(84)	32(71)	33(64.7)
Church Groups	28(56)	22(48.8)	23(45.1)
Youth Oganisation	12(24)	13(28.8)	14(27.5)
Social Clubs e.g Isusu	4(8)	5(11.1)	3(5.8)
Observation	**50**	**45**	**51**

Abia SAPZ field work 2024

4.18. 7 Household Characteristics

Household characteristic will deal with the respondents demographic factors like age, sex, marital status, occupational and social organizational profile, household size and level of employment.

i. Age distribution

From the result, 31-53 age bracket was the majority beneficiaries of the SAPZ project followed by the age bracket of 16-30 years then 54-65 years.

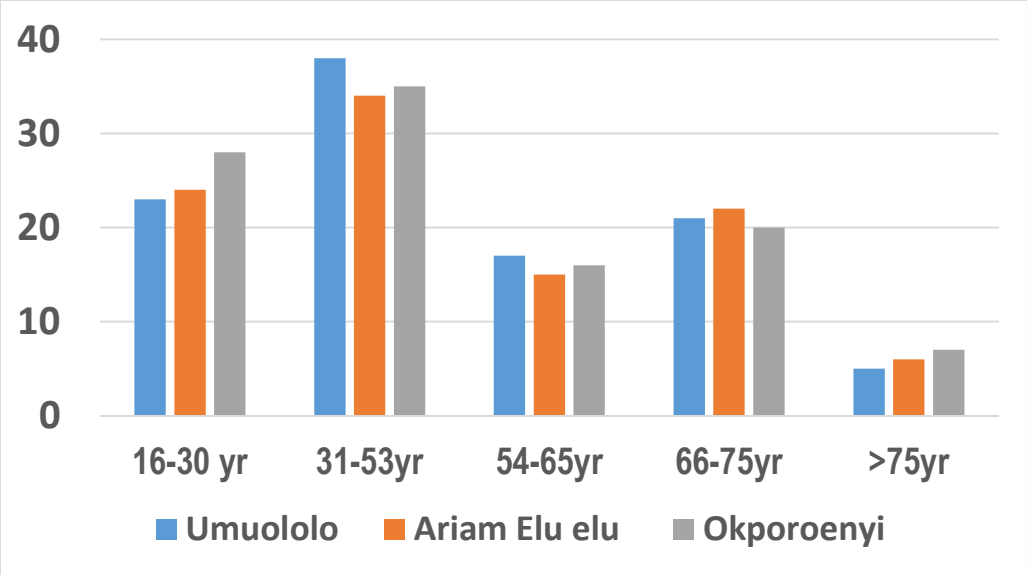

Fig. 4.15 Age Distribution of Community Beneficiaries of the proposed Abia SAPZ project (**Abia SAPZ field work 2024**

ii) Distribution of respondent based on Gender

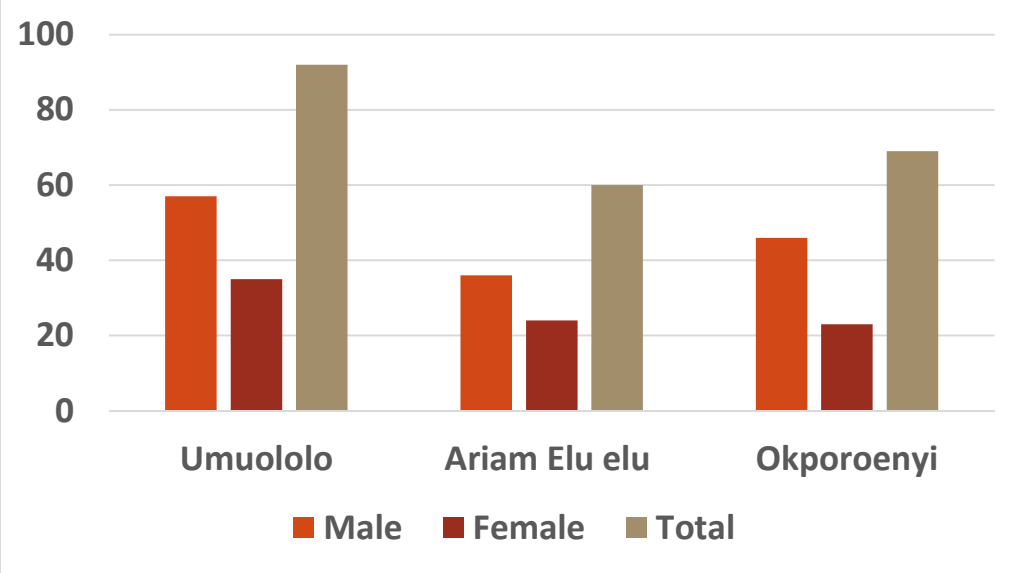

Fig. 4.16 Distribution of respondents based on gender.

The result shows male dominance across the three communities. However, Umuololo community had the highest number of respondents.

Iii Gender of Heads of Household

Information on the gender and number of household heads in the project area is presented in Table 4.38

Table 4.39: Gender of Head of Respondent Households of Project Communities

Gender	Umuololo	Ariam elu elu	Okporoenyi	Average %
Male	50	44	48	**85.4**
Female	6	5	12	**13.9**
Total	56	49	60	

The 85.4% male house heads is less than the Nigerian average of 85.7%, though all areas in the Abia SAPZ have more male house heads. Reasons being because of the culture and traditions of the people in the project area which does not promote female leadership.

Iv Marital Status of Head of Households in the communities

There are more married household heads in all the communities within Abia state SAPZ project. The result for all marital status is slightly above those obtained from NBS, 2011. Table. 4.39

Table 4.40: Marital Status of Head of Households in the communities

Marital status	Umuololo	Ariam elu elu	Okporoenyi	Total	%	NBS (2011) data for Abia (%)
Single	8	8	7	23	13.8	38.1
Married	44	34	42	120	71.9	50.5
Widowed	7	6	7	20	12	10.6
Divorced/Separated	1	1	2	4	2.3	0.8
Total	60	49	58	167	100	

Vi Household Size

Information on household size of the communities in are presented in Table 4.30

Table 4.41. Information on household size of the communities

Numbers per household	Umuololo	Ariam Elu elu	Okporoenyi	% average
1-2	6	7	10	12.6
3-5	45	46	37	70.3
6-10	12	10	9	17.0
11-15	-	-	-	0
>15	-	-	-	0

The dominant household sizes in the project area are those made up of 3-5 persons and 6-10 persons accounting for about 82.9% of the households. The findings are in tandem with 2010 NBS statistics which put the average family size in Abia State at 3.9 persons. At the national level, the number of persons in the size class 3-8 was about 136 million.

Vii Ethnic Composition

Seven ethnic groups were observed to be present within the project areas. These ethnic groups and their respondent populations in each affected community are presented in Table 4.41. The data revealed dominance of the landowners (Ibo) where the proposed project is to be sited. The results also revealed high relationship between project area and the contiguous ethnic groupings. This was evident in the presence of Anioma, Ikwere, Ijaw and Ibibio & Efik.

Table 4.42: Ethnic Groups in the three communities of the Project Area

Ethnicity	Umuololo	Ariam elu elu	Okporoenyi	Total	% Average
Ibo	55	56	53	164	74.9
Anioma	1	1	0	2	0.9
Edo/Eshan	0	0	0	0	0
Hausa/ Fulani	4	4	5	13	5.93
Ijaw	8	0	0	0	0
Ibibio & Efik	3	10	7	20	9.13
Isoko, Itsekirii & Urhobo	0	0	0	0	0
Tiv & Idoma	0	0	0	0	0

Ikwerre	8	0	2	10	4.56
Yoruba	2	1	7	10	4.56

Viii Religion

The study revealed that the people are adherents of three religions. These are Christianity, Animist/ African Traditional Religion (ATR) and Islam. Christianity was the most practiced religion with about 91% of the respondents across all communities within the three project states. This was followed by ATR with an average of 7.7%.

Plate 4.12. Catholic church in the study

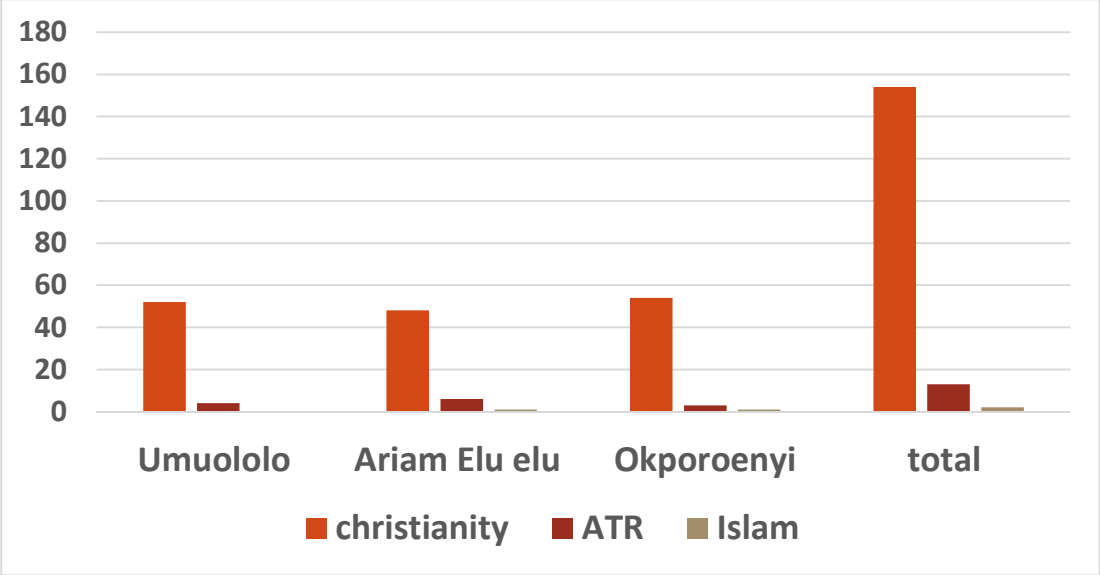

Fig. 4.17 Religion of the study area Abia SAPZ ESIA 2024

Majority of the Christians in the project area are Catholics. The Islamic and Christianity adherents in the area observe the worldwide traditional Muslim and Christian festivals respectively. Traditional festivals offer opportunities for the people to seek divine favour, prosperity, bumper harvest, peace, security, long lives and good health for the communities.

4.18.8 Economics and Livelihoods of Households

(i) Occupational Profile of People in the Selected Communities

The result of occupation profile of the respondents is shown in Table 4.42 below. The data on occupational distribution of the people in these communities is done using multiple response, since each person can engage in multiple occupations.

Plate 4.13 Market place in the study area

Table 4.43: Occupational Distribution of the Respondents.

Occupation	Percentage Distribution of People in the Communities		
	Umuololo	Ariam Elu elu	Okporoenyi
Farming	39.6	40.1	42.1
Trading	62.5	52.7	58.3
Artisan/Technician	50	47	39.4
Hospitality/Textile/Arts	23	23.4	21.3
Civil Service/Teaching	8.3	13.7	15.2
Professionals	2.1	1.8	2.7
Traditional Physician	01	0	0
Retired/Schooling	01	0	0

Abia SAPZ ESIA 2024

The result shows that trading is the prevailing occupation of the people in the selected areas with Umuololo (62.5%) community in Ukwa West recording the

highest trading activities followed by Okporoenyi(58.3%) Bende LGA and Ariam elu elu (52.7%). Farming is the second predominant occupation in the communities studied.

ii. Formal Education Level of the Respondent

Table 4.43 below presents the levels of formal education attainment of the respondents in the selected community beneficiaries of the proposed electricity SAPZ in Southeast, Nigeria**.**

Table 4.44: Educational Distribution of the Respondents

Education	Percentage Distribution of People in the Communities		
	Umuololo	Ariam Elu elu	Okporoenyi
No Formal Education	2.4	2	1.0
Adult Education	2.4	3.4	4
Primary Education	25.0	28	25
Secondary Education	55.0	45.5	48
Tertiary education	15.2	21.1	22
Total observation	58	46	52

Abia SAPZ ESIA 2024

The result shows that the respondents with no formal education attainment in Umuololo, Ariam elu elu and Okporoenyi are only about 2.4%, 2% and 1% respectively. The same communities have presence of adult education of 2.4%, 3.4%

and 4% respectively. High level of formal education attainment is presented in Umuololo 55%, Ariam Elu elu (45.5%) and Okporoenyi (48%) communities. High level of formal education attainment increases the level of knowledge of the importance of development project in a place and will increase the level of acceptability of the project in the selected communities.

(iv) Income of the Selected Communities in Abia.

Crop farming, trading, artisanship, livestock rearing, processing of farm produce and self-employment are the income generating activities of the people in the project area.

Table 4.45: Income of the Selected Communities in Abia.

Income per month	% frequency			
	Umuololo	Ariam elu elu	Okporoenyi	% average
1-50,000.00	22.2	22.2	23.4	22.6
51,000-100,000	34.2	32.2	35.2	33.9
101,000-150,000	32	33	32	32.3
151,000-650,000	5.6	5.6	4.4	5.2
651,000-1m	5	5	4	4.7
>1m	1	2	1	1.3

Abia SAPZ ESIA 2024

From the result, the household income generated from both farm and non-farm income is so small and unevenly distributed among the respondents in the selected areas. The income level of the people is mostly between fifty one thousand to one hundred thousand and accounts for 33.9% of the community.

V Households' Main Source of Energy

From the survey, sources of energy used by household in the project area revealed that electricity from the national grid is the main source of energy. Other frequently used energy source for lighting are Kerosene and generator. Conversely, torchlight,

wick lamps, solar and candles were the least sources of energy used by the households. On the other hand, kerosene and fuelwood were the energy sources used for cooking.

Vi Link between Income and Poverty among the respondents in the areas under Survey

Income disparity of the respondents may be conceptualized as dispersion of welfare status of the population and may explain a dimension of poverty. Where majority of the populace fall at a common base in wealth status while a few individual are at the top rank of wealth in a region, it can create a wide disparity in consumption expenditure of different household, thus living some in perpetual poverty while a few remain in affluence (Adeola and Dopper, 2011). This means that the increase in cost of living is stimulated by the disparity in standard of living of these two extreme income groups. It is therefore possible to attribute the wide spread poverty situation in the selected communities in Ukwa west , Bende and Ikwuano to income induced poverty.

Vii Monthly Consumption Expenditure Profile

The monthly consumption expenditure obtained across the selected communities in Umuololo, Ariam elu elu is presented in Table 4.45 below. The result shows that the grand monthly mean consumption expenditure in Ariam ₦14,981.00) and Okporoenyi (₦14,580.75) dominated the value obtained from the other communities in the study.

There is a poor standard of living orchestrated by a very high cost of living in the area. Surprisingly, umuololo an adjacent community to Aba town has the least amount of ₦9,387.1 in the area. Thus the standard of living in that area is poor due to high cost of living. Expenditure on utility (electricity, water etc.), which is relatively higher in Okporoenyi than any other place in the study area.

Table 4.46: Mean Per capita (MPCE) Consumption Expenditure of the People

Consumption Expenditure	Mean Monthly Consumption Expenditure (₦)		
	Umuololo	Ariam Elu elu	Okporoenyi
Food	₦15,234	₦18,453.00	₦16,543.00
Services	₦23,345	₦24,543.00	₦25,023.00
Utilities	₦5,564	₦4,589.00	₦6,325.00
Household Durables	₦10,234	₦12,342.00	₦10,432.00
Grand Mean Exp	₦12,203.25	₦14,981.00	₦14,580.75
Poverty line (Naira)	₦9,387.1	₦11,524.4	₦11,215.9

Abia SAPZ ESIA 2024

The result also shows that poverty line varies significantly across the communities. It's expected that an evenly distributed moderate household size will present an evenly distributed poverty status.

However, the poverty lines presented in this study ranges from ₦9,387.in Umuololo to ₦11,524.4 in Ariam elu elu . Despite the close proximity of the two towns, the varying poverty line is not surprising because the communities have different living standards, different cost of living and household sizes.

4.18.9 Social Amenities and Infrastructure

Socio-cultural and economic activities as well as social infrastructures in the communities such as: structural organization of the area, types of religion, private and government owned institutions, level of income and expenditure, employment and dependency ratio, poverty profile etc. were discussed in this section of the study**.**

(i) Government and Private Institutions Present in the Selected Communities

The presence of public and private institutions in the selected communities is presented in Table 4.46 below. The presence of some primary, post primary and

higher institutions in a place is a drive to socio-economic development of the people.

Table 4.47: Number Public and Private Institutions across the Selected Communities in Southeast, Nigeria

Category	Umuololo	Ariam Elu elu	Okporoenyi
No. of Primary schools	4	2	3
No. of Secondary Schools	3	2	2
No. of High Institutions	0	1	0
No. of Hospitals	2	2	2
No. of Restaurants/Hotels	3	1	0
No. of Churches	5	7	5
No. of Mosques	0	0	0
Markets	1	2	1

Abia SAPZ ESIA 2024

The selected communities have the presence of both private and government owned primary and secondary schools. However, there are several reports of poor maintenance of these schools making the people to choose private schools as alternative. The deplorable condition of both primary and secondary schools in the three communities is a source of concern. There are no tertiary institutions in the selected communities except for Micheal Okpara University of Agriculture located close to Ariam elu elu community. The selected communities have well markets situated for daily activities or operate on the traditional market days.

4.19 Health Study

(i) Sources of Drinking Water

The source of drinking water is a very important aspect of development of an area because it promotes the socio-economic development and peoples' wellbeing (Uzoh and Osuagwu, 2017). Availability, types and pattern of potable drinking water in the selected communities can express their level of development.

Hence, this survey presents the percentage availability and use of different sources of water for drinking by the selected communities in Southeast, Nigeria in Table 4.47 below:

Table 4.48: Sources and availability of drinking water in the communities

Sources of Drinking Water	Umuololo	Ariam elu elu	Okporoenyi
Central town water supply "Yes"	0(0.0)	0(0.0)	23(45.2)
Tube well/Boreholes "Yes"	54.2(80.2)	48(85.2)	43(60.2)
Open well "Yes"	0(0.0)	0(0.0)	0(0.0)
Mono pumps "Yes"	12(45.2)	3(2.3)	24(23.2)
Rain water "Yes"	0(0.0)	0(0.0)	10(24.2)
Streams/River "Yes"	1(2.1)	2(3.4)	25(54.2)
Tankers/Mobile supply "Yes"	3(4)	2(5)	14(23.2)

Abia SAPZ ESIA 2024

As an essential ingredient of well being and a healthy life, water should be taken in its purest, odorless, colourless and tasteless form but due to human and animal activities in the area, it's sources have different levels of solid, human and chemical contaminants. Town water supply, which supplies quality water to the people is conspicuously lacking in the area except in Okporoenyi (45%).. Access to safe drinking water in communities is tied to tube well with majority (80.2%,85.2% and 60.2% accessing tube well (borehole water) for drinking and domestic activities in Umuololo, Ariam elu elu and Okporoenyi, respectively.

Tube-well (borehole) as the commonest source of water supply may not need any treatment to meet drinking water standard but needs steady power supply to power it from the source. USEPA (2021) noted tube wells usually sourced underground have natural filtering agents to removes germs and chemical contaminants depending on the water's depth and the local geology.

(ii) Health services profile in the selected communities in Southeast

Health service is an important condition for socio-economic development and unfortunately, many communities lack adequate health services. The use and conditions of health service system of the beneficiary communities are presented in Table 4.48 below:

Table 4.49: Health Service Profile of the Respondents

Health Profile	Hospital Services/Status	Umuololo No (%)	Ariam elu elu no (%)	Okporoenyi No (%)
Frequency of Use of any of the following Health Facilities (One year memory recall)	Cottage Hospital	14(64.2)	23(45.5)	28.5(34)
	Patent Med/Chemist	9(15.5))	12(23.8)	21(27)
	Pharmacy	2(4.7)	3(9.2)	2(1.9)
	Alternative./Herbal	1(0.8)	3(6.9)	2(2.3)
	Food Supplements	0(0.0)	0(0.0)	0(0.0)
	Spiritual healing/homes	0(0.0)	0(0.0)	1(0.92)
Condition of Services provided by the health	No. Doctors	Nil	nil	1(0.73)
	No. Nurses/Midwives	3(1.2)	3(2.4)	3(2.7)
	Availability of	12(25.6)	10(20.6)	19(23.6)

facilities	Drugs			
	Hospital Beds ("Yes")	2(4.5)	3(2.4)	3(2.6)
	Functional labs. ("Yes")	1(0.9)	2(2.4)	1(2.3)
	Functional Toilets ("Yes"	3(8.9)	1(0.9)	2(2.5)
	Counseling session("Yes")	0(0.0)	1(1.2)	1(2.4)
Distance to the nearest health facility	50 – 500m (1 – 10 poles)	12(56.2)	2(2.2)	1(1.9)
	401–1000m(11–20 poles)	10(30.3))	1.(0.9)	2(8.9)
	> 1000m	3(1.4)	2(2.3)	3(2.4)
Affordability	Very affordable	32.9(76)	43(87.3)	39(76)
	Moderately affordable	27(45)	24.7(43.2)	36(64)
	Not affordable	6(12.2)	12.4(21)	15.8(23.7)
Mean per-capita Health expenditure		₦8,570.00	₦7,870.00	₦8,870.00

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iii. Accessibility and affordability of health facilities and services in communities

Due to the limited number of government owned cottage hospitals in the selected area, most of the respondent find health services inaccessible. Poor access to health facilities and services is lack of effective and appropriate utilization of cottage health facilities and services provided by government and health care

intervention agencies. Although this result shows that most of the respondents in the selected communities moderately access the health facilities closest to them.

Iv. Condition and frequency of use government health-care services

Condition of service provided by these health facilities in the areas under survey suggests that huge global and national investment aimed at effective health care delivery have not yielded the desired result given the poor utilization and lack of access to these health care centres in Southeast. National Health Service system designed that patients should have initial contact with primary health-care system through the primary health care centres located close to them. Patients are there after referred to higher level of health care. Unfortunately, services at the centres are very poor and unaffordable. It can be seen from the result that the primary health care centres in the selected communities have limited doctors and nurses, functional laboratory are conspicuously lacking.

(v) Toilet system and sanitation status of the selected communities

The study investigated the toilet system used by the people in the selected communities in the last one year so as to establish the level of sanitary condition of the selected communities. The toilet systems and its content in the selected communities as shown in Table 4.49 below is a suitable baseline parameter that can be useful especially when the level of development due to the electrical SAPZ will be carried out.

Table 4.50 : Distribution based on toilet system used by the people in the last one year

Toilet System	Umuololo	Ariam elu elu	Okporoenyi
Using the surrounding bushes	25(54.3)	31(59.5)	33(45.7)
Bucket/ Pit Latrine	46(78.6)	45(60.4)	48(58.6)
Water closet	23(49.2)	31(55.3)	32(38.7)
River/stream	0	0	0
Estimated duration of use in years			
Use of Bushes	20	25	26
Bucket/Pit latrine	12	26	23
Water Closet	5	7	2
River stream	0	0	0

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Toilet condition of most rural communities in Southeast may not properly understood in terms of its forms and content, yet it is a common indicator of the sanitary condition of the place and a surrogate for policy outcomes in rural welfare and development.

Toilet system in most of the selected rural communities of Southeast may not be mutually exclusive implying that any type accessible at one time does not stop the use of the other at a different time and there is no particular choice of toilet system for an individual (Pat-Mbano and Okeoma, 2012). The use of pit-latrine or bucket system does not prevent the use of surrounding bushes for the same defecation purpose.

Forms and contents of toilet facilities in the communities.

The distribution of toilet system shows that rural communities are predominantly poorly developed with surrounding bushes everywhere. The bushes are ideal ground for disposal of human and animal waste. This can be indiscriminately done. The use of surrounding bushes for human waste disposal is a common practice in almost all the communities. Ariam elu elu had the highest percentage (59.5%) followed by Umuololo (54.3%) then Okporoenyi (45.7%).

(vi) Health problems/ailment, cost implications and consequences in the communities

The health issues of individual household in the selected communities in the last one year were analyzed and presented in Table 4.50

The common health issues are malaria in Umuololo(50%), Ariam elu elu (66.3%), Okporoenyi (68%)

Table 4.51: Health Issues of Individual Household

Health/Ailment Presented in the last one year	**Umuololo No (%)**	**Ariam elu elu No (%)**	**Okporoenyi No (%)**
Malaria	34 (50.0)	47(66.3)	56(68)
Typhoid	26(15.4)	27(18.2)	22(18.3)
Diabetes/Stroke/HBP	33(56.3)	32(32.7)	35(47.4)
Cough	43(46.3)	46(58.2)	48(60.2)
Leprosy	2(5.4)	2(6.2)	1(0.9)
Ulcer/Stomach issues	12(13.5)	23(36.7)	14(23)
Fracture and Bones Issues	2(1.9)	10(0.3)	0(0.0)
COVID – 19	0(0.0)	0(0.0)	0(0.0)
HIV/AIDS	0(0.0)	0(0.0)	0(0.0)

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The prevalence of health these health problems in these communities could be an indication of poor healthy lifestyle which allows the breeding of malaria parasite and other disease causing vectors in the areas (OjUkwa and Njom, 2012). The prevalence of malaria in these communities Umuololo, Ariam and Okporoenyi is because of mosquito bites, which transmit plasmodium falciparum to its victim.

In a similar manner, typhoid is a common disease caused by the ingestion of contaminated foods and drinks. Although the people in the host communities did not show a high prevalence of the disease, the low rate of spread is very worrisome as the spread of the disease implies a poor sanitary condition of the place.

It can be seen that the same community ranked higher than other communities in the incident of diabetes and stroke, which is attributed to bad lifestyles of the people. The Abia SAPZ will introduce a better living condition that will not only ensure a better sanitary condition but also reduce stress induced livelihood activities to ensure that prevalence of these diseases are reduced in the community.

4.19.1 Housing and Living Conditions

In all the communities surveyed there were a mix of housing types ranging from modern houses built with bricks to mud houses which were predominant in most of the communities. While the modern houses appear conducive the same cannot be said of the mud houses most of which were poorly ventilated, with poor flooring and roofing materials. Most of the houses lack toilet facilities therefore human wastes were often disposed into the surrounding bush.

Data from this study revealed that 47.3% of the houses that respondents live are houses built with cement block and zinc roof, 36% were houses built with cement block and asbestos roof.

One common feature in most of the rural communities is that an average of 3 persons sleep in a room. Overcrowding is depicted in many of the houses and this will facilitate the spread of communicable diseases.

4.19.2 Household Facilities

Several facilities were surveyed to be present in the households of the community members in the project area. These include power generators, televisions, cars/trucks, refrigerators, etc. (Table 4.51). Lighting and cooking equipment were the most frequently found in the households of the project area. Most of these facilities are meant to improve the livelihood of the households while others are income generating. They serve as indices to infer the quality of life of the PAPs.

Table 4.52: Household Facilities among Respondents in the communities

Facilities	Umuololo	Ariam Elu elu	Okporoenyi
Power generator	14	13	10
Gas stove/Kerosene	15	21	26
Refrigerator	10	12	12
Television	15	21	23
Radio/cassette/music system	46	39	43
Car/Truck	4	3	4
Motorcycle	4	9	6
Bicycle	4	4	3
House in town	0	0	0
Land in town	1	2	1
TOTAL	109	124	128

Abia SAPZ ESIA 2024

A total of 128 facilities were reported to be owned by PAPs in communities within communities of the project area.

4.20 Land Use

Land planning and uses

Land ownership in the project site is either by community or family. However, by virtue of the Public Lands Acquisition Law, the state government may acquire land compulsorily for public purpose from individual landowners, subject to the payment of compensation to such landowners. The way leave is served by the existing road infrastructure and other rural roadways from which access along the way leave is provided.

The residential areas are mostly rural settlements. The population in the Project Affected communities is predominately made up of low and middle with few high-income earners. Access to financial institution especially in the rural communities is very poor as there are none within these areas. The residential areas and the surrounding sub-places consist mostly of single unit residential homes. On the other hand, the rural settlements (all other communities except the listed semiurban/urban) are sparsely populated with low cost, single unit dwellings on small stands.

4.20.1 Waste Disposal by Households

Refuse

Figure 4.18 shows refuse disposal methods by households. Open dumping and burning are the two waste methods practiced by the people in the project.

Open dumping (exclusive) is the most practiced waste disposal method across the project area, followed by burning while open dumping and burning (in combination) is the least practiced method.

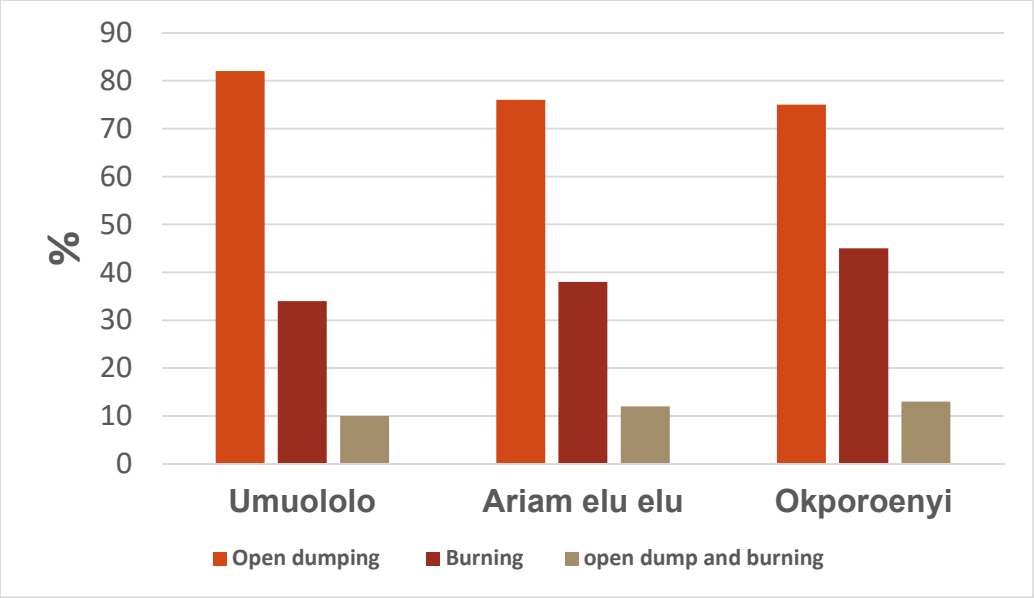

Figure 4.18: Refuse Disposal. Abia SAPZ ESIA 2024

4.20.2 Vulnerable Groups

The category and number of vulnerable groups in the project communities were identified and analyzed as shown in Table 4.52.This was compiled with assistance with the village heads. A total of 102 vulnerable persons are present in the three project communities. A breakdown of the result showed that children (96 individuals), women (84 individuals) and land tenants (85 individuals) were the prominent vulnerable groups in the project area.

Table 4.53: Proportion of vulnerable groups in the communities

Vulnerable groups	Umuololo	Ariam elu elu	Okporoenyi	Total
Children	25	30	41	96
Land tenants	34	21	30	85
Women	33	28	23	84
Non indigenes	12	11	13	36
Elderly	23	21	22	66
Infirm/physically challenged	9	8	8	25
Herdsmen	0	0	0	0
Total				**392**

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4.21 STAKEHOLDER CONSULTATION

Stakeholder identification and consultation at an early stage of an EIA is considered critical in the assessment of interest, concerns, relationships, assumptions, their level of influence and the ways in which they affect project risks. A number of regulatory bodies including Nigeria Federal Ministry of Environment (FMEnv), the World Bank (Operational Directive (OD) 4.01), African Development Bank , International Finance Corporation (IFC), etc. also require that affected groups be consulted as part of the environmental assessment of projects and particularly those with potentially significant impacts.

4.21.1 Stakeholder Information and Consultation Rounds

Three stakeholder information and consultation rounds were planned, and two has been implemented as shown in table 4.53 . These included the scoping stage (1st round), the fieldwork which include affected community survey and consultation (2nd round). The third round of consultations is scheduled for the disclosure of ESIA Draft

Report which will be anchored by Federal Ministry of Environment (3rd round).

Table 4:54 Stakeholder Consultation Rounds

Round	Objectives	Target groups	Implementation period
Stage 1: Environmental and Social Scoping	Present the project and the ESIA process to key authorities; Identify key issues, concerns and expectations related to the project and study area; Complete the stakeholders' list and validate the general approach for consultations.	FMEnv. State and LGA Administration Customary Chief's of areas affected by the Abia SAPZ	March 2024
Stage 2: ESIA Fieldwork	Involve key stakeholders in the analysis of the « hot spots » identified with the 3 communities for SAPZ project. Inform affected communities Identify the concerns and expectations of affected communities	FMEnv. State-level and LGA-level authorities and Technical services. Affected people and their leaders. Women representatives. Customary chiefs	March 2024
Stage 3: Disclosure of ESIA Report	Ensure compliance of the proposed measures with the requirements of regulatory authorities; Evaluate the social acceptability of the project and its proposed measures	FMEnv. State-level and LGA-level authorities and technical services. Affected people and their leaders. Women representatives. Customary chiefs. NGOs	To be determined by Federal Ministry of Environment

Stakeholder Identification

Two main categories of Stakeholders have been identified as shown below and in Table 4.54:

- ✓ Primary stakeholders - are those that will be directly or indirectly affected by the project; and
- ✓ Secondary stakeholders - are those having an interest in the project or the ability to influence its outcome, either positively or negatively.

Table 4.55: List of identified stakeholders and influence on the project

Stakeholder Groups	Relevant Stakeholders	Stakeholders	Profile/Status	Nature of influence
Host Communities	Communities living Within the SAPZ project area of influence or close to the project site. • Vulnerable groups within these communities; and	Primary	Communities Within the SAPZ area of influence or close to the site	Protest and/or Causing delays
Host Communities	Eze, Community Development Associations; Religious leaders; Village elders, Youth	Primary	Other communities within the Project area of influence.	
Institutional Stakeholders	Project investors e.g farmers, manufacturers	Primary	Financial outlay for the project	Project Execution
Regulatory Authorities	FMEnv.	Secondary	- Registration of the Project; - Scope of data collection and ToR approval; -Issues concerning site visits;	Permit and Execution of the project

			-ESIA process and scope of the ESIA - Approval for oneseason Fieldwork	
	National Environmental Standards and Regulations, Enforcement Agency (NESREA).	Secondary	Compliance monitoring of approved ESMP.	Project execution: Operation Phase
	• Abia State Ministry of Env & affected LGA-level authorities and	Secondary	Compliance monitoring of approved ESMP. Engagement with Communities. Potential positive Impacts (employment opportunities for local people and provision of electricity); and Community Development.	Project execution
Other Groups	NGOs and Civil Society; Media; Others	Secondary		

4.21.2 Scoping Workshop

The scoping workshop was held on the 5th March at Umuololo- Ukwa West , 6th March at Ariam Elu elu Ikwuano and 7th March 2024 at Okporoenyi Bende. The pictures are shown in Plate . Attendance sheet of Scoping Workshop is shown in Appendix

4.21. 3 Fieldwork Consultation

A qualitative data collection from the host communities on the proposed SAPZs was also done using a Focus Group Discussion (FGD). Information elicited through this research guide include; socio-cultural acceptance of the proposed SAPZ, economic activities, social structure and organization of the people and attitude of the people towards the facility if completed. The study was done in two (2) phases.

The first phase was a recognizance survey to identify the various social groups that were recruited as participant. The participants were drawn from the different social groups (of between 8 to 12 members from the community) with the host village president general of each community as the moderator. The questionnaire was also randomly distributed to the beneficiary communities during this period.

The second phase was the focus group discussion on the socio-economic impact of the proposed SAPZ. A total 3 focus group discussion were done with only 24 participants to better understand the impact of the proposed electricity project on their economic, social structure and organization, social-cultural acceptance of the project in the area. The completed questionnaires were returned at the same time.

Plate 4.14a: A Scoping meeting with the Ariam Elu elu community

(b)Scoping with Ariam elu elu community

(c) . Scoping with the women wing of Umuololo community

(d). Scoping meeting with the elders of Umuololo community.

(e)

(F)

Plate (4.14 (a-g) A Scoping meeting with community members

4.21.4 Outcome of the consultation with Stakeholders

Table 4.56: Outcome of the consultation - Scoping Stage (**Umuololo-Ukwa West**)

Topic	Concerns, Comments and Recommendations	Stakeholders who made comment / recommendation	Actions to Address Concerns
Proposed SAPZ project	What is the difference between AIIP and SAPZ and mandate crops in for the project	Village Head secretary	SAPZ will operate under AIIP, mandate crops : oil palm, cassava, rice soybean and maize
	How will the agro waste be managed?	Council member	Adequate measure is on ground to convert all agro waste to useful product.
	Will SAPZ plant new crops are use existing crops in the community		SAPZ will increase the production of the mandate crops by expansion of farms lands

Table 4.57: Outcome of the consultation - Scoping Stage (**Okporoenyi –Bende LGA**)

Topic	Concerns, Comments and Recommendations	Stakeholders who made comment / recommendation	Actions to Address Concerns
Proposed SAPZ project	We are ready to support SAPZ project in our community	Council member	Highly commended

	what are the benefits of SAPZ project to the community members	President general	Youth employment, community development, capacity building and business opportunities.
	What are planned mitigation measures of the impact of the SAPZ	Council member	Adequate measure will be taken to mitigate all identified negative impacts of the SAPZ project.
	What model will drive SAPZ project, fully owned by government?	Council member	SAPZ will be public driven, Private, public participation for maximum benefit

Table 4.58: Outcome of the consultation - Scoping Stage (Ariam Elu Elu-Ikwuano LGA)

Topic	Concerns, Comments and Recommendations	Stakeholders who made comment / recommendation	Actions to Address Concerns
Proposed SAPZ project	How many Hectares of land will be involved in SAPZ project in the community	Council member	SAPZ will need as much land the community can provide.
	what are the benefits of SAPZ project to the community members	Village Head	Youth employment, community development, capacity building and business opportunities.
	What model will drive SAPZ project, fully owned by government?	Council member	SAPZ will be public driven, Private, public participation for maximum benefit

CHAPTER FIVE
ASSOCIATED AND POTENTIALS IMPACTS

5.1 INTRODUCTION

This chapter describes associated and potential environmental and socioeconomic impacts from Abia SAPZ Project during the project execution from construction, and operation/maintenance phase only. The primary objective of the impact assessment is to establish the type of impacts that may occur as a result of project activities, differentiate between insignificant (those impacts that can be sustained by natural system) and those that are significant (impacts that cannot be sustained by natural systems).

A description of the assessment methodology used to assess the significance of impacts, taking into account impact magnitude and sensitivity of receptors and resources affected, is provided in the chapter. Mitigation measures to avoid, reduce, remediate or compensate for potential negative impacts and actions to be taken to enhance the benefits are provided in chapter six. The residual impacts were also assessed and reported in chapter 6. An impact assessment summary table is provided at the end of this chapter.

5.2 IMPACTS ASSESSMENT METHODOLOGY AND MITIGATION MEASURES

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 proposals 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
- ✓ Assessment of residual significant impacts after the application of 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.

5.3 Definition of Impact Terminologies

Nature/Type of impacts

There are a number of ways that impacts may be described and quantified. Table 5.1 provides definitions of terms used in this section

Table 5.1 Definition of Impacts

Term	Explanation
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. **Negative** – an impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor **Positive** – an impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
TYPE OF IMPACT**:**	**Direct (or primary)** – impacts that result from the direct interaction between a planned project activity and the receiving environment (e.g., between digging tower foundation and injury to the worker).

	Secondary – impacts that result from the primary interaction between the Project and its environment because of subsequent interactions within the environment. **Indirect** – impacts that result from other activities that are encouraged to happen because of the Project
TEMPORAL SCALE OF IMPACT:	Temporary - impacts are predicted to be of short duration, reversible and intermittent/occasional in nature. The receptor will return to a previous state when the impact ceases or after a period of recovery. 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). Long-term - Impacts that will continue for the life of the project but cease when the project stops operating (i.e. 50years or when there is improvement in technology which requires replacement). These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period.
SPATIAL SCALE OF IMPACT:	On-site – impacts that are limited to the Project site.

	Local - impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community. For this ESIA, local impacts are restricted to the Project site and adjacent areas. Regional - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries.
National	- impacts that affect nationally important environmental resources; affect an area that is nationally important/protected; or have macro-economic consequences (i.e. Nigeria). International - impacts that affect internationally important resources such as areas protected by International Conventions. Trans-boundary - impacts that are experienced in one country as a result of activities in Another.

5.4 Magnitude of Impact

The term 'magnitude' covers all the dimensions of the predicted impact to 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.

For biophysical impacts, the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment were provided in Table 5.2

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 (1) 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).

Sensitivity of resources and receptors

Sensitivities are defined as aspects of the natural or social environment which 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 wider community, or its economic value.

Likelihood

Terms used to define likelihood of occurrence of an impact are explained in Table

Table 5.2 : Explanation of terms used for likelihood of occurrence

Definition of likelihood		
High probability	Refers to a very likely impact	Refers to very frequent impacts
Medium probability	Refers to a likely impact	Refers to occasional impacts
Low probability	Refers to a very unlikely impact	Refers to rare impacts

Impact Evaluation

The third stage in the assessment procedure involved the evaluation of the impacts identified in order 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

• Severity of Environmental and Social Impacts

• Magnitude/Scale of Impacts

• Frequency of Occurrence of Impacts

The above criteria and the rating adopted for the evaluation are described in Table

Table 5.3: Impact Evaluation Criteria and Ratings

Consequence

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
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 serious 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 reputation of the client	-3
Severity of Environmental Impact	What is the severity of environmental impacts?	score
	The impact has a moderate detrimental effect on the environment	3

Scale of Impacts	or a scarce, non-renewable resource. Long Term/ Irreversible Impact.	
	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 yea	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 moderate positive effect on the environment and on scarce, non-renewable resource.	-2
	The impact has a major positive effect on the environment or a scarce, non-renewable resource	-3
	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
LIKELIHOOD		
Frequency		score

	How frequently does the impact occur?	5
	The impact occurs on a daily basis	4
	The impact occurs on a weekly basis	3
	The impact occurs on a monthly basis	2
	The impact occurs on an annual basis	1
	The impact is unlikely to occur	0

Overall Significance Ranking

Following the evaluation of each impact using the criteria highlighted in Tables 5.2 and 5.3 above, the identified environmental impacts are categorized and scored according to Table 5.4 and the equation below.

Consequence (A+ B + C + D) x Likelihood (Z) = Significance evaluation score

Table 5.4: Significance Level Categories

Impact Significance	Score
Low Negative Significance	1 – 25
Medium Negative Significance	26 – 50
High Negative Significance	> 50
Positive Significance	< -1

The definition of the impacts, terminologies, sensitivities, Tables, etc. are too lengthy rather been direct and definite

5.5 Approach to mitigation measures

The approach used in this ESIA for identifying mitigation measures where there were significant impacts include: Environmental laws and regulations in Nigeria, with emphasis on permissible limits for waste streams (FMEnv (formerly FEPA), 1991.

The AfDB

Best available Technology for sustainable Development;

Feasibility of application of the proposed mitigation measures in Nigeria;

Views and concerns of stakeholders as expressed during extensive consultations carried out during the study.

Mitigation measures are developed to avoid, reduce, remedy or compensate for any negative impacts identified, and to create or enhance positive impacts such as environmental and social benefits. In this context, the term "mitigation measures" includes operational controls as well as 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);

- ✓ engineering controls and other physical measures applied (e.g. SAPZ maintenance facilities);
- ✓ operational plans and procedures (e.g. Occupational Health Safety Plans); and the provision of like-for-like replacement, restoration or compensation.

For impacts that are 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 assessed to be of Minor significance are

usually managed through good industry practice, operational plans and procedures. 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.

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 that which remains even after proffered mitigation measures have been implemented. The residual effects that may remain after the application of the impact mitigation measures have also been discussed for further reduction as possible.

The method for residual impact ranking was exactly the one used in the initial impact assessment. Table 5.5 is the criteria for residual impact determination. The calculations and formula was established with the assumption that the application of mitigation measures can reduce impact severity, consequence and perception to a lower risk.

Table 5.5. Residual Impact Assessment Method

Consequence criterion	Legend	Explanation
Minor		When the application of any mitigation measure is capable of reducing all five evaluation criteria (legislation, stakeholder concern, severity, scale and frequency) to 6-9 after dividing overall rating by 4
Negligible/insignificant		When the application of any mitigation measure is capable of reducing all five evaluation criteria (legislation, stakeholder

		concern, severity, scale and frequency) to ≤ 5 by after dividing overall rating by 4

5.6 Potential Impacts during initial decommissioning and preconstruction Phase

5.6.1 Impacts on Air Quality

Table 5.6: Impacts on Ambient Air Quality during site clearing and expansion of existing farmlands

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Ambient Air Quality	
A1: Reduction in ambient air quality A2: Contribution to global warming	site preparation and clearing of farmland and burning	Use covered trucks for the transportation of materials that release dust emissions Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	3
			Severity	2
			Scale	2
			Frequency	4
			Overall rating	40
			Impact Significance	Medium

Mitigation measures

Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations; Use covered trucks for the transportation of materials that release dust emissions; and Speed limits on-site of 25km/hr on unhardened roads and surfaces. Provide and encourage use of PPEs. Limit vegetal clearing to only farm plots.

Residual Impact: minor

A1: Vehicles transporting men and materials will generate PM, SO_2, CO, NOx, CO_2 emissions. This activity is expected to add to baseline concentrations. This impact is rated Medium and the implementation of the mitigation measures in Table 5.6 will reduce the impact to a minor level.

A2: A small volume of vegetal biomass shall be generated through clearing of existing forest and farm expansion.

This shall contribute to global warming as sink for carbon sequestration will be lost. During transport and clearing activities, 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 the mitigation measures in the Table above shall reduce the impact to a minor level.

5.6.2 Impacts on Soil and Geology

The summary of the potential impact on soil and geology, sources, rating criteria and mitigation measures are presented in Table 5.7

Table 5.7: Soil and Geology Impacts during vegetal clearing

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Soil and geology	
SQ1: Change in soil structure SQ2: Exposure of soil to erosion clearing of existing farm plots and cultivation Limit vegetation clearing Only farm plot to be cultivated			Impact criteria	Rating
			Legislature	2
			Stakeholder concern	1
			Severity	3
			Scale	1
			Frequency	5
			Overall rating	35
			Impact Significance	medium

Mitigation measures,

Use of existing track for transport of man and material to the extent possible.

Limit vegetation clearing only to the farm areas as required.

Residual Impact: **Minor**

Transportation of materials to site may change the structure of the soil making it more compacted.

Clearing of vegetation for access round widening will also expose the soil to water erosion. Soils in the project area are prone to erosion. This impact is rated Medium according to the criteria in Table 5.7

S2: Minimal widening of the existing access roads linking the major access road to the farm plots is likely to render soils vulnerable to water erosion. This impact is also rated Medium.

Implementation of the mitigation measures in Table 5.8 will reduce both impacts to Minor

Impact on Biodiversity

The potential impact on biodiversity, sources, rating criteria and mitigation measures are presented in Table 5.8

Table 5.8: Biodiversity Impacts during site preparation.

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on biodiversity	
-Loss of threatened species and plants of important indigenous uses -Habitat loss Migration of	(1) Vegetation clearing for access road widening (2) Transport of men & materials	Final farm plot optimization to possibly avoid locations of Threatened species	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	3
			Severity	3
			Scale	2

fauna species as a result of site establishment and clearing			frequency	5
			Overall rating	55
			Impact Significance	medium
Mitigation measures				
Clearing of vegetation (which are habitats of wild animals) shall be minimized and restricted to the farm plots Preconstruction equipment shall be optimally maintained in order to reduce noise generation that may lead to species migration Enlighten contractors and third-party agents against indiscriminate poaching of wildlife during clearing				
Residual Impact: medium				

Impact Description

It is estimated that a negligible vegetal biomass shall be cleared for the establishment of this project for widening of existing access roads and new farm plots .

Baseline result showed that five flora species were of conservation interest. These are *Sericanthe toupetou* (Endangered), and *Afzelia africana, Dalbergia latofolia*, *Ricinidendron heudelotii* and *Lophira alata,* in the vulnerable category. *Sericanthe toupetou*

Similarly, there are seventeen (17) species inventoried in the study offering Provisioning Services. However, the impacts are rated Low, considering the insignificant vegetal quantity that would be cleared as well as sensitivity of the

habitats and the threatened plant species. Implementation of the mitigation measures listed shall reduce these impacts to **Negligible**

Vegetal clearing for widening of access roads shall result in the small reduction in area of the secondary forest. The impact is rated minor, considering the duration, magnitude and sensitivity of the receptor. Implementation of the mitigation measures shall reduce these impacts to **Medium**

Noise and vibrations coming from the equipment and vehicular movements are expected to impact on the mammalian species censored in the project area of influence. The project would render noise sensitive ground dwelling species like the frogs, common rainbow lizard and rats that were censored in this study homeless temporarily.

There is also the possibility of accidental fauna kills, hunting and poaching. The impact is rated Medium.

However, implementation of the mitigation measures shall reduce these impacts to Low

Impacts on land use

The potential impact on land use, sources, rating criteria and mitigation measures are presented in Table 5.9

Table 5.9: Land Use Impacts during Initial site establishment

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on land use	
Involuntary displacement of PAPs	Clearing of existing land	Site clearance activities to be restricted to the minimum required area Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	3
			frequency	5
			Overall rating	55
			Impact Significance	high
Mitigation measures				
Site clearance activities to be restricted to the minimum required area				

• Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household
Residual Impact: medium

Impact Description

Lands and properties affected by the project shall be compensated for. There is need for these PAPs to be properly resettled according to principles and procedures spelt out in an efficient and robust RAP.

However, with the development of Resettlement Action Plan (RAP) (on-going) followed by efficient resettlement and compensation process the residual Impact shall be **Medium**

5.6.3 Impacts on Community Infrastructure, Socio-cultural and Health Status

Table 5.10: Impacts on Community Socio-cultural and Health Status

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Community Socio-cultural and Health Status	
-Risks and Tensions between incoming expatriate and local workers.	(1) Employment of preconstruction workers (2) Influx of workers and	Develop a code of Behavior for workers Funding of local	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1

-Violation of norm and culture by incoming workers -Increase incidences of communicable & non communicable diseases -Pressure on existing social infrastructure	marketers	community projects to compensate impacts.	Severity	2
			Scale	1
			frequency	3
			Overall rating	21
			Impact Significance	Low
Mitigation measures				
Develop a code of behaviours for workers • All workers to receive training on community relations and code of behaviour • Employ workers (especially for activities not requiring high skill levels) majorly from host communities • Management practices aimed at eliminating disease vector breeding sites. • The provision of alternative facilities for workforce e.g. medical services, firefighting equipment etc. • Carry out enlightenment and Awareness campaign among workers on health matters especially on communicable diseases.				
Residual Impact: Negligible				

Impact Description

Differences in religious and socio-cultural backgrounds between local preconstruction workers and expatriates may lead to tensions and conflicts. Existing norms and cultures of the host communities may also be violated by these incoming expatriates. These impacts are rated low and application of the mitigation measures shall reduce the impacts to a Negligible level.

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 such as HIV/AIDS and interaction with the locals may further spread the diseases. This impact is rated low and application of the mitigation measures shall reduce the impacts to a Negligible Status.

Impacts on Traffic and Safety

The potential impact on Traffic and Safety, sources, rating criteria and mitigation measures are presented in Table 5.11

Table 5.11: Impacts on Traffic and Safety

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Traffic and Safety	
-Risk of Accidents to locals -Traffic Congestion on local roads	Transportation of materials on-site and wastes offsite	Implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of traffic	Impact criteria	3
			Legislature	3
			Stakeholder concern	3
			Severity	3
			Scale	3
			frequency	5

		guards, procedures for transport of oversized loads (e.g., engines)	Overall rating	60
			Impact Significance	High
Mitigation measures				
• Implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of • traffic guards, procedures for transport of oversized loads (e.g., engines), • Maintain log of traffic related incidents, sensitization of road users and people living close to the construction site. • Periodic maintenance of transport vehicles • The contractor will develop appropriate strategies to minimize the need for transportation of supplies and will ensure • Compliance with all applicable laws, such as maximum load restriction and speed limits. • An awareness program for truck drivers to speed limits and other precautionary • Prepare and disseminate a Journey Management Guide (JMG) to the trined vehicle drivers and supervisors				
Residual Impact: Medium				

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 High significance, and

implementation of the mitigation measures shall reduce the impact to a Medium Level

5. 6.4 . Impacts on Employment and opportunities

The potential impact on Employment and opportunities, sources, rating criteria and mitigation measures are presented in Table 5.12

Table 5.12: Impacts on Employment and Opportunities

Impact Statement	**Sources of Impact**	**Enhancement Measures Integrated in Project Design**	**Impact on impact on Employment and opportunities**	
Employment	Material requirement and sales Employment of Workers for site mapping and clearing	Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with	Impact criteria	
			Legislature	
			Stakeholder concern	
			Severity	
			Scale	
			frequency	
			Overall rating	
			Impact Significance	beneficial

		selection criteria including health and safety, to allow them to prepare for upcoming opportunities		
Enhancement measures				
Prepare a local content plan to facilitate identification and selection of 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				
Residual Impact: beneficial				

Employment of casual un-skilled labour would occur, for short-term contracts or for the entire preconstruction phase. The main jobs that will be available are the widening of existing access roads, tower and tower foundation dismantling, tower unstringing, sales and requirement of materials. Supplies will include raw materials that meet standards as required for the construction of the agro processing hub in the three LGAs. This is a positive impact and as such does not require mitigation.

5.7 Construction Phase Impacts and Mitigation Measures

5.7.1…..Impacts on Ambient Air Quality

The potential impact on Ambient Air Quality, sources, rating criteria and mitigation n measures are presented in Table 5.13

Table 5.13 Impacts on Ambient Air Quality

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Ambient air quality	
-Reduction in ambient air quality -Dust emission from land preparation and vehicle movements. -Impact on climate change	Operation of construction equipment and machine Transportation and traffic	• Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations • Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	2
			Scale	2
			frequency	5
			Overall rating	40
			Impact Significance	Medium

Mitigation measures
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; • Use covered trucks for the transportation of materials that release dust emissions; and • Speed limits on-site of 25km/hr on unhardened roads and surfaces • Cover properly loose materials and keep top layers moist • Use binder material for erosion and dust control for long term exposed surfaces • Implement re-vegetation action plan
Residual Impact : Minor

The movement of vehicles for the construction will result in PM, SO_2, CO, NOx, CO_2 emissions. It is noteworthy to mention that the quantity of emissions is dependent on the vehicle type, amount and their 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 Particulates emitted from diesel vehicles 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 observed to emanate from poorly maintained diesel-fuelled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase. Particulate emissions from petrol-driven vehicles are usually negligible. Such emissions when they do occur would result from unburned lubricating oil, and ash-forming fuel and oil additives. speeds hydrocarbon and CO emissions decrease, while NOx and CO_2 emissions increase. Emissions from diesel-fuelled vehicles include particulate matter, NOx, SO_2, CO and hydrocarbons, the majority of which occurs from the

exhaust. Operating at higher air-fuel ratios (about 30:1 as opposed to 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.

The impact of emissions arising from vehicles and equipment's associated with construction activities is considered Medium and application of the mitigation measures shall reduce the impact Minor level.

Dust emission from land preparation and vehicle movements

The dust emissions arising from the construction activities of the Project are as a result of land preparation activities and vehicular movements. Dust emissions have the potential to create impact on the close receptors due to the physical appearance, deposition on the roof of the residential areas and creating nuisance for the surrounding community. Removal of material usually takes place with a bulldozer, cleared material is then stored in piles for later use or during rehabilitation procedures. Fugitive dust is generated during the clearing of material, as well as from wind-blown dust generated from cleared land and exposed material stockpiles.

Dust problems can also be generated 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 due to dust blown from the back of the trucks during transportation.

The impact is rated Medium. However, implementation of the mitigation measures shall reduce the impact to Minor.

Impact on climate change

A series of stages are involved in estimating the climate change impact of an electricity transmission network.

During the construction stage, following activity is considered for climate change impact.

Process from material production:

GHG will be emitted from the manufacturing process of construction material though it is indirect impact of the project, but still necessarily considered as part of lifecycle of the project. The assumption used for the GHG emission calculation on this item, based on Global Emission Model of Integrated Systems (GEMIS) database (World Bank, 2010).

5. 7.2 Impacts on Soil and Geology

The potential impact on Soil and Geology, sources, rating criteria and mitigation measures are presented in Table 5.14

Table 5.14. Impacts on Soil and Geology

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Soil and Geology	
Change to soil structure (erosion and compaction Potential contamination of soil from inadvertent	Creation of Foundations and other excavations activities	Ensure that the land is physically restored (include re vegetation where possible)	Impact criteria	Rating
			Legislature	2
			Stakeholder concern	1
			Severity	3
			Scale	1

release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminum oxide paint, etc			frequency	5
			Overall rating	35
			Impact Significance	Medium
Mitigation measures				
• Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers. • Accidental spills from machine maintenance shall be properly managed • Develop project specific waste management plan and ensure proper implementation • Provide adequate containers for waste collection • Periodically audit contractor activities to check the level of compliance to regulatory waste management requirements • Ensure engagement of government approved waste management contractors • Safe operating practices are enforced during construction				

Residual Impact: Minor

-During the construction phase, the main activities likely to affect soil structure and quality are digging of foundation pits for construction and removal of vegetation (for foundation purposes). Foundations will be dug up to variable depths, depending upon the building type and soil characteristics. Although existing roads and tracks will be used to access the farm plots, 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 Minor if the proffered mitigation measures are implemented.

-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 accidental events. A significant amount of solid waste (including, wood, metal scarps, office and domestic wastes, etc.) will be generated in this phase of the project. The methods put in place for handling and disposing of these wastes to be generated play an important role in the significance of impacts expected from wastes management. Waste handling and disposal have been assessed to pose a medium impact to 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 avoiding storage of materials within these areas as well as implementation of an Emergency Response Plan will help manage accidental spills properly will reduce the impact to a Minor Status.

5.7.3 Impacts on Water Resources

The potential impact on Water Resources, sources, rating criteria and mitigation measures are presented in Table 5.15

Table 5.15 Impacts on Water Resources

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on Water Resources</th></tr>
<tr><td rowspan="9">-Potential surface -Contamination change in hydrological flow regimes of surface water -Potential groundwater contamination -Exploitation of water resources</td><td rowspan="9">Operation and maintenance of construction machines and equipment</td><td rowspan="9">Rivers and streams shall not be dammed for the purpose of water abstraction</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>1</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>40</td></tr>
<tr><td>Impact Significance</td><td>medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">Rivers and streams shall not be dammed for the purpose of water abstraction
• Accidental spills from machine maintenance shall be properly managed
• Continuous training of workers on HSE protocols
• Conducting daily safety briefings</td></tr>
</table>

• using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas
Residual Impact: Minor

Sources of impacts to water resources are removal of vegetation, vehicle movement and construction sites and excavation building construction etc.

Vegetation removal in swampy areas can increase soil erosion in erosion prone areas, causing sediment to be deposited into the water bodies, especially during rain events. This shall likely add to the baseline surface water Turbidity levels at all sampling points which are above threshold limits. These areas are likely to be most impacted. Poor waste management practices are likely to have an effect on water quality (e.g. improper waste disposal in surface waters). The risk of accidental oil spills from heavy machinery during construction phase could result in surface water contamination. This shall likely add to the baseline surface water DO levels at all sampling points since hydrocarbon utilizing microbes are known to increase DO levels in water. However, the contamination level resulting from accidental spills will depend on their magnitude which of this case is small, but the receptor is very sensitive leading to a Medium Impact Rating. However, proper application of the mitigation measures listed in the Table above will reduce the impacts to a minor level.

Construction of access routes as well as vehicular movement along the construction sites can result into 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. However, mitigation measures such as using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas will reduce impacts on water resources to Minor.

Groundwater could be contaminated during digging of foundation pits for the hub building, particularly near watercourses or the areas around any of the water bodies in the area. This Impact is rated Medium and the application of the mitigation measure shall reduce the impact to Minor.

Water to be used for construction activities shall be sourced from borehole. The impacts are rated Medium and implementation of the mitigation measures listed above shall reduce impacts to Minor status.

5.7.4 Impacts on Aquatic Species

Table 5.16: Impacts on Aquatic species

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Aquatic biota during construction	
Loss/disturbance of aquatic species	Building construction Transport and traffic	Natural flow of a River shall not be blocked	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	3
			Scale	2
			frequency	5
			Overall rating	45
			Impact Significance	Medium
Mitigation measures				

Conduct activities during the dry season to minimize disturbance of sensitive water bodies • Perform all vegetation clearing work manually along streams/rivers. • Avoid vegetation clearing along stream shores and on steep slopes. • Based on an appropriate project design, avoid building close to water bodies. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. • Prohibit construction of permanent access roads along riverbanks or in areas where soils are saturated • Maintain vegetated buffer zones within and around rivers and along both sides of watercourse crossings. • Complete project timely to enable ecosystem rejuvenation and stabilisation
Residual Impact: Minor

Construction related activities will result in water quality deterioration with attendant impacts on macro-invertebrates, fishery resources. This impact would however be limited in terms of duration and is ranked at a medium significance level. Implementation of the mitigation measures is predicted to reduce the impact to **Minor**

5.7.5. Impacts on Biodiversity

The potential impact on Biodiversity, sources, rating criteria and mitigation measures are presented in **Table 5.17.**

Table 5.17 : Impacts on Biodiversity

Impact Statement	**Sources of Impact**	**Recommendation Measures Integrated in Project Design**	**Impact on Biodiversity during construction**	
-Further migration of fauna species as a result of construction noise -Introduction of invasive and alien species	Construction of buildings , Transport and traffic	Re-vegetation shall be done using native species for erosion control	Impact criteria	**Rating**
			Legislature	**3**
			Stakeholder concern	**2**
			Severity	**1**
			Scale	**1**
			frequency	**2**
			Overall rating	**14**
			Impact Significance	**Low**
Mitigation measures				
Restrict construction activities, including vehicle movements and material storage, inside the				

• Minimize the construction of new access roads. Promote the use of existing access roads for machinery and vehicle movements. • 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.
Residual Impact: Negligible

During construction, there shall be faunal disturbance within the farm plots in which sensitive ground dwelling animals especially from the reptilian taxon will further migrate from the area during construction. This impact is short termed and rated Low. The application of Mitigation Measures will reduce the impacts to a negligible level.

There is possibility of creating fertile loci for alien and invasive flora species 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 substantially modify wildlife habitat which can impact associated fauna populations. *Chromolaena odorata*, *Mimosa pudica* and *Dalbergia sisso* listed as invasive to Nigeria were found in this study. This impact is rated Low. The application of Mitigation Measures will reduce the impacts to a negligible level.

5.7.6 Community Agitation

The potential impact on Community Agitation, sources, rating criteria and mitigation measures are presented in Table 5.18

Table 5.18: Impacts on Community Agitation.

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on community agitation during construction	
Agitation by locals linked to compensation	Construction activities	Engage communities in the construction activities to enhance transparency and involvement	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	2
			frequency	5
			Overall rating	50
			Impact Significance	Medium
Mitigation measures				
• Develop and implement a resettlement action plan to ensure equitable • settlement of all project affected persons • Develop, establish and publicize effective grievance procedures; • Early stakeholders' engagement sessions are held, and all agreed issues properly documented and signed.				

• All affected stakeholders and legacy issues are identified early, clearly defined, and agreed upon. • Stakeholders (communities, Govt., landowners, etc.) are adequately consulted and relevant issues addressed • Agreed fair compensation/rent for land are paid to identified owners promptly as per set standards. • As far as possible employ persons from the surrounding communities during the construction phase of the development to reduce the numbers of persons that will migrate to the area seeking employment. • The Abia SAPZ, PIU will develop a community relations and engagement plan that identifies fair strategies of engagement for all communities. Contents of the Community Relations and Engagement Plan • Enhance ongoing consultations with local communities (with good representation) by Abia SAPZ to create continuous dialogue, trust and planning of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan • Maintain consultation with relevant stakeholders throughout the life cycle of the project.
Residual Impact: Minor

There is tendency for agitations by some groups of people or individuals over non-satisfactory engagement and compensations over land and other associated properties. This could lead to strife within communities or groups. During labour recruitment and prior to full construction activities, there is also potential for conflicts between neighbouring communities or individuals over employment quota systems, sub-contracting procedures or recruitment methodology. This will pose High significant impact on the project construction phase. However, implementation the mitigation measures will reduce the impact to a Minor level.

5.7. 7. Impacts on Socio-economic

The potential impact on Socio-economic, sources, rating criteria and mitigation measures are presented in table 5.19

Table 5.19 : Impacts on Socio-economic

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><th colspan="2">Impact on Socio-economic</th></tr>
<tr><td rowspan="6">-Risking tensions between outside (partly possibly expatriate and local worker
-Violation of norm and culture by outsiders, workers and marketers
-Increase incidences of communicable &</td><td rowspan="6">Employment of construction workers
Temporary influx of outsider and marketers to the communities</td><td rowspan="6">-Develop a code of behaviours for workers
-Enhance ongoing consultations with local communities (with good representation) by Abia SAPZ to create continuous dialogue, trust and planning of community development activities</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>2</td></tr>
<tr><td>Stakeholder concern</td><td>1</td></tr>
<tr><td>Severity</td><td>2</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>frequency</td><td>3</td></tr>
</table>

non-communicable diseases		-Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan	Overall rating	21
			Impact Significance	Low
Mitigation measures				
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 Management practices aimed at eliminating disease vector breeding sites. • Awareness/health campaigns shall include other communicable diseases such as dysentery and cholera • Enhance ongoing consultations with local communities (with good representation) by Abia SAPZ to create continuous dialogue, trust and planning of community development activities. • Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan • Develop a health plan to address potential health issues • Initiate /enforce Abia SAPZ corporate health awareness programs for malaria, AIDS, etc) • Provide site medical personnel to attend to emergency situations • Engage the services of retainer clinics to manage health issues				

• Educate workforce on the prevention of malaria as well as encourage the use of mosquito nets Ensure personnel use appropriate PPE • Prepare and implement emergency response plan • Ensure availability of first aid facilities onsite • Provide information, education and communication about safe uses of water and occupational hygiene and safety • Ensure Environmental Management for vector control and avoidance via settlement location and • Develop and implement safe food storage and handling practices

Residual Impact: negligible.

Potential socio-economic impacts are expected to arise from socio-cultural conflicts between the construction workforce and natives due to contrast in belief and religion systems. This may also lead to the violation of the existing traditional norms in the project area. These impacts are rated Low as application of the mitigation measures shall reduce the impact to a Negligible status.

Construction activities have the potential to create new malaria vector (mosquito) habitats due to 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 which may result to death. This impact if not managed is expected to pose a major significance characteristic. Influx of workers into the project area also increases the risks of Sexually Transmitted Diseases (STDs) and could impact adversely on the spread of HIV/AIDS.

This impact if left unmanaged may result in long term health issues which may eventually lead to fatality.

Impact arising from this is ranked as High. Application of the mitigation measures would reduce the impact to a Minor level

Table 5.20 Impacts on Socio-infrastructure

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Socio-infrastructure	
Pressure on existing social infrastructure	Influx of outside workers	Funding of local community projects to compensate for impacts	Impact criteria	Rating
			Legislature	1
			Stakeholder concern	1
			Severity	2
			Scale	1
			frequency	5
			Overall rating	25
			Impact Significance	low
Mitigation measures				
The provision of alternative facilities for workforce e.g. medical services, fire-fighting equipment etc. Funding of local community projects to compensate for adverse/negative impacts after consultations with community members				

Residual Impact: Negligible.

Another challenge on the socio-economic aspect is increased demand on existing infrastructures due to influx of people to the project area. These impacts have been

ranked on a Low significance level and application of the mitigation measures shall reduce the impact to a Negligible status.

5.7.8 Socio-economic impacts on road accidents, kidnappings and traffic Congestion

Table 5.21: Impacts on accidents, kidnapping and traffic congestion

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on accidents, kidnapping, banditry and traffic congestion	
Risk of road Accidents and Kidnapping Traffic Congestion	Transportation of materials on-site	Implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines	Impact criteria	Rating
			Legislature	1
			Stakeholder concern	1
			Severity	2
			Scale	1
			frequency	5
			Overall rating	25
			Impact Significance	low
Mitigation measures				
Implement a traffic safety plan including design of access point, signalization, speed limits, training				

of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines),

• Maintain log of traffic related incidents, sensitization of road users and people living close to the construction site.

• All vehicles are certified road / water worthy prior to being mobilized for work activities.

• Compliance to all roads safety transport rules including speed limits

• Competency training and certification of drivers before mobilization.

• Limit movement to daytime only

- Setting and enforcing speed limits of 100km/hr (major roads) 40-60km/hr (built-up areas) and 10-30km/hr (construction sites);

• Consultation and good public relation with the stakeholder communities.

• Ensure government approved security personnel is used on transport vehicles and boats when warranted

• Coordinate work activities to avoid heavy traffic periods

• Use warning signs and traffic wardens/directors

• Ensure activities causing blockages at road crossings are carried out within shortest time practicable

• Develop appropriate strategies to minimize the need for transportation of supplies

• Ensure compliance with all applicable laws, such as maximum load restriction and speed limits

• Prepare and implement JMG for the trained drivers and supervisors

Residual Impact: Negligible

Construction and transportation activities will increase traffic congestion, risk of injuries, hostage and kidnapping as well as damage to assets.

Accidents arising from road trips (transport of materials and personnel) along mobilization routes may result in injury or loss of life of personnel as well as damage to company assets. This impact is rated Low significance, and implementation of the mitigation measures shall cascade the impact to a Negligible Level.

Table 5. 22: Impacts on Employment and Opportunities

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Enhancement Measures Integrated in Project Design</th><th colspan="2">Impact on impact on Employment and opportunities</th></tr>
<tr><td rowspan="10">Supply chain opportunities for Nigerian companies and locals that can provide goods and services needed by the company</td><td rowspan="10">Material requirement Employment of workers</td><td rowspan="10">Prepare a local content plan To facilitate identification and selection of 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</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td></td></tr>
<tr><td>Stakeholder concern</td><td></td></tr>
<tr><td>Severity</td><td></td></tr>
<tr><td>Scale</td><td></td></tr>
<tr><td>frequency</td><td></td></tr>
<tr><td>Overall rating</td><td></td></tr>
<tr><td>Impact Significance</td><td>Beneficial</td></tr>
<tr><td colspan="5">Enhancement measures</td></tr>
</table>

Prepare a local content plan to facilitate identification and selection of 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
Residual Impact: Beneficial

Based on the results of the socio-economic assessment, the un-employment rate in the area is high. The locals are however optimistic about possibility of job availability with the project. Any available jobs will provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the regional and national levels. The impact is beneficial. Employment of casual un-skilled labour would occur, for short-term contracts or for 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 SAPZ 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.

5.7. 9 The potential impact on loss of employment, sources, rating criteria and mitigation measures are presented.

Table 5.23: Impacts on loss of employment

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on loss of employment	
Loss of employment	Demobilization on completion of construction	Organize career development workshops, skills acquisition and enhancement	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	1
			Scale	1
			frequency	5
			Overall rating	
			Impact Significance	35
Mitigation measures				
Organize career development workshops, skills acquisition and enhancement • programs to further empower the workforce • Project will develop, establish and publicize grievance procedures; • Adequately pay due wages for worked period and settle all financial commitments to workforce before demobilization				

Residual Impact: Low.

Completion of the construction phase of the project will lead to loss of employment and business opportunities. This impact has been assessed with a medium significance level. Implementation of the above measures reduces the impact to Low.

5.7.10: Impact on Workplace Health and Safety

Table 5.24: Assessment of Impacts on workplace Health and Safety

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on workplace Health and Safety	
Risk of workplace accidents and hazards	Tower erection Earthwork Tower stringing Establishment of tower foundation	Develop project specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	2

		provisions for training and certifications to be followed by all workers including subcontractors. Especially slip-trip and fall hazards with tower erection and electrocution need attention	frequency	5
			Overall rating	50
			Impact Significance	High
Mitigation measures				
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 with tower erection and electrocution need attention. • 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. • Periodic training of staff on workplace health and safety • Make sure all personnel are qualified and certified for their relevant works • Make sure approved safe work procedures are provided and complied with at all times prior to commencement of work • Ensure SHE briefings, job hazards identification and controls, prior to • commencement of work activities				

• Use of appropriate personal protective equipment (PPE) e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site • Limit work activities to daytime only. Ensure availability of first aid facilities onsite • Ensure retainer clinics are engaged and site medical personnel are available in case of accidents. • Maintain medical emergency response plan so that injured or ill persons can promptly access appropriate care. • Ensure all fuel storage tanks are kept at safe distances from work areas • Ensure storage areas are identified with caution signs. • Educate workforce on risks associated around storage areas and prohibit activities (such as smoking) that can ignite storage tanks • Designate no-smoking and smoke areas.
Hold HSE meetings and talks on fire hazard • design work area to internationally acceptable standards
Residual Impact: Minor

In any civil works, public as well as construction staff SHE risks can arise from various construction activities such as earth works, 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 especially in the construction phase. Work related incidents and accidents resulting from trips, falls, object at height during construction activities are likely to occur. Fire and explosions may be described as technological hazards, which can cause serious 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 fire have been ranked with a High significance level. Implementation of the mitigation measures is likely to reduce the impact to a Minor level.

5.7.11 Impacts and Mitigation Measures During Operation Phase of Abia SAPZ

Impact on Ambient Noise Level

Table 5.25: The assessment of the potential impacts on Ambient Noise level, sources, rating criteria and mitigation measures.

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Ambient Noise level	
Increase in ambient Noise level	Processing hub activities, vehicular movement and noise from human activities. Noise and vibration disturbances from operation of weeding machines.	Abia SAPZ shall install mesh at sensitive receptor locations	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	1
			Scale	1
			frequency	5
			Overall rating	30
			Impact Significance	medium

Mitigation measures
Noise during the operation phase, maintenance activities and vehicular movement could lead to an increase in noise levels which may disturb neighboring communities. However, these disturbances will be temporary since they will be felt only during maintenance activities in the day. Communities likely to be affected are mainly those where the Abia SAPZ project are sited. Overall, noise-related impacts during the operation phase is ranked medium, with implementation of mitigation measures, impacts on noise shall reduce to Negligible Status

5.7.11 Impact on Soil and Geology

Table 5.26: Impacts on Soil and Geology

Impact statement	**Sources of impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Soil and Geology during Operation**	
Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants,	Agricultural intensification in the form of continuous cassava farming systems may lead to declining soil fertility and	Appropriate flow diversion and erosion control structures i.e. earth embankments shall be put	Impact criteria	Rating
			Legislature	**3**
			Stakeholder concern	**1**
			Severity	**3**
			Scale	**1**

aluminum oxide paint, etc	lower crop yields overall.	in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc	frequency	**2**
			Overall rating	**16**
			Impact Significance	**Low**

Mitigation measures

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 operation of Abia SAPZ business

• Implementation of project specific spill and Emergency Response Plan

• Ensure hydrocarbon/chemical spill containment and prevention measures and equipment are functional and effective on site and for equipment and vehicles

• Double handling to be avoided where possible

• When transfer has to take place, ensure it is done in lined and secured areas where containment is possible

• Educate personnel on hydrocarbon and chemical handling risks/hazards, through HSE briefings/toolbox meetings.

Residual Impact

Negligible

Table 5.27 Impacts on Socio-economic during operation phase

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Socio-economic	
Effectively evacuate Abia SAPZ products to the market space and export Development of new infrastructures or improvement to existing ones.	Haulage and vehicular movement.	Impact is beneficial and shall be enhanced by sustaining the Production line life span, through adequate and effective maintenance activities as well as complying with federal government's policies and laws on food security and distribution	Impact criteria	
			Legislature	
			Stakeholder concern	
			Severity	
			Scale	
			frequency	
			Overall rating	
			Impact Significance	**Beneficial**
Enhancement measures				
Impact is beneficial and shall be enhanced by sustaining the production life span, through adequate and effective maintenance activities as well as complying with federal government's policies and laws on food security and distribution				

5.7.12 Impact on Biodiversity

Table 5.28. Impacts on Biodiversity

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	**Impact on Biodiversity**	
Local fauna disturbances from the SAPZ operations	Human and vehicular movement and	Develop policies that prohibiting hunting by staff	Impact criteria	**rating**
			Legislature	**3**
			Stakeholder concern	**2**
			Severity	**3**
			Scale	**3**
			frequency	**2**
			Overall rating	**22**
			Impact Significance	**Low**
Mitigation measures				
Routine patrols by SAPZ maintenance crew to look out for any bird collisions, individuals hunting wild life. If any collision "hot spots" are identified, these can be mitigated reactively. • Disturbance of vegetation during construction and operation should be kept to a minimum. • Develop policies that prohibit hunting by staff				

Residual Impact: Negligible

The presence of the SAPZ project is likely to affect bird communities during the operational phase, especially when located in open air space habitats as grasslands.

The presence of the SAPZ Hub can affect birds flying from 50m to 75m mainly through

- Collision with power lines or towers leading to death or injury. Greater collision risk is associated with the thin ground wire which is located above the thicker high voltage wire
- Electrocution: Due to contact with live components

5.7.13 Impact on Health, Safety and Security

The Assessment off the potential impacts on Health, Safety and security, sources, rating criteria and mitigation measures are presented in Table 5.29.

Table 5.29 Impacts on Health, Safety and security

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Health, Safety and security	
Health issues from exposure to agro-chemicals. Death and injury from farm operations	Operation of SAPZ hub , farm mechanization etc Exposure to injuries from falling of trees, venomous wildlife & insects	The SAPZ projects will be designed according to best practices and standards; Prohibition of drug and alcohol use by workers while on the job.	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	3
			Severity	3
			Scale	1
			frequency	5
			Overall rating	50
			Impact	High

	(snakes, scorpions, bees, wasps, spiders)	• Provision of adequate first aid, first aiders, PPE, signages (English and Local languages), engineering barriers e.g., fencing. •Restrict unauthorized access to all areas of high-risk activities.	Significance	
Mitigation measures				
The SAPZ will be designed according to best practices and standards Use of appropriate personal protective equipment (PPE) e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site Use trained Staff to for maintenance of facilities				

Residual Impact: Medium

Table 5.30 Impact on Surface Water Quality

Impact Statement	Sources of Impact	Mitigation Measures Integrated in Project Design	Impact on Surface water quality	
Surface water pollution.	Alteration of aquatic habitat in Albine and Imo river as a result of pollution and sedimentation may lead to depletion of aquatic biota -Eutrophication/nutrient-enrichment/ Siltation of Albine and Imo river as a result of sediment runoffs from exposed soils on the farms	Protect all vegetation not required to be removed against damage particularly the riparian vegetation along Albine and Imo river River channel. • Ensure prompt cultivation of all cleared areas to restore vegetation cover	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	2
			Scale	2
			frequency	4
			Overall rating	30

		and soil stability. • Where possible, ensure site clearing is done during the dry season to protect.	Impact Significance	medium

Ensure early installation of temporary drainage and diversion structures to include silt traps.

5. 7.14 : Impacts and Mitigation Measures during Decommissioning Phase

The decommissioning phase refers to all the activities which relate to the proposed SAPZ project when it is no longer in use. Potential issues that relate to the decommissioning phase refers to impacts such as the removal crops, structures and irrigation materials.

During the decommissioning phase, the demolition activities are likely to have similar impacts on the environment as were identified for the construction phase. These include potential impacts such as sedimentation, surface water, visual impact, dust and noise pollution, a 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.

Mitigation measures for impacts during decommissioning will be implemented in line with practices as at the time of decommissioning. However, to a minimum the following mitigation measures have been put in place for impacts arising due to decommissioning process:

Develop and implement a decommissioning plan in line with requirements as at the time of decommissioning.

Ensure that excavated and stockpiled soil material is stored and bermed on the higher lying areas along the site and not in any run-off channels where it is likely to cause erosion.

Decommissioning activities should preferably take place 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 transportation of decommissioned structures and personnel so as to avoid obstruction of local traffic by vehicles, heavy machinery/trucks.

The decommissioning contractor as at the time of decommissioning will have to develop a decommissioning security plan and implement its use.

Ensure effective waste management from cradle to grave for all wastes generated during and after the decommissioning period.

Enforce proper waste management policies in line with FMENV standards and requirements as at time of decommissioning.

Ensure use of road worthy vehicles and equipment as well as skilled operators and drivers

Implementation of the above measures will reduces the impacts to negligible.

5.8 Cumulative Impacts

5.8.1 Defining Cumulative Impacts

In theory, any development such as the proposed Project may be taking place at the same time as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential

development 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 is 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 impacts 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 all 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 impacts 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 focus of the cumulative impact assessment is on the combination effects of the Project with potential future development in the immediate area around the Project site. Our assessment cumulative impacts regarding the potential project in view,

depends on the status of other projects and the level of data available to characterize the magnitude of the impacts in view of the paucity of available information regarding such future developments, this assessment follows a generic pattern and focuses on key 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 assistant in this assessment. The main developments identified are

• Cumulative impacts from other projects within Abia Industrial and Innovation Park (AIIP)

• Those likely to arise from other agro processing and allied industries.

5. 8.3 Summary of Cumulative Impacts

Air Quality and Noise: Given the findings of impact assessment and the baseline ambient noise quality. It appears unlikely that the cumulative impact on noise will not be significant. With regards to ambient air quality, SO_2 levels are very likely to increase since baseline levels are already above regulatory limits.

Also, the cumulative impacts from the project area will be localized to immediate environment.

Traffic: The construction phase will require large amounts of material and equipment to be transported to the Project site. It is expected that the ongoing developmental projects listed in cumulative impacts section which will place pressure on the local road network especially during the construction phases of the projects.

Given the foregoing, there is increased potential for accidents and disruption to the road traffic network for local users associated with the increase in traffic movements from overlapping construction traffic. It is expected that the traffic management plan

to be developed for the project will consider other traffic movements associated with the development of the project in view which will help to mitigate this impact. However, in overall consideration, this impact is considered to be moderate due to the high likelihood of accidents occurring.

Economy, Employment and Skills: The operation of the various considered projects earlier outlined is proposed to occur simultaneously with the project in view. As such, the economic, employment and skills development opportunities will be greater for all the projects combined than a single project.

It should be noted that expectations regarding economic development, employment and skills development will be high amongst stakeholders in the local community and as such, in the event that one project does not meet expectations, there is the potential for all projects within the area to be the target of this negative outcome.

Based on the above, the cumulative impacts of the various proposed industrial projects on the economy, employment opportunities and skills development within the communities is expected to be positive.

5.9 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

A summary of key identified impacts for all project phases is presented in Table 5.31 Below

Table 5.31: Summary of identified impacts for all phases in the project

Project Activities	Associated and Potential Impacts	Mitigation Measures
Land Clearing And Preparation including ploughing and ridging using	-Conflicts from land acquisition for Cassava, rice , soyabean and maize farming from local farmers	Abia SAPZ PIU shall ensure collaboration with all stakeholders (Umuololo, Ariam elu elu and Okporoenyi ,communities) to ensure the

tractors	-Conflicts between communities members over project opportunities and benefits	provisions of the MoU amongst the parties are strictly adhered throughout the project. • Abia SAPZ shall not take, alienate or assigned any land to any other party (other than farmers from host communities) or for any other project other than the sole purpose of the mechanised cassava, rice , soya farming out-grower project by local farmers. • Abia SAPZ PIU shall ensure priority employment and training for youths from project communities as extension workers, tractor drivers, security etc.
	Air quality deterioration from release of dusts and gaseous emissions from exposed soil surfaces and tractors used in clearing, ploughing & ridging	Use spraying devices such as water tanker to sprinkle water on exposed soil surfaces to limit dusts. • Ensure all tractors and machines are serviced before being brought to site. • Train drivers/ workers on proper operation of tractors & equipment to include

		fuel efficiency and anti-idling techniques
	Noise and vibration from the use of tractors for clearing, ploughing and ridging	Ensure tractors and other farm machines not in use are turned off. • Provide appropriate PPE for hearing protection and enforce usage. • Use low-noise tractors and ensure all tractors are serviced before being brought to site. • Fit tractors with exhaust mufflers/silencers to minimize noise.
	Loss of vegetation cover due to Over clearing of the 1000 -ha project site	Restrict removal of vegetation and trees to the boundary of project site only. • Where possible, schedule vegetation clearing to occur in phases so that the entire area is not cleared at once. • Protect all vegetation not required to be removed against damage particularly the riparian vegetation along Imo and Ibine River channels. • Ensure prompt cultivation of all cleared areas to restore

		vegetation cover and soil stability. • Where possible, ensure site clearing is done during the dry season to protect farms from erosion. • Ensure early installation of temporary drainage and diversion structures to include silt traps.
	Generation of vegetal wastes from de-vegetation and site clearing activities	Prepare and Implement Waste Management Plan (WMP). • Vegetal waste shall be used as compost by local farmers or left on the farms to decompose to improve soil fertility. • Woody debris and slash shall be given to locals for use as fuel wood for cooking.
	Eutrophication/nutrient-enrichment/ Siltation of Imo and Ibine Rivers as a result of sediment runoffs from exposed soils on the farms	Protect all vegetation not required to be removed against damage particularly the riparian vegetation along Imo River channel. • Ensure prompt cultivation of all cleared areas to restore vegetation cover and soil stability. • Where possible, ensure site clearing is done during the dry

		season to protect farms from erosion.
	Exposure to injuries from falling of trees, venomous wildlife & insects (snakes, scorpions, bees, wasps, spiders)	Develop a project specific Occupational Health and Safety Plan (OHSP) commensurate to mechanised farming activities. OHSP to include: • Prohibition of drug and alcohol use by workers while on the job. • Provision of adequate first aid, first aiders, PPE, signages (English and Local languages), engineering barriers e.g., fencing. • Restrict unauthorized access to all areas of high-risk activities. • Training of personnel on worksite OHS management, induction/ daily toolbox and refresher program.
Cassava, soyabean, rice , oil palm and maize Planting	Agricultural intensification in the form of continuous cassava farming systems may lead to declining soil fertility and lower crop yields overall	Ensure steady application of the combination of medium amounts of compost with the right balance of N, P, and K in chemical fertilizer to ensure steady soil fertility. • Consider intercropping with grains and legumes if the

		mechanisation of the farm will allow it.
	Destruction of crop plants/ yield loses due to pest infestation and diseases particularly cassava mosaic disease (CMD) and cassava brown streak disease (CBSD), maize weevil and other related crop diseases	Ensure cultivation of disease-resistant crop varieties recommended by the International Institute of Tropical Agriculture (IITA) and FAO. • Ensure optimal use of pesticides by applying the minimum amount recommended by FAO for cassava farming. • Where possible, cultivate cassava farm without chemical fertilizers, herbicides or pesticide application.

	Disproportionate engagement of women based on gender biasedness and lack of employability skills	Ensure at least 25% of employment opportunities (as cassava farmers, extension workers etc) are reserved for women. • Any form of capacity building or women empowerment program by the project shall be well thought out to prevent upsurge in domestic violence in communities and to ensure sustainability. • During resettlement, special consideration shall be given to women particularly female headed households
Weed Management Disease Control Fertilizer Application	Noise and vibration disturbances from operation of weeding machines	The frequency and intensity of weeding can be reduced if land is cleared immediately before the start of a rainy season. • The frequency of weeding shall be reduced four months after planting as weeds have little impact on yield and weeding becomes less essential at this stage
	Generation of vegetal wastes from weeding activities	Prepare and Implement Waste Management Plan (WMP).

		• Vegetal waste shall be used as compost by local farmers or left on the farms to decompose to improve soil fertility. • Woody debris and slash shall be given to locals for use as fuel wood for cooking.
	Generation of hazardous waste and potential contamination of Imo and Ibine Rivers from fuel storage and indiscriminate handling of hazardous materials such as containers for herbicides, fertilizer bags and pesticides.	Storage of hazardous waste onsite shall be done in closed/ labelled containers, stored away from direct sunlight/ rain with bunds provided to contain spillage. • Use of authorised contractors for hazardous and any other wastes which the project cannot dispose of safely. • Ensure fuel storage tanks are installed in a bunded area and checked daily. • Ensure all vehicles and machines are serviced before being brought to site to avoid leaks of oil. Install impermeable surface at fuel storage areas, tractor servicing & limit zone to contain potential leakages.
	Use of pesticides may have adverse effects on beneficial insect populations	Cultivate pest/weed resistant varieties to reduce the burden and frequency of

	or non-target bird and aquatic animals in Imo River	pesticides/herbicides application. • Ensure optimal application of pesticides/herbicides to avoid excessive use. • Train farmers to practice rouging, a practice where diseased plants are identified and removed as they are found to reduce use of pesticides.
	Run-off of chemicals may lead to nutrient loading, deoxygenation of Imo and Ibine River and loss of fish and other aquatic organisms.	Use erosion protection structures such as sediment traps as additional measures to control erosion and run-off from the farms to Imo and Ibine River. • Establish vegetation buffers/ green belts and protect the riparian vegetation between the farms and Imo- and Ibine Rivers.
	Occupational health risk (including poisoning, skin irritation, respiratory problems) to farmers due to handling of chemicals including fertilizers, herbicides and pesticides.	
Harvesting	Air Quality deterioration from dusts generated during excavation to remove cassava tubers, maize, soyabean, oil palm and cocoa gaseous emission from operating tractors	Use of modern harvesters that meet appropriate emissions standards, and regular preventative maintenance. • Use of dust control and suppression measures such as wetting, dampening etc. to control dust during harvesting.
	Post-harvest physiological and microbial deterioration of cassava	Harvested cassava tubers shall be evacuated to SAPZ Hub

	tubers due to storage on the farms	within 24 hours after harvesting to prevent deterioration and post-harvest loses.
Transportation/ Evacuation of Cassava Tubers to the Hub	Road Traffic Accident/ disruption of traffic flow	Hire drivers with appropriate driver's license, train drivers and enforce speed limit. • Evacuation of cassava tubers to AIPC Ikom shall be done at off-peak period (11am – 3pm). • Ensure trucks and other vehicles are parked at the designated parking lot within the cassava farms and prohibited from parking along the expressway to prevent obstruction of traffic.
Presence of Migrant Workers & Business Opportunists	Threat to community culture, safety and security due to presence of workers and business opportunists.	Develop an induction program including a code of conduct for all workers. Code of conduct shall address the following: Respect for local residents; No hunting or unauthorized taking of products or livestocks; Zero tolerance

		of illegal activities such as child sexual exploitation and underage sex, prostitution, harassment of women, GBV, purchase or use of illegal drugs, Disciplinary measures and sanctions (e.g. dismissal) for infringement of the code of conduct and/or company rules; Commitment to cooperate with law enforcement agencies investigating perpetrators of GBV

CHAPTER SIX
MITIGATION MEASURES AND ALTERNATIVES

6.1 INTRODUCTION

The objective of this chapter is to present the mitigation measures that have been identified through impact assessment process in chapter 5 for Abia State SAPZ project located in three Local government areas : Ukwa west , Ikwuano and Bende. The identified negative impacts have been ranked variously as Minor(Low), Moderate(Medium) and Major(High). To preserve the environment, a number of steps have been taken to mitigate the significant, Major and Moderate negative impacts, as well as enhance those impacts identified as positive.

The mitigation being proposed are specific, measurable, achievable, and relevant to the project and time based (SMART) and takes into account environmental laws in Nigeria (with emphasis on permissible limits for waste streams of FMENV, principles of sustainable development and best available technology, feasibility of application of the measures in the project area (and Nigeria) and social wellbeing and concerns of stakeholders.

6.2 METHODOLOGY

Mitigation refers to minimizing or avoiding the described impacts. Overall, mitigation measures are a response to the findings of impact assessment; they need to cover all the areas identified. The key focus of mitigation actions is:

• Preventive measures that avoid the occurrence of impacts and thus avoid harm or even produce positive outcomes.

• Measures that focus on limiting the severity and the duration of the impacts.

• Compensation mechanisms for those impacts that are unavoidable and cannot be reduced further.

These mitigation measures proposed for SAPZ project, could be any or a combination of the following:

- Engineering design,
- Elimination of Hazard,
- Reduce the probability of the Hazardous event occurring, and
- Minimize the consequences, in the event of the occurrence of the event.
- Compensations for impacts that are unavoidable, e.g Land take.

The residual impact after mitigation will be handled by the regular HSE policy and procedures for Abia SAPZ .

6.3 IMPACT MITIGATION MEASURES

6.3.1 Air Quality

Land Preparation and Construction Phase

The impacts of land preparation and construction on Air quality; major impacts are emissions from vehicles and equipment engines, dust from land clearing and excavation.

The following mitigation measures are recommended:

- ✓ Dust suppression methods such as water suppression will be employed to reduce visible fugitive dust during construction works in the dry season.
- Trucks, Vehicles, Generators and machinery will be kept good working condition and undertake regular maintenance.
- We will ensure vehicles and trucks have catalytic converters installed.
- Stationary generators shall be well located to facilitate emission plume dispersion;
- Cover properly loose materials and keep top layers moist;
- Use binder material for erosion and dust control for long term exposed surfaces;

- Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt

Use covered trucks for the transportation of materials that release dust emissions;

- Speed limits shall be maintained on-site of 15.0km/h on unhardened roads and surfaces.

With the implementation of the above measures the residual air quality impacts can be expected to be moderate.

Operation Phase

The impacts of Operations on Air quality, from emissions from vehicles, oil spill Sf6 releases and ozone from corona effect.

The following mitigation measures are recommended:

- Trucks, Vehicles, Generators and machinery will be kept in good working condition and undertake regular maintenance.

- We will ensure, vehicles and trucks have catalytic converters installed.

- the impact of SF6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques.

- Oil spill will be reduced by containing oil tank in bounded area.

With the implementation of the above measures the residual air quality impacts can be expected to be minor

6.3.2 Green House Gas

Land Preparation and Construction Phase

The impact of vegetation clearing, resulting to reduction of carbon sink ability of the environment and the use of equipment and vehicles during the construction resulting to the release of GHG gases shall be mitigated through:

- the use of good international practice, including maintaining and operating all vehicles and equipment engines in accordance with manufacturers recommendations,
- restriction of vegetation clearing to only the required area.

The impact on climate change is minor.

6. 3.3 Water Resources

Land Preparation and Construction Phase

Impact of ground and surface water contamination from accidental spills and improper disposal of excavated materials, waste and wastewater.

The following mitigation measures will be adopted to reduce potential impacts from project activities on surface and groundwater:

▪ Storm-water drains and stream channels will be protected against erosion through a combination of adequate design dimensions and slope angles.

▪ Permanent drainage installations will be designed for heavy rainfall events.

▪ Temporary toilets will be provided for workers

The following mitigation measures will be adopted to reduce potential impacts from spills and leakages.

▪ Petroleum and Chemical storage Drums, tanks will have appropriate secondary containment (bunds) or dyke, and procedures for managing the containment systems

▪ Impervious concrete surfaces will be in place at all areas of potential leaks and spills, and loading /unloading areas.

Operation Phase

The impact is considered **minor,** no additional measures have been identified because best practices and guidelines shall be used for all operations.

6.3.4 Terrestrial Ecology

Land Preparation and Construction Phase

Impact on Terrestrial flora and Fauna

The following recommendations for mitigation measures are outlined below:

• Limit lightening on site;

• Sensitivity training to staff and anti-poaching policy; and

• Site clearance activities to be restricted to the minimum required area.

The residual impacts on terrestrial ecology can be expected to be minor

Impact due to the introduction of alien species

Alien invasive species have been identified in the project area. There will be regular vegetation cutting within the project area. The residual impact is being kept as minor.

Operation Phase

No additional impact is envisaged from project operation. The residual impact is being kept as **minor**

6.3.5 Geology, Soil and Land-use

The following mitigation measures to reduce impacts on soil structure from compaction and erosion are recommended:

• Protect excavated soil materials from erosion;

• Ensure that the land is physically restored before leaving to next tower location and before the next rainy season; and

• Use of existing track for transport of man and material to the extent possible;

Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques;

• Set-up and apply procedure regarding dealing with contaminated soils;

• Development and implementation of a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly; and

• Spread sheet underneath the tower structure prior to start any painting activity.

With the implementation of the above measures the residual soil and geology quality impacts can be expected to be **minor.**

Operation Phase

No additional impact is envisaged from project operation. The residual impact is being kept as minor.

6.3.6 Waste Management

Land Preparation and Construction Phase

Mitigation Measures:

▪ Abia SAPZ contractor will update the Waste Management plan of ESMP for construction.

▪ All waste on site will be identified, collected, classified, stored and segregated.

▪ SAPZ contactors will work with the State Waste Management Agency and approved waste contractors, which meet the appropriate standards will be used for transport of wastes to approved landfill.

▪ Illegal dumping of waste on site will be prohibited.

▪ There will be proper housekeeping on site.

▪ Open bush defecation will be prohibited on site and camp.

▪ Waste bin with standard cover will be used at worker's camp and work area.

▪ There will be rigorous waste management campaign on site.

With the implementation of the above measures the residual impacts can be expected to be **moderate.**

Operation Phase

Mitigation Measures:

▪ PIU will update the Waste Management plan of ESMP for operation phase

▪ PIU will work with respect State Waste Management Agency and approved waste contractors, for collection of waste at SAPZs.

▪ Waste bin with standard cover will be used at SAPZ.

▪ Waste will be segregated.

With the implementation of the above measures the residual impacts can be expected to be **minor**

6.3.7 Employment, Labour and Working Conditions

Mitigation Measures:

• Employment and procurement: The project will afford preferential status to people from the local communities, with regards to employment.

• Skills training: In recognition of the current skills shortage in the local area, SAPZ will implement vocational skill training programme to ensure that an adequate supply of basic skilled workers will be available from the local area for selected positions.

• Business Opportunities: The project will also assess the potential goods that the community could supply to the project and will preferentially procure these locally as long as they are competitive with the goods from other sources.

• A Community Liaison Officer (CLO) will be employed to liaise between communities.

• SAPZ and contractors will develop transparent human resources policies and procedures for recruitment process, working conditions, terms of employment wages, worker-employer relations, nondiscrimination policy, monitoring, roles and responsibilities;

• Abia SAPZ contractor Provide reasonable, and if applicable negotiated, working terms and conditions;

✓ Establish worker's grievance mechanism, so that potential conflicts can be dealt with in an early and proper way;

✓ No use of child labour (workers under age 18) or forced labour is allowed;

✓ Provisions to ensure compliance with labour standards by supply chain and

subcontracts, including training if required;

- ✓ Provide proper work place facilities for water/sanitation/rest rooms;
- ✓ If case of retrenchment needs first viable alternatives are analysed and then adverse impacts of retrenchment on workers are reduced as much as possible. A transparent retrenchment plan will be prepared;
- ✓ There will not be hiring of short-term labour to be made at the site gate.
- ✓ A Local Content Plan should be prepared to facilitate involvement of local labour as much as possible. The implementation of the plan will enhance ability to locate local hires and Nigerian nationals. This plan should include provisions for hiring women and for "equal pay for work of equal value". 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.

There is positive impact of employment of workers for the project, the mitigation measures will enhance the positive impact. The negative impact has been mitigated and the residual impact is **moderate**.

6.3.8 Stakeholder and Community Expectation

The concerns of the close-by communities of cumulative effects of environmental and safety/security impacts and inconveniences of the transmission lines in combination with the existing activities.

Mitigation measures proposed:

- Implements mitigation for construction phase air quality, noise and traffic;
- Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting;
- Set-up, manage and effectively manage construction phase grievance mechanism system. Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in the ESMP;

• Engage communities in the monitoring activities to enhance transparency and involvement.

• Enhance ongoing consultations with local communities.

• Ongoing reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts.

• A Local Content Plan should be prepared to facilitate involvement of local labour as much as possible. The implementation of the plan will enhance ability to locate local hires and Nigerian nationals. This plan should include provisions for hiring women and for "equal pay for work of equal value". 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.

With the implementation of the above measures the residual impacts can be expected to be **moderate.**

6.3.9 Community Health, Safety and Security

Land Preparation and Construction Phase

To reduce the potential adverse impacts and risks of the construction works on the community health, safety and security, the following mitigation measures should be implemented:

To reduce traffic accident risks the Contractor should implement a traffic Management and safety plan, including design of access point, signalization, speed limits,

- ✓ There shall be regular training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), maintain log of traffic related incidents, sensitization of road users and people living close to the construction site. If this plan is thoroughly implemented, this residual risk can be minor.

- ✓ Further a code of behaviours for workers should be developed, which should be trained and periodically refreshed, as needed based on community liaison/grievance mechanism feedback. This will help in reducing the potential for frictions between outside labour and local community members to a minor level.
- ✓ To reduce the risk of an increase in STD prevalence, awareness raising material and condoms should be provided to all workers. Herewith the risk can be mitigated to a minor level.
- ✓ The construction site should be managed to eliminate potential mosquito breeding sites. This includes the prevention of surface water ponding and stagnant water on site.
- ✓ With the construction activities, valuable materials and equipment and the presence of a labour force come to the construction site. Opportunistic people (possibly local youth) or organised crime may be tempted to steal materials from the site. These security risks may threaten all staff working at the construction site and neighbours. There will be armed security guards on site and security forces in the area, the residual impact is to be kept as **minor**

Operation Phase

To reduce the external safety risks for the people living close to Abia SAPZ project sites the following measures will be implemented:

- ✓ To prevent as much as possible emergencies and to manage the response to emergencies when they occur in the operation phase of the Project an emergency response plan should be developed and implemented following Abia State Ministry of Agriculture standards and international best practice including provisions for prevention and response to bush fires, roles and responsibilities and emergency response. This plan should be coordinated by PIU and the Local Government;

- ✓ Annual safety audit of all Abia SAPZ facilities should be performed to identify potential safety risks in an early stage and keep maintenance at high standards, so that snapping of lines or collapsing of towers is prevented as much as possible; and
- ✓ The affected communities in the area of influence of the SAPZ project should be informed about the safety risks related to the operations of the processing hub the do's and don'ts in the site and the response measures in place, when an incident
- ✓ happens (from the emergency response plan).
- ✓ Signage will be placed on strategic places to warn about the risk in the hub.

With the serious implementation of the above measures the residual safety risks can be expected to be reduced to a **minor** level.

6.3.10 Cultural Heritage

Mitigation Measures

▪ SAPZ contactors will liaise with community leaders to confirm the location of the cultural sites.

▪ PML will develop an education programme to encourage good relations with the local community and raise awareness about the transmission of communicable diseases including HIV/AIDS and other sexually transmitted infections (STIs).

▪ A grievance process will be developed to enable community concerns to be documented and addressed. A CLO will be appointed and the community informed of this contact and process of communication with the project.

6.3.11 Occupational Health and Safety

Land Preparation and Construction Phase

Occupational health and safety hazards from construction works can lead to various impacts on the workers, such as injuries, temporary/ permanent disabilities, fatalities.

1. Accidents from moving objects

This impact will be mitigated with the traffic management plan and lifting procedures on site

2. Working at height. This impact will be mitigated with Work at height Procedures in HSE plan of the project.

3. Exposure to chemicals. There will be mitigated with the HSE plan of the project.

4. Live power lines from other adjourning facilities,

This will be mitigated by regular HSE permit procedures on site which include site inspection and risk assessments.

5. Material and Manual Handling etc. There will be mitigated with the HSE plan of the project.

6. Outbreak of epidemic.

This will be mitigated with the HSE plan of the project.

These residual impacts are considered **Moderate**

Operation Phase

Exposure to chemicals

Occupational exposures to chemicals in this sector primarily include handling of pesticides (herbicides) and other agro-chemicals used for improved crop production, and exposure to PCBs from gasoline

Pesticides

Recommendations specific to the use of pesticides include:

- ✓ Train personnel to apply pesticides and ensure that personnel have received the necessary certifications, or equivalent training where such certifications are not required;
- ✓ Ensure hygiene practices are followed (in accordance to FAO and PMP) to avoid exposure of family members to pesticides residues.

6.4 SUMMARY OF THE MITIGATION MEASURES

The Summary of the mitigation measures from the impact of all project activities is included in Table 6.1 for Site preparation and construction Phase and Table 6.2 for Operation Phase

Table 6.1: Summary of Mitigation Measures during Site Preparation and Construction.

Indicator	Potential Environmental Impact	Receptors	Impacts (pre-mitigation)	Mitigation	Impacts (Post-mitigation)
Air Quality	Elevated dust levels in nearby communities and roads as a result of site preparation, construction and vehicular movements	Communities and roads user within SAPZ project sites	**Major**	SAPZ Shall: -Use dust suppression methods. -Trucks, Vehicles, Generators and machinery will be kept good working condition and undertake regular maintenance. -Cover properly loose materials. -Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt; -Use covered trucks for the transportation of materials that release dust emissions; -Speed limits shall be maintained on- site of 15.0km/h on unhardened roads and surfaces.	**Moderate**
	Industrial machinery and vehicular movement during site preparation, construction will result in PM, SO_2, CO, NOx, CO_2 gases emissions	Communities and roads user along SAPZ sites	Moderate	SAPZ shall -Use good international practice: -Maintain and operate all vehicles and equipment engines in accordance with manufacturers recom. -Stationary generators to be located	Minor

				to facilitate dispersion -We will ensure vehicles and trucks have catalytic converters installed.	
GHGs	The estimated GHG Forest clearing during the land preparation stage for the proposed project is small	Climate Change	Minor	SAPZ -Use of good international practice, including maintaining and operating all vehicles and equipment -Restriction of vegetation clearing to only the required area	Minor
Noise and Vibration	Nuisance noise and vibration from construction activities	Communities and roads user within SAPZ sites	Moderate	SAPZ -Ensure construction activities, especially noisy activities such as pilling will be carried out during the day. •Mechanical equipment with lower sound power levels will be selected to ensure that permissible occupation exposure limit of 90 dB(A) is not exceeded. • Construction workers and personnel will wear hearing protection when required.	Minor
Geology, Soil and Landuse	Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation.	SAPZ project site	Moderate	SAPZ •Protect excavated soil materials from erosion; •Ensure that the land is physically restored before leaving to next tower -Use of existing track for transport of man and material to the extent possible; •Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques	Minor
	Potential contamination of soil from inadvertent	SAPZ site	Minor	SAPZ	Minor

	release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminum oxide paint, etc.)			-Ensure storm water drains and stream channels will be protected against erosion.	
Water Resources	Impact of ground and surface water contamination from accidental spills and improper disposal of excavated materials, waste and wastewater	Surface and ground water with SAPZ sites	Moderate	-Temporary toilets will be provided for workers. -Petroleum and Chemical storage Drums, tanks will have appropriate secondary containment (bunds) or dyke, and procedures for managing the containment systems	Minor
Terrestrial Ecology	Loss of vegetation due to clearance activities	SAPZ site	Major	-Site clearance activities to be restricted to the minimum required area.	Moderate
	Inversion of alien species	SAPZ site	Minor	SAPZ -Ensure there will be regular vegetation cutting along the SAPZ roads	Minor
	Loss/disturbance of habitats of fauna and flora arising from dust, air emissions, light, noise and vibration, traffic, accidental spillages and sediment run-off.	SAPZ site	Minor	SAPZ •Limit lightening on site; •Sensitivity training to staff and anti- poaching policy;	Minor
Waste management	Waste generated during site preparation and construction	SAPZ site	Major	SAPZ contractor will update the Waste Management plan of ESMP for construction. -All waste on site will be identified, collected, classified, stored and segregated. -SAPZ contactors will work with respective State Waste Management Agency and approved waste contractors, which meet the appropriate standards will be used	Moderate

				for transport of wastes to approved landfill. -Illegal dumping of waste on site will be prohibited There will be proper housekeeping on site. -Open bush defecation will be prohibited on site and camp. -Waste bin with standard cover will be used at worker's camp and work area. -The will be rigorous waste management campaign on site	
Employment, Labour And Working Conditions	Employment opportunities for communities during site preparation and construction	SAPZ Communities	Positive	SAPZ -The project will afford preferential status to people from the local communities, with regards to employment. •Skills training: PML will implement vocational skill training programme. •Business Opportunities: The project will also assess the potential goods that the community could supply to the project and will preferentially procure these locally as long as they are competitive with the goods from other sources. •A Community Liaison Officer (CLO) will be employed to liaise between communities.	Positive
	Contractor recruiting	Communities	Minor	SAPZ -Ensure PML and EPC contractor	Minor

	Labour paying them low wages and not too good working conditions	Within SAPZ site		develop transparent human resources policies and procedures for recruitment process, working conditions, terms of employment wages, worker-employer relations, nondiscrimination policy, monitoring, roles and responsibilities;	
	Hazards of work	Communities Within SAPZ site	Moderate	SAPZ -Ensures HSE rules are established and not flouted -Ensure PPE are used regularly	Minor
Stakeholder and Community Expectation	Construction activities causing air and dust emissions, traffic, influx and community safety/security, noise/vibrations and the adverse impacts and inconveniences experienced from these issues	Communities with SAPZ sites	Moderate	SAPZ Implements mitigation for construction phase air quality, noise and traffic; •Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads	Moderate
Community Health, Safety And Security	There will be increased risks of traffic safety incidents on public roads	Communities within SAPZ site and other workers	Moderate	SAPZ -Implement traffic safety plan, -ensures HSE are on site at all times, -Speed limit should be enforced	Minor
	Health risk from temporary influx of outside workers due to the construction activity	Communities With SAPZ and other workers	Moderate	To reduce the risk of an increase in STD prevalence, awareness and condoms should be provided to all workers. -Contractors eliminate potential mosquito breeding sites	Minor

Cultural Heritage	No Shrines is located Within SAPZ site and not close to biodiversity conservation priority area . Potentially the construction works generating additional traffic, noise and dust may interact with these cultural festivals,	Communities With SAPZ and other workers	Minor	-Ensures PML and EPC contactors will liaise with community leaders to confirm the location of the cultural sites. SAPZ - to raise awareness about the transmission of communicable diseases including HIV/AIDS and other sexually transmitted infections (STIs). -A grievance process will be developed to enable community concerns to be documented and addressed.	Minor
Cumulative Impacts	Traffic from diff. construction activities will lead to cumulative impact on communities and road user	Communities With SAPZ and other workers	Moderate	Implement traffic management plan. Ensures Trucks and vehicles adhere to speed limit	Moderate
	Employment form different projects will lead to positive cumulative impact	Communities With SAPZ and other workers	Positive	Ensures workers are employed from communities around project area	Positive
Occupational Health And Safety	Unrest from Workers injuries or fatalities. outbreak of diseases.	Workers	Major	Implement HSE plan for operations approved SAPZ	Major

Legend

Positive	Low	Moderate	Minor

Table 6.2: Summary of Mitigation Measures during Operation.

Indicator	Potential Environmental Impact	Receptors	Impacts (pre-mitigation)	Mitigation	Impacts (Post-mitigation)
Air Quality	Forest fires and Spill of this Oils and leakage of SF6 will results to both air pollution and contaminated soil.	Communities and other Road users	Moderate	Bound oil storages area to prevent spills on ground.	Minor
	Transport emissions (SO_2, CO, NOx, CO_2, PM) and Ozone from Corona effect	Communities and other roads user	Moderate	Use good international practice: -Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendation. -We will ensure vehicles and trucks have catalytic converters installed.	Minor
GHGs	The estimated GHG for vegetation clearing along	Climate Change	Minor	Restriction of frequent vegetation clearing to only. -Operations vehicles will be kept good working condition.	Minor
	Accidental discharge of SF6 during operation.	Climate Change	Moderate	the impact of SF6 shall be mitigated through the improvements in the leak	Minor

				rate of equipment	
Noise and Vibration	Nuisance noise and vibration from humans and machinery during SAPZ operations	Communities and roads use	Minor	Noise effect will be Reduced when machineries are operated according to manufacturer's specification and operation procedures.	Minor
Water Resources	Impact of ground and accidental spills and improper disposal of excavated materials, waste and wastewater	Groundwater Within SAPZ sites	Minor	Implements Environmental Management System(EMS)	Minor
Terrestrial Ecology	Loss of vegetation due to regular vegetation clearance	SAPZ site	Moderate	Implements Environmental Management System(EMS)	Minor
Waste management	Waste generated during operations	SAPZ operations	Major	-SAPZ - will update the Waste Management plan of ESMP for operation phase -SAPZ will work with respect State Waste Management Agency and approved waste contractors, for collection of waste at subsites	Minor

				Waste bin with standard cover will be used at subsites. -Waste will be segregated	
Employment, Labour And Working Conditions	Employment opportunity is available for community members both skilled and unskilled. Other indirect jobs will be available	SAPZ project	Positive	Employment of communities members during SAPZ operation	Positive
Community, Occupational Health, Safety And Security	Occupational health risk (including poisoning, skin irritation, respiratory problems) to farmers due to handling of chemicals including fertilizers, herbicides and pesticides	SAPZ and other workers	Moderate	Develop a project specific Occupational Health and Safety Plan (OHSP) commensurate to farming activities and sensitize workers and farmers. OHSP to include. • Ensure chemicals are securely stored and handled by only trained personnel equipped with appropriate PPE. • Train workers/farmers on chemical handling, provide hand and respiratory PPEs and enforce usage. • Provide adequate first aid and first aiders on the farms. • Restrict unauthorized access	Minor

				to all areas of high-risk activities. • Adequate safety signage and barriers at staging areas, equipment parking areas etc shall be installed to alert workers, community members, drivers and pedestrians.	

Legend

Positive	Low	Moderate	Minor

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 INTRODUCTION

This chapter covers the Environmental and Social Management Plan (ESMP) for Abia State SAPZ project. The ESMP will be used to deliver the project's HSE regulatory compliance objectives and other related commitments.

The ESMP covers project activities during site preparation, construction and operation and will be subject to thorough reviews prior to the commencement of activities to ensure completeness. The ESMP details the mitigation and enhancement measures SAPZ project is committed to implement throughout the life of the Project and includes desired outcomes; performance indicators; targets or acceptance criteria; monitoring and timing for actions and responsibilities. In addition, it provides the means whereby the mitigation measures developed for reducing the effects of significant impacts to as low as reasonably practicable (ALARP) be implemented and monitored throughout the project lifecycle. ESMP Plan includes:

Institutional arrangements – the assignment of responsibilities in SAPZ for carrying out health, safety and environment (HSE) practices;

- Environmental Management Plan, monitoring and reporting procedures;
- Waste management plan, WMP;
- Traffic Management and Safety Plan;
- Social management plan, SMP;
- Staff training and awareness;
- Contingency Planning/Emergency response preparedness;
- Monitoring of the effectiveness of environmental protection measures; and
- Environmental management reviews/audits.

7.2 THE OBJECTIVES OF EMP

- Identification of environmental Aspect and impact sensitivities; promote environmental and social management and communicate the aims and goals of the ESMP; ensure that all PML workers, subcontractors and others involved in the Project meet legal and other requirements with regard to environmental and social management;
- Address concerns and issues raised by the stakeholders and those that will likely arise during project lifetime;
- Serves as action plan for environmental management;
- Prepare and maintain records of project environmental performance;
- Monitoring of the effectiveness of environmental protection measures; and
- Periodic auditing of the success of the overall strategy.

7. 3 –PLANNING

7.3.1 Project Commitments

The goal of this ESMP is to ensure full compliance with the project's policies and with mitigation, monitoring and other commitments made in the ESIA report. It outlines the actions necessary to attain this goal, and describes the means, and designation of responsible persons required for compliance and conformance. The outline ESMP provides the link for implementation of mitigation and monitoring actions described in Chapters 6.

To this end Abia SAPZ shall put in place measures to enforce compliance by the project team on a daily basis throughout the duration of the project. The ESMP section of this EIA shall be extracted as a standalone document for ease of usage.

Implementation of Mitigation Measures

All the mitigation measures identified in this ESIA are listed in Chapter Six. All the measures listed represent Abia State's expressed commitment and shall be incorporated into the HSE manual of SAPZ project.

7.3.2 Management Plans

Management Plan comprise a number of related detailed management plans and procedures for compliance with specific environmental and social elements and describes the plans and processes required for carrying out the necessary activities. The key management plans are outlined in Table 7.1 with information on how these relate to the activities and impacts being discussed in the ESIA report, including reference to who has lead responsibility.

Abia SAPZ shall also establish the institutional capability to implement the environmental management plan. The Company shall have:

- HSE who develop HSE policies and implement them. An HSE management system will be put in place according to international best practice.
- Safety and Environment Officers who will carry out health, safety and environment audits, inspections and other programmes as a means of identifying and eliminating hazards and unsafe practices at work.
- A Community Relations officer that will deal with common security threats such as community and local staff agitations and demonstrations, and sabotage and community development.
- Qualified Abia SAPZ Contractor will handle all construction processes and the contractors will be supervised by certified Engineers with proven experiences in construction industry.
- in compliance with relevant national and international EHS legislation
- and regulations, and with other requirements to which the project
- subscribes; in conformance with the project's EMP; and

- in accordance with contractual technical and quality specifications.

Supervision of subcontractor activities will be conducted by Project Manager and his team. This will be accomplished through management controls over strategic project

aspects and interaction with subcontractor staff where project activities take place. The Organisation includes a CLO whose role is crucial to the successful implementation of the ESMP and the continuation of liaison with the local community.

Table 7.1: ESMP Key Plans.

S/N	Plan Name	Includes	Plan Owner
1	Project Overall ESMP	Overarching plan linking all the other plans to the project ESMP	SAPZ Project coordinator
2	Occupational Health and Safety Management Plan	A set of policies, procedures and plans that systematically manages health and safety at work and can help to minimise the risk of injury and illness from workplace operations	HSE Manager
3	Environmental Monitoring Plan	Groundwater monitoring, routine effluent and discharge monitoring and air quality monitoring, noise monitoring	HSE Manager /Consultant
4	Waste Management Plan	Project-related waste handling procedures for hazardous and non-hazardous solid wastes. Including chemical handling procedure	HSE Manager /Coordinator
5	Emergency Preparedness And Response Plan	Administration (policy, purpose, distribution, definitions, etc.), organization of emergency areas	E and S safeguard officer
6	Traffic Management Plan	routes, driver training, vehicle maintenance, speed restrictions, appropriate road safety signage, and vehicle loading and maintenance measure	Transport Manager

7	Stakeholder Engagement /Community Development Programme;	Management of all stakeholder	Government /Community Relation Manager
8	Human Resources Policies and Procedures	Management of all staff	Human Resources Manager

7. 4 Institutional Framework for Implementation of the ESMP

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

These are represented in Figure 7.1.

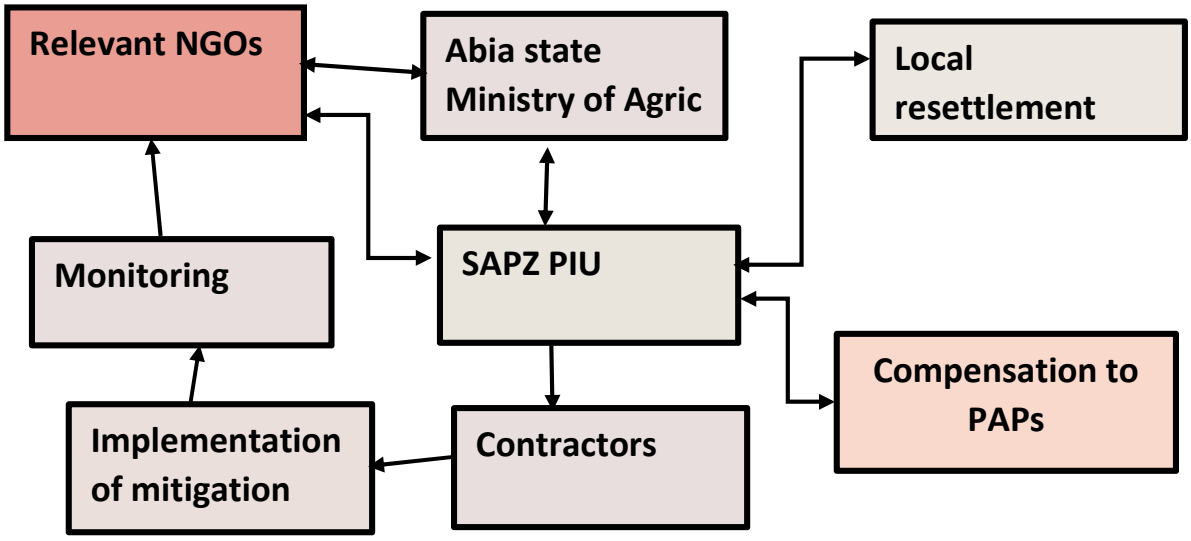

Figure 7.1: Institutional Arrangements for the implementation of ESMP of Abia SAPZ

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

Overall:

Abia SAPZ through the State Ministry Agriculture will have principal responsibility for all measures outlined in the ESMP for the construction phase.

• SAPZ is responsible for the implementation of the measures in the operation phase.

• Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, this is clearly 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.

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 RAP and ESMP to a certain extent. SAPZ contractors are responsible for implementation of the ESMP and an independent consultant responsible for RAP implementation. Overall regulatory agencies at National State and Local Government levels are responsible for the implementation of ESMP.

7.4.1 Project Proponent (Abia State Ministry of Agriculture)

Abia State Ministry of Agriculture is the implementation agency for this project. Hence, has the overall responsibility for its success. The PIU for AfDB projects has been established by the ministry to handle this responsibility. The PIU is headed by a Project Manager who reports to the Commissioner

7.4.2 Project Implementation Unit(PIU).

The PIU set up by Abia Ministry of Agriculture-AfDB is saddled with the responsibility of project implementation. It is headed by a Project Manager/coordinator. Members of the PIU consist of technical experts and environmental, social as well as two liaison officers shall be appointed drawn

from relevant departments of the Ministry, including HSE, Projects, Lines, procurement, planning, etc.

Abia state Ministry of Agric/PIU is responsible for the overall project planning and execution, including preparation of bidding documents, hiring of project management consultants, SAPZ contractors and supervision of the works. This approach includes ensure proper implementation of the environmental and social management measures contained in the ESMP, the RAP and their surveillance and monitoring.

In order to provide additional oversight, the project PIU will hire an independent consultant to manage the RAP and ESMP implementation including payment of compensation. The PIU will also invite relevant NGO to monitor and insure effective implementation of the RAP. It shall be responsible to ensure that the Project's detailed design of the ESMP is based on the final detailed engineering design and ensure that measures to be undertaken during construction and environmental technical specifications are included in the bidding documents and contractual obligations with the winning bidder for each of the contracted elements of the

Project.

7.5 Abia state Ministry of Agric, Environment Division

The Environment Unit of AB Ministry of Agric 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.

7.5.1 Regulatory Agencies and Other Concerned Authorities

The Federal Ministry of Environment (FMEnv) has the responsibility for the implementation of the EIA Act 86 of 1992. Furthermore, State Ministries for

Environment (Abia) and affected LGAs, Bende, Ikwuano and Ukwa West have certain oversight roles, which they perform under coordination of the FMEnv. Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the Abia State Ministry Agriculture and the contractors as presented in the Table 7.2.

Table 7.2: Responsibilities of PIU, Abia State Agric and Contractors

Concerned ministries	Competent authorities	Project implementation unit (PIU),	Ministry of Agric and the contractors
Federal Ministry of Environment (FMEnv) • Abia State Ministry of Environment Abia state ministry of Agriculture	Federal Government of Nigeria. Abia state Ministry of Physical Planning and Urban Development(renewal) (ASMPPUD) • Abia State Environmental Protection Agency (ASEPA) • Abia State Ministry of Land Survey and Urban planning (ASMLSUP) • Abia State Ministry of Women Affairs (ASMWA) • Abia State Ministry of Transport (ASMT)	AfDB Project Implementation Unit (PIU)	SAPZ and Local government representatives

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 approval and

implementation, in accordance with the EIA Act. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures, when the project commences. And they can issue directives to the project on specific actions related to the environment in the project area. The Ministry normally involves the states and sometimes local governments in this responsibility depending on the specific activity.

Abia State Ministry of Environment (ASMEnv)

Abia State Ministry of Environment is charged with the obligation of developing and implementing environmental policies, programs and legislation, environmental protection and control, environmental technology including efficient implementation of research and development.

Table 7.3 Mitigation of identified Environmental and Social Impacts

Activities	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Supervision	Institutional Responsibility (Monitoring)	Costs (USD)
A	**PRE-CONSTRUCTION PHASE**											
	Site Clearing and Mobilization											
Environmental Impacts												
1	Increase in amounts of fugitive dust, exhaust fumes and GHGs from movement of heavy-duty vehicles and equipment into work areas.	Sprinkling of water via spraying devices to limit dusts.	Contractor	500	Gaseous pollutants: SO_2, NO_2, CO_2, CO,VOCs, H_2S, TSP Vehicle emission	In-situ Air Quality Measurement Visual Observation Vehicle emission testing (VET) and vehicle exhaust screening (VES Report	FMEnv air pollutants permissible limit	2-3 Km Radius of project area	As required	AfDB PIU	SPIU, Ministry's Enviro safe guard officers	300
		Ensure that vehicles are serviced; undergo vehicle emission testing (VET) and vehicle exhaust screening (VES) as laid down in the NESREA guidelines.	Contractor	650			FMEnv air pollutants permissible limit	On-site and nearby community	Monthly	AfDB PIU	SPIU, Ministry's Environment/ Social Safeguard Officer	
2	Loss of top soil and soil compaction due to	Limit zone of vehicle and equipment weight impacts	Contractor	300	Visible demarcation of vehicles	Visual observation	Visual observation	Project camp sites and equipme	Monthly	AfDB PIU	SPIU, Ministry's Environment/ Social	400

	movement of vehicles to site and stacking of heavy-duty equipment	(designate an area for parking and stacking equipment)			and equipment limit zone	Soil Compaction test	Soil Compaction test	nt packing zones			Safeguard Officer	
	Leakages from stacked equipment and subsequent intrusion of oil and chemical substances into soil.	Ensure fastening of loose parts (bolts, nuts); Install impermeable surface at the limit zone to contain potential leakages	Contractor	400	Installation of impermeable platform at limit zone.	Project camp sites and equipment packing zones	Soil quality test	Project camp sites and equipment packing zones	Monthly	AfDB PIU	PIU, Ministry's Environment/ Social Safeguard Officer	
3	Increase in noise level above permissible noise level, (90dB) during movement	Equipment should be transported after school hours (3.00pm)/ weekends when it will cause least disturbance Retrofit machines with sound proof	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	2-3Km Radius of project site	As required	AfDB PIU	SPIU, Ministry's Environment/ Social Safeguard Officer	300
4	Displacement of soil fauna and damage to flora.	Limit vegetation clearing to minimum area required to create access path	Contractor	-	Radius of cleared path	Visual Observation	Evidence of vegetation	School premises	One-off	AfDB PIU	SPIU, Ministry's Environment/ Social Safeguard Officer	

5	Occupational accidents and injuries from the use of machineries and equipment	Provision of PPE to workers; Worker Education Incident/accident reporting; Provision of First Aid onsite	Contractor	800	Contractors Compliance.	Routine inspection	Use of PPEs by Workers Training Records	Construction site	Daily		Safeguard officers	600
6	Accidents involving vehicles or pedestrians during vehicle and equipment movement to the site.	Training of drivers on safe driving practices Install safety signage	Contractor	400	Accident Report	Site Inspection Consultations	Training Report Accident/ Incident Report	Routes through community to the sites School premises	Every 2 weeks	AfDB PIU	NESREA	100
Social Impacts												
1	Nuisance to nearby residential areas and school pupil	Retrofit with suitable cost effective vehicle sound proofing materials/ technologies.	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	2-3Km Radius of project site	Weekly	AfDB PIU	Ministry's Environment/ Social Safeguard Officer, Project Engineer	300
2	Uproar if equipment is not parked at designated location	Ensure equipment is taken straight to the construction Camp where this is not achievable as some point due	Contractor	-	Complaints from residents	Site Inspection Consultations	Contractor's compliance	Routes through community to the parking Camp	One-off	AfDB PIU	Ministry's Environment/ Social Safeguard Officer, Project Engineer	-

		to extreme condition, adequate communication should be made to the relevant authority.										
Sub Total				**3,050**								**2,000**

Table 7.4 Environmental and Social Management and Monitoring Plan - Construction Phase

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
	Operation and movement of equipment/ Rehabilitation works											
Environmental Impacts												
1	Release of exhaust fumes, hazardous gases (NOx, CO, SOx, SPM,), Oxides from machinery	Regular servicing of machinery and equipment	Contractor	400	Gaseous pollutants: SO_2, NO_2, CO2, CO,VOCs, H_2S, TSP	In-situ Air Quality Measurement	FMEnv air pollutants permissible limit	On-site and nearby community	Every two months	SPIU, NESREA Environment/Social Safeguard Officer, Project Engineer, Imo SMEV	AfDB PIU	500
	GHG Emissions	Fuel switching- Fuel switching from high- to low-carbon content fuels (where available) can be a relatively cost effective means to mitigate GHG emissions during this phase. Energy efficiency- Machines e.g. generator plants could be turned off when not in use, in order to reduce carbon emissions.	Contractor	1000	Gaseous pollutants: SO_2, NO_2, CO_2, CO,VOCs, H_2S, TSP	Visual Observation Vehicle emission testing (VET) and vehicle exhaust screening (VES Report	FMEnv air pollutants permissible limit	Project	Every two months		AfDB PIU	

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
2	Pollution of the environment from open defecation by contractors workers	Contractor to provide mobile toilets for workers Sensitize workers against open defecation	Contractor	2,500	Evidence of feacal waste within the project sites	Site inspection	Absence of feacal waste on-site	Camp sites and working zones	Weekly	SPIU, NESREA Environment/Social Safeguard Officer,	AfDB PIU	400
3	Surface soil compaction from Movement of heavy vehicles/Stationary vehicles and equipment	Creation of limit zones Minimize compaction during stockpiling by working in the dry state Rip compacted areas to reduce runoff and re-vegetate where necessary	Contractor	500	Visible demarcation of vehicles and equipment limit zone	Visual observation Soil Compaction test	Visual observation Soil Compaction test	Project camp sites and equipment packing zones	Monthly	SPIU, NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	400
4	Pollution of soil and groundwater contamination by oil spills, lubricants and other chemicals	All oil and lubricants should be sited on an impervious base and should have drip pans The storage area should be far from boreholes, all containers should be clearly labelled	Contractor	400	Soil quality parameters (especially hydrocarbon contaminants) Compliance	In situ/ Laboratory Analysis Visual Observation	FMEnv soil pollutants permissible limit	Project areas	Twice during construction	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
					with fuel storage procedures							
5	Vibrations to existing buildings and subsequent building collapse if not attended to	Mitigation at source (for all activities) A noise barrier or acoustic shield will reduce noise by interrupting the propagation of sound waves. Limiting operation to specific areas where work is carried out	Contractor	500	Presence of affected buildings	Visual inspection	Machinery fitted with acoustic shield	Project areas	Monthly	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	500
6	Presence of construction waste on-site which can pollute the environment	Implement site-specific waste management plan Liaise with State Environmental Protection Agency for effective waste management and safe handling/disposal of waste	Contractor	500	Presence of construction waste on-site	Site inspection	Compliance with the site waste management plan Good house keeping	Project areas	Weekly	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	1,800
7	Air quality deterioration	Suppress dust emission by sprinkling water	Contractor	1500	PM levels	In-situ measurement	Emission of noxious gases	Location of work	Daily	NESREA Environment/Social	AfDB PIU	400

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
										Safeguard Officer, Project Engineer		
8	Increase in noise level above permissible noise level, (90dB) during movement	Adequate maintenance of equipment and machineries to reduce noise Retrofit machines with sound proof	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	2-3Km Radius of project site	Weekly	NESREA Environment/Social Safeguard Officer	AfDB PIU	700
9	Loss of Vegetation cover	Limit clearing to required road built up area Re-plant where it is relevant	Contractor	1000	Vegetation cover within the area	Visual Observation	vegetation at the appropriate outside the ROW	Project ROW	Monthly	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	500
10	Disruption in current flow of streams and rivers	Construct temporary diversions or re-channel streams and rivers temporarily	Contractor	1000	Gaseous Pollutants such as SO_2, NO_2, CO_2, CO, VOCs, H_2S, TSP	In-situ Air Quality Measurement	Routine testing procedures are being conducted	Project Site	Daily Two months	Imo SMENV; NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
11	Creation of Burrow Pits	Ensure covering of pits after use; Limit the need to dig excessive borrow pits Ensure not to exceed approved max. depth of burrowing	Contractor	2000	Contractors' Compliance	Inspections	Number of borrow pits	Project roads	Monthly	Imo SMENV; NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	500
	Operation and movement of equipment/ Rehabilitation works											
Social Impacts												
1	Grievances and negative perception by community members	Conduct stakeholders consultation with the host community at every phase of the project	Contractor	1300	No of complaints by community persons	Consultations Review grievance log	Minimal number of reported cases	Host community	Every 2 months	NESREA Environment/Social Safeguard Officer, Project Engineer		700
2	Increase in sexual activities leading to possible spread of STDs/STIs from influx of workers (foreigners) to project location	Awareness campaign on sexual diseases, and distribution of male and female condoms.	Contractor	600	Level of Awareness and Education No of new STI cases	Rapid health survey	Level of awareness and knowledge of preventive measures.	Nearby communities Health care facilities	Twice during Construction	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
							% of reported STI/ STD cases among workforce					
3	Potential risk of Sexual Exploitation and Abuse (SEA)/ Gender Based Violence (GBV) Influx of workers (foreigners) to project location	All contractors workers to sign Code of Conduct (CoC) and be sensitized on zero tolerance for sexual integration with students/ community Community leaders/ women group/youth group to sensitise the community on appropriate conduct with contractors	SPIU GBV Specialist	800	Stakeholders concerns on risk of GBV	Consultations GBV Incident Report	Signed CoCs with the SPIU Conduct of sensitization campaigns	Project communities	Twice during Construction	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	300
4	Cultural integration may be affected by foreigners who do not understand the culture	Adequate sensitization of contractor workers on the cultures of the project area (dos and don'ts, festivals etc.)	Contractor, SPIU	500	No of complaints from the host community	Consultation Incident Report	Conduct of sensitization campaigns	Project Communities	One-off	NESREA Environment/Social Safeguard Officer	AfDB PIU	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
5	Conflicts between contractor and community members over labour intake	Good work enforcement program Grievance Redress Mechanism Regular consultations	Contractor Grievance Redress Committee (GRC)	400	No of complaints received	Consultation Review Grievance redress Log	No of cases handled by the GRC	Project area of influence	Continuous	Grievance Redress Committee	AfDB PIU	800
6	Increase demand on existing community health and sanitation infrastructure due to influx of temporary workers	Provide all basic amenities (water, sanitation etc to workers)	Contractor	1,200	No of amenities in worker's camp	Visual observation	Availability of all essential amenities in workers' camp	Workers camp site Host community	Monthly	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	600
Occupational Health and Safety												
1	People in the project area may be exposed to vehicular or on-site accident	Contractors should prepare and implement a Community Affairs, Safety, Health, Environment and Security (CASHES) manual, to coordinate OHS issues during the construction phase.	Contractor	1500	Accident Report	Reporting and feedback mechanism GRM	No of accidents reported	Project area of influence	Continuous	NESREA Environment/Social Safeguard Officer	AfDB PIU	1400

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
B	**CONSTRUCTION PHASE**											
2	Risk of occupational accidents, injuries and diseases	Implement project specific HSE Plan Provide and enforce usage of appropriate PPE.	Contractor	1500	HSE Plan Developed Compliance with HSE Plan	Consultations Accident Report	increase/decrease in Lost Time Injuries	Project area	Monthly	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	500
Sub Total				**19,100.00**								**11,600.00**

Table 7.5 Environmental and Social Management and Monitoring Plan –Operation Phase

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
	Demobilization of equipment and construction materials from the site											
Environmental Impacts												
1	Potential oil contamination of soil and water	Cart away all spoils through the relevant authorities Clean out impact areas	Contractor	500	Oil Spillages, Littered construction waste and spoilt equipment/parts	Site inspection	Good house keeping	Workers Campsite	Quarterly for one year	NESREA Environment/Social Safeguard Officer, Project Engineer	AfDB PIU	2000
2	Increase in vehicular movements will lead to increase in air pollution from exhaust fumes	In collaboration with the State Government, implement regular sensitization via mass media on the allowable vehicular	ESS UNIT; FRSC; VIO	1000	Gaseous Pollutants such as SO_2, NO_2, CO_2, CO, VOCs, H2S, TSP, PM_{10} and $PM_{2.5}$	In-situ measurement of air quality	General compliance	Project site	Quarterly	NESREA,	AfDB PIU	1800

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		emission limit and the need for regular vehicle maintenance and the effect of excessive emissions into the atmosphere. Routine inspection of motorists' compliance										
3	The drainages may become conveyors for surface debris and improperly disposed wastes during a heavy rain, leading to drainage blockage and disruption of free flow. This may result in	Routine maintenance of drainages Proper waste management system in the communities	SMENV;	1000	Flow rate of water through the drainage systems Adequate waste treatment in the communities	Visual observation	Implementation of proffered mitigation	Project site and community	Quarterly	NESREA;	AfDB PIU	1500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
	stagnated water, and water contamination downstream.											
4	Odour from: Wastewater Treatment Plant; Composting pad Slaughter / processing plant; Broiler sheds; and Movement of waste from broiler sheds to composting pad. Land spreading of composted manure	Optimise broiler shed management to reduce ammonia emissions from litter; Maintain aerobic conditions within windrows to minimise odour production during composting; Ensure broiler sheds are thoroughly cleaned between cycles; Maintain a clean and tidy Site, cleaning up spillages rapidly; Maintain and	Contractor Contractor and SAPZ	800	NH_3, H_2S , SO_2		Fed ministry eviro. Permissible limits	Project sites	Quarterly	NESREA, Ministry of Works and Ministry of Agric.	AfDB PIU	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		clean vehicles to reduce road vehicle odour; Location of odorous processes well away from the Site boundary.										
5	Dust from: Pens, Abattoir operations; Preparation of litter (chopped straw); Litter spreading within broiler sheds pre-cycle; and Removal of waste from broiler sheds and transportation to composting pad	Appropriate bag filters on feed mill exhausts (BAT); Consideration of alternative bedding (e.g. coarser material such as wood shavings); Use oil as binding agent within feed; Manual spreading of litter; Cover waste when transporting to composting pad; Water unpaved roads to prevent spreading of	SAPZ, HSE officer	700	PM_{10}		Fed. Ministry enviro permissible limits	Project site	Quarterly	NESREA , HSE officer	AfDB PIU	400

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		dust, particularly during dry weather conditions; Pave internal roads										
6	Emissions from: Vehicles operating on-site, as well as vehicles travelling to and from the Site; On-site energy generating plant; The broiler houses; Composting; and Disinfection	No idling vehicles on Site; Ensure all vehicles are well maintained; Develop and implement a Staff Travel Plan; Optimise broiler shed management to reduce emissions from litter; Maintain aerobic conditions within windrows to minimise emissions during composting.	SAPZ	400	CO_2, SO_2, VOCs, NH_3,	Using gas monitors	Fed min, of Enviro. Permissible limits	Project site and community	Quarterly	NESREA	AfDB PIU	400

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
7	Wastewater generation and disposal	Appropriate bag filters on feed mill exhausts (BAT); Consideration of alternative bedding (e.g. coarser material such as wood shavings); Use oil as binding agent within feed; Manual spreading of litter; Cover waste when transporting to composting pad; Water unpaved roads to prevent spreading of dust, particularly during dry weather conditions; Pave internal roads Emissions from: Vehicles	SAPZ HSE officer and management	500	BOD, E.coli, COD, BTEX in water	Physicochemical determination	Fed. Min of Enviro. Permissible limits	Project site	Yearly	NESREA	AfDB PIU	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		operating on-site, as well as vehicles travelling to and from the Site; On-site energy generating plant; The broiler houses; Composting; and Disinfection Regularly inspect and ensure proper maintenance of wastewater collection tank, vehicle washing systems, leachate collection and treatment facilities; Regularly inspect and maintain the surface water										

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		collection systems; Ensure regular cleaning of drainage ditches/ culverts; Avoid potential spills through application of appropriate staff training and occupational rules; Washing of vehicles and equipment on the site to be restricted to garage areas; Chemicals and other liquids and solid dangerous materials must be stored and properly managed; and Wastewater from the administrative										

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		facilities and poultry farm shall be collected and treated at the WWTP.										
	Land spreading of the manure on agricultural land	Develop land spreading procedures that cover: Nutritional need of land and crops; Prevention of spreading too close to rivers, when land too wet, whilst snow is present on the ground, on sloping fields and take into account land practices; Manage land spreading during public holidays and weekends,	SAPZ , HSE	400			Odor control and soil health	Community	annually	NESREA	AfDB PIU	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		take into account wind direction and how to incorporate into the ground. Develop a spill prevention and response plan for addressing land spreading operations including spill prevention measures, training requirements, spill response actions, spill response kits and notification to authorities; Train employees to promptly contain, report and/or clean up any spill; Provide portable spill										

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
		containment and clean-up equipment in all vehicles; Document accidental releases as to cause, corrective actions taken, and resulting in environmental or health and safety impacts.										
Social Impacts												
1	The rural communities will become more accessible and more exposed to people and activities from outside their communities including criminals,	The communities with government support shall constitute community vigilante groups, mobilize the youths and request for police posts for regular surveillance of	NPF, Abia State Command; Community executives and Traditional Leaders	10000	**Incidence of security breach**	Routine interview	Absence of security threat	Communities along project path	Quarterly for 2 years	NESREA Environment/Social Safeguard Officer; State Police Force	AfDB PIU	600

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
	armed robbers, kidnappers and terrorist groups like etc.	the communities. The design of local community alertness system shall be useful, to alert neighbours in case of invaders or criminals										
2	Accidents involving vehicles or pedestrians are likely to occur as a result of increased vehicle density, operation and increased speed, as community roads	Adequate road signs for motorists and pedestrians Routine maintenance of roads Routine inspection of motor-able roads and road users Training of road users on interpretation of road signs	FRSC	2,300	Road accidents/animal crushing	Routine interview	No complaints from the community	Communities	Quarterly	NESREA Environment/Social Safeguard Officer	AfDB PIU	1,000

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	**OPERATION PHASE**											
3	Exposure of communities to foreign cultures, negative fashion trends and habits; Increased tendency of migration	Community leaders and parents shall sensitize especially the youth against such attitudes and habits	Community Executives	TBD	Youth behaviours	Visual observation	Youth decency	Communities	Twice Yearly	Imo Environment/Social Safeguard Officer	AfDB PIU	-
4	Discrimination against gender and vulnerable group Gender Based violence Grievance and conflicts amongst members	Continues sensitization and awareness program and ensure that community level programs allow for gender inclusiveness Reporting GBV, SEA VAC cases properly and timely Implement requirements of GRM that addresses such issues	Community project monitoring committee	2000	Reports and awareness	Number of cases indicated	General compliance	communities	Quarterly	NESREA Environment/Social Safeguard Officer	AfDB PIU	800

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	supervision	Costs (USD)
C	OPERATION PHASE											
Sub Total				10,600.00								9500.00
TOTAL A+B+C				32,750.00								23,200.00

7. 6 INSTITUTIONAL RESPONSIBILITIES AND ACCOUNTABILITIES

The successful implementation of this ESMP depends on the commitment and capacity of various institutions and stakeholders to implement the ESMP effectively. Thus, the arrangement as well as the roles and responsibilities of the institutions and persons that will be involved in the implementation, monitoring and review of the ESMP is presented in Table 7.6

Table 7.6 Institutional Arrangement for ESMP Implementation

s/n	Category	Roles & Responsibilities
1	African Dev. Bank	• Inclusion of relevant provisions in the Legal Agreement. • Provision of advice on expected or likely issues based on Bank experience. • Project supervision and implementation support to verify compliance with the ESMP and CESMP.
2	Abia SPIU	• Monitoring of project/contractor performance and taking appropriate action to ensure ESMP provisions are met. • Inclusion of relevant provisions in the SPMU contract. • Safeguards due diligence • Implementation of request for environmental and social protection.
3	Safeguards Unit	**Environmental Safeguards** • Analyze potential environmental impacts; • Ensure that project activities that are implemented will in accordance to best practices and guidelines • Identify and liaise with all stakeholders involved in environment related issues in the project; and be responsible for the overall monitoring of mitigation measures and the impacts of the project during implementation. **Social Safeguards** • Develop, coordinate and ensures the implementation of the social aspects of the proposed project. • Identify and liaise with all stakeholders involved in social related issues during the proposed road rehabilitation;

		• Ensure that project activities that are implemented will be in accordance with best practices and guidelines • Ensure that GBV mitigation and response measures are in place & working correctly.
4	Contractor	• Compliance to BOQ specification in procurement of material and construction • Follow the ESMP provisions during project implementation • Ensure compliance with 'Chance find Procedures' • Establish and maintain communication with project host communities through a Community Liaison Officer.
5	Site Engineers/Supervisors	• Provide oversight function during site mobilization, construction and demobilization
6	Abia State Ministry of Environment	• Oversees environmental compliance at the State level Provision of advice on site assessment and monitoring of ESMP implementation
7	Other relevant State Government MDAs	• Relevant areas or resources under their jurisdiction or management are likely to be affected or implicated by the proposed project. • Participate in the EA processes and in project decision-making that helps prevent or minimize environmental and social impacts and to mitigate them.
8	Local Government Areas	• Provide oversight function across the project area for ESMP compliance. • Liaising with the SPIU, engage and encourage carrying out comprehensive and practical awareness campaign for the proposed project amongst the various relevant grass roots interest groups
9	Project Host Communities	• Promote environmental and social awareness • Project Support amongst the various relevant grass roots interest groups.
10	CDA & CBO	• Ensure Community participation by mobilizing, sensitizing community members;
11	NGOs/CSOs	• Assisting in their respective ways to ensure effective response actions during project implementation. • Awareness campaigns

12	Others/General Public	• Identify environmental and social issues that could derail the proposed project and support project impacts mitigation measures. • Awareness campaigns

7.7 CONTRACTUAL MEASURES

The mitigation measures to be implemented during the proposed SAPZ Processing zone shall be the obligation of the Contractor.

Table 7.7. Contractual Measures

Step	Action	Remarks
1	The measures as described in this ESMP shall be included in the tender documents with appropriate flexibility to adjust these measures to site circumstances and the potential contractor will have to prepare its proposals taking into account these measures	• The non-inclusion of these measures in the proposal will lead to a disqualification of the Proponent. • The contract with the successful bidder should contain these environmental and social management measures as firm conditions to be complied with.
2	Cost of mitigation measures of 32,750.00USD only shall be added to the cost of the contractual document	• The contactor must take into account and put the cost for the environmental and social requirements specified in the ESMP.

7.8 IMPLEMENTATION SCHEDULE

The activities related to environmental and social management and monitoring have to be integrated in the overall construction, operation of the livestock processing zone schedule. The environmental and social mitigation actions are standard measures applicable to proposed Abia SAPZ

Table 7.8. Tentative Implementation Schedule

S/N	Activity	Responsibility	Preconstruction	Construction	Operation/De mobilization
Month			1	2	3
1	Clearance of ESIA	SPIU			
2	Inclusion of Environmental & Social Requirements in Bid Documents	SPIU			
3	Inclusion of ESMP in Contract Documents	SPIU			
4	Review and Approval of Contractor's ESMP	SPIU			
5	Finalization of Engineering Designs	PIU /Engineering Design Consultant			
6	Implementation of Environmental and Social Mitigation Measures	Contractor			
7	Supervising ESMP Implementation	SPIU, Safeguard Consultants			
8	Monitoring and Reporting on ESMP Implementation	SPIU, Safeguard Consultants, NGOs			
9	Environmental and Social Auditing	SPIU, Safeguard Consultants,			

		FMEnv, Abia State Min. of Environment etc			

7.9 INDICATIVE BUDGET FOR ESMP IMPLEMENTATION

The tentative budget for the project includes the environmental and social mitigation cost, cost of environmental and social monitoring. All administrative costs for implementing the ESMP shall be budgeted for as part of the SPIU costing. The total cost for implementing the ESMP for the proposed Abia SAPZ processing zone is estimated at **Fifty five Thousand, nine Hundred and fifty Dollars ($55,950) only**

Table 7. 9. Estimated Budget for the Implementation of ESMP

Item	Responsibility	Cost Estimate in Nigerian Naira (₦)	Cost Estimate in US Dollars (US$)
Mitigation	Contractor	49,125,000.00	**32,750**
Monitoring	SPIU, Imo State Ministry of Environment, Imo State Waste Management Board.	34,650,000	**23,100**
ESIA Disclosure	SPIU	6,675,000.00	4,450
Capacity building	SPIU (Engineers, Safeguard Officers, Procurement Officers, relevant MDAs, Community leaders /CBOs /NGOs	12,686,250	**8,457.50**
Sub- Total		103,136,250.00	**68,757.50**
Contingency (Add 10%)		10,313,625.00	**6,875.75**
Total		**113,449,875**	**75,633.25**

Currency Unit = Nigerian Naira
US$1 = ₦1500

7.10 DISCLOSURES OF SAFEGUARD INSTRUMENT

The ESIA has been prepared in consultation with relevant state MDAs, project host communities and other stakeholders. Copies of this ESIA, like other safeguard instruments will be made available to the public by the PIU. The PIU will disclose the ESIA as required by the Nigeria EIA public notice and review procedures as well as the African Development Bank.

Table 7.10 Estimate for ESIA Disclosure

S/N	**ACTIVITY**	**COST ESTIMATE**	
		Nigerian Naira (₦)	**US Dollars (US$)**
1	Publication in national daily newspapers	1200,000.00	800
2	Radio announcement on the draft ESIA	1125,000.00	750
3	Logistics and contingency for public consultation on the draft ESIA	1200,000.00	800
	Total	**3525,000.00**	**2350.00**

7.11 CAPACITY BUILDING

Abia state Project implementation unit and Ministry of Agriculture have a sub-component which covers capacity building measures to implementing agencies, as may be necessary in environmental and social safeguards and annual program planning. Capacity building can be achieved by training program for the existing staff and Technical Assistance: knowledge sharing and on-the-job training and mentorship. Specific areas for effective institutional capacity requirements are given in Table 7.11

Table 7.11 Training Modules on Environment and Social Management

Training Description	Participants	Form of Training	Duration	When	Facilitator	Training Organizers	Training Cost	
Environment								
Introduction to the environment: Policies, Regulations and Statutory requirements in Nigeria and African development Bank	Abia SPIU (farmers, Engineers, Safeguard Officers, Procurement Officers etc)	Workshop	2 days	Project Planning Phase	Safeguards Specialist, external agency engaged for capacity building.	PIU	$5500	₦8,250,000.00
Review of the ESIA and its integration into designs: methodology, provisions, Implementation arrangements, assessment and monitoring, site selection for waste disposal area etc.	Engineers of implementing MDAs	Lecture and field visit	1 day	Project planning phase	Safeguards Specialists of Design Consultant/ external agency engaged for capacity building.	SPIU	$1500.00	₦2250,000.00

Training Description	Participants	Form of Training	Duration	When	Facilitator	Training Organizers	Training Cost	
Training on Code of Conduct, OHS, HSE, C-ESMP, GRM	SPIU, Supervision Consultants, Contractors/workers, GRCs	Workshop	2 days spread across the project lifecycle	Project Planning/ Construction Phase	OHS Consultant	SPIU	$6,850	10,275,000.00
Gender and GBV Awareness raising Gender mainstreaming in project, GBV prevention, mitigation and response	SPIU, Supervision Consultants, Contractor/workers management	Workshop	2 days	Pre-Construction Phase	GBV Consultant	SPIU	$7,500	11,250,000.00
Conducting Health and Safety Assessments	SPIU, Supervision Consultants	Workshop	1 day	Pre-Construction phase	HSE Consultant	SPIU	$4100	6150,000.00
Community Based Road Maintenance safeguard requirements	Community groups	Workshop/ Field Practical	2days	Close of Construction phase	Environmental Management Consultant	SPIU	$3500	5250,000.00
						SUB-TOTAL	**28950.00**	**43,425,000.00**

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATION

The Environmental and Social Impact Assessment (ESIA) of the proposed project 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 project area of influence, 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 project's life cycle has also been put in place to ensure environmental sustainability of the project. The environmental baseline condition of the project area was also carried out. Also documented were unique assemblages of wild flora and fauna species with their 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 Abia State and Nigeria at large. The ESMP developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation. Socio-economic 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 project.

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Appendices

Apenndix 1. TERMS OF REFERENCE (TOR)

FOR THE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED AGRO-PROCESSING ZONES AT OWAZA, UKWA AND BENDE LOCAL GOVERNMENT AREA, ABIA STATE.

SUBMITTED TO THE FEDERAL MINISTRY OF ENVIRONMENT

BY

ABIA STATE MINISTRY OF AGRICULTURE

FEBRUARY, 2024

INTRODUCTION

The Environmental and Social Impact Assessment (ESIA) study for the proposed Agro-Processing Zones project, has been initiated to ascertain the probable environmental impacts that may likely occur as a result of the various staple food milling/processing activities within and around the proposed project area. The Terms of Reference (ToR) will provide a guide for the Environmental and Social Impact Assessment (ESIA) framework and gives direction to impact identification, quantification/qualification, mitigation and provision of Environmental Management Plan (EMP). The Terms of Reference has been compiled as part of the EIA process for the proposed Agro-Processing Zones project in Owaza, Ukwa West and Bende Local Government Area, Abia State.

The essence of this proposed project is to bridge the gap of the state of the ever- growing demands of staple food in Nigeria, aside the economic benefits that shall be earned by both the local community and the country at large.

Abia State Ministry of Agriculture is particularly aware of and committed to focus on Health, Safety and Environment protection in accordance with international practice. The Ministry has adopted business

strategies that are long-term and can only be sustainably achieved when it delivers quality work without exception. In that respect, Abia State Ministry of Agriculture intends to conduct an Environmental and Social Impact Assessment (ESIA) of the proposed Abia State Ministry of Agriculture project prior to its commencement. This intention is in line with the Environmental Impact Assessment (EIA) Act LFM 2004, which is implemented by the Federal Ministry of Environment (FMENV) and also complies with the Abia State Ministry of Agriculture's corporate Health, Safety and Environment (HSE) Policy. This TOR which is subject to regulatory approval, therefore, defines the framework for the intended EIA study.

The Aims of the project

The aim of this particular project is for the establishment of Oil Palm, Cassava, Cocoa, Maize and Rice processing/milling at Owaza, Ukwa West Bende and Ikwuano LGAs, Abia State. This is to enhance adequate and affordable produce for consumption in the city and the rest part of the country at large. This has the advantage of achieving the need of enhancement of local staple food production and improving its standard in meeting up with the global standard practices.

PROJECT LOCATION/AREA

The proposed project is to be located at Owaza community, Ukwa West, Bende and Ikwuano Local Government Areas, Abia State.

Project implementation

In the pursuance of the project ESIA implementation, the proponent shall:

- Recognized and comply with all applicable regulations, guidelines and standards of the Federal Republic of Nigeria as issued by the appropriate Ministries and Agencies such as:
  - The Federal Ministry of Environment
  - Abia State Ministry of Environment
  - International Conventions/Guidelines and agreements related to the proposed project to which Nigeria is signatory.
- Undertake extensive consultation with stakeholders which is ongoing and respecting agreements and understandings reached with any party.
- Develop and implement Environmental Management Plan (EMP) as main reason of EIA.
- Follow strictly Ministry's Quality, Health, Safety and Environment Policy. It shall be the responsibility of the applicant to educate all parties on the policy.

To ensure that this proposal is in accordance with statutory requirement and Abia State Ministry of Agriculture QHSE Policy, the Ministry will conduct an Environmental and Social Impact Assessment

(ESIA) study of the Agro-Processing Zones project. The result of the ESIA process will be translated into specific actions and will be used as the basis for communication to obtain relevant approvals from the FMENV; this will also be used to satisfy public information needs on the project as well as to ensure the project is environmentally sustainable.

These Terms of Reference (TOR) document has therefore been developed to;

- Outline the general scope of the ESIA study including the overall data requirement on the proposed project and affected environment.
- Define the procedure/protocols for identification and assessment of associated and potential impacts.
- To select appropriate mitigation measures for such impact and develop an effective Environmental Management plan (EMP) for the project
- Define frame work for interaction and integration of view of a multidisciplinary project team with regulators, host community and other stakeholders.
- Define the relevant framework of legal and administrative requirements of the project.

The TOR shall on approval by the FMEnv, be used as a guide in executing and implementing the EIA study of the proposed project.

Abia State Ministry of Agriculture shall comply with the Environmental Impact Assessment (EIA) Act LFN 2004 as applied. The ESIA shall also be carried out in line with the provisions of the Federal Ministry of Environment Procedural and Sectoral Guidelines for Agricultural processing.

LEGAL AND ADMINISTRATIVE FRAMEWORK FOR THE PROPOSED PROJECT

General

The statutory (Legal and Administrative) framework within which the ESIA study shall be executed are provided by the following regulations, guidelines and standards. These shall be appropriately reviewed in carrying out the ESIA and complied with in the course of executing the proposed project as applicable.

ABIA STATE MINISTRY OF AGRICULTURE QHSE POLICY

The Ministry's Quality, Health, Safety and Environmental (HSE) policy shall guide the ESIA process and the execution of the proposed project.

STATE REGULATION, GUIDELINGS AND STATNDARDS

The Abia State Ministry of the Environment was established by the State edict. The regulation, guideline and standards of establishing the Ministry shall be reviewed as applicable to the proposed project ESIA.

NATIONAL LEGISLATION

The regulations, guidelines and standard of the Federal Ministry of Environment (FMEnv) and any other national regulations concerning Agricultural processing activities in Nigeria as applicable to the proposed project will be reviewed and adhered to accordingly.

These include:

- The National Environmental Impact Assessment Decree No. 86 of 1992.
- Federal Environmental Protection Agency (FEPA) EIA Procedural Guidelines, 1995
- S.I.8 - National Environmental Protection (Effluent Limitations) Regulations of 1991
- S.I.9 - National Environmental Protection (Pollution Abatement in Industries and Facilities Generation Wastes)
- S.I.15 - National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations of 1991
- Endangered Species (Control of International Trade and Traffic) Act of 1985
- Land Use Act of 1978
- Factory Act 1992
- Revised National Health Policy, 2004
- National Health Act 2005
- National Guidelines and Standards for Environmental Protection 1991
- Forestry Law CAP 51, 1994
- Criminal Code Act: The Nigeria Criminal Code Act (Chapter 77) of 1990.

STATE REGULATIONS

- Abia State Environment Ministry of the Environment Laws
- State Environmental Protection Law, Edict No.2 of 1994

INTERNATIONAL CONVENTIONS AND AGREEMENTS

All international conventions on Environment Protection to which Nigeria is a party shall also be complied with during the execution of the proposed project.

- World Bank Operational Directives 4.01: Environmental Assessment of 1991 which classifies projects according to the nature and extent of their environmental impacts
- African convention on the conservation of nature and natural resources1968
- 1992 United Nations Framework Convention on Climate Change
- 1972 Convention on the Concerning the Protection of the World Cultural and National Heritage (World Heritage Convention)
- 1973 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).
- 1992 Convention on Biological Diversity
- The Kyoto Principle on Climate Change
- The Word Bank IFC Performance Standards 1 to 8 and equatorial principle.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OBJECTIVES, PROCESS, WORK SCOPE AND METHODOLOGY

OBJECTIVES OF THE ESIA

The purpose of the ESIA study will be to establish a baseline of existing conditions in the area and to assess proactively the potential impacts and associated impacts (including Health and Socioeconomic impacts) of the proposed project area. The main objective of the EIA is to:

- To establish the existing biophysical and socio-economic condition of the project area.
- Characterized the environment thereby identifying the resultant hazards (including social) associated with the within and around the mining areas.
- To proffer measures to eliminate/mitigate/control the magnitude and significant of the hazards and effects.
- Proffer control techniques to eliminate/minimize the severity of the effect and to manage it.
- Put in place plan and procedures to manage the consequence.
- To ensure proper consultation with the communities bordering the area of the proposed project in line with the FMENV requirement.

The EIA Process

The Federal Ministry of Environment has established a National EIA Procedural Guidelines that indicate the process for conducing and ESIA of this proposed project in Nigeria. The process is initiated by registration of a project TOR/Proposal with FMENV and concluded with audit and review of the project report. In between the first and the final stages come the project screening, scoping, public disclosure, draft EIA report preparation, review and Final EIA report preparation and issuance of Environmental Impact Statement.

THE EIA WORK SCOPE

Detailed work scope of the ESIA shall include:

- Project definition and preparation of project TOR for the study in accordance with FMENV guidelines.
- Extensive literature review of previous environmental studies carried out proximate to the quarry project and two season data gathering followed by laboratory analysis to fill information/data gaps shall be carried out.
- Full description of project activities and identification of associated and potential impacts with logistics, site preparations, mobilization to site, project commissioning, operation and decommissioning/abandonment at each stages of the project life span.
- Qualification of potential impacts, their prediction and evaluation of their significance using appropriate models.
- Identification of effective mitigation measures for the project activities.
- Identification of all communities within the project location for effective consultation, including FMENV, Abia State Ministry of the Environment.
- Development of a Comprehensive Environmental Management Plan, including monitoring, decommissioning/abandonment and remediation plan.
- Remediation plan after decommissioning, closure or abandonment.
- Writing of report that conforms to the standards and guidelines set by the FMEnv.

METHODOLOGY

The methodology of conducting the ESIA shall include:

Literature Review

This will involves extensive study of existing literature particularly from reports of resent environmental studies and other relevant studies on the environmental characteristics of the study area. Materials to be

reviewed shall include ESIA reports, Environmental audit reports, Environmental Evaluation/post Impact reports, survey maps, aerial photographs, articles and other international journals.

Reconnaissance Survey

A reconnaissance Survey of the study area shall be under taken to familiarize the ESIA team of the proposed project area. This will help them in the concept of design of field studies execution.

ESIA Study Consultation Programme

In line with the FMENV 1995 Procedural Guideline for EIA in Nigeria, there shall be consultation with landowners/stakeholders and other interested group within and around the proposed project. Their view/ideas will be integrated into the ESIA report as appropriate.

Fieldwork Activities/Laboratory Analysis

One season fieldwork activities and laboratory analysis of samples shall be carried out and augmented with other baseline studies to be acquired from the existing environment ESIA study. The activities shall be carried out in accordance with FMENV, NESREA, APHA, World Bank and USEPA methodologies.

Environmental and Social Impact Assessment Methodologies

This shall involve impact identification, prediction, and evaluation. Impact evaluation will be carried out using a methodology that is applicable, specific and quantifiable, while the overall assessment will be carried out through the use of the "Strength of Relationship Matrix Approach" method. A method that defines numerically the degree of interdependence the various environmental parameters shall be considered. The 1-4 rating will be assigned to characterize the interrelationship by panel expects. The impact evaluation results shall form the basis for developing the EMP for the proposed project.

Report Writing

There shall be documentation of the EIA findings in the report format as specified in the EIA Procedural Guidelines, 1995.

Description of the Proposed Project

The ESIA shall give a detailed description of all the proposed project components/elements. Also, all wastes associated with the proposed project and there management plans shall be described. Demobilization and restoration plans shall be included in the report.

IMPACT ASSESSMENT, MITIGATION/ALTERNATIVES AND MONITORING PLAN

The identification, prediction and evaluation of associated and potential impacts shall be carried out in accordance with the standard methodologies including:

- Identification of Impact Sources-check List.
- Identification of Impact Indicators-check List.
- Prediction of impact magnitudes.
- Evaluation of Importance of environmental components – consensus of opinions.
- Evaluation of Impacts – "The strength of Relationship Matrix"
- Identification of Mitigation Measures avoidance, elimination/minimization and enhancement strategies.

The associated and potential impacts of the proposed project shall be described for the various phases of the project as follows;

- Impact resulting from project location/sitting.
- Impact resulting from construction activities
- Impact resulting from project operation activities
- Impact resulting from project abandonment

Impacts shall further be classified as:

- Incremental Impact.
- Adverse and beneficial impacts
- Cumulative impacts
- Short terms or long terms impacts
- Temporal or permanent impact
- Direct or Indirect Impacts
- Impacts associated with project risks and hazards.
- Reversible and irreversible impacts.

Where impacts are uncertain, the uncertainty will be made explicit and in this respect, risk assessment method will be applied.

IMPACT MITIGATION MEASURES AND ALTERNATIVES

All impacts identified shall be considered for mitigation and control through preventive, mitigation and amelioration measures. These measures shall be incorporated in the proposed project to minimize or

completely eliminate the key impacts. Where the effectiveness of mitigation measures is uncertain, or depends on assumptions about operational procedures, monitoring programmes of management procedure will be defined. Otherwise, the following alternatives will be considered:

- No project option
- site alternatives

MONITORING PLAN

This shall be carried out to provide specific information on the characteristics and functioning of environmental and social valuables in space and time.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The EMP shall clearly specify guidelines for ensuring conformance of project implementation with procedures, practice and recommendation s out line in the EIA reports.

The guidelines shall as a minimum include the following:

- Guideline for ensuring conformation of detailed design with concept design.
- Guideline for implementation programme.
- Guideline by which objectives and commitment will be achieved.
- Guideline for procedure for dealing with change and modification of project.
- Guideline for responsibility and accountabilities.
- Guideline for corrective action which will be employed should the need arise.
- Guideline for Inspection auditing band monitoring of all phases of project.
- Guideline for decommissioning and abandonment of project.

QUALITY CONTROL / QUALITY ASSURANCE

Abia State Ministry of Agriculture QC/QA protocol will be strictly adhered to knowing that data acquired is critical for the preparation of meaningful and good ESIA report.

CONSULTATIONS WITH REGULATORY AGENCIES AND OTHER STAKEHOLDERS:

Throughout the duration of the project, Abia State Ministry of Agriculture shall maintain effective communication with relevant regulatory agencies at the Federal, State and Local Government levels on the port expansion project. The stakeholder shall include the following:

- Federal Ministry of Environment.
- Abia State Ministry of the Environment.

- Local Government Area.
- The Community Based Organizations
- The Non-Governmental organizations.
- Neighboring Companies within the project area

OBJECTIVES OF CONSULTATIONS

This consultation is to.

- Address issues Promptly to Avoid conflicts
- Building consensus on potential impacts identified and proffers mitigative measures before the project gets underway.
- avoid any misunderstanding about the development
- Ensure that any apprehension and fears about the project, nature, scale and impact of the operation have been addressed.

FIELDWORK ACTIVITIES/LABORATORY ANALYSIS

A detailed one-season baseline data acquisition for the proposed project site will be conducted. Having realized the Federal Ministry of Environment as the apex body charged with environmental regulations in Nigeria, we plead for the Ministry approval for a one-season data collection for the project ESIA. The one season data will be augmented with existing studies and similar data gathering spatial boundaries on the proposed project site

DESCRIPTION OF ENVIRONMENTAL COMPONENTS

The description of environmental specific to the study area of interest shall be covered including.

PHYSICAL CHARACTERISTICS

Climate/Meteorology

- Temperature
- Rainfall
- Humidity
- Wind Speed
- Wind direction.

Air Quality

- Ambient Air Pollutant (NOx, Sox, Cox, SPM, H_2O and VOC).

- Noise Level.

Aquatic System (1)

- Surface water system identification and characterization
- Water Quality – pH, Temperature, conductivity and salinity, nutrients, DO, BOD, COD, TSS, THC content and heavy metals (Cr, Hg, Mn, Ni, Pb, Zn, Cu, V and Fe)
- Water Microbiology (total coliform, THB, HUB, THF and HUF).
- Sediment Quality – pH, conductivity, Heavy Metals (Cr, Hg, Mn, Ni, Pb, Zn, Cu, V and Fe) and Microbiology (THB, HUB, THF and HUF).

Aquatic System (2)

- Plankton (Phyto- and Zoo-plankton)
- Fish/Fisheries
- Benthic organism

Soil/land use and Agriculture.

- Soil Quality: pH, Nutrients including TOC, THC. and TPH, and Heavy metals (Cr, Hg, Mn, Ni, Pb, Zn, Cu, V and Fe)
- Soil Microbiology (THB, HUB, THF and HUF).
- Soil morphological characterization including porosity, colour and textural characteristics – sand, silt and clay.
- land use description

Ground Water Study

- Determination of ground water characteristics from three existing boreholes
- Ground water quality - pH Temperature, conductivity and salinity, nutrients, DO, BOD, COD, TSS, THC content and heavy metals (Cr, Hg, Mn, Ni, Pb, Zn, Cu, V and Fe)
- Ground water Microbiology (THB, HUB, THF and HUF).

Wildlife/forestry

- Identification of vegetation and plant species and there population
- Identification of wildlife species
- Estimation of wildlife species population
- Identification of wildlife species behavioral patterns and habitat requirements.
- Identification of economic species.

Socio-Economic and Health Characterization

- Description of settlement and manmade features
- Description of economic and historical sites
- Description of population distribution and demographic patterns
- Description of income distribution
- Description of recreational facilities
- Description of social organization and institution
- Description of occupation and employment structure.
- Description of host community health status and facilities
- Description of project health risk
- Description of community health and need and concern of host communities.

Waste and Waste Management Issues

- Project Waste stream
- Proposed disposal option
- Project Waste Management Plan.

Table Showing Summary Environmental Parameters and detailed Sampling Frame for the Proposed Project Site

S/N	ENVIRONMENTAL COMPONENTS/PARAMETERS & DETAILS.	PARAMETERS TO BE MONITORED.
1	**a) Climate/ Meteorology** • Microclimate • Regional Climatic features	The In-situ measurement, secondary data of the project area Temperature, Rainfall, Relative humidity, Wind direction and speed, visibility, cloud cover and their local effects.
2	**B). Surface water** • Physico-Chemical • Microbial • Fisheries	-Three (3) sampling points of surface water of each detailed components where **applicable** from upstream to downstream and control samples such as: Heavy metals – (Mn, Cr, Cd, Ni, V, Zn, Hg, Cu, Pb, Fe etc), Colour, pH, turbidity, Salinity, hardness, DO, BOD,

	• Plankton	COD, THC, BTEX, TPH, PAH, Electrical conductivity, Phosphate, SO_4, NO_3, TSS. oil and grease -Microbiology – (faecal coliform, total coliform, total plate), water body depth and width, flow direction and flow rate, fisheries and fish spawning areas, planktons, benthos, aquatic macrophyte and hydrodynamics.
3	**C). Ground Water** • Physico-chemical • Microbial.	One (1) number and control of ground water to determine the depth to and thickness, hydraulics, recharge and, uses. The Colour, pH, turbidity, Salinity, hardness, heavy metals - Cu, Pb, Fe, K, Ba, DO, BOD, COD, THC, Electrical conductivity, Phosphate, SO_4, NO_3, TSS.
4	**D). Soil** • Physical • Chemical • Soil Microbiology	Ten (10) numbers of soil with a control sample for the profile (depth, type) colour, permeability, porosity, bulk density, texture (grain size). Ten (10) numbers of soil for heavy metals – (Mn, Cr, Cd, Ni, V, Zn, Hg, Cu, Pb, Fe etc), Colour, pH, turbidity, Salinity, hardness, DO, BOD, COD, THC, BTEX, TPH, PAH, Ten (10) numbers of soil for total heterogenic bacteria (total hydrocarbon, T. fungi, total hydrocarbon bacteria (THB), faecal coliform.
5	**e). Land Use** • Land cover	Approved Land Use types: Recreational, agricultural, forestry, industrial, residential, institutional, commercial. Trends etc
6	**f). Ambient Air Quality**	Ten numbers of in-situ at different elevations of both sites of suspended particulate matter, NO_x, SO_x, CO_2, CO, VOCs, H_2S.
7	**g). Noise Level**	Six numbers of in-situ at both site for Db
8	**i). Ecology (**Vegetation)	Flora and fauna, Habitat status, floral composition, density and distribution, vegetation structure, plant pathology
9	**J). Geology** **K). (**Local and regional	Stratigraphy, structure, fractures patterns, flow direction, aquifer level, Regional geology, Stratigraphic/Lithologic properties
10	**L). Socio-Economic**	Education, culture, distribution of livelihood, land use, etc. with structured questionnaire administration.

11	**m). Health Impact Assessment**	Health status and prevalent diseases within and around the project area and host community.

DECOMMISSIONING AND REMEDIATION PLAN

An appropriate plan shall be put in case for restoration of the environment in case the project is decommissioned, closed or abandoned.

EIA DELIVERABLES

The deliverables shall be report writing/produced in accordance with the FMENV report format and standard. It shall be produced in phases indicated below:

- **Draft ESIA Report**

  This will provide detailed information on desk study, literature reviews, field data and laboratory analyses. It will also contain preferred options, impact Identification, prediction and assessment, mitigation measures and recommendations.

- **Final ESIA Report.**

  The Final EIA report will address all comments/problems raised by the regulatory authorities and other stakeholders during the duration of the project, in addition to other items in the draft report.

CONCLUSION

A detailed description of work and scope of the Environmental and Social Impact Assessment (ESIA) of the proposed project has been covered in this Terms of Reference (ToR) prepared by Abia State Ministry of Agriculture. The ESIA work Scope considered the existing laws, guidelines and standards on which the project shall be carried out. The key result of the ESIA will be used as a bases of communication to obtain relevant approvals and to obtain productive interaction within the public and also serve to ensure environmental sustainability of the project and its environment where it will be domiciled.

Consequently, Abia State Ministry of Agriculture believes that the adoption of this ToR shall enhance early commencement of the ESIA as well as the execution of the proposed project plan to the collective benefit of the stakeholders.

APPENDIX 2

Socio Economic Assessment Instrument

SPECIMEN QUESTIONNAIRE ON SOCIO ECONOMIC CHARACTERISTICS OF AGRO-PROCESSING ZONE AT BENDE LGA .

Please take time to complete this questionnaire. The questionnaire will not be used to provide basis for gain or compensation to any individual or the community. Kindly provide realistic and honest answers as close to correct situation as possible.

SECTION A

A1. Project Name…….

A2. Date…….

A3. Name of community……..

A4. Name of local government Area……

A5. State……

A6. Name of major community Association……..

A7. Functions of Association……..

…….

……..

SECTION B

HISTORY, TRADITIONAL AND ADMINISTRATIVE STRUCTURE OF COMMUNITY/GROUPS OF COMMUNITIES.

B1. Is the village part of a clan? Yes/No.

Name of clan, if yes……

B2. Who is the overall/highest traditional and administrative ruler of the community……

B3. Where does he reside?.....

B4. Traditional chiefs of the village/group of villages in order of hierarchy. Provide titles, names and ranks. …….

……..

……..

B5. Is there a council of chiefs? Yes /No.

B6. State functions of the council of chiefs……..

…….

B7. Is there a village head? Yes/No

Name……Title……

SECTION C.

CULTURE, RELIGION AND ARCHAEOLOGY.

C1. Name of shrine/deity Worshipped in the community…….

C2.Name of sacred forest and their locations. ……..

C3.Religious and social festivals celebrated by the community.
……

C4. Name the forest reserve(s) within or near the community……

C5. Name lakes……

C6. Name rivers……..

C7.Name sites of archaeological interest e.g for digging ground to study culture of the area……

C8. Name social clubs in community……..

C9. Name community based improvement schemes/organizations including community bank or monthly contributions paid per household.

……..

C10. Give estimate of religious worshippers in community.

SECTION D: DEMOGRAPHY.

D1. Give estimate of:

a. Village population

males…….females……children……..total……

D2. Major crops grown in the community……..

D3. Major livestock bred in the community…….

D4. List the different occupation/employment profile of community and income. What is the percentage/ number of the unemployed in community?

(a).% Farmer……, %Civil Servants…… %self-employed……..

% unemployed…….

(b) Average monthly Income. #1-50,000……., #51,000-100,000……., #101,000-150000……. Above 150,000……..

SECTION E: INDUSTRIES PRESENT.

E1. Name companies/industries present in the area.

…….

…….

E2. Names and location/addresses of estates present in the area…….

E3. Names and addresses/location of hotels and guest houses present within or near the community.…….

E4. Name of bank(s) in or near the community…….

SECTION F EDUCATION.

F1. Names, addresses and ownership of educational institutions in the area.

……

……

……..

F2. Give percentage estimate of literacy level in the community for primary……., secondary……. and tertiary……levels.

SECTION G. INFRASTRUCTURE PROVISION.

G1. Names and ownership of Health facilities in the community…….

G2. What are the main health problems? Give % of total population. e.g AIDs/HIV, chicken pox, diarrhea, Malaria, leprosy, meningitis, diabetes, pneumonia, skin infection, asthma, pregnancy related, hepatitis, guinea worm infection, round worm infection etc……..

……
……
……
……
……..

G3. Give approximate % of toilet facilities used in community: viz

(a). Pit toilet …… b. bush …… c. water closet (WC) ……

d. river. ……

G4. What is the general form of houses for people in the community?

* ownership of dwelling: give % of total

i. owned by occupier……

ii. Rented…….

iii. Supplied free by employer…….

G5. What is the method of disposal of solid wastes/garbage?.....

G6. Source of portable Water supply……

G7. What is the condition of Roads and drainage system in the community…….

G8. Electricity supply to the community (a) national grid……

(b) has community generating plant……..

(c) None

G9. Fuel used by households…….

SECTION H: ENVIRONMENTAL IMPACT.

H1. Do you think this livestock market and abattoir will negatively affect your community? yes ….. / No.……..

H2. If yes, what ways do you think it will negatively affect your community…

(a) affect our river (b) cause erosion (c) affect the air quality of community (d) others …….

H3. State major environmental problems of the area (a) erosion problem (b) water scarcity (c) soil pollution (d) Poor air quality

SECTION I: LAND ACQUISITION AND DISPLACEMENT

I1 (a) Impact on community member's land

s/n	Description	Negative impact	No impact	Positive impact	Indifferent
1	Do you think that the project will impact on community members' land?				
2	How has the process of land acquisition affected the community members' land?				

(b) Land Assessment

s/n	Description	Yes	No	unknown
1	Evidence of land title documents?			
2	Land was acquired through lease?			
3	Land acquired through MOU, Customary rites, outright purchase?			
4	Does the land acquired cause loss of shelter,/ housing and loss of assets?			

SECTION J: Stakeholders' impression on SAPZ Development project

1. What is your overall impression about the Abia State Special Agro –processing project(SAPZ)?

☐ Very Good initiative ☐ Good initiative ☐ Bad initiative

2. Will you like to encourage someone you know to participate in the SAPZ project?

☐ Yes ☐ NO ☐ indifferent

3. What are your expectations on the Abia SAPZ project in your community?

…….
……
……..
……
……

Thank you and God bless you.

(a)

(b) Pics for sample collection

APPENDIX 3: Flora Checklist

s/n	*Species*	Common name	Protected in Nigeria/Reserves
1	*Abrus sp*	Jequirity brean	
2	*Acacia albida*	White acacia	
3	*Acacia seyal*	Shittah tree	
4	*Acanthus montanus*	Bear's breech	
5	*Aerangis biloba*	Aerangis	
6	*Afzelia sp*	Doussle	Protected (P) Oban, Afi forests
7	*Ageratum conizoides*	Goat weed	(P) Okomu reserve
8	*Albizia lebbeck*	Flatcrown	
9	*Albizia zygia*	West African Albizia	(P) Okomu, Okwangwo reserves
10	*Alchornea cordifolia*	Christmas Bush	
11	*Anchomane s giganteus*	Forest anchoma nes	(P) Oban , Afi, Okwangwo forests
12	*Andropogon citrata*	Broomse dge bluestem	
13	*Anielema sp*	Anielem a	
14	*Annona muricata*	wild custardapple	
15	*Anthocarpus preissi*	Anthocar pus	
16	*Anthocleista djalonensis*	Cabbage tree	(P) Oban, Okwangwo forest
17	*Anthocliesta grandiflora*	Cabbage tree	
18	*Aspilia africana*	Wild sun flower	
19	*Azadirashta indica*	Neem	
20	*Bambusa vulgaris*	Indian bamboo	
21	*Baphia nitida*	Camwood	
22	*Berlinia bracteosa*	Berlinia	(P) Oban, Okwangwo forests
23	*Cyathea australis*	Tree fern	
24	*Ceiba pentandra*	Silk Cotton Tree	

25	*Chromolaena odorata*	Siam weed	(P) Okomu reserve
26	*Cola spp*	kola	(P) Oban, Okwangwo forests
27	*Combretum racemosa*	Velvet bush willow	
28	*Combretum tomentosum*	Bushwillows	
29	*Dalbergia latifolia*	Coinvine	
30	*Dalbergia sissoo*		(P) Oban forest
31	*Daniellia oliveri*	African copaiba balsam tree	
32	*Dialium guineense*	Black velevet	(P) Oban forest
33	*Diospyrous sp*	African ebony	
34	*Elaeis guineensis*	African oil palm	
35	*Eluecine indica*	Goosegr ass	
36	*Ephioglossu m pendulum*	Old-world adder'stongue	
37	*Ficus exasperata*	Sandpaper fig	
38	*Ficus leprieuri*		
39	*Ficus sur*	Cape fig	
40	*Gardenia imperialis*		
41	*Gardenia jasminoides*	Cape jessamin e	(P) Oban , Afi , Okwangwo forests
42	*Gmelina aborea*	Gmelina	
43	*Grewia bicolor*	Grewia	
44	*Grewia occidentalis*	Crossber ry	
45	*Harungana madagascari ensis*	Haronga	
46	*Isoberlinia angolensis*	Mutondo	
47	*Lophira alata*	Azobe	(P) Oban , Afi, Okwangwo forests
48	*Lophira lanceolata*	Red iron wood tree	
49	*Machaerium scleroxylon*	Pau ferro	
50	*Milicia excelsa*	African teak, Iroko	

51	*Mimosa pudica*	Sensitive plant, Touch me not	
52	*Mitragyna speciosa*	Kratom	
53	*Musanga cecropioides*	Umbrella Tree	
54	*Mussaenda elegens*		
55	*Nephrolepsi s biserrata*	Giant sword fern	
56	*Nephrolepsi s biserrata*		
57	*Newbouldia laevis*	tree of life	
58	*Panicum maximum*	Panic grass	
59	*Parkinsonia aculeata*	Jerusalem thorn	(P) Afi, OkomuO kwangwo reserves
60	*Paspalum distichum*	Knot grass	
61	*Pennisetum purpureum*	Elephant grass, Napier grass	
62	*Pentaclethra macrophylla*	African oil bean	
63	*Phylanthus amarus*	Baronianus	
64	*Phyllantus niruri*	Gale of the wind	
65	*Phymatodes swlopendria*	Monarch fern, Musk fern	
66	*Pterocarpus lucens*		
67	*Raphia hookeri*	Raphia palm	
68	*Rauvolfia sandwicensis*	Devil's pepper	
69	*Salacia reticulata*	Salacia	
70	*Selaginella apoda*	Meadow spikemos s	
71	*Spondias mombin*	yellow mombin	
72	*Terminalia catappa*	Countryalmond	
73	*Thalia dealbata*	Powdery alligatorflag	
74	*Thaumatoco ccus daniellii*	Miracle fruit	(P) Oban, Okomu forest reserves
75	*Triplochiton scleroxylon*	African white wood	
76	*Urena lobata*	Caesarw eed	(P) Okomu reserve
77	*Vitex agnuscastus*	Chastebe rry,	

Accreditation No: 0004828

FEDERAL MINISTRY OF ENVIRONMENT

ACCREDITATION TO OPERATE AS ENVIRONMENTAL CONSULTANT

The Permanent Secretary of the Federal Ministry of Environment (FMENV), hereby accredits the bearer whose particulars appear below to operate as Environmental Consultant pursuant to an Application for Registration/Renewal dated 15TH day of JULY, 2020

1. Full Name of Consultant: NEW CONCEPTS ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LIMITED
2. Location of Business Premises/Laboratory: 32, FUTO ROAD, UMUANUNU OBINZE, OWERRI
3. Year of Incorporation of Business: 19TH JULY, 2016
4. Area(s) of Competence: ENVIRONMENTAL LABORATORY SERVICES xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

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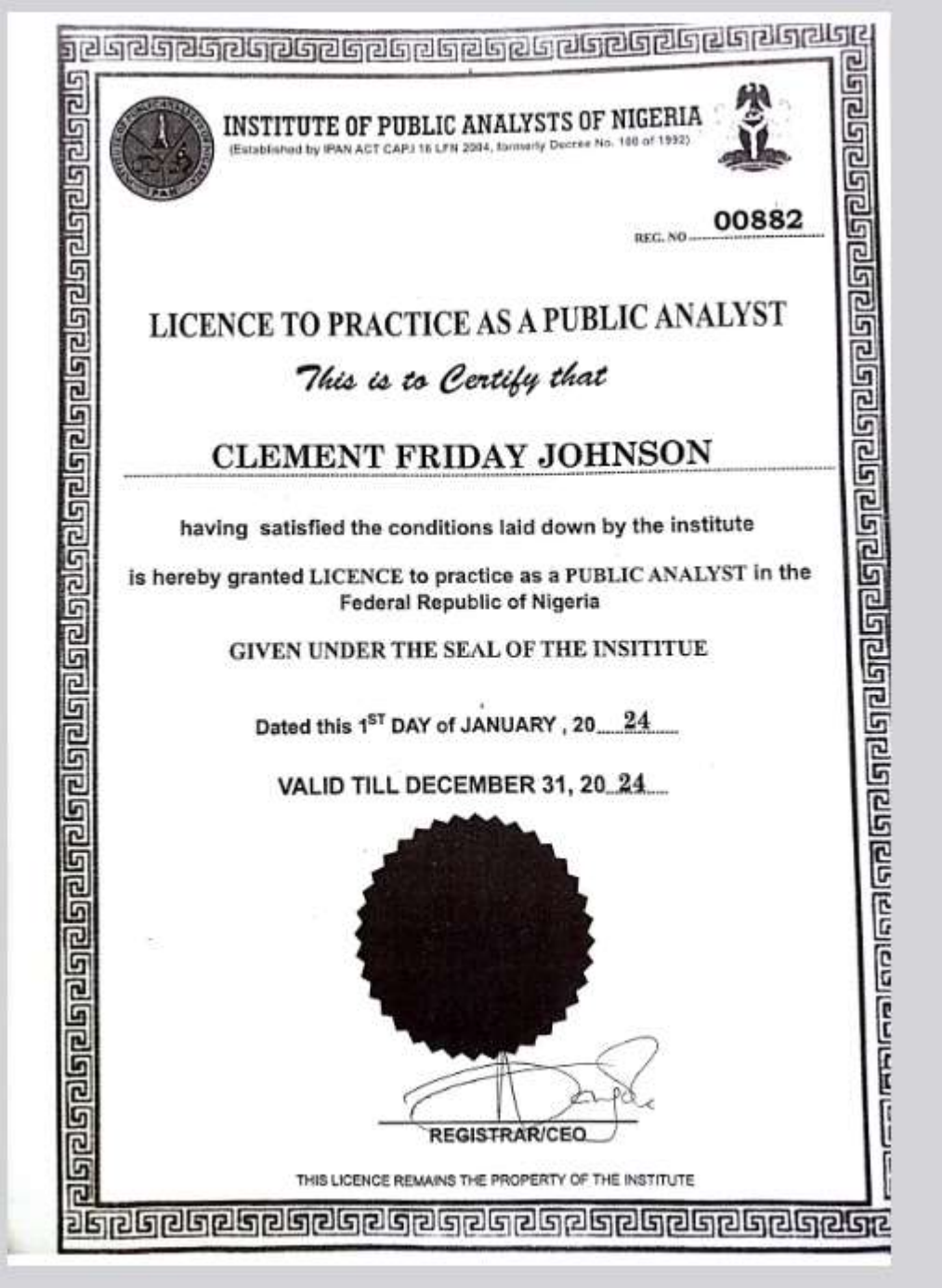
This Accreditation is granted subject to compliance with all regulations, Guidelines, Standards and Control criteria as may be issued by the Federal Ministry of Environment from time to time.

Date of Issue: 22ND JULY, 2023 Expiry Date: 21ST JULY, 2028

Seal of the Federal Ministry of Environment

FMENV shall not be liable to any claim(s) under this permit

Permanent Secretary



INSTITUTE OF PUBLIC ANALYSTS OF NIGERIA
(Established by IPAN ACT CAP.I 16 LFN 2004, formerly Decree No. 100 of 1992)

REG. NO 00882

LICENCE TO PRACTICE AS A PUBLIC ANALYST

This is to Certify that

CLEMENT FRIDAY JOHNSON

having satisfied the conditions laid down by the institute

is hereby granted LICENCE to practice as a PUBLIC ANALYST in the Federal Republic of Nigeria

GIVEN UNDER THE SEAL OF THE INSITITUE

Dated this 1ST DAY of JANUARY , 20 24

VALID TILL DECEMBER 31, 20 24

REGISTRAR/CEO

THIS LICENCE REMAINS THE PROPERTY OF THE INSTITUTE

FEDERAL MINISTRY OF HEALTH

IPAN INSTITUTE OF PUBLIC ANALYSTS OF NIGERIA

(Established by IPAN ACT CAP. I 16 LFN 2004, formerly Decree No. 100 of 1992)

Certificate of Registration of Laboratory

REGISTRATION No 0050

1. Full Name of Laboratory NEW CONCEPTS ANALYTICAL LABORATORY & ENVIRONMENTAL SERVICES LTD. with C.A.C. Reg. No. RC 1349

2. Location of Business premises/Laboratory 32, Futo Road, Umuanunu, Obinze, Owerri West, Imo State, Nigeria.

3. Year of Incorporation of Business July, 2016.

4. Duly Registered for the Analysis of Food/Food Products, Water/Wastewater, Soil, Air Pollution Monitoring, and Microbiological Analysis.

This Registration is Subject to the Provision of the Institute of Public Analysts Act Ca. 116 LFN 2004 Formerly Decree No. 100 of 1992

Date of Issue: March 05, 2024

Expiry Date: March 04, 2027

REGISTRAR/CEO

This Certificate of Registration remains the Property of the Institute

Accreditation No: 0003333

FEDERAL MINISTRY OF ENVIRONMENT

ACCREDITATION TO OPERATE AS ENVIRONMENTAL CONSULTANT

The Permanent Secretary of the Federal Ministry of Environment (FMENV), hereby accredits the bearer whose particulars appear below to operate as Environmental Consultant pursuant to an Application for Registration/Renewal dated 13TH day of DECEMBER 2022

1. **Full Name of Consultant:** EPIC AGRO-CONSULT LIMITED
2. **Location of Business Premises/Laboratory:** 5 ADONAISTREET, OGURUBE LAYOUT, UMUAHIA, ABIA STATE
3. **Year of Incorporation of Business:** 16TH MAY,2012
4. **Area(s) of Competence:** ENVIRONMENTAL CONSULTANCY SERVICES (EIA, BASELINE/POST IMPACT STUDIES & COMPLIANCE MONITORING/AUDIT) 2. ENVIRONMENTAL MANAGEMENT SERVICES (POLLUTION CONTROL & REMEDIATION) 3. MUNICIPAL SOLID WASTE (COLLECTION)xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

This Accreditation is granted subject to compliance with all regulations, Guidelines, Standards and Control criteria as may be issued by the Federal Ministry of Environment from time to time.

Date of Issue: 13TH NOVEMBER, 2022 **Expiry Date:** 12TH NOVEMBER, 2024

Seal of the Federal Ministry of Environment

FMENV shall not be liable to any claim(s) under this permit

Permanent Secretary

FEDERAL MINSTRY OF ENVIRONMENT
ENVIRONMENTAL ASSESSMENT DEPARTMENT
SCOPING WORKSHOP EXERCISE
ATTENDANCE SHEET.

PROJECT TITLE:

PROJECT PROPONENT:

LOCATION: Umuololo-Owaza Ukwa West LGA

DATE: 05 — 03 — 2024

S/N	Names of Participants	Organization	Phone Nos.	E-Mail Address	Signature
1	Dr Nwele Uche	TPM	08035523000	[illegible]	[signature]
2	Chukwuemeka Ezekiel	Village Head	09059215225	emekaezekiel[illegible]@gmail.com	[signature]
3	Nwogu O. Sylvanus	ELDER	08037241814	Sylvanus Nwogu 2017@ G-Mail.Com	[signature]
4	David Nwogu	StakeHolder	08037419451		[signature]
5	Felix Chinedu Nwogu	✓	08037149973	nwogufelix@yahoo.com	[signature]
6	Chief Mba AE	✓	07035225102		[signature]
7	Chief Friday Eletuo	✓	08132479396		F. N
8	Chief RAPHEAL OKEKE	✓	08039596687	C.D.C	[signature]
9	Elder Lucky Nwole	✓	08064173680	vic Chairman	[signature]
10	Pst. Ezekiel Aliele	C. Liaison	08145293302	[illegible]	[signature]
11	1st Ikenyi Nwele	Village chairman	08060006511	—	[signature]
12	Nwanche Uba C	Village Sec.	08066652439	ChiefUba450@Gmail.com	[signature]

STAKEHOLDERS' ENGAGEMENT FOR AGRO-PROCESSING ZONE AT IKWUANO LGA, ABIA- STATE

ATTENDANCE

Name of Community: Umuezeala Community Oboro DATE: 5th March 2024

s/n	Name	Designation	Signature/Phone number
1.	[illegible] Ikeonyi Mmelo		
2.	Chief Monday Ogbuji	Chairman	08064046511
3.	Nwanchukwu Chris Uba	V. Chairman	08018197409.
4.	Okoro Chukwu	SEC. GEN.	08066657139.
5	Kingsley Ariogu	Ndi [illegible]	08063645078
6	Gabriel Elekwe	P. O	07015617192
7	Emeka		08032928875
8	Elder Emeka Morris Chigbu		07041133794
9.	Moses I. [illegible]		09132928514
10	Elder Lucky Nwele		08064173680
11	Ikenna Ogbuji		09045418306
12	Ndukwe Ogbuji		09038124149
13	Ikenna Nwabueke		08039700099
14	EMMANUEL OGBU	EPIC AGRO CONSULT	0705 9395191
15	Dr Ngozi Frank-ogu	Epic - Agro Consult	08035976672
16	Uche Jane C.	Epic - Agro Consult	09035549551
17	CLEMENT FRIDAY JOHNSON	PUBLIC ANALYST, NEW CONCEPTS LAB	07039125358
18	Akanimo Jumbo E.	STAFF, NEW CONCEPTS LAB	08036263405
19	Chinekeokwu Samuel	STAFF, NEW CONCEPTS LAB	08147461063
20	Ozioma Stephen G.	STAFF, NEW CONCEPTS LAB	07037611480
21	Agharanya Gordon C.	ABIA MENV	08037987701
22	Dr. U. Victor Okonmah	Epic Agro-Team	08034119344
22	Nkwogu Franklin I	FMEnv	08030983447

STAKEHOLDERS' ENGAGEMENT FOR AGRO-PROCESSING ZONE AT [illegible] LGA, ABIA- STATE

ATTENDANCE DATE 05/03/2024

Name of Community Umuoloto Community Obiga

s/n	Name	Designation	Signature/Phone number
1	Samuel Chigby	Youth Chairman	08037509503
2	Eleazu Stanley	Vice ✓✓	08132744679
3	Reward Ejimo	Secretary	08102814142
4	Chinonso Nwachi	D.R.O	08064876463
5	Chima Nwambu	Fin.-Sec	08032322762
6	Okechi Ikeagwu	Provost I	07041667041
7	Udochukwu Ezekiel	Member	09168928516
8	Odinakachi Mba	Member	
9	Chukwunenye Ezekiel	✓ ✓	
10	Uchechukwu Nwuju	✓ ✓	07063518291
11	Chinagozom Sunday	✓ ✓	
12	Chigozie Kingsely	✓ ✓	
13	Cedar Nwogbo O.	✓ ✓	09135912124
14	Done Ejimo	✓ ✓	
15	Chidubem Nwuju	✓ ✓	08141942995
16	Ikechukwu Nwuju	✓ ✓	08123091292
17	Ezinwachukwu Smart	✓ ✓	08105888886
18	Chinedu Iroha		
19	Maduabuchi Nwabekee	✓ ✓	08038842420
20	Maxwell Eketuo	✓ ✓	08036423189
21	Chukwudi Nwogu	✓ ✓	
22	Uche Sunday	✓ ✓	08139688413
23	Amachi Ogbonna	✓ ✓	08060126897
24	Feechi Ogbonna	✓ ✓	07059125229
25	Chikezie Bright	member	09130864257
26	Chukwudi Ezigbo	✓✓	
27	[illegible]	✓✓	
28	Bright Nwogu	✓✓	
29	Udochukwu Alwell	OO✓	09012936531
30	Ejimo Done	✓✓	09063693148
31	Ikenna Alwell		
32	Omenado Moses	✓✓	
33	Morgan Nwabekee	✓✓	
34	Osinachi Nwele	✓✓	

STAKEHOLDERS' ENGAGEMENT FOR AGRO-PROCESSING ZONE AT ARIAM ELU-ELU IKWUANO LGA, ABIA- STATE

ATTENDANCE DATE 06/03/24

Name of Community ARIAM ELU-ELU

s/n	Name	Designation	Signature/Phone number
1	Bob Tom [illegible]	Vice Village Head	[illegible]
2	Chief Charles [illegible]	Dep [illegible]	08141848700
3	Chief Amaogu [illegible]	[illegible]	09065112373
4	UKOHA [illegible]	[illegible]	[illegible]
5	Anthony [illegible]	Dev union [illegible]	07064868999
6	AMAOGU VICTOR. I.	P.G [illegible]	07038363813
7	Josephine [illegible]	[illegible]	07061300009
8	Priscilla [illegible]	women [illegible]	08129150201
9	[illegible]	Asst women	09057730107
10	Lizzy [illegible]	Sec. women	09014344276
11	Beatrice Ewelike	Sec-woman	08101930383
12	Chidinma Ewelike		08064035587
13	[illegible]	[illegible]	[illegible]
	Chief Clement Ewelike	Chief	09033387676
14	George Chinkwe	Ekpiri [illegible]	[illegible]
15	Dr U. Victor [illegible]	Epic Agro Team	[illegible]
16	CLEMENT FRIDAY JOHNSON	PUBLIC ANALYST NEW CONCEPTS LAB.	07039125358
17	AKANIMO JUMBO .E.	NEW CONCEPTS LAB	08036263405
18	Uche Jane. C.	Epic -Agro Consult	09035549851
19	Dr. Ngozi Frank-Ogu	Epic -Agro Consult	08035976672
20	OZIOMA STEPHEN G.	STAFF, NEW CONCEPTS LAB	07037611480

06/3/24

STAKEHOLDERS' ENGAGEMENT FOR AGRO-PROCESSING ZONE AT
BENDE LGA , ABIA- STATE

ATTENDANCE Umuisiobu Auto. DATE 07/03/24

Name of Community ~~Bende~~ Community

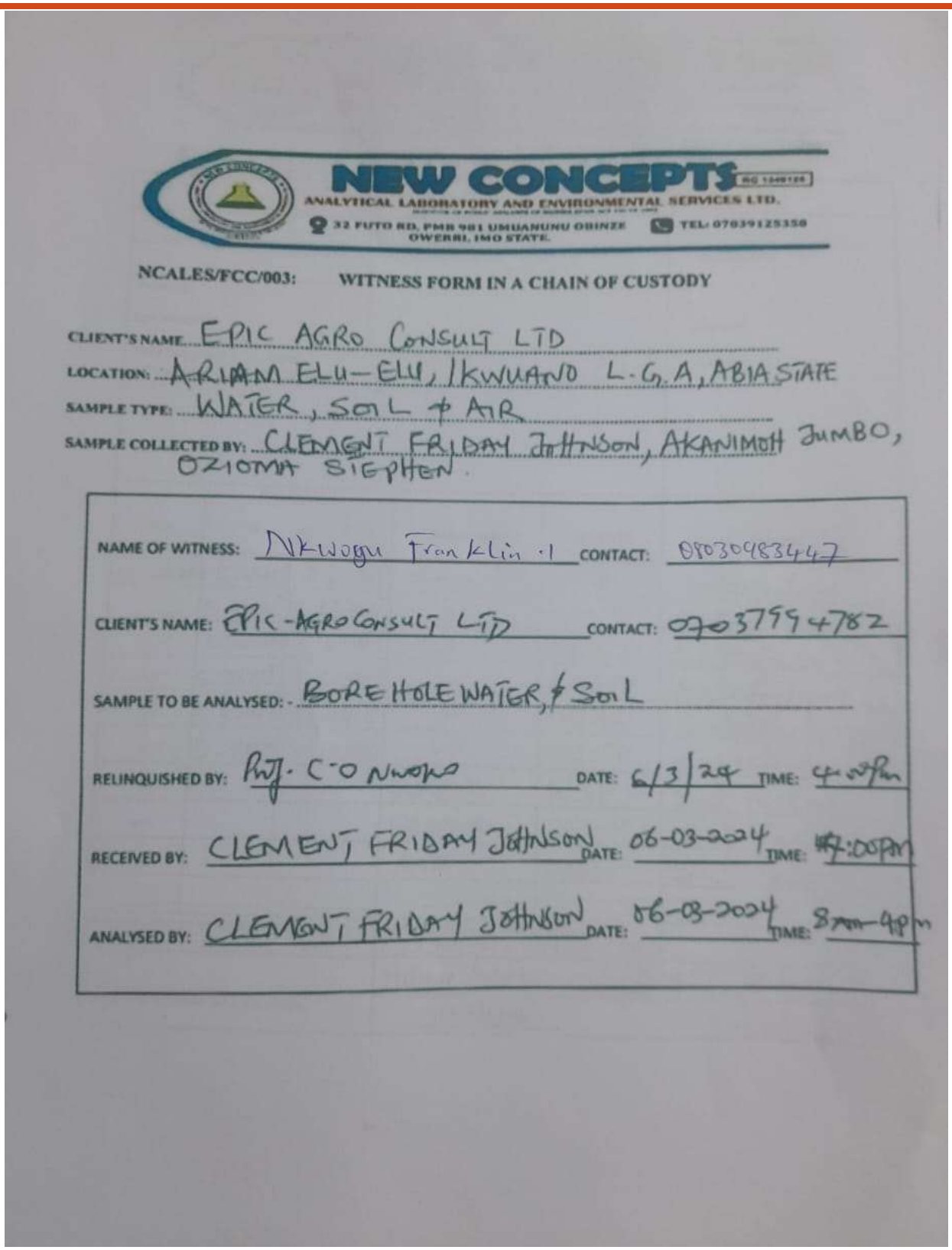
s/n	Name	Designation	Signature/ Phone number
1	EZE O. C. IROMANTU	TRADITIONAL RULER	08033187445
2.	LOLOEZE CELIA IROMANTU	WOMAN LEADER	09065608875
3	MAZI OGBONNAYA ARUKWE	VILLAGE ELDER	Ogbonnaya T.S. 07087170511
4	UCHENNA IGWE	CABINATE MEMBER	08089725744
5	CHIKWADU ORJI	YOUTH SECRETARY	09016479053
6	MAZI EMMANUEL OBASI	CABINATE MEMBER	09065400003
7	MR. EMEKA NWANKWO	CABINATE MEMBER	08064237554
8	MAZI CHINWUBA KANU	COUNCIL OF ELDERS	Ackam 09067741815
9	MAZI OKORO OBASI	COUNCIL OF ELDERS	
10	Duu Metcalfe	Comm. member	09162380015
11	ALFRED ONYEKACHI	COMM. MEMBER	08035803224
12	EMMANUEL NWACHUKWU	VIGILANT MEMBER	08126911878
13	Ikechukwu .S. Kanu	Ndi-toti. Com	08066541868
14	Amuche Jonah	Indigine	09124567350
15	Elder Francis E Ochiandam	Council of Elder Bende	08123422755
16	Ojiegwe Akwuonwu	Ukpom Village	O. Ak
17	Chijioke Samuel Agey		08020927796
18	KALU JOHN OBIOMA	NKALUNTA VII	08057467388
19	EZIOHA OBABIRO NKEMA	NKALUNTA VI	07019530020
20	Chialuma Kanu	Ndi toti	08039500991
21	FRIDAY NWOSU	UKpom	08100148739
22	Nwaburu Orji		08132486226
23	OGUMKA CHINONSO	NKALUNTA	08143378244
24	Ikechukwu Blessing	Nditoti. com.	09166784684
25	Ego micheal	Nditorty Com	09063785591
26	Emmanuel Nwankwo	Okporoenyi	08064896989
27	Engr. JACK O. OKWUONU	NKalunta	08068849700
28	Ihuoma Ugochukwu	Okporoenyi	07063708797
29	Kalu Onyinyechi	Okporoenyi	09011939169
30	Ugozi Issac	Okporoenyi	09137133370
31	Nnenna Emma	Okporoenyi	
32	Nwabulo Okorafor	Nditorty	
33	Chi Maurice Nwankwo	Nditoty	
34	Rose Nworen	Okporoenyi	
35	Ikechukwu Otfor	Okporoenyi	08088111449

STAKEHOLDERS' ENGAGEMENT FOR AGRO-PROCESSING ZONE AT BENDE LGA , ABIA- STATE

ATTENDANCE DATE 07/3/22

Name of Community Umuisiton Okporoenyi Bende

s/n	Name	Designation	Signature Phone number
36	Emeka Fubura	[illegible]	08[illegible]4353
37	Ihuoma Ekereke	[illegible]	
38	Dr. Frank-Ogu Nzei	Epic-Agro	08035976674
39.	Uche Jane	Epic-Agro consult	08035549[illegible]
40	CLEMENT FRIDAY JOHN	NCALES	07035125355
41	Akanimo Jumbo E.	NCALES	0803[illegible]
42	OZIOMA STEPHEN G.	NCALES	0[illegible]37611480
43	CHINEKEOKWU SAMUEL	NCALES	08147461063
44	Achonwa Gideon	Abia Comm Rep	08[illegible]
45	Dr U. Victor Okorie	Epic Agro	0[illegible]



NEW CONCEPTS
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125350

NCALES/FCC/003: WITNESS FORM IN A CHAIN OF CUSTODY

CLIENT'S NAME: EPIC AGRO CONSULT LTD

LOCATION: ARIAM ELU-ELU, IKWUANO L.G.A, ABIA STATE

SAMPLE TYPE: WATER, SOIL & AIR

SAMPLE COLLECTED BY: CLEMENT FRIDAY JOHNSON, AKANIMOH JUMBO, OZIOMA SIGPHEN.

NAME OF WITNESS: Nkwogu Franklin .I CONTACT: 08030983447

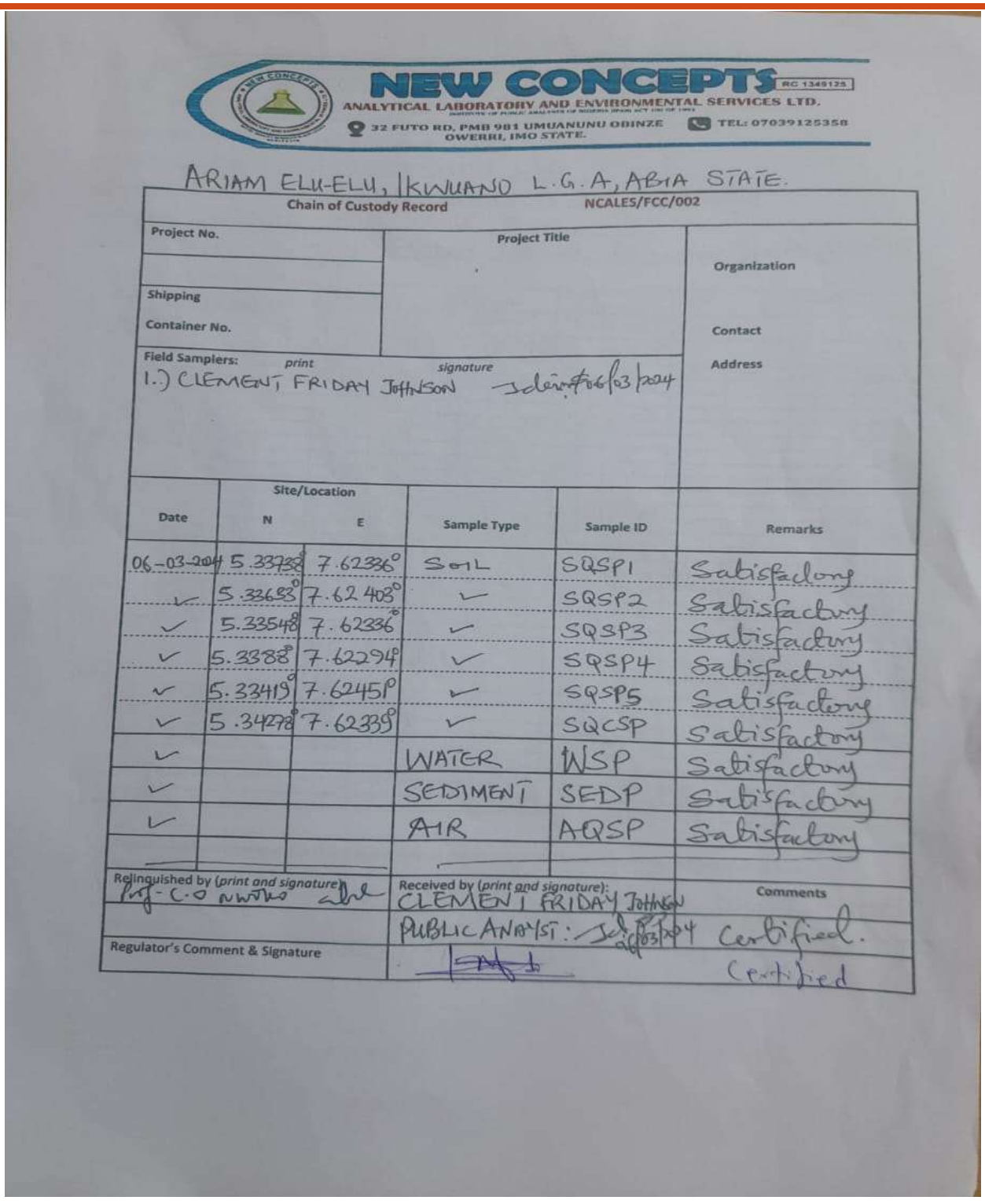
CLIENT'S NAME: EPIC-AGRO CONSULT LTD CONTACT: 07037994782

SAMPLE TO BE ANALYSED: - BOREHOLE WATER, & SOIL

RELINQUISHED BY: Mrj. C.O NWOKO DATE: 6/3/24 TIME: 4:00pm

RECEIVED BY: CLEMENT FRIDAY JOHNSON DATE: 06-03-2024 TIME: 4:00PM

ANALYSED BY: CLEMENT FRIDAY JOHNSON DATE: 06-03-2024 TIME: 8am-4pm



NEW CONCEPTS RC 1349125
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125358

ARIAM ELU-ELU, IKWUANO L.G.A, ABIA STATE.

Chain of Custody Record NCALES/FCC/002

Project No.	Project Title	Organization
Shipping Container No.		Contact
Field Samplers: print / signature: 1.) CLEMENT FRIDAY JOHNSON		Address

Date	Site/Location N	Site/Location E	Sample Type	Sample ID	Remarks
06-03-2024	5.33738°	7.62336°	SOIL	SQSP1	Satisfactory
✓	5.33653°	7.62408°	✓	SQSP2	Satisfactory
✓	5.33548°	7.62336°	✓	SQSP3	Satisfactory
✓	5.3388°	7.62294°	✓	SQSP4	Satisfactory
✓	5.33419°	7.62451°	✓	SQSP5	Satisfactory
✓	5.34278°	7.62339°	✓	SQCSP	Satisfactory
✓			WATER	WSP	Satisfactory
✓			SEDIMENT	SEDP	Satisfactory
✓			AIR	AQSP	Satisfactory

Relinquished by (print and signature)	Received by (print and signature):	Comments
Engr. C.O NWOKO	CLEMENT FRIDAY JOHNSON	
	PUBLIC ANALYST: 06/03/24	Certified.
Regulator's Comment & Signature		Certified

NEW CONCEPTS RC 1349128
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 9H1 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125350

NCALES/FCC/001: **FIELD CHAIN OF CUSTODY**

CLIENT'S NAME: EPIC AGRO CONSULT LTD

LOCATION: ARIAM ELU-ELY, IKWUANO L.G.A, ABIA STATE

SAMPLE TYPE: AIR MONITORING, WATER, SOIL

SAMPLE COLLECTED BY: CLEMENT FRIDAY JOHNSON, AKANIMOH JUMBO, OZIOMA STEPHEN

	PARAMETERS	Point7 AQSP1 N 5.33468° E 7.62391° Min.	Max.	Point8 AQSP2 N 5.3344° E 7.62328° Min.	Max.	Point8 AQCSP N 5.33421° E 7.62362° Min.	Max.	Point9 N E Min.	Max.	Point10 N E Min.	Max.
Air Quality	CO_2, ppm	1032	1039	1037	1032	887	892				
	CO, ppm	0	0	0	0	6.1	6.1				
	O_3, ppm	0	0	0	0	0.03	0.03				
	NO2, ppm	0.052	0.052	0.060	0.060	0.002	0.102				
	CH4, ppm	23	29	26	27	19	19				
	H2S, ppm	0	0	0	0	0	0				
	VOC, ppm	99	99	96	96	62	62				
	SO2, ppm	0	0	0	0	0	0				
	NH3, ppm	0	0	0	0	0	0				
	PM2.5	0.018	0.019	0.020	0.021	0.040	0.041				
	PM10	0.045	0.050	0.056	0.061	0.061	0.071				
	Air Temp., oC	36.4	36.4	36.6	36.6	35.6	35.6				
	Wind Speed, m/s	2.5	2.5	1.8	1.8	1.0	1.2				
	Relative Humidity, %	61.7	61.7	60.5	60.5	53.5	53.6				
	Dew Point, oC	26.2	26.2	26.6	26.6	28.4	28.4				
	Wet Bulb Temp., oC	28.4	28.4	28.7	28.8	28.1	28.1				
	Noise, dB	67.8	67.2	64.1	54.3	39.2	35.6				
		BHWQ N 5.3445° E 7.6204°									
Water	pH	6.60	6.60								
	Temperature, °C	29.3	29.3								
	Conductivity, µS/cm	473	473.24								
	DO, mg/l	10.88	10.82								
	TDS, mg/l	329.09	346.1								

I hereby acknowledge that the above test results are correct and as obtained from the environmental test equipment.

Supervising Personnel Onsite: Nkwogu Franklin .I

Date: 06-03-2024

Signature:

Regulator's Signature:

Laboratory Personnel: CLEMENT FRIDAY JOHNSON

Date: 06-03-2024

Signature:

NEW CONCEPTS
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
22 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125350

NCALES/FCC/001: FIELD CHAIN OF CUSTODY

CLIENT'S NAME: EPIC AGRO CONSULT LTD

LOCATION: OKPORO-ENYI, BENDEL, A/R, G.A., ABIA STATE

SAMPLE TYPE: AIR MONITORING, SURFACE WATER, SEDIMENT, TSOIL

SAMPLE COLLECTED BY: CLEMENT FRIDAY JOHNSON, AKANIMOH JUMBO, OZIOMA STEPHEN.

		Point1 AQSP1		Point2 AQSP2		Point3 AQSP3		Point4 AQCSP		Point10	
		N 5.5045°		N 5.50372°		N 5.50274°		N 5.51106°		N	
	PARAMETERS	E 7.5988°		E 7.59998°		E 7.60146°		E 7.60145°		E	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Air Quality	CO_2, ppm	1059	1059	932	977	842	892	905	950		
	CO, ppm	0.0	0.0	0.0	0.0	0.0	0.0	3.30	3.30		
	O_3, ppm	0.05	0.05	0.01	0.01	0.06	0.06	0.06	0.06		
	NO_2, ppm	0.011	0.011	0.075	0.075	0.100	0.101	0.074	0.079		
	CH_4, ppm	29	30	14	14	13	13	14	14		
	H_2S, ppm	0	0	0	0	0	0	0	0		
	VOC, ppm	95	95	55	56	39	39	40	40		
	SO_2, ppm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	NH_3, ppm	0.011	0.01	0.000	0.00	0.440	0.40	0.03	0.03		
	PM2.5	0.013	0.013	0.0130	0.013	0.010	0.011	0.011	0.011		
	PM10	0.024	0.024	0.0240	0.024	0.0230	0.024	0.023	0.023		
	Air Temp., oC	32.0	32.90	41.20	29.00	43.10	46.90	41.50	41.50		
	Wind Speed, m/s	1.20	1.00	1.20	1.40	1.10	1.40	1.00	1.20		
	Relative Humidity, %	49.20	57.20	55.00	56.40	33.50	38.90	40.40	40.40		
	Dew Point, oC	26.70	26.70	24.30	25.90	22.10	27.00	26.30	26.30		
	Wet Bulb Temp., oC	24.10	24.10	22.20	24.40	20.50	30.50	31.30	31.30		
	Noise, dB	50.10	60.30	52.40	52.40	48.00	48.00	50.00	52.60		
		SWQ1 N 5.5053° E 7.9970°		SWQ2 N 6.5129° E 7.6013°		SWQ3 N 5.5126° E 7.6018°					
Water	pH	5.20	6.2	6.20	6.20	6.3	6.30				
	Temperature, °C	28.20	25.20	28.90	28.90	28.80	28.80				
	Conductivity, µS/cm	47.00	47.00	57.00	57.00	109.00	49.00				
	DO, mg/l	14.00	13.90	9.40	9.70	10.10	10.10				
	TDS, mg/l	30.55	30.55	37.05	37.70	31.85	31.85				

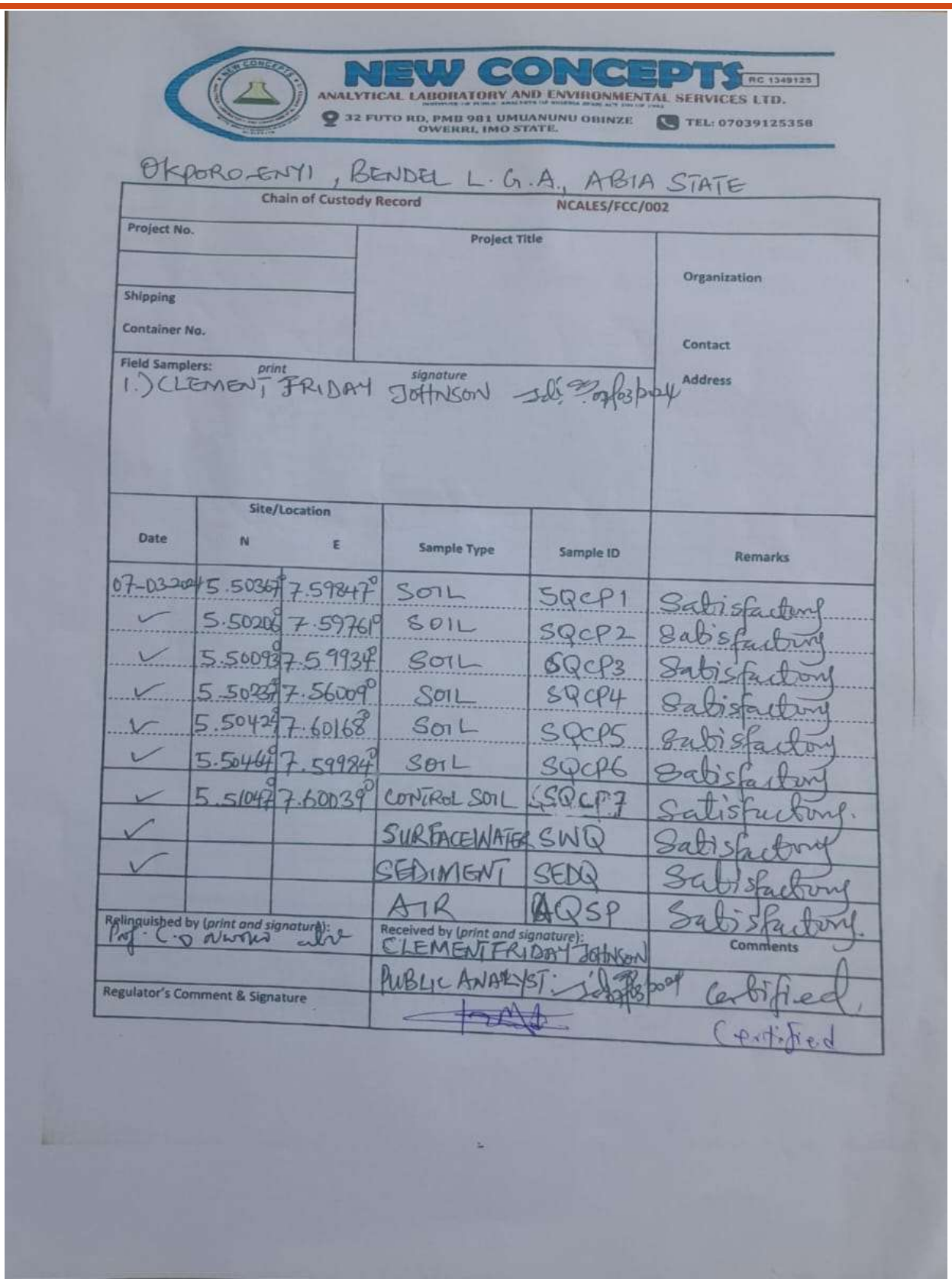
I hereby acknowledge that the above test results are correct and as obtained from the environmental test equipment.

Supervising Personnel Onsite: Nkwogu Franklin Laboratory Personnel: CLEMENT FRIDAY JOHNSON

Date: 07-03-2024 Date: 07-03-2024

Signature: Signature:

Regulator's Signature:



NEW CONCEPTS RC 1349125
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125358

OKPORO-ENYI, BENDEL L.G.A., ABIA STATE

Chain of Custody Record NCALES/FCC/002

Project No. | Project Title | Organization

Shipping Container No. | Contact

Field Samplers: print signature | Address

1.) CLEMENT FRIDAY JOHNSON 07/03/2024

Date	Site/Location N	E	Sample Type	Sample ID	Remarks
07-03-2024	5.50367°	7.59847°	SOIL	SQCP1	Satisfactory
✓	5.50206°	7.59761°	SOIL	SQCP2	Satisfactory
✓	5.50093°	7.59934°	SOIL	SQCP3	Satisfactory
✓	5.50233°	7.56009°	SOIL	SQCP4	Satisfactory
✓	5.50429°	7.60168°	SOIL	SQCP5	Satisfactory
✓	5.50464°	7.59984°	SOIL	SQCP6	Satisfactory
✓	5.51047°	7.60039°	CONTROL SOIL	SQCP7	Satisfactory.
✓			SURFACEWATER	SWQ	Satisfactory
✓			SEDIMENT	SEDQ	Satisfactory
			AIR	AQSP	Satisfactory.

Relinquished by (print and signature): Prof. C.O Nwuba

Received by (print and signature): CLEMENT FRIDAY JOHNSON

Comments: PUBLIC ANALYST: 07/03/2024 Certified, Certified

Regulator's Comment & Signature

NEW CONCEPTS RC 1349125
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125350

NCALES/FCC/003: WITNESS FORM IN A CHAIN OF CUSTODY

CLIENT'S NAME: EPIC AGRO CONSULT LTD
LOCATION: OKPORO-ENYI RENDEL L.G.A, ABIA STATE
SAMPLE TYPE: SURFACE WATER, SEDIMENT, SOIL, & AIR
SAMPLE COLLECTED BY: CLEMENT FRIDAY JOHNSON, AKANIMOH JUMBO, DZIOMA STEPHEN

NAME OF WITNESS: Nkwogu Franklin .I CONTACT: 08030983447
CLIENT'S NAME: EPIC-AGRO CONSULT LTD CONTACT: 07037794782
SAMPLE TO BE ANALYSED: SURFACE WATER, SEDIMENT, & SOIL
RELINQUISHED BY: PWJ-C-U NWOKO DATE: 07/03/24 TIME: 4pm
RECEIVED BY: CLEMENT FRIDAY JOHNSON DATE: 07/03/2024 TIME: 4:30pm
ANALYSED BY: CLEMENT FRIDAY JOHNSON DATE: 07/03/2024 TIME: 8am-4pm Daily

NEW CONCEPTS RC 1349125
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125358

OKPORO-ENYI, BENDEL L.G.A., ABIA STATE

Chain of Custody Record NCALES/FCC/002

Project No.	Project Title	Organization
Shipping Container No.		Contact
Field Samplers: print: 1.) CLEMENT FRIDAY signature: JOHNSON 07/03/2024		Address

Date	Site/Location N	E	Sample Type	Sample ID	Remarks
07-03-2024	5.50367°	7.59847°	SOIL	SQCP1	Satisfactory
✓	5.50206°	7.59761°	SOIL	SQCP2	Satisfactory
✓	5.50093°	7.59934°	SOIL	SQCP3	Satisfactory
✓	5.50239°	7.56009°	SOIL	SQCP4	Satisfactory
✓	5.50429°	7.60168°	SOIL	SQCP5	Satisfactory
✓	5.50464°	7.59984°	SOIL	SQCP6	Satisfactory
✓	5.51047°	7.60039°	CONTROL SOIL	SQCP7	Satisfactory.
✓			SURFACE WATER	SWQ	Satisfactory
✓			SEDIMENT	SEDQ	Satisfactory
			AIR	AQSP	Satisfactory.

Relinquished by (print and signature): Prof. C.O Nwosu

Received by (print and signature): CLEMENT FRIDAY JOHNSON

PUBLIC ANALYST: 07/03/2024

Comments: Certified. Certified

Regulator's Comment & Signature

NEW CONCEPTS RC 1349125
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 901 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125358

NCALES/FCC/003: WITNESS FORM IN A CHAIN OF CUSTODY

CLIENT'S NAME: EPIC AGRO CONSULT LTD
LOCATION: UMUOLOLO, OWAZA, UKWA WEST L.G.A., ABIA STATE
SAMPLE TYPE: AIR, WATER, SEDIMENT, & SOIL
SAMPLE COLLECTED BY: CLEMENT FRIDAY JOHNSON, AKANIMOH JUMBO & OZIOMA STEPHEN.

NAME OF WITNESS: Nkwogu Franklin. I CONTACT: 08030983447
CLIENT'S NAME: Epic-Agro Consult LTD CONTACT: 07037994782
SAMPLE TO BE ANALYSED: - BOREHOLE WATER, SURFACE WATER, SEDIMENT, TOP & SUB-SOIL
RELINQUISHED BY: Prof. C.O Nwoko DATE: 5/3/24 TIME: 4:30pm
RECEIVED BY: CLEMENT FRIDAY JOHNSON DATE: 05-03-2024 TIME: 4:30 PM
ANALYSED BY: CLEMENT FRIDAY JOHNSON DATE: 05-03-2024 TIME: 8:00AM - 4PM

NEW CONCEPTS RC 1349124
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD. PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125358

NCALES/FCC/001: **FIELD CHAIN OF CUSTODY**

CLIENT'S NAME: EPIC AGRO CONSULT LTD

LOCATION: UMUOLOLO, DWAZA, UKWA WEST L.G.A, ABIA STATE

SAMPLE TYPE: AIR MONITORING, BOREHOLE & SURFACE WATER, SOIL

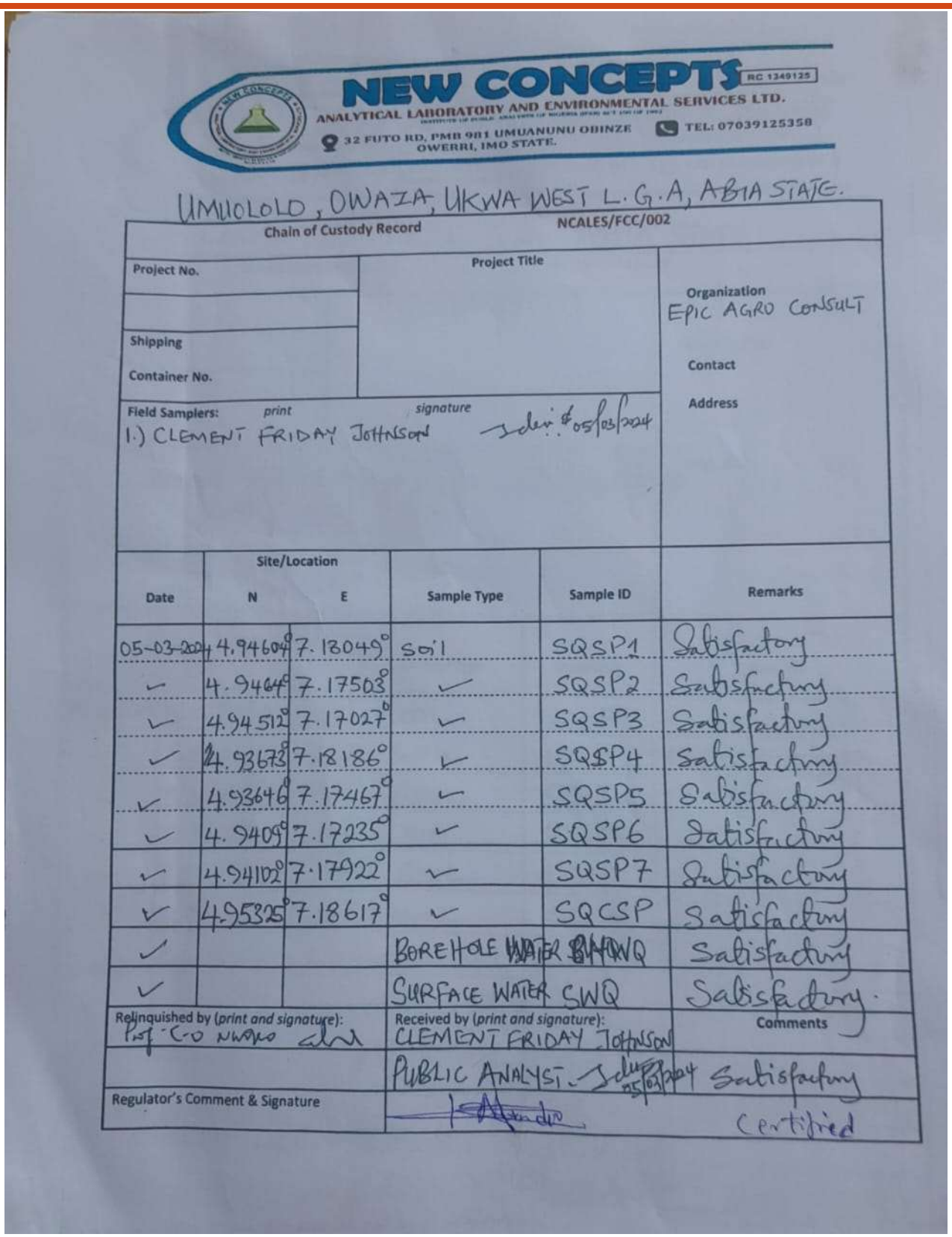
SAMPLE COLLECTED BY: CLEMENT FRIDAY JOHNSON, AKANIMOH JUMBO, & OBIOMA STEPHEN

		Point6 AQSP1		Point7 AQSP2		Point8 AQSP3		Point9		Point10	
	PARAMETERS	N 4.94606°		N 4.94315°		N 4.95558°		N		N	
		E 7.18284°		E 7.17334°		E 7.18554°		E		E	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Air Quality	CO_2, ppm mg/m³	878	919	911	902	856	896				
	CO, ppm mg/m³	2.5	2.5	2.0	1.9	40	4.2				
	O_3, ppm mg/m³	0	0	0	0	0	0				
	NO2, ppm mg/m³	0.094	0.094	0.080	0.083	0.104	0.104				
	CH4, ppm mg/m³	6.6	6.6	8.5	8.8	29	39				
	H2S, ppm mg/m³	0	0	0	0	0	0				
	VOC, ppm mg/m³	97	97	77	77	56	56				
	SO2, ppm mg/m³	0	0	0	0	0	0				
	NH3, ppm mg/m³	0.6	0.6	0.7	0.7	0.6	0.6				
	PM2.5 mg/m³	0.030	0.031	0.029	0.031	0.030	0.031				
	PM10 mg/m³	0.041	0.044	0.040	0.042	0.049	0.055				
	Air Temp., oC	22.9	32.2	32.4	32.4	31.6	31.6				
	Wind Speed, m/s	0.9	0.8	1.6	1.5	1.1	1.0				
	Relative Humidity, %	79.3	79.3	78.4	78.4	78.3	78.3				
	Dew Point, oC	27.3	27.3	27.1	27.1	26.6	26.5				
	Wet Bulb Temp., oC	29.4	29.4	29.6	29.4	29.7	29.6				
	Noise, dB	72.5	72.8	70.4	72.5	70.0	80.0				
		MIRSP N4.94794° E7.16521°		MIRSP N4.94022° E7.16774°		DIRSP N4.93302° E7.16736°		UWAP N4.95546° E7.18465°			
Water	pH	4.90	5.10	5.20	5.20	5.10	5.10	6.40	6.40		
	Temperature, °C	26.90	26.90	27.20	27.20	28.00	28.00	23.40	28.40		
	Conductivity, µS/cm	16.10	16.10	20.00	20.00	19.00	19.00	25.0	25.0		
	DO, mg/l	13.0	13.0	12.40	12.40	11.90	11.90	8.9	8.9		
	TDS, mg/l	10.47	10.47	13.00	13.00	12.35	12.35	16.25	16.25		

I hereby acknowledge that the above test results are correct and as obtained from the environmental test equipment.

Supervising Personnel Onsite: NKwogu Franklin
Date: 05-03-2024
Signature:
Regulator's Signature:

Laboratory Personnel: CLEMENT FRIDAY JOHNSON
Date: 05-03-2024
Signature:



NEW CONCEPTS RC 1349125
ANALYTICAL LABORATORY AND ENVIRONMENTAL SERVICES LTD.
32 FUTO RD, PMB 981 UMUANUNU OBINZE OWERRI, IMO STATE. TEL: 07039125358

UMUOLOLD, OWAZA, UKWA WEST L.G.A, ABIA STATE.

Chain of Custody Record NCALES/FCC/002

Project No.	Project Title	Organization: EPIC AGRO CONSULT
		Contact
Shipping Container No.		Address

Field Samplers: print signature
1.) CLEMENT FRIDAY JOHNSON 05/03/2024

Date	Site/Location N	Site/Location E	Sample Type	Sample ID	Remarks
05-03-2024	4.94604°	7.18049°	soil	SQSP1	Satisfactory
✓	4.9464°	7.17503°	✓	SQSP2	Satisfactory
✓	4.94512°	7.17027°	✓	SQSP3	Satisfactory
✓	4.93673°	7.18186°	✓	SQSP4	Satisfactory
✓	4.93646°	7.17467°	✓	SQSP5	Satisfactory
✓	4.9409°	7.17235°	✓	SQSP6	Satisfactory
✓	4.94102°	7.17922°	✓	SQSP7	Satisfactory
✓	4.95325°	7.18617°	✓	SQCSP	Satisfactory
✓			BOREHOLE WATER	BHWQ	Satisfactory
✓			SURFACE WATER	SWQ	Satisfactory.

Relinquished by (print and signature):	Received by (print and signature):	Comments
Prof. C.O NWAKO	CLEMENT FRIDAY JOHNSON	
	PUBLIC ANALYST 05/03/2024	Satisfactory
Regulator's Comment & Signature		Certified