FINAL ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT OF THE PROPOSED AGRO-PROCESSING PARK AT MAKURDI INDUSTRIAL AREA, MAKURDI LOCAL GOVERNMENT AREA, BENUE STATE.

BY

FEDERAL MINISTRY OF AGRICULTURE ANDRURAL DEVELOPMENT (FMARD): SPECIAL AGRO-INDUSTRIAL PROCESSING ZONE 2
(SAPZ 2)

SUBMITTED TO

FEDERAL MINISTRY OF ENVIRONMENT HEADQUATERS, MABUSHI, ABUJA

MARCH, 2024.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACI	American Concrete Institute
ADI	Area of Direct Influence
AfDB ISS	African Development Bank Integrated Safeguards
AFDB	African Development Bank
AII	Area of Indirect Influence
AIDS	Acquired Immune Deficiency Syndrome
AISC	American Institute of Steel Construction
ALARP	As Low As Reasonably Practicable
ANSI	American National Standards Institute
AoA	Agreement on Agriculture
AoI	Area of Influence
API	America Petroleum Institute
ARAP	Abbreviated Resettlement Action Plan
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATASP	Agricultural Transformation Agenda Support
ATR	African Traditional Religion
AWPA	America Wood Preservers
AWS	American Welding Society
AWWA	American Water Works Association
BENTHA	Benue State Tractor Hiring Agency
BENESA	Benue state Environmental and Sanitation Authority
BCG	Bacillus Calmette and Guérin
BNARDA	Benue State Agricultural and Rural Development
BNMANR	Benue State Ministry of Agriculture and Natural Resources
BMP	Biodiversity Management Plan
BOD	Biochemical Oxygen Demand
BPL	Below Poverty Line
BS	British Standards
BSEPA	Benue State Environmental Protection Agency
BSMT	Benue State Ministry of Transport

BSMH	Benue State Ministry of Health
BSMLSHUP	Benue State Ministry of Land Survey Housing and Urban Planning
BSMW	Benue state Ministry of Work
BSMPPUD	Benue State Ministry of Physical Planning and Urban Development
C of O	Certificate of Occupancy
CBD	Convention on Biological Diversity
CCTV	Closed Circuit Television
CDM	Construction design and management
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CITES and Flora	Convention to Regulate international trade in Endangered species in Fauna
Cl	Chlorine
CMAA	Crane Manufacturers Association of America
CMIP5	Coupled Model Intercomparison Project Phase 5
CMP	Construction management Plan
CRS	Cross River State
CO_2	Carbon dioxide
CSO	Chief Security Officer
COVID-19	Corona Virus novel 19
dB	decibel
DG	Distributed Generation
DPT	Diphtheria, Pertussis and Tetanus
DTC	Direct Town Cleaning
DO	Deoxygenated Oxygen
E&SEA	Environmental and Safety Enforcement Agency
EPC	Engineering, Procurement and Construction
ESAP	Environmental and Social Assessment Procedures
ESIA	Environmental and Social Impact Assessment
EMS	Environmental Management System
EMSP	Environmental Management Science Program
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
EMS	Environmental Management System
EPC	Engineering, Procurement and Construction
EWP	Emergency Watershed Protection

FAO	Food and Agricultural Organization
FEPA	Federal Environmental Protection Energy
FGM	Female Genital Mutilation
FGN	Federal Government of Nigeria
FI	Financial Intermediaries
FMARD	Federal Ministry of Agriculture and Rural
FMEnv.	Federal Ministry of Environment
FMW	Federal Ministry Of Works
FRAP	Full Resettlement Action Plan
FRSC	Federal Road Safety Corps
GBV	Gender-Based Violence
GCM	Global Climate Models
GDP	Gross Development Plan
GEMIS	Global Emission Model of Integrated Systems
GHG	Green House Gas
GRE	Glass Reinforced Epoxy
GSM	Global System for Mobile Communications
HBFC	Hydro Bromo fluorocarbon
HCN	Hydrogen Cyanide
HDT	Heavy Duty Trucks
HEI	Heat Exchange Institute
HIV	Human Immunodeficiency Virus
HSE	Health, Safety and Environment
IBA	Important Bird Area
IBC	International Building Code
IEC	International Electro-technical Commission
IEE	Initial Environmental Evaluation
IEEE	Institute of Electrical and Electronics Engineers
IESIA	Integrated Environmental and Social Impact
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IRC	International Rice Commission
ISA	Institute Society of America
ISO	International Organization for Standardization
ISTS	Integrated Safeguards Tracking System

ISQG	Interim Sediment Quality Guidelines
IT	Information Technology
ITU-R	International Telecommunication Union - Radio Sector
ITU-T	International Telecommunication Union-Telecommunication Sector
IUCN	International Union for the Conservation of Natural Resources
JCB	Joseph Cyril Bamford Excavators Ltd.
JIT	Just in time principles
KLD	???
kV	Kilovolt
KVA	kilovolt-ampere
kW	Kilowatt
LAN	Local Area Network
LC	Least Concern
LCD	Liquid Crystal Detector
LFN	Laws of the Federation of Nigeria
LGA	Local Government Area
LRF	Livelihood Restoration Framework
LRP	Livelihood Restoration Plan
Lux	Luminous flux per unit area
MC	Male Circumcision
MCC	Manual Classified Count
MCNL	Mifor Consult Nigeria Limited
MGW	Maximum gross weight
NACE	National Association of Corrosion Engineers
NaCl	Sodium chloride
NAIC	Nigerian Agricultural Insurance Corporation
NALDA	National Agricultural Land Development Authority
NAFDAC	National Agency for Food and Drug Administration And Control
NBC	Nigerian Building Code
NBCN	National Building Code of Nigeria
NBS	National Bureau of Statistics
NCOS	Non-commissioned officers
NDC	Nigeria Nationally Determined Contribution
NDHS	Nigeria Demographic and Health Survey
NE	Not Evaluated
NEC	National Electrical Code
NEEDS	National Economic Empowerment and Development Strategy
NEMA	National Electrical Manufacturer’s Association

NERC	Nigeria Electricity Regulatory Commission
NEPZA	Nigeria Export Processing Zone Authority
NESC	National Electric Safety Code
NESREA	National Environmental Standards and Regulations
NFPA	National Fire Protection Association
NGO	Non-Governmental Organisation
NID	National Immunization Days
NiMET	Nigerian Meteorological Agency.
NIS	Nigeria Immigration Service
NNBC	National News Broadcasting Corporation
NPC	National Populace Commission
NOSDRA	National Oil Spill Detection and Response Agency
NOx	Oxides of Nitrogen
NRN	Nigeria Research Network
OPV	Oral Polio Vaccine
OSs	Operational Safeguards
OVC	Orphans and Vulnerable Children
OSHA	Occupational Safety and Health Administration
PAC's	Project Affected Communities
PAP	Project Affected Person's
PAGA	Public Address and General Alarm
PBX	Private Branch eXchange
PCI	Precast Concrete Institute
PPAS	Plan, Policy, Analysis & Statistics Program
PPE	Personal Protective Equipment
PFIC	Prior, Free, Informed and Consented
PHCN	Power Holding Company of Nigeria
PIU	Project Implementation Unit
PSD	Phase-sensitive detection
PSP	Private Service Provider
PVC	Polyvinyl Chloride
PUI	Project Implementation Unit
RAAMP	Rural Access and Agricultural Marketing Project
RAP	Resettlement Action Plan
RCM	Regional Climate Models
RFP	Request for Proposal
RMC	Regional Member Country

SAPZs	Special Agro-Industrial Processing Zones
SARS-CoV-2	Severe Acute Respiratory Syndrome Corona Virus 2
SCEG	South Carolina Electric and Gas
SIEP	Senior Intelligence Executive Professional
SJI	Steel Joist Institute
SO_2	Sulfur dioxide
SON	Standards Organisation of Nigeria
SNSC	Safeguards and Compliance Department
SSPC	Steel Structures Painting Council
STI	Sexually Transmissible Infection
SUVs	Sport Utility Vehicles
RMC	Regional Member Country
TBD	To Be Discussed
TDP	Titled Deed Plan
THC	Total Hydrocarbon
THRC	Theoretical Hourly Ride Capacity
ToR	Terms of Reference
TMP	Traffic Management Plan
TT	Tetanus Toxoid
UBC	Uniform Building Code
UHF	Ultra-High Frequency
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations sexual and reproductive health agency
UNICEF	United Nations Children's Fund
UPVC	Unplasticized Polyvinyl Chloride
USA	United States of America
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
WASD	Women Affairs and Social Development
WBS	World Bank Standard
WHL	Western Highland
WP	Western Plains
WTO	World Trade Organization

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EXECUTIVE SUMMARY

ES 1 Overview of the project

Benue State Ministry of Agriculture and Natural Resources is the project proponent. It was created on the 3rd of February, 1979. The Ministry is responsible for formulating, monitoring and implementation of agricultural policies and programmes. The project involves establishing a cluster of Agro-processing industries in Phase 2 of the Makurdi Industrial Park with Agro produce processing, storage, quality assurance laboratory and cold chain services as core business activities. The project life span is expected to cover a period of 50 years. The project aims to offer a state–of–the–art infrastructures and services comparable with International Best Practices. This project covers the establishment of;

- Industrial shed
- Arterial Roads
- Drainage System
- Power Station & Electric Supply Lines
- Street Lighting
- Green Area and
- Water Supply

ES 1.2 Institutional and legal framework for implementation of the project

National Environmental & Social Policies

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

- National Policy on the Environment (1988)
- EIA Act Cap E12 LFN 2004
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2007
- National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991
- National Environmental (Sanitation and Wastes Control) Regulations, 2009
- National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991
- National Environmental (Noise Standards and Control) Regulations, 2009
- National Environmental (Surface & Groundwater Quality Control) Regulations 2011

- Land Use Act CAP L5 LFN 2004
- Forest Law CAP LFN 1994
- Endanger Species (Control of International Trade and Traffic) Act CAP HI LFN 2004
- National Environmental (Soil Erosion and Flood Control) Regulations, 2011
- Factories Act (CAP F1), 2004
- Employee Compensation Act, 2010
- Nigerian Urban and Regional Planning Act CAP 138 LFN 2004
- EIA Procedural Guidelines, 1995
- Natural Resources Act CAP 268 LFN 1990

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

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

Nigerian Gender Related Policies

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

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

Nigerian Institutional Provisions and Arrangement

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

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

State Laws

- Benue State Ministry of Agriculture and Natural Resources
- Benue State Ministry of Water Resources and Environment
- Benue State Agriculture and Rural Development Authority (BNARDA, 1986)

LGAs Bye Laws on Environment

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

International Conventions and Agreements applicable to the sector

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 agriculture. A list of some of the relevant International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria are;

- Convention on Conservation of Migratory Species of Wild Animals 1979
- African Convention on the Conservation of Nature and Nature Resource 1968
- Agreement on Agriculture (AoA) 1995
- Food and Agriculture Organization of the United Nations (FAO) 1945
- International Rice Commission (IRC) 1948
- International Fund for Agricultural Development (IFAD) 1977
- International Plant Protection Convention (IPPC) 1951
- Convention on Biological Diversity (CBD) 1988
- World Trade Organization (WTO) 1995
- United Nations Framework Convention on Climate Change 1994
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal 1989
- Montreal Protocol on Substance that Deplete the Ozone Layer 1987
- Vienna Convention on the Ozone Layer 1985

- Convention on the Protection of the World Cultural and Natural Heritage (world Heritage Convention) 1975
- Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES) 1973
- Paris Agreement 2015

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

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

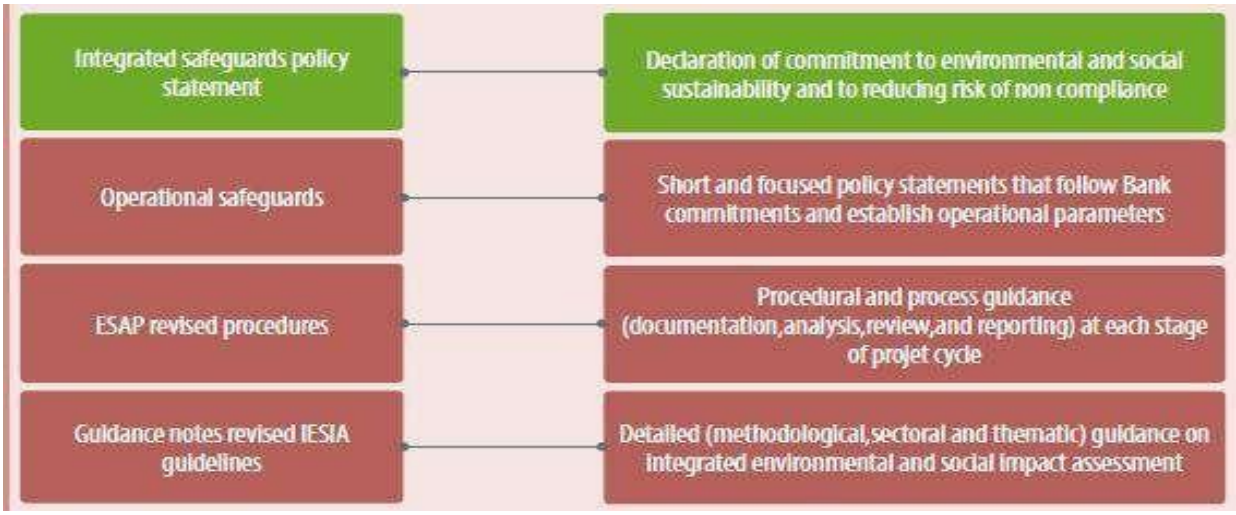

Figure ES-1: Structure of the AfDB ISS

Institutional and Administrative Framework

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

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Environment
- Federal Ministry of Finance
- Benue State Ministry of Agriculture and Natural Resources (Proponent)

- AfDB Project Implementation Unit (PIU)
- Benue State Ministry of Environment
- Benue State Bureau for Lands and Survey
- Benue State Waste Management Authority
- Local Government Authority (LGA)
- The Customary District Councils head of the affected LGA
- Village Chiefs (Zaki) of Affected Communities

ES-1.3 PROJECT JUSTIFICATION

ES- 1.3.1 Need for the Project

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

ES-1.3.2 Benefits of the Proposed Project

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

The following few are worth mentioning;

- ✓ boost farm incomes, reduce poverty, create clusters of economic growth, and increase tax revenue through value additions.
- ✓ encourage longer-term private sector investment, thereby assuring the sustainability of industrial development, through Government's intervention in creating and maintaining enabling environments
- ✓ stimulate private-public partnership
- ✓ increase food and nutritional security, create new/green jobs, and thereby reduce rural-urban migration through enhancement of productivity at the farm level

- ✓ promote private sector investment in climate-smart and green technologies, enabled by investment in public goods, policy interventions and the provision of pertinent support services and skills development
- ✓ reduce the low levels of post-harvest loss/deterioration of agricultural produce and increasing net profits to farmers
- ✓ guarantee availability of feedstock for sustainable input supply to agro-processing plants
- ✓ General improvement of the standard of living for the populace.

Envisaged Project Sustainability

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

- Technical Sustainability
- Economic Sustainability
- Environmental Sustainability
- Social Sustainability

Project Options

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

ES 1.4 Project Alternatives

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

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

Alternatives	**Options Considered**	**Selected Alternatives**
Location	Makurdi (Makurdi LGA) Mbiagii (Ushongo LGA) Mbiakyor (Ushongo LGA)	Makurdi

Industry Type.	Agro-processing.	Agro-processing Industry
	Cocoa Horticulture Industrial Cassava Rice	Horticulture, Industrial Cassava, Rice
Water supply.	Groundwater Surface water State water board Private water supply	Groundwater and State water board Private water supply
Power source.	national grid; Private source. Coal Gas power plant.	National grid power supply backed up with the Park's dedicated 320 kW generators.
Drainage.	Point drainage Channel drainage	Channel drainage
Sewage disposal	On-site disposals systems Sewage lagoons Sewage pre-treatment plant	Sewage pre-treatment plant.

ES 1.5 Project Schedule

Table ES-2: Project schedule for the proposed agro-industrial park

S/N	Description	Duration (months)	2nd Qtr. 2021	3rd Qtr. 2021	1stQtr 2022	2ndQtr 2022	3rd Qtr 2022	1st Qtr. 2023	2nd Qtr 2023	3rdQtr 2023	1s Qtr. 2073	2ndQtr 2073
	Pre-construction Phase											
1	Feasibility studies	3										
2	EIA studies	9										
3	EPC Contract award	1										

	Process											
4	Check survey of EPC Contractors	1										
5	Detailed design of the facility	1										
6	Mobilisation of construction materials to the site	15 days										
	Construction Phase											
7	Construction of facility and Associated utilities	6										
	Operation Phase											
8	Facility operation	600										
	Decommissioning Phase											
9	Demobilization of facility	6										
10	Decommissioning	One day										

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

Figure ES-2 shows a map of the project area. It shows that the project area located in Tse-Agube community in Makurdi LGA of Benue state, in North-central Nigeria. The Project's direct impacts outside of the footprint area include the biophysical and socio-economic impacts. It is expected that all direct biophysical impacts resulting from construction and operation of the agro-processing industrial park will be limited within the 1.5km^{2}base radius. The socioeconomic ADI is illustrated using a 1.5km^2 radius centered on the facility. The project area is drained by Fete River. The area records significant levels of rainfall in July, August and September, with the highest level experienced in August while no rainfall was recorded in January. The project area is characterized by secondary forest, guinea savannah and freshwater swamp. There are no protected areas in the project area. The closest are (Cross river national park, Okwango Division 175 km, Afi mountain and wildlife sanctuary 207km both in Cross River State and the Pandem wildlife forest in Plateau State 231.7km) from the project area. Topographically, the study area is mainly undulating plains with occasional elevations of between 1,500m and 3,000m above sea level. The state's main geologic formations are sandy-loam shelf basement complex and alluvial plains.

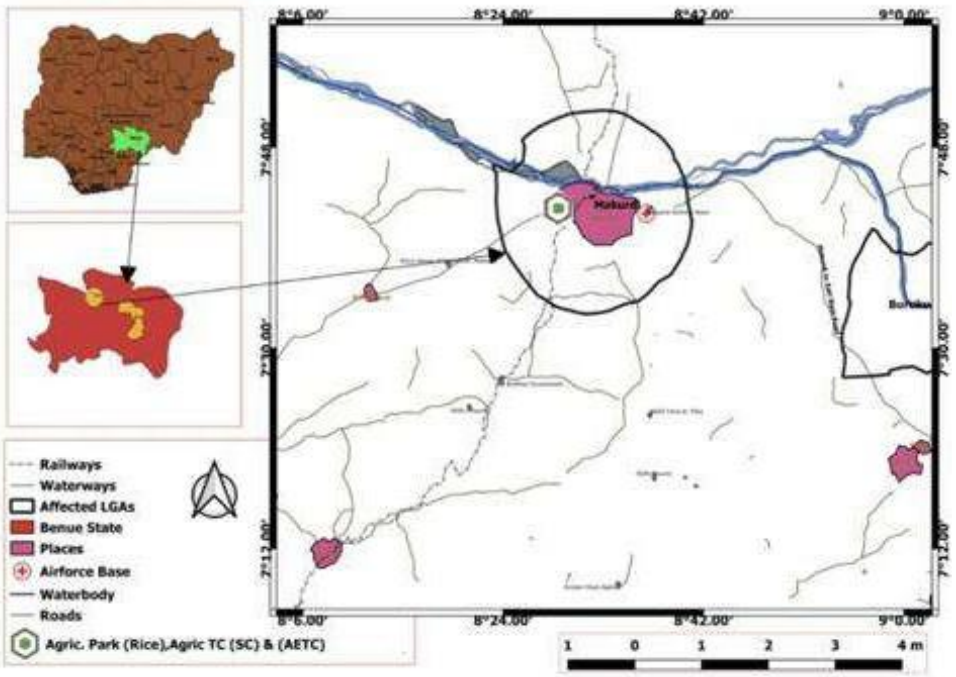

Figure ES-2: Map of the project area

ES 1.6.1 Land Cover

The Land take for the proposed project is 16 ha of the 272 hectares for the Industrial park. The remaining hectares will be used for future projects to be sited in the industrial park.

ES 1.6.2 Baseline condition of Bio-Physical Environment

All soil and groundwater baseline physico chemical parameters measured were within WHO regulatory limit. Noise results revealed an elevated noise level above the daytime threshold limit stipulated for the various environments (school, hospital, residential and farmlands) for all the sections. However, these results were within the general noise level of prolonged exposure. Air quality result revealed values within regulatory limits except for NO_2 at sampling point 7, VOC SO_2 across all sampling points. All analyzed parameters were within WHO 2011 safe limits for the sustenance of aquatic lives except dissolved oxygen, turbidity, phosphate and copper concentrations. The high values obtained for these parameters implies episodes of anthropogenic activities in form of deposition of domestic wastes, as well as infiltration from surface runoffs leading to eutrophication. The sediment samples' results establish a similar trend as that of the surface water, thus exhibiting similar discharges and sources and al physico chemical parameters analyzed in the sediment were all within Interim Sediment Quality Guidelines (ISQG) and Federal Ministry of Environment (FMEnv.) threshold values. Data for fisheries studies were based on combination of methods: direct observation of fishermen's catch in their canoe and nets at the fishing grounds and consultation in the field with the fishermen. Thereafter, fish markets in Makurdi North bank market were visited to ascertain the type of fish species being sold. A total of 20 species of fish were collected and reviewed and they include *Eutropius niloticus, Auchenoglanis occidentalis, Protopterus annectens, Hemichromis fasciatus (Iyoshu), Heterotis niloticus, Parachelon grandisquamis, Sardinella madarensis, Penaeus notialis (Akande)*. None of the species is listed in the IUCN list of threatened species. A total of 44 plant species were inventoried in the project area. Two of these species (*Vitellaria paradoxa* and *Khaya senegalensis*) are threatened species in the area and are categorized as Vulnerable in the IUCN List of Threatened Species. Two of the inventoried species (*Chromolaena odorata and Ageratum conyzoides*) were invasive and also alien in the study area. With respect to fauna diversity, a total of eight (8) avian species were sighted, four (4) mammalian species, three (3) amphibian species and five (5) reptilian species. None of the fauna species were in the IUCN list of threatened species.

ES 1.7 Project Impacts

The following are the key project impacts:

- Pollution/nuisance levels= SO_2, NO_2 and VOC levels in air, BOD, COD and DO levels in surface water
- Noise = Elevated noise levels across all sampling points
- Surface water physico-chemical parameters above WHO/FMEnv regulatory limits = Turbidity, BOD, COD and DO
- Invasive/invasive species = *Chromolaena odorata and Ageratum conyzoides*
- Threatened species= *Vitellaria paradoxa* and *Khaya senegalensis*
- Estimated amount of greenhouse gas to be generated by project activity= **291.115** $MTCO_2$ Equivalence is estimated to be emitted from project activities

ES 1.8 Consultations

Details of the first, second, third and fourth rounds of consultations held with various stakeholders of the project are presented in Table ES-2.

Table ES-2: Details of Stakeholder Consultation

Site	Date and venue	Name of Stakeholder	Outcome
ROUND 1			
Makurdi	25-**09**-2020 Ministry of Agric office Makurdi	Ministry of Agriculture and Natural Resources (Proponent)	The Ministry officials and Mifor Consult team took a tour of the proposed sites, including the Makurdi Industrial Park.
Makurdi Industrial Park	25-09-2020 Industrial layout	Private entrepreneurs and intermediaries in the supply and distribution chain	The engagement noted farmers concerns on the flooding of paddies due to incomplete and blocked canalization, bulk purchases by aggregators from the farmers who then supply to processing mills at exorbitant prices. Oracle firm called for the damming of the Fete River. The private millers attributed input types and species and harvesting as primary determinants of processed products. The fruit processing company failed due to mismanagement.
Makurdi	26-09-2020 Tse Makurdi palace	Zakis of all communities in Makurdi LGA	The Traditional institutions gave their blessings and called for government sincerity and their gainful engagement across the project life cycle.
ROUND 2: INCEPTION MEETING ENGAGEMENT			
		FMEnv, BNMAND, AfDB Mifor Consult	The FMEnv Deputy Director promised to communicate the briefings to the Director, Environmental Assessments and pledged that the briefs would be factored into their decision making on the project.

Site	Date and venue	Name of Stakeholder	Outcome
ROUND 3: AUTHORITY VISIT AND SCOPING WORKSHOP			
		Directorate cadre of the Ministry Rep of BNMAND and Mifor Consult	The meeting took a tour of Phase 1 and 2 vis-a-vis the allotted space. Director Fidelis Annuneh took and showed the team to a State government 16ha allotted land in Phase 11 of the Makurdi Industrial Park.
Makurdi	25th April 2021 Project land take	FMEnv, State Ministry of Environment, Federal controller, Environment, Benue State, BNMAND, BNMTI, Mifor Consult	Director Annuneh claimed that total compensation was while the Federal controller mentioned the NEPZA ESIA project site (less than 8km away) as a recent study as proximate to the industrial park site.
Makurdi	25th April 2021 Benue State Min of Agriculture conference room, Tse Makurdi place & project site	Institutional, traditional, PACs, PAPs, uptakers, farmers cooperatives, aggregators, and owners of agro-processing firms	The details of the meeting are in the submitted and approved scoping report. Nonetheless, the outcome was immediately factored into the formal terms of reference for the data-gathering exercise.
ROUND 4 CONSULTATION: DATA GATHERING EXERCISE			
Date and venue			**Outcome**
26th May 2021 Tse Makurdi palace			A roster of community engagement was developed and circulated.

<table>
<tr><th>Site</th><th>Date and venue</th><th>Name of Stakeholder</th><th>Outcome</th></tr>
<tr><td colspan="4">ESIA COMMUNITY /HOUSEHOLD ENGAGEMENT- @ ZAKI'S RESIDENCE</td></tr>
<tr><td colspan="3">Date and venue</td><td>Outcome</td></tr>
<tr><td colspan="3">28/04/2021 Agber</td><td rowspan="11">The community engagement harvested data across community governance structure, history, grievance redress mechanisms, cultural heritage, belief systems, gender issues, household social, cultural and health infrastructures. Energy consumption rates were also obtained.</td></tr>
<tr><td colspan="3">28/04/2021 Iorbee</td></tr>
<tr><td colspan="3">26/04/2021 Kigir</td></tr>
<tr><td colspan="3">28/04/2021 Kwaghtamen</td></tr>
<tr><td colspan="3">26/04/2021 Tionsha</td></tr>
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<tr><td colspan="3">26/04/2021 Tse Khave</td></tr>
<tr><td colspan="3">26/04/2021 Tse Perver</td></tr>
<tr><td colspan="4">ENGAGEMENT WITH RICE, CASSAVA AND HORTICULTURAL CROPS ASSOCIATION AND COOPERATIVES</td></tr>
<tr><td colspan="2">Makurdi 26th May 2021</td><td colspan="2">The meeting resolved for an aggressive and sustained sensitization campaign of rice, cassava and horticultural crops that will boost production and enlarge the numbers of cooperatives and aggregators.</td></tr>
</table>

ES 1.9 Environmental and social management plan (ESMP)

The specific measures addressing each significant/moderate impact are

Air Quality

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

Surface Water, Groundwater and Soil

- Regular checking and maintenance of all vehicles and equipment to minimize the risk of fuel or lubricant leakages
- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques
- Install oil/water separators and silt traps before effluent, leaves the site
- 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

Biodiversity

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

ES 1.9.1 Management measures for STD - HIV and awareness programs

- The Contractor will develop a policy and management plan to reduce the transmission of STIs, including HIV/AIDS. This strategy will:
- Make provision for awareness, counseling and testing for all Project personnel, including voluntary testing for STDs and HIV/AIDS as part of any health screening program (workers will not be denied employment or discriminated against in any way based on their HIV status);

- Provide guidance and counseling to workers with HIV/AIDS to access treatment through existing health facilities or NGO campaigns or programs;
- Ensure that all Project personnel are given specific HIV and STD prevention training;
- Undertake information, education and communication campaigns around safe sexual practices and transmission of STDs and
- HIV/AIDS as well as condom distribution at stopping locations on key transport routes targeting commercial sex workers and truck drivers;
- Support public health or NGO initiatives to reduce STD transmission including working through schools, women's and youth groups;
- The Contractor will provide non-local workers with a schedule and transportation that avoids limiting off-time activities at nearby communities;
- Conduct community awareness campaigns in communities around the project area.

ES 1.9.2 Management measures of employees-communities relationship

The contractor with the supervision of the PIU will ensure:

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

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

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

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

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

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

ES 1.9.3 .1 Specific arrangements and management strategies for GBV risks

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

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

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

The SEA/GBV Accountability and Response Framework will include;

- Allegation Procedures: How the project will provide information to employees and the community on how to report cases of SEA/GBV, CoC breaches to the GRM;
- SEA/GBV Allegation Procedures to report SEA/GBV issues to service providers, and internally for case accountability procedures which will clearly lay out confidentiality requirements for dealing with cases;
- Mechanisms to hold accountable alleged perpetrators associated to the Project;

- Disciplinary action for violation of the CoC by workers. It is essential that such actions be determined and carried out in a manner that is consistent with local labor legislation and applicable industrial agreements.

ES 1.8.4 FMEnv Environmental monitoring matrix

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

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

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NOx, CO_2, PM)	Affected communities in area of influence	Minor	Use good international practice: Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators to be located to facilitate dispersion	Negligible	EPC Contractor	AfDB-PIU	FMEnv and BSMEnv

ES 1.9.5 Key ESMP implementation indicators

The following are some of the key ESMP indicators

- Concentration of NO_2, SO_2 exceeds regulatory limit during periodic monitoring
- Number of accidental spills
- Noise level

ES 1.9.6 Institutional Framework for Implementation of the ESMP

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

- BSMANR will have principal responsibility for all measures outlined in the ESMP for the construction phase.
- The HSE department of BMEnv shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations the operations. Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.
- The PIU shall hire and manage contractors, a witness NGO shall be accredited to monitor and evaluate the implementation of the ESMP to a certain extent. EPC contractors are responsible for implementation of the ESMP.
- PIU is responsible for the overall project planning and execution, including preparation of bidding documents, hiring of project management consultants, EPC contractors and supervision of the works
- The HSE department of BSMANR shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations the operations
- The Federal Ministry of Environment (FMEnv.) has the responsibility for the implementation of the EIA Act Cap E12 LFN 2004. Furthermore, the Benue State Ministry for Environment and the affected LGA (Makurdi) have certain oversight roles, which they perform under coordination of the FMEnv.

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

ES 1.9.7 Estimated overall budget

Table ES-4 presents the summarized annual estimated ESMP budget

Table ES-4 Estimated annual overall budget for ESMP

Construction phase					**Operation phase**			
Components	Cost Estimates (NGN)	Frequency	Annual Estimates (NGN)	Annual Estimates (USD)	Cost Estimates (NGN)	Frequency	Annual Estimates (NGN)	Annual Estimates (USD)
Air quality	800,000	Monthly	9,600,000	22,454.4	550,000	Bi-Annually	1,100,000	2,572.9
Noise & vibration	800,000	Monthly	9,600,000	22,454.4	880,000	Bi-Annually	1,760,000	4,116.64
Soils integrity	1,800,000	Quarterly	5,400,000	12,630.6	1,000,000	Bi-Annually	2,000,000	4,678
		Quarterly	5,400,000	12,630.6		Bi-Annually	2,000,000	4,678
Water quality	1,200,000	Twice a year	2,400,000	5,613.6	-	-	-	
Vegetation integrity and Fauna protection	350,000	Once during vegetation removal in the project site	-		-	-	-	
Visual amenities and Land	350,000	Quarterly	1,050,000	2,455.95	-	-	-	

Construction phase					Operation phase			
Components	Cost Estimates (NGN)	Frequency	Annual Estimates (NGN)	Annual Estimates (USD)	Cost Estimates (NGN)	Frequency	Annual Estimates (NGN)	Annual Estimates (USD)
planning and use								
Stakeholder relations Management	3,200,000	Quarterly	9,600,000	22,454.4	2,500,000	As need arises	-	
Health, Safety and Security	350,000	Quarterly	1,050,000	2,455.95	350,000	Bi-Annually	700,000	1,637.3
Employment and economy	700,000	Quarterly	2,100,000	4,911.9	200,000	As need arises	-	

The Executive Summary is too lengthy. It should be made more concise, succinct, in simple not-too-technical prose for the Executive to understand and make effective decisions.

ACKNOWLEDGEMENT

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

CHAPTER ONE: INTRODUCTION AND LEGAL/REGULATORY FRAMEWORK

1.1 Introduction

1.1.1Background Information

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

With financing to be provided by the African Development Bank (AfDB), the Federal Government of Nigeria, through the Agricultural Transformation Agenda Support Program seeks to establish Special Agro-Industrial Processing Zones in the country, in four clusters (Table 1.1). This project's scope covers Benue State in the fourth cluster. The industries shall utilise products derivable from cassava, horticulture and rice as feedstock. The project also involves identifying value chain ancillary subcomponents to be driven and anchored principallyby the private sector. The sub-components would primarily serve the proposed main components.

Table 1.1: SAPZ Clusters

	Identified Commodities	States Identified
SAPZ Cluster 1:	Rice, maize, dairy, beef, cotton, and horticulture	Katsina; Kano; Jigawa; Kaduna
SAPZ Cluster 2:	Industrial cassava, poultry, cocoa, fisheries, agro-forestry	Ogun; Lagos; Ondo; Oyo; Osun; Ekiti

SAPZ Cluster 3:	Rice, livestock	Niger; Kogi; FCT; Kwara; Kebbi, Sokoto
SAPZ Cluster 4:	Horticulture, rice, industrial cassava and cocoa	Benue, Cross River; Anambra; Ebonyi;

Consequently, the State *proposes establishing an agro-industrial park to process cassava, horticultural crops and rice in Phase 2 of Makurdi Industrial Park.*

In line with the EIA Act Cap E12, LFN 2004, AfDB operational Safeguards and alignment with the Environmental and Social Management Framework (ESMF), this type of project shall undergo an environmental and social impact assessment.

1. Therefore, this ESIA study will aim to identify potential and significant adverse environmental and social impacts and propose means of mitigating them to acceptable levels.

2. The ESIA will also consider the capacity of existing institutions to manage the predicted ecological and social issues and implement an Environmental and Social Management Plan (ESMP) for this purpose.

3. This ESIA is also prepared in compliance with the Federal Government of Nigeria (FGN) Environmental Impact Assessment (EIA) Law and the Federal Ministry of Environment Guidelines.

4. It is also compliant with the Environmental and Social Policies of the African Development Bank (AfDB). The AfDB has various instruments for addressing the environmental and social impacts of projects. The development of the proposed project will trigger all the five AfDB Operational Safeguards Policies, including:

    i. OS 1: Environmental and social assessment;
    ii. OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and compensation;
    iii. OS 3: Biodiversity and Ecosystem Services;
    iv. OS 4: Pollution Prevention and

5. Control, Greenhouse Gases, Hazardous Materials, Resource Efficiency; and OS 5: Labour Conditions; Health and Safety.

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

- identifies and assesses the potential environmental and social impacts and recommends

appropriate mitigation strategies and prepared ESMP.

- identifies and enumerate Project Affected Persons, Communities and their economic activities based on national/ local and international stantards and principles presented in the Resettlement Policy Framework.

Provide the coordinates of the exact project location, and the map of the project/study area in this introductory chapter.

1.1.2 The Proponent

Benue State Ministry of Agriculture and Natural Resources is the project proponent. It was created on the 3rd of February, 1979. The Ministry is responsible for formulating policies, programmes and monitoring the implementation of the following policy objectives:

- Attainment of self-sufficiency in the essential food products for enhanced food security.
- Increase production of Agricultural raw material to meet the growing demand in the agro-allied industries.
- Increased production of exportable products to attract foreign exchange earnings for the nation at large.
- Modernization of agricultural production processing, storage and distribution through the infusion of improved technological packages and management so that agriculture can be more expensive to the demands of other sectors of the economy.
- Creates more agricultural and rural employment opportunities and improve the living standards of farmers and rural dwellers through enhanced income.
- Protection and improvement of land resources through appropriate farming systems.
- Establish appropriate support institutions to facilitate the integrated development and realization of the State's agricultural potentials. Table 1.2 provides the contact details of the proponent.

Table 1.2: Proponents Contact Details

Project Proponent	Benue State Ministry of Agriculture and Natural Resources (BNMANR)
Address	Shittu Alao Avenue, Makurdi
Contact Person	Timothy Ijir PhD
Contact Email	timijir@yahoo.com

1.1.3 Purpose of the ESIA Report

The purpose of the ESIA is to assess the potential biophysical and social impacts of the proposed project, which includes a detailed Environmental and Social Management Plan (ESMP). The

ESIA will establish modalities of implementing the ESMP under Nigeria Environmental policies and laws and the AfDB ISS.

1.1.4 Objectives of the ESIA

The ESIA study aims to ensure compliance with national environmental reulation guidelines and AfDB operational safeguards. The objectives include to;

- establish baseline biophysical and social environment within the project area of influence;
- identify and analyze alternatives to the proposed projects, including sites, technology, layout, etc.;
- to identify and assess the anticipated potential environmental and social impacts of the proposed project;
- propose cost-effective mitigation measures across all phases of the project life cycle.
- Identify any future environmental and social issues and concerns which may affect the project development;
- prepare and cost an implementable Environmental and Social Management Plan (ESMP) detailing mitigation measures and institutional roles and responsibilities.
- Develop environmental management plans for residual impacts above Minor categorization.
- Recommend an environmental management program for the rehabilitation of the scheme, including compliance, monitoring, auditing and contingency planning; provide the basis for co-operation and consultation with regulatory and non-regulatory authorities and the public.
- assist project design and planning by identifying those aspects of location, construction and operations, which may cause adverse environmental, social, health and economic effects;
- carry out consultations with relevant stakeholders, including potential project-affected persons, to obtain their views and suggestions regarding the environmental and social impacts of the proposed project. The outcome of the consultations will be reflected in this ESIA report and will be incorporated into the project design as appropriate; and
- provide an opportunity for Interested and Affected persons to be engaged/involved in the disclosure process**.**

1.1.5 Scope of the Study

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

1. Legal and Administrative framework
2. Project and process description
3. State of the bio-physical and socio-economic issues.

This structure is to reduce the complexity of the proposed project and ensure a comprehensive

study.

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

Table 1.3 outlines regulatory requirements undertaken and to be undertaken within the Nigerian Regulatory framework.

Table1.3: ESIA Process in Nigeria

ESIA Step	Description	Status	Remark
ESIA registration	This step initiates the ESIA process providing draft terms of reference, letter of Introduction from the client and a covering letter	This step has been satisfied	See Annexure 1
Authority Visit	This step provides the regulatory authorities (FMEnv, affected state and LGAs Environment Ministries and Departments respectively) opportunity to appraise the proposed project	This step has been satisfied	Not Applicable
Scoping	The ESMF report was mooted as an alternative to Scoping exercise, hence sampling was permitted. On further considerations by FMEnv, a Scoping exercise was approved. Subsequently, a Scoping workshop was conducted after the field sampling exercise.	This step has been satisfied	See Annexure 2
Project Categorization	Steps 2 and the Scoping Report document provides the regulatory Ministry with the project overview, environmental settings and stakeholder concerns/perception to be factored into the categorization process	Official Terms of Reference was issued	See Annexure 2
Data Gathering Exercise	Data gathering exercise was conducted with active involvements of FMEnv, State, LGAs and the Ministry's officials	This was conducted from April 24 and 27th 2021	See chapter four
Submission of Draft ESIA report	FMEnv Specified copies of draft ESIA report to be submitted	This step has been satisfied	-
Public Disclosure	This step provide avenue for the ESIA findings to be made available to the wider public over a 21-working days period	This step has been satisfied	See Punch newspaper of 13 July, 2021
Panel Review	This step subjects the ESIA report to experts evaluation, assessment and evaluate of stakeholders observations	This step has been satisfied	-

Submission of Final ESIA report	On receipt of comments from FMEnv and incorporation, a final report is developed and submitted to FMEnv within a specified time frame.	TBD	Not yet satisfied
Issuance of Approval or disapproval Certificate	This conveys the approval to the client	TBD	Not yet satisfied

1.2. Administrative and Legal Framework

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

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

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

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

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

- Nigerian administrative and legislative organization;
- National environmental and social legislation deemed applicable to the Project;
- E&S policies and procedures of AfDB;
- AfDB environmental and social standards applicable to the project;
- National Climate Change Policy
- Nigeria Nationally Determined Contribution (NNDC)
- National Waste Management Policy
- United Nations Framework Convention on Climate Change (UNFCCC)
- Other international conventions to which Nigeria is a signatory; and
- International standards and guidelines to which the project will be aligned.

1.2.1 National Environmental & Social Policies and Legal Provisions

1.2.1.1 National Policy on the Environment (1999)

The National Policy on the Environment describes the conceptual framework and strategies for achieving sustainable development in Nigeria. Specifically, the purposes of the Policy include:

- Secure quality of the environment that is adequate for good health and human well-being;
- Conserve and use the environment and natural resources sustainably for the benefit of present and future generations;
- Restore, maintain and enhance ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and promote understanding of the essential linkages between the environment, resources and development, and encourage individual and community participation in environmental improvement efforts; and
- Co-operate with other countries, international organisations and agencies to achieve optimal use of transboundary natural resources and effective prevention or abatement of transboundary environmental degradation.

1.2.1.2 EIA Act Cap E12 LFN 2004

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

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

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

The Act established a body known as NESREA to be the enforcement Agency for environmental standards, regulations, rules, laws, policies and guidelines in Nigeria except for Oil and Gas Industry which is handled by NOSDRA. The Act empowers the agency to have responsibility for the protection and development of the environment, biodiversity conservation and sustainable

development of Nigeria's natural resources in general, and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

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

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

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

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

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

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

- Establish and maintain a pollution monitoring unit within their premises;
- Ensure on-site pollution control; and
- Assign the responsibility for pollution control to a person or body accredited by the FMEnv. **Section 5** of the Regulations mandate industries or facilities to submit to the nearest office of FMEnv. a list of chemicals used in the manufacture of its products, details of stored chemicals and storage conditions and where these chemicals were obtained, bought or sold.

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

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

1.2.1.8National Environmental (Surface& Groundwater Quality Control) Regulations 2011

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

1.2.1.9 The Standards Organization of Nigeria (SON) Act, 2015

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

1.2.1.10 Land Use Act CAP L5 LFN 2004

The Land Use Act is the legal framework for land acquisition and resettlement in Nigeria. The Act stipulates that all land in Nigeria is to be held by State Governors in trust for the people. The administration of urban land is directly under the control and management of the Governor, whereas non-urban land is under the control and management of the Local Government Authority. By implication, the Governor has the right to grant statutory rights of occupancy to land while the Local government has the right to grant customary rights of occupancy. At any rate, all lands irrespective of the category belong to the State. At the same time, individuals only enjoy a right of occupancy as contained in the certificate of occupancy or where the grants are "deemed". Thus, the Land Use Act is the key legislation that directly relates to resettlement and compensation in Nigeria. The Act makes it lawful for the Governor to grant statutory rights of occupancy for all purposes, grant easements appurtenant to statutory rights of occupancy, and demand rent. The local government, under the Act, can enter, use and occupy for public purposes any land within

its jurisdiction that does not fall within an area compulsorily acquired by the Government of the Federation or of relevant State; or subject to any laws relating to minerals or mineral oils.

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

1.2.1.11 The National Policy on Environment

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

1.2.1.12 Agenda 21 for the Nigerian Environment

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

1.2.1.13 National Climate Change Policy 2021

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

1.2.1.14 Other Applicable E&S Legal Provisions

Table 1.4 summarises other relevant existing Nigerian laws and regulations.

Table 1.4: Other Relevant Nigerian E&S Laws and Regulations

Laws and Regulations	Summary of Provisions
Forestry Law CAP 51 LFN 1994	The Forestry Law prohibits any act that may lead to the destruction of or cause injury to forest products, forest growth or forestry property in Nigeria. The law prescribes the administrative framework for the management, utilisation and protection of forestry resources in Nigeria.

Laws and Regulations	Summary of Provisions
Endanger Species (Control of International Trade and Traffic) Act LFN 2016.	The Act provides for the conservation and management of Nigeria's wildlife and prohibits the hunting, capture and trade of endangered species.
Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004	An Act that prohibits carrying, depositing, and dumping toxic waste on any land, territorial waters, and matters relating thereto, including penalty for offences for individuals and corporate bodies. The Act prohibits all activities relating to the purchase, importation, transit, transportation, deposit, storage or, sale of harmful wastes.
National Environmental (Ozone Layer Protection) Regulations, 2009	These provisions seek to prohibit the import, manufacture, sale and use of ozone-depleting substances and materials that contain these substances.
National Environmental (Soil Erosion and Flood Control) Regulations, 2011	The overall objective of these Regulations is to control erosion and flooding by checking all earth-disturbing activities, practices or developments for non-agricultural, commercial, industrial and residential purposes.
Factories Act (CAP F1), 2004	The Act establishes a legal framework for the registration of factories and to make adequate provisions regarding the safety of workers against occupational hazards, and impose penalties for any breach of its conditions. This Act covers all workplaces.
Employee Compensation Act, 2010	The Act provides compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at the workplace or in the course of employment. Payment of compensation by the employer is as enshrined in the accepted principle that the employer has a duty of care to protect workers' health, welfare, and safety at work.
Nigerian Urban and Regional Planning Act CAP 138 LFN 2004	The Act aims at overseeing realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. The Act establishes grounds for land development rejection.
EIA Procedural Guidelines, 1995	Provides Procedural context and guidance for the conduct of EIA, ESIA, ESHIA etc. in Nigeria.

Laws and Regulations	Summary of Provisions
Natural Resources Conservation Act CAP 268 LFN 1990	The Natural Resources Conservation Act CAP 268 LFN 1990 is the most direct existing legislation on natural resources conservation. The Act establishes the Natural Resources Conservation Council, which is empowered to address soil, water, forestry, fisheries, and wildlife conservation by formulating and implementing policies, programmes, and projects to protect the country's natural resources.

1.2.2 Agricultural Policies and Legal Provisions

The Legal Framework on Agricultural Practice in Nigeria includes:

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

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

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

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

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

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

1.2.2.4 The Agricultural Credit Guarantee Scheme Fund Act, 1977

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

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

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

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

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

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

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

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

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

1.2.2.9 National Economic Empowerment and Development Strategy (NEEDS)

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

1.2.2.10. The Food and Nutrition Policy

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

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

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

1.2.2.12. The New Nigerian Agricultural Policy 2001-2013

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

1.2.2.13. The National Agricultural Development Fund

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

1.2.3 Nigerian Gender-Related Policies

1.2.3.1 The Gender Policy Framework in Nigeria

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

Moreover, as a member of the United Nations, Nigeria signed and ratified the various relevant international instruments, treaties, and conventions without reservation. These instruments have always emphasised that member nations put the necessary mechanisms needed to eliminate gender discrimination and ensure equality and human dignity to all men and women. The government of Nigeria in 2000 adopted a National Policy on Women; it was reviewed and upgraded in 2006 to become the National Gender Policy. Other key government policies with gender equality and empowerment of women frameworks include the National Economic Empowerment and Development Strategies (NEEDS) in May 2004; and the Transformation Agenda.

1.2.3.2 National Gender Policy, 2006

The overall goal of the National Gender Policy of Nigeria is to promote the welfare and rights of

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

- Contribution towards women's empowerment and the eradication of unequal gender power relations in the workplace and economy, in trade unions and broader society;
- Encouragement of the participation, support and co-operation of men in taking shared responsibility for the elimination of sexism and redefining of oppressive gender roles;
- Increase the involvement of women in leadership and decision-making;
- Ensure that through labour legislation and collective bargaining, the particular circumstances of women are considered and that measures are promoted to eliminate discrimination based on gender;
- Ensure that there is a gender perspective in all sectors of development.

1.2.4 Nigerian Institutional Provisions, Regulatory Agencies and Arrangement

1.2.4.1 Federal Ministry of Environment

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

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

1.2.4.2 National Environmental Standards and Regulations Enforcement Agency (NESREA)

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

1.2.4.3 Federal Ministry of Agriculture and Rural Development (FMARD)

The Federal Ministry of Agriculture and Rural Development (FMARD) is a Ministry of the Nigerian government regulating agricultural research, agriculture and natural resources. The

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

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

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

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

i. ***Technical Departments:*** Agriculture (Trees and Crops), Fisheries, Livestock, Land Resources, Fertilizer, Food Reserve & Storage and Rural Development.

ii. ***Service Departments:*** Finance, Human Resources, Procurement, PPAS (Plan, Policy, Analysis & Statistics) and Co-operatives.

1.2.5 Relevant States Regulatory Agencies

1.2.5.1 Benue State Ministry of Agriculture and Natural Resources

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

- Attainment of self-sufficiency in the essential food products for enhanced food security.
- Increase production of Agricultural raw material to meet the growing demand in the agro-allied industries.
- Increase in production of exportable products to attract foreign exchange earnings for the State.
- Modernization of agricultural production, processing, storage and distribution through the infusion of improved technological packages and management so that agriculture can be more expensive to the demands of other sectors of the economy.
- Create more agricultural and rural employment opportunities and improve the living standards of farmers and rural dwellers through enhanced income.
- Protection and improvement of Agricultural Land resources and safety of the environment through appropriate farming systems.
- Establishment of formal support institutions and operation of administrative organs to facilitate the integrated development and realization of the State's agricultural potentials.

- Train and retrain and enlightened human resource stock to make agriculture a business and not a hobby.

1.2.5.2 Benue State Ministry of Water Resources and Environment

Benue State Ministry of Water Resources and Environment was created in July 1999. With the statutory responsibility to attend to issues of water supply, ecological and environmental challenges. The ministry manages both human and industrial waste, protects and conserve the environment, and enforces laws on the environment in the state.

The ministry undertakes the following core functions:

- Public Health and Sanitation does monthly sanitation exercise early Flood warning system monitoring.
- Urban Renewal executes the following installation of directional signs.
- Environmental impact assessment (EIA).
- Beautification and greening of major streets.
- Waste Management Waste management and recycling plant.
- Collaboration with private service providers, PSPs for effective waste management.
- Direct Town cleaning (DTC).

1.2.5.3 Benue State Agriculture and Rural Development Authority (BNARDA, 1986)

Benue State Agricultural and Rural Development Authority has the overall responsibility of initiating and implementing agricultural extension programmes that directly impact rural farmers, introducing new and improved breeds methods while sensitising and building capacities of rural farmers.

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

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

1.2.7 International Conventions and Agreements applicable to the sector

International agreements, also known as conventional international law, create law for the parties of the agreement. There is a multitude of international agreements relevant to agriculture. These agreements attempt to regulate how governments relate to each other on a host of issues. Trade agreements are among the most common types of international agreements that contribute to international agricultural law.

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

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

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

1.2.8 The African Development Bank (AfDB)

1.2.8.1 Integrated Safeguards System (ISS)

The Environmental & Social safeguards (E&S) of the AfDB are a cornerstone of the Bank's support for inclusive economic growth and environmental sustainability in Africa. AfDB will apply the Integrated Safeguards System for all subprojects considered under ATASP- 1. The Bank ISS is designed to promote project outcomes by protecting the environment and people from the potentially adverse impacts of projects. The ISS requires that all the projects comply with the ISS's safeguard requirements during subprojects preparation and implementation. The safeguards aim to:

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

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

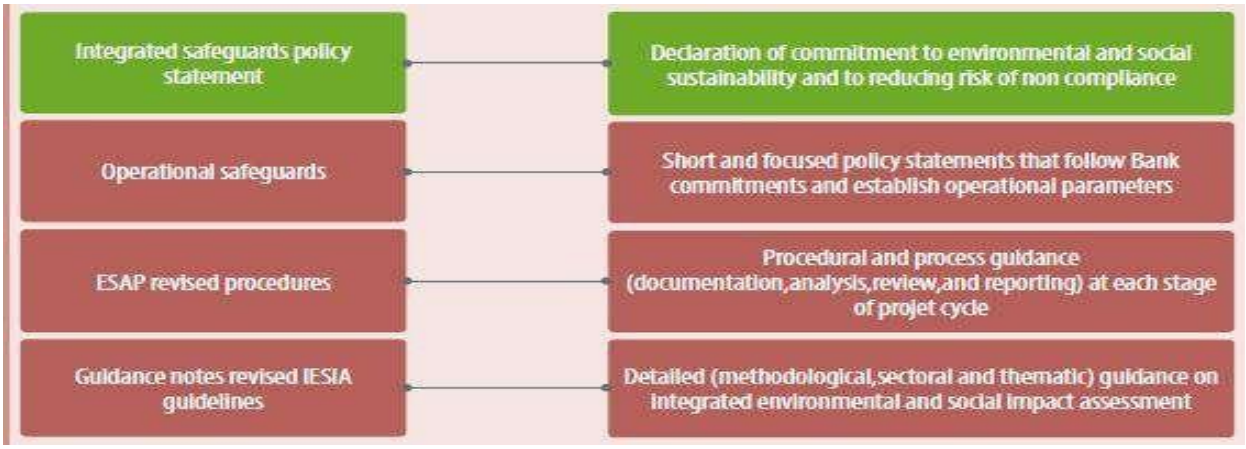


Figure 1.1: Structure of the AfDB ISS

1.2.8.2 The Integrated Safeguards Policy Statement

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

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

1.2.8.3 Operational Safeguards (OSs)

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

The OSs is intended to:

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

Table 1.6: AfDB Operational Safeguards OS1-5

Operational Safeguard	Description
OS 1: *Environmental and social assessment*	This overarching safeguard governs the process of determining a project's environmental and social category and the resulting social and ecological assessment requirements.
OS 2: *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 incorporate a few refinements designed to improve the operational effectiveness of those requirements.
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.
OS 4: *Pollution Prevention and Control, Greenhouse*	This safeguard covers the range of critical impacts of pollution, waste, and hazardous materials for which they are aligned to international

Operational Safeguard	Description
Gases, Hazardous Materials and Resource Efficiency	conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.
OS 5: *Labour Conditions, Health and Safety*	This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonisation with most other multilateral development banks.

1.2.8.4 Environmental and Social Assessment Procedures (ESAPs)

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

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

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

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

AfDB Project Cycle	Details
Country Programming Phase	• During **country programming**, the critical task is to develop and update baseline data on RMCs' E&S components, policies, programs, and capacities to better integrate E&S dimensions into lending priorities. • These are the responsibilities of the Bank's Sector Departments and Regional Departments.
Project Identification Phase	• At the **project identification phase**, the **screening exercise** focuses on the E&S dimensions of a **project to categorise it in one out of four categories** based on the potential adverse E&S impacts of the project. • The Bank and FMENnv. will conduct these tasks in collaboration with the client.
Project Preparation Phase	• During **project preparation**, the **scoping exercise** helps define the scope of the Environmental and Social Assessments (ESA) to be completed by the Borrower based on the project category, with staff assistance from the operational departments. • The preparation of these assessments, including the development of management plans and systems, requires consultations with primary and secondary stakeholders. • Once ESAs are finalised, the review process allows operational departments to ensure that Bank's vision, policies, and guidelines were adequately considered in project design and implementation. • The clients/borrower will be in charge of preparing the required studies and plans, while the Bank will be responsible for reviewing and validating them.
Project Appraisal Phase	• During the **appraisal phase**, **ESIA Summaries** shall be reviewed and cleared by the Safeguards and Compliance Department (SNSC). • The procedures require the public disclosure of summaries under specified deadlines. o All Category one (1) operations shall be disclosed for 120 days before Board deliberations. o All category two operations shall be disclosed for 30 days before Board deliberations. • The Bank will be responsible for conducting site visits and verification activities concerning the borrowers' studies, plans, and systems.
Project Implementation	• At the **project implementation phase**, the Borrowers shall ensure the implementation of E&S management plans developed to address adverse

AfDB Project Cycle	Details
Phase	impacts while monitoring the project impacts and results. • The Bank's operational staff shall supervise the Borrowers' work and verify compliance through **supervision missions and E&S audits**, whenever necessary. • Audits are undertaken during the completion phase, and post evaluations shall also aim to assess the E&S sustainability of the results.

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

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

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

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

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

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

1.2.8.6 AfDB Project Categorization Process

The ESAP also includes procedural requirements such as categorising projects, disclosing and monitoring projects during implementation and operation. All projects under ATASP will be categorised and structured to meet AfDB ISS requirements. Under AfDB ISS, each subproject will undergo E&S appraisal to determine a project funding feasibility as well as ensuring that the E&S considerations are incorporated effectively in the planning, implementation, and operation of the subprojects. Each subproject will undergo **initial E&S screening** and be categorised accordingly at the initial stage of the project cycle to determine the nature and level of E&S investigations, information disclosure and stakeholder engagement required. The categorisation shall be done according to the guidelines stipulated in the AfDB ESAPs.

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

Table 1.8: AfDB Project Categorization Process

AfDB Project Category	Description
Category 1	• Projects likely to cause significant E&S impacts. • Category 1 projects are likely to induce significant and irreversible adverse environmental and social impacts or significantly affect social or ecological components that the Bank or the borrowing country considers sensitive.
Category 2	• Projects likely to cause less adverse E&S impacts than Category 1. • Category 2 projects are likely to have detrimental site-specific environmental and social impacts that are less adverse than those of Category 1 projects. • Likely impacts are few, site-specific, largely reversible, and readily minimised by applying appropriate management and mitigation measures or incorporating internationally recognised design criteria and standards.
Category 3	• Projects with negligible adverse E&S risks • Category 3 projects do not directly or indirectly affect the environment adversely and are unlikely to induce adverse social impacts. They do not require an E&S assessment. • Beyond categorisation, no action is required. • Nonetheless, to design a Category 3 project properly, it may be necessary to carry out gender analyses, institutional analyses, or other studies on specific, critical social considerations to anticipate and manage unintended impacts on the affected

AfDB Project Category	Description
	communities.
Category FI	• Projects involving lending to financial intermediaries (FI). • Category FI projects involve lending to financial intermediaries that on-lend or invest in subprojects that may produce adverse E&S impacts. • FIs include banks, insurance, reinsurance and leasing companies, microfinance providers, private equity funds and investment funds that use the Bank's funds to lend or provide equity finance to their clients.
Subcategory FI-A	• The financial intermediary's portfolio is considered high risk. It may include subprojects with potentially significant adverse environmental, climate change, or social impacts and are equivalent to Category 1 projects.
Subcategory FI-B	• The financial intermediary's portfolio is deemed to be medium risk. It may include subprojects with potentially limited adverse environmental, climate change, or social impacts equivalent to Category 2 projects.
Subcategory FI-C	• The financial intermediary's portfolio is considered low risk and includes subprojects that have minimal or no adverse environmental or social impacts and that are equivalent.

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

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

Apart from the gaps highlighted above, the main challenge facing E&S safeguarding in Nigeria is the enforcement of these policies, guidelines and legislative provisions. Institutional capacity strengthening and funding are recommended in this ESMF to support the due diligence process and consistent treatment of E&S issues across the subproject intervention areas.
To ensure E&S safeguard during subproject implementation, both the Nigerian and AfDB E&S safeguard systems need harmony. However, in divergence and gaps, the more stringent AfDB safeguard system will take precedence (Table 1.9).

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

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
ESMF for Projects involving multiple Subprojects. Screening	Not a national requirement EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment OS 1: Environmental and social assessment	OS 1: Environmental and social assessment OS 1: Environmental and social assessment
Scoping	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	EIA Act Cap E12 LFN 2004
Environmental and Social Impact Assessment Guideline	EIA Act Cap E12 LFN 2004 ESIA Procedural Guidelines, 1995 ESIA Sectoral Guidelines for Production Sector, 2013	IESIA Guidance Notes ESAP	ESIA Sectoral Guidelines for production Sector, 2013 and IESIA Guidance Notes ESAP
Environmental Categorisation	EIA Procedural Guidelines, 1995 Categories I, II & III	OS 1 – Categories 1, 2,3, and FI for operations involving lending to Financial Intermediaries.	OS 1 – Categories 1, 2, 3, and FI for operations involving lending to financial Intermediaries
Environmental and Social Assessment	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: Environmental and social assessment
Environmental and Social Management Plan	EIA Act Cap E12 LFN 2004	OS1: Environmental and social assessment	OS1: Environmental and social assessment
Consultation and Participation	EIA Act Cap E12 LFN 2004	OS1 (include the provision of IESIA Guidance Notes on consultation)	OS1 (include the provision of IESIA Guidance Notes on consultation)
Involuntary Resettlement	-Land Use Act CAP L5 LFN 2004 –Acquisition of Land	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation	OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation
Compensation	Cash compensation is generally made based upon market value.	OS 2: Affected Persons are compensated for all their losses at full replacement cost. They	OS 2: Affected Persons are compensated for all their losses at full replacement cost.

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
	Whilst in principle there is allowance for in-kind compensation or replacement of assets, cash Compensation is common practice	can be offered a range of different compensation packages, Resettlement assistance & livelihood improvement options	They can be offered a range of different Compensation packages, resettlement assistance & livelihood improvement options
Pollution Prevention and Control	National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991; and National Environmental (Surface & Groundwater Quality Control) Regulations 2011	OS4 – Pollution prevention And control, hazardous Materials and resource Efficiency	OS4 – Pollution prevention and control, hazardous materials and resource Efficiency
Greenhouse Gases	National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991	OS4– Pollution prevention And control, hazardous materials and resource Efficiency (Special screening for GHGs is also Considered under OS 1)	OS4 – Pollution prevention and control, hazardous materials and resource Efficiency (Special screening For GHGs is also considered under OS 1)
Waste and Hazardous Materials	-National Waste Management Policy -National Environmental Protection (Management Of Solid and Hazardous Wastes) Regulations, 1991 -Harmful Wastes (Special Criminal Provisions etc.) Act CAP HI LFN 2004	OS4 –Pollution prevention and control, hazardous materials and resource Efficiency	Operational safeguard 4 – Pollution prevention and control, hazardous materials and resource Efficiency
Resources and Conservation	Natural Resources Conservation Act CAP 349 LFN 1990	OS3: Biodiversity and Ecosystem Services	OS3: Biodiversity and Ecosystem Services

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
Labour Conditions	Employee Compensation Act, 2010 Labour Act, 1990	OS5 – Labour conditions, health and safety	Employee Compensation Act, 2010 Labour Act, 1990
Health and Safety	Factories Act (CAP F1), 2004	OS5 – Labour conditions, health and safety	OS5 – Labour conditions, health and safety
Natural Habitat and Biodiversity	Forestry Law CAP 51 LFN 1994 Endangered Species (Control of International Trade and Traffic) Act 2016 Natural Resources Conservation Act CAP 349 LFN 1990	OS3- safeguard 3: Biodiversity and Ecosystem Services	OS3: Biodiversity and Ecosystem Services
Gender	National Gender Policy, 2010	Special consideration is given to the needs and rights of women. In the context of Gender vulnerability, the client must consider the social and political constraints and barriers women may face.	There is a need for the project to consider the implications of the AfDB Gender Marker System and how to design and implement an appropriate Gender Action Plan for the subprojects
Vulnerable Groups	Some Nigerian policies address the needs of vulnerable people, such as the Gender Policy, Child Act or NEEDS framework. However, there are no specific provisions related to E&S Assessment.	OS 1: Environmental and social assessment. Special attention is given to vulnerable groups.	OS 1: Environmental and social assessment. Special attention is given to vulnerable groups.
Indigenous People	No Provision for indigenous people	OS 1: Environmental and Social Assessment	OS1: Environmental and Social Assessment
Differentiated	No provisions	Provision for	Provision for

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be adopted by project
Measures or Vulnerable Group		Differentiated measures for inclusion	Differentiated measures for inclusion)
Environmental Monitoring	EIA Act Cap E12 LFN 2004	ESAP	ESAP
Disclosure and Access to Information	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	OS1: Environmental and social assessment

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

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

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

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

Category	Nigerian Legislation	AfDB OS 2
Minimise Land Take and Involuntary Displacement	Explore all viable alternative project design options to ensure minimisation of impacts (Land Use Act Cap L5 LFN, 2004)	Project proponent to consider feasible alternative project designs, including re-citing and re-routing, to avoid or minimise physical or economic displacement.
Consultation and Disclosure	The Ministry of Lands usually prepares a notice of acquisition in conjunction with the survey description.	Open, inclusive and effective consultation with local communities is required. Consultation must be (Prior, Free, Informed and Consented) PFIC.

Category	Nigerian Legislation	AfDB OS 2
	This notice is then published in two newspapers (one national and one local and the government gazette	
Eligibility	Under Nigerian legislation, all land rights constitute occupancy rights rather than ownership rights and accordingly, eligibility for compensation for loss of land is not provided. Anyone possessing a statutory or customary right of occupancy to affected land is entitled to compensation for unexhausted improvements made to that land. Encroachers are not recognised as an eligible group and are thus not entitled to any compensation provisions.	AfDB identifies three groups of displaced people that shall be entitled to compensation or resettlement assistance for loss of land or other assets taken for project purposes: • Those who have formal legal rights to land or other assets recognised under the country's laws concerned. • Those who may not have formal legal rights to land or other assets at the time of the census/asset survey can prove that they have a claim that would be recognised under the customary laws of the country. • Those who have no recognisable legal right or claim to the land they are occupying in the project area of influence and who do not fall into either of the two categories described above but are entitled to resettlement assistance instead of compensation for land to improve their former living standards provided that they or witnesses can demonstrate that they occupied the project area of influence for a reasonable time (at least six months) before a cut-off date established by the borrower or client and acceptable to the Bank.
Census and Asset Inventory	A survey to record the dimensions of the affected land parcels needs to be carried out. The enumeration process is asset driven and not	A census, asset inventory and comprehensive socio-economic survey are required with gender-disaggregated information.

Category	Nigerian Legislation	AfDB OS 2
	household driven. There is no particular format that the Land Department currently uses. The method mainly comprises generic questions that are administered orally.	
Livelihood	Provisions are integrated into the 2004 Land Use Act.	Strategies to improve the livelihoods of PAPs are required.
Gender	National gender policy 2006 and National Climate Change Policy 2021	Special consideration has to be paid to the needs and rights of women. In the context of gender vulnerability, the client must give careful consideration to actively facilitating consultation with both women and men in ways that are sensitive to the social and political constraints and barriers that women and men may face. The land-taking report (RAP or LRF/LRP) must include a specific protocol specifying safeguards for the quality and quantity of land allocated to women, especially widows and divorcees, to ensure their means to generate income and achieve food security. Specifically, applicable to resettlement, land titles at the resettlement site are to be in the name of both spouses and single heads of household, regardless of gender, if this does not conflict with the borrower or client's laws and legislation. Compensation payments to families are made to both husbands and wives when this is technically feasible and socially acceptable.
Cut-off date	Though a cut-off date is not defined by Nigerian legislation, there is a six-week notice period given for land to	There is a requirement to establish a cut-off date for eligibility acceptable to project financiers/lenders. The borrower or client documents the cut-off date and disseminates

Category	Nigerian Legislation	AfDB OS 2
	be acquired by most projects. This notice period is not, however, a formal cut-off date.	information about it throughout the project area of influence in a culturally appropriate and accessible manner before taking any action on clearing land or restricting local community access to land.
Timing of Compensation	Once the compensation amounts have been discussed with the affected people.	Compensation is to be made before land, and related assets are taken; and if the project is implemented in phases before project activities begin for each particular stage.
Compensation	Cash compensation is generally made based upon government rate as well as depreciation value. In principle, there is an allowance for in-kind compensation or replacement of assets; cash compensation is standard practice.	PAPs are compensated for all their losses at full replacement cost. PAPs can be offered a range of different compensation packages, resettlement assistance, and livelihood improvement options. Engagement is vital to determine the appropriate compensation packages.
Communal resources	No provisions	Page 32 of the ISS mentions compensation for the loss of communal resources.
Livelihood Assistance	No provisions	Displaced people are provided with targeted assistance to ensure that their living standards, income-earning capacity, production levels and overall means of livelihood are improved beyond pre-project levels.
Vulnerable People	Many Nigerian policies address the needs of vulnerable people, such as the Gender Policy, Child Act or NEEDS framework. However, there are no specific provisions related to physical or economic displacement.	Special attention needs to be paid to vulnerable groups and special provisions required in the livelihood restoration process.
Grievances	Section 30 of the Land Use	There is a requirement to establish a

Category	Nigerian Legislation	AfDB OS 2
	Act 1990 6 v: "Where there arises any dispute as to the amount of compensation calculated under the provisions of section 29, such dispute shall be referred to the appropriate Land Use and Allocation Committee."	culturally appropriate and accessible grievance and redress mechanism to resolve any disputes arising from the land-taking process and compensation procedures in an impartial and timely manner. PAPs must be informed about the mechanism.
Monitoring	No provisions	An independent third party is required to monitor the implementation of large-scale or complicated resettlement or livelihood restoration plans, with regular feedback from PAPs. For large scale displacement operations, quarterly reviews are recommended, and in-depth reviews of 6 months progress, consistent with the overall project scheduling, are critical.

1.2.11 Disclosure Requirements

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

Table 1.11: Disclosure requirements of the FMEnv. and AfDB

Entity	Project Type	Project Category	Disclosure documents	Disclosure Requirements*
FMEnv	Public and Private sector	Category 1, 2 & 3	ESIA	21-working days
AfDB	Public Sector	Category 1	ESM/ESMP, ARAP or FRAP	120-working days
		Category 2	ESMP	30-working days
	Private Sector	Category 1	ESM/ESMP, FRAP	60-working days

		Category 2	ESMP	30-working days

1.2.12 INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK AS APPLICABLE TO THE PROPOSED PROJECT

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

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

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

1.2.13 ESIA PROCEDURAL GUIDELINES

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

1.2.14 ESIA TERMS OF REFERENCE

In line with Nigeria's ESIA procedural guidelines (FEPA, 1995), a Terms of Reference (ToR) for the ESIA of the proposed project was developed, for the FMEnv's approval, at the early stages of

the study based on an initial assessment of the environmental issues relating to the proposed project. The specific objectives of the ToR were to:

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

1.3 Report Structure

Table 1.12 provides the structure of the report.

Table 1.12 Structure of Report

Chapter	Content
Chapter 1	Introduction, Background information, Legal and Administrative Framework Provides a background to the proposed project and the EIA and includes information about the Proponent, the EIA consultant team and the report's main goals and structure. It also, outlines the legal framework within which the EIA has been undertaken and identifies other environmental legislation, standards and guidelines applicable to the project
Chapter 2	Project Justification and Description This chapter presents project justification; the need/value and its envisaged sustainability. It also presents the description and activities of the project.
Chapter 3	Project Alternatives This chapter presents the various alternatives considered and those selected.
Chapter 4	Project area of influence and Description of Baseline Environment This chapter presents the project area of influence (Direct and Indirect), approach and methodology for the EIA process. It also describes the biophysical baseline of the project's areas of influence.
Chapter 5	Associated and potential Impact This chapter identifies and assesses potential Project impacts.
Chapter 6	Impact Mitigation Measures Defines relevant mitigation measures to avoid, reduce, compensate or enhance Project impacts (as applicable).
Chapter 7	Environmental and Social Management Plan Presents the Project ESMP, organizing all mitigation, management and monitoring requirements set out in the EIS into thematic management programs.
Chapter 8	Decommissioning/Abandonment Presents the steps to be taken during the decommissioning of the project and the main findings of the EIS report, and recommendations for the following phases of the project
Chapter 9	Conclusion
Chapter 10	References

CHAPTER TWO: JUSTIFICATION AND PROJECT DESCRIPTION

2.0 Introduction

This chapter presents the justification for the project as well as describe the key elements and planned activities of the proposed establishment of an Agro-Industrial Park in Makurdi Industrial Park, Markudi Local Government Area in Benue state. Impact prediction is dependent on an excellent understanding of the project activities, and scope as presented in chapter seven of this report.

2.1 PROJECT JUSTIFICATION

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

2.1.1 Need for the Project

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

Processing agricultural materials at the source of production have many advantages. Processing adds value, reduces bulk (by lowering moisture content and other unwanted materials), removes any spoiled or sub-standard materials and helps with grading and packing according to the manufacturing processes involved, provision of employment opportunities and technology transfer to the local population. Better quality materials are prepared for the market, and lower quality

materials and wastes remain at the point of production. This process makes handling, storing and transporting more efficient and cost-effective. While retaining the characteristics of the original materials, processing should where possible, also improve shelf life. This can extend the area of distribution and sales. In addition, processing and packaging should enable the product to withstand the demands of transportation and distribution better.

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

The post-harvest practice in the State is also an issue. How foods/materials are collected, handled and transported require improvement. Distribution mechanisms have to be improved to reduce the high levels of loss that typify much of production. If the infrastructure is poor – limited roads, non-specialised transport, limited care when handling, inadequate packaging, etc. - then fresh produce will continue to deteriorate at a rate proportional to the distance, time and handling involved. Losses of the order 50 percent, for example, are possible for soft fruits when shipped in an open truck from Vandekiya, Ukum, Ushongu, Tarka etc., to Makurdi during the heat of the day. Losses, by comparison, are negligible for soft fruits shipped overnight by air from East Africa to Europe. The differences are value and packaging, and access to experienced management and dedicated transport equipment and facilities. Good handling and marketing facilities are essential to minimise the losses. It is not sufficient to encourage the growth of processing separate from, and independent of, the service industries that provide the support, facilities, and resources essential for commercial success.

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

Agro-industrial parks provide networks of contacts between producers, markets, and processors and provide the physical infrastructure required for the transforming industries.

2.1.2 Benefits of the Project

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

The following few are worth mentioning;

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

2.1.3 Envisaged Sustainability

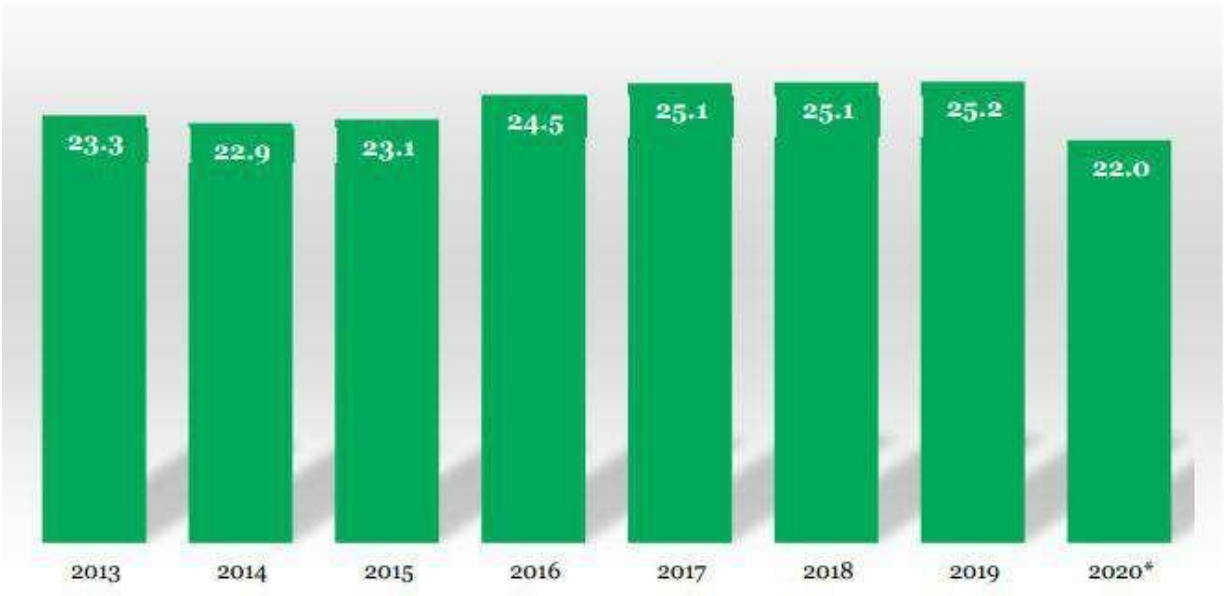
The general sustainability principles (technical, economic, environmental and social) that guided the project's design are set out below.

2.1.3.1 Technical Sustainability

The proposed project is technically feasible because it is professionally designed, and the technology employed is readily available. The proposed site selection has also considered the accessibility for operation and maintenance work after commissioning. There is a pool of technical human resources available In Benue State to drive the Industrial Park. This is ably exemplified by the plethora of agro-processing factories within the Park. The project will be technically sustained by applying best international and national best practices in the operation of the project.

2.1.3.2 Economic Sustainability

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



Source: Federal Ministry of Agricultur and Rural Development, Bulletin 2021

Fig. 2.1: Potentials of Nigeria Agro-industry over the years

The project will beco-funded by Benue state Government and African Development Bank (AfDB). The availability of skilled and unskilled labour force in the project area, functional organisational structure, presence of up takers and deployment of good industrial best practices in construction technology is expected to make the project economically sustainable.

2.1.3.3 Environmental Sustainability

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

2.1.3.4 Social Sustainability

The project has secured the buy-in of the people due to their quest for high food productivity. Also, the benefit to create job opportunities for unemployed indigenes and Nigerians would ensure social sustainability. The land has been acquired and fully compensated and there are no resettlement issues. In addition, the State ministry is committed to effective and continuous stakeholders' engagements and consultations. The Ministry is also committed to complying with

applicable national social laws, relevant international conventions, and AfDB safeguards requirements and training and retraining the PIU team members on environmental and social management risks.

2.2 Project Overview

The Benue State government has identified an opportunity to establish a cluster of Agro-processing industries in Phase 2 of the Makurdi Industrial Park with Agro produce processing, storage, quality assurance laboratory and cold chain services as core business activities. The project aims to offer a state–of–the–art infrastructures and services comparable with International Best Practices. The Land take for the proposed project is 16 ha of the 272 hectares for the Industrial Park. The footprint for each component is provided hereunder;

- Industrial area (11.76 hectares)
- Truck and Car park area (0.58 hectares)
- Office buildings (0.29 hectares)
- Green belt (0.29 hectares)
- Buffer corridor/setback (0.58 hectares)
- Reserve for future planning (1.16 Hectares)
- Internal road network (0.116 hectares)
- Service Area (1.16 hectares) which will include the following;
    - ✓ Power Generation Plant
    - ✓ Sewage Treatment Plant
    - ✓ Water treatment plant
    - ✓ Forklifts Workshop
    - ✓ Fire station
    - ✓ Telecommunication and Information Technology (IT) infrastructure
    - ✓ Security

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

- Industrial shed
- Arterial Roads
- Drainage System
- Power Station & Electric Supply Lines
- Street Lighting

- Green Area
- Water Supply

2.3 Project Location

The proposed agro-industrial park is located at Phase 2 of the Makurdi Local Government Area, Benue State, Nigeria. The proposed site is located between 7° 43.601'N/ 8° 28.667'E, 7° 42.149'N/ 8° 28.935', 7° 41.890'N/ 8° 27.495'E, 7° 43.318'N/ 8° 27.163'E. The project site can be accessed via;

- land by the Gboko-Makurdi, Jos-Makurdi and Ankpa-Aukpa roads,
- via air by the Makurdi airport (it recently commenced operations), which is about 30km from the site and
- via water by the Benue River (about 3km from the site), and
- Possibly, via the proposed Port-Harcourt-Maiduguri railway.

The Railing is about 2km from the proposed site. The project site is characterised by Farmlands and patches of derived savanna forests. The Ankpa-Aukpa road borders the east of the site, farmlands within the industrial park to the west and north and the Oracle dam (under construction) to the south. Figure 2.1 is a map of Nigeria showing project location, Figure 2.1 is a layout plan of the site, while Figure 2.2 is the layout of the entire industrial park (Phase 2).

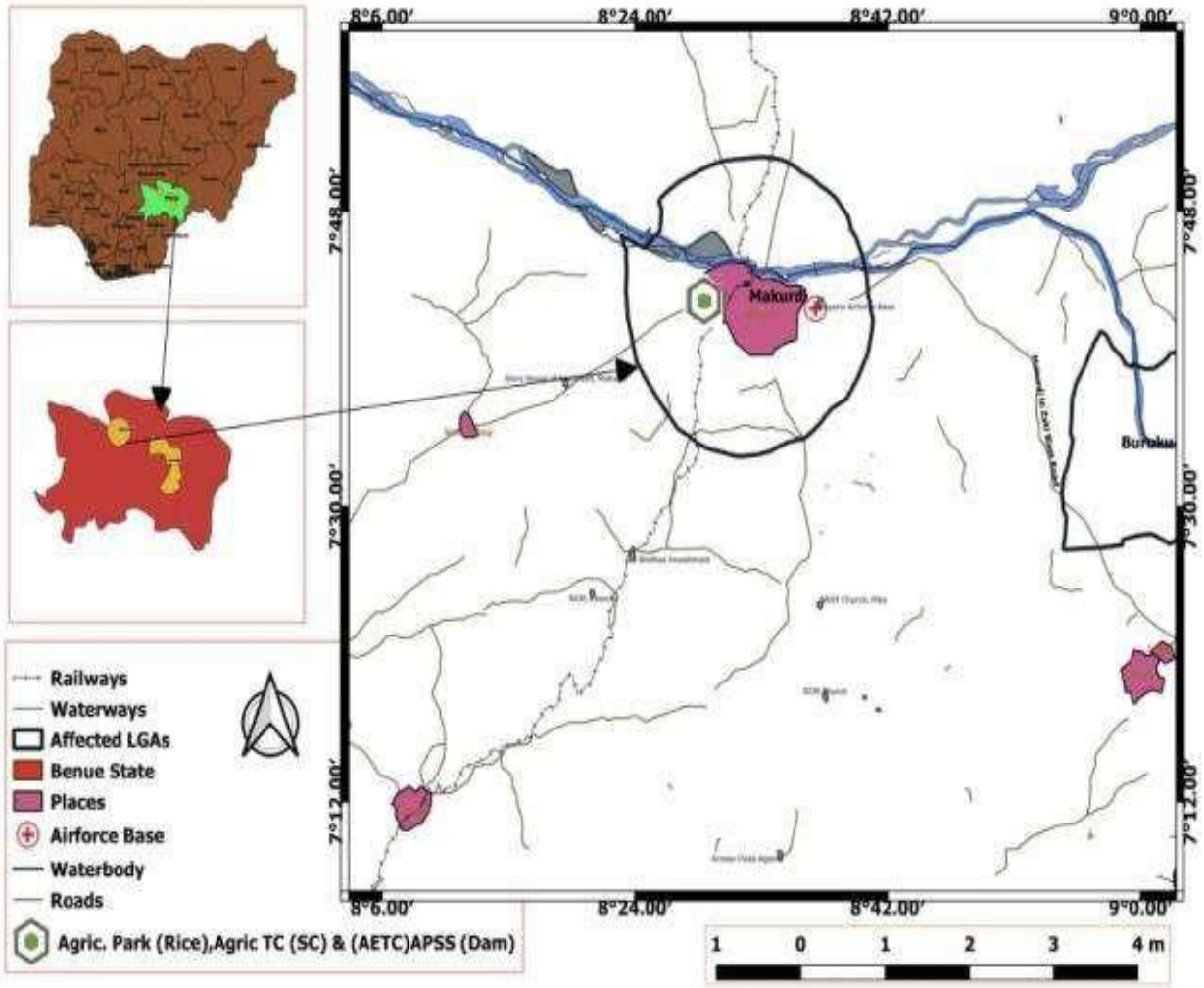


Figure 2.1: Map of Project Area

Figure 2.2: Plan for Makurdi Industrial Layout (Phase 2)

2.4 Project Activities

The activities will include:

- ✓ Project layout and design
- ✓ The assemblage of heavy pieces of machinery and materials
- ✓ Land clearing
- ✓ Disposal of vegetal waste
- ✓ Site preparation
- ✓ Excavation, compaction, grading and disposal of waste
- ✓ Construction of drainages/internal road network and waste disposal
- ✓ Installation of prefabricated agro-industrial sheds, construction of service facilities, administrative buildings, apartment blocks, truck and car parks, workshops and waste treatment plant, foul drainage system
- ✓ Installation of power/electrical, plumbing, telecommunication facilities and waste disposal
- ✓ Commissioning
- ✓ Operation/maintenance
- ✓ Decommissioning/Abandonment
- ✓ Closeout

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

2.5 Infrastructure Development

2.5.1 Site Preparation

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

2.5.2 Road Development

The development of roads is an integral part of planning for an industrial park. Although the Makurdi-Naka-Ankpa Road is the site Approach Road, the State government plans to develop the internal road networks as part of its commitments to the project. The details of road infrastructure proposed within the agro-industrial park is unfinalised.

2.5.3 Project layout and design

The project shall be executed in phases.

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

There shall be no interval between phase one and phase two. The schematic layout of the sheds and the service areas are presented in Figure 2.3 and 2.4

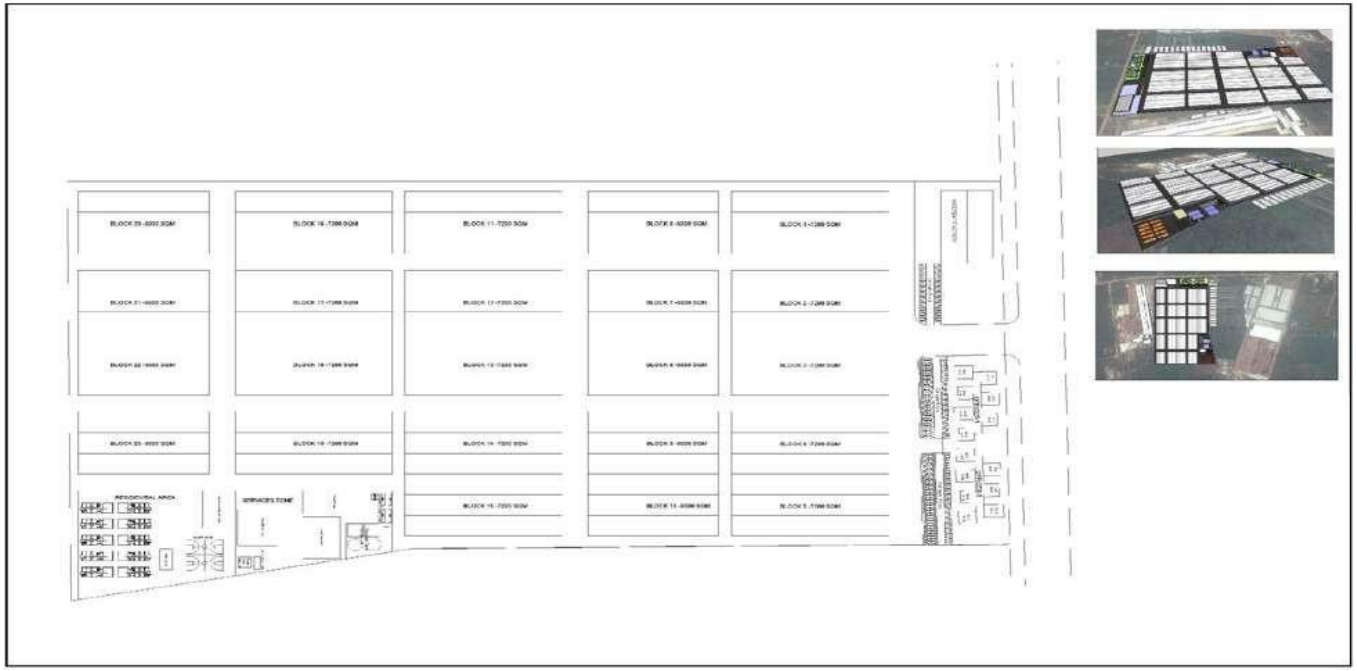


Figure 2.3: Layout of planned industrial sheds

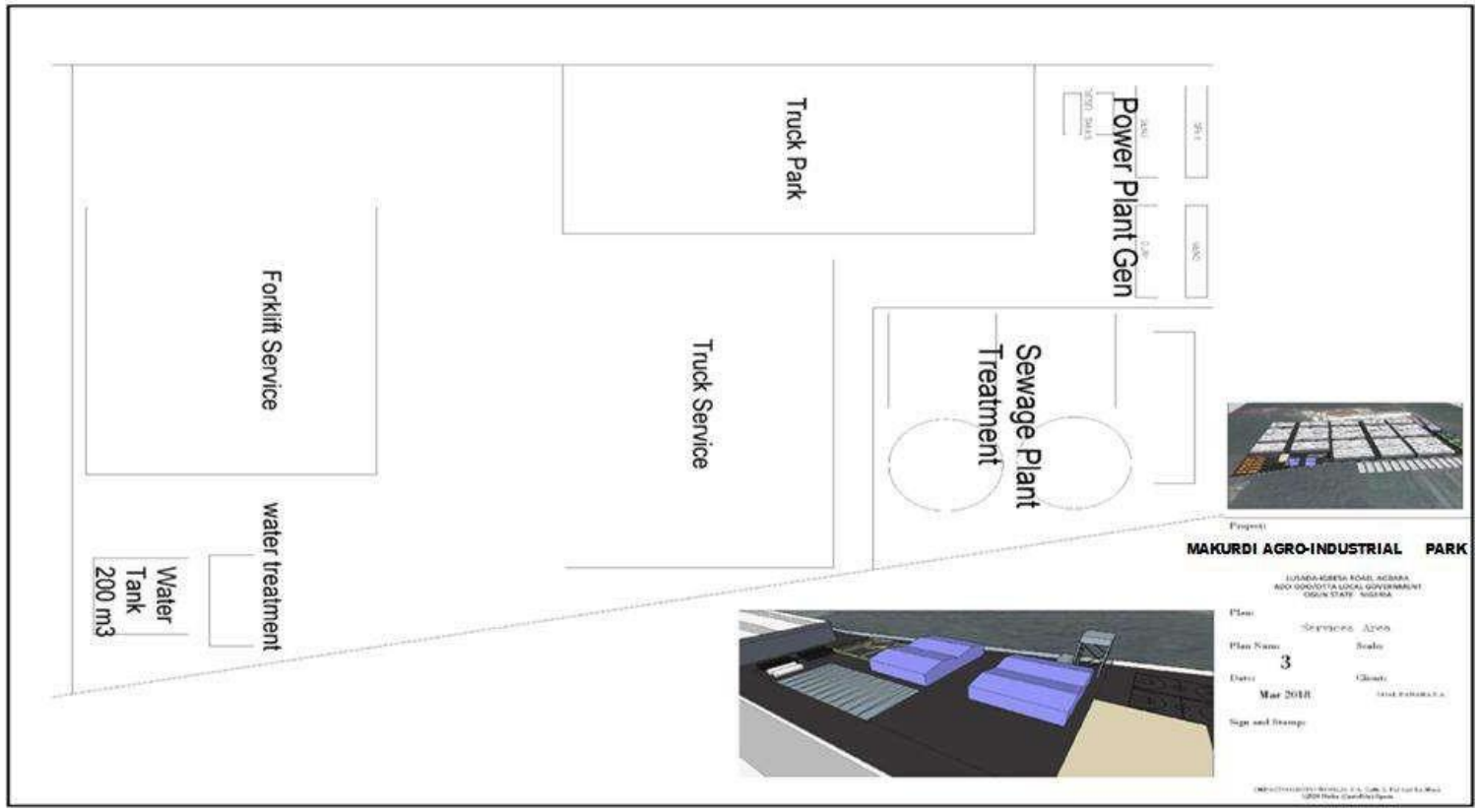


Figure 2.4: Layout of the service area

2.5.4 Applicable Standards

The applicable engineering standards for the proposed project are;

Table 2.1 Nigerian Standards/Organizations

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

Table 2.2 International Standards/Organizations

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

Table 2.3 US Standards

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
API	America Petroleum Institute
ASHRAE	American Society of Heating, Refrigeration And Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	America Wood Preservers
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CMAA	Crane Manufacturers Association of America
HEI	Heat Exchange Institute
IEEE	Institute of Electrical and Electronics Engineers
ISA	Institute Society of America
NACE	National Association of Corrosion Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association

NESC	National Electric Safety Code
OSHA	Occupational Safety and Health Administration
PCI	Precast Concrete Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code

2.5.5 Shed Design

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

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

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

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

In areas with high sided steel frames, the wall would be reinforced with wind bracing as high sided steel frames can be unstable during high winds. Roofs of steel-framed buildings are usually supported on steel purling. The roof shall be constructed with a single apex since multiple apex roofs are notorious for leaking.

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

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

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

Partition walls are constructed from mineral wool and rock wool since foam-filled panels are major fire risks.

Walling, flooring, and ceiling materials are proposed to be adaptable to foaming, fogging, scrub-down, and cleaning techniques. The project is planned to adjust to 'Just in time principles' (JIT), utilizing the packaging sheds nearby to supply raw materials.

CEILING DESIGNS

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

FLOORS

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

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

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

2.5.6 Design for administrative block

2.5.6.1 Relevant codes and standard

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

- ✓ NNBC (2006) section 7.1.1.4 Building design requirements for apartment houses
- ✓ BS 8004 Foundations
- ✓ BS 8110 Structural use of concrete, Parts 1, 2 & 3.
- ✓ BS 63399 Design loading for buildings
- ✓ BS 5896 Specification for high tensile steel wire strand for the pre-stressing of concrete
- ✓ BS 5075 Concrete admixture
- ✓ BS 4483 Steel fabric for the reinforcement of concrete
- ✓ BS 4482 Hard drawn mild steel wire for the reinforcement of concrete
- ✓ BS 4466 Specification for bending dimensions and scheduling of reinforcement concretes
- ✓ BS 4461 Specification for cold-worked steel bars for the reinforcement of concrete

- ✓ BS 4449 Specification for hot rolled steel bars for the reinforcement of concrete
- ✓ BS 1881 Methods of testing concrete

2.5.7 Construction of common and service facilities

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

2.5.7.1 Cable Galleries

Major installations comprising a large number of cables shall pass through large high-risk areas. A cable gallery shall be designed to allow enough space for technicians to move and work within. It shall be routed along masonry walls comprising of as few bends as possible. The sheds are proposed to be equipped with a fire detection system and emergency lighting.

2.5.7.2 Internal Drainage

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

2.5.7.3 Internal Road Network

The main access road in the facility will link the Ankpa-Aukpa road in the east direction. The route will run through 1.2km, terminating west of the facility. It will be a single carriageway which will include the following;

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

Seven feeder single-lane internal road networks would then be constructed to connect all processing facilities and service areas.

Road Safety Criteria for Junctions Design

The main objective of junction design is to increase convenience, comfort and safety while at the same time enhancing the efficient movement of all road users (motor vehicles, buses, trucks, bicycles, and pedestrians). Junctions are intended to operate where vehicles often must share space with other vehicles and pedestrians. Negotiating a connection requires many simultaneous or closely spaced decisions, such as selecting the proper lane; maneuvering to get into the appropriate position; need to decelerate, stop, or accelerate; and selection of a safe gap. The following essential areas were

considered in the design: junction angle; coordination of the vertical profiles of the intersecting roads; coordination of horizontal and vertical alignment for junctions on curves; improvement of operation, safety, and capacity through channelization; and drainage requirements for safe operation. Poor integration of these two elements often results in a junction that is less safe and uncomfortable to use.

Junctions

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

2.5.8 Truck Workshop

Table 2.4 outlines the basic criteria considered in the truck workshop design.

Table 2.4: Basic criteria considered in truck workshop design

Element for consideration	**Specific Focus Area**
Sight Distance	✓ Stopping Sight Distance ✓ Decision Sight Distance ✓ Passing Sight Distance ✓ RR-Highway Grade x-ing Sight Distance ✓ Intersection Sight Distance
Horizontal Alignment	✓ Curve Radius ✓ Super elevation ✓ Intersection and Channelization ✓ Pavement Widening
Vertical Alignment	✓ Critical Length of Grade ✓ Downgrades
Cross- Section Elements	✓ Lane Width ✓ Shoulder Width and Composition ✓ Side slopes and Drainage Features ✓ Pavement Cross-slope Breaks ✓ Vertical Clearance ✓ Traffic Barrier ✓ Passive Signs ✓ Curbs ✓ Acceleration Lanes

The design specifications are;

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

- Platform floor: Steel plate

Workshop with two pit bays each pit with two independent EWPs

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

2.5.9 External Drainage

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

- Drainage type would be closed box drain with reinforced concrete construction;
- The proposed minimum gradient would be 1:1000;
- All secondary drains are expected to discharge to the primary drains;
- Primary drains are proposed to discharge storm water to the nearest Fete stream;
- The maximum primary drain width would be 2.5 m, but the depth varies from 1.4 m to 2.5 m; and
- The maximum secondary drain width would be 1.5m, but the depth ranges from 0.6m to 2.0m.
- The estimated monthly volume of drains is 450,000 liters

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

All foul drains within the Industrial park will be channeled to the 600 m^3 retention pond and pre-treated before being discharged into the existing central drainage system established for the Park.

2.5.10 Sewage Treatment Plant

Three modular Sewage Treatment Plants of 50 KLD capacity will be provided to fasten, removing contaminants from wastewater. A by-product of sewage treatment is usually a semi-solid waste or slurry, called sewage sludge. After that, pre-treated wastes shall be fed to the existing sewage treatment plant established by the park. The treatment plants shall undergo several treatment processes, including primary, secondary, and tertiary treatment processes. The plant will also have facilities for handling and treating sludge generated during the treatment process. This can include sludge thickening, dewatering, and sometimes digestion. There will be a control room for monitoring and controlling the treatment processes, as well as a laboratory for conducting water quality analysis. There will be pumping stations to move wastewater between different treatment stages. The sewage

treatment plants shall include odor control systems to minimize odors generated during the treatment process. The plant will have safety features in place, such as fencing, signage, and emergency response equipment, to ensure the safety of workers and the public. The treated effluent will be discharged into the existing central drainage system established for the park.

2.6 Telecommunication Network

A communication system comprising telephones, fax machines, wireless sets, computers, etc. and a public address system will be provided at all areas in the facility. Telecommunication networks are critical infrastructure for an industrial park. Businesses and industries are becoming heavily reliant on fast, reliable and secured telecommunication networks. Providing world-class telecommunication services will thus be a factor in attracting investors, leading tenants and customers to the park. Local telecom operators would provide global System for Mobile Communication (GSM) infrastructure. The land portion will be reserved for one telecom exchange, and cable corridors would be reserved for cabling. The following Telecommunication Systems will be considered during the construction phase:

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

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

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

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

- International Telecommunication Union - Telecommunication Sector (ITU-T).

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

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

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

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

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

2.7 Power Supply

The Park is connected to the National electricity grid. In addition, a 320 kW backup diesel generator will be installed at the site. The diesel generator will supply power to the facility, including the stirred slurry tanks, during a power outage.

Diesel will be stored on-site in an above-ground fuel storage tank to fuel the mobile equipment (forklifts and front end loader). Diesel consumption for mobile equipment at peak demand will be approximately 10 L/hour.

Table 2.5 details the power required for the facility's operation and the DG fuelling.

Table 2.5 Power and Fuel Requirement

Details	Capacity	Remarks
Power	2220 KVA	National grid Jos *Electricity Distribution Company*
DG set	30 KVA	DG set is used for emergency power backup. Fuel will be procured from local dealers.
Diesel	3.6 Ltrs/hr	
Sulphur - content	<0.05%	

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

For the commercial and residential areas, cables shall be pre-laid to provide stand-alone outdoor package switchboards at every plot. Future Industrial Park investors and occupants will pick up the connection points from there. Cables would be laid below side tables for easy access without disturbing the traffic. They would generally be buried directly without pipes except at crossings 200mm diameter, where UPVC pipes would be laid in single rows and hunched in concrete. This provision would facilitate cable pulling.

2.8 Street Lighting

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

Lighting types/specifications being proposed are as follows:

Major road:

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

Minor roads:

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

2.9 Water Supply

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

Water Storage Tanks

Three Boreholes and storage tanks capable of holding about 500,000 litres of water are planned on a land take of 770 m^2. This is the overall capacity of the distribution reservoir when all the facilities are in place. One of the storage tanks will be reserved for firefighting. However, this distribution tank capacity is considered to adequately serve the population that would be resident in facilities for the next ten years.

The preferred tank shall be a 650 m3 overhead steel (hot-pressed mild steel plates of external type connection 4 ft x 4 ft, galvanised finish, stays, cleats, bolts, washers, nuts, sealant) tank of Braithwaite type or approved equivalent on a 15-metre high steel-framed tower. These shall include all inlet, outlet and overflow pipework, valves, internal and caged external ladders, perimeter tank surrounding the platform, level indicator, access maintenance hole, rest platform, screened vent, lightning protection and ancillaries.

Pipes, Fittings Supply and Installation

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

2.9.1 Water Requirement

Water requirement (Table 2.5) for the project will be met through the bore wells within the boundary premises.

Table 2.6 Water Requirement

S/No	Utility	
		Cum/day
1	Domestic	11
2	Fire fighting	20
3	WorkShop/ Vehicle Maintenance shed	5
4	Hazardous waste treatment, Recycling, etc.	99

8	Green belt	100
	Total	235

2.10 Fire Fighting

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

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

- A firewater grid system;
- Sprinkler systems;
- Inergen/ Argonite installations;
- Carbon dioxide extinguishing systems;
- Portable firefighting equipment and fire/ smoke stopping system; and
- Fire station for housing fire engines, ancillary equipment and supplies.

Firewater System

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

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

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

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

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

Firewater piping system

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

The fire water supply lines shall not be smaller than 45 cm in diameter. Material for constructing pipelines shall be carbon steel given the high cost of Glass Reinforced Epoxy (GRE) pipe. The lines shall favour the least hazardous side of the road to facilitate access to fire hydrants. Firewater lines around process equipment and large machinery shall generally be on the side of the road remote from them.

Hydrants

All hydrants shall have two 21/2 inch hose connections. Each hose connection shall be capable of passing 55 m3/h of water. Hydrants shall be located adjacent to risks to provide the requisite amount of water for the specific risk. The average distance between fire hydrants shall be 45 m to 90m. Wherever practicable, the distance between a hydrant and a building or structure to be protected shall be at least 15 m.

The hydrants shall be provided and suitably located to supply firewater for cooling and spaced to permit coverage of any section of the industrial zone. One hose stream shall be provided for each 900 m^2 of service area containing combustible material. The hydrants to be used shall be fabricated from carbon steel materials with a 150 mm riser with a weld cap and two 21/2 inch valve hose connections. Also, the hose threads shall be interchangeable with those used by the local fire brigade or other firefighting institutions.

Water Sprinklers

Water sprinklers shall be installed within facilities except for the electrical panel room. Sprinkler system shall be automated and be adequately distributed in conference halls, laboratories,

maintenance workshops, restaurants, hotels and other buildings where combustible material may be present. Installation of sprinkler systems in buildings shall be by NFPA codes.

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

Inergen/ Argonite Fire Protection System

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

Hose Stations and Hose Reel Stations

Service water stations shall be provided at the diesel oil pump house, fuel gas arrival and metering facilities, diesel oil truck unloading bay, diesel tanks, laboratory and maintenance workshops.

However, buildings shall be provided with fixed hose reel stations on each floor. The number of hose reel stations on each floor shall be sufficient to permit the coverage of any portion of the floor with a 6 m water stream from a nozzle attached to 20 m of 11/2“fire hose. The nozzles shall have an 11/2"tip.

Fire and Gas Detection, Control and Alarm Facilities

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

2.11 Other Activities

Other project activities will be discussed under the following subheadings:

- ✓ Mobilization or pre-construction phase,
- ✓ Construction phase,

- ✓ Operation/Maintenance Phase and
- ✓ Decommissioning phase

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

2.11.1 Mobilization or pre-construction phase

This phase entails mobilization of the labour force, equipment and establishment of construction offices, and the acquisition of various permits as required by the law. Other activities during this phase include topographical survey, geotechnical investigation, and identification of sources of construction materials, storage and material preparation.

Duration

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

Types, Quantities, and Sources of material requirements during the project's pre-construction phase are shown in Table 2.7.

Table 2.7: Types, Quantities and Sources of Materials for Pre-construction Phase

Requirements	Type	Source	Estimated Quantity Required	
Raw Materials	Coarse aggregates	From the nearby existing commercial quarries	64,000m^3	
	Hardcore	Same as coarse aggregates	50,000 m^3	
	Fine aggregates	From commercial suppliers	104,000 m^3	
	Water	Groundwater	1,000,000 litres	
	Cement	Local cement depot	78,809 tons	
	Reinforcement bar	reinforcements are readily available in local iron and steel stores	53,846 tons	
	Timber	Local vendors around the project area	68,420 m	
Energy	Electricity	Jos Electricity Distribution Company and generators	2220 kV	
	Fuel	Local Vending Stations	500,000 litres	
Workforce	Skilled	Contractor	M	F
			32	18
	Un skilled	Locals in the project area	67	83
		TOTAL	**99**	**101**

Equipment	Dump trucks	Contractor	20
	Graders	Contractor	10
	Dozers	Contractor	25
	Water Boozers	Contractor	10
	Vibrators	Contractor	15
	Excavators	Contractor	25

Source: MCNL, 2021

Transportation

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

Storage

Some of the materials supplied will be used directly after delivery. Cement and reinforcement bars will be held in dedicated storage rooms. Timber will be used directly in the required areas, and hence, there will be no stockpiling of wood onsite. Fuel/oils will be stored in drums, which shall be kept in bunds (well-paved areas that do not allow fluids to contact the soil).

2.11.2 Construction phase

The major construction activities include;

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

Duration

The duration of this phase will be six months.

Types, Quantity and sources of project requirements during the construction phase are shown in Table 2.8.

Table 2.8: Types, Quantity and sources of project requirements during the construction phase

Requirements	Type	Source	Estimated Quantity Required	
Raw Materials	Coarse Aggregates	From the nearby existing commercial quarries and vendors	864,000 m^3	
	Hardcore	Same as coarse aggregates	250,000 m^3	
	Sand	From nearby vendors and markets	504,000 m^3	
	Water	Groundwater	5,000,000 litres	
	Cement	Reinforcements are readily available in iron and steel stores	553,846 tons	
	Reinforcement bar	Local vendors around the project area	568,420 m	
Energy	Electricity	Jos Electricity Distribution Company and diesel-fuelled generators	6220 kV	
	Fuel	Local Vending Stations	3624.9 litres	
Workforce	Skilled	Contractor	M	F
			302	198
	Un skilled	Local in the project area	1975	1525
		TOTAL	**2,277**	**1,723**
Equipment	Dump trucks	Contractor	4	
	Excavator	Contractor	2	
	Shovel loading M/C	Contractor	2	
	Bulldozer	Contractor	1	
	Wheel loader	Contractor	1	
	Diesel Tanker	Contractor	3	
	Grader	Contractor	1	
	Mobile Maintenance Van/Pick-up Jeep	Contractor	1	
	Ambulance	Contractor	1	
	Water boozers	Contractor	1	
	Jeeps	Contractor	3	
	44MGW Generator	Contractor		

Source: MCNL, 2021

Transportation and storage

The exact methods for transportation and storage of materials discussed in section 2.13.1 shall be adopted.

2.11.3 Operation/Maintenance Phase

The actual usage of the facilities is expected to commence after the construction works. The design period is 50 years. However, within the period, the Benue state government will carry out routine maintenance of the park.

Other activities may include management, monitoring and evaluation

Duration

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

Types, Quantities and sources of project requirements during the operational phase are shown in Table 2.9.

Table 2.9: Types, quantities and sources of project requirements during the operational/Maintenance phase

Requirements	Type	Source	Estimated Quantity Calculate not to exceed	
Raw Materials	Coarse aggregate	Same as in Table 4.8	25,000m^3	
	Fine aggregate		50,000 m^3	
	Water		2,000000 litres	
	Cement		40 tons	
Energy	Electricity		Average of 300 kVA/day	
	Diesel		5.30 gallons per day	
Workforce	Skilled		Male	Female
			14	6
	Un skilled		24	26

Source: MCNL, 2021

Transportation and storage

The exact methods for transportation and storage of materials discussed in section 2.11.2 shall be adopted.

2.11.4 Decommissioning phase

Activities include:

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

Duration

Decommissioning stage will last for six (6) months.

Types, quantities and sources of project requirements during the demobilization phase are shown in Table 2.10

Table 2.10: Types, quantities and sources of project requirements during the Demobilization Phase

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

Source: MCNL, 2021

2.12 Emission Estimation

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

2.13.1 Dust Emission Estimation

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

Pre-construction and Construction phases

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

The quantity of dust estimated during these phases is 1 × 106 m tones. The expected emission rate of particulate matter is obtained using the formula:

TPM =2.6 (s)1.2

(m)1.3

PM (10) = 0.45(s1.5)

(m1.4) × 0.15

PM (2.5) = 2.6 (s)1.2

(m1.3) × 0.105

Where

S = silt content

M = moisture content

The projected particulate emission using the formula above is shown as:

TPM = 0.101E +01

PM (10) = 0.187E + 01

PM (2.5) = 0.975E + 01

2.12.2 GHG Emissions Estimation

2.12.2.1 Estimated Green House Gas (GHG) Emission Rate during the Construction Phase of the Project

2.12.2.1.1 Estimation of GHG Emissions for mobile equipment

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

Fuel usage and mileage are reported the same for hybrid vehicles as for conventional vehicles such as Pickups and Vans are classified as "Light Trucks", Trucks (Diesel heavy dump truck, water truck) weighing more than 8,500lb are classified as "Heavy- Duty Trucks". In contrast, non-highwayvehicles (graders, crane, excavators, concrete batching plants) used in construction are classified as "Construction Equipment while Tractor /Trailer is termed Diesel Agricultural Equipment. Tables 2.11 present the details of equipment and vehicles required for the construction of the proposed industrial park.

Table 2.11: The expected diesel consumption -fired equipment for the proposed industrial park project

Equipment	Capacity/Specification	Number	Status
Dump trucks	40T Rigid body dumpers	4	Diesel Heavy Dump Truck
Diesel Tanker	-	3	
Excavator	Cat 340 Hydraulic rammer (breaker) and one with front shovel	2	Diesel construction equipment
Shovel loading M/C	Cat 966	2	
Bulldozer	CAT D7R	1	
Wheel loader	5 -6 m3 bucket,430 HP	1	
Grader	280 HP	1	

Water boozers	-	1	Diesel light trucks duty trucks
Mobile Maintenance Van/Pick-up Jeep		1	Passenger Car
Ambulance	-	1	
Jeeps	-	3	
44MGW Generator			

* These assumptions are based on our current knowledge

Source: MCNL, 2021

The construction phase is expected to last for six (6) months, after which operation shall commence. The total estimated GHG emissions expected to result from construction activities is presented in Table 2.12

Table 2.12 Details of estimated GHG to be emitted during the construction phase

Equipment Category	Number	Average fuel economy (mileage/g)	Fuel usage (gal)	Mileage	CH4 (g)	N20 (g)	CO_2 (kg)
Diesel Construction Equip.	6	17.1	21,546.0	781.2	12281.27	5601.9	0.53186521
Diesel Light-Duty Trucks	7	7.2	4536.0	1953.0	1.9	3.0	
Diesel Passenger Cars	5	23.3	10485.0	1952.5	1.0	2.0	
Total	16		36,567.0	4,686.7	12,284.2	5,606.9	0.74568177

In all, 482.5kg (0.53186521) metric tons of CO_2 are estimated to be emitted during the construction phase of the proposed project. This also includes 12,284.2g (0.00122842 metric tons) of Methane and 5,606.9 g (0.0056069 metric tons) of Nitrous oxide. When this was extrapolated, taking into consideration the global warming potential of nitrous oxide (32) and Methane (28) results indicated

that an estimated total of 0.74568177CO_2 equivalent emissions (metric tons) of CO_2 shall be emitted as a result of activities during the construction phase.

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

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

- The construction phase will last for six months (168 working days)
- The capacity of the diesel-electric generators is 30 KVA
- The facility shall utilize alternative power (diesel generators) for at most 6 hours per day

According to USA's Environment Protection Agency, https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf, the average heating value of diesel (uncontrolled levels) was assumed to be 19,300 Btu/lb with a density of 7.1 lb/gallon or 0.00322051 metric tons of CO_2 per gallon. It is also assumed that a 30 KVA generator on half load uses about 3.6 liters (0.95 gallons) of diesel in an hour (https://www.ablesales.com.au/source/Diesel Generator Fuel Consumption Chart in Litres.pdf).

- *6 hours (estimated running hours/day for generators) × 168 working days = 1008 (total working hours for diesel generators during operation phase)
- *0.95 gallons (average fuel consumption rate per hour) × 1008 (total working hours for diesel generators during operation phase) = 957.6 gallon (for six months construction phase)
- *If I gallon of diesel emits 0.00322051 metric tons of CO_2 (https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf) then 957.6 gallons will emit metric tons of CO_2

The estimated emissions from diesel generators throughout the construction phase are about 3.083 metric tons of CO_2

2.12.2.2 Estimated GHG Emission Rate during the operation phase of the Project

The primary sources of GHG emissions during the operation phase of the project would be from the dedicated Diesel generators. The operation phase would last for 50 years. The assumptions used to calculate GHG emission from stationary sources during the construction phase (see section 4.13.1.2) was also adopted for the operation phase. Other factors considered included;

- *6 hours (estimated running hours/day for generators) × 15650 working days = 93900 (total working hours for diesel generators during operation phase)
- *0.95 gallons (average fuel consumption rate per hour) × 93900 (total working hours for diesel generators during operation phase) = 89205 gallons (for 50 years operation phase)

- *If I gallon of diesel emits 0.00322051 metric tons of CO_2 (https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf) then 89205 gallons will emit 287.286 metric tons of CO_2

The estimated emissions from diesel generators throughout the operation phase are about **287.286** metric tons of CO_2

Table 2.13 outlines the gross total carbon footprint (expressed in terms of MT CO_2 equivalence) resulting from the proposed agro-industrial park project.

Table 2.13: Total $MTCO_2$ Equivalence

GHG supply Component		
Project Phases	$MTCO_2$ Equivalence	
Construction	Mobile sources	0.74568177
	Stationary sources	3.083
Operation	Stationary sources	287.286
Net $MTCO_2$ Equivalence	291.115	

A total of 291.115 $MTCO_2$ Equivalence is estimated to be emitted from project activities. This data will be factored in preparing the Green House Gas Management Plan.

2.12.3 Noise Environment

Activities during construction would lead to increase in ambient noise level. These activities include:

- ✓ Vehicular Movement
- ✓ Equipment and machine use.

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

Sound level dB (A) = Lw- 20 log10 R-8

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

R = Source distance (m)

For an approximate estimation of noise dispersion from the source point, a standard mathematical model for sound wave propagation is used by considering 95 dB(A) as the resultant noise level generated from the proposed project activity and output (see Figure 3.24).

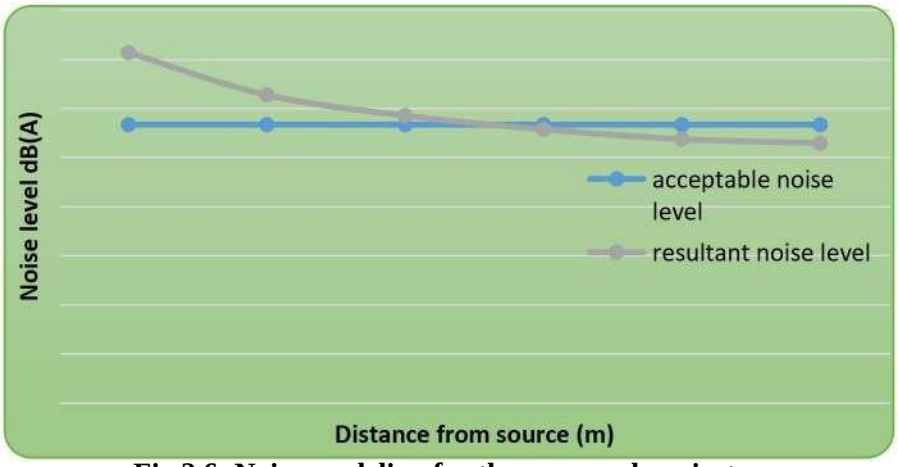


Fig 2.6: Noise modeling for the proposed project

Source: MCNL, 2021

From the result shown in Figure 2.18, it is clear that noise to be generated (modeling was done using Sound Plan software) by the proposed project activities will average 65 dB (A) at a distance of 150 m from the machines construction phase. When this modeled noise value was superimposed on the average noise level of 48.1 dB (A) obtained from the existing environment (Table 2.7), the resulting value of 113.1 dB (A) exceeded the regulatory limit of 90 dB (A) as prescribed by WHO/FMEnv for an 8hr duration. This will result in adverse noise impact addressed in chapter 7 & 8 of this report.

2.13 Waste Streams

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

Stage I: Site Preparation

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

Stage II: Construction

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

Stage III: Operations

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

The waste inventory for the proposed project is presented in Table 2.14

Table 2.14: Waste Inventory

Stage	Activity	Type of waste generated	Nature of waste
Site preparation	land preparation Construction administrative block Disposal of waste	Top soils, vegetal matter, Gaseous emissions aluminum, and metal scraps	98% of the wastes are organic and can be easily disposed.
Construction	- construction of sheds and service facilities Construction of internal road network, Construction of drainages and residential quarters - disposal of waste	- Loose soil - Construction debris, drill cuttings - Plastics, rubber, tins, cardboard, zinc, nails etc. - domestic waste spent oil Gaseous emissions - metal scraps	Organic and inorganic materials
Operations	Production; movement of goods and services, vehicular/human activity, maintenance recreation disposal of waste	Parking materials (paper, plastics, polythene etc.) Food remnants, Gaseous emissions Rubber, plugs, filters, engine oil, grease etc. Sanitary waste Caustic soda Spent oil and filters Mineral acid Soda ash Polyvinyl alcohol Faecal waste Suspended solids	Organic, in-organic and metals

		peroxide Naphthol Synthetic waxes' and resins Dyestuffs Wastewater from finishing's	
Demobilization	Removal of structures Rehabilitation Buyback activities	- Loose soil - Removal debris - Off-cuts (wood, wires etc.) - Plastics, rubber, tins, cardboard, zinc, nails etc. - Asphalt waste - metal scraps	Organic and inorganic materials

Source: MCNL, 2021

2.13.1 Quantification of Waste and Treatment

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

2.13.1.1 Waste Quantification during Pre-construction

Three types of wastes are expected from the Pre-construction stage:

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

It is assumed that each person will eat and drink at least once during the pre-construction activities and is expected to take place twenty-eight (28) days a month and will, as a result, generate wastes as presented in Table 2.15.

Table 2.15: Waste Quantification (Estimation)

Vegetal Waste		**Overburden Spoil**		**Other Wastes**		
Parameter	Estimated tons	Parameter	Estimated tons/km^2	Parameter	Estimated tons km^2	Mass of a single waste (g)
No woody plant recorded	648	Topsoil removal per km^2	0.5	Total No of persons	150 (from the labour force)	
Average Height of woody plant (Ft)	20	Land take of the cleared area	(0.14 km^2)	Duration (months)	2	
The average circumference of a woody plant (inch)	4		1.6	Total pure water sachet from workers (wayleave and substations	150 ×12 (number of days) = 1800 pieces	3
(Tree to ton Conversion Standard (inch.)	24 trees at 40 ft. x 7 inch		2.1	Total bottled water container from workers	1800 pieces	18.9
Estimated Ton from trees to be felled	51,840 /6720 **= 7.7 tons**	Total Estimated topsoil removal (tons)	**0.07**	Total snack wrappers from workers	1800 pieces	5
Total of the cleared portion of the project site	**7.77 tons**			Total polythene packaging material from workers	1800 pieces	5
				Total weight of polythene and packaging materials, water bottle, water sachet, snack wraps and	0.06 tons	

		nylons (tons)	
Grand Total (Tons)	**7.83**		

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

2.13.1.2 Construction Phase Waste Quantification

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

- 13.906 hectares (0.14 km^2) of the 16 (0.16km^2) is estimated to be cleared
- Estimated duration = 6 months

It is assumed that each person will eat and drink at least once a day throughout this phase (Table 2.16)

Table 2.16: Waste Quantification and Disposal Details for Construction Phase (Estimation)

Overburden spoil		Other wastes			Disposal party	Disposal methods/use	Disposal (Action Party)
Parameter	Estimated tons/ km^2	Parameter	Estimated tons km^2	Unit mass (g)	*Benue state Environmental and Sanitation Authority (BENESA)*	Reuse, Recycle	*BENESA*
Topsoil removal per km^2	0.5	Total No of persons working on-site	= 200 (number of the labour force from)				
Total land take cleared for project activity.	0.14	Total pure water sachet for each worker both on-site	200 (number of workers) × 168 days in 6 months of construction phase) = 33,600 pieces	5			
Total Estimated topsoil removal	**0.07**	Total pure water sachet for each worker both on-site	33,600 pieces	5			
		weight of waste (g)	336,000				
		Total Weight of waste (tons)	0.37				
Grand Total (tons)	**0.71**						

2.13.1.3 Decommissioning Phase Waste Categorization

The demolition of temporary structures will generate solid wastes such as timber, iron sheets and spent oils. Timber and iron sheets will be sold to locals in the project area for reuse, while the consumed oils will be drained out and sent to authorise dumpsites. The 50 years duration of the project makes it difficult to quantify. However, a similar waste volume projected for the construction phase is expected at the decommissioning phase. The expected Waste stream from the decommissioning process is presented in Table: 2.17.

Table 2.17 Waste Stream from Decommissioning Process (Estimation)

Project Phase	Type of waste	Form of Waste	Source of Waste	Disposal company	Disposal method/use	Disposal (Action Party)
	Non-Hazardous wastes					
Decommissioning	Solid waste (Non – degradable)	Demolished concrete, tins, metals, glasses, plastics, soil	Buildings, service areas and industrial sheds	BENESA	• The proponent shall obtain reusable members • Topsoil will be sold to quarry and used for backfilling tower foundation • strings, insulators, tins, glasses, plastics will be sold to licensed local recycling companies	Scrap buyers/ reuse location
	Type of waste	Form of Waste	Source of Waste	BENESA	Disposal method/use	Disposal location
	Hazardous wastes					
	Liquid waste	Spent oils	Services areas, Industrial sheds	BENESA	• to be Managed by BENESA or other BENESA approved waste contractors	BENESA approved waste management contractor

2.14 Project Schedule

Table 2.18 outlines the timeline for the start-up and completion of the project.

Table 2.18: Project schedule for the proposed agro-industrial park

S/N	Description	Duration (months)	2nd Qtr. 2021	3rd Qtr. 2021	1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	1st Qtr. 2023	2nd Qtr 2023	3rd Qtr 2023	1s Qtr. 2073	2nd Qtr 2073
	Pre-construction Phase											
1	Feasibility studies	3										
2	EIA studies	9										
3	EPC Contract award Process	1										
4	Check survey of EPC Contractors	1										
5	Detailed design of the facility	1										
6	Mobilisation of construction materials to the site	15 days										
	Construction Phase											
7	Construction of facility and	6										

	Associated utilities											
	Operation Phase											
8	Facility operation	600										
	Decommissioning Phase											
9	Demobilization of facility	6										
10	Decommissioning	One day										

2.15 Decommissioning

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

• Decommission and site-clean – up

• Disposal of waste generated

• Site review and reclamation.

The decommissioning plan after the life cycle of the Industrial park shall include conflicts and grievances resolution, especially among workers and project host communities during the project implementation. This is intending to ensure the seamless acquisition of the project area in the course of future development. The decommissioning plan shall also outline measures to return the project area to its natural state as much as possible.

CHAPTER THREE:

PROJECTALTERNATIVES

3.1 INTRODUCTION

This chapter presents the description of all alternatives considered to ensure that the least environmentally and the socially damaging options were selected.

3.2 Project Options and Alternatives

3.2.1 Project Options

'Do-Nothing' Option

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

- There would be absence of facilities for the processing and storage of agro and agro-allied products
- There shall be loss of potentially accruable revenue to the government
- Foreclosure of anticipated employment opportunities
- Foreclosure of anticipated technology transfer

Delayed Project Option

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

Project Implementation Option

The Immediate Project Implementation Option entails the development of the agro-industrial park. This ESIA report has undertaken a detailed impact assessment to demonstrate the inherent benefits and minimise the negative impacts. This **o**ption was accepted because the execution of the project will boost attendant job opportunities, peace and security, technology transfers,

reduction in overdependence on Oil & Gas sector, increased food productivity and national growth.

3.2.2 Analyses of Alternatives

The following alternatives were considered**:**

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

Details of the options considered are presented in Table 3.1

Table 3.1: Analysis of project alternatives

S/N	Alternatives	Various Options Considered	Selected Alternatives	Justification
	Location	Makurdi (Makurdi LGA) Mbiagii (Ushongo LGA) Mbiakyor (Ushongo LGA)	Makurdi	Mbiagii and Mbagiir are highly agrarian and more accessible from Cross River State. Nonetheless,poor road infrastructures and the need for land acquisition and all the attendant concerns make their selection challenging. Thus, Mbiagii and Mbagiir were Rejected. Conversely, Makurdi is the State capital with better infrastructure and human resources. Makurdi can easily be accessed from the capital territory. More importantly, there is a mapped out industrial park in Makurdi. It is wholly owned and operated by the Benue State government, has acquired the272-ha land and paid total compensation in 1985 (See Annexure 3). More so, siting the proposed project within the operational vicinity of other industrial facilities would confer economic scale on all existing industries. Thus, the Makurdi option is Selected.
	Industry Type.	Solid mineral processing Agro-processing.	Agro-processing Industry	Several studies, including Eyre & Agba (2007) and Damulak (2017), revealed vast deposits of limestone, gypsum, anhydride, kaolin, coal, calcite, germ stones, magnetite and natural gas in Benue State. However, the prohibition by international financial institutions in funding projects contributing to net positive carbon emissions and their reluctance in funding projects that poses significant environmental concerns coupled with the diversification agenda of the present administration from natural makes investment in solid mineral exploitation unattractive. Hence Solid mineral processing industrial park for Benue State is Rejected.

				The AfDB and Benue State Ministry of Agriculture have a specific project in Agricultural Sector. Nonetheless, the focus of the Buhari administration in agribusiness and the visible unequivocal consensus that Benue State is the food basket of the nation, leading the other Nigeria States in rice, horticultural and cassava production, makes it an agro-processing haven. Yet, the cultivatable area and yields per hectare remain primarily low. More so, more than three-quarters of these harvests are lost to poor storage, off-season and low conversion into processed products. These challenges further contribute to food insecurity in Nigeria. Therefore the establishment of an Agro-processing park is Selected.
		Logistic and haulage Packaging and storage. Research and Development Cold Chain Input distribution platform Service centre Food quality control Agricultural	Logistic and haulage Packaging and storage. Research and Development Cold Chain Input distribution platform Service centre	Dams and feeder roads are essential infrastructures for agricultural production. However, their establishment in various parts of the State makes its inclusion in this ESIA study non-feasible. More so, the State government, RAAMP and other programs are constructing dam and feeder roads in targeted agro producing areas. Including it in this project amounts to duplication. Therefore, this option is REJECTED. Nonetheless, the supplied agro produce and processed goods need to be stored in a Cold Chainbefore and after processing; hence Cold chain option is SELECTED. The need for the processed goods to be packed makes SELECTION of the packaging optionimperative. The requirements that all processed goods should meet SON and NAFDAC specifications informsthe SELECTION of food quality control and Research/Development options. The incidence of pest, continuous soil cultivation and improved farming methods makes it imperative for input distribution centres and extension services to be included in the industrial

		extension services Dam Feeder roads	Food quality control	park. Hence input distribution centre and agricultural extension services are SELECTED.
		Cocoa Horticulture Industrial Cassava Rice	Horticulture, Industrial Cassava, Rice	The Federal Ministry of Agriculture and Rural Development classified Benue State along Anambra, Cross River and Ebonyi States as having a comparative advantage in cassava, cocoa, horticulture and rice production. While Benue State does not rank among the first ten cocoa-producing States in the country, the State ranks among the first three in cassava, horticulture and rice production (World and regional statistics, national data, maps and rankings, 2020). Moreover, the proximity of the cocoa-producing LGAs (Ushongo and Vandikeya) in Benue State to Ikom, Cross River State, where the proposed industrial park for Cocoa processing is sited makes the inclusion of cocoa processing in the Benue State industrial park unviable. The option is thus Rejected. Conversely, more than two-thirds of Benue State LGAs produce horticultural crops, rice and cassava, making the State SAPZ the processing haven for these crops. More so, the export of these produce to other States despite the array of small-scale processing industries in the State speaks to the enormous feedstock availability in the State. The *one man-one farm* policy of the state government would further enlarge cultivatable areas, improve yields and increase feedstock supply. Therefore, the option of processing cassava, horticulture and rice in the Benue SAPZ is Selected. The absence of industries exploiting horticultural, cassava and rice produce for producing ethanol,

				drugs, chemicals, reagents, starch, alcoholic beverages, fertilisers in the State amidst the considerable raw material availability imposes on Benue SAPZ the inevitability of utilising these harvests.
	Water supply.	Groundwater Surface water State water board Private water supply	Groundwater and State water board Private water supply	Water supply is required for agro-processing industries. Abstraction of water from rivers and streams are not environmentally friendly. The nearby Fete stream is ephemeral, and that the Benue River is more than 8km away from the Project site makes surface water abstraction as water supply to the Park untenable. The option of surface water as a water source is thus Rejected. The need for water supply in the Benue SAPZ projects assumes greater importance because of the considerable depth to the water table in the area. Nonetheless, the success recorded in abstracting groundwater in about 75% of drilled cases makes groundwater source feasible. This option is thus Selected. Moreover, industries within the Industrial Park and environs, including the nearby Oracle farms, complement groundwater source with water supplies from the State water board agency and private water supplies. These options are also Selected.
	Power source.	national grid; Private source. Coal	National grid power supply backed up with the	Coal occurs naturally in the crust, and it is an abundant source of energy for industrial activities. It can be burned directly, transformed into liquid, gas, or feedstock and can be used to produce fuel at an affordable cost. However, coal emits waste, SO_2, Nitrogen Oxide and ash and is a significant contributor to global warming. More so, AfDB does not fund projects that trigger

		Gas power plant.	Park's dedicated private generators.	climate change. This option is thus Rejected. The proposition to power the Park with Gas would result in a cleaner environment and a cheap energy source. Nonetheless, the Park is a considerable distance away from the nearest duct of the Makurdi-Jos gas pipeline route. Also, there is the challenge of poor part-load efficiency, acquisition of imported metals and alloys, and unique cooling methods for the turbines. All these would increase cost, cause delay and require specialized personnel and periodic turnaround maintenance. Worst still, the uncertainty in gas supplies from Niger Delta further makes this option a tricky one. This option is thus Rejected. Alternatively, using a dedicated generating set by the Park though costly to acquire, would guarantee power availability, eliminate load sharing and open to periodic regulatory monitoring. This option is thus Selected. Similarly, since the project area is connected to the National grid, it makes sense that it is also served from this source. This shall be the primary power source to the Park, while the Parks dedicated generating sets would complement it. This source is thus Selected.

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

				close to the facility. The sewage can be treated in a septic tank or macerator system. Nonetheless, there is the issue of slow-draining sinks and toilets, gurgling sounds in the plumbing, constant plumbing backups, strong sewage odours and stagnant water. This option is thus Rejected. The sewage pre-treatment plant is best suitable for the Park. Though expensive, it is environmentally friendly, efficient and fast. The pre-treatment plant shall consist of pre-engineered and pre-fabricated structures with minimal construction impacts suitable for larger industrial parks. The use of sewage treatment plants is international best practice.

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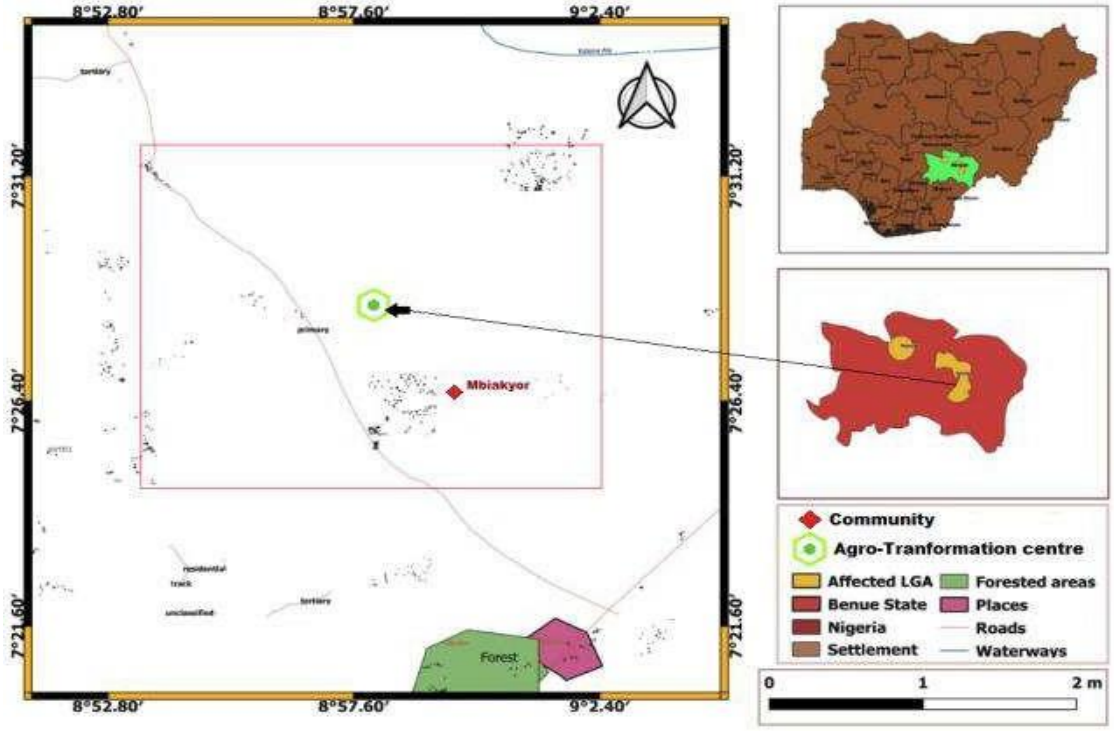
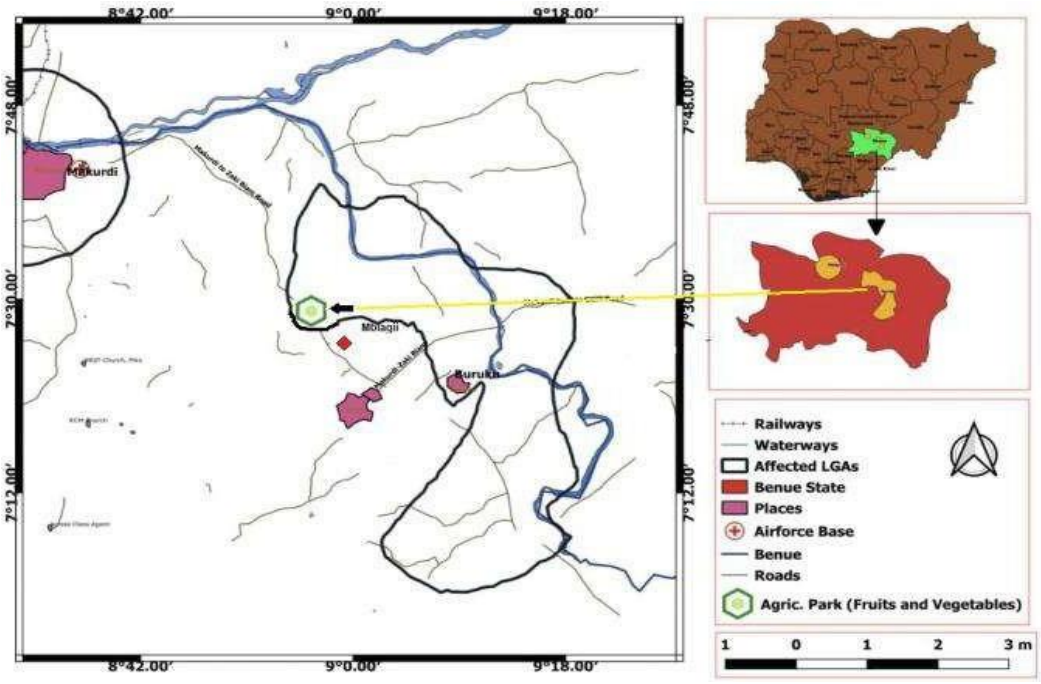
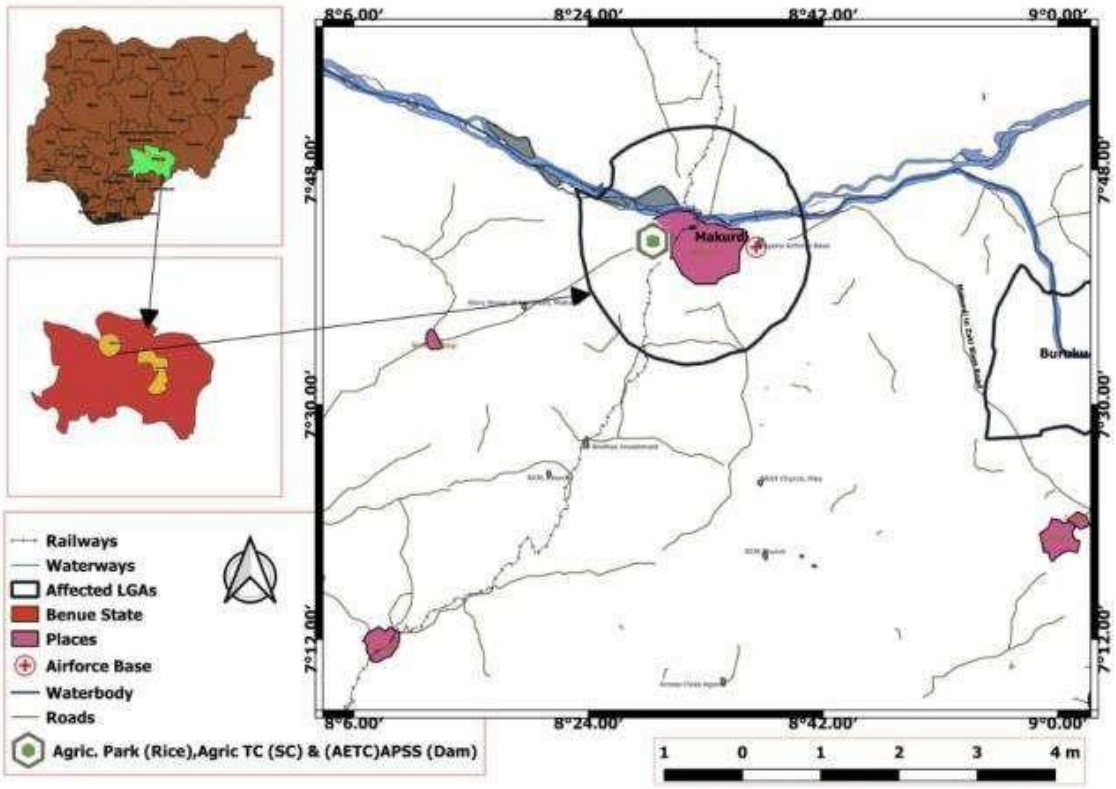
Fig 3.2 provides land-use land cover maps of the three sites considered



A: Mbaikyor site



B: Mbiagii site



C: Makurdi industrial park site

Fig 3.2 (a-c): Land-use cover maps of the three sites considered

CHAPTER FOUR:
PROJECT AREAS OF INFLUENCE AND DESCRIPTION OF THE ENVIRONMENT AND SOCIAL BASELINE

4.1 Project Area of influence

4.1.1 General Considerations

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

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

4.1.2 Area of Direct Influence (ADI)

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

- The 16ha footprint area, i.e., the space occupied by the Project's infrastructure; and
- The area where direct impacts from the construction and operational activities will be felt.

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

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

- **Biophysical environment**: it is expected that all direct biophysical impacts resulting from Project construction and operation will be limited to a 1.5 km^2 radius. This dimension would accommodate temporary accesses, machinery movement, etc.
- **Socioeconomic environment**: Direct socioeconomic impacts are expected to be felt mainly by the persons residing or working within a 1.5km^2 radius of the project footprint. Fig 4.1 provides a graphical illustration of the Areas of Influence.

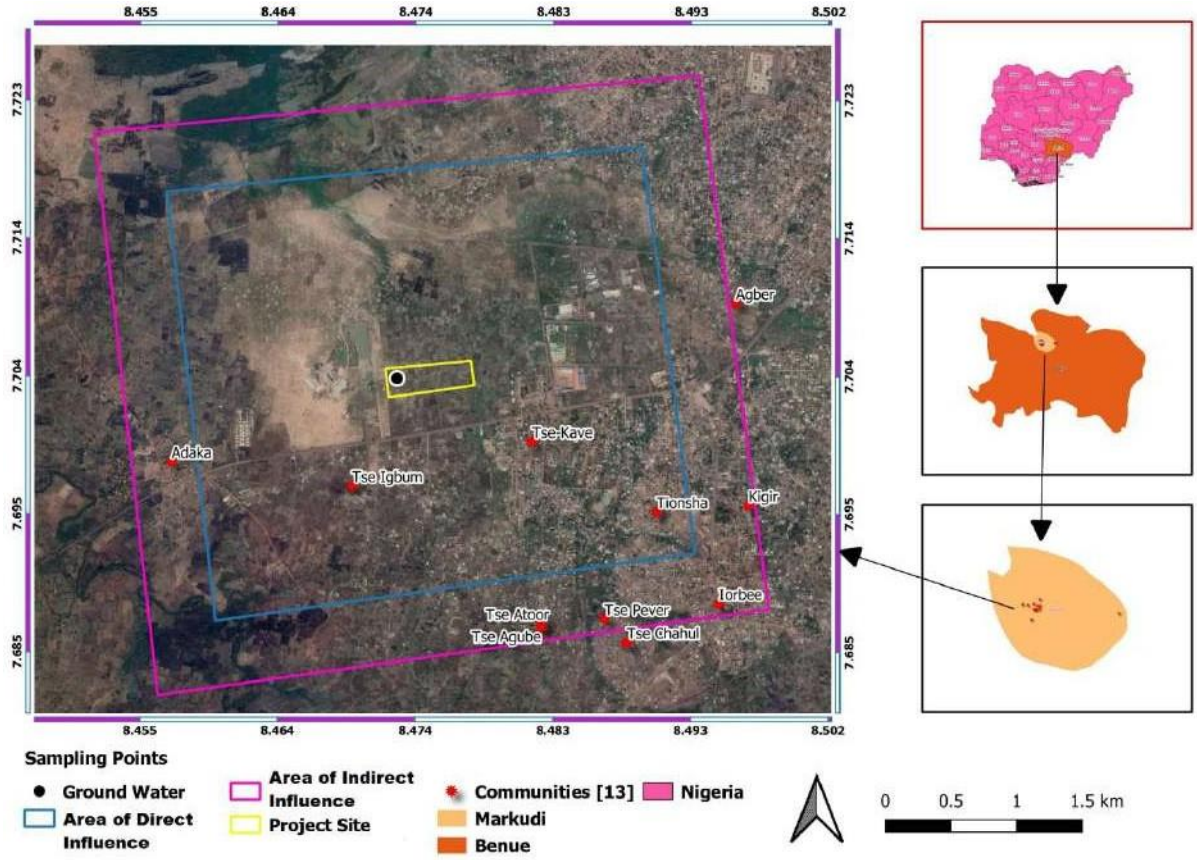


Fig 4.1: Sphere of Influence for the project

4.1.3 Area of Indirect Influence (AII)

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

The Project AII is estimated to cover a further 0.5km^2 away from the ADI. Summarily put, the project AII is 2km^2 radius from the 16ha.

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

Table 4.1 provides the communities within the biophysical and socio-economic components of the project.

Table 4.1: Communities within the ADI (1.5km^2) and AII (2km^2) Influence

Communities in the A**rea of Direct influence**	Communities within the **area of indirect influence**
Adaka	Adem
Tse-Kave	Tse chahul
Tionsha	Tse Pever
Tse-Igbum	Kigirr
	Kwangtamen
	Agber
	Tse-Agube
	Tse Atoor

4.2 Description of the Environment

4.2.1 Identification of the Study Area

The study area of the proposed agro-industrial park is located in Tse-Igbum community in Makurdi LGA of Benue state, in North-central Nigeria. Details of the project location have been provided in chapter four of this report. Figure 4.2 is a map of the proposed site.

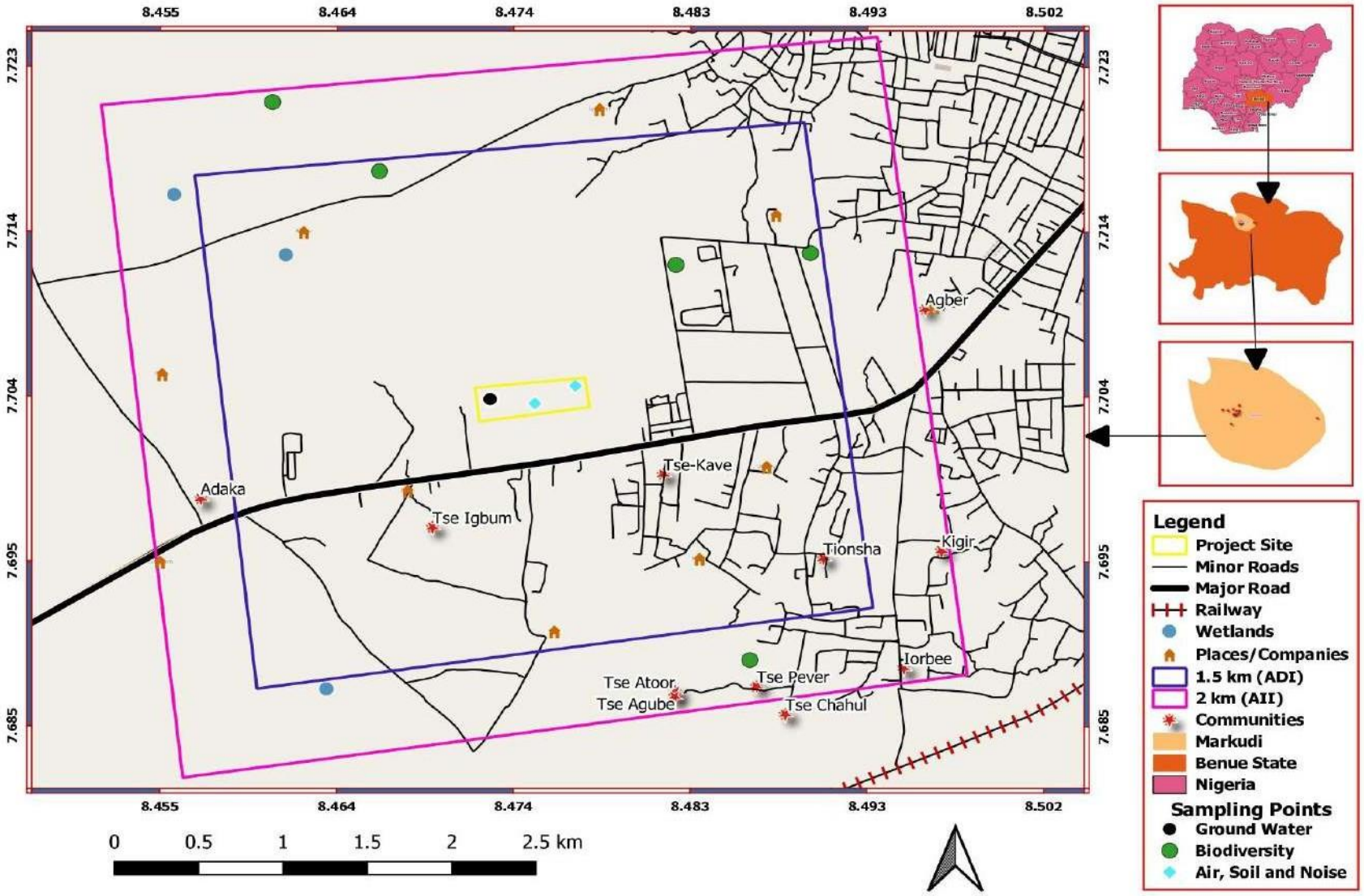


Fig 4.2: Generalized Sampling Map

The 16-ha proposed site is a government-owned land situated in a developed industrial area. It is made up of patches of derived savanna habitat and farms owned. River Fete generally drains the area, and it's about 1.8km from the site. The topography is level, there are no protected forests in the project area however, the project site is about 151km and 146km away from the Pandem Wildlife Park and Afi mountain wildlife sanctuary, respectively as the closest protected reserve. The site is approximately 1.41km away from the Ankpa-Naka Road. The road conditions and network around the project site are excellent with light volumes. There are no reports of kidnapping except Herders - Farmers skirmishes, as at the time of this study. The site is withinan industrial area and, as such, is not in proximity to schools, churches and hospitals or other places of public gathering. The telecommunication network available in the project area are MTN, Glo, Etisalat and Airtel, and the signals provided are strong.

4.2.2 Overall Data Collection Methodology

The summary of baseline conditions is based on information sourced from works of literature (see relevant sections) as well as findings from a one-season (wet) field sampling program supplemented by secondary data from the approved report (NEPZA 2019) dry season data) laboratory analyses of samples obtained and socio-economic and health surveys specific to this ESIA. The data acquired will be used to make environmental management decisions and future monitoring of changes in ecological and social components.

A combination of data from existing literature and field sampling campaign was used to inform the preparation of the baseline chapters for various environmental and social components. Following the approved ToR by the FMEnv. and EMSF document for this project, data were collected as follows:

Baseline data for the dry season was collected from existing literature, notably the approved ESIA of the Nigeria Export Processing Zone Authority (NEPZA) 2019. The dry season data-gathering exercise was conducted between November 17 and 21, 2019,in Makurdi. The project involved the establishment of a Free Trade Zone in Makurdi. The NEPZA project site is about 7.3km away from this proposed project. The QA/QC guiding the sample collection analyses is presented in annexure 10.

Wet season baseline data for this project was collected between 24th through 27th April 2021.

A summary of the available data for the wet and dry season used in the preparation of the baseline chapter of this ESIA is presented in Table 4.2

Table 4.2 Summary of Data Collected for the ESIA

	Wet Season (based on data collected between 24th through 27th May 2021)

Environmental/Social Component	Samples requested by FMEnv.	No of samples collected	Comments
Climate and meteorology	8	8	The field studies provided information on local meteorology of the project location and was supplemented with data sourced from secondary sources (NiMET).
Air quality and noise levels	8	8	Air and noise quality samples points were the same as for soil and meteorology.
Soil	8	8	Topsoil and subsoil samples were collected at each point
Groundwater	3	3	Samples were collected and analyzed from three boreholes in the project area
Surface water	3	3	Samples were collected at 3 points from the Fete River, including a control point.

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 and noise levels;
- Geology/hydrogeology;
- Surface and groundwater;
- Soil and sediment;
- Flora and Fauna
- Hydrobiology, fisheries
- Traffic survey
- Climate change and
- Socioeconomics/health impact, demography and community characteristics.

The acquisition of data involved field data gathering, measurements and the collection of representative samples used to establish the environmental conditions of the study area. This exercise involved a multi-disciplinary approach and was executed within a QHSE management system approach (details are spelt

out in Appendix 4.1). This approach assured that the required data and samples were collected under standard requirements (scientific and regulatory) using the best available equipment, materials and personnel. Elements of this approach include:

- review of existing reports that contain environmental information on the study area;
- designing and developing field sampling strategies to meet work scope and regulatory requirements;
- pre-mobilization activities (assembling of field team, sampling equipment/materials calibrations/checks, review of the work plan and schedule with the team, and job hazard analysis);
- mobilization to the field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- demobilization from the field; transfer of sample custody to the laboratory for analyses. 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 materials consulted is specified in relevant sections.

4.2.3 BIOPHYSICAL ENVIRONMENT

4.2.3.1 Climate change

Climate change poses severe threats to sustained economic growth, poverty reduction, quality of life, and political stability. According to the IPCC, Africa is the most vulnerable continent to climate change and climate variability; and the situation is aggravated by the interaction of multiple stresses occurring at various levels, compounded by low adaptive capacity. Climate change experts project that all sub-regions of the continent will experience a temperature rise very likely more significant than the global mean annual warming. At the same time, most parts of the continent are expected to experience reduced yearly average rainfall and increased aridity and droughts. The combination of reduced rainfall and hotter temperatures is likely to result in net drying and increased aridity for a greater part of the continent.

Benue State, like the other Nigerian States, is dealing with significant climate change. The State has witnessed a more considerable increase in mean temperature than the core north during 1990-2020. Other key climate change indices for the State (NiMET 2021) are as follows;

- The average maximum temperatures have been increasing in the State
- The annual number of 'hot' nights and 'hot' days has increased between 1990 and 2020; 'hot' days have increased by 53 days between 1990 and 2020, with the rate most substantial during September-November.

- 'Cold' days and nights have decreased between 1990 and 2020. The annual average number of 'cold' nights has decreased by 19 (statistically significant), with the most substantial rate of decrease seen during September-November.
- The average precipitation per year has decreased significantly by 1.5 mm per month between 1990 and 2020.
- The maximum rainfall period in the State has shifted from August to July, and the primary rainfall peak from July to September.
- The high intra-annual variability of Nigeria's rainfall is becoming more prominent.
- The mean annual temperature is 28.5°C (1990-2020)
- The mean annual precipitation is 1037.03mm (1990-2020)

Table 4.3 Climatic data distribution of the project area

Parameter	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Comments
Temperature range (^{0}C)	29.2	30.9	31.9	31.0	29.2	27.4	26.4	26.0	26.4	27.0	28.4	28.7	The mean monthly temperature for the project area ranged from 26.4^{0}C to 31.0^{0}C. This variance temperature is particularly striking between regions of different altitudes. This contrast is more apparent in the dry season than in the rainy season
Rainfall (%)	0.0	0.2	0.5	1.8	3.8	5.2	7.3	8.9	7.0	3.6	0.3	0.1	The state records significant levels of rainfall in July, August and September, with the highest level experienced in August while no rainfall was recorded in January.
Mean Rel. Humidity (%)	29	34	45	58	69	77	80	82	82	80	64	36	The area's relative humidity ranged from as low as 29% during January to as high as 82% during August and September.
Wind speed (ms-1)	7.7			5.9					4.2			5.9	The mean monthly wind speed experienced in the project area were grouped into four, with January-March having an average wind speed of 7.7; April-August having 5.9 same values as that obtained in December, while September-November recorded an average value of 4.2 m/s
Sunshine duration(hours)	10	9.6	8.9	7.3	5.6	4.9	5.5	5.4	5.1	5.3	8.0	9.9	The states experience intense radiation from November through March. On the other hand, August and October recorded the least amount of radiation. Average sunlight hours ranged between 5.1 and 8.10

Source: NiMET, 2021

*All values for the dry season sampling obtained from the (NEAQCR) 2014 and NEPZA approved report 2019 were within regulatory limits.

The climatic review for temperature and sunlight (6.53 hours) were suitable for horticulture, cassava and rice. Meanwhile, relative humidity value (34%) was ideal for cassava.

Projections for Nigeria

- The following are key climate change projections obtained for Nigeria from the Global Climate Models (GCM);
- The mean annual temperature is projected to increase between 1.1° C and 2.5° C by the 2060s and 1.4° C and 4.6° C by the 2090s. Projections indicate that warming will be more significant in the northern part of Nigeria.
- The annual number of 'hot' nights is projected to increase in Nigeria. Projections indicate an increase of 32-60% by the 2060s and 37-74% of nights by the 2090s, with 'hot' nights increasing most rapidly in June-August.
- The most significant increase in the length of heat waves is projected for northern Nigeria.
- Most projections indicate small increases in mean annual precipitation over Nigeria but exhibit wide variations across the country.
- There is low to medium confidence in GCM projections for heavy rainfall over West Africa by the end of the 21st Century. Still, Regional Climate Models (RCMs) indicate an increase in the number of days with extreme rainfall in May and July over West Africa.
- This section provides the options to visualize climate variables and indices derived from scientifically vetted CMIP5 projections for different timeframes, statistics, emission scenarios, and climate models.
- The mean annual temperature will rise by 1.81°C (1.25°C to 2.76°C) in 2040-2059
- Annual precipitation will decrease by -3.52mm (-308.01mm to 354.90mm) in 2040-2059
- Annual Cooling Degree Days will rise by 1289.42mm (1034.42mm to 1693.55mm) in 2040-2059
- Annual Maximum 5-day Rainfall (25-yr RL) will rise by 12.82mm (-53.51mm to 180.32mm) in 2040-2059

4.2.3.2 Meteorology Measurements (Microclimatic conditions)

The prevailing microclimatic conditions (temperature, rainfall, humidity and atmospheric pressure) obtained in the study area was measured on the field. Measurement was carried out with the aid of Aeroqualaerocet 531. This equipment was calibrated and held at arm-length towards the direction of the prevailing wind. The value of the climatic elements was read off-screen and data documented. The sampling locations for noise were the same for air quality. The detailed result of this study for the various sections investigated is presented in Table 4.4

Table 4.4: Result of On-Site Meteorological Measurement

SAMPLING PARAMETER	Wind speed (m/s)	Wind direction (%)	TEMP. (0C)	RH (%)
Mean	2.4	NW	33.1	60.9
Min.	1.5	NW	29.3	34
Max.	4.1	NW	34.9	74.3
NEPZA 2019 secondary data results				
Mean	2.7	NW	33.4	61.3
Range	1.7 – 4.3	NW	30.1 – 34.7	54.6-65.4

Source: MCNL Survey, 2021

4.2.3.3 Topography

Nigeria is characterized by four elevation regions (Adelana et al., 2008). This results from the merging of the River Niger and Benue. The lowland topographic regions found mainly in the south have elevations ranging between 0-200m. This area merges into highly degraded forest inland. To the southwest of the Niger valley lies a rugged landscape defined by the Western Plains (WP) interspersed with the Western Highlands (WHL). The heavily populated Jos, Plateau with its semi-temperate climate, is Nigeria's highest elevation area, recording above 1,000-m. It rises prominently from the riverine plains. The northern part of the country is characterized by somewhat lower elevations, level terrain, and sandy soils, where agriculture dominates. Figure 4.3 presents the topographic map of Nigeria.

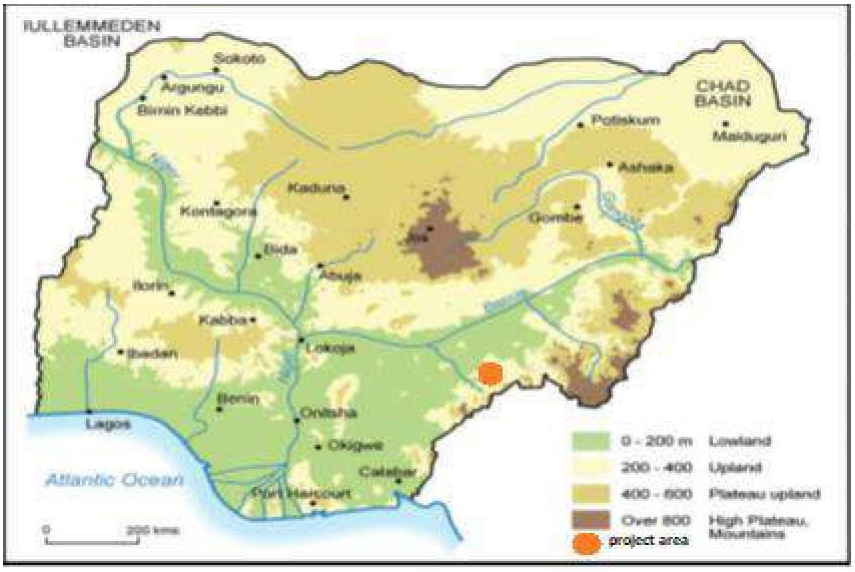


Fig 4.3: Topographic Map of Nigeria

Source: Adelana et al., 2008

Topographically, the project/study area is mainly undulating plains with occasional elevations of between 1,500m and 3,000m above sea level. The state's main geologic formations are sandy-loam shelf basement complex and alluvial plains.

4.2.3.4 Ambient Air Quality

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

4.2.3.4.1 Ambient Air Quality Measurement

Atmospheric gases were measured with the aid of Universal Gas Analyzer MX6. This equipment was calibrated and held at arm-length towards the direction of the prevailing wind. The value of the atmospheric concentrations of each gaseous pollutant was read off directly on the equipment screen and data documented.

Measurements were conducted between 07:00 and 19:00hrs Nigerian time for air measurements. Specific locations for measurements were selected to consider concentrations of human receptors such as residential areas, commercial areas, hospitals, churches, schools and farmlands. The coordinates of the sampled locations for air quality are presented in Table 4.5 and the sampling map in Figure 4.4

Table 4.5 List of Air and Noise Quality Measuring Equipment Used in the Study

Parameter	Equipment	Detection Limit
Total Suspended Matter	Casella Cel Micro Dust Pro 880nm	0.001
Hydrogen sulphide	Gas Alert Extreme (BW Technologies) Model GAXT-H-DL	0.001
Carbon monoxide	Gas Alert Extreme (BW Technologies) Model GAXT-M-DL	0.001
Sulphur oxides	Gas Alert Extreme (BW Technologies) Model GAXT-S-DL	0.001
Ammonia	Gas Alert Extreme (BW Technologies) Model GAXT-A-DL	0.001
Nitric Oxide	Toxi RAE II PGM -1140	0.001
Nitrogen iv oxide	Gas Alert Extreme (BW Technologies) Model GAXT-N-DL	0.001
Carbon iv oxide	Alnor CF910	0.001

Total Hydrocarbon (THC)	Crowcon MultiGas indicator	0.001
Noise Level	Pulasa Sound Meter Model 14	10.0
Meteorology	Aeroqualaerocet series 531	0.1
Chlorine (Cl2)	Cl2 Crowcon Gasman S/N: 19812H	0.001
Hydrogen Cyanide (HCN)	HCN Crowcon Gasman S/N: 19773H	0.001

Source: MCNL survey, 2021

Measurements were conducted between 07:00 and 19:00hrs Nigerian time for air measurements. Specific locations for measurements were selected to consider concentrations of human receptors such as residential areas, commercial areas, hospitals, churches, schools, and farmlands see Table 4.6, while plate 4.1 shows sampling exercise.

Table 4.6 Coordinates of Air/Noise Quality Sampling Locations

CODE	Latitude	Longitude	TIME
AN1	07’42.223`	008’28.519	07:55am
AN2	07’42.284	008’28.660	08:27 am
AN3	7.699325	8.468362	09:26 am
AN4	7.690963	8.476253	10:32 am
AN5	7.695272	8.484099	11:46 am
AN6	7.700541	8.487290	04:31 pm
AN7	7.710192	8.496747	05:35 pm
Control	7.715007	8.488117	03:35 pm

SOURCE: MCNL survey, 2021.

Plate 4.1: Sampling activity for air/noise quality with the FMEnv. representative

6.3.4.2 Ambient Air Quality Result

The summarised result of this study is presented as shown in Table 4.7, while Appendix 6.1 contained detailed result. Particular attention was paid toCO_2, N_2O and CH_4, being components of Greenhouse gases (GHG).

Table 4.7 Ambient Air Quality Result Measured in the Study Area

SAMPLING PARAMETER	WHO Limits	FMEnv. Limits	Project area		NEPZA 2019	Comments.
			Min	Max	Range	
SO_2 (ppm)	0.002	0.002	0.16	0.45	0.13-0.53	Concentrations were generally above WHO and FMEnv. detection limit for sampling points across the area
CO (ppm)	10-20		NA	NA	0.4-0.6	Concentrations were below the equipment detection limit in all sampling stations.
PM1 (ppm)	0.15-0.25	150	1.2	1.6	1.5-1.9	All concentrations were within the WHO threshold value
PM 2.5 (ppm)			2.1	2.2	1.9-2.3	
PM 4 (ppm)			1.9	2.2	1.6-1.9	
NO_2 (ppm)	0.04-0.06	0.05	0.05	0.075	NA	Concentrations measured in all sampling points were within regulatory limits except for values obtained at sampling station seven (7)

VOC (ppm)	0.1		2.0	6.8	1.8-9.9	Concentrations were generally above WHO and FMEnv. detection limit in all sampling stations. Elevated concentrations of VOC in this area is presumably due to fragrance from natural and anthropogenic sources.
HCL (ppm)			NA	NA	NA	Concentrations measured in all sampling points were below the equipment detection limit
H_2S	<10		NA	NA	NA	Concentrations measured in all sampling points were below the equipment detection limit.

Source: MCNL, Survey 2021. *NA=Not Available

4.2.3.5 Noise Quality

4.2.3.5.1 Noise Quality Measurement

Noise is a periodic fluctuation of air pressure causing unwanted sound. Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (SIEP, 1995). The impact of noise on residents generally relates to the annoyance/nuisance caused by the short- and long-term high noise levels. Also, disturbance to wildlife is significant, especially during breeding seasons or when rare species are present. The rate at which these air pressure fluctuations occur is the frequency expressed in hertz (cycles per second). The range of sound pressures encountered is extensive, and to keep numbers in manageable proportions, noise levels are measured in decibels (dB), which have a logarithmic scale. Most legislations and measurements refer to the 'A' frequency weighting, dB(A), which covers the range audible to the human ear. A 10dB (A) typically represents a doubling of loudness.

The regulatory limit for noise provided by the FMEnv. is specific to the workplace (90dB (A). this limit is for a prolonged exposure of 8hrs. However, noise due to the construction activities is expected to rise. The IFC, WHO (See chapter two) and FMEnv limits shall be used to benchmark the ambient noise levels measured in the project area. Table 4.8 presents the WHO guidelines for community noise.

Noise measurements were conducted following IFC 2012 standard. The document implies the measurement of noise for the various micro-habitats present in a given area. In this study, the micro-habitats present are houses, farmlands, religious grounds and hospitals, as shown in Table 4.8

The ambient noise level was measured in different stations (selection criteria was earlier explained) with the aid of a handheld Pulsar Sound Level Meter about 1.9 m high during the day. This meter has a Liquid Crystal Detector (LCD) where readings are displayed for observation. The noise level was read off from the LCD after about 3 minutes of the display.

4.2.3.5.2 Noise Quality result

Table 4.8 shows the summarized result of noise measurement, while Appendix 6.1 presents the detailed result for noise level.

Table 4.8 Noise Measurements in the Study Area

SAMPLING CODE	Noise dB(A)	MIN. (dBA)	MAX. (dBA)	TIME	NEPZA 2019 secondary data range
NQ 1	53.9	46.4	61.3	07:55am	49.2-72.1
NQ 2	72.8	59.8	85.7	08:27 am	
NQ 3	67.8	55.1	80.4	09:26 am	
NQ 4	48.2	43.1	53.2	10:32 am	
NQ 5	54.8	44.8	64.7	11:46 am	
NQ 6	50.4	48.5	52.3	04:31 pm	
NQ 7	70.6	57.1	84.1	05:35 pm	
Control	48.9	43.2	54.6	03:35 pm	
WHO/FMEnv. Regulatory daily limit for Noise					
General Noise Level limit	- 105 lb. (A) per hour or 90dB(A) per day for prolonged exposure				
School	45dB (day) 35 dB (night)				
Hospital	30 dB for day and Night				
Residential	45 dB for Day and 35 dB for Nighttime				
Farmlands	40 dB for Day and 45 dB for Night				

Source: MCNL survey, 2021

The results presented in Table 4.8 indicated an elevated noise level above the daytime threshold limit stipulated for the various environments (school, hospital, residential and farmlands) for all the sections. However, these results were within the general noise level of prolonged exposure of 90dB (A) and compared favourably well with the approved secondary data.

4.2.3.6 Geology

4.2.3.6.1 Geology

Three main rock types form the geology of Nigeria. These are the Precambrian basement with crystalline metamorphic-igneous-volcanic rocks; Mesozoic basement with tertiary sediments, granites/volcanic and The Quaternary alluvial deposits. A vertical electrical sounding (VES) stations sounding using Schlumberger electrode configuration revealed a total of 3 to 4 geoelectric layers. The resistivity of the first layer ranges from 2.8 to 149.2 â„¦m, with the 149.2 â„¦m obtained in VES12. The thickness and depth of this layer range from 0.1 to 6.5 m and on the average is relatively low.

The lithology of this top layer can be said to be made up of clay, sand clay and lateritic soil. The clayey soil comprises silicate, mica, iron and aluminium hydroxide and is expansive in nature. The thickness and depth of the first layer are below 1.0 m except in VES 7, 12 and 14. Generally, the first layer will be harmful to foundation of engineering structures within the study area, unless escavated and refilled with sand, gravel and laterite. Figure 4.4 is the geologic map of Benue State.

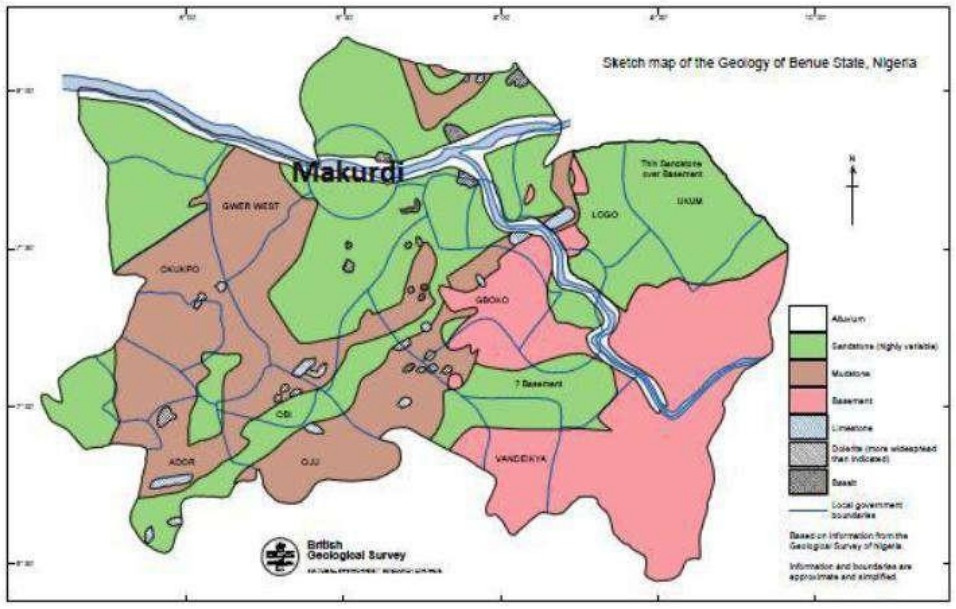


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Fig 4.4: Geologic Map of Benue State

Source: British geologic survey, (2001).

The project area lies within the Benue Valley/trough (Table 4.9), which is believed to be structurally developed. During the Tertiary and possibly the Interglacial periods of the Quaternary glaciation, the Benue and Niger Valleys, otherwise known as the Niger/Benue trough, were transgressed by the waters of the Atlantic Ocean.

The hydrogeologic conditions of the project site is very relevant for proffering mitigation measures for risk of subsurface formation and groundwater contamination from leachates, especially during the project implementation. The data on the hydrogeology has not been included in this report.

Table 4.9: Geologic basin of Benue Trough

Age	Middle Benue Trough
Quaternary	
Pliocene	VOLCANIC
Miocene	
Oligocene	HIATUS
Eocene	
Paleocene	

Maastrichtian	LAFIA

Campanian	
Santonian	
Coriacian	MAKURDI AWGU
Turonian	Ezeaku/Konshisha/Wadata
Cenomanian	Arufu/Uomba/Gboko
Albian	Arutu/Umomba/Gboko
Pre-Albian	Basement complex

Source: Ofoegbu, 1985

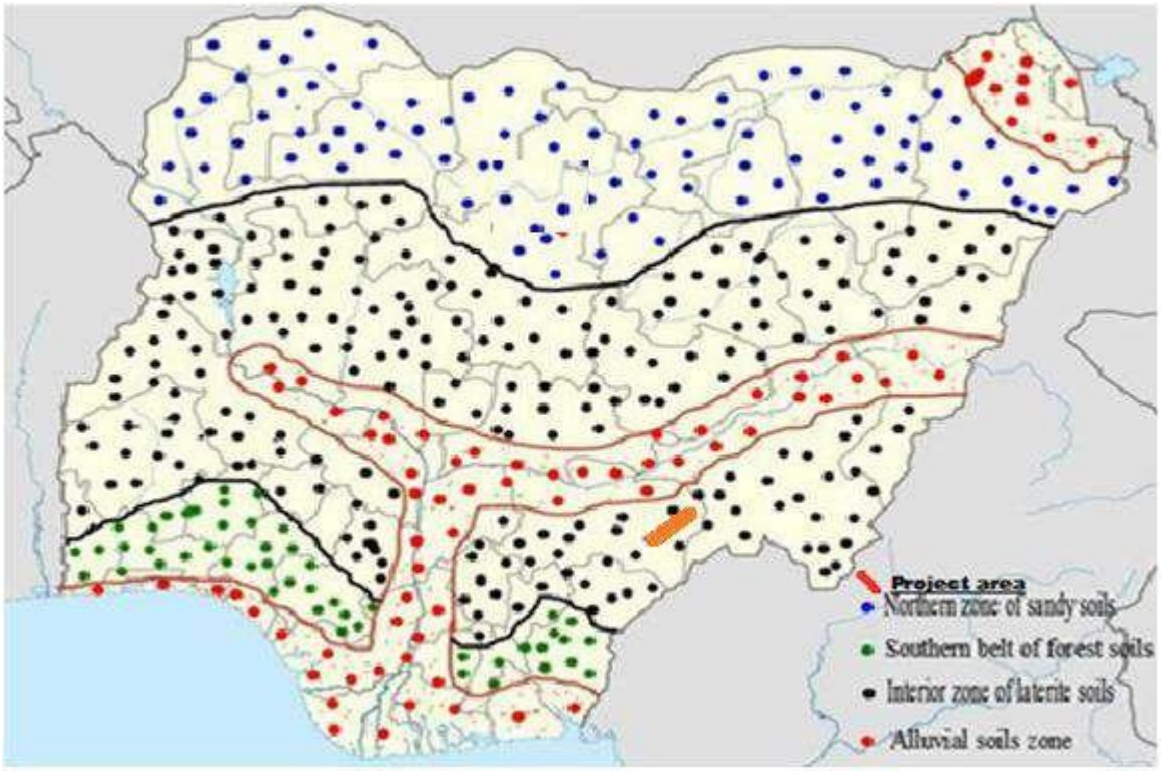

Fig 4.5: Soil zones and types in Nigeria, showing the project location

Source: Agriculture Nigeria, ND, 2006

The textural composition of the soil in the Benue State ranged from loamy sand to sandy loam to clay loam while the pH ranged from slightly - moderately acidic in most parts (Akan et al., 2013). Critical erosion zones were not identified during the field survey. Available information indicates that the soils on site are ubiquitous to the region, and no unusual occurrences have been identified.

4.2.3.7 Soil Quality

Soil resource is of vital importance for the survival and welfare of the people. Pollution and pedology changes are the most severe problems of soils on which developmental projects are sited. These changesdegrade soil quality and alter physical and chemical parameters.

4.2.3.7.1 Soil physicochemical properties

Methodology

Eight (8) sampling stations were established in the study area (same as air/noise sampling points shown in Table 4.2). Stainless steel, hand-held Dutch type Soil Auger was used to collect soil sample (Plate 4.2) at each soil sampling station. Annexure 10 presents the QA/QC protocol for field activities. At each sampling station, soil depth 0-15 cm and 15-30 cm for topsoil and subsoil levels respectively were collected, yielding a total of sixteen (16) samples. Soil samples to be analyzed for physical and nutrient elements were sub-sampled and appropriately labeled using masking tape and indelible ink to indicate sample location, time, date, soil depth level and other relevant observations. Soil samples to be analyzed for hydrocarbon content were collected into amber glass bottles and labeled appropriately using masking tape and indelible ink. In contrast, soil samples for microbiology were put in sterile glass bottles and preserved under cool temperature prior to transportation to the accredited laboratory for analyses. Physical attributes of the soil of the Industrial Park project area like colour and consistency were determined by comparing moist samples on the Munsel soil colour chart, and rolling samples in between fingers. Table 4.10 outlines the soil physicochemical result.

Plate 4.2: Soil sampling activity

Results

Summarily, the physicochemical results presented in Table 4.10 closely mirrors reported values in the area, Akan et al., 2013 and NEPZA 2020 EIA report). However, the relatively higher percentage of surface clay content in some areas of the project and take in comparison to the subsurface indicated differential land-use patterns resulting in differential ecological disturbance (See Impact section for concurrence). Ibrahim and Idoga 2015 outlined erosion, deforestation, and harmful farming practices as ecological causal factors around Makurdi that result in subsurface unconsolidation and leaching. These differences in land-use patterns accounted for the soil colour variations and the wide ranges in concentrations of moisture content, THC, nutrients and heavy metals (See Table 4.10). All physicochemical parameters measured in the soil samples were within FAO threshold values except pH and exchangeable phosphate at sample sites 1 and 2. Attoe 2018, attributed soil enrichment and

vertical migration of weathered calcite and dolomite materials from subsurface phosphorites. The elevated phosphate concentrations would infer a considerable presence of quartz, clay (The PSD percentage of clay in sampling points 1 and 2 corroborates this assertion) and carbonates materials.

Since sampling sites, 1 and 2 were on farmlands (See Plate 4.2), the increase in phosphate levels would have resulted from irrigation and fertilizers application over some period of time.

Table 4.10: Soil physicochemical results

PARAMETERS		NEPZA 2019 Sec Data Range	0-15cm (Surface soil level)								15-30cm (Subsurface soil level)								FAO 2012 limit (*Coren 2016)
			SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	
PH			4.16	5.46	5.53	5.91	5.68	5.62	6.02	5.99	4.28	5.49	5.58	5.88	5.45	5.64	5.79	5.52	5 - 8
Colour		Brown	Brown	Brown	Dark brown	Dark brown	Dark brown	Dark brown	Black	Black	Brown	brown	black	black	Very dark brown	Dark brown	brown	black	Black and brown
Moisture Content @ field capacity ((%))		NA	18.9	27.5	25.9	37.4	36.3	43.2	36.8	35.6	27.2	23.3	39.1	44.2	35.7	41.7	38.9	40.2	
Atterberg limit	PL	NA	26	16	17	18	19	24	17	24	29	17	26	18	20	25	20	18	
	LL		43	31	32	41	36	58	29	42	48	29	54	34	44	56	38	41	
Casagrande classification			MP	LP	MP	MP	MP	HP	LP	LP	MP	LP	HP	MP	MP	HP	MP	MP	
Specific gravity @ 23°C		NA	2.69	2.76	2.73	2.66	2.72	2.71	2.73	2.74	2.70	2.77	2.74	2.67	2.72	2.71	2.73	2.75	*2.65-2.80
PSD (%)	Fines (Clay+silt)	8.5-12.7	48.5	44.5	43.5	19.38	46.5	45.6	42.8	47.4	49.5	42.5	49.0	19.8	49.2	49.8	43.9	49.6	

	Sand	48.7 – 77.3	39.0	47.5	49.0	38.5	43.1	30.7	48.4	45.3	36.5	49.0	46.0	37.0	40.0	36.9	46.9	42.9	
	gravel	NA	12.5	8.0	7.5	42.0	10.4	13.7	8.8	7.3	14.0	9.5	6.0	42.2	10.8	13.3	9.2	7.5	
Soil classification			SC+G	SC	SC	GSC	SC	SC+G	SC	SC	SC+G	SC	SC	GSC	SC	SC+G	SC	SC	
Organic matter (%)		NA	3.9	2.8	2.6	2.3	2.7	2.8	2.3	2.4	4.3	2.6	2.4	2.7	2.1	3.0	3.1	2.8	
Ext. nitrate (mg/kg)		20.1-42.6	42.2	28.9	32.4	26.5	24.9	28.6	29.8	30.2	44.6	22.3	31.9	34.6	31.3	25.2	21.3	20.1	500
Potassium (meq/100g)		0.03-0.19	0.20	0.08	0.11	0.10	0.13	0.12	0.10	0.13	0.22	0.08	0.10	0.10	0.06	0.08	0.10	0.10	
Phosphate (mg/kg)		8.9-13.2	18.7	12.4	11.7	10.3	11.1	13.4	11.9	10.9	20.2	11.2	11.2	11.6	10.3	12.1	11.1	11.4	5
Na^{+} saturation (%)		NA	15.6	12.4	9.8	7.6	8.8	10.2	13.1	12.9	13.2	10.6	9.3	7.2	9.0	9.6	11.3	9.9	
Al^{3+} saturation (%)		NA	89.2	81.3	86.8	65.6	72.7	63.2	77.8	80.7	84.2	67.2	71.4	61.0	78.9	58.7	61.2	68.9	
Ca^{2+} (meq/100g)		NA	12.3	6.8	8.2	6.4	5.9	7.6	3.9	4.7	15.3	6.5	8.3	6.0	5.8	7.8	4.0	4.9	
Mg (meq/100g)		NA	0.31	0.25	0.19	0.10	0.16	0.18	0.23	0.21	0.28	0.23	0.19	0.08	0.12	0.16	0.20	0.21	
THC (mg/kg)		ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	ND	ND	ND	ND	
Boron (mg/kg)		NA	1.87	0.96	1.45	1.65	1.26	1.18	1.85	1.64	2.13	0.69	1.26	0.87	1.61	1.18	2.07	1.20	
Copper (mg/kg)		0.5-18.6	5.84	3.82	5.07	2.45	4.08	3.70	4.38	2.76	7.23	4.70	6.21	1.48	25.4	1.01	3.20	1.73	36
Lead (mg/kg)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	85
Manganese(mg/kg)		67.3-	126.9	87.9	112.5	138.9	201.9	89.7	137.	97.3	117.5	98.6	91.9	77.3	97.5	67.9	81.6	95.7	

	104.6							1										
Nickel(mg/kg)	NA	0.81	0.66	0.54	0.82	0.61	0.57	0.62	0.64	0.80	0.70	1.00	0.98	0.89	0.95	0.90	1.01	35
Zinc(mg/kg)	6.9-18.6	31.28	12.81	34.72	19.05	23.12	18.17	33.18	38.14	42.71	34.97	31.26	13.32	18.86	16.50	32.11	34.49	140

- Top and sub soils were collected between 75 - 150 cm respectively for moisture content, atterberg limit, compaction, dry density and specific gravity tests.
- They are no fundamental differences between the wet season data and the secondary dry season data.

All the holes in the study area show dark grey hard to loose sandy clay at the uppermost layer, and occasionally hard lateritic soils, commonly called hardpan, ranges from 0 - 1.50 m in depth. The particle size distribution analysed from the soil samples differs significantly. The soil samples are mostly well-graded, ranging from clay, silt, sand and gravels, and in some locations (e.g., Adoka), a combination of two or more of the soils mentioned earlier are observed. Dense sands and gravels are important foundation soils because they can carry weight above 600 kN/m^2 with minimal settlement (Lekmang et al. 2016). The northern and western part of the project footprint (SS1) is characterized by dense sands and gravels and can accommodate structures whose weight exceeds 600 KN/m^2.

In contrast, the western and southern parts have relatively loose sand, soft clays and silts and hence should not be loaded above 150 kN/ ^{2}(Lekmang et al. 2016) to ensure stability and integrity of the structure. Plasticity parameters, also called Atterberg limits, are important indices used alone or with other parameters in characterising the swelling potential and the shear strength of soils based on water content. Test results show that samples are low to moderate compressibility, with about three (3) sampling sites in (Tionsha, Iorbee and Aden) indicating high compressibility and predominantly exhibiting negligible swelling potentials. This is because the foundation soil may not experience the twin problem of swelling and shrinking of foundation soils, which usually leads to the heaving and settlement of structures. Nonetheless, the soil in the project footprint becomes compacted from 96cm down to 1.5m.

4.2.3.7.2 Soil Microbiology

The two most important organic matter decomposers in the soil are the two groups of microorganisms studied: fungi and bacteria. Their counts provide information on the level of ongoing biochemical activities in soil. Microbial counts under normal circumstances increase with an increase in soil organic matter. About 1g of fertile soil should contain 1 x 10^6 to 1 x 10^8Cfu/g bacteria and fungi (Odu et al., 1985).

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

Results

Table 6.9 indicated surprisingly more fungi diversities (seven species) but more bacteria counts. Also, the subsoils are more diverse microbiologically than their corresponding topsoils, but with lesser counts, and

that some sites are more diverse than others. Only two bacteria genera (*Pseudomonas* and *Bacillus*) among the eight could utilise hydrocarbon products as growth substrates as against four among the seven fungi genera.

Although reports with higher fungi diversities than bacteria are rare (Navratilova et al. 2019), their preference for plant-based substrates (Makipaa et al. 2017) as growth media possibly indicates an abundance of logs, plant litters, sawdust, wood splinters, and tree stumps in the study area. This assertion further implies significant logging activities, the establishment of tree gaps, soil erosion and the inevitable introduction of foreign materials, including alien species.

The recording of Norcardia species only in the subsoil of sampling site eight (8) suggest a history of localized sludge enrichment or an open defecation practice. The absence of this species in the topsoil indicates a cessation or perhaps a hiatus; its presence in the subsoil from faecal enrichment may be owed to fallowed farm clusters as evident in the area during field studies. Apart from this site, species found in the top soils and sub soils of all other sampled sites were uniform suggesting uniformity in substrates composition over time.

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

Table 4.11: soil microbial result

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
SS1	Topsoil	*Pseudomonas sp* *Bacillus sp* *Proteus sp*	$2.18x10^5$	*Pseudomonas sp*	$2.85x10^4$	*Mucor sp* *Fusarium sp* *Aspergillus sp* *Penicillium sp*	$6.00x10^2$	*Mucor sp* *Aspergillus sp* *Fusarium sp*	$5.50x10^2$
	Subsoil	*Pseudomonas sp* *Bacillus sp*	$1.39x10^5$	*Pseudomonas sp* *Bacillus sp*	$6.40x10^3$	*Penicillium sp* *Mucor sp* *Aspergillus*	$1.00x10^2$	*Mucor sp* *Aspergillus sp* *Candida sp*	$5.00x10^1$

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
						sp *Fusarium sp* *Candida sp*			
SS2	Topsoil	*Pseudomonas sp* *Bacillus sp*	$3.30x10^5$	*Pseudomonas sp* *Bacillus sp*	$4.70x10^4$	*Aspergillus sp* *Penicillium sp* *Mucor sp* *Candida sp*	$1.15x10^3$	*Mucor sp* *Candida sp* *Aspergillus sp*	$4.10x10^2$
	Subsoil	*Pseudomonas sp* *Bacillus sp* *Actinomyces sp*	$4.30x10^5$	*Pseudomonas sp*	$3.70x10^4$	*Aspergillus sp* *Penicillium sp* *Mucor sp* *Candida sp*	$1.62x10^3$	*Aspergillus sp* *Mucor sp* *Candida sp*	$7.50x10^2$
SS3	Topsoil	*Pseudomonas sp* *Bacillus sp*	$1.95x10^5$	*Pseudomonas sp*	$2.88x10^4$	*Penicillium sp* *Mucor sp* *Aspergillus sp* *Fusarium sp* *Candida sp* *Trichoderma sp*	$8.00x10^1$	*Mucor sp* *Fusarium sp* *Candida sp*	$6.00x10^1$
	Subsoil	*Pseudomonas sp* *Bacillus sp* *Actinomyces sp*	$2.11x10^5$	*Pseudomonas sp* *Bacillus sp*	$3.20x10^4$	*Mucor sp* *Aspergillus sp* *Candida sp* *Fusarium sp*	$1.70x10^2$	*Mucor sp* *Fusarium sp* *Aspergillus sp*	$7.00x10^1$

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
		Staphylococcus sp							
SS4	Topsoil	*Pseudomonas sp* *Bacillus sp*	$1.59x10^5$	*Pseudomonas sp*	$2.36x10^4$	*Mucor sp* *Fusarium sp*	$1.00x10^2$	*Mucor sp* *Fusarium sp*	$7.00x10^1$
	Subsoil	*Pseudomonas sp* *Bacillus sp* *Proteus sp*	$3.30x10^5$	*Pseudomonas sp*	$3.90x10^4$	*Aspergillus sp* *Mucor sp* *Rhizopus sp*	$3.00x10^2$	*Mucor sp* *Aspergillus sp*	$3.70x10^2$
SS 5	Topsoil	*Pseudomonas sp* *Bacillus sp*	$2.26x10^5$	*Pseudomonas sp* *Bacillus sp*	$2.59x10^4$	*Aspergillus sp* *Mucor sp* *Rhizopus sp*	$4.40x10^2$	*Mucor sp* *Candida sp*	$3.20x10^2$
	Subsoil	*Pseudomonas sp* *Bacillus sp*	$4.00x10^5$	*Pseudomonas sp* *Bacillus sp*	$3.70x10^4$	*Penicillium sp* *Fusarium sp* *Candida sp* *Aspergillus sp* *Mucor sp*	$2.70x10^2$	*Mucor sp* *Aspergillus sp* *Fusarium sp*	$1.10x10^2$
SS 6	Top soil	*Pseudomonas sp* *Bacillus sp* *Proteus sp*	$1.48x10^5$	*Pseudomonas sp* *Bacillus sp*	$2.81x10^4$	*Aspergillus sp* *Mucor sp*	$6.00x10^1$	*Aspergillus sp* *Mucor sp*	$5.00x10^1$
	Subsoil	*Pseudomonas sp* *Bacillus sp* *Proteus sp*	$8.30x10^4$	*Pseudomonas sp* *Bacillus sp*	$5.90x10^4$	*Trichoderma sp* *Aspergillus sp* *Mucor sp*	$1.90x10^2$	*Aspergillus sp* *Candida sp*	$1.60x10^2$

Sampling points	Soil depth	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Utilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Utilising Fungi	Count (cfu/ml)
						Rhizopus sp *Candida sp*			
SS 7	Top soil	*Pseudomonas sp* *Bacillus sp* *Proteus sp*	$3.80x10^4$	*Pseudomonas sp* *Bacillus sp*	$3.20x10^4$	*Aspergillus sp* *Mucor sp*	$6.00x10^1$	*Aspergillus sp* *Mucor sp*	$5.00x10^1$
	Subsoil	*Pseudomonas sp* *Bacillus sp* *Proteus sp* *Actinomyces sp*	$4.10x10^5$	*Pseudomonas sp*	$5.70x10^4$	*Mucor sp* *Aspergillus sp* *Penicillium sp* *Rhizopus sp*	$1.10x10^3$	*Mucor sp* *Candida sp* *Aspergillus sp*	$9.40x10^2$
SS 8	Topsoil	*Pseudomonas sp* *Bacillus sp* *Actinomyces sp*	$2.90x10^5$	*Pseudomonas sp*	$5.80x10^4$	*Mucor sp,* *Candida sp* *Aspergillus sp* *Penicillium sp*	$6.00x10^2$	*Mucor sp* *Candida sp* *Aspergillus sp*	$4.90x10^2$
	Subsoil	*Pseudomonas sp* *Bacillus sp* *Norcadia sp*	$4.80x10^5$	*Pseudomonas sp*	$6.20x10^4$	*Mucor sp* *Candida sp* *Aspergillus sp* *Penicillium sp*	$1.49x10^3$	*Candida sp* *Mucor sp* *Aspergillus sp*	$1.03x10^2$

Microbes, including bacteria and fungi, are known to grow on waste media called substrates. The microbial data presented in Table 4.11 suggest possible substrates or waste streams in the study area. Table 4.12 listed domestic refuse, agro waste, herds presence, wood/plant waste river deposits, industrial waste weathered rock deposits and sewage, as indicator substrates for the soil microbes assayed in this

study. Except for *Norcadia*, all species observed in this study was reported in the NEPZA 2019 document.

Table 4.12: Microbial – Waste Substrate Matrix

Microbial Species	**Broad-spectrum media nutrients**	**The possible substrate in Project Area**
Bacteria		
Pseudomonas sp	Sodium, potassium, iron, calcium, glucose, vitamins	Garbage, weathered rock deposits, oil/grease/artisanal waste, domestic refuse and agro-waste
Bacillus sp	Vitamins, carbohydrates, nitrogen, and salts	Domestic garbage, refuse, animal/herd waste, plant biomass, weathered rock deposits.
Proteus sp	Sodium, potassium, iron, calcium, glucose	garbage, weathered rock deposits, oil/grease/artisanal waste, domestic refuse and agro-waste
Actinomyces sp	Propionic acid, sodium salt, nitrogen	Agro waste, domestic refuse and faecal waste, logs, plant litters, decomposing fauna remains
Staphylococcus sp	vitamins, carbohydrates, nitrogen, and salts	weathered rock deposits, garbage, oil/grease domestic refuse and agro-waste, plant litters and logs
Norcadia sp	Urea, glucose. Gelatin, blood, paraffin	Herds, animal waste, oil/grease/artisanal waste, domestic and agro-waste
Fungi		
Mucor	Sodium, potassium, iron, calcium, glucose	Garbage, weathered rock deposits, oil/grease/artisanal waste, domestic refuse and agro-waste, logs, plant litters, decomposing fauna remains.
Rhizopus	Sodium, potassium, iron, calcium, glucose	
Aspergillus	Sodium, potassium, iron, calcium, glucose	
Candida	Vitamins, carbohydrates, nitrogen, and salts	Plant biomass, animal waste and weathered rock deposits, plant litters, decomposing fauna remains

Fusarium	Sodium, potassium, iron, calcium, glucose	weathered rock deposits, garbage, domestic refuse, oil/grease/artisanal waste and agro-waste, logs, plant litters, decomposing fauna remains
Trichoderma	vitamins, carbohydrates, nitrogen, and salts	Weathered rock deposits, garbage, oil/grease domestic refuse and agro-waste, logs, decomposing fauna remains.

MCNL survey, 2021

The listed broad-spectrum media disaggregated the project environment into residential, agricultural, forested, degraded, artisanal and erosive. The correlated microbial identities to the discharged garbage indicated varying household lifestyle in the project area. Nonetheless, all microbial species assayed in the soil samples are important in nutrient recycling. However, the composition, abundance, and broad-spectrum media nutrients of the microbial species assayed in the various samples correlated primarily with reviewed literature. Thus, the data showed a reasonably stable ecosystem, albeit with some episodic events.

The frequency of *Pseudomonas, Bacillus* across all sampling stations is possibly indicative of the presence of vitamins as the overarching substrates in addition to sodium, potassium, iron, calcium and glucose-based food substrates. At the same time, the occurrence of *Mucor* sp and Aspergillus in all but one sampled site could be owed to the availability of plant-based decomposing materials across the project area.

The isolated occurrence of *Actinomyces, Proteus, Staphylococcus, Norcadia* (Table 4.11) could be attributed to the absence of vitamin-based waste as substrates but selective availability of chloride, urea, and peptone rich substrates. The presence of *Escherichia* sp, a member of the Coliform group, is symptomatic of ongoing faecal waste discharges, indicative of open defecation and herd's actions (Munoz et al., 2006).

The highest microbial diversity and count were observed in soils obtained from sites proximate to or within the farmland portion of the sampling area and suggestive of a lower topographic plane, hence serving as a depositional sink.

4.2.3.8 Groundwater Quality

Table 4.13 outlines the physicochemical and microbial characteristics of groundwater obtained from the study area. Doing this will allow for future evaluation and monitoring of the impact. The proffered mitigation measures for the potential negative impacts are well documented in chapter five of this report.

4.2.3.8.1 Sampling Methodology

Groundwater samples were obtained from wells in Iorbee with the aid of sample bottles. Each sample bottle was flushed with distilled water before being used at every station (See Appendix 11 – QA/QC protocols for details)

Plate 4.3: Ground Water Sampling Activity (25th April, 2021)

4.2.3.8.2 Result

The result (Table 4.13) showed that the Cleared appearance of the three (3) groundwater samples were slightly alkaline, indicating, possibly, an underlying halite rocky structure. Such alkaline water often correlates to little or no dissolved carbonate or hydroxide ions. In contrast, it suggests bicarbonate's predominance as the significant dissolved inorganic carbon (Freeze and Cherry, 1979). Although climate change and urbanization do trigger an increase in the ecology of aquifers (Riedel 2020), the temperature values obtained in this study correlated strongly with a-decade old results in published reports covering the project area.

Table 4.13: Groundwater Physico-chemical/Microbial result

Community		**NEPZA 2019 Range**	**Tionshia**	**Tse-Aden**	**Iorbee**	**NIS standard**
Geographical coordinates			$7^0$41.683'N $8^0$24.441'E	$7^0$39.800'N $8^0$28.644'E	$7^0$41.078'N $8^0$29.466'E	
Parameters			GW1	GW2	GW3	
General appearance		Clear	Clear	Clear	Clear	Clear
pH @ 21.2^{o}C		6.8 -7.3	7.5	7.6	7.9	6.5-9.2
Temperature (0C)		26.3- 28.1	27.9	28.1	27.8	40 ^{o}C
Turbidity (NTU)		1.02 -1.08	1.05	1.32	1.83	5
TDS (mg/l)		1.4-1.7	1.7	2.1	1.5	
Conductivity (µS/cm)		52.1-65.3	58.21	40.25	59.12	2500
Total Hardness (mg/l)		3.68-7.04	6.23	3.25	4.23	
THC (mg/l)		ND	ND	ND	ND	0.05
Chloride (mg/l)		8.1-14.3	11.6	4	10	**NIS standard**
Nutrients	Nitrate (mg/l)	0.97-2.56	2.52	0.64	0.64	50
	Phosphate (mg/l)	0.10-0.21	0.25	0.15	0.15	
	Sulphate (mg/l)	0.20-0.34	0.36	0.24	0.24	100
	Lead (mg/l)	ND	ND	ND	ND	0.05
	Zinc (mg/l)	0,07-0.14	0.14	0.17	0.17	
	Total Iron (mg/l)	0.2-0.45	ND	ND	ND	1.0
	Copper (mg/l)	ND	ND	ND	ND	1.0
	Manganese (mg/l)	ND	ND	ND	ND	
Total Coliform (cfu/100ml)		0	0	2	$6.8x10^4$	
Faecal Coliform		0	0	0	$5.3x10^2$	

(cfu/100ml)					
E-coli (cfu/100ml)	0	0	0	0	
Faecal Streptococci (cfu/100ml)	0	0	0	0	

Source: MCNL survey 2021

The narrow temperature range indicates negligible climate change effects on the aquifer ecosystem of the area. The low turbidity values indicate a near-absence of silt, clay, organic and inorganic particles, alga and coloured substances in the area's aquifers. The results of THRC and Total Hardness are suggestive of negligible pollution levels (Sawyer, 1994). Electrical conductivity correlated linearly with total dissolved solids and compared favourably with the WHO standard recommended for potable water and other domestic uses confirming that the groundwater is Fresh. The values obtained in these study areas for chloride were lower than permissible values for potable water by WHO values of 250 mg/L. This value is indicative of no inorganic pollution.

Although the groundwater nutrient (nitrates and phosphate) concentrations in this study are negligible, they acted as substrates for the proliferation of the coliforms. The nitrate enrichment in SW 3 was possibly induced fecally. In contrast, SW1, SW 2 and SW4 were non-faecally induced (correlate the low nitrate concentrations with the highest faecal coliform concentration in SW3 as against the higher nitrate concentrations in other borehole samples with negligible or no coliform member). The nutrient concentrations provided the growth media that promoted coliform proliferations in GW 3 (at Iorbee community, Plate 4.3). Since faecal coliform accounted for over 80% of the total coliform concentrations, faecal seepage into groundwater became evident.

Moreover, since seepage often correlates with leaching effects (Man, *et al*., 2011), the presence of coliforms present a timely warning of recent contamination and significant potential impact. The trace amount in the heavy metal species further confirms the contamination source as mainly organic. Interestingly, the automated self-recovery processes in groundwater guarantee *in - situ* remedial purificationmeasures. The result of this study is in tandem with that reported for NEPZA 2019.

4.2.3.9 Hydrology and Drainage

4.2.3.9.1 General overview

Nigeria has two major Rivers, the Niger, after which the country is named, and the Benue. They meet at the Lokoja confluence and enter the Gulf of Guinea through a network of creeks and distributaries which form the Niger Delta. There are, however, a few other tributary rivers that drain into the Niger-Benue

trough and Lake Chad. These include the Sokoto-Rima, Kaduna, Anambra, Gongola, Hadejia, Jama'are and Yobe rivers. The basins of these major rivers and their tributaries constitute the drainage pattern of the entire country. Other major rivers, e.g. Cross, Imo, Ogun, Osun, Benin, Qua Iboe etc., empty directly into the Atlantic Ocean. The majority of small rivers are seasonal (Fig 4.6).

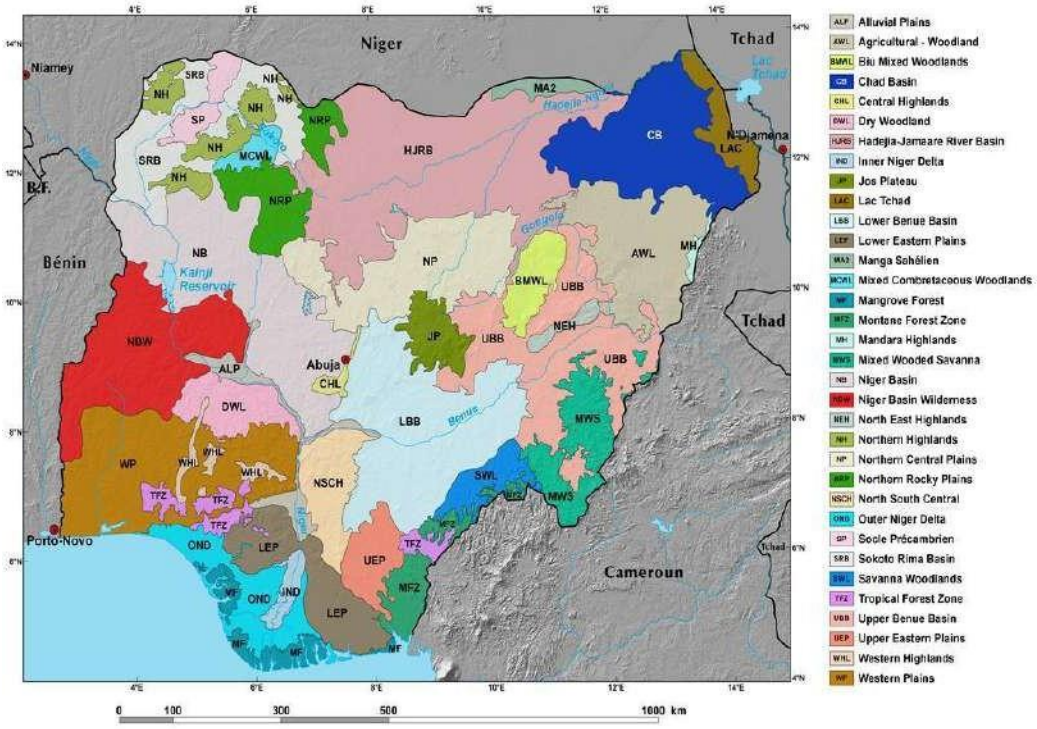

Fig 4.6: Nigeria Drainage System

Separating the two segments of the coastal plain and extending to the northeast and northwest are the broad river basins of the Niger and Benue rivers. The upper reaches of these rivers form narrow valleys and contain falls and rapids. However, most of the lower portions are free from rapids and have extensive floodplains and braided stream channels.

North-central Nigeria

The Benue Trough is one of Africa's most important rift features and is believed to be formed by the rifting of the central West African basement during the Cretaceous. The trough is subdivided into Lower, Middle, and Upper Benue with its Southern limit towards the northern boundary of Niger Delta. Its north sector includes the easterly Yola/Garoua Flank extending across the Cameroon border and the northerly Gongola Flank.

4.2.3.10 Surface Water Quality

4.2.3.10.1. Sampling Methods

Plate 4.4 shows the Fete River that drains the proposed site. The altitudinal gradient of the water body was used to determine the flow direction, and samples were collected at the upstream, midstream and downstream sections. Salinity, temperature, turbidity, pH, dissolved oxygen and conductivity parameters were conducted *in-situ*. Simultaneously, water samples for other physicochemical analysis, heavy metals analysis, microbial analysis and hydrocarbon content were also collected separately as appropriate (See Appendix 9). They were subsequently transported to the Mifor laboratory at Calabar for further analysis.

Plate 4.4: Surface water sampling activity and *in-situ* measurement at Fete River 26th April 2021.

4.2.3.10.2 Results

All analyzed parameters were within WHO 2011 safe limits for the sustenance of aquatic lives except dissolved oxygen, turbidity, phosphate and copper concentrations. Also, the results closely mirror that of the secondary data.

The dissolved oxygen (DO) concentrations in the three sampled sites suggest an anoxic condition induced by a disproportionate decomposition rate over photosynthetic and respiratory rate. The narrow DO concentration range (3.59 –3.82mg/l) suggests uniformity in waste inputs and decomposing episodes (Table 4.14). Such a scenario is promoted more by point source discharges than non-point sources (Imoke& Igelle 2019). The deliberate and uncontrolled domestic and farm waste discharges into the stream observed during field studies supports this assertion. These waste discharges could have actedas growth substrates for the proliferation of the alga population that used up the available dissolved oxygen.

The turbidity concentrations of the three sampled sites testify to the continuous and sustained waste discharges into both rivers by residents. The over-reliance of these water bodies worsens this open dumping practice by the residents for household (including cooking, drinking) and agricultural purposes. Although interviews with the residents (see socio-economic section) confirmed a decline in the degree of abstraction in the wet season, Nganje et al. 2017 wet season studies in the rivers reported higher concentrations above regulatory limits in some sections. The selective higher turbidity concentrations supported the occurrence of non -point sources as earlier stated and year-round abstraction by some communities utilizing the water bodies. F

BOD results suggest that the water is in a self-recovery phase and supports the seasonally induced eutrophic nature of the water as posited by the interviewees.

Table 4.14: Result for Surface Water Physico-chemical Characteristics

Name of River	NEPZA	Fete River			**WHO (2011) Limits for the sustenance of Aquatic Lives**
Geographical Coordinates	2020 Sec Data Range	7.692736N 8.451434E	7.693364N 8.451252E	7.693881N 8.450954E	
PARAMETERS		SW1	SW2	SW3	
PH	5.1-8.3	7.3	7.8	7.6	4.8-8.5
Temperature (oC)	25.4-32.1	28.3	29.4	29.2	22 – 40
Conductivity (µS/cm)	134-198.8	53.7	63.8	58.4	980
Salinity (g/l)	NA	1.41	2.14	0.60	
DO (mg/l)	3-7	3.82	3.59	3.66	4 – 9
Turbidity (NTU)	16.8-21.3	27.37	26.90	26.55	≤5
Total Dissolved Solids (mg/l)	45 -64	89.0	52.0	58.0	
Oil & Grease (mgl)	NA	<1.00	<1.00	<1.00	
PCB (ppb)	NA	ND	ND	0.2	0.5

BOD (mg/l)	7.8-14.1	4.36	15.43	12.27	≤10
COD (mg/l)	18.5-34.7	22.03	48.26	43.73	40
Nitrate (mg/l)	15.6 -76.3	20.36	61.41	53.39	50
Phosphate (mg/l)	0.04-5.64	4.71	6.61	5.25	0.5
Sulphate (mg/l)	58.9-85.4	67.9	92.3	144.8	250
Manganese (mg/l)	NA	0.10	0.10	0.10	100
Lead (mg/l)	NA	0.20	0.20	0.20	1.0
Zinc (mg/l)	0.39-0.78	0.20	0.20	0.20	5000
Copper (mg/l)	0.65-0.76	0.61	0.58	0.64	0.5
Total Iron (mg/l)	2.56-8.04	1.25	1.24	1.99	300

*ND= Not Detected

4.2.3.10.3 Surface Water Microbiology

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

The occurrence of nine (9) bacteria species (Table 4.15) attests to the heterogeneous nutrient inputs into the water bodies. Besides the considerable species diversities, the significant bacteria and fungi counts indicate river bodies under a rich supply of diverse organic waste load.

The isolated occurrences of Pseudomonas and Staphylococcus in the upstream section of the river and its absence in the downstream area coupled with Escherichia and Arthrobacter in the downstream section and its absence in the corresponding upstream section speaks to differential waste load availability in the river. There is the possibility of lifestyle and occupational differences among residents living in the upstream and downstream sections of the river.

There were several microbial species censored in this study that were absent in the NEPZA 2019 report. The water body sampled and the temporal gradient would have accounted for these differences

Table 4.15: Surface water microbiology results

SW1	*Alcaligenes sp.* *Proteus sp.* *Escherichia sp.* *Actinomyces sp.*	2.54 x 10^4	*Escherichia sp.* *Actinomyces sp.*	1.44 x 10^2	*Mucor sp* *Rhizopus sp.*	1.67 x 10^2	*Rhizopus sp.*	1.1 x 10^2

SW2	*Bacillus sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	3.8 x 10^5	*Micrococcus sp.*	1.33 x 10^3	*Mucor sp* *Rhizopus sp.* *Geotrchium*	3.47 x 10^2	*Mucor sp.* *Rhizopus sp.*	224
SW3	*Escherichia sp* *Arthrobacter sp* *Micrococcus sp* *Pseudomonas sp*	4.15 x 10^4	*Micrococcus sp.*	4.66 x 10^2	*Mucor sp.* *Geotrichum spp.*	3.47 x 10^2	*Mucor sp*	220

Table 4.16: Possible waste spectrum of surface water microbes in the project area

Surface Water Species		
Species	Broad Spectrum	Possible Substrates
Alcaligenes	Vitamins, carbohydrates, nitrogen, and salts	Household garbage, refuse and herds faecal matter
Proteus	Sodium, potassium, iron, calcium, glucose	Industrial waste, garbage, weathered rock deposits, oil/grease/artisanal waste, domestic refuse and agro-waste
Escherichia	Nitrogenous, protein, glucose, lactose, sodium	Sludge and faecal waste and agro-waste
Actinomyces	Propionic acid, sodium salt, nitrogen	Agro waste, refuse dump and garbage
Bacillus	Vitamins, carbohydrates, nitrogen, and salts	Domestic garbage, refuse, animal/herd waste, plant biomass, weathered rock deposits.
Micrococcus	Sodium, potassium, iron, calcium, glucose	Industrial waste, weathered rock deposits, garbage, oil/grease domestic refuse and agro-waste
Pseudomonas	Nitrogenous substances, vitamins, carbohydrates, salts, nutrient	Faecal waste, domestic, agro waste and garbage waste
Staphylococcus	vitamins, carbohydrates, nitrogen, and salts	Industrial waste, weathered rock deposits, garbage, oil/grease domestic refuse and agro-waste
Arthrobarter	Sodium, chlorine, nitrogen	River deposits, Industrial waste, weathered rock deposits, garbage, oil/grease refuse and

		faecal matter
Mucor	Sodium, potassium, iron, calcium, glucose	Industrial waste, weathered rock deposits, garbage, oil/grease refuse, plant biomass, sawdust, wood splinters, logs, plant litters and agro-waste
Rhizopus	Sodium, potassium, iron, calcium, glucose	
Geotrchium	Magnesium, Nitrogen, carbon, sodium, ammonium phosphate Sulfate, Monopotassium Phosphate, Peptone, glucose, Sodium, potassium, iron, calcium	Industrial waste, garbage, River/runoff deposits, animal/herds waste, weathered rock deposits, oil/grease/artisanal waste and refuse

Common microbes observed in the soil and the surface waters speak to a high energy environment where terrestrial clastic materials are transported into adjoining water bodies. Several studies, , have correlated high energy environment to shallow water bodies and subsequent migration of depth-loving aquatic lives. Ultimately, this condition would alter the microbial ecosystem balance of the aquatic habitat.

4.2.3.11 Sediment study

4.2.3.11.1 Sediment Physico-chemical result

Since sediments are reservoirs of a waste load of the aquatic environment over an extended duration, the river was studied to gain insight into the past discharges, thereby acting as a baseline for future studies. Several sediment physicochemical parameters, including pH, Total Hydrocarbon Content (THC), nitrates, phosphates, sulphates, and heavy metals (xxxxxxxxxxxxxxxxx), were analyzed for the three obtained samples. Also, the results of the baseline study were compared with permissible limits set by the FMEnv. The sampling stations for sediment studies were the same as that of the surface water.

Results

The sediment samples' results establish a similar trend as that of the surface water, thus exhibiting similar discharges and sources. However, the PSD revealed the varied nature of the sediment samples. Sediments ladened with textural clay classes are best suited to serve control purposes during environmental audit exercises. This implies that SD2 should be designated as such for this project. Near-shore environments, continental shelves are often characterized by sediments of silty clay configurations (Ye, 2017). The graduation from clay in the upstream section to silty clay in the downstream section could best be explained in terms of localized differential activities in the latter section than sediment transport from the upstream to their downstream (Table 4.17).

Table 4.17: Sediment Physico-chemical Results

		NEPZA 2019 Sec Data Range	Fete River			International Sediment Quality Guidelines (ISQG Limits Aquatic lives
			7.692736N 8.451434E	7.693364N 8.451252E	7.693881N 8.450954E	
PARAMETERS			SD1	SD2	SD3	
pH		6.8-7.4	7.75	8.13	8.35	6.5-9
THC (mg/kg)		ND	1.45	2.87	<5.00	
PSD (%)	+Clay	12.3-16.3	29.5	43.2	42.3	
	Silt	46.8 – 61.2	51.1	23.7	45.9	
	Sand	43.2 – 61.9	19.4	34.1	11.8	
Textural Class		Sandy Silty loam & clayey	Silty clay loam	Clay	Silty clay	
Chloride (mg/l)		NA	73.9	74.5	75.1	
Ext. Nitrate (mg/kg)		0.08 -0.14	0.14	0.15	0.16	
Ext. Phosphate (mg/kg)		1.98-5.09	1.22	1.55	3.06	
Ext. Sulphate (mg/kg)		2.98-4.65	4.29	3.81	3.86	
Lead (mg/kg)		ND	0.08	0.06	0.08	35
Zinc (mg/kg)		0.96-1.88	1.48	1.41	1.49	150
Copper (mg/kg)		2.78 -4.02	3.78	2.87	3.33	28
Total Iron (mg/kg)		1.19-2.08	1.81	1.00	1.10	300

Silty clay loam sediments have been shown (Wantzen, 2006) as a preferential habitat for most benthonic lives. This is owed in part to the relative ease in releasing locked-up nutrients for benthonic lives metabolic processes. Nonetheless, they are susceptible to changes in the aquatic environment and less tolerant to episodic water dynamics (Wantzen, 2006). This often creates hiatus in the benthonic records. This condition may have accounted for the absence or low benthonic abundance in some of the sampled samples.

Nonetheless, the negligible concentrations of the heavy metal species in the sediment samples in comparison to that in the surface water column suggests their active removal or conversion in the upper column (Couceiro et al. 2010). It could also indicate that the heavy metal pollution in the water body is episodic or has a relatively short history.

4.2.3.11.2 Sediment Microbiology

Sediment samples were also analyzed for microbial content. The result of sediment microbiology is presented in Table 4.18.

The bacteria species in the sediment samples closely mirrors that of the surface water (Hence the possible waste substrates provided in the surface water section subsist here also). This is suggestive of a shared and uniform substrate over time. Also, it indicates a similar metabolic process in the water body which is an index of aquatic ecosystem stability.

Table 4.18: Microbial species observed in the Sediment samples

	Total Heterotrophic Bacteria (THB)	Count (cfu/ml)	Hydrocarbon utilizing Bacteria (HUB)	Count (cfu/ml)	Total Heterotrophic Fungi (THF)	Count (cfu/ml)	Hydrocarbon Utilizing Fungi (HUF)	Count (cfu/ml)
SW1	*Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces sp* *Proteus sp*	3.86 x 10^4	*Staphylococcus sp.* *Micrococcus Sp.*	2.0 x 10^3	*Aspergillus sp* *Candida sp* *Rhodotorula Sp.*	3.24 x 10^2	*Aspergillus sp* *Candida sp*	1.68 x 10^2
SW2	*Staphylococcus sp* *Micrococcus sp* *Actinomyces* *Pseudomonas sp* *Bacillus sp*	4.63 x 10^4	*Micrococcus sp* *Actinomyces* *Bacillus sp*	3.18 x 10^2	*Aspergillus sp* *Candida sp* *Rhodotorulasp* *Penicillium sp*	1.42 x 10^2	*Rhodotorulasp* *Penicillium sp*	56
SW3	*Pseudonomassp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces sp* *Proteus sp*	4.91 x 10^4	*Pseudomonas sp* *Staphylococcus sp* *Micrococcus sp*	2.6 x 10^2	*Candida sp.* *Rhodotorula sp.* *Penicillium sp.* *Mucor sp.* *Fusarium sp.*	104	*Penicillium sp* *Mucor sp*	48

Nonetheless, the introduction of *Rhodotorula sp* in the three sediment samples speaks to a history of hydrocarbon contamination and discharges of lipid-rich organic discharges (Shailubhai, et al., 1985). Their absence in the surface water column implies HC waste and lipid deposition cessation or reduction. Rhodoturula species was not reported in the NEPZA 2019 report.

4.2.3.12 Plankton studies

4.2.3.12.1 Phytoplankton

Ecological sensitivity of the phytoplankton taxa (Appendix 4.5) was reviewed for the seventeen (17) species comprising the dominant Diatom, Blue Green bacteria, dinoflagellate and green algae in Table 4.19. Phytoplankton sample collection was done by lowering the plankton net just below the water surface and dragged (horizontally) on the waterway at a speed of about 1.5knots per hour for 5 minutes. The phytoplankton samples were collected in clearly labelled containers and preserved in Lugol's iodine solution.

Table 4.19: Reviewed ecological significance of Phytoplankton taxa

Species	Division	Optimum ecological conditions	Mode of nutrition	Remark
Asterionella japonica	Diatom		Phototrophic	Found in both marine and freshwater environment, their diversity and count indicated an abundance of dissolved carbon, sourced from discharged organic matter with which they carry out photosynthesis.
Asterionella sp	Diatom		Phototrophic	
Ceratiumextensum	Diatom		Mixotrophic	Found in the upper region of the aquatic environment, their diversity and count indicated an abundance of carbon sourced from discharged organic matter. The occurrence and activities of these species had been linearly correlated to toxins formation, changes in water quality, and reduced dissolved oxygen (Anoxic) conditions, leading to fish poisoning. (1) also linked water consumption containing the released toxins from these diatoms to cases of biomagnification and shellfish poisoning, up the food chain to man.
Ceratiumtripos	Diatom	Temp: 20-34^{0}c Salinity:13-35	Phototrophic	
Chaetoceros satlanticus	Diatom	Temp: -2-29^{0}c Salinity:18-37	Chemotrophic	Found in both marine/ freshwater environment, serves as an essential food source within the water column and is a significant carbon contributor to the benthic habitat (Booth et al., 2002). Also, it has been reported to contribute about 91% of total phytoplankton cells, serving as an essential primary producer and contributing to oxygen production (Booth et al., 2002). Due to its high growth rates and high lipid concentrations, research has been conducted on its biofuel potential [4].
Cyclotella sp	Diatom	NA	Saprotrophic	Found in marine/ freshwater environments, they thrive in a wide range of salinities, at high nutrient levels, and under small-scale turbulence [5] [6][7] and can be used as an early indicator of water quality deterioration. [9) reported the use of these species as predictive models for extreme flood events.
Cyclotellalittoralis	Diatom			

Dinophysis sp	Dinoflagellate		Mixotrophic	Found in the upper region of aquatic environments, they produce diarrhetic shellfish poisoning (DSP) toxins and pectenotoxins (PTXs) and pose a major concern to public health and the

				aquaculture industry. [10] They also produce okadaic acid, dinophysis toxins, and pectenotoxins, which inhibit protein phosphatase and causes diarrhoea.[11].
Eucampian zodiacus	Diatom	Temp: -2-29^{0}c Salinity: 25-36	Saprotrophic	They are found in marine/ freshwater environment and are good indicators of water pollution. It has become known as the predominant organisms causing the bleaching of aqua-cultured nori seaweed (Pyropiayezonesis), and its blooms have caused the exhaustion of nutrients in water columns. [12]
Melosiramoniliformis	Diatom	Temp: -1-25^{0}c Salinity: 23-36	Phototrophic	Littoral dwelling *Melosira* species are freshwater pollution indicators [13]. Their diversity and counts across the sampling stations indicate huge petroleum hydrocarbon contents.[14] In extreme cases, depletion of dissolved oxygen and biological oxygen demand has been reported [15]. Their presence in the study area serves as breeding and spawning grounds for fishery resources since fish larvae depend on *Melosira* for metamorphic development [18]. They are a part of most foreign fish feeds (Siglerand Sigler 1986) [19]. *Melosira* is a biomarker [20] of the aquatic environments and undergoes chelation with lead (Pb) [21]; hence has biosorption properties [22]. Bloom of *Melosira* has been reported in wastewater rich in Carbontriles, Manganese and Nickel [23]. They are utilized as a food source for fish fries.[24][25]
Melosiranummuloides	Diatom	Temp: 0-20^{0}c Salinity: 0-21	Heterotrophic	
Melosira sp	Diatom	Temp: 0-26^{0}c Salinity: 9-30	Phototrophic	
Odontella sinensis	Diatom	Temp: 2-12^{0}c Salinity; 27-35	Heterotrophic	Consumption of this neretic dwelling species confer immunities and antioxidants properties on fishes [26] and serves as a rich source of Eicosapentaenoic acid- EPA [27]. Their environment of occurrence serves as a spawning and recruitment grounds for crabs, oysters, and other fishery resources [28] Odontella is among a consortium of microalgae involved in the degradation of solid and liquid waste [29] reported urea, ammonium chloride and silica-based media as excellent growth media capable of stimulating exponential growth.
Odontella sp	Diatom	Temp: 2-12^{0}c Salinity; 27-35 pH: 8.2-8.7	Heterotrophic	
Oscillatoria	Diatom	NA	Chemotrophic	

limnetica				
Peridinium cinatum	Diatom	NA	Phototrophic	They are found in marine/ freshwater environment; the sediment seedbeds of hypnozygotes may enable occasional blooms (population increases) of Peridinium, which are known to impart a brownish discolouration to the water.[30]
Skeletonem acostatum	Diatom	Temp: 25^0c Salinity: 18-25	Phototrophic	This marine/ freshwater species causes water discolouration [31], produces reactive aldehydes that negatively impact hatching copepods [32], and produces toxic chemicals, blocking critical biochemical pathways in algae.[33]

NA- Not Available *FOOTNOTE

(1)Bienfang et al., (2012), (2) Booth et al.,(2002) (3) Booth et al.,(2002) (4) Spaulding and Edlund, (2008), (5) Jackson et al., 1987, (6) Weckstrom and Juggins, (2006) (7) Yang et al., 2005 (8) Collins & Arar 1997, (9) Juggins, (2014), (10) Yang et al., (2005), (11) Medioli and Brooks, (2003), (12) Egmond et al., (1993), (13) Reguera et al., (2012), (14) Ferris, et al., (2016), (15) Onyema, (2012), (16) Dombrowski et al., (2017), (17) Onyema (2012), (18) Murawski et al.,2000, (19) Siglerand Sigler (1986), (20) Harvey et al.,(2004), (21) Jackson and Morgan, (1978), (22) Al-Degs at al., (2000), (23) Khraisheh et al., (2004), (24) Brown, et al., (2002), (25) Guedes and Malcata, (2012), (26) Xia et al., (2014), (27) Vazhappilly and Chen (1998), (28) Boonyubol, (1996), (29) Sheppard, et al., (2019), (30) Lee, (2008), (31) Kraberg et al., (2010), (32) Miralto et al., (1999), (33) Andreae and Klumpp (1979)

4.2.3.12.2 Zooplankton

The ecological sensitivity of the Zooplankton taxa (Appendix 4.6) was reviewed for the thirteen (13) species comprising the dominant Copepoda and Mollusca. Table 4.20 also contained members of Annelida, Arthropoda, Chaetognatha, Protohordata, and Rotifera.

Table 4.20: Reviewed ecological significance of Zooplankton taxa

SPECIES	Order/Phylum	Optimum pH, Temperature (0C) & Salinity(ppm) Ranges	Food/Feeding Habits	REMARK
Polychaete larvae	Annelida	pH =6.6 – 8.1 (7.4) Temp – 15 -30 (26.2) Salinity – 0.2-25	invertebrate and phytoplankton	The euryecious ability of this species revealed by the reviewed physicochemical parameters is evident in their presence in all aquatic environments [1]. Their proficiency in turning over nutrients from bottom sediments to epilimnion layers alters physicochemical parameters and influences trophic levels, migration, and site for breeding grounds [2]. Though the species is eurythermal, their larvae development is inhibited at a temperature above 26.20C [3]
Meta-nauplius larvae	Branchiopoda	pH- 7–8.2 (6.37) Temp 25.6-29.8 (27.9) Salinity 0.1- 28 (0.2)	Bacteria, Algae, rotifers, crustacean larvae and other fairy shrimps.	This larvae metaphases into Nematoscelisdifficilis (a species of Krill). Their diurnal vertical migration tendencies, broadcast spawning nature (since larva and not female was observed) coupled with their ecosystem services (plastic degradation, food and fish baits, main preys of predatory fishes, livestock fodder, human delicacies and source of 'Krill Oil' -used as therapy for blood lipid and heart health [4], imposes species protection burden since they are negatively impacted and vulnerable to predation and wastewater discharges. Abrupt changes in pH, temperature and salinity have been reported in inactivating and prolonging metamorphosis beyond four weeks [5].
Sagittaenflata	Chaetognatha	pH 5.5 – 7.3 (6.46) Temp 26.5 – 29.0 (28.0) Salinity 0.1-15 (0.30)	Copepods, organic detritus, bacteria or algae	The egg fecundity and number laid by this oligotrophic and copiotroph species, found across all spectrum of the aquatic habitat, are gravely impacted by wastewater discharges, habitats alterations, seasonal variations and abrupt changes in environmental conditions [6]. The population of S. enflata is reduced with low

				temperatures. Hatching difficulties [7] and predation by Copepods including Oithona spp censored in this study are significant threats. Temperature interferes with their hatching.
Parasagitta asetosa	Aphragmophora	pH 5.5 – 7.3 (6.20) Temp 26.5 – 29.0 (27.4) Salinity -0.15 – 15 (0.42)	Copepods and phytoplanktons	Their preference for the water bodies' neritic zones indicates their inclination for warm and photic conditions that determine their daily vertical migration pattern. The introduction of alien biotic and wastewater discharges induces mortalities [8] due to changes in temperature, dissolved oxygen and pH.
Oikopleura fusiformis	Protochordata	pH 5.78- 7.2 (6.37) Temp 25.7 – 28.6 (27.9) Salinity: 0.01 – 20 (0.4)	Planktons	This Neritic species, acting as a bridge between producers and higher consumers and influenced by seasonal variations, produces bio illuminant light which is being researched for street lightening.[9] Their high growth rate, grazing impact and daily vertical influx of organic matter make them excellent carbon recycling candidates. Their consumption of organic particulate matters is vital as they help water purification and removal of waste loads. Mucus house formed daily to act as nutrient sources to benthos aggregates nutrients and containment of pollutants and sites of heterotrophic bacterial production [10]
Eucalanus elongatus	Copepoda	pH 7.5 and 8.5 (8.0) Temp 24–30 (27) Salinity 0.15 – 35 (0.9)	organic detritus, bacteria or algae	Copepods constitute the largest zooplankton populations [11] in any aquatic system since they are both Euryhaline and eurythermal. Their presence also directly correlates with high productivity, hence indicating high deposition of waste loads. Numerous studies [12] has shown a strong relationship between larval fish survival and copepod abundance and diversity. In aquaculture, copepods constitute a significant component of excellent fish feed [13]. In natural waters, they act as micro predators of fish, fish parasites, intermediate hosts of fish parasites, and hosts and vectors of human diseases
Eurytemora sp		pH -7.5 and 8.5 (8.1) Temp-24–30 (27.9) Salinity -0.15 –		

		35 (0.8)		[14]. The recurring presence of Oithona, the most diverse and abundant Copepod in this study (with a total count of 4 in SW2 and 4 in SW 3), is an index of the pollution [15] conditions of the water body.
Microsetellanorvegica		pH-7.5 and 8.5 (7.8) Temp. 24–30 (27.2) Salinity- 0.15 – 35 (1.1)		
Nauplius larvae		pH -7.5 and 8.5 (7.7) Temp. 24–30 (24.8) Salinity 0.15 – 35 (0.5)		
Oithonasimilis		pH -7.5 and 8.5 (8.43) Temp -24–30 (26.6) Salinity- 0.15 – 35 (0.5)	Feeds on motile phytoplankton and microzooplankton	
Temora longicornis		pH -7.5 and 8.5 (7.90) Temp-24–30 (27.3) Salinity -0.15 – 35(0.9)	Feeds on diatom and phytoplankton	
Lamellibranch larvae		pH -7.8 – 8.3 (7.9) Temp -12- 26 (27.9) Salinity – 0.05-25 (1.6)	Feeds on plant detritus, bacteria and algae that characterize sediment surface	Lamellibranch larvae is a Freshwater pollution indicator species [16]. Temperature and wastewater discharges, altering optimum physicochemical conditions, represents the most negative significant impact on larva metamorphosis into adulthood [17].
Branchion	Rotifera	Temp – 24 - 28	They eat	This species offers energy transfer, regeneration and

usfalcutus		(26.1) Salinity 0 – 34 (0.3) pH – 6.6-7.5 (6.9)	organic matters such as dead bacteria, algae, and protozoans.	transport of nutrients into the food web [18] of water bodies. Light penetration, chlorophyll content, seasonal variations, herbivory, competition, predation [19] influences species sustenance. While no correlation was found between pH, electrical conductivity and D.O. concentrations to species survival, The presence of Branchionusfalcutus, a capiotroph[20], indicates a considerable accumulation of organic waste. The species huge utilization of dissolved oxygen creates anoxic conditions and massive fish kills [21]

*Values in bracket are personalized to the species

FOOTNOTE

(1) Ebigwai et al., (2014), (2). Bhaud & Cazaux (1990), (3) Thorson (1966), (4) Parra, et al., (2009), (5) Tou et al (2007) (6) Dawson et al (2018), (7) Frederiksen et al, (2006), (8) Ban (1994), (9) Atashgahi et al (2015), (10) Sato M, et al. (2008), (11) Allddrege, (2005), (12) Merrix et al, (2013), (13) Beaugrand G. (2003), (14) Choi & Chee (1995), (15) Drira et al (2017) (16) Hennes & Suttle (1995), (17) Vaquer-Sunyer et al, (2011), (18) Chowdhury et al, (2007), (19) Brett et al (2000), (20) Abo-Taleb et al (2015), (21) Jäger et al (2008).

A total plankton count of 890 (444 zooplankton and 446 phytoplankton) cells and 34 (17 each for both zooplankton and phytoplankton) species were observed in all the sampled stations during the survey period (Appendix 4.6). Various researchers had noted similar species compositions and total counts in tropical inshore brackish environments (Ebigwai et al., 2014). The observed plankton diversity and abundance could be attributable to Nitrate-nitrogen and phosphate-phosphorous levels during the survey period. Out of the observed total plankton, phytoplankton species constituted the highest percentage count of 69% in cell count, while zooplankton accounted for 52 % in terms of species diversity.

This result conforms with the findings of previous researchers, who indicated that phytoplankton serves as an inevitable food source for the zooplankton and has a higher and shorter regeneration rate (Wiafe and Frid, 2001).

The prevalence of some planktonic species like diatoms – *Odontella spp, Coscinodiscus spp, Pleurosigma spp,* and *Melosiranummuloides* indicated that the water body is alkaline as a result of the strong influence

of terrestrial inputs. The reverse is expected to be the case during the peak wet season when there will be alteration in the existing community structure of plankton species because of rain events.

Some harmful and nuisance algae species were observed, especially among the groups- Dinoflagellates, Cyanobacteria and Diatoms. Their concentrations in the water were too low to cause any form of toxicity or discolourations within the environments (Ezra & Nwankwo 2001; Adriana & Henrik 2000). However, recent reports by SAHFOS (1997), Ibe and Shermam (2002), and Steinberg, et al. (2001) indicated distressing signs arising from the increasing occurrence of harmful algal blooms, indicating intense eutrophication and therefore excessive nutrient loading in the lagoon from anthropogenic sources. The bloom observed in *Odontella* spp and *Coscinodiscus* spp in most of the sampled stations could be attributed to prevailing Physico-chemical parameters in this area. Bloom of *Coscinodiscus* species portends the danger of discolouring the water surface with its adverse ecological consequences and clogging of fishing gears.

The observation that the same sampling stations had the highest and lowest (Margalef indices of 2.62 and 1.94) for both phytoplankton and zooplankton indicates ecosystem stability. Ecologically, stations with a higher Margalef index are more stable or experiencing lesser stress than stations with lower values. Many researchers suggested that plankton species diversity and abundance are being influenced by spatial and temporal changes in the aquatic ecosystem, which is determined by the rainfall in tropical climate (Wiborg 1976).

4.2.3.13 Macro-benthos

Comparative qualitative and quantitative results on macrobenthos survey and analysis among the sampling stations showed relative variations in species diversity and abundance values (Annexure 9). Total species diversity (taxa) of 3 and the abundance value of 5 were recorded during the study period. This could be attributable to variations in the adaptability of benthos species to the nature of water current and the nature of sediment type, preferred food species, and Physico-chemical parameters of the water (Raman and Ganapati 1983, Lawson 1977 and Snelgrove 1999).

Out of the observed total benthos species abundance of 5 observed in all the sampled stations, station-SW2 had the highest total abundance value (3), and SW3 had two. No benthos species occurred in stations SW 1. The presence of benthos could be as a result of the high adaptability of organisms in this area to sediment type, an abundance of preferred food species in the form of plankton and detritus and more favourable physico - chemical parameters (UNESCO Report 1981, UNEP 1982 and 1989, Rhoads 1974).

Prevalent benthic invertebrates species observed among the stations are *Nereis* sp. and *Pachymelania* sp. These species had been noted to have high pollution tolerant index, possibly indicating high enrichment of the sampled stations. These organisms are also more adaptable to peculiar prevailing environmental conditions in terms of sediment, very low temperature, salinity, low dissolved oxygen, and high pressure. They are more physiologically equipped with haemoglobin that can saturate oxygen at negligible concentration. Aberhan, et al., (2006) noted that macrobenthos plays active roles in biotic and abiotic interactions characterizing aquatic ecosystems. Benthic invertebrate cycle nutrients and influence microbial production of greenhouse gases, toxic gases and nitrogen. Benthos species transforms organic detritus to dissolved nutrients taken up by macrophytes and algae, enhancing primary productivity. Widespread ecotoxicity at the benthos level will propagate up through the food web and also disrupt nutrient cycles.

Stations SW2 had the highest Margalef index of 0.91, while the least occurred in stations without benthos species. Margalef (1968) believed that diversity is an index of maturity; the mature ecosystem produces less entropy than immature ones. Thus, sample stations with higher index values are more stable than other stations with lower values.

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

Ecosystem health around the proposed project can therefore be sustained.

4.2.3.14 Fishery Resources

4.2.3.14.1 Background

Traditionally, fish has been one of the significant sources of food for riverine communities. The study of fish composition was conducted for the Fete River and North Bank area. Key fish species in the project area is presented in Table 4.21.

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

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

4.2.3.14.2 Methodology

Information gathering involved a combination of direct observation of fishermen's activity in their canoe (Plate 4.5), nets and other fishing gears at the fishing grounds, and consultations with fisherfolks on-site and off-site. Makurdi North bank market was visited for fish inventory. Samples of fishes observed were identified using flashcards, checklists, photographs and scientific identification keys.

4.2.3.14.3 Result

Generally, fishing activities are well known and a past time practice among inhabitants of the study area. The type of fishing here is mainly artisanal, in terms of scale, where the catch is usually for family consumption with little for sale. Fishing gears commonly used for fishing in the region include hook and line, hand pole, fence, seine nets, cast nets, gill nets, bamboo traps, lift-nets, long line and basket traps (Emmanuel and Awojide, 2016). Fish catch per unit effort is reasonable, especially for the more abundant fish species. However, fish capture techniques used in the study area included canoe netting, seining, and trapping. Setlines were deployed for an overnight period in suitable deepwater locations on the River. The traditional fishing craft is the dug-out canoe or half plank-constructed canoe. Fishing gears commonly used in fish exploitation include traps, set gillnet and cast nets. The set gill net with mesh size ranging between 30 and 120 mm is bottom-set and used in the open water and Creeks. However, some fisherfolks use selective and non-selective gears, which indiscriminately catch juveniles and deplete the stock and reduce the sustainable yield. For the shrimps, and other shellfishes, the fishing crafts are non-motorized canoes driven with paddles and sails; each craft is about 6.7m long, with a maximum of (3) three fisherfolks. Three gears exploit the fishery: beach seine, push net (active) and trap (passive).

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

Plate 4.5: Fishing activities in the area

Detailed information on baseline data and reviewed physicochemical parameter per fish species is presented (Table 4.21)

Table 4.21: Fishery Inventory in the study area

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

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
	s niloticus(Kwoshu)	Tilapia	Herbivore	Adult	commercial	zoo benthos, aufwuchs & phytoplankton	canals, streams, lakes.	8.0 - 42.0 1.0 - 6.5 6.0– 36.0	livelihood of disease or death among fish (Osman & El-Khateeb, 2016), causing a shortage of animal protein in markets as well as economic loss.
4	**Gymnarchus niloticus*	Freshwater rat-tail	Carnivorous	Adult and juvenile	Highly commercial	Zooplankton, dipteran insect larvae & copepods	Water deep; shallow and grassy floodplains	6.5-8.0 24.0 - 34.0 5.0 - 7.2 0.5 – 28	In mass spawning, mating is not controlled, and a small number of breeding individuals may account for a large proportion. However, adult species prey on their young due to its trophic category.
5	**Tilapia zillii*	Redbell	Herbivore	Adult	Moderatel	Zooplankton	Inside river	6.0 – 9.0	The aggressive interactive

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
	(Kpough)	y Tilapia	Carnivorous	Juvenile	y commercial	& arthropod species with a chitin content		20 – 32 6.1 - 7.6 29 – 45	nature of this species may alter the composition of fish communities. More so, being a voracious herbivore may negatively impact plant density, decreasing abundance and changing the composition of native plants (Kour et al., 2014). This can then negatively affect native organisms that depend on such plants for spawning, protection or foraging (Kour et al., 2014).
6	***Gnathonemus petersii*	Elephant nose	Carnivore	Adult	Moderately	Bloodworms and aquatic	Water bottom	6.8-7.2 22.0 - 28.0	The predatory nature of this species makes it a threat to

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO(mg/l) Salinity(ppt) Depth range (m)	Remarks
		fish			commercial	invertebrates		0.8- 5.5	other smaller fish species.
7	***Hydrocynus forskahlii*	Elongate Tigerfish	Piscivore	Juvenile	Highly commercial	Zooplankton & other invertebrates	Near the bottom of the inhabited water body	6.5-8.0 22.2-27.8	Incessant roaming of juveniles individuals in the shallow waters would reduce the colony of the species as it increases the number of fish caught.
				Adult	Highly commercial	Tilapia fry			
8	***Penaeus notialis (Akande)*	Southern pink shrimp	Carnivore	Adult	Moderately commercial	Filamentous algae, plankton, crustaceans &other plant materials	Brackish water, lagoons and estuaries	7.0-8.0 26.0-31.5 3.5 -5.7 15.4-23.0	Due to the water chemistry to the growth of most terrestrial plant species (Barnes, 1999), proper management is necessary to be detrimental to the environment.
9	*Acanthurus monroviae*	Monrovia doctor	Herbivore	Adult	Highly commerci	Zooplankton, phytoplankton	Rivers, canals,	8.1-8.4 22.2-25.6	The extreme temperature has a significant influence on the

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
		fish			al	and detritus	streams		reproductive capacity of this species, affecting the maturity process, spawning, and the survival of offspring (Vaquer-Sunyer, *et al*., 2016).
10	*Schilbe mystus*	African Butter Catfish	Omnivore	Adult	Moderately commercial	Fish, insects, crustaceans, ostracods, snails, diatoms, algae, plant roots, seeds and fruits.	Tributaries of rivers and streams	NA 23oc-27oc NA NA 4m-69m	This fish is of commercial importance in many parts of Africa as an important food fish. It faces threats from water pollution, drought, and water depletion (Azeroual, 2010). The species is in severe decline due to overfishing and exploitation and is assessed regionally as Vulnerable.

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
11	***Sardinella madarensis*	Flat sardinella	Omnivore	Adult and juvenile	Highly commercial	Small planktonic invertebrates, phytoplankton and fish larvae	The surface of estuaries and lagoons	NA <24 NA 0-0.5 0-80	This species is stenohaline (Tsikliras & Antonopoulou, 2006); hence an increase in salinity reduces the population. Its population is declining due to overexploitation, with the average size of fish in the catch decreasing. The IUCN status is 'Vulnerable' (Tous et al., 2015).
12	*Pomadasys jubelini*	Sampat grunt	Carnivore	Adult	Moderately commercial	Fish, crustaceans, molluscs and worms.	Brackish water, lagoons and estuaries, freshwaters	NA 20-30 NA NA 20-50	Adult species prey on their young individuals. This feeding habit negatively impact its population (Koslow, *et al*., 2019)

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
13	****Parachelon grandisquamis***	Large scaled mullet	Piscivore	Adult	Moderately commercial	Mainly fishes	Shallow coastal waters, estuaries and brackish lagoon	NA 25-30 NA 30-35 0-10m	The high rate of catch observed during field expedition may represent the primary threat to this species in the study area
14	*Clarias gariepinus*	Sharp tooth Catfish	Omnivore	Adult	HC	Insects (adult and larvae), worms, gastropods, crustaceans, small fish, aquatic plants and debris, water birds, living and	Freshwater lakes, rivers, swamps and floodplains	NA 24-30 NA NA NA	This is an aggressive invasive species. Its high fecundity, flexible phenotype, rapid growth, general habitat preferences, tolerance to extreme water conditions and the ability to subsist on a wide variety of prey can devastate indigenous fish and aquatic invertebrate populations

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
						dead animal matter.			(Bruton, 1986). Because of the abundance of this species and its lack of mobility on land and water, it is preyed upon widely by Man, leopards, crocodiles, and birds (Skelton 1993).
15	**Heterotis niloticus*	Bony Tongue	Omnivore	Adult and juvenile	HC	Invertebrates, copepods, ostracods and chironomids.	Freshwater rivers, streams, floodplains, lakes and swamps	5.4 15-30 0.4-4.5l NA 0.42	Due to general environmental degradation, including oil spillages, pollution and destruction of mangrove swamps, this species has lost an estimated 60% of its previous breeding and nursery habitat in Nigeria (Adite, 2012). Bake and Sadiku

S/N	Biological Name (local names in bracket)	Common Name(abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO(mg/l) Salinity(ppt) Depth range (m)	Remarks
									(2005) recorded a decline of the species, which indicates that the species is threatened locally
16	*Lates niloticus*	Nile Perch	Predator (piscivore)	Adult and juvenile	Highly commercial	Fish (including its species), crustaceans, insects, juveniles feed on zooplankton.	Channels, ponds, rivers, lakes and irrigation canals; adults inhabit deep water, while juveniles are found in shallow water.	NA NA NA NA 10-60	L. niloticus has been listed among the 100 "World's Worst" invaders (ISSG, 2009). Due to their feeding habit, their presence leads to the decline or disappearance of other species.
17	**Hemichromi*	Banded	Carnivore	Adult	Moderatel	Shrimps.	Littoral	NA	Its adaptability to a wide range

S/N	Biological Name (local names in bracket)	Common Name(abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO(mg/l) Salinity(ppt) Depth range (m)	Remarks
	s fasciatus (Iyoshu)	Jewelfish/five-spot cichlid			y commercial	Small fishes and insects.	riverine and permanent floodplain lagoons with clear water.	23-25 NA NA NA	of habitat makes it ubiquitous in the study area. However, the carnivorous nature of the species may mount pressure on other smaller species in the habitat.
18	*Protopterus annectens*	African Lungfish	Carnivore	Adult and juvenile	Moderately commercial	Mollusks, crabs, prawns and small fishes.	Freshwater, buried within riverbeds.	NA 25-30 NA NA NA	P. annectens has been assessed as Least Concern because it has an extensive range, and there are no known widespread threats to the species.
19	**Auchenoglanis occidentalis*	Giraffe Catfish	Omnivore	Adult and juvenile	Highly commercial	Plankton, molluscs, seeds and detritus	Lakes, large rivers, shallow water with a muddy	6.5-7.8 21-25 NA NA	This species is threatened by the loss of flood plains and vegetated marshes around rivers and lakes due to

S/N	Biological Name (local names in bracket)	Common Name (abundance)	Trophic categories	Life stage history	Fishery Importance	Food/Feeding habits	Breeding grounds and migratory habits	pH Temp(0c) DO (mg/l) Salinity(ppt) Depth range (m)	Remarks
							bottom.	NA	agriculture extension and overfishing. Also, dams, water pollution (agriculture, domestic and commercial/ industrial), groundwater extraction and drought all pose possible threats to this species.
20	Eutropius niloticus	Schilbe	Omnivore	Juvenile	Moderately commercial	Insects, fish,	Freshwater, large rivers, lakes.		E. niloticus serves as food for other fishes, and overfishing of this species has led to its decline.

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

During construction and operations,glass or plastic bottles, water sachets and food wrappings would be transported through surface runoff as sediments into Fete River, down to North bank. Chemicals such as Sulphuric acid, gypsum, lead and lime has been reported to alter the baseline conditions of an environment (Inagaki, et al., 2016). Plates 4.6-4.8 shows some fish resources in the project area

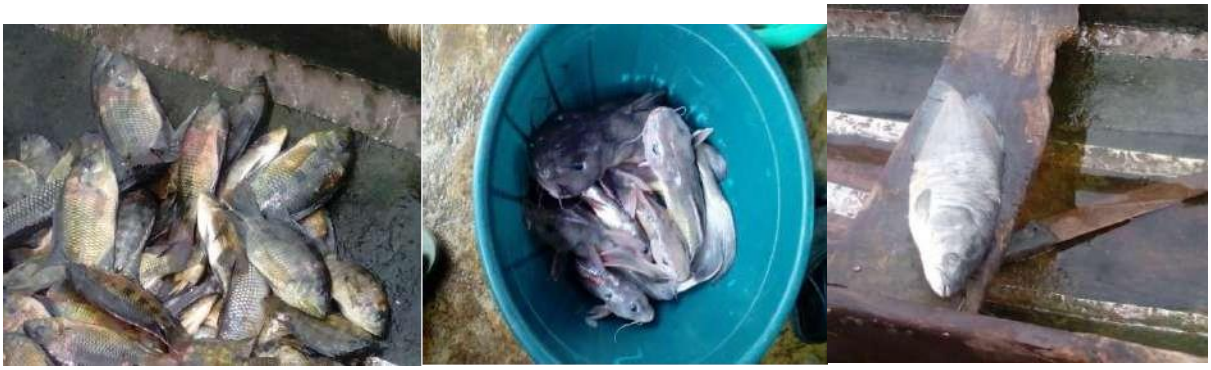

Plate 4.6: Oreochromis niloticus Plate 4.7: Chrysichthys nigrodigitatus Plate 4.8: Heterotis niloticus

**Fish species from the Fete River Source: MCNL, 2021

4.2.3.14.4 Fishery Socioeconomics

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

In the study area, 95% of the households are headed by male members. Female-headed homes comprise about 5% of the community households. Most of the fishermen in this area are monogamous, with very few having two or more wives. It is estimated that the average household (hh) size is 5-6 people per household, suggesting a high population growth or influx. Most of the fishermen do not have any source of finance other than the money that accrues to them from the sale of their fish. At this time of the year, a fisherman makes about N3, 000 to N6 000 per day, depending on the total catch. In the study area, the most typical fish processing and preservation method is smoke-drying. Storage of processed fish is mainly done at the artisanal level by women in this community whose main economic activities are fish processing, distribution and marketing. The educational qualification of these people ranged from non-formal education to secondary education for traditional storage operators. Immediately after landing, fishes are thoroughly washed with either clean water or saltwater to remove dirt and microorganisms on

the surface. This cools the fishes whose temperature might have been raised due to ambient conditions and slows the rate of deterioration.

4.2.3.15 Terrestrial Biodiversity

4.2.3.15.1 General overview

There are three vegetation types in Benue state, namely (i) Riparian (ii) Guinea savanna (iii) Secondary savanna (Jimoh, *et al*., 2009).

4.2.3.15.2 Vegetation/Flora

Sampling parameters and methods

Table 4.22 outlines the flora sampling method adopted for the project.

Table 4.22: Flora Methods and Procedures

Flora		
Sampling Parameter	Sampling Method	Sampling Analytical Method
Habitat type	Aerial observation, Use of transects and quadrats around Project area	Field ecological characters used for habitat delineation include: canopy cover, presence of indicator species, litterfall and soil moisture content
Species and family identification		Field botanical characters used for identification include flowers, fruits, leaves, slash, exudates, and sometimes smell. Field guides include Letouzey 1986, Hutchinson and Dalziel, 1963, 1972. Hawthorne1993, Souane 1985, White and Abernethy 1997, Akobundu and Okezie 1998, Arbonnier 2006, Nyannanyo 2006 and Ebigwai 2012
Species richness		Species richness was evaluated by counting the number of species identified in each Whittaker transects.
Species Diversity Indices		H= -ΣPilnPi, Where H = Shannon's index, ln = log. E= EQ = -ΣPilnPi / lnS; Where EQ = equitability, S = total number of species (Begon, et al 1986))
Species Abundance		The abundance of species was evaluated by counting the number of individuals of a species in each Whittaker transects (Gauch, 1982).
Species frequency		number of transects the species occurred total number of transect sampled
Indigenous uses	Ethno botanical questionnaires	The various indigenous uses and most used plant species were recorded.

Alien & invasive species	IUCN & Literatures and absence of local names	The presence of alien and invasive species was compiled based on the list of exotic/invasive plant species in Nigeria Odugbemi (, 2006)
Conservation status	IUCN Red List of 2021	Number of threatened species x 100 Total number of species
Protected species	IUCN database 2019 and CITES ACT 2016	-

Three transects measuring 15 by 15 were used to study the vegetation. A biodiversity expert identified the species, and sampling was done using the Whitakers transect module. (Plate 4.9, Table 4.23).

Table 4.23: Biodiversity Sampling Coordinates

Transect 1		Transect 2		Transect 3	
Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
8.477993	7.700456	8.478076	7.705745	8.480046	7.707962
8.478136	7.700509	8.478052	7.705813	8.480026	7.707907
8.478099	7.700386	8.478127	7.705751	8.479939	7.707885
8.477978	7.700327	8.478081	7.705810	8.479945	7.707935

4.2.3.15.2.1 Habitat Types

Habitat study was evaluated in this project to influence decisions on the type of preconstruction and construction activities that may be selectively conducted in specific areas. The study area consisted of three habitats. The dominant cultivated lands habitat constitutes about 90% of the total study area, while the Guinea savannah and Riparian (gallery) forests account for the remainder 10 %. Sampling evidence of the three habitats are shown in Plate 4.9

Guinea savanna Riparian Forest

Secondary forest

Plate 4.9 Overview of Habitat types in the Study area

The presence of three separate habitats would indicate the type and number of machinery to be deployed to a particular site and the number of personnel during the project's construction phase. Since the entire land take is either under cultivation or derived savanna, a complimentary access route to the site shall be situated on it linking Phase 1 of the Industrial layout.

4.2.3.15.2.2 Species Richness

Species richness often used as a criterion for ecosystem stability is the total number of species censored in a defined area. The about 2:1:2 ratio in species richness obtained for the Guinea savanna, Riparian Forest and Secondary Forest habitats, respectively, suggest sites with a higher likelihood of harbouring species

with greater indigenous uses. Nonetheless, the low species diversity in the land occurs where more human and material resources needed to be committed during bush clearing indicate negligible vegetal waste shall be generated.

4.2.3.15.2.3 Diversity indices

Sensitive habitats usually have a Shannon wiener index of at least 2 (Ebigwai and Akomaye, 2014; Aisling et al., 2018). A Shannon wiener index of 2.893, 3.601 and 3.636 was calculated for the Riparian Forest, Guinea savanna, and Secondary Forest habitats respectively. This does trigger IFC Performance Standard 6. Its equivalent Operational Safeguard 04 in IFC and AfDB categorization, respectively, would require developing a Biodiversity Action Plan for the project.

4.2.3.14.2.4 Community structure

Community structure provides information on habitat disturbance or stability (Montesinos-Navarro et al., 2018). The average Diameter at Breast Height (DBH) of species in the study showed 95% having below 8cm. Habitats with such low DBH values are often characterized by herbaceous and wilding species (Zenner et al., 2013), and hence earth moving equipment would not be required for vegetal removal. The volume of vegetal waste to be generated from bush clearing was too insignificant to be calculated, as shown by inputting the obtained results into vegetal waste quantification per acre formula:

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

4.2.3.15.2.5 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. *Chromolaena odorata and Ageratum conyzoides* (Plate 4.10) were the exotic and invasive taxa recorded in this study listed in the International Union for the Conservation of Natural Resources (IUCN) for Nigeria. Their presence in all sampling habitats was indicative of a disturbed ecosystem with fertile loci for proliferation. It hence triggered the need for the development of an alien and invasive species management plan.

Chromolaena odorata (Invasive & Alien) *Ageratum conyzoides* (Invasive)

Plate 4.10: Alien and Invasive species censored in the study

4.2.3.15.2.6 IUCN Status

The IUCN status of the plant resources of the studied area was evaluated using the IUCN red list version 2021 -1 criterion. *Vitellaria paradoxa* and *Khaya senegalensis* (Plate 4.11) were the only species of conservation interest as they were categorized as Vulnerable (VU).

Vitellaria paradoxa *Khaya senegalensis*

Plate 4.11: pictorial evidence of the two vulnerable species

4.2.3.15.2.7 Indigenous Uses of Censored Plant Resources

The process provided information (Table 4.24) on the various indigenous uses of the flora resources available in the community.

Table 4.24: Indigenous uses of the sampled plant species

Indigenous Services	% of species	Species

	used	
Food, vegetables, nuts, fruits and seeds	28.57	*Elaeis guineensis, Cordyline australis, Ficus exasperata, Baphianitida, Ipomoea aquatica, Oryzasativa, Coixlacryma-jobi, Samolusvalerandi*
Fuelwood and charcoal	4.42	*Morindalucida,Acacianilotica*
Medicinal	35.17	*Alchornea cordifolia, Mucuna pruriens, Cordyline australis, Ficus exasperata, Alstonia boonei, Rauvolfia vomitoria, Baphianitida, Acacia nilotica, Coixlacryma-jobi, Nymphaea odorata, Hygrophiladifformis, Acorus calamus, Samolusvalerandi, Ceratophyllum demersum, Ageratum conyzoides.*
Fodders	13.85	*Alchornea cordifolia, Mucuna pruriens, Pennisetum purpureum, Acacia nilotica, Hygrophiladifformis, Murdanniakeisak*
Fibre	6.23	*Elaeis guineensis, Cordyline australis, Ipomoea Aquatica*
Tannin	4.54	*Ficus exasperata, Acacia nilotica*
Sundry products	11.42	*Elaeis guineensis, Cordyline australis, Baphianitida, Morindalucida, Nymphaea odorata*
Wrapping leaves	1.39	*Alchornea cordifolia,*
Wattles	1.52	*Elaeis guineensis,*
Pole	1.08	*Morindalucida*
Green manure and soil reclamation/erosion control and shade from the sun	4.15	*Mucuna pruriens, Chromolaena odorata*
Roof Trusses(Roof rafters) and Purloins	1.62	*Elaeis guineensis*

Source: MCNL, 2021

All species censored in the area had one or more indigenous uses as all Forty-four (44) species were represented in Table 6.22. The species are mainly used for Medicine, Food, fuelwood, and as raw material for the construction of electric pole). *Alchornea cordifolia, Mucuna pruriens, Cordyline australis, Ficus exasperata, Alstonia boonei, Rauvolfia vomitoria, Baphianitida, Acacia nilotica, Coixlacryma-jobi, Nymphaea odorata, Hygrophiladifformis, Acoruscalamus, Samolusvalerandi,Ceratophyllumdemersum,*

Ageratum conyzoides (used for medicine) were the most used plant species in the community with a percentage of 35.17.

N/B: Percentages exceed 100% since some species have more than one (1) function

Plate 4.12 illustrates the process of obtaining data on plants indigenous uses.

Plate 4.12: Interview with some community persons on plants indigenous uses

All censored species have indigenous uses. The finding that 100% of the censored species offers provisional services underlines the importance of each species on the people's livelihood, health, and food. Also, the analysis revealed huge dependence of the people on timber products,fruits and vegetables of *Elaeis guineensis, Irvingia wombulu* (Ogbonno), *Chrysophyllum africanum, Dialium guineese* (ube), *Cola laurifolia* and *Cola gigantea*, underscores specific conservation actions in the overarching Biodiversity Management Plan (BMP).

(a) Fruit of *Irvingia wombulu* (Ogbono)

(b) Fruit and leaves of *Ficus congesta* (Red leaf fig)

(c) Edible bunch within *Elaeis guineensis* (Palm tree)

Plate 4.13: a-c: Some plant species used for provisional services

Revelation from interviews that parts and various products of *Elaeis guineensis*, timber products, *Irvingia wombulu* (Ogbono), *Chrysophyllum africanum, Dialium guineese* (ube) and others provide a dealer about N50,000, N45,000, N30,000, N15,000, N15,000 and N10,000 respectively on the average per month(since these sources of income would be affected by project development and operation) triggers the need for a standalone or abridged livelihood restoration plan for the project.

Ecosystem services for each species were equally evaluated. The review indicating the use of all the censored species for various ecosystem services implied that continuous vegetal clearance, construction and operational activities do expose topsoil to erosion, cause soil infertility, create fertile loci for alien and invasive proliferation and concentrate pollutants within soil matrixes (Stelios Katsanevakis et al., 2014) activate the need for the development of Contingency Management Plan for the project.

4.2.3.15.3 Fauna Study

4.2.3.15.3.1 Mammals

The study of Mammalian taxa for this project was in response to project activities on their habitat, niche and ecosystem functions to humans and the environment.

4.2.3.15.3.1.1 Species Diversity

The sighting of two species only (See Table 4.25) is indicative of the predominant urbanized land use nature of the study area. Their joint presence amidst the absence of all other mammalian taxa suggests the proximate location of refuse waste deposit (Witmer, 2011) and nearby agricultural garden farms. This provides information on the possible composition of waste streams in the derived habitat section of the concession during vegetal clearance. It also provides insight on contingency planning for appropriate disposal method after site clearance. The additional burden of public disclosure on the proponent is reasserted to inform the garden owners to either halt new cultivation or harvest existing crops at least six months before the gainful occupation of the land.

Table 4.25: Sighted Mammalian fauna

Species	Common Name	2021 IUCN Status	Cultivated lands	Reviewed remarks on Preferred Environment
Rattus rattus	Common house rat	LC	7	Dwells in a filthy environment
Cricetomys gambianus	Gambian pouched rat	LC	1	Dwells in a filthy environment, farmlands and uncompleted buildings
**Thryonomysswinderianus*	Grasscutter	LC		Dwells in disturbed forest and areas near agricultural land.
**Xeruserythropus*	African squirrel	LC		Dwells in grassland areas

No species were sighted in the gallery forest, LC=Least concern, *=indirect shreds of evidence.

Source: MCNL survey, 2021

Interviews with the natives revealed that *Thryonomysswinderianus and Xeruserythropus* are seen occasionally. The species identity typifies the wastes as more agricultural waste and domestic garbage, while the abundance of eight (8) sighted individuals indirectly correlates with waste volume. Their presence provides insight into possible protective gears to be worn during de-bushing to avoid microbial (viral, fungal and bacterial) contamination. Expectedly, the IUCN 2021 status for both sighted and non-sighted species are our Least Concern.

4.2.3.15.3.2 Avifauna

The study of the Avian taxon is imperative for this project since the release of gaseous pollutants above the height of the stack. Bush clearing would negatively impact diversity, breeding and wintering grounds, abundance, and migratory birds corridor. Birds study is also necessary since the proposed project area is

158km away from Obudu and 181km away from the southern Adoru forest reserve. These are IBA identified by IBA ID NG011 -Ezealor, 2002.

Species Checklist

The Avifauna checklist alongside some reviewed parameters is presented in Table 4.26

Table 4.26 Avian fauna checklist and some Reviewed parameters

Species	TivLocal name	Common Name	Average altitude (Ft)	Average distance away from the project site (Ft)	Habitat			Bird Behaviour at time of the sighting	Ecological significance	Breeding surface	Remarks on preferred habitat
					Gallery	GS	CL				
Bubulcusibis		Cattle egret	132	70	6	2	1	Feeding, resting, flying	The biological pest control agent	On any surface that supports a nest	Bioindicator of polluted areas
Apus affinis		Little swift	375	300	3	1	1	Flying	The biological pest control agent	In holes in buildings or sometimes on cliffs	They are ubiquitous
Hirundo rustica		Barn Swallow	375 114	230	3			Flying	They serve as indicator or trigger organism, indicating environmental trouble. They are also a pest of crops.	On human-made structures	They are ubiquitous
Polyboroides typus		African harrier-hawk	250 76.2	410		3		Flying, feeding	The biological pest control agent	On rocks, near ravines erected towers and stakes	They are ubiquitous
Accipiter melanoleucus		Black sparrow-hawk	225 68.58	720	1	2	2	Flying	Pest of crops	Within a tree canopy	They are ubiquitous

Elanus caeruleus		Black-winged kite	375 114	340	3	1		Flying, feeding	The biological pest control agent	On trees and residential areas.	Bioindicator of polluted areas
Turdus pelios		West African thrush	375 114	520		2	1	Flying, feeding	Biological pest control agent	On horizontal branches, in trees or bushes and among vines	They are ubiquitous
Hirundo smithii		Wire-tailed swallow	337.5	400	3		1	Flying, feeding	Biological pest control agent	On vertical surfaces near water, such as below the ledges of cliffs or human-made structures, such as buildings and bridges.	They are ubiquitous

The conservation status of all species is Least Concern, but not all were protected under the CITES Act 2016. Tran. = transect, GS = Guinea savannah, GF= Gallery Forest, SS – Cultivatable Land

Source: MCNL survey, 2021

Bubulcus ibis (Cattle Egret)

As a bioindicator of polluted environments, the presence of Bubulcus ibis suggests the study area as polluted, presumably from vehicular and industrial emissions. The nine (9) sighted individuals is suggestive of the degree of pollutants in the ambient environment. The altitudinal range of 100ft-132ft where the individuals were censored could probably mark the boundary of the polluted zones just as the range of 115ft- 125ft and ground level, where flocking was observed, may correspond to the most polluted zones. Two-thirds of individuals resting on plantain trees or feeding on soil insects indicate the main surface of food derivation. Hence, the vegetal impact clearance may have on their continued presence, breeding and wintering grounds. Nonetheless, no individual was seen displaying any behaviour at or near the 60m height where the Smoke Stack would be emitting gaseous wastes.

Apus affinis (Little Swift)

Its excellent air buoyancy and adaptability to a wide range of environmental conditions could be a causal factor in the flight behaviour and the wide range in altitude observed for all the sighted individuals. Additionally, predation on mainly flying insects makes the species less susceptible to project activities and impacts.

Elanus caeruleus (Black kite)

Four individuals of this species were sighted at the project site, indicating environmental pollution (Abed & Salim, 2017). Two of the individuals were observed flying at an altitude of 375ft, making them less susceptible to smokestack emissions. They feed mainly on cadavers. Hence, they may be responsible for the low diversity and abundance of mammals found in the area. Also, their presence suggests an alternative source of food, such as a dumpsite, in the project area. Clearing during project development could lead to loss of food sources for this bird and their subsequent migration.

Turdus pelios (Thrush)

The West African Thrush is a resident bird of the area, preferring insects as their primary food source (Akinpelu and Oyedipe, 2004). Although a gallery forest was present in the project area, the low abundance of this species (two individuals) could result from habitat degradation. Its high altitude range could reduce its vulnerability to emissions from the smokestack; however, bush clearing could cause the elimination of food sources and increase the risk of migration of this species.

Hirundo rustica (Barn Swallow)

There was an abundance of this species in the study area, indicating pollution by domestic wastes. Since they are aerial insectivores, exhibiting great flight habits while preying on flying insects, the availability of several insect pests within the proposed project area may be the major attractants of this

species. It was observed at an altitude of 375 feet which may minimize the effects of the smokestack emissions. Site clearing is likely to eliminate their food source, leading to their migration.

Polyboroides typus (African Hawk)

This raptor species readily adapts to partly deforested areas (Ferguson-Lees and Christie, 2001). The species rests and nests on erected towers such as telecom mast electric poles and stakes. Individuals were sighted at 250ft, where there may be possible inhalation of gaseous substances emitted by the smokestack. The presence of this species indicates the availability of prey such as rodents, amphibians, reptiles. Amphibians and reptiles, in turn, feed on insects; hence the presence of this species has a significant impact on the terrestrial food chain. Availability of food source and spawning ground is the primary threat to this species.

Accipiter melanoleucus (Black Hawk)

This territorial raptor species are not uncommon around residential areas, secondary forests and cultivations (Del Hoyo et al., 2016). They play an essential role in local agriculture. Preying on smaller and weaker birds, their presence in a community suggests regulating avian-pest species of crops. All five (5) individuals were sighted at an elevation of about 225 ft; thus, individuals observed at this height are likely to be affected by the smoke emitted from the stack. Also, habitat destruction could lead to the migration of these birds.

Hirundo smithii (Wire tailed swallow)

This species is a fast-flying insectivore. The four (4) individuals sighted could indicate an abundance of insects in the study area due to the gallery forest and the several farmlands in the project area. Although it soars at a high altitude, there is a possibility of inhalation of poisonous gasses emitted from the smokestack. The ability of the species to travel at 322 km/h mph could make the species less prone to impact generated by the project activities even though land clearing during preconstruction could eliminate the food source of the species. None of the species was sighted flying around the height of the smokestack.

4.2.3.15.3.2.2 Ecologically Important Habitats for Birds

The importance of both habitats for birds was evaluated by rating (Table 4.27) each habitat against the seven ecological indicators. Selected characters were based on bird's activities that would be impacted the most during the construction and operational phases of the project.

Table 4.27: Ecologically critical habitat for birds

Indicator	Gallery	Guinea Savanna	Cultivated Land

	(Riparian)forest		
Species Diversity	6	3	7
Flight Altitude above 50m	13	9	2
Species Abundance	19	11	8
Bird Behaviour: Resting	1	1	4
Bird Behaviour: Feeding	11	3	7
Migratory Species	1	2	0
Raptors Species	2	3	1
Total	53	35	29

MCNL, 2021

Analysis of sensitivity index for the habitats showed gallery as a priority habitat for the bird species. A significantly (P=<0.5) higher individuals preferred the riparian and Guinean habitat to the cultivated land habitat. This could be due to the availability of food and water sources in both habitats. Bird diverters would be required after the construction of any smokestack.

4.2.4.15.3.2 3 Species of Conservation Interest

Analysis for the conservation status of the species censored in the project area was conducted using the IUCN 2021-1 Red List of Threatened species. None of the species is of conservation interest.

4.2.3.15.3.3 Herpetofauna (Amphibians and Reptiles)

Herpetofauna study is necessary for the project as most fauna species provide income and serve as a source of protein for the people who depend on them. Species that were censored in three transects across the three habitat types in the study area are presented in Table 4.28

Table 4.28: Herpetofauna in the study area

Taxa	Species	Common name	IUCN status	Family	Local name (Yoruba)		Abundance		Preferred habitat	Diet
						(CL)	GS	GF		
Amphibians	*Hyperoliusfuscicventrisburtoni*	Variable reed frog	LC	Hyperolidae	Akere	1	2	1	Degraded forest, cultivated land, secondary bush, and forests in savanna	Insects
	Afrixalusnigeriensis	Nigeria banana frog	LC	Ranidae	Opolo	1	1	2	Primary rainforest and bushes	Insects and other arthropods
	Sclerophrys regularis	African common Toad	LC	Bufonidae	àgbọn	*	2	*	degraded habitats and towns	comprising ants, beetles, termites
Reptiles	*Agama agama*	Common rainbow lizard	LC	Agamidae	Alangba	8	3	3	Urban, suburban and wild areas	Insectivorous, but eat small mammals, reptiles and vegetation.
	Panaspis togoensis	Togo Skink	LC	Sincidae	Timole	*	2		savannah habitat	Feed on larger invertebrates and other small insects
	Bitis arietans	African puff adder	LC	Viperidae	Paramole	*	1	*	It is found in a wide range of habitats	Mammals, birds, amphibians and lizards.

	Grayia smythii	African water snake	LC	Colubridae	omiejò			*	Seasonal rainforest swamps, streams, and permanent water bodies	Fish and frogs
	Najanigricollis	Black-necked spitting cobra	NE	Elapidae	Oka	*		*	Moist savannah and cleared former forest regions near rivers and streams.	They prey primarily on small rodents.

*N/B species with an asterisk are indirect shreds of evidence; LC = Least concerned, Tran. = transect, NE = Not Evaluated, GS = Guinean Savanna, CL = Cultivated Lands, GF=Gallery forest, NT = Near Threatened. Source: MCNL, 2021

Derived savannah (Table 4.27) had the highest species richness and abundance, indicating a preference for this habitat. This suggests reduced threat, sunlight for basking, food availability and optimum breeding grounds provided by this habitat.

Hyperolius fusciventrisburtoni

This species preference for degraded habitats is due to the prevalence of insects associated with domestic wastes in the project area (Portik et al., 2018). However, the presence of two (2) individuals only may indicate stressors such as the presence of raptor predators and lack of spawning ground. Bush clearing, landfilling, and indiscriminate disposal of effluents may pose additional stress on the species.

Afrixalus nigeriensis

Three (3) individuals in the study area may imply an abundance of arthropods and insects, which constitutes major food sources for the species. Their preference for freshwater swamp as breeding grounds and degraded terrestrial environment for other life processes is well documented (Pechmann et al., 2001). Bush clearing, land reclamation and industrial wastewater/ effluents have inhibitory effects on larvae development (Egea-Serrano et al., 2012, Sowers et al., 2009).

Agama agama

This species is observed to be the most abundant in the study area. This could be due to the abundance of food sources derived from the study area. Although habitat loss due to vegetation clearance, sand-filling and effluents may likely bring about perturbation and possible species migration, this species is known to adapt efficiently to live in degraded habitats and industrial and residential areas (Uetz et al., 2019).

4.2.3.15.3.3.1 IUCN Status of Herpetofauna Resources

All sighted species were of Least Concern (LC) status using the IUCN Red list version 2021 -1 criterion. The primary threat for all the species is hunting. No threatened mammalian species were recorded.

4.2.3.15.4 : Protected Areas

There are no protected areas within the proposed project area.

Table 4.29: Details of Protected Area with closest Proximity to Project area

Name	State	Area (km^2)	Approximate distance from the site
Cross river national park, Okwango Division	CRS	4,000 km^2	175 km
Afi mountain and wildlife sanctuary	CRS	104 km^2	207km
Pandem wildlife forest	Plateau State	224km^2	231.7km

4.2.3.15.5 Key Ecological Problems

Commencement and operations of developmental projects shall result in the following ecological problem;

- the direct removal or disturbance of plants, animal
- Species migration occasioned by developmental activities and poor enforcement of ESMP
- Susceptibility of the area to increase run-offs
- Leaching action
- Waste discharge into the Fete stream

4.2.4 Social Environment

This section presents held and planned consultations, demographic profiles and data obtained from the community and household engagements. The obtained data were compared with NBS 2012 report and other publicly available literature works. The essence is to develop a trend and possibly social causal factors for deviations.

4.2.4.1 Consultation of stakeholders;

4.2.4.1.1 Invitation to consultation sessions and Notification of Project

Table 4.30 outlines the letter introducing the Project proponents, the Project and inviting attendance and participation to scheduled engagements. These letter notifications were distributed to key stakeholders' groups identified.

Table 4.30: Identified Stakeholders Invitation for all consultation rounds

Stakeholder Group and Interest in the Project	Stakeholder Name	Stakeholder Level	Engagement Activity	Mode of Invitation

		National	State	Local	Meeting	Email
Government Authorities: State and local government of primary political importance to the Project with permitting Requirements that the Project must meet.	Federal Ministry of Environment	X			X	X
	Federal Ministry of Agriculture, Forestry and Natural Resources	X			X	x
	Controller, Federal Ministry of Agriculture and Rural Development, Makurdi	x				
	Benue State Ministries of Environment and Trade & investment	X			X	x
	Makurdi LGAs			x	X	x
Project Affected Communities	13 affected communities				X	verbal
Farmers cooperatives	Rifan, Benue State		X		X	x
	Cassava growers association		X		X	x
	Fruit crops association, Benue State		X		x	X
Operators of processing facilities at the Industrial Park and Makurdi	Oracle Farms Ltd, Benfruit Nig. Ltd, Robothan Pharm, Lobi Cassava Flour Mill, Rantito Dairies, Yipcow Nig. Ltd, Chweny Global Enterprises, Ogahi Foods Nig. Ltd, Wanfa Nig. Ltd, PZ Nig. Ltd.		X		x	x

4.2.4.1.2 Stakeholder Information and Consultation Rounds

Six rounds of stakeholder consultation are planned, of which the first four have been conducted. These included the ESMF consultation stage (1st round), scoping (2nd round) socio-economic and health engagement during the ESIA process (3rd round), documentation of farmers on the project footprint stage (4th round).

The fifth round of consultations is scheduled for the disclosure of the ESIA (5th round). The sixth round is the panel review. The attendance list for each stakeholders meeting is presented in Annexure 7.

Table 4.31 present details of the first four rounds that have taken place

Table 4.31: Details of the first four rounds of consultations

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
Makurdi	25-09-2020	Ministry of Agric office Makurdi	Institutional	Ministry of Agriculture and Natural Resources (Proponent)	8	The Ministry discussed agro produce of the State, candidate sites for the proposed agro park. It provided the team with a list of agro-processing industries in the State and farmers' cooperative societies.	The Ministry officials and Mifor Consult team took a tour of the proposed sites, including the Makurdi Industrial Park.
Makurdi Industrial Park	25-09-2020	Industrial layout	Aggregators, farmers, rice and fruit processors	Private entrepreneurs and intermediaries in the supply and distribution chain	9	The meeting called for challenges in rice and fruit production, issues in the supply and distribution value chain, factors affecting the quality of processed products and reasons why the fruit processing company in the Industrial layout is winded up.	The engagement noted farmers concerns on the flooding of paddies due to incomplete and blocked canalization, bulk purchases by aggregators from the farmers who then supply to processing mills at exorbitant prices. Oracle firm called for the damming of the Fete River. The private millers attributed input types and species and harvesting as primary determinants of processed

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
							products. The fruit processing company failed due to mismanagement.
Makurdi	26-09-2020	Tse Makurdi palace	Traditional institutions	Zakis of all communities in Makurdi LGA	27	The Ministry officials, Yakubu Nenge, briefed the traditional leaders about the project and harped on its importance to the State and crave their cooperation and active collaboration.	The Traditional institutions gave their blessings and called for government sincerity and their gainful engagement across the project life cycle.
ROUND 2: INCEPTION MEETING ENGAGEMENT							
Virtual	16th April 2021	Zoom conference	Institutional	FMEnv, BNMAND, AfDB Mifor Consult	4	The inception meeting involving Bakia (AfDB), Engr. Gomwalk (Deputy Director, Environmental Assessment, Federal Ministry of Environment, Timothy Ijir, Honourable Commissioner, Agriculture and Rural Development, Benue State and Ebigwai, JK, Mifor Consult Nigeria Limited. The virtual meeting afforded the commissioner to brief the panel of the project scope details; the conducted ESMF, and the need for an accelerated ESIA process. At	The FMEnv. Deputy Director promised to communicate the briefings to the Director, Environmental Assessments and pledged that the briefs would be factored into their decision making on the project.

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
						the same time, the AfDB representative informed the meeting of the AfDB procedural steps. Ebigwai thanked the participants and appealed for a speedy ESIA process.	
ROUND 3: AUTHORITY VISIT AND SCOPING WORKSHOP							
Makurdi	24th April 2021	Benue State Ministry of Trade& Investment	Institutional	Directorate cadre of the Ministry Rep of BNMAND and Mifor Consult	4	Yakubu Nenge briefed the team about the project and called on the Ministry to apportion a 16ha land within the Industrial Park project. The Ministry told the crew of the memo from His Excellency, Governor Ortom and the brief from the Hon Commissioner, Trade and Investment about the project.	The meeting took a tour of Phase 1 and 11 via-a-vis the allotted space. Director Fidelis Annuneh took and showed the team to a State government 16ha allotted land in Phase 11 of the Makurdi Industrial Park.
Makurdi	25th April 2021	Project land take	Authority Visit	FMEnv, State Ministry of Environment, Federal controller, Environment, Benue	8	Ebigwai briefed the team about the project scope and details. Director Annuneh showed the group around the project site, a list of allottees, their operational status (See Annexure 4) and its coordinates using the Industrial Park map. The Head of the Environmental Minister Representative (Ogar) asked	Director Annuneh claimed that total compensation was paid in 1985 (see Annexure 3) while the Federal controller mentioned the NEPZA ESIA project site (less than 8km away) as a recent study as proximate to

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
				State, BNMAND, BNMTI, Mifor Consult		about the feedstock sustainability, land ownership, compensation, alternative routes to the site, recent approved ESIA reports within the project area, and cut off dates for the farmers. Annexure 5 presents the list of the farmers on-site	the industrial park site.
Makurdi	25th April 2021	Benue State Min of Agriculture conference room, Tse Makurdi place & project site	Scoping workshop	Institutional, traditional, PACs, PAPs, uptakers, farmers cooperatives, aggregators, and owners of agro-processing firms	47	The commissioner welcomed all and spoke in Tiv and pidgin language on the project and its multiplier effects on the individual, State and Nigeria. Ebigwai of Mifor Consult presented a PowerPoint lecture in Pidgin English that was interpreted in Tiv language by Yakubu Nenge, desk officer of the project. Ebigwai called on the people to express their perception, concerns and expectations of the project.	The details of the meeting are in the submitted and approved scoping report. Nonetheless, the outcome was immediately factored into the formal terms of reference for the data-gathering exercise.
ROUND 4 CONSULTATION: DATA GATHERING EXERCISE							
Makurdi	26th April 2021	Project land take	Institutional and PAPs	FMEnv, State	17	Two BNMAND officials (Yakubu Nenge and Lupee) sent invite to the	The identity of each farmer on a farm was confirmed.

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
				Ministry of Environment, Federal controller, Environment, Benue State, BNMAND, BNMTI, Mifor Consult and Farmers the proposed site		farmers on the project footprint. They were briefed about the project, and the possible date of April 30, 2022, as the cutoff date when they should have harvested their produce and ceased further cultivation on the land. The farmers confirmed government ownership of the land and plead for the engagement across all phases of the project.	The bio-data, including farmers' photographs, crop type, size of farm and life cycle stage, were recorded.
Makurdi	26th May 2021	Tse Makurdi palace	Traditional institutions of affected communities	Tse Makurdi palace	23	Yakubu Nenge briefed the traditional leadership (Zaki and tax collectors) that their communities are within the project's zone of influence and that the ESIA team shall be visiting their communities. The traditional leaders provided the team with the Histories of Tiv nation and some of the affected	A roster of community engagement was developed and circulated.

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
						communities.	
ESIA COMMUNITY /HOUSEHOLD ENGAGEMENT- @ ZAKI'S RESIDENCE							
Community	Date of interview	Average household size	Number of houses	questionnaires issued	Questionnaires retrieved	Issues discussed	Outcome
Adem	27/04/2021	5	199	115	111	The team briefed the community members (men. women, youths) about the project and conducted community engagement with the community leaders, focus group discussion (FGD), key informant interviews (KII) and household interviews using questionnaires. The team confirmed receipt of compensation payments to those whose name appeared in the list in Tse-Atoor and Tse-Agube	The community engagement harvested data across community governance structure, history, grievance redress mechanisms, cultural heritage, belief systems, gender issues, household social, cultural and health infrastructures. Energy consumption rates were also obtained.
Adaka	26/04/2021	5	1309	759	747		
Agber	28/04/2021	6	658	382	377		
Iorbee	28/04/2021	4	312	181	169		
Kigir	26/04/2021	6	272	158	151		
Kwaghtamen	28/04/2021	5	88	51	50		
Tionsha	26/04/2021	6	1812	1051	901		
Tse agube	27/04/2021	5	34	20	19		
Tse atoor	27/04/2021	6	32	19	19		
Tse Chahul	27/04/2021	5	25	15	14		
Tse Gbum	27/04/2021	5	42	24	24		
Tse Khave	26/04/2021	6	125	73	71		
Tse Perver	26/04/2021	5	31	18	18		

Site	Consultation Date	Venue	Stakeholder Type	Name of Stakeholder	No of persons	Issues discussed	Outcome
Total			**4939**	2865	2671		
ENGAGEMENT WITH RICE, CASSAVA AND HORTICULTURAL CROPS ASSOCIATION AND COOPERATIVES							
Makurdi	26th May 2021	Royal choice Hotel, Makurdi	Agro value chain	Crop Associations, Aggregators and Cooperatives	25	Yakubu Nenge briefed the meeting on the project and the critical roles expected of them. Ebigwai called on them to provide the ESIA team with their expectations, challenges, and proposals for the project. The cooperatives called for the project to prioritize shed allocations to their members. In contrast, the Associations and the Aggregators called for improved support services to boost production and transportation of agro produce. The Aggregators further called for the establishment of an Agro-produce marketing board.	The meeting resolved for an aggressive and sustained sensitization campaign of rice, cassava and horticultural crops that will boost production and enlarge the numbers of cooperatives and aggregators.

Plate xxx: Stakeholders meeting with farmers cooperatives (28th April, 2021)

Plate xxx: Consultation at Zaki's palace Tionsha (26th April 2021) Consultation at Zaki's palace Kigir (26th April2021)

Plate xxx: FGD with women at Tionsha (26th April 2021) Consultation at Adem community (27th April 2021)


Plate xxx: Consultation at Tse-Agube (27th April, 2021) Consultation at Tse-Khave (26th April, 2021)


Plate xxx: Consultation at Tse-atoor (27th April, 2021) Consultation at Pever (26th April, 2021)


Plate xxx: Consultation at Kwaghtamen (28th April, 2021) FGD with women at Adaka community (26th April 2021)

Plate xxx: Consultation with the Zaki and community members at Tse-Agebe (27th April, 2021)

Plate xxx: Consultation with the Zaki and community members at Iorbee (28th April, 2021)

Plate xxx: Consultation with the Zaki and community members at Tse-Gbum (27th April, 2021)

Plate xxx: Consultation with the Zaki and community members at Agber (28th April, 2021)

Plate xxx: Consultation with the Zaki and community members at Tse-Chahul (27th April, 2021)

Plate xxx: Site visit 24th April, 2021

Plate xxx: Meeting with the Zaki of the various communities

Plate xxx: Consultations with the fishermen in the area

Plates 4.14: Evidences of stakeholder consultations in the project area

4.2.4.2 Political Context

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 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, including East Central State. In 1976, Imo and Anambra States were created from the then East Central State. Between 1967 and 1996, the 12 states were further divided into 19, then 21 and finally 36 states, of which Benue State was one 3rd February 1976. Benue state is made of 23 local governments, but the project is located in Makurdi LGA. The LGA is run by an elected Executive Chairman and elected Counselors.

4.2.4.2.1 Administrative structure

The political and administrative structure of the project area is presented in Table 4.32.

Table 4.32: Administrative structure

<table>
<tr><td colspan="3">System of Government

The country operates a Presidential System of Government.</td></tr>
<tr><td rowspan="5">Federal tier</td><td colspan="2">Executive - Implementation of laws, maintenance of law and order, initiate bill into parliament. A President heads it.</td></tr>
<tr><td colspan="2">Legislature- Nigeria operates a bicameral (Senate and House of Representatives) legislature. They make laws, approves the annual budget, ratifying treaties negotiated by the executive and conduct oversight functions on government activities. Senate President heads the Senate, and a Speaker governs the House of Representative.</td></tr>
<tr><td>Senatorial District</td><td>House of Representative</td></tr>
<tr><td>There are 109 senatorial districts in Nigeria. Benue State is represented by three senators representing the South, North East and Northwest Senatorial districts.</td><td>There are 360 House members. Benue has eleven (11) House members. The project is located in the Makurdi Federal constituency.</td></tr>
<tr><td colspan="2">Judiciary - There is the supreme court, appeal court, federal courts, Industrial court, customary courts of appeal and magistrate court. They Interpret laws protects the right of individuals. A Chief Justice heads the Judiciary.</td></tr>
<tr><td rowspan="3">State tier of Government</td><td colspan="2">Executive- There are 36 states in Nigeria and the Federal Capital Territory. An elected Governor heads the executive arm of the state government. The proposed project is located in Benue State.</td></tr>
<tr><td colspan="2">Legislature - Each State operates a unicameral system headed by a Speaker of the State House of Assembly.</td></tr>
<tr><td colspan="2">Judiciary -There is the State High court, customary courts and Magistrate courts. The head of the state judiciary arm is the Chief Judge.</td></tr>
<tr><td>Local</td><td colspan="2">Executive-The executive arm is headed by a Chairman. This arm performs similar functions to that of the President and Governor at</td></tr>
</table>

Government tier of Government	federal and state levels.
	Legislature - The legislature is formed by at least ten wards in each LGA. They make bye-laws for the LGA. A Speaker heads it. The project is located in Makurdi LGA.

4.2.4.3 Land planning and uses

Land ownership in the project area is either by community or family. However, under the Public Lands Acquisition Law, the state government may acquire land compulsorily for public purpose from individual landowners. There are high herds-grazing activities observed in the PAC owned mainly by Oracle farms. The project site is served by Makurdi-Naka-Ankpa Road. The residential areas are primarily rural settlements except for Adoka, Tionsha and Iorbee (semi-urban settlements). The population in the PACs is predominately made up of low- and middle-class-income earners with very few high-income earners. The residential areas and the surrounding sub-places consist primarily of single-unit residential homes. On the other hand, the rural settlements such as Tse-Atoor, Tse-Igbum, Tse Agube are sparsely populated with low cost, single-unit dwellings on small stands.

4.2.4.4 Demography

Following the 2006 census, the National Population Commission (NPC) published the population of Nigeria as 140,431,790 comprising 71,345,488 males and 69,086,302 females. The NPC estimated annual population growth at 3.2% (NDHS, 2008). The current population, projected at 3.2% annual growth and using the exponential model, is 180,735,714, with a 198.6 per square kilometre density. A higher male population and sex ratio of 103 was recorded for the country. Children (age 0-14) constituted 41.8% of the population while those less than 20 were 52.3% and those less than 25 years 61.9%. The elderly (65 years and above) were 3.2% of the population. The age dependency ratio was 82.0. Given these proportions, the population of Nigeria is quite young. The average household size in Nigeria is 4.9 (NBS 2012). See Table 4.33

Table 4.33: Demography of the Nigeria, Benue State and Makurdi LGA

Parameters	General statistics in Nigeria	Statistics in Benue State	Statistics in Makurdi LGA
Total population (2006 Census)	140,431,790	4,253,641	405,500
Total Area of Land	923,763km2	34,059km2	937.4 km
Population Density	198.6/km2	5,741,800	432.6/km²
Population Distribution			
Men	98,742,155.4	2,144,043	2,144,043
Women	95,615,441.9	2,109,598	2,109,598
Children (age 0-14)	41.8%	1,958,919	1,958,919
15–64	28.8%	2,158,292	2,158,292
65+	3.2	136,430	101,418
Literacy rates	59.6	45.1	78.3
infant mortality level (per 1,000	64.8	59.2	186,364

live births				
life expectancy		55 years	35-45	832
Youth Literacy in any Language	Female	63.7%	49.6%	71.4
	male	79.3%	72.9%	86.5

Source: NBS 202

4.2.4.5 Community and Household Consultation

Community consultation is an inclusive and culturally appropriate process that involves sharing information and knowledge about the project, seeking to understand the concerns of others project affected persons and building relationships based on collaboration. It allows the community to understand the risks, impacts and opportunities of the project to achieve positive outcomes. And provides the proponent the views and perceptions of the project community members. It involves information dissemination and interaction/dialogues with the host communities of the proposed project.

4.2.4.6 History of the Tiv nation

The Tiv tribe is the major ethnic group in the project, accounting for about 60% of the Benue State population, (Historical background Government of Benue State, 2017). They migrated through southern, south-central and west-central Africa before arriving at the savannah lands of west African. They settled at swemkaragbe, the region adjoining Cameroon and Nigeria, at the beginning of 1500CE. Over time, they moved into core Benue valley, which is present-day core central Nigeria. They constitute approximately 3.5% of Nigeria's total population and about 14 million individuals in Nigeria and Cameroon. The Tiv people were free people without any king; hence every clan or kindred was administered by the eldest man called "Orya". Kingship was later introduced to the Tiv people by the Europeans in the 1940s, and the title of the king is the 'Tor Tiv'. The name of the current Tor Tiv is His Royal Majesty, Begha U Tiv Orchivirigh Prof Iorzua James Ayatse. In Nigeria, the Tiv language is spoken in Benue, Taraba, Nasarawa and Plateau states (Anifowese,1982). 14 Tiv are speaking local government areas in Benue State, including Makurdi LGA, host of the proposed site.

4.2.4.7 History of the Project Communities

The genealogical information of the project affected communities is illustrated in Figure 4.7

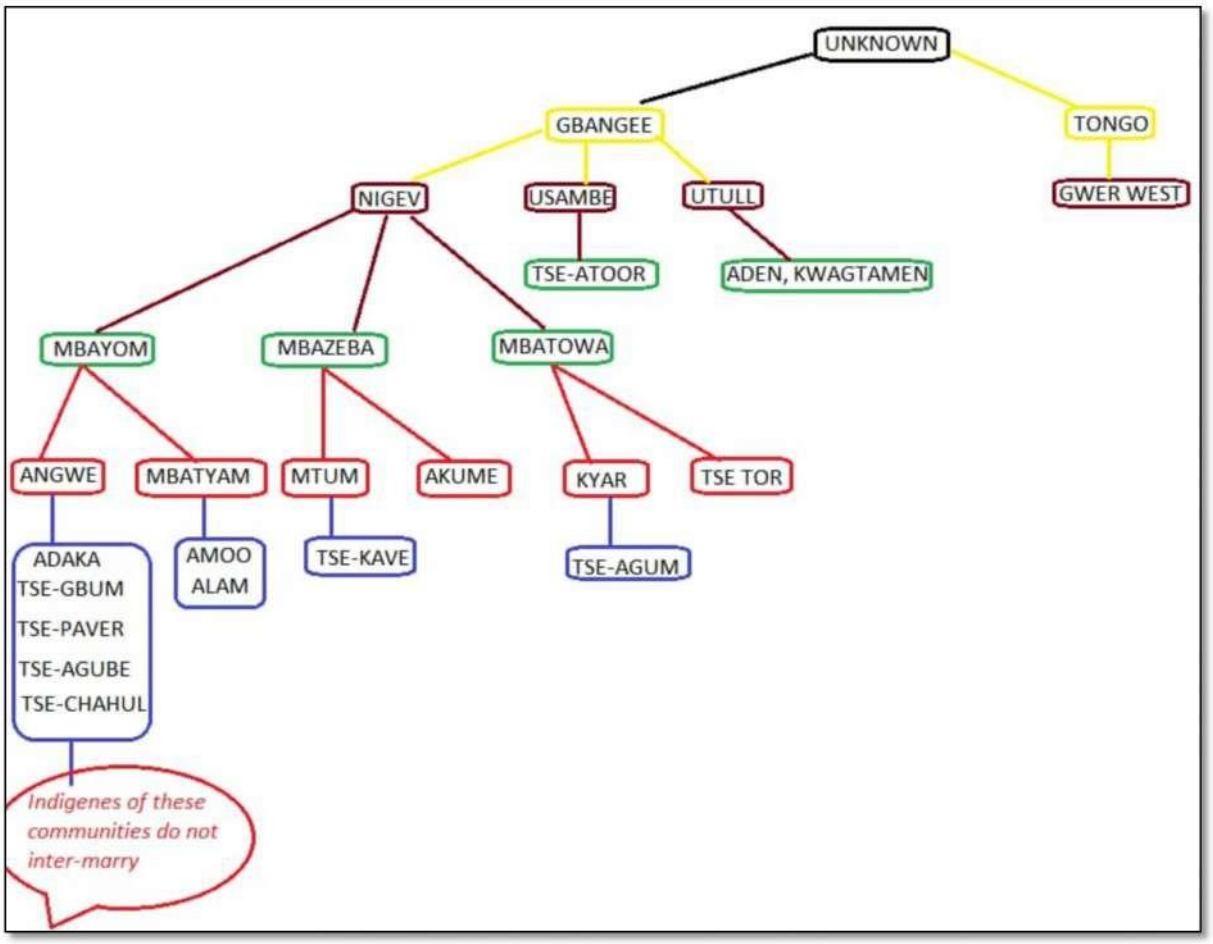

Figure 4.7 Genealogy of the project affected communities

Nonetheless, Vandikya is the Ancestral home of the indigenes of Kigir, Tionsha, Agber and Iorbee

4.2.4.8 Conflict Resolution

Civil cases in the communities are arbitrated by the Chiefs (Zaki)-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 (Zaki and tax collectors) of the communities involved. If it cannot be resolved at that level, the case is taken to the Tse Makurdi for adjudication. Criminal cases are referred to the government law enforcement agents. It is interesting to note that most of these communities have never recorded any case of security threat. Nevertheless, the communities have organized themselves into vigilante groups to complement the security architecture provided by the State. Concerning the project, predicted sources of conflicts include

- Non-recognition of communities as critical stakeholders
- Agitation for employment/contracts
- 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. The existing peace-building mechanisms were factored into the developed grievance redress mechanism for the project.

4.2.4.9 Household and Community Characteristics

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

The KII was organized with the chiefs and elders of the affected communities at their respective town halls. FGD meetings were held with representatives from youths, women, traders/business owners and famers/hunters in the communities.

The household questionnaires were administered on a Household basis to 2865 willing homesteads representing 58% of the total household of 4939. A total of 2671 questionnaires retrieved represented 93.2% success. This data implies that some homes are still skeptical about the project. Nonetheless, the study recorded a 100% community questionnaire retrieval success. The socio-economic results are presented on a community basis (see Table 4.31 for details of the sampled questionnaire and retrival).

4.2.4.9.1 Demography and Gender of household head

Table 4.34 presents the demographic data of the project area

Table 4.34: Respondent by age, gender and household head

Community	Age bracket (years)						NBS 2012	Household head	Baseline Report 2016
	Gender	0-14	15-44	45–64	Above 65	Total	Nigeria (Benue)		Nigeria (Benue)
Adem	Male	17.1	20.6	10.6	2.9	34.1	(0-14) = 47.2 (15-44)=39.2% (45-64)=10.9% (65 and above) =2.6%.	**76.9**	(Headed by Male) = 82.3% (Headed by Female) =17.7 %
	Female	20.6	25.3	14.7	5.3	**65.9**		**23.1**	
Adaka	Male	15.3	20.2	9.2	3.1	47.7		**88.9**	
	Female	16.7	22.0	10.0	3.7	**52.3**		**11.1**	
Agber	Male	16.0	18.1	10.0	3.4	47.6		**84.4**	
	Femal	18.	19.	9.7	4.6	**52.4**		**13.6**	

	e	3	8						
Iorbee	Male	15.7	17.1	9.6	3.6	46.1		**83.8**	
	Female	18.2	19.3	10.0	6.4	**53.9**		**12.2**	
Kigir	Male	17.6	14.9	9.0	4.5	46.2		**76.3**	
	Female	20.4	17.2	10.4	5.9	**53.8**		**23.7**	
Kwaghtamen	Male	19.5	18.2	11.9	1.9	51.6		**80.0**	
	Female	15.7	13.8	15.7	3.1	**48.4**		**20.0**	
Tionsha	Male	15.6	19.6	8.9	2.7	46.8		**79.7**	
	Female	16.9	21.4	11.4	3.6	**53.2**		**30.3**	
Tse agube	Male	19.0	13.9	12.7	3.2	48.7		**73.3**	
	Female	16.5	17.7	15.2	1.9	**51.3**		**26.7**	
Tse Atoor	Male	19.9	14.3	12.4	1.2	47.8		**74.1**	
	Female	16.8	18.6	13.0	3.7	**52.2**		**25.9**	
Tse Chahul	Male	9.1	18.2	13.6	3.4	44.3		**65.0**	
	Female	11.4	22.7	15.9	5.7	**55.7**		**35.0**	
Tse Gbum	Male	18.4	19.0	12.0	1.9	51.3		**75.0**	
	Female	17.1	14.6	13.3	3.8	**48.7**		**25.0**	
Tse Khave	Male	16.5	15.8	10.4	3.2	45.9		**74.5**	
	Femal	17.	20.	11.	5.0	**54.1**		**25.5**	

	e	6	1	5					
Tse Perver	Male	12.0	15.2	15.2	3.2	45.6		**75.0**	
	Female	13.6	18.4	20.0	2.4	**54.1**		**35.0**	

Source: MCNL 2021

Persons within the age bracket of 15-44 (37%) and 0-14 (33%) years constituted about 70% of the PACs, contrasting the NBS 2012 data for Makurdi LGA of more individuals in the latter age range than the former. The proximity, ease and low cost of land acquisition and availability of inherited lands and houses by the indigenes make the PACs an ideal residential choice for most adult workers in Makurdi and the industrial park. The increase in more agro-industrial activities and the establishment and expansion of the Oracle farms in Adaka after the 2006 census contributed to the PACs population growth against other Makurdi LGAs communities. It was also observed that two in five homes within the PACs elect to school and reside their primary and secondary schools, age children, in Makurdi town. This household policy accounted partly for the contrast between the NBS 2012 and this study age categorisation demography.

Additionally, the attraction of persons within the 19-65 age bracket to the PACs because of jobs availability and prospects further shrink the dependency ratio (40%) in favour of the independent (60%) category. This finding presents, at the least, readily available unskilled labour forces across all phases of the project. It was noted that 72% of the houses that declined interviews were those owned by persons aged 65 and above. This attitude may have influenced the percentage of the elderly. The significant presence of young unmarried working and trading class ladies within the PACs also contributed to the age-gender contrast. The study revealed more women than male, also contrasting the NBS 2012 data for Makurdi LGA.

Similarly, the 19.6% of female-headed households in the study was higher than the Nigerian average of 17.7%. The sample size, the semi-urban/ rural nature of the PACs and most males headed households aged 65 years and above declining to respond may have contributed to this contrast.

4.2.4.9.2 Marital Status of Head of Household

The findings that about 95.3% of respondents are or once married (existing marriages, widowed or divorced) inform the sacred importance the PAC attached to the family union. Like most cultural beliefs in Nigeria, several studies, including Ahua, 2019, reported social discrimination among unmarried adults in Tiv land. About 86.5% of the recorded divorced cases in the study were marriages involving persons of different ethnicities, religions or huge age differences. The institutionalised internal marriage redress mechanisms in Tiv land possibly accounted for the

negligible divorced rate; first, among Unions between Tiv couples and second, among the non-Tiv couples residing in the PACs. The 4.7% unmarried respondents strongly correlate with independent adults aged between 25 and 29 years.

Except for the divorced cases, the study findings on marriage, widowed and single percentages were inconsistent with the NBS 2012 data. The sampling size, largely homogenous socio-cultural belief systems, and the PACs' urbanization levels possibly explain these deviations. The findings of a higher failed percentage in proximate communities to Makurdi (e.g. Tionsha) linearly correlate urbanization and influx of persons with diverse socio-cultural belief systems to frictions in marriages. It was also gathered that 72.8% of these failed marriages occurred within the first ten(10) years, lending credence to counseling young couples as a divorce antidote. Table 4.35 provides data on the marital status of household heads.

Table 4.35: Marital Status and Nature of Marriages in the Project Area

Community	% Marital Status of Household Heads				NBS 2012	Nature of Marriages of heads of Household		Ashavar & Agada, 2013
	Single	Married	Divorced	Widowed	Nigeria	Monogamy	Polygamy	Benue
Adem	12.8	64.1	5.1	17.9	Married (50.0%) Single (46.4%) Widowed (1.97%) Divorced (1.58%)	80.0	20.0	Polygamy 27.6%, Monogamy 72.4%
Adaka	8.1	80.8	2.0	9.1		80.0	12.8	
Agber	6.8	79.7	1.7	11.9		87.2	21.8	
Iorbee	2.9	80.9	4.4	11.8		78.2	24.0	
Kigir	11.1	69.4	5.6	13.9		76.0	16.7	
Kwaghtamen	12.9	58.1	6.5	22.6		83.3	19.6	
Tionsha	10.8	68.9	4.1	16.2		80.4	31.6	
Tse agube	10.0	63.3	6.7	20.0		68.4	22.2	
Tse Atoor	7.4	66.7	3.7	22.2		77.8	25.0	
Tse Chahul	5.9	70.6	0.0	23.5		75.0	27.3	
Tse Gbum	6.3	68.8	3.1	21.9		72.7	31.3	
Tse Khave	6.4	68.1	4.3	21.3		68.8	23.5	
Tse Perver	8.4	69.9	3.9	17.7		80.0	20.0	

MCNL, 2021

Doosuur and Arome 2013 summed up the 27.6% polygamous marriages observed in this study as wife inheritance was regarded as a potent cause of bigamy among the PACs. The Zakis corroborated the wife inheritance system as customary and significant adherents of this belief system are farmers

who practice ATR and are non-university graduates. The prevalenttraditional mode of farming that imposes manual land cultivation on children was also observed as a driver of the wife inheritance practice in the study area. Nonetheless, the more monogamous marriages across all the PACs is due to the predominant Christian belief system prohibiting polygamy.

4.2.4.9.3 Ethnic Composition

The nine (9) main ethnic groups (Table 4.36) observed in these non-urban communities attest largely to communal harmony and warm reception of non - indegenes. The study revealed cultivatable arable lands, the avalanche of agro-processing firms in the industrial park, oracle farm and proximity to Makurdi and social infrastructures as the primary causal factors for non-indigenous residency in the PACs. Expectedly, the data revealed Tiv as the dominant ethnic group in the project area.

Table 4.36: Ethnic composition within the PACs

Community	Ethic group								
	Tiv	Idoma	Egede	Ogoja/CRS	Igala	Okun	Hausa	Eggon	Others
Adem	52.6	15.8	7.9	0.0	2.6	5.3	7.9	2.6	5.3
Adaka	71.7	12.1	7.1	1.0	2.0	2.0	1.0	0.0	3.0
Agber	62.7	10.2	5.1	0.0	5.1	3.4	5.1	1.7	6.8
Iorbee	60.3	11.8	7.4	1.5	4.4	2.9	5.9	1.5	4.4
Kigir	58.3	8.3	11.1	5.6	2.8	2.8	2.8	2.8	5.6
Kwaghtamen	77.4	6.5	6.5	0.0	3.2	0.0	3.2	0.0	3.2
Tionsha	54.1	12.2	9.5	2.7	5.4	5.4	8.1	1.4	1.4
Tse agube	53.3	6.7	10.0	0.0	3.3	3.3	10.0	3.3	10.0
Tse Atoor	55.6	7.4	3.7	0.0	3.7	3.7	11.1	7.4	7.4
Tse Chahul	47.1	5.9	5.9	0.0	17.6	5.9	11.8	0.0	5.9
Tse Gbum	53.1	6.3	9.4	3.1	3.1	0.0	9.4	3.1	12.5
Tse Khave	53.2	12.8	6.4	2.1	4.3	4.3	8.5	4.3	4.3
Tse Perver	54.2	12.5	4.2	4.2	0.0	0.0	12.5	4.2	8.3

% Average	58.0	9.9	7.2	1.6	4.4	3.0	7.5	2.5	6.0

*Others=Yoruba, Fulani, Igbo

Nonetheless, the study observed that the smaller communities relatively remote from the Makurdi-Naka road and devoid of road and constant power supply infrastructures are more inhabited by persons of the Tiv tribe than Adoka, Tionsha, Iorbee and Agber. Moreso, the observed sheltering of displaced farmers in Adaka from herders in neighbouring Gwer west LGA contributed to the non-indigenous population (Igbo and Eggon).

4.2.4.9.4 Religion

Just as NBS 2012 reported, this ESIA study revealed Christianity, Traditional Religion (ATR) and Islam as the main religions of the respondent population. Christianity was the most practised across all the respondent communities/persons, accounting for approximately 90%. Traditional worshipers were the least represented in the area (Table 4.37).

Table 4.37: Distribution of religion practiced among households in the project area

Religion	Adem	Adaka	Agber	Iorbee	Kigir	Kwaghtamen	Tionsha	Tse agube	Tse Atoor	Tse Chahul	Tse Gbum	Tse Khave	Tse Perver	%	NRN 2012
Christianity	94.6	93.9	94.4	93.3	96.1	95.1	95.8	93.3	91.8	94.4	90.1	94.4	92.7	93.8	85
Islam	2.8	3.1	3.9	1.8	0.0	2.9	0.0	2.3	3.3	2.6	3.6	2.1	2.5	2.4	6
ATR	2.6	3.0	1.7	4.9	3.9	2.0	4.2	4.4	4.9	3.0	6.3	3.5	4.8	3.8	9

*ATR=African Traditional Religion, NRN-Nigeria Research Network

The Muslim and ATR populations in the affected communities were lower than the State averages of 6 and 9%, respectively, corresponding to an increase in the percentage of Christian faith adherents. NRN 2012 correlated religion multiplicity in Benue State to urbanization. Nonetheless, the Islamic and Christianity devotees in the affected communities observe the festivities of either Faith. In contrast, the followers of a particular faith use the festivities to seek divined favour, prosperity, bumper harvest, peace, security, long lives, and good health for the communities, the adherents of other religions solidarise with their friends of the other Faith and revel in the off-work day the festivity affords.

Plate 4.15: ATR practice in an anonymous community (27th April 2021)

4.2.4.9.5 Educational Attainment

UNESCO 2012 defines a literate person as one who can read and write a short, simple statement on his(her) everyday life in any language. About 46.5% attained secondary school education in contrast to 16.4% that attended tertiary institutions. The literacy level in the project area (72.1%) is higher than the value (45.1%) reported for the Benue state by UNESCO, 2012. Therefore, educational attainment in the project area implies that the area is characterized by a high literacy level (Table 4.38). Similarly, the study correlated a linear relationship between respondents with no formal education to possession of artisanal skills as most pre-tertiary graduates absorbed in most agro-processing firms in the industrial park.

Table 4.38: Respondents Educational Status and facilities in the Project Area

Communities	No formal education	Primary	Secondary	CoE and polytechnic	University Degree	Literacy level, Benue state (UNESCO, 2012)	Primary	Secondary	Tertiary	NBS 2012, Benue State
Adem	29.1	10.6	37.2	1.5	21.6	45.1%	6	3	0	Private primary school (131,862) Public primary school (4,486) Private secondary school (243l) Public Secondary school (321)
Adaka	31.8	7.1	45.2	1.2	14.7		13	5	0	
Agber	24.6	9.5	45.6	0.9	19.4		6	2	0	
Iorbee	18.2	10.4	49.6	0.4	21.4		9	3	0	
Kigir	23.5	8.6	50.2	2.3	15.4		5	2	0	
Kwaghtamen	30.2	13.2	42.8	3.1	10.7		3	1	0	
Tionsha	29.2	8.5	48.8	1.8	11.7		8	4	0	
Tse agube	24.7	12	49.4	1.2	12.7		3	1	0	
Tse atoor	34.2	6.8	44.1	3.1	11.8		1	1	0	
Tse Chahul	22.7	15.9	50	1.2	10.2		1	0	0	
Tse Gbum	27.2	9.5	43.6	7	12.7		3	0	1	
Tse Khave	35.1	7.5	47	1.4	9		6	1	0	
Tse Perver	26.4	9.6	51.2	0.8	12		2	0	0	
% total	27.5	9.9	46.5	2.0	14.1					

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Conversely, the study revealed the presence of about 45.1%of educational facilities in the project area. Although there is a private tertiary institution in the PAC, Makurdi LGA has four (4) of the twelve (12) public tertiary institutions in the State. There are a total of 66 primary and secondary schools in the affected communities. The NBS number 5140 of primary and secondary schools in Makurdi LGA implies that the project area constitutes less than 1% of the schools in the LGA, despite accounting for about 5% of the LGA population. The absence of secondary schools (Tse Chahul, Tse Gbum and Tse Pever) imposes a burden of accessing formal pre-tertiary education in other surrounding communities. Accessing these communities by mostly foot through bush paths or the Makurdi-Naka paved road exposes them to potential reptile and herders attacks and road accidents.Plate 6.16 illustrates some of the educational institutions pictorially within the PACs.

Plate 4.16: Educational facilities in the project area

4.2.4.9.6 Access to Potable Water

The PAC's access to potable water is majorly obtained via private wells/boreholes (Table 4.39) complemented by the communally owned borehole. The variable depth to water table (see baseline chapter) within the PACs implies seasonal groundwater supply from the boreholes. During poor periods of aquifer recharge, the residents purchase portable water from tankers and store it in overhead tanks.

Table 4.39: Water Sources across the Project Area

Community	Communal borehole	Private well/borehole	Surface water
Adem	0	9	
Adaka	1	29	1
Agber	0	11	1
Iorbee	1	13	0
Kigir	0	15	0
Kwaghtamen	0	12	0
Tionsha	1	22	0
Tse agube	0	10	0
Tse atoor	0	9	0
Tse Chahul	0	6	1
Tse Gbum	0	9	0
Tse Khave	0	11	0
Tse Perver	0	4	1

Source: MCNL Survey, 2021

All the communities have private well/boreholes (although most privately owned wells are dried up during the data-gathering exercise), with only Adaka, Iorbee and Tionsha communities having functional communal boreholes provided by the government. Housesteads in Adaka, Tse paver and Tse Chahul also abstract water from Fete and Idya streams for domestic uses.

6.4.9.7 Households' Main Source of Energy

Table 4.40 revealed that five (5) energy sources are used for lighting and cooking among the respondent populations across the PACs. The effective use of firewood for cooking speaks to its availability and overexploitation (These findings were factored into the Impact section), especially in smaller communities. It may have contributed to the air quality data obtained in the area. These findings were factored into the air quality and climate change adaptation sub-plan in Chapter eight. The study also

correlated epileptic power supply and the economic status of respondents to high firewood usage. The limited use of electricity-powered, solar devices for cooking, solar energy for cooking is expected in semi-urban and rural communities of the project area.

Table 4.40: Household Main Source of Energy for cooking and lighting

cooking						Lighting					
Community	Main electricity	Gas	Paraffin/kerosene	Charcoal	Firewood (biomass)	Main electricity	Solar	Wick lamp	Candles	Generators	Torchlight
Adem	2.6	15.4	25.6	5.1	51.3	55.3	2.6	5.3	2.6	23.7	10.5
Adaka	1.0	36.4	38.4	4.0	20.2	52.5	0	4	2	28.3	13.2
Agber	0.0	28.8	35.6	3.4	32.2	45.8	0	3.4	1.7	35.6	13.5
Iorbee	0.0	39.7	33.8	7.4	19.1	27.9	0	10.3	4.4	41.2	16.2
Kigir	2.8	16.7	33.3	2.8	44.4	61.1	0	8.3	2.8	13.9	13.9
Kwaghtamen	0.0	6.3	28.1	0.0	65.6	74.2	0	0	3.2	12.9	9.7
Tionsha	0.0	44.6	37.8	4.1	13.5	48.6	0	8.1	0	23	20.3
Tse agube	3.3	23.3	16.7	6.7	50.0	53.3	0	13.3	10	10	13.4
Tse atoor	0.0	22.2	22.2	3.7	51.9	63	0	18.5	0	7.4	11.1
Tse Chahul	0.0	0.0	11.8	0.0	88.2	64.7	0	11.8	0	5.9	17.6
Tse Gbum	3.1	25	31.3	6.3	34.3	56.3	0	9.4	3.1	15.6	15.6
Tse Khave	0	38.3	38.3	2.1	21.3	46.8	0	17	0	17	19.2
Tse Perver	0	8.3	33.3	8.4	50	54.2	0	20.8	4.2	8.3	12.5

Source: MCNL Survey, 2021

Expectedly, the use of gas and electricity-powered devices for cooking was recorded more in the semi-urban towns.

4.2.4.9.8 Household Construction Materials

Table 4.41 showed that mud bricks, concrete (walling materials), iron sheet and aluminum (roofing materials) and smooth cement and ceramics (flooring materials) constituted at least 80% of housing construction materials across the PACs. The study correlated income, educational, occupational and community size to household construction materials. About 75% of respondents with a higher education qualification in paid employment living in Adaka. Agber, Iorbee, Tse khave and Tionsha communities used the dominant construction materials (Plate 4.17) for their houses. Exceptions were observed among households of some artisans, farmers and traders without higher education qualifications in Adaka, Tse chahul, Tse perver, Tse Gbum, Tse Atoor with the dominant construction materials.

Table 4.41: Household Construction Materials

Community	Walling				Roofing					Flooring			
	Mud bricks	Concrete	Thatch	Wood	Iron sheet	Thatch	Asbestos	Aluminium	No roof	Smoothed mud	Smooth cement	Wood	Ceramic tiles
Adem	64.1	25.6	2.6	7.7	38.5	20.5	10.3	30.7	0	10.3	43.6	12.8	33.3
Adaka	52.5	38.4	3	6.1	48.5	10.1	7.1	34.3	0	6.1	55.6	8.1	30.2
Agber	44.1	33.9	6.8	15.2	50.8	13.6	5.1	30.5	0	3.4	47.5	6.8	42.3
Iorbee	47.1	41.2	4.4	7.3	48.6	8.8	2.9	39.7	0	7.4	44.1	10.3	38.2
Kigir	47.2	33.3	8.4	11.1	52.7	5.6	5.6	36.1	0	8.3	47.2	5.6	38.9
Kwaghtamen	45.1	35.5	6.5	12.9	45.1	9.7	6.5	38.7	0	3.2	51.6	9.7	35.5
Tionsha	45.9	40.5	4.1	9.5	43.2	10.8	8.2	37.8	0	2.7	50	5.4	41.9
Tse agube	50	36.7	6.6	6.7	46.7	10	3.3	40	0	6.7	50	10	33.3
Tse atoor	40.7	33.4	11.1	14.8	37	17.4	13.7	28.2	3.7	3.7	44.4	11.2	40.7
Tse Chahul	41.2	29.4	11.8	17.6	39.2	15.4	5.9	33.6	5.9	11.7	41.2	11.8	35.3
Tse Gbum	40.6	31.3	12.5	15.6	37.5	18.8	12.5	31.2	0	0	46.9	15.6	37.5
Tse Khave	48.9	38.3	4.3	8.5	44.7	10.6	4.3	40.4	0	2.1	48.9	6.4	42.6
Tse Perver	58.3	33.3	4.2	4.2	48	11.4	4.2	32.2	4.2	8.3	54.2	8.3	29.2

Source: MCNL Survey, 2021

Nonetheless, about 6% of respondents with higher education qualifications lived in houses constructed without the dominant materials in Adaka, Adem, Kiir, and Iorbee. In comparison, about 3.5% without paid employment and higher degrees lives in an inherited apartment with the dominant construction materials. (Check my mail of two days ago for more site pics. Ferdy sent the mail)

Plate 4.17: Household construction materials across the PACs

The percentage of the dominant household construction materials were observed most in Adem, Adaka, Agber, Iorbee and Tionshia communities. This data agrees with NBS 2012, which listed brick, cement, aluminium, iron sheets and ceramics as dominant household construction materials in Makurdi. Aribigbola 2000 reported that indigenes of rural and semi-urban communities are likely to construct houses with traditional construction materials than non-indigenous residents. This assertion finds practical expression in most of the PACs.

4.2.4.9.9 Household Waste Management

About 46% of the respondents utilise an in-built water closet for faecal waste discharge. About 54% (44% uses pit latrine and 10% defecate in pit latrines or bushes) situated their toilet facilities outside their homes, and there is no home without a toilet facility within the PACs**.** The 44% who uses pit latrine exclusively are found in semi-urban communities. In comparison, about 10% that combines the pit latrine and open defaecation system are found mainly in Tse-gbum, Tse atoor, Kigir, Tse khave, Adaka, Tse chahul and Tse perver. About 65% of the pit latrine respondents depend on water to flush the waste.

Table 4.42: Household waste management

Community	Faecal waste			Refuse		
	Water closet	Pit latrine	Pit/Bush defecation	Waste vendor	Open dumping	Burning & Open dumping
Adem	38.5	51.3	10.2	30.8	48.7	20.5
Adaka	53.5	45.5	1	42.4	33.3	24.3
Agber	50.8	45.8	3.4	40.7	33.9	25.4
Iorbee	63.2	32.4	4.4	39.7	32.4	27.9
Kigir	47.2	38.9	13.9	47.2	36.1	16.7
Kwaghtamen	41.9	51.6	6.5	35.5	48.4	16.1
Tionsha	54.1	44.6	1.3	40.5	32.5	27
Tse agube	43.3	36.7	20	36.7	43.3	20
Tse atoor	44.5	40.7	14.8	33.3	44.4	22.3
Tse Chahul	35.3	47.1	17.6	29.5	52.9	17.6
Tse Gbum	37.5	46.9	15.6	31.2	46.9	21.9
Tse Khave	51.1	40.4	8.5	44.7	29.8	25.5
Tse Perver	37.5	50	12.5	37.5	41.7	20.8

Source: MCNL 2021

About two-thirds of the respondents practice inappropriate waste disposal methods of either open dumping or burning, with just about a third using either private or public waste vendors. Open dumping is practiced more in under populated communities, while the use of waste vendors is predominant among respondents in semi-urban communities. Nonetheless, a similar correlation between incomes, educational attainment, paid employment, occupation and urbanization community nature discussed in household construction materials applies here.

4.2.4.9.10 Household Facilities

Table 6.42 provides generated data used by the respondent populations in the project area. Lighting and cooking equipment were the most frequently found in the households of the project area. Most of these facilities are meant to improve households' livelihood, while others are income generating. Nonetheless, the findings that at least a respondent in each PAC owns a functional power generating set speaks to power supply epilepsy in the area. Similarly, the ownership and daily listening to radio services broadcast in Benue State ethnic languages over Television imply the former as the most viable mode of information sharing and dissemination in the area. Also, the predominant use of motorcycles and Pick-up van in the area is meant for agro produce evacuation to markets than for pleasure.

Table 4.43: Household Facilities in Project area

Facilities	Adem	Adaka	Agber	Iorbee	Kigir	Kwaghtamen	Tionsha	Tse agube	Tse Atoor	Tse Chahul	Tse Gbum	Tse Khave	Tse Perver
Power generator	6.8	21.1	15.8	21.1	3.8	3.0	12.8	2.3	1.5	0.8	3.8	6.0	1.5
Gas stove/Kerosene	5.3	20.0	11.1	12.1	6.3	4.7	14.7	2.6	3.2	1.1	5.3	9.5	4.2
Refrigerator	9.0	20.5	15.7	12.0	5.4	4.8	12.7	2.4	1.8	1.8	4.2	7.2	2.4
Television	6.7	17.8	10.4	12.9	6.3	5.7	13.7	2.9	4.1	2.4	5.1	8.0	3.9
Radio/cassette/music system	6.7	15.0	11.3	13.4	5.8	6.0	13.9	4.4	4.4	2.1	6.0	7.6	3.2
Car/Truck	5.4	26.8	8.9	10.7	5.4	5.4	12.5	3.6	1.8	1.8	5.4	8.9	3.6
Motor Cycle	4.1	15.5	10.9	9.3	3.1	3.6	8.3	17.6	3.1	6.7	6.2	4.7	6.7
Bicycle	5.1	13.7	7.7	8.5	4.3	2.6	10.3	5.1	6.0	10.3	6.8	11.1	8.5
Plough	7.7	23.1	7.7	7.7	0.0	15.4	7.7	0.0	0.0	7.7	0.0	7.7	15.4
Cart	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	33.3	0.0	0.0	33.3
House in town	7.0	21.1	8.5	11.3	4.2	5.6	16.9	2.8	5.6	1.4	4.2	9.9	1.4
Land in town	9.1	22.7	9.1	9.1	0.0	4.5	9.1	4.5	4.5	0.0	9.1	13.6	4.5
AVERAGE	6.1	18.1	9.7	10.7	3.7	5.1	13.8	4.0	3.0	5.8	4.7	7.9	7.4

Source: MCNL Survey, 2021

It was observed that most owners of refrigerators depend on the public power supply for functionality as most privately owned generators cannot power it. Although some homes in the smaller communities like Tse Perver and Tse Chahul own refrigerator sets, the low voltage of their privately owned refrigerators implies immediate sales of their easily perishable agro produce, most times at give-away pricethe preses to forestall total loss. The insignificant number of persons holding land and houses in Makurdi speaks to the economic status of the PAPs. Although most prefer building their homes in their ancestral heritage lands, most respondents are limited in financial resources to own and build houses in Makurdi and other cities in the State and elsewhere.

4.2.4.9.11 Economics and Livelihoods of Households

4.2.4.9.11.1 Occupation

The economic life of the communities revolves mainly around farming and its related activities. This is practiced by both the male and the female folks (Table 4.44). Crops like yam, potatoes, rice, oil palm, maize, cassava, mango, Orange, rice, and yam are the major crops. Other livelihood activities revealed by questionnaires include trading, fishing, artisans, firewood trading, food vending, and processing.

Table 4.44: Percentage Distribution of Respondents by Their Livelihood Activities the Project Area

Communities	Crop farming	Trading	Artisan	Livestock	Civil service	Fishing
Adem	82.3	7.3	2.3	2.7	5.4	0
Adaka	60.1	13.7	4.3	2.1	12.5	7.3
Agber	62.6	15.3	3.1	1.3	12.5	5.2
Iorbee	67.1	10.7	7.1	2.9	12.2	0
Kigir	74.5	8.9	5.3	3.8	7.5	0
Kwaghtamen	82.9	4.3	4.9	4.5	3.4	0
Tionsha	70.3	13.2	8.9	3.9	3.7	0
Tse agube	83.2	6.3	2.9	6.4	1.2	0
Tse atoor	79.3	5.9	1.9	8.8	4.1	0
Tse Chahul	78.2	6.8	2.9	8.5	3.6	0
Tse Gbum	85.1	6.9	1.2	4.1	1	1.7
Tse Khave	75.3	10.1	4.2	3.6	6.8	0
Tse Perver	73.9	9.2	5.9	7.9	3.1	0
Total (%)	75.0	9.1	4.2	4.7	5.9	1.1

Source: MCNL Survey, 2021

It is clear from the above that majority of the inhabitants in the project area are farmers. Nonetheless, about three-quarters of the respondents claimed to have more than one livelihood source. Moreover, the fisher folks often indulge in migrant fishing expedition occasioned by a seasonal reduction in caught fishery resources, the ephemeral nature of the Fete stream and the onset of the farming season. About 85% of the respondents claimed they acquired their livelihood skills from their parents or needs induced from the environment.

4.2.4.9.11.2 Constraints to Livelihood of Respondents

Respondent household heads blame access to funds, storage facilities, poor roads, inadequate and delayed input supply, absence of extension services, flooding, drying up of the Fete River, power supply, and activities of aggregators as the major constraints to their livelihood activities (Table 4.45).

Table 4.45: Constraints to Livelihood Activities in the project area

Constraints	Communities													Total	Rank
	Adem	Adaka	Agber	Iorbee	Kigir	Kwaghtamen	Tionsha	Tseagube	Tse Atoor	Tse Chahul	Tse Gbum	Tse Khave	Tse Perver		
Insufficient land	0.3	0.23	0.27	0.33	0.23	0.27	0.23	0.23	0.27	0.33	0.41	0.33	0.25	3.68	11th
Poor Quality land	0.42	0.43	0.38	0.50	0.38	0.43	0.50	0.28	0.42	0.3	0.23	0.27		4.54	6th
Flooding	0.23	0.41	0.33	0.25	0.29	0.32	0.46	0.33	0.23	0.27	0.33	0.25	0.29	3.99	8th
Low water quality	0.4	0.45	0.44	0.42	0.44	0.44	0.46	0.33	0.53	0.33	0.37	0.62	0.45	5.68	4th
Lack of inputs	0.42	0.35	0.33	0.53	0.33	0.37	0.30	0.33	0.25	0.29	0.3	0.23	0.27	4.3	7th
Lack of capital	0.60	0.47	0.53	0.67	0.56	0.54	0.49	0.72	0.67	0.72	0.72	0.72	0.35	7.76	1st
Drying of River Fete	0.32	0.33	0.33	0.28	0.42	0.32	0.33	0.23	0.27	0.23	0.23	0.27	0.27	3.83	9th
Lack of storage facilities	0.45	0.62	0.45	0.72	0.46	0.54	0.65	0.47	0.53	0.67	0.72	0.45	0.62	7.35	2nd
Low processing capacity/po	0.42	0.48	0.38	0.61	0.38	0.45	0.55	0.45	0.62	0.23	0.27	0.33	0.33	5.50	5th

wer supply															
Inadequate extension	0.27	0.42	0.26	0.56	0.21	0.32	0.21	0.23	0.27	0.33	0.27	0.23	0.23	3.81	10th
Poor marketing channel	0.48	0.40	0.49	0.39	0.54	0.45	0.40	0.41	0.33	0.25	0.67	0.56	0.54	5.91	3rd

Source: MCNL 2021

These findings are unexpected in agrarian communities, and they are in tandem with NBS 2012.

4.2.4.9.11.2 Income

The income-generating activities of the people in the communities of the project area include crop farming, trading, artisanship, livestock rearing, processing of farm produce, hunting, fishing and self-employment. The estimated monthly income of the people shows that, about 61.6% of the respondents made less than ten thousand Naira a month. While about 32.0%, made between eleven and ten thousand Naira within the same period. This is an indication that the majority of the people were low-income earners. This could be the rain-dependent nature of their livelihood activities and a minimal number of livelihood alternatives within the study area (Table 4.46).

Table 4.46: Income Level of the PAPs in project area based on questionnaire administration and FGD

Community	Less than 100,000	100,000 – 199,999	200,000 – 299,999	300,000 – 399,999	400,000 –499,999	500,000 - 999,999	>1,000,000
Adem	10.3	17.9	30.8	7.7	17.9	5.1	10.3
Adaka	10	8	34	24	9	10	5
Agber	11.9	13.6	23.7	32.2	6.8	10.1	1.7
Iorbee	17.6	8.8	14.7	13.2	30.9	10.4	4.4
Kigir	13.9	8.3	30.6	8.3	27.8	5.5	5.6
Kwaghtamen	6.5	12.9	25.8	9.7	38.7	3.2	3.2
Tionsha	6.8	16.2	12.2	29.7	16.1	12.2	6.8
Tse agube	23.3	6.7	23.3	13.3	20	6.7	6.7
Tse atoor	22.2	25.9	11.1	29.6	0	3.8	7.4
Tse Chahul	29.4	11.8	5.9	29.4	5.9	17.6	0
Tse Gbum	31.3	6.3	6.3	12.5	18.8	15.4	9.4
Tse Khave	19.1	25.5	12.8	17	8.5	12.8	4.3
Tse Perver	16.7	8.3	4.2	8.3	33.3	16.7	12.5

Source: MCNL Survey, 2021

4.2.4.10 Facilities in the Project Area

4.2.5.10.1 Communication

The people in all the communities have access to mobile communication through fixed wireless lines provided by communication service providers like MTN, GLO, AIRTEL and ETISALAT. Also, there are

no postal services, but the inhabitants obtain news about other parts of Nigeria and the world through radio, television and mobile handsets.

4.2.4.11 Health Studies

Access to health facilities in the project area is limited in the project area. Adaka Heath centre and CKUM clinic in Tionsha community are some of the few. Many respondents revealed they travel several kilometers to receive healthcare at the Federal medical centre and Benue state university teaching hospital, which are about 14km and 20km from the project area.

This section presents the baseline health data based on information generated from sampled groups in the study communities.

The prevalence of Diseases in the study area is presented in Table 4.47

Table 4.47 Prevalence of Diseases in the project area

S/N	Disease	Prevalence (%)
1	Malaria Fever	39.2
2	Upper Respiratory Tract Infection	19.2
3	Typhoid Fever	10.5
4	Hypertension	7.2
5	Vomiting And Diarrhoea	5.2
6	Worm Infestation	5.1
7	Diabetes Mellitus	4.2
8	Lower Respiratory Tract Infected	4.3
9	Arthritis	2.4
10	Others	2.7

Source: MCNL Survey, 2021

A cursory look at Table 6.45 shows that water-related diseases have the highest prevalence percentage. Upper Respiratory Tract Infection has the second-highest prevalence occurrence in the region. This could be due to bush clearing/ burning and unpaved surfaces.

The following factors could explain the high prevalence rate of malaria:

- The abundance of mosquitoes (the insect vector of malaria, which consists predominantly of Plasmodium falciparum, and less of Plasmodium vivax and Plasmodium malaria);

- Presence of stagnant water;
- Absence of pest control practices, and
- Inadequate prophylactic drug supply.

4.2.4.11.1 Sexual Activities and Knowledge of Sexually Transmissible Infections (STI)

Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) have become is a public health concern in Nigeria. However, there are no data on sexual practices, knowledge and beliefs about HIV/AIDS and other Sexually Transmissible Infections (STIs) in the study area. Therefore, several questions were included in this study to ascertain their awareness of these health problems. Both men and women were asked about their sexual practices, about what they believed was the mode of transmission of Covid, HIV, treatment centers for STIs and condom use and availability. The respondents did not divulge information on the numeracy of sexual partners they keep.

4.2.4.11.2 Condom Availability and Use

Condoms serve as barrier to the transmission of HIV and other sexually transmitted infections. Respondents were asked about condom use. The data presented is limited to those who have had sexual intercourse. Condoms were readily available in over 90% of the chemist stores (where one is available) across all the project communities. However, the average number used weekly could not be accurately verified.

4.2.4.11.3 Immunization Status in Children

The proportion of children under five years old immunized against DPT, BCG, OPV, and Measles were 65% across all sampling stations. These figures were below the national target of 70% (BCG and TT for pregnant women) but in line with the 65% for the other antigens in the National Programme on Immunization. Oral Polio Vaccine (OPV) was the most commonly received vaccine in all the project communities. This may partly be due to the OPV given during the National immunization days (NIDs) set aside by the Federal Ministry of Health through the National Programme on Immunization every year. Each child below five years is expected to receive two drops of OPV during each round of NID. The fact that the few health facilities available in the communities had an inadequate immunization record could indicate insufficient vaccination.

4.2.4.11.4 Corona Virus, 2019 (COVID-19) pandemic

The COVID-19 pandemic in Nigeria is part of the worldwide pandemic of corona virus disease 2019 (COVID-19) caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). The first confirmed case in Nigeria was announced on 27 February 2020, when an Italian citizen in Lagos tested positive for the virus. On 9 March 2020, a second case of the virus was reported in Ewekoro, Ogun State,

a Nigerian citizen who had contact with the Italian citizen. The incidence of COVID-19 grew steadily in Nigeria, moving from an imported case and elitist pattern to community transmission. The case fatality stood at 2.8%. The country recorded an upsurge (52% of total cases) in the transmission of COVID-19 during the short period the lockdown was relaxed. The potential of overwhelming COVID-19 is still imminent in Nigeria as the country is attempting to hurriedly open the economy, which could sacrifice public health gains for temporary economic gains (Akinmayowa & Amzat, 2020; Maclean, *et al.*, 2020 and NCDC, 2020). The respondents knew about COVID-19 and its mode of transmission. However, about 78% respondents doubted its occurrence and claimed it was a hoax. Expectedly, the respondents are poor complaints to COVID-19 protocols.

4.2.4.12 Artisanal Skills Present in the Project Area

The respondents were asked to confirm artisanal skills (skills related to the proposed project) within their communities; the result indicated persons with all the skills in the project area. See Tables 4.48 a and b

Table 4.48a: Population with skills related to the proposed project

Skills	Tse agube	Tse Atoor	Tse Chahul	Tse Gbum	Tse Khave	Tse Perver	Total
Carpenter	5	2	3	3	5	2	20
Welder	1	1	0	2	1	0	5
Electrician	1	1	2	1	2	3	10
Truck driver	1	1	2	4	2	1	11
Taxi (car, tricycle, motocycle)	3	2	2	4	3	2	16
Heavy machinery operator (shovel operator, caterpillar, etc.)	1	0	0	0	1	0	2
Mechanic/Agro machine technician	2	3	2	3	2	3	15
Mason	3	4	4	6	4	3	24
Painter	2	3	5	5	3	2	20
Crane operator	1	0	0	1	0	1	3
Commercial Farmworkers	12	17	13	10	14	15	81
Plumbing	3	3	3	4	1	2	16
Total	37	38	37	45	39	36	232

Source: MCNL Survey, 2021

Table 4.48b: Population with skills related to Agro-industrial work in Host communities in the project area

Skills	Adem	Adaka	Agber	Iorbee	Kigir	Kwaghtamen	Tionsha	Total
Carpenter	1	1	1	0	2	1	4	10
Welder	1	2	3	1	0	2	3	12
Electrician	0	0	2	3	1	3	4	13
Truck driver	1	1	1	2	1	0	1	7
Taxi (car, tricycle, motorcycle)	0	0	1	0	4	1	2	8
Heavy machinery operator (shovel operator, caterpillar, etc.)	0	0	2	0	0	1	0	3
Mechanic/Agro machine technician	1	1	2	3	2	0	5	14
Mason	3	2	2	3	3	2	2	17
Painter	2	2	4	3	1	3	4	19
Crane operator	1	1	0	0	0	2	0	4
Commercial Farmworkers	7	10	10	8	15	9	22	81
Plumbing	1	2	0	1	5	2	3	14
Total	18	22	28	24	34	24	50	202

Source: MCNL, 2021

4.2.4.13 Vulnerable Groups in the Project Affected Communities (PACs).

The category and number of vulnerable groups in the communities within the project area were identified and analyzed as shown in Table. 4.49. This was compiled with assistance from the village heads; hence they could not be independently verified.

Table 4.49: the proportion of vulnerable groups in the project area

Vulnerable groups / Communities	Children	Land tenant	Women	Non-indigenes	Elderly	physically challenged	Herdsmen
Adem	23.0	9.6	19.1	23.9	11.0	9.1	4.3
Adaka	21.4	13.9	16.6	33.7	7.5	5.3	1.6
Agber	12.9	10.9	21.8	24.2	11.7	15.3	3.2
Iorbee	20.1	10.3	11.3	19.6	12.3	22.5	3.9

Kigir	23.0	12.8	23.0	23.0	9.7	6.6	2.0
Kwaghtamen	18.4	13.0	24.6	20.8	11.6	8.2	3.4
Tionsha	22.9	11.2	13.8	27.1	9.0	13.3	2.7
Tse agube	21.1	10.3	22.0	26.5	11.7	6.7	1.8
Tse Atoor	16.6	12.7	18.5	23.4	13.2	14.1	1.5
Tse Chahul	20.7	13.8	18.4	23.6	8.6	11.5	3.4
Tse Gbum	18.7	13.5	14.6	32.2	10.5	6.4	4.1
TseKhave	17.3	12.6	20.9	27.2	9.9	7.9	4.2
Tse Perver	18.6	11.9	20.0	22.4	13.3	11.4	2.4

From the illustration above, the most vulnerable group across the communities in percentage occurrence terms are non-indigenes, followed by children and women. In contrast, the least susceptible group recorded in the area was the herdsmen.

4.2.4.14 Cultural Heritage Resources

There are no cultural heritage sites within the 2km^2 socio-economic area of influence considered for the project.

4.2.4.15 Gender Issues

Data relating to gender issues were obtained using community questionnaires involving all the communities in the project area. Male and female folks were separated and assisted in responding to the gender indicators parameter in the questionnaire. The result is represented in Table 4.50

Table 4.50: Gender Parameters in Project Area

Community	Sex	Circumcision	Land ownership	Access to credit	Decision making at household	Decision making at the country level
Adem	Male	100	88	61	85	92
	Female	0	12	39	15	8
Adaka	Male	100	91	70	80	85
	Female	0	9	30	20	15
Agber	Male	100	95	70	90	74
	Female	0	5	30	10	26
Iorbee	Male	100	85	69	96	85

	Female	0	15	31	4	15
Kigir	Male	100	80	65	89	81
	Female	0	20	35	11	19
Kwaghtamen	Male	100	91	67	75	83
	Female	0	9	33	25	17
Tionsha	Male	100	90	64	90	90
	Female	0	10	36	10	10
Tse agube	Male	100	88	61	85	92
	Female	0	12	39	15	8
Tse Atoor	Male	100	91	70	80	85
	Female	0	9	30	20	15
Tse Chahul	Male	100	95	70	90	74
	Female	0	5	30	10	26
Tse Gbum	Male	100	85	69	96	85
	Female	0	15	31	4	15
Tse Khave	Male	100	80	65	89	81
	Female	0	20	35	11	19
Tse Perver	Male	100	91	67	75	83
	Female	0	9	33	25	17

Source: MCNL Survey, 2021.

4.2.4.15.1 Circumcision:

The non-therapeutic alteration of children's genitals is typically discussed in two separate ethical discourses; one for girls in which such alteration is conventionally referred to as Female Genital Mutilation (FGM), and one for boys, which is conventionally referred to as Male Circumcision (MC). There is an increased risk of adverse health outcome with increased severity of FGM. Health agencies and medical practitioners are opposed to all forms of FGM and are absolutely against the practice being carried out by health care providers. Some of the effects of FGM include; severe pain, excessive bleeding, shock, genital tissue swelling and infection. In the project area, 100% of the male were circumcised, while none of the females was circumcised. Nigeria average for circumcision for male is 93.2%, while for the female is 27.8%.

4.2.4.15.2 Land ownership:

There is a higher ratio of male landowners than female in the project area. This shows discrimination in the sharing of inherited properties such as lands. The respondents reported that it's customary for female folks to be excluded in sharing inherited properties. Nonetheless, the Nigerian average (NBS 2012), which showed a 5:1 in favour of the male folks, closely mirrors the findings of this report.

4.2.4.15.3 Access to credit:

Banks and lending agencies, including local thrift societies in the project area, often establish one set of criteria for male folks and another, including a male surety for the female folks. The imperativeness to fulfil this criterion is perhaps why the obtained data do not correlate strongly with the Nigerian average, which was put at 55:45 by NBS 2012.

4.2.4.15.4 Decision making at Household:

Socio-cultural and religious bias favouring the male folks in the household decision process is evident in the data obtained. Households with proportionate decision-making process between the male and female partner reported a degree of exposure, educational background and working status of the female gender as influencing factors. The Nigerian average is almost at 1:1 (NBS 2012)

4.2.4.15.5 Decision-making at the community level:

The same reasons adduced for decision-making at household levels also pertain here. However, the reserve of some exclusive traditional titles and roles for the female folks in the project area accounted for the higher proportionate representations in this parameter than the former. The data obtained in this report bettered the Nigeria average of 6:1 due perhaps primarily to the solid traditional institutions within the project area.

4.2.4.16 Traffic Survey

The Manual Classified Count (MCC) method -Observers count the number of vehicles passing the express and classify them according to vehicle type (e.g. cars, jeep, Lorries, motorbikes etc.) survey was used to quantify the level of traffic in the study area. Specifically, the study's objectives are to determine the: traffic volume, type or classification of traffic travelling through the study area (e.g. car, jeep, lorries, motorbike.) and projected traffic load on commencement of operation. The study was conducted along the only access route to the site, the Makurdi-Naka-Ankpa road. The study was conducted between 6 am – 6 pm between 24th – 27th April 2021 and between May 10 -17th 2021. The counting station was at the Mopol junction, leading into the proposed site.

Table 4.51: Average hourly traffic survey results over a twelve-day duration along Makurdi-Naka-Ankpa Road

Time	Vehicle categorisation	Outgoing traffic from Makurdi	Incoming traffic to Makurdi	Time	Vehicle categorisation	Outgoing traffic from Makurdi	Incoming traffic to Makurdi
6-7	Motorbike/Keke	194	104	12-1	Motorbike/Keke	96	70
	Cars	86	65		Cars	72	202
	SUVs	41	33		SUVs	25	107
	Lorries	25	38		Lorries	52	15
7-8	Motorbike/Keke	234	267	1-2	Motorbike/Keke	209	112
	Cars	103	149		Cars	134	219
	SUVs	56	72		SUVs	37	128
	Lorries	34	41		Lorries	12	10
8-9	Motorbike/Keke	264	213	2-3	Motorbike/Keke	162	99
	Cars	149	159		Cars	45	135
	SUVs	63	81		SUVs	20	73
	Lorries	45	33		Lorries	10	12
9-10	Motorbike/Keke	201	98	3-4	Motorbike/Keke	126	146
	Cars	123	167		Cars	42	143
	SUVs	53	74		SUVs	17	87
	Lorries	52	26		Lorries	12	19
10-11	Motorbike/Keke	162	76	4-5	Motorbike/Keke	188	157
	Cars	101	188		Cars	99	178
	SUVs	45	86		SUVs	48	93
	Lorries	55	20		Lorries	10	17
11-12	Motorbike/Keke	104	66	5-6	Motorbike/Keke	167	174
	Cars	87	195		Cars	121	219
	SUVs	33	91		SUVs	58	102
	Lorries	57	14		Lorries	9	18

- It is assumed that construction activities and park operational activities should be between 6 am – 6 pm at most.

The study revealed the following.

- That motorbike, including Keke, cars, SUVs and Lorries, plies the Makurdi-Naka Ankpa Road.
- Although the number of Makurdi in-bound vehicles (4,891) slightly out-numbered Makurdi outbound vehicles (4,138), the number is statistically insignificant ($p < 0,01$ at 0.05 confidence limit)
- That the number of motorbike and cars constitutes about 90% of the vehicular types
- That 7-9 am, 1-2 pm and 5-6 pm are peak vehicular traffic hours

Fig 4.8 is a graphical illustration of the findings

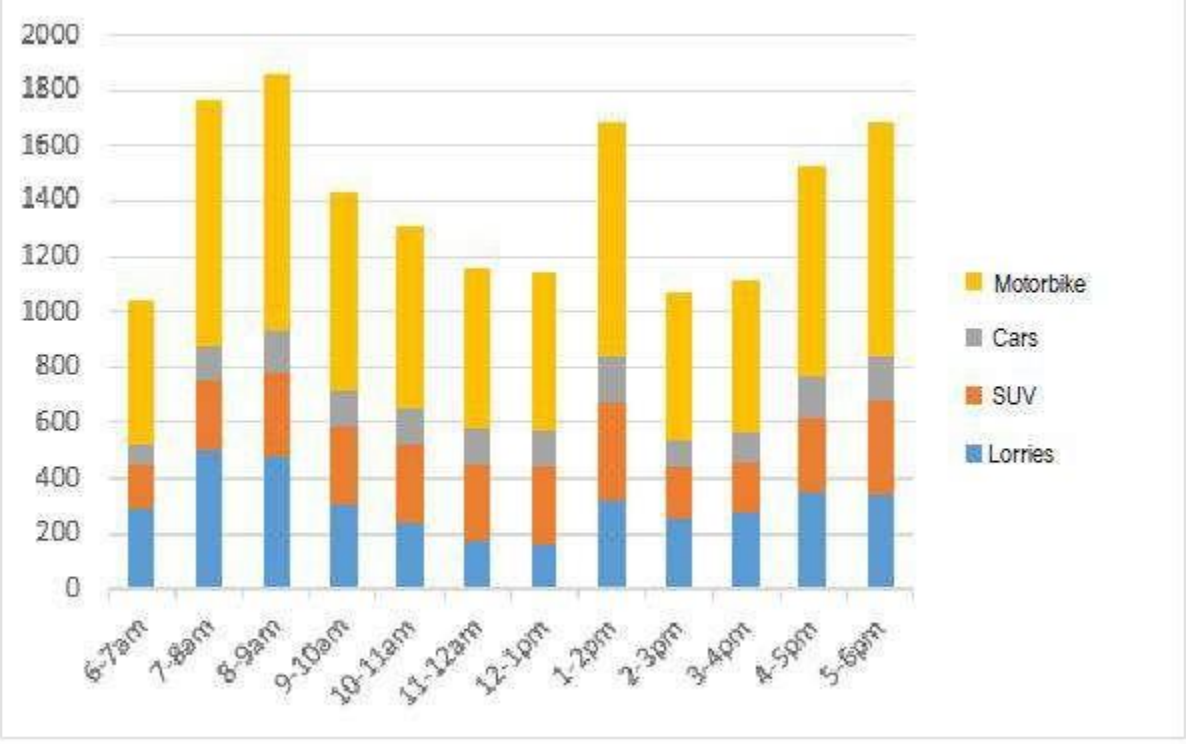

Fig 4.8: Graphical illustration of the traffic survey

The study observed that school children and paid employment workers account for most of the early traffic into Makurdi. In contrast, agro vendors to Oracle farms, transport vehicles from central and eastern Kogi State to Makurdi, Lafia, Akwanga, Jos and the Northeast geopolitical zone accounted for most of

the early and mid-hours traffic volume through the junction of the proposed project site. Traffic volume was also observed to be influenced by Adaka market days.

CHAPTER FIVE: POTENTIALAND ASSOCIATED IMPACTS

5.0 Introduction

This chapter provides information on the assessment of potential environmental and socio-economic impacts from the proposed project. It also presents the approach adopted for the mitigation of identified impacts. The chapter also outlines the approach for predicting any residual consequences after the application of mitigation measures. The short-term (activities related to preconstruction, construction and decommissioning phases) and the long-term (activities related to operational phase) were considered. Provision of the assessment methodology used in evaluating impact significance, considering the impact magnitude and sensitivity of receptors and resources affected, is also outlined.

As part of the impact assessment process, the primary project activities (source of potential impacts) considered and the environmental and social aspects and receptors assessed for potential effects during the construction and operational phase of the development are presented in Table 5.1.

Table 5.1 Indicative project activities and environmental/social receptors assessed.

Aspect	Phases	Activities
Indicative project activities	Pre- Construction Phase	Consultation with PAPs, Vegetation clearance, Transportation of men & materials
	Construction Phase	Transportation of men & construction materials, Establishment of a construction yard; Preparation of building foundations; Assembly of machinery and equipment for construction; Use of natural resources (water, energy sources);

		Construction of sheds, offices and other ancillary facilities; Construction of internal access roads; Construction of parking areas; Construction of wastewater treatment facilities Disposal of waste materials from construction activities and wastewater; and Non-routine events (e.g. spills, traffic, accidents, occupational health & safety incidents).
	Operation Phase	Operation of the facility; Routine maintenance of the industrial park's shared facility
	Decommissioning Phase	Building/Facility dismantling Dismantling of building Foundation Waste management
Environmental indicators, resources or receptors considered in the impact assessment	Construction, Operations and Decommissioning	**Biophysical Environment:** • Air quality; • Noise, vibration; • Climatic conditions and meteorology • Soils and geology/hydrogeology; • Land use and land use cover • Surface water and aquatic resources; • Terrestrial and aquatic ecology. **Human Environment** • Visual amenities; • Community-level impacts; • Community health, safety and security; • Labour and working conditions;

		• Infrastructure; • Stakeholder engagement and stakeholder perception

		• Employment and economy; and • Cultural Heritage

For each of the above-mentioned environmental component, the associated potential impacts of project activities are identified and the significance of the impacts assessed.

A summary table of all potential impacts with their significance is presented in this chapter.

5.1 Impact Assessment Methodology

This section describes the overall approach used for the assessment of impacts. Topic-specific methodologies are described under each section of the impact assessment.

In general, the assessment of impacts will pass through an interactive process involving the following four key elements:

- Prediction of potential impacts and their magnitude (i.e., the consequences of the 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 assess significant residual impacts after applying mitigation and enhancement measures.
- Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are as low as reasonably practicable for the Project.

5.2 Definition of Impact Terminologies

Nature/Type of impacts

There are several ways that impacts may be described and quantified. Table 5.2 provides definitions of terms used in this section.

Table 5.2: Definition of impacts

1	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 represents an adverse change from the baseline or introduces a new undesirable factor. Positive – an impact that represents an improvement to the baseline or introduces a new desirable factor.
2	TYPE OF IMPACT: Direct (or primary) – impacts that result from the direct interaction between planned project activity and the receiving environment 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.
3	TEMPORAL SCALE OF IMPACT: Temporary - impacts are predicted to be of short duration, reversible and intermittent/occasional. The receptor will return to a previous state when the impact ceases or after a period of recovery. 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 project's life but cease when the project stops operating (i.e. 50years or when there is improvement in technology that requires replacement). These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended period.
4	SPATIAL SCALE OF IMPACT: On-site – impacts that are limited to the Project site. Local - impacts that affect locally significant environmental resources or are restricted to a single (local) administrative area or a single community. For this ESIA, local impacts are limited to the Project site and its zone of influence. Regional - impacts that affect regionally significant environmental resources or are experienced at a regional scale as determined by administrative boundaries. National - impacts that affect nationally significant environmental resources; affect an area that is nationally important /protected, or have macro-economic consequences (i.e. Nigeria). International - impacts that affect internationally essential resources such as areas protected by International Conventions. Transboundary - impacts that are experienced in one country as a result of activities in another.

Magnitude of Impact

The term 'magnitude' covers all the dimensions of the predicted impact on the natural and social environment, including:

- the nature of the change (what resource or receptor is affected and how);
- the spatial extent of the area impacted, or proportion of the population or community affected;
- its temporal extent (i.e. duration, frequency, reversibility); and
- where relevant (accidental or unplanned events),
- the probability of the impact occurring.

Table 5.2 provides the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment for biophysical impacts.

For social impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or losses access to or control over socio-economic resources (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 that support and sustain people and nature. Once affected, their disruption could lead to a disturbance of the stability or the integrity of that environment.

For ecological impacts, sensitivity can be assigned as low, medium or high based on the conservation importance of habitats and species. For habitats these are based on naturalness, extent, rarity, fragility, diversity and importance as a community resource.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as a stakeholder's (or groups of stakeholders') resilience or capacity to cope with sudden changes or economic shocks'. The sensitivity of a resource is based on its quality and value/importance, for example, by its local, regional, national or international designation, its importance to the local or broader community, or its economic value.

Likelihood

Terms used to define the likelihood of occurrence of an impact are explained in Table 5.3

Table 5.3: Explanation of terms used for the likelihood of occurrence

Definition of likelihood		
High probability	Refers to a very likely impact	Refers to very frequent impacts
Medium probability	Refers to a potential impact	Refers to occasional impacts
Low probability	Refers to an improbable impact	Refers to rare impacts

Impact Evaluation

The third stage in the assessment procedure involved the evaluation of the impacts identified to determine their significance. This was based on the methodological framework set by International Standard Organisation (ISO) 14001 – Environmental Management System (EMS) and EMSP Aspects and Impacts – Determining Significance developed by the University of Bristol in 2015. The evaluation of impact significance was based on the following clearly defined criteria:

- Environmental Legislation and Policy
- Stakeholders' Concern and Interest
- The severity of Environmental and Social Impacts
- Magnitude/Scale of Impacts
- Frequency of Occurrence of Impacts

The above criteria and the rating adopted for the evaluation are described in Table 5.4.

Table 5.4: Impact Evaluation Criteria and Ratings

	Consequence		
A	Environmental legislation and corporate Policy	Is there any legislation affecting the aspect?	Score
		The impact is covered by legislation & Policy	3
		The impact is covered by legislation	2
		The impact is covered by Policy	1
		The impact is not covered by legislation or Policy	0
B	Stakeholder concern/interest	What stakeholder concern or interest does the Stakeholder raise?	Score
		The impact raises considerable global, national and local interest or would have a seriously detrimental effect on the reputation of the client	3
		The impact raises some interest and may have some detrimental effect on the reputation of the client	1
		The impact raises no interest and would have no effect on the reputation of the client	0
		The impact raises some interest and may have some	-1

		positive effect on the reputation of the client.	
		The impact raises global, national and local interest or would have a significant positive effect on the client's reputation.	-3
C	The severity of Environmental Impact	What is the severity of environmental impacts?	Score
		The impact has a moderate detrimental effect on the environment or a scarce, non-renewable resource. Long Term/ Irreversible Impact.	3
		The impact has a moderate detrimental effect on the environment or a scarce, non-renewable resource. Impact not reversible within a year.	2
		The impact has a minor detrimental effect on the environment and on scarce, non-renewable resource. Impact reversible within a month to a year.	1
		The impact has no known effect on the environment	0
		The impact has a minor positive effect on the environment and on scarce, non-renewable resource.	-1
		The impact has a moderately positive effect on the environment and on scarce, non-renewable resource.	-2
		The impact has a significant positive effect on the environment or a scarce, non-renewable resource.	-3
D	Scale of Impacts	What is the scale of the impact?	Score
		The negative impact occurs in high or large quantities	3
		The negative impact occurs in medium quantities	2
		The negative impact occurs in low or small quantities	1
		The positive impact occurs in low or small quantities.	-1
		The positive impact occurs in medium quantities.	-2
		The positive impact occurs in high or large quantities.	-3
	LIKELIHOOD		
Z	Frequency	How frequently does the impact occur?	Score
		The impact occurs daily	5
		The impact occurs weekly	4

		The impact occurs monthly	3
		The impact occurs on an annual basis	2
		The impact is unlikely to occur	1

Overall Significance Ranking

Following the evaluation of each impact using the criteria highlighted in Tables 5.1 to 5.4 above, the identified environmental impacts are categorized and scored according to Table 5.5 and the equation below. Consequence (A+ B + C + D) X Likelihood (Z) = Significance evaluation score

Table 5.5: Significance Level Categories

Impact Significance	Score
Low Negative Significance	1 – 25
Medium Negative Significance	26 – 50
High Negative Significance	> 50
Positive Significance	< -1

ISO, 1996

5.3 Residual Impact Assessment

Impact prediction considers any mitigation, control and operational management measures that are part of the project design and project plan. A residual impact is predicted to remain after mitigation measures have been designed into the intended activity. The residual effects that may persist after applying the impact mitigation measures have also been discussed for further reduction as possible.

5.4 Potential Impacts during initial preconstruction Phase

5.4.1 Impacts on Air Quality

The assessment of potential impacts on air quality, sources, rating criteria and mitigation measures are presented in Table 5.6

Table 5.6 Impacts on Ambient Air Quality during initial preconstruction Phase

Impact Statement	Sources of Impact	Impact on Ambient Air Quality	
A1: Reduction in ambient air quality A2: Contribution to global warming	Site preparation (land clearing) transport of materials to the site	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	2
		Scale	2
		Frequency	4

Impact Statement	Sources of Impact	Impact on Ambient Air Quality	
		Overall rating	40
		Impact Significance	**Medium**

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 mitigation will reduce the effect to a minor level.

A2: Vegetal removal during site clearance shall contribute to global warming as a sink for carbon sequestration will be lost. During transport, the operation of the vehicles and machine will also result in the emission of greenhouse gases such as methane and CO. This impact is rated Medium, and the implementation of mitigation measures shall reduce the impact to a minor level.

5.4.2 Impacts on Ambient Noise Level

The assessment of the potential impact on noise, sources, rating criteria and mitigation measures are presented in Table 5.7

Table 5.7 Assessment of Impacts and mitigation measures on ambient Noise impact During Initial Preconstruction Phase

Impact Statement	Sources of Impact	Impact on Noise	
NQ1: Increase in ambient noise level and Vibrations	Noise and vibration result from construction activities such as heavy machinery, concrete mixing plants, stone crushing, etc. Presence of workers on site Transport of materials to the site	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	1
		Severity	2
		Scale	1
		Frequency	4
		Overall rating	35
		Impact Significance	**Medium**

The baseline noise levels were above the regulatory limit for schools, residential areas and churches; the project shall add to the baseline noise level during this phase, the impact is rated Medium. However, implementing mitigation measures shall reduce the impact to a **minor** level.

5.4.3 Impacts on Soil and Geology

The summary of the potential impact on soil and geology, sources, rating criteria and mitigation measures are presented in Table 5.8

Table 5.8 Soil and Geology Impacts during Preconstruction Phase

Impact Statement	Sources of Impact	Impact on Soil and geology	
SQ1: Change in soil structure SQ2: Exposure of soil to erosion	Land clearing Transport of men and materials to the site	Impact criteria	Rating
		Legislature	2
		Stakeholder concern	1
		Severity	3
		Scale	1
		Frequency	5
		Overall rating	35
		Impact Significance	**Medium**
Agriculture and Landuse			
Geology			
Hydrogeology			

Impact Description

S1: land clearing, transportation of materials to the site shall likely cause a change in the soil structure, making it more compacted. Clearing of vegetation will also expose the soil to water erosion. This impact

is rated Medium according to the criteria in Table 5.8. Implementation of mitigation measures will reduce both impacts to **Minor.**

5.4.4 Impacts on Surface and Groundwater

The potential impact on water resources, sources, rating criteria and mitigation measures are presented in Table 5.9

Table 5.9 Impacts on water Resources during Preconstruction Phase

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on water resources</td></tr>
<tr><td rowspan="8">W1: Potential surface and groundwater contamination

W2: Potential groundwater contamination

W3: Sedimentation of Streams and Rivers</td><td rowspan="8">Operation and maintenance of preconstruction equipment/machines

Vegetation clearance

Movement of vehicles in conveying men and materials</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>4</td></tr>
<tr><td>Overall rating</td><td>32</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
</table>

Impact Description

W1: Baseline surface water DO were lower (3.59 in SW2 to 3.82 in SW1) and turbidity levels (26.55 in SW3 to 27.23 in SW1) to were above regulatory limits at all sampling points. The project activities will produce overburden which may be washed down by rain into nearby water bodies. This shall add to the baseline turbidity level, which is currently above WHO regulatory limits

Vegetation clearing will increase the runoff rate into the fete river, adding to the present turbidity levels. Also, runoff may accidentally deposit spilt oil during machine/equipment repair and maintenance into the natural watercourses. This shall further influence the baseline surface water DO levels below the regulatory limits at all sampling points. Hydrocarbon utilizing microbes are known to reduce DO levels in the Fete River, rendering it anoxic.

W2: Depending on the spill's magnitude, a vast accidental spill may seep into the groundwater and contaminate the water source. This shall lead to groundwater pollution; thus, rendering these waters unsafe for drinking.

W3: Clearance of existing vegetation will expose the upper layers of the soil horizon to soil erosion. The transport of eroded soil into surface water resources will impact water quality. The stockpiling of excavated earth and construction materials can result in runoff to the water bodies.

W1, W2, and W3: Overall, impacts resulting from sedimentation problems and groundwater/surface water and groundwater contamination problems are predicted to have a medium significance. Implementation of possible actions shall reduce the impact to negligible.

5.4.5 Impacts on Biodiversity

The potential impact on biodiversity, sources, rating criteria and mitigation measures are presented in Table 5.10

Table 5.10 Biodiversity Impacts during Preconstruction Phase

Impact Statement	Sources of Impact	Impact on biodiversity	
B1(A): Loss of threatened species and plants of important indigenous uses B1 (B): Habitat loss B1(C): Migration of fauna species as a result of noise and vibrations	(1) Vegetation clearing (2) Transport of men & materials	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		frequency	5
		Overall rating	55
		Impact Significance	**High**

Impact description

It is estimated that a relative amount of vegetal biomass shall be cleared to establish this project. This will lead to species migration, loss of habitat and loss of Threatened flora species in the area. The baseline result showed that two flora species were of conservation interest. These are *Vittalaria paradoxa* and *Khaya senegalensis*.

Similarly, almost all the species inventoried in the study area were reviewed to offer Provisioning Services. However, considering the relative amount of vegetal quantity that would be cleared and the sensitivity of the habitats and the threatened plant species, implementing mitigation measures shall reduce these impacts to **Medium** significance.

5.4.6 Impacts on Community Infrastructure, Socio-cultural and Health Status

The potential impact on biodiversity, sources, rating criteria are presented in Table 5.11,

Table 5.11 Impacts on Community Socio-cultural and Health Status

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on Community Socio-cultural and Health Status</td></tr>
<tr><td rowspan="9">SE1 (A): Risks and tensions between incoming expatriate and local workers

SE1 (B): Violation of norm and culture by incoming workers

SE1 (C): Increased incidences of communicable & non-communicable diseases

SE1 (D) Pressure on existing social infrastructure</td><td rowspan="9">(1) Employment of preconstruction workers

(2) Influx of workers and marketers

(3) Vegetal clearance

(4) Movement of men and materials</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>2</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>frequency</td><td>4</td></tr>
<tr><td>Overall rating</td><td>28</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
</table>

Impact Description

SE1 (A, B, C and D): The influx of preconstruction workers and marketers into the project area may increase disease incidence rates in the area. Most of these persons may be carriers of communicable

diseases, and interaction with the locals may further spread the diseases. This impact is rated medium considering the duration of this phase, and the application of mitigation measures shall reduce the effects to minor status. On the other hand, considering the quantity and nature of materials used during construction, transporting these materials to the site will increase the burden on existing roads in the project area. This shall indirectly affect roads not also captured in the AoI since materials will be moved from other parts of the country to the project lay down area. Material transport is likely to cause a traffic logjam (See Traffic survey). This impact is of high significance. Implementing mitigation measures shall reduce this impact to a minor level.

5.4.8 Impacts on Traffic and Safety

The potential impact on Traffic and Safety, sources, rating criteria and mitigation measures are presented in Table 5.12

Table 5.12 Impacts on Traffic and Safety

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on Traffic and Safety</td></tr>
<tr><td rowspan="9">SE1 (E): Risk of Accidents to locals

SE1 (F): Traffic congestion</td><td rowspan="9">Transportation of materials on-site and wastes offsite</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>3</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>3</td></tr>
<tr><td>frequency</td><td>4</td></tr>
<tr><td>Overall rating</td><td>48</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
</table>

TR1 (A&B): Increase in traffic during material, and personnel transport in the villages and the roads could also be a source of accidents. This impact is rated medium significance due to the duration of the project phase, and implementation of mitigation measures shall reduce the result to a Minor level.

5.4.9 Impacts on Employment and opportunities

The potential impact on Employment and opportunities, sources, rating criteria and mitigation measures are presented in Tables 5.13

Table 5.13 Impacts on Employment and Opportunities

Impact Statement	Sources of Impact	Impact on the impact on employment and opportunities	
SE1 (H) Employment	Material requirement and sales Vegetal clearance Transport of construction materials Employment of workers	Impact criteria	Rating
		Legislature	
		Stakeholder concern	
		Severity	
		Scale	
		Frequency	
		Overall rating	
		Impact Significance	**Positive**

SE1: Employment of casual un-skilled labour would occur for short-term contracts or the entire preconstruction phase. The main jobs that will be available are the vegetal clearance, sales and requirement of materials. Supplies will include raw materials that meet standards as required for the construction of the facilities. This is a positive impact and, as such, does not require mitigation.

5.5 Construction Phase Impacts and Mitigation Measures

5.5.1 Impacts on Ambient Air Quality

The potential impact on Ambient Air Quality, sources, rating criteria and mitigation measures are presented in Table 5.14

Table 5.14 Impacts on Ambient Air Quality

Impact Statement	Sources of Impact	Impact on Ambient air quality	
AQ1 (A): Reduction in ambient air quality AQ1 (B): Dust emission from land preparation and vehicle movements AQ1 (C) Impact on climate change	Operation of construction equipment and machine Transportation and traffic	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	**High**

AQ2 (A): The vehicle movement 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 conditions. Light-duty petrol vehicles not equipped with pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration and idling cycles. Frequent cycle changes characteristic of congested urban traffic patterns thus tends to increase pollutant emissions. At higher cruise speeds, hydrocarbon and CO emissions decrease, while NOx and CO_2 emissions increase. Emissions from diesel-fueled vehicles include particulate matter, NOx, SO_2, CO, and hydrocarbons,most of which occur from the exhaust. Operating at higher air-fuel ratios (about 30:1 than 15:1 characteristic of petrol-fueled vehicles with electronic fuel injection engines), diesel-powered vehicles tend to have low HC and CO emissions, despite having considerably higher particulate emissions.

Particulates emitted from diesel vehicles consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel-fueled vehicles, the contribution of soot to particulate emissions is between 40% and 80%. The black smoke emanating from poorly maintained diesel-fueled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase. Particulate emissions from petrol-driven vehicles are usually negligible. When they occur, such emissions will result from unburned lubricating oil and ash-forming fuel and oil additives.

The impact of emissions arising from vehicles and equipment associated with construction activities is considered high. The application of mitigation measures shall reduce the Medium impact level.

AQ2 (B) Dust emission from land preparation and vehicle movements

The dust emissions arising from the construction activities of the Project are a result of land preparation activities and vehicular movements. Dust emissions can impact the close receptors due to the physical appearance, deposition on the roof of the residential areas and creating a nuisance for the surrounding community. Removal of material usually occurs with a bulldozer, and cleared material is stored in piles for later use or during rehabilitation procedures. Fugitive dust is generated during the clearing of material and from wind-blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be caused during the transportation of the material, usually by truck, to the stockpiles. This dust can take the form of entrainment from the vehicle itself or dust blown from the back of the trucks during transportation.

The impact is rated high. However, implementation of mitigation measures shall reduce the impact to Medium.

AQ2 (C) Impact on climate change

A series of stages are involved in estimating the climate change impact. During the construction stage, the following activity is considered for climate change impact.

The process from material production:

Green House Gases (GHGs) will be emitted from the manufacturing process of construction material. However, it is an indirect impact on the project but still necessarily considered part of the project's lifecycle. The assumption used for the GHGs emission calculation on this item, based on the Global Emission Model of Integrated Systems (GEMIS) database. Green House Gases (GHGs) will be emitted from material production as well as energy use in construction activity. GHG emission during the construction stage is short, and temporally, the impact on

climate change is considered to be high. Implementation of mitigation measures will reduce effects to a Medium level.

5.5.2 Impacts on Ambient Noise Level

The potential impact on Ambient Noise Level, sources, rating criteria and mitigation measures are presented in Table 5.15

Table 5.15: Impacts on Ambient Noise Level

Impact Statement	Sources of Impact	Impact on Ambient noise level	
NQ2: Increase in ambient noise level	Operation of construction equipment and machine Transportation and traffic Presence of workers	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	**High**

NQ 2: During the construction phase, construction activities, traffic, and the use of construction equipment and machinery are likely to lead to a temporary increase in noise levels that may disturb adjoining areas and local fauna.

The project area is noise degraded. Baseline noise levels were above recommended threshold limit for all microclimates, including hospitals, churches and schools. The project shall add to the baseline noise level. The construction activity will be undertaken during the daytime. Construction activities will be concentrated and done sequentially so that no area is prone to the long duration of noise impacts. There will be some noise generated from tractors and trucks transporting the materials and equipment, but the traffic volumes are expected to be occasional.

Considering the construction activity schedule and nature of construction, the overall noise impact on nearby sensitive receptors with embedded controls in place will be of **high** significance; however, applying mitigation measures will reduce the effect to the **Medium** level.

5.5.3 Impacts on Soil and Geology

The potential impact on Soil and Geology, sources, rating criteria and mitigation measures are presented in Table 5.16

Table 5.16 Impacts on Soil and Geology

Impact Statement	Sources of Impact	Impact on Soil and Geology	
SQ2 (A): Change to soil structure (erosion and compaction SQ2 (B): Potential contamination of soil from accidental release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc.	General construction works Building of internal road networks	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	1
		Scale	1
		Frequency	5
		Overall rating	40
		Impact Significance	**Medium**

SQ2 (A): During the construction phase, the main activities likely to affect soil structure and quality are digging foundation pits, constructing internal access road networks, and removing vegetation (for foundation purposes). Foundations will be dug up to variable depths, depending upon the building/structure type and soil characteristics. Vehicle movement around the project area can lead to soil compaction in those areas where soils are clayey or highly saturated. This impact is rated medium and shall be reduced to Minor if the proffered mitigation measures are implemented.

SQ2 (B): Also, Soils can be contaminated during the construction phase by accidental oil/fuel spills from heavy machinery either at storage yards or work sites. In the event of an accidental spill, the proportion of soil contamination will depend on the magnitude of these unintentional events. A significant amount of solid waste (including wood, metal scarps, office and domestic wastes, etc.) will be generated in this project phase. The methods used to handle and dispose of these wastes to be generated play an essential role in the significance of impacts expected from waste management. Waste handling and disposal have been assessed to pose a medium impact on the environment. Application of specific mitigation measures such as de-compaction of soils following construction as well as avoiding construction activities during times when soils are saturated and preventing the storage of materials within these areas as well as the

implementation of an Emergency Response Plan will help manage accidental spills properly will reduce the impact to a Minor level.

5.5.4 Impacts on Water Resources

The potential impact on Water Resources, sources, rating criteria and mitigation measures are presented in Table 5.17

Table 5.17 Impacts on Water Resources

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on Water Resources</td></tr>
<tr><td rowspan="8">WQ2 (A): Potential surface contamination

WQ2 (B): change in hydrological flow regimes of surface water

WQ2 (C): Potential groundwater contamination

WQ2 (D): Exploitation of water resources</td><td rowspan="8">Operation and maintenance of construction machines and equipment</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>
</table>

Sources of impacts on water resources include removing vegetation, vehicle movement, and contamination from potential spills.

WQ2 (A): Vegetation removal is not planned within the Fete Stream as it's not within the project footprint. Nonetheless, vegetal clearance can increase soil erosion, causing sediment influx into the Stream Fete, especially during rain events. This shall likely add to the baseline surface water Turbidity levels above threshold limits. Poor waste management practices are likely to affect water quality (e.g. improper waste disposal in the stream). The risk of accidental oil spills from heavy machinery during the construction phase could result in Fete River contamination. This shall likely add to the baseline surface water DO levels since hydrocarbon utilizing microbes are known to deplete DO levels in the water. However, the contamination level resulting from accidental spills will depend on their magnitude, which in this case, is

negligible. Still, the receptor is very sensitive, leading to a Medium Impact Rating. However, proper application of mitigation measures will reduce the impacts to a minor level.

WQ2 (B): Construction of internal road networks and vehicular movement along the construction sites can result in changes in hydrological flow regimes of watercourses. Depending on the level of disturbance, watercourses can be temporarily or permanently impaired. This impact is rated Medium considering the proximity of the Fete River (the only available surface water source within the project area). However, mitigation measures will reduce impacts on water resources to Minor.

WQ2 (C): Depending on the spill's magnitude, a huge accidental spill may seep into aquifer layers and contaminate the water source. This Impact is rated Medium, and application of mitigation measure shall reduce the impact to Minor.

WQ2 (D): Water to be used for construction activities shall be sourced from the borehole. The impacts are rated Medium, and implementing mitigation measures shall reduce effects to Minor status.

5.5.5 Impacts on Biodiversity

The potential impact on Biodiversity, sources, rating criteria and mitigation measures are presented in Table 5.18

Table 5.18 Impacts on Biodiversity

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on Biodiversity during construction</td></tr>
<tr><td rowspan="8">B2(A): Further migration of fauna species as a result of construction noise

B2 (B): Introduction of invasive and alien species</td><td rowspan="8">Construction of offices, internal roads and other ancillary facilities

Transport and traffic</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>2</td></tr>
<tr><td>Severity</td><td>2</td></tr>
<tr><td>Scale</td><td>2</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>45</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
</table>

B2 (A): During construction, there shall be faunal disturbance within the project area. Sensitive ground-dwelling animals, especially from the mammalian and reptilian taxa, will further migrate during construction. This impact is short-termed and rated **medium**. The application of Mitigation Measures will reduce the effects to a **minor** level.

B2 (B): The possibility of creating fertile loci for alien and invasive flora species is being introduced to the area during material transport (sand, gravel). The proliferation of invasive species can have negative impacts on local species by outcompeting native taxa. Alien invasive species have the potential to modify wildlife habitat, which can impact associated fauna populations substantially. *Chromolaena odorata* and *Ageratum conizoides*is listed as invasive to Nigeria and was censored in this study. This impact is rated **medium**. The application of Mitigation Measures will reduce the effects to a **minor** level.

5.5.6 Impacts on Community Health and Safety

The potential impact on Community Health and Safety, sources, rating criteria and mitigation measures are presented in Tables 5.19, 5.20, 5.21, and 5.22

Table 5.19 Impacts on Community Health and Safety

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on Community Health and Safety</td></tr>
<tr><td rowspan="7">(A): Risking tensions between outside (partly possibly expatriate and local worker

(B): Violation of norm and culture by outsiders, workers

and marketers</td><td rowspan="7">Employment of construction workers

The temporary influx of persons to the communities</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>2</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>35</td></tr>
</table>

Impact Statement	Sources of Impact	Impact on Community Health and Safety	
(C): Increase incidences of communicable & non-communicable diseases		Impact Significance	**Medium**

(A), (B): Potential socio-economic impacts are expected to arise from socio-cultural conflicts between the construction workforce and natives due to differences in belief systems. This may also lead to the violation of the existing traditional norms in the project area. These impacts are rated medium as the application of mitigation measures shall reduce the impact to a minor status

(C): Construction activities can create new malaria vector (mosquito) habitats due to the establishment of small pit lakes. An influx of workers with no or partial immunity to malaria parasite (Plasmodium sp) increases the risk of serious illness, resulting in death. This impact, if not managed, is expected to pose a significant characteristic. The influx of workers into the project area also increases the risks of Sexually Transmitted Diseases (STDs) and could adversely impact the spread of HIV/AIDS. If left unmanaged, this impact may result in long-term health issues that may eventually lead to fatality. The impact arising from this is ranked as a medium. Application of mitigation measures would reduce the impact to a Minor level.

Table 5.20 is an assessment of Socio-economic impacts on the existing social infrastructure of the project that is expected to occur during the construction phase.

Table 5.20 Impacts on Socio-infrastructure

Impact Statement	Sources of Impact	Impact on Socio-infrastructure	
SE2 (D): Pressure on existing social infrastructure	An influx of workers	Impact criteria	Rating
		Legislature	2
		Stakeholder concern	2

		Severity	2
		Scale	2
		frequency	5
		Overall rating	40
		Impact Significance	**Medium**

Table 5.21 is an assessment of Socio-economic impacts on road accidents, kidnappings and traffic congestion.

Table 5.21 Impacts on road traffic accidents (RTAs) and traffic congestion

Impact Statement	Sources of Impact	Impact on accidents, kidnappings banditry and traffic congestion	
SE2 (E): Risk of road Accidents and Kidnapping SE2 (F): Traffic Congestion	Transportation of materials onsite	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	**High**

Construction and transportation activities will increase traffic congestion, risk of injuries, hostage and kidnapping, and damage to assets.

SE2 (E): Accidents arising from road trips (transport of materials and personnel) along mobilization routes may result in injury or loss of life of personnel and school children trekking to distant schools from communities like Kwangthamen, Pever, etc., damage to company assets. This impact is rated with **high** significance, and implementation of mitigation measures shall cascade the impact to a **medium l**evel.

Tb1 (F): Transportation of men and materials for construction shall add to a traffic load on the Makurdi-Naka express road. This impact is rated **high**, and implementing mitigation measures shall reduce the result to a **medium** level.

The potential on the impact on employment and opportunities, sources, rating criteria and mitigation measures are presented in Tables 5.22

Table 5.22 Impacts on Employment and Opportunities

Impact Statement	Sources of Impact	Impact on the impact on employment and opportunities	
SE2 (G): Supply chain opportunities for Nigerian companies and locals that can provide goods and services needed by the company SE2 (H)Employment	Material requirement Employment of workers	Impact criteria	Rating
		Legislature	
		Stakeholder concern	
		Severity	
		Scale	
		Frequency	
		Overall rating	
		Impact Significance	**Positive**

SE2 (G), SE2 (H): Based on the results of the socio-economic assessment, the unemployment rate in the area is high. The locals are, however, optimistic about the possibility of job availability with the project. Any available jobs will positively impact the employment and income situation at the study area and the regional and national levels. The effect is beneficial. Employment of casual un-skilled labour would occur for short-term contracts or the entire construction phase. This could result in a positive spin off during the construction phase as any level of employment in this region of moderate unemployment, and low wage

levels will have a beneficial social spinoff. The impact is beneficial. During the construction phase, there will be provision for sub-contracting to local supplies. Supplies will include raw materials that meet standards as required for the construction of the facilities. Equal opportunities will be given to sub-contractors from the host communities. This is a positive impact and, as such, does not require mitigation.

5.5.7 Visual Impacts

The potential on Visual Impacts, sources, rating criteria and mitigation measures are presented in Table 5.23

Table 5.23 Assessment of Visual Impacts

Impact Statement	Sources of Impact	Impact on Visual Impacts	
VI 1: Visual effects	The presence of an active construction site	Impact criteria	Rating
		Legislature	2
		Stakeholder concern	1
		Severity	1
		Scale	3
		Frequency	5
		Overall rating	35
		Impact Significance	**Medium**

VI 1: Aesthetic impacts during the construction phase will be limited to work zones. The area already has many existing facilities, the changes in the landscape are not likely to produce significant impacts in most areas. These areas are not known to have unique landscape values. Setting up of these facilities may create visual intrusion by altering the typical landform pattern. Domestic waste might be disposed to the construction area, creating a visual nuisance. Construction waste will be disposed of at sites approved by relevant waste management. The duration of the construction activity is short term in nature, and the area's sensitivity is also medium. Thus the impact is rated **medium**.

5.5.8 Impact on workplace Health and Safety

The summary of the potential impacts on workplace Health and Safety, sources, rating criteria and mitigation measures are presented in Tables 5.24

Table 5.24 Assessment of Impacts on workplace Health and Safety

Impact Statement	Sources of Impact	Impact on Workplace Health and Safety	
HS1: Risk of workplace accidents and hazards	Construction of internal road networks Construction of offices and other facilities	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	**High**

SHE risks can arise from various construction activities such as earthworks, operation, and movement of heavy equipment and vehicles, storage of hazardous materials, traffic, waste disposal etc. The probability of an accident occurring at the project site during the phases of the development is High. This is due to the intense use of machinery and other heavy-duty equipment used primarily in the construction phase. Work-related incidents and accidents resulting from trips, falling objects at heights during construction activities are likely to occur. Fire and explosions may be described as technological hazards, which can cause severe injury or result in loss of lives and damage to properties and the environment. Flammable substances, including diesel and motor oil, may be stored or used on the project site for heavy-duty equipment. These substances are precursors for fires and explosions. Envisaged impacts from accidental explosions resulting in a fire outbreak are ranked High. The land area to be cleared will be kept to the minimum necessary to sedimentation on River Fete courses. Where practicable, structures to provide natural attenuation shall be provided. Implementation of mitigation measures is likely to reduce the impact to a Medium level.

5.6 : Operation Phase Impacts and Mitigation Measures

The assessment of the potential impacts on air quality, sources, rating criteria and mitigation measures are presented in Table 5.25

5.6.1 Impact on Air quality

Table 5.25 Impacts on Ambient Air Quality

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td colspan="2">Impact on Ambient Noise level</td></tr>
<tr><td rowspan="8">Reduction in ambient air quality

Dust emission from land preparation and vehicle movements

Impact on climate change</td><td rowspan="8">Operation machines, equipment and power generating sets

Transportation of agro products for processing

The odour from untreated wastewater effluents</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>3</td></tr>
<tr><td>Stakeholder concern</td><td>3</td></tr>
<tr><td>Severity</td><td>3</td></tr>
<tr><td>Scale</td><td>3</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>60</td></tr>
<tr><td>Impact Significance</td><td>High</td></tr>
</table>

Dust generated from the movement of company vehicles, including trucks, can cause a considerable nuisance to communities along the access road, within and around the processing zone and can cause health problems, including respiratory complaints/diseases.

Emissions from vehicles, equipment and machinery could cause adverse impacts on air quality affecting the health and welfare of workers. Also, odour from untreated wastewater effluents will impact the air quality negatively. The production of greenhouse gases from the exhaust emissions of vehicles and machinery would contribute negatively to climate change. However, implementing measures will reduce the residual impact to a medium level.

5.6.2 Impact on Ambient Noise level

The assessment of the potential impacts on Ambient Noise level, sources, rating criteria and mitigation measures are presented in Table 5.26

Table 5.26 Impacts on Ambient Noise level

Impact Statement	Sources of Impact	Impact on Ambient Noise level	
NQ 3: Increase in ambient Noise level	Movement of vehicles Presence of people in the facility Noise from power generating sets	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	**High**

Movement of vehicles, maintenance activities, and noise from power generating sets will increase noise levels, disturbing neighbouring communities. Baseline data revealed high noise level exceeding the regulatory limit for all climatic environment. Noise generating operations may cause adverse health effects on workers as well. Overall, noise-related impacts during the operation phase are ranked high considering the duration of the project phase. However, with mitigation measures, the effects on noise shall be reduced to a medium level.

5.6.3 Impact on Soil and Geology

The Assessment of the potential impacts on Soil and Geology, sources, rating criteria and mitigation measures are presented in Tables 5.27

Table 5.27 Impacts on Soil and Geology

Impact Statement	Sources of Impact	Impact on Soil and Geology during

		Operation	
Potential contamination of soil from accidental release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, wastewater, etc. Soil compaction from the movement of vehicles conveying raw materials and the finished products	Maintenance of shared facilities (roads, power generating sets), effluent from wastewater facilities Movement of vehicles	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	2
		Severity	3
		Scale	2
		frequency	3
		Overall rating	30
		Impact Significance	**Medium**

During the operation phase, oil leaks resulting from equipment breakdown or accidental spills from machinery used for maintenance purposes could lead to soil contamination. The movement of vehicles can also lead to soil compaction. During the construction phase, the risk of soil contamination due to leaks and accidental spills cannot be wholly discarded. This impact has been ranked medium. However, the application of management measures will help reduce this risk significantly to minor status.

5.6.4 Impact on Socio-economy

The Assessment of the potential impacts on Socio-economy, sources, rating criteria and mitigation measures are presented in Table 5.28

Table 5.28 Impacts on Socio-economy

Impact Statement	Sources of Impact	Impact on Socio-economy	
SE3 (A): Development of new infrastructures or improvement to existing ones.	Processing of agro products Transportation of raw materials as well as finished products	Impact criteria	Rating
		Legislature	
		Stakeholder concern	

		Severity	
		Scale	
		frequency	
		Overall rating	
		Impact Significance	**Positive**

The functionality of the industrial park will result in the improvement of social services infrastructure in the area and a reduced cost of providing these services. The facility will offer supplying opportunities for skilled and unskilled PACs members; hence, the impact on infrastructure during operation and maintenance is Beneficial.

5.6.5 Impact on Community/Occupational Health, Safety and security

The Assessment of the potential impacts on Health, Safety and security, sources, rating criteria and mitigation measures are presented in Tables 5.29

Table 5.29 Impacts on Health, Safety and security

Impact Statement	Sources of Impact	Impact on Health, Safety and security	
Health issues from exposure to noise, odour from wastewater effluents, potential attack from pests as a result of breeding sites for pest proliferation Death and injury from accidents during transport of raw materials and finished products. Impacts during maintenance of shared	Operation of the processing facility	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	1
		Frequency	5

facilities		Overall rating	50
		Impact Significance	**Medium**

Health issues from exposure to noise, odour from wastewater effluents, potential attack from pests as a result of breeding sites for pest proliferation, death and injury from electrocution, accidents during transport of raw materials and finished products, impacts during maintenance of shared facilities and other work-related injuries could occur, mainly as workers may not be familiar with the operational methods and machinery. Implementation of mitigation measures shall reduce the impact to a medium level.

5.6.6 Impact on waste

The Assessment of the potential impacts on waste, sources, rating criteria and mitigation measures are presented in Tables 5.30

Table 5.30 Impacts on waste

Impact Statement	Sources of Impact	Impact on Surface water quality	
Waste generation from different operations in the industrial park	Wastewater effluents Solid wastes from processing activities Spent/used oils	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	3
		Frequency	5
		Overall rating	60
		Impact Significance	**High**

Improper management of waste may result in environmental and human health hazards such as pollution and disease. Improper managing of waste oils could result in soil contamination and contamination of

groundwater and surface watercourses (through seepage and surface runoff). This impact has been ranked High. However, the application of management measures will help reduce this risk to Medium status.

5.6.7 Impact on Emergency Response and Disaster Management

The Assessment of the potential impacts on Emergency Response and Disaster Management, sources, rating criteria and mitigation measures are presented in Tables 5.31

Table 5.31 Impacts on waste

Impact Statement	Sources of Impact	Impact on Surface water quality	
Emergency Response and Disaster Management	Loss of life, injury, damage to equipment, fire outbreaks, building collapse	Impact criteria	Rating
		Legislature	3
		Stakeholder concern	3
		Severity	3
		Scale	2
		Frequency	3
		Overall rating	33
		Impact Significance	**Medium**

5.7: Decommissioning Phase Impacts

The decommissioning phase refers to all the activities related to the proposed agro-industrial park when it is no longer in use. During the decommissioning phase, the demolition activities are likely to have similar impacts on the environment identified for the construction phase. These include potential consequences such as sedimentation, surface water, visual impact, air and noise pollution, risk of fires and explosions, safety and security and traffic impacts etc. Impacts arising from decommissioning activities have been ranked with significance levels of Low to High.

5.8 Cumulative Impacts

Defining Cumulative Impacts

In theory, any development such as the proposed Project may be taking place simultaneously as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential outcome will be cumulative. According to the Performance Standard, cumulative impacts can be defined as impacts that:

“result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process are conducted."

Generally, Cumulative Impacts are considered to be impacts that act with impacts from other projects such that:

- The sum of the impacts is greater than the parts; or
- The sum of the effects reaches a threshold level such that the impact becomes significant.

The types of cumulative impacts that may be of relevance are detailed below:

- **Accumulative**: the overall effect of different types of impacts at the same location. An example would be fugitive dust emissions, construction noise and construction traffic, impacting the local communities as a nuisance/ disturbance.
- **Interactive**: where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important) (e.g. water abstraction from a watercourse might exacerbate the consequences caused by increased sediment loading).
- **Additive** or **In-combination**: where impacts from the primary activity (i.e. the construction and operation of the Project) are added to impacts from third-party activities, e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future).

Identification of Relevant Development(s)

The cumulative impact assessment focuses on the combined effects of the Project with potential future development in the immediate area around the Project site. The cumulative assessment impacts the potential project in view, depending on the status of other projects and the level of data available to characterize the magnitude of the impacts.

Given the paucity of available information regarding such future developments, this assessment follows a generic pattern. It focuses on critical issues and sensitivities for this project and how these might be influenced by cumulative impacts with a combination of other developments. Consultations with local and state authorities and identification of relevant and significant developments via searches of relevant documents provided invaluable assistant in this assessment. The main developments identified are cumulative impacts from other projects within 2km SoI. The list of

projects around the sphere of influence (SoI) is highlighted in Table 5.32. Figure 5.1: Existing projects within the sphere of influence.

Fig. 5.1: Existing projects within the sphere of influence

Table 5.32: Facilities within 2km Radius that could potentially contribute to Cumulative Impacts

S/N	Name of Business	Nature of Activity	Environmental/Social Impact	Remarks
1	Modern market	Selling of goods and services	Noise pollution Waste generation Air pollution	Ambient Air/Noise quality: The release of consistent noise, gaseous pollutants that are harmful to human health, increased traffic and accident risk from the listed facilities within 2km sphere of influence to the proposed project from the existing facilities (markets, agro-processing facility and the industrial area among other facilities) will add up to that which will be generated from the proposed agro-industrial park. Hence this can cause hearing impairment, render the air toxic and further deteriorate the environment. It can also lead to loss of life in case of accidents and increased pressure on the existing facilities of the area, including road, electricity hospital, etc., in this light; effort shall be made to manage waste and monitor for air and noise quality. Waste: waste from these existing facilities will add to the proposed project and, if not properly managed, may cause environmental effects to both the workers and the communities around the project area. Traffic: The movement of vehicles transporting raw materials and finished products to and from the proposed facility
2	Goshen sachet water company	Production, packaging and distribution of sachet water	Waste generation Noise pollution Air pollution Risk of accident Increase in traffic	
3	Tergram industries.	Processing and transport of agro products	Waste generation Noise pollution Air pollution Impact on soil quality Risk of accident Increase in traffic	
4	Fertilizer company	Production and distribution of fertilizer	Waste generation Noise pollution Impact on soil quality Air pollution Risk of accident Increase in traffic	
5	Industrial area	Agro processing	Waste generation	

		firms	Noise pollution Air pollution Impact on soil quality Risk of accident Increase in traffic	respectively will add to the existing traffic of the project area. This will, in turn, increased the rate of accident risk within the project area. On soil, maintenance activities, movement of vehicles, accidental spills, etc., will further deteriorate the soil quality in the project area and its surroundings. On the Economy, Employment and Skills: The operation of the various considered projects outlined will co-occur with the proposed project. The economic, employment and skills development opportunities will be more significant 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. If 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 are expected to be positive.
6	Ankpa-Aukpa Road	Transport of men, goods and services	Noise pollution Air pollution Risk of accident Impact on soil quality Increase in traffic	
7	Timber market	Selling of timber products	Waste generation Noise pollution Air pollution	
8	Oracle and Hen Farms	Farming activity	Waste generation Impact on soil quality	

CHAPTER SIX: MITIGATION MEASURES

6.1 Introduction

As presented in Chapter 5, the proposed Agro-industrial park and associated project can impact the various components of the biophysical, health and social environment of the project area. The identified negative impacts have been ranked variously as High, Medium and Minor. To preserve the environment, several steps have been taken to mitigate the significant, medium ranking negative impacts and enhance those impacts identified as positive. The mitigation measures proffered for the predicted impacts of the proposed project activities took cognizance of the following:

- ✧ Environmental laws and regulations in Nigeria, with emphasis on permissible limits for waste streams (FMEnv. (formerly FEPA), 1991);
- ✧ Best available Technology for Sustainable Development;
- ✧ Feasibility of application of the proposed mitigation measures;
- ✧ View and concerns of stakeholders as expressed during consultations carried out during the study.

The residual effects that may remain after applying the impact mitigation measures have also been discussed for further reduction of residual impacts to as low level as possible.

6.2 Mitigation Methodology

6.2.1 Definition of Mitigation Measures

Mitigation measures are developed to avoid, reduce, remedy or compensate for any adverse impacts identified and create or enhance positive impacts such as environmental and social benefits. For this project, the mitigation hierachy used is **Minimisation** (reduction), as the probable project impact cannnot be avoided. In this context, the term “mitigation measures” includes operational controls and management actions. These measures are often established through industry standards and may include:

- ✧ changes to the design of the project during the design process (e.g., changing the development approach);
- ✧ operational plans and procedures (e.g. waste management plans)

For impacts assessed to be of Major significance, a change in design or layout is usually required to avoid or reduce these. For impacts assessed to be of Moderate significance, specific mitigation measures such as engineering controls are usually required to reduce these impacts to As Low As Reasonably Practicable (ALARP) levels. This approach takes into account the technical and financial feasibility of mitigation measures. Impacts of Minor significance are usually managed through good industry practice, operational plans and procedures and negligible impacts require no mitigation action, other than those already included in the project design.

In developing mitigation measures, the first focus is on measures that will prevent or minimize impacts through the design and management of the project rather than on reinstatement and compensation measures.

6.2.2 Assessing Residual Impacts

Impact prediction considers any mitigation, control, and operational management measure part of the project design and plan. A residual impact is the impact that is predicted to remain once mitigation measures have been designed into the intended activity. The residual impacts are described in terms of their significance following the categories identified in Chapter 5.

Social, economic and biophysical impacts are inherently and inextricably interconnected, and change in any of these domains will lead to changes in the other domains. This section looks at how the local way of life might change due to the proposed Project. Potential changes to local culture, livelihoods, health and well-being, and personal and communal property rights are examined.

Table 6.1 Responsibilities for Implementation and Monitoring of Mitigation Measure (Pre-construction/Construction Phase)

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
Air quality/ Climate change	Localised impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NOx, CO_2, PM) Elevated dusted levels in nearby communities result from the dust raised by vehicle movements, wind, and handling	Affected communities in the area of influence	High	- Maintain and operate all vehicles and equipment engines under manufacturers recommendations - Restrict clearance to project footprint - Dust minimisation measures shall be implemented, including watering the construction areas, including the road surfaces before construction. - Soil stockpiles and stores of friable material will be covered to reduce the potential for fugitive emissions of dust where possible. - Vehicles carrying friable materials will be enclosed or sheeted.	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
	of dusty material. GHGs emissions that could addto climate change effects			- Loading, unloading and handling of dusty materials will only be carried out in designated areas. - Workers would be provided with dust protection PPE. Effective preventative maintenance established to ensure all construction equipment is maintained in good working order not to produce an inordinate/excessive amount of exhaust emissions. Construction machinery will not be allowed to remain in idle mode over extended periods. Use ozone-depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane, and halogenated hydro Bromo fluorocarbons (HBFCs) will not be permitted.	
Noise, vibration &	Nuisance noise from construction activities	Affected communities in the	High	A detailed noise control plan for relevant work practices shall be used to during health & safety	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
EMF		area of influence Construction workers		briefings with construction staffs Select 'low noise' equipment or methods of work Restrict construction activities to day-time Avoid dropping materials from height, where practicable. Avoid metal-to-metal contact on equipment. Activities producing excessive noise levels will be restricted to the day-time, and equipment typically producing high levels of noise will be suppressed or screened when working within a distance of some 200 m from any sensitive noise receptors (particularly along access road alignments) Near places of worship, construction producing nuisance level noise be minimised or rescheduled so as not to occur on a locally recognised religious day.	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				This is particularly relevant along the access road alignment. Work areas will be organised and operated to restrict noise levels not to exceed recommended thresholds at the nearest sensitive receptor during everyday activities. As current noise levels in and around the project area already exceed this threshold value, the project will strive not to cause more than a 3dB increase in measured ambient levels during normal activities. Advance notice will be given to communities if short-term noisy construction activities occur, which could cause these levels to be exceeded. Measures to minimise noise during construction will include: • locating and orientating equipment to maximise the distance and to direct noise	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				emissions away from sensitive areas; • using buildings, earthworks and material stockpiles as noise barriers where possible, and • turning off equipment when not in use. A preventative maintenance program established for equipment and vehicles to not emit excessive noise or vibration due to inadequate maintenance or damage Personnel will be made aware of the importance of minimising noise and the required measures in this regard.	
Soils, geology and land-use	-Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation, etc.	The soil on the construction site	High	Construction of foundations to be undertaken in the dry season. Backfill foundation pits by the excavated soils, which will resemble the order of the original soil layers.	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				Protect excavated soil materials from erosion. Ensure that the land is physically restored (include re-vegetation where possible) before the next rainy season. Accidental spills from machine maintenance shall be managed appropriately. 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	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				management contractors Safe operating practices are enforced during construction Slope stability measures will be incorporated, such as benching and installing erosion protection features such as silt barriers and sedimentation ponds. The land area to be cleared will be kept to the minimum necessary to prevent soil disturbance outside the streams. Other surface water bodies will be protected where practicable to provide natural attenuation of flows. In areas of ground clearance, topsoil will be stripped and salvaged as much as possible.	
				Implement adequate site drainage on the construction yard to allow for the directed flow of	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				surface water off-site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. Install oil/water separators and silt traps before effluent leaves the site. Minimise bare ground and stockpiles to avoid silt runoff. Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas). Remove all water accumulation within bunds using manually controlled positive lift pumps, not gravity drains. Regular checking and maintenance of all plant and equipment to minimise the risk of fuel or lubricant leakages.	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				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. Develop and implement a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly. Spreadsheet underneath the tower structure before starting any painting activity.	
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well, borehole and Fete River	Medium	Groundwater shall be used for construction in place of surface water. Rivers and streams shall not be dammed for water abstraction.	Minor

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
	The exploitation of water resources (e.g. casting of foundations) sourced from nearby water bodies through tanks.			Accidental spills from machine maintenance shall be managed appropriately. Continuous training of workers on HSE protocols Conducting daily safety briefings using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas Refueling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies and provided with secondary containment measures. The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills/leaks and take necessary measures to prevent materials from falling into the	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				river. Water for construction will be sourced from project boreholes. Water use will be monitored and recorded to maximise the efficiency of water use and minimise waste. Re-use of water will be undertaken where practical and safe.	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread and loss of grazing fields for herds. Loss of species that offer Provisioning Services	Flora and fauna and habitat in the area of influence	Medium	Restrict construction activities, including vehicle movements and material storage in the project area Promote the use of existing access roads for machinery and vehicle movements Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control. Workers would be advised not to be killed in the unlikely event animals are encountered but instead caught and released into a similar environment. Vegetation clearing will be confined to the immediate construction site.	Minor
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	Medium	Develop a code of behaviours for workers All workers to receive training on community relations and code of behaviour.	Minor

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				Employ workers majorly from host communities Management practices aimed at eliminating disease vector breeding sites. Awareness/health campaigns shall include other infectious diseases such as dysentery and cholera. Enhance ongoing consultations with local communities (with good representation) to create continuous dialogue, trust and planning of community development activities. Co-ordinate Stakeholder Engagement of all partners of the industrial site, prepare and implement Stakeholder Engagement Plan Develop a health plan to address potential health issues	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				Initiate /enforce corporate health awareness programs for malaria, AIDS, etc.) Provide site medical personnel to attend to emergencies 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 the emergency response plan. Ensure availability of first aid facilities onsite Provide information, education and communication	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				about safe uses of water and occupational hygiene and safety Ensure Environmental Management for vector control and avoidance via settlement location Develop and implement safe food storage and handling practices	
Employment and economy	Creation of temporary jobs for residents and Nigerian nationals with skilled trades Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Residents of affected communities, Nigerian nationals, Nigerian companies and local SMEs	Positive	Prepare a local content plan to facilitate identifying and selecting qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities	Positive

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
Infrastructure	An influx of outside workers may pose additional pressure on social infrastructure, like medical costs, emergency services, water supply, solid waste management.	Affected communities in the area of influence	Medium	Co-ordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. Install proper and independent facilities at the construction site for water supply, sanitation, solid, liquid waste, medical services, fire-fighting equipment etc., so that pressure on community infrastructure is limited. Funding of local community projects to compensate for impacts.	Minor
Traffic congestion	Risk of Road Traffic Accidents, and Kidnapping Traffic Congestion	Workers and people in the affected communities	Medium	Implement a traffic safety plan including design of access point, signalisation, speed limits, training of drivers, use of traffic guards, procedures for the transport of oversized loads (e.g., engines), Maintain a log of traffic-related incidents, sensitisation of road users and people living close to the construction site.	Minor

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				All vehicles are certified road/water worthy before being mobilised for work activities. Compliance with all roads safety transport rules, including speed limits Competency training and certification of drivers before mobilisation. Limit movement to day time 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	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				used on transport vehicles and boats when warranted Co-ordinate 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 the shortest time practicable. Develop appropriate strategies to minimise the need for transportation of supplies Ensure compliance with all applicable laws, such as maximum load restriction and speed limits Community consultations and meetings on the ongoing road works and related hazards will be held. Active sites will be sealed off from the public using reflective tapes and cones; where necessary, road	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				diversions will be created. Road safety initiatives will be developed and implemented, including: Ensuring that only qualified (licenced) drivers operate machinery; Enforcing speed limits and traffic control measures in appropriate locations; Implementing road safety signage; Installing speed control devices such as governors on trucks.	
Visual amenities	Visual effects (Aesthetics)	Project area	Medium	Restore temporal work zones after construction Maintain orderliness in the work area Proper handling (treatment and disposal) of generated waste	Minor
Workplace Health and Safety	Risk of workplace accidents and hazards	Workers at the construction site	High	Develop project-specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training	Medium

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				and certifications to be followed by all workers, including subcontractors. Especially slip-trip and fall hazards 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 before commencement of work. Ensure SHE briefings, job hazards identification and controls, before the commencement of work	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				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 day-time only. Ensure availability of first aid facilities onsite Ensure retainer clinics are engaged and site medical personnel are available in case of accidents. Maintain a 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	

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures ***(the proponent shall ensure the execution of the under listed mitigation measures)***	post-mitigation Significance
				Ensure storage areas are identified with caution signs. Educate workforce on risks associated with storage areas and prohibit activities (such as smoking) that can ignite storage tanks Designate no-smoking and smoke areas Hold SHE meetings and talks on fire hazard design work area to internationally acceptable standards The contractor will be required to submit an OHS management plan. Workers will be provided with all the required PPE. Toolbox talks will be carried out daily on safe work practices and other OHS issues.	

6.3 Summary of public consultations and the opinions expressed

Table 6.2: Summary of consultations

Site	Date and venue	Name of Stakeholder	Outcome
ROUND 1			
Makurdi	25-**09**-2020 Ministry of Agric office Makurdi	Ministry of Agriculture and Natural Resources (Proponent)	The Ministry officials and Mifor Consult team took a tour of the proposed sites, including the Makurdi Industrial Park.
Makurdi Industrial Park	25-09-2020 Industrial layout	Private entrepreneurs and intermediaries in the supply and distribution chain	The engagement noted farmers concerns on the flooding of paddies due to incomplete and blocked canalization, bulk purchases by aggregators from the farmers who then supply to processing mills at exorbitant prices. Oracle firm called for the damming of the Fete River. The private millers attributed input types and species and harvesting as primary determinants of processed products. The fruit processing company failed due to mismanagement.
Makurdi	26-09-2020 Tse Makurdi palace	Zakis of all communities in Makurdi LGA	The Traditional institutions gave their blessings and called for government sincerity and their gainful engagement across the project life cycle.
ROUND 2: INCEPTION MEETING ENGAGEMENT			
		FMEnv, BNMAND, AfDB Mifor Consult	The FMEnv. Deputy Director promised to communicate the briefings to the Director, Environmental Assessments and pledged that the briefs would be factored into their decision making on the project.
ROUND 3: AUTHORITY VISIT AND SCOPING WORKSHOP			

Site	Date and venue	Name of Stakeholder	Outcome
		Directorate cadre of the Ministry Rep of BNMAND and Mifor Consult	The meeting took a tour of Phase 1 and 2 vis-a-vis the allotted space. Director Fidelis Annuneh took and showed the team to a State government 16ha allotted land in Phase 11 of the Makurdi Industrial Park.
Makurdi	25th April 2021 Project land take	FMEnv, State Ministry of Environment, Federal controller, Environment, Benue State, BNMAND, BNMTI, Mifor Consult	Director Annuneh claimed that total compensation was while the Federal controller mentioned the NEPZA ESIA project site (less than 8km away) as a recent study as proximate to the industrial park site.
Makurdi	25th April 2021 Benue State Min of Agriculture conference room, Tse Makurdi place & project site	Institutional, traditional, PACs, PAPs, uptakers, farmers cooperatives, aggregators, and owners of agro-processing firms	The details of the meeting are in the submitted and approved scoping report. Nonetheless, the outcome was immediately factored into the formal terms of reference for the data-gathering exercise.
ROUND 4 CONSULTATION: DATA GATHERING EXERCISE			
Date and venue			**Outcome**
26th May 2021 Tse Makurdi palace			A roster of community engagement was developed and circulated.
ESIA COMMUNITY /HOUSEHOLD ENGAGEMENT- @ ZAKI'S RESIDENCE			

Site	Date and venue	Name of Stakeholder	Outcome
Date and venue			**Outcome**
28/04/2021 Agber			The community engagement harvested data across community governance structure, history, grievance redress mechanisms, cultural heritage, belief systems, gender issues, household social, cultural and health infrastructures. Energy consumption rates were also obtained.
28/04/2021 Iorbee			
26/04/2021 Kigir			
28/04/2021 Kwaghtamen			
26/04/2021 Tionsha			
27/04/2021 Tse agube			
27/04/2021 Tse atoor			
27/04/2021 Tse Chahul			
27/04/2021 Tse Gbum			
26/04/2021 Tse Khave			
26/04/2021 Tse Perver			
ENGAGEMENT WITH RICE, CASSAVA AND HORTICULTURAL CROPS ASSOCIATION AND COOPERATIVES			
Makurdi 26th May 2021	The meeting resolved for an aggressive and sustained sensitization campaign of rice, cassava and horticultural crops that will boost production and enlarge the numbers of cooperatives and aggregators.		

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Introduction

This chapter provides the Environmental and Social Management Plan (ESMP) for the proposed Benue State Agro-processing park project. Elements of this plan will be taken forward and incorporated into a comprehensive project Environmental and Social Management System (ESMS) that will be used to deliver the Project's HSE regulatory compliance objectives and other related commitments.

This ESMP is a delivery mechanism for environmental and social mitigation and enhancement measures made in the ESIA Report. The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. Therefore, the ESMP is a management tool used to ensure that undue or reasonably avoidable adverse impacts of initial preconstruction, construction, operation and decommissioning are prevented or reduced and that the positive benefits of the Projects are enhanced (Lochner, 2005).

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the AfDB ecological and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS). The ESMP is intended to cover those activities described in Chapter four of this EIA report; this includes project activities during the initial preconstruction, construction, operation (actions on the shared facilities) and decommissioning and will be subject to thorough reviews before the commencement of activities to ensure completeness. The ESMP does not include measures for actions related to equipment and facility fabrication being done off-site. It should be noted that this provides the outline requirements for environmental management. The ESMP will be updated once the detailed project design is completed and adapted. The ESMP to will serve as part of the overall project ESMS.

The ESMP details the mitigation and enhancement measures the client has committed to implement through the Project's life and includes desired outcomes, performance indicators, targets or acceptance criteria, monitoring and timing for actions and responsibilities. Suppose during the construction and operational phase; the impact is found to be

higher than initially predicted; additional mitigation measures will need to be implemented to control, reduce or prevent an impact from occurring. Therefore, the ESMP is a dynamic document that will need to be continuously updated and amended as necessary throughout the project life cycle to ensure that any negative impacts from the Project are prevented or reduced, and positive ones are enhanced. Any significant changes will need to be discussed with the Federal Ministry of Environment and the AfDB.

The total cost of implementing the ESMP should be presented, and included in the Executive Summary (for Executive Decision-making) in the revised report.

7.2 Objectives of the ESMP

The ESMP is needed to successfully manage the project's environmental and social performance throughout its lifecycle. It integrates social and ecological management with overall project engineering, procurement, construction, and operations. The ESMP is prepared to achieve the following objectives:

- promote environmental and social control in the project implementation in all phases;
- ensure that all relevant stakeholders are aware of their respective responsibility -promoter, contractors, regulators and other relevant agencies;
- incorporate environmental and social management into project design and operating procedures and activities;
- serve as an action plan for social and ecological management for the project;
- provide a framework for implementing environmental and social commitments (such as mitigation measures identified in the ESIA);
- prepare and maintain project ecological and social performance records for monitoring and evaluating performance monitoring, audits and non-compliance tracking).

7.3 Institutional Framework for Implementation of the ESMP

Responsibilities in implementing and monitoring the ESMP are shared between multiple stakeholders, including regulatory and concerned agencies, the AfDB-PIU, the Ministry, and the contractors. These are represented in Figure 7.1

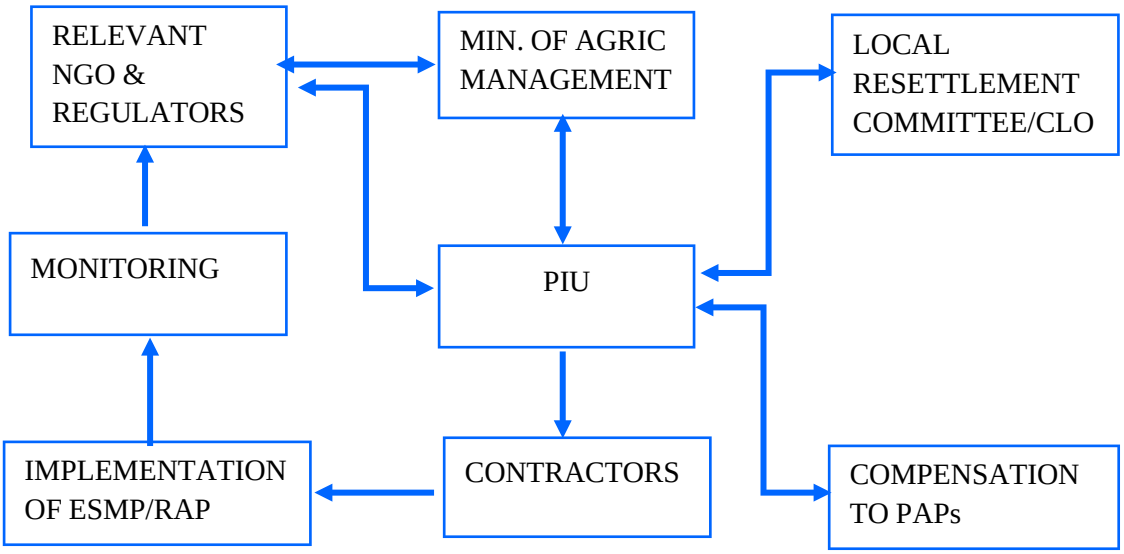

Figure 7.1 Institutional Arrangements for the implementation of ESMP of the Benue Agro-Industrial Park Project.

Figure 7.2 is the organogram for the Benue State Ministry of Agriculture and Natural Resources

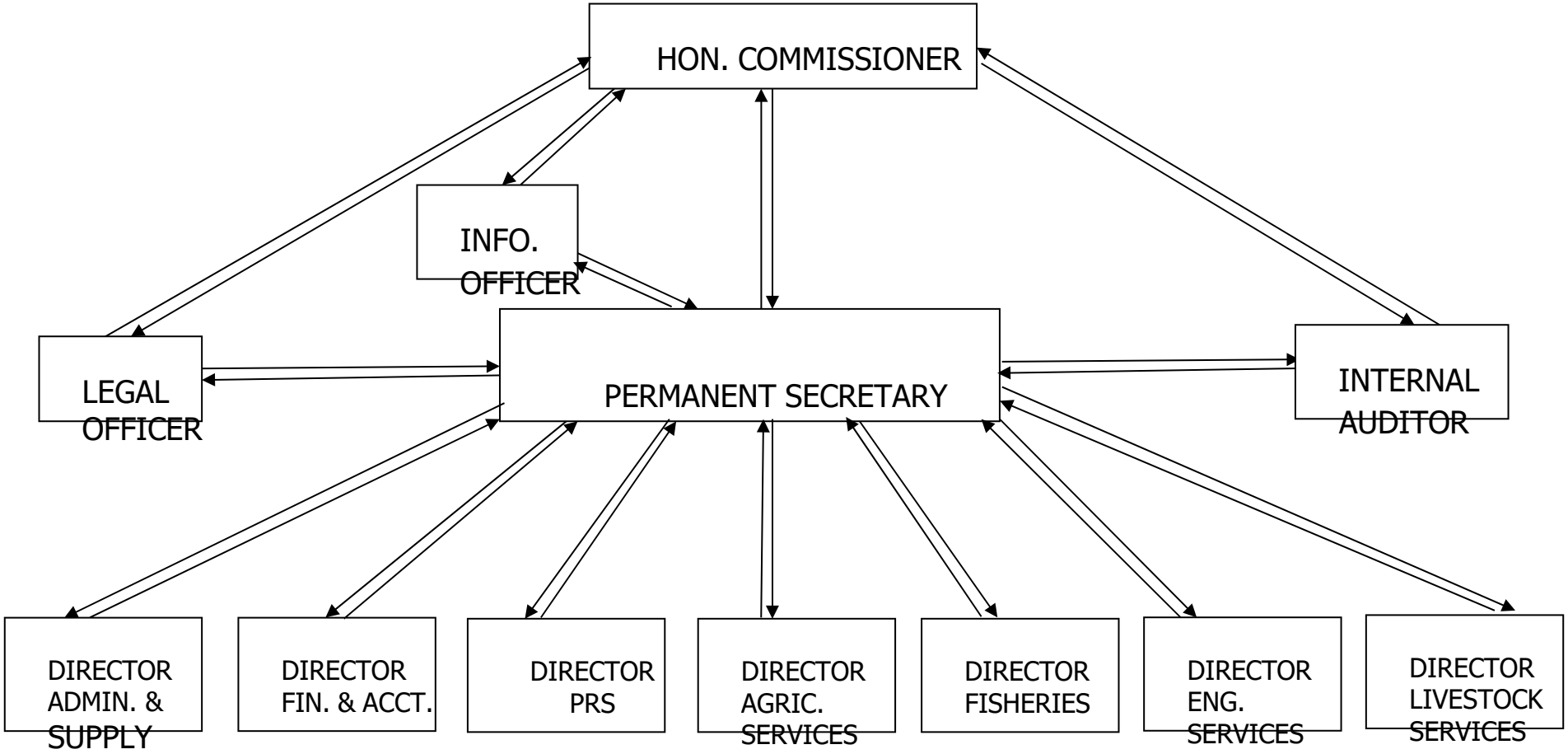

Figure 7.2 Benue State Ministry of Agriculture and Natural Resources

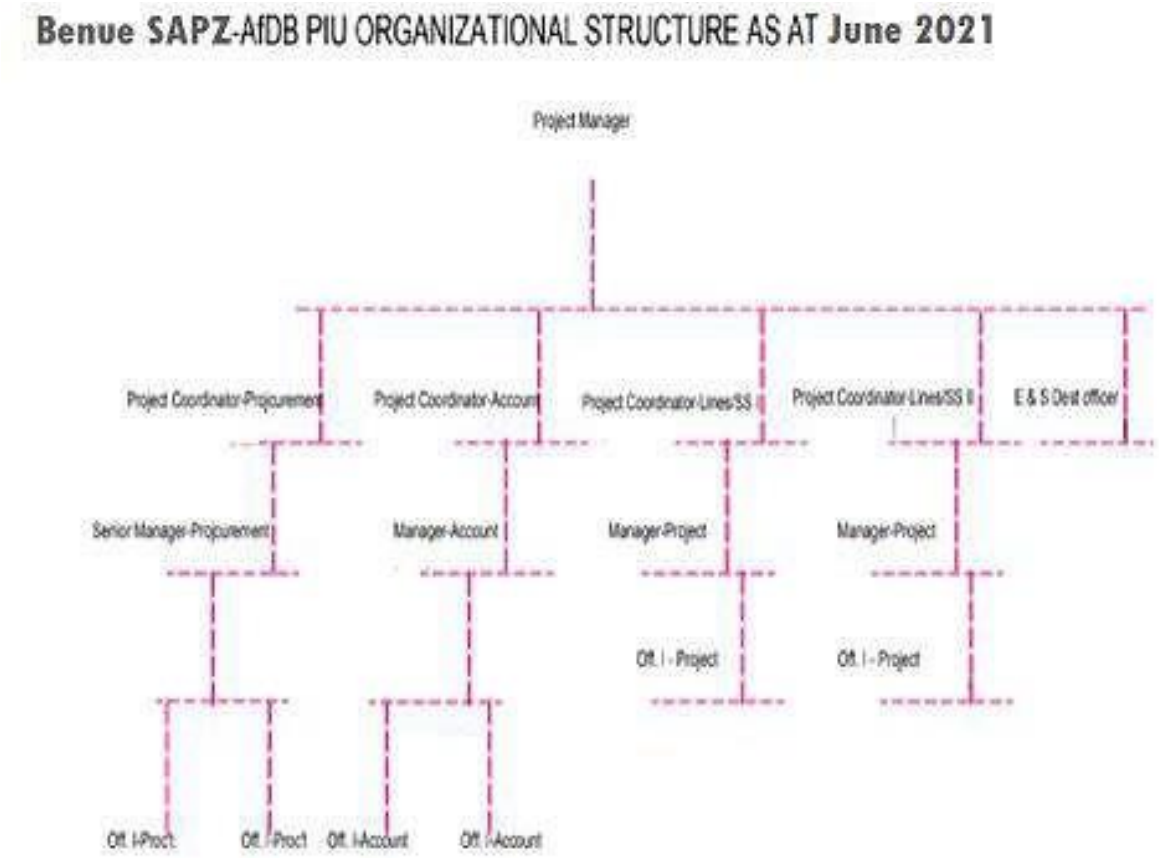

Fig 7.3: Organogram of the BNMAND-AfDB PIU (Roles are yet to be filled) The

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

Overall:

- The Benue State Ministry of Agriculture and Natural Resources will have principal responsibility for all measures outlined in the ESMP for the construction phase.
- The Ministry is responsible for the implementation of the measures in the operation phase.
- Both may delegate responsibility to their contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, this is indicated in Tables 7.2 and 7.3
- Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.

The Project Implementation Unit (PIU) will manage the project.

The PIU shall hire and manage contractors; a witness NGO shall be accredited to monitor and evaluate the implementation of the ESMP to a certain extent. The contractors are responsible for the

performance of the ESMP. Overall regulatory agencies at the National, State and Local Government levels are accountable for implementing ESMP.

7.3.1 Project Proponent (Benue State Ministry of Agriculture and Natural Resources)

The Ministry is the implementation agency for this project. Hence, it has the overall responsibility for its success. The Ministry Management has established the PIU for the proposed project to handle this responsibility. The PIU is headed by a Project Manager who reports to the Director, planning, research and statistics.

7.3.2 Project Implementation Unit (PIU)

The PIU set up by the Ministry-AfDB is saddled with the responsibility of project implementation. A Project Manager heads it. Members of the PIU consist of technical experts and environmental, social, and two liaison officers appointed drawn from relevant ministry departments, including HSE, Projects, procurement, planning, etc.

PIU is responsible for the overall project planning and execution, including preparing bidding documents, hiring project management consultants, EPC contractors, and supervising the works. This approach includes ensuring proper implementation of the environmental and social management measures contained in the ESMP and monitoring.

To provide additional oversight, the project PIU will retain the services of Mifor Consult Nig. Ltd. to manage the ESMP implementation. The PIU will also invite relevant NGOs to monitor and ensure the adequate performance of the ESMP.

7.3.3 The Ministry's HSE Department

The HSE department shall be responsible for ensuring the implementation of management measures during the operation phase (post-commissioning), including audits, compliance monitoring, and preparation of periodic reports required by regulations to the operations.

7.3.4 Regulatory Agencies and Other Concerned Authorities

The Federal Ministry of Environment (FMEnv.) is responsible for implementing the EIA Act 86 of 1992. Furthermore, State Ministry for Environment (Benue State) and the affected LGA (Makurdi) has specific oversight roles, which they perform under the 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 proponent and the contractors as presented (Table 7.1).

Table 7.1: Project implementation unit (PIU), proponent and contractors

No	Steps/Activities	Responsible	Collaboration	Service Provider
1.	Identification and siting of the project	PIU	• State authorities	Specialist Consultant
2.	Screening, categorization and identification of the required instrument (national EIA procedure)	Env. safeguards specialist (ESS) on the PIU	• beneficiary; local authority; Social Safeguards Specialist (SSS) on the PIU, FMEnv. and AfDB	Specialist Consultant
3.	Approval of the classification and the selected instrument by the Public EA Agency	PIE coordinator	• ESS-PIU; SSS-PIU	• Public EA Agency (PEA-FMEnv.) • The Bank
4.	Preparation of the safeguard document/instrument (ESIA, Env. Audit, simple ESMP, etc.) following the national legislation/procedure (considering the Bank policies' requirements)			
	Preparation and approval of the ToRs	ESS-PIU		• The Bank
	Preparation of the report		• Procurement specialist (PS-PIU); SSS-PIU; Local authority	• Consultant
	Report validation and issuance of the permit (when required)		• Procurement specialist (PS-PIU); SSS-PIU; Local authority	• Public EA Agency (PEA); The Bank
	Disclosure of the document		Project Coordinator	• Media; The Bank; Supervising engineer; PEA
	(i) Integrating the construction			

No	Steps/Activities	Responsible	Collaboration	Service Provider
4.	phase mitigation measures and E&S clauses in the bidding document prior advertisement; (ii) ensuring that the constructor prepares his ESMP (C-ESMP), gets it approved and integrates the relevant measures in the works breakdown structure (WBS) or execution plan.	Technical staff in charge of the project (TS-PIU)	• ESS-PIU; PS-PIU	Procurement Specialist
5.	Implementation of the other safeguards measures, including environmental monitoring (when relevant) and sensitisation activities	ESS-PIU	• SSS-PIU, PS-PIU; TS-PIU; Financial Staff (FS-PIU); Local authority	• Consultant; National specialised laboratories; NGOs; State Ministries and Local Government Councils
6.	Oversight of safeguards implementation (internal)	SSES	• Monitoring and Evaluation Specialist (M&E-PIU); FS-PIU; State and Local Governments	•Control Firm (Supervisor)
	Reporting on project safeguards performance and disclosure	Coordinator	• M&E-PIU; ESS-PIU; SSS-PIU	M&E specialist and technical officer
	External oversight of the project safeguards compliance/performance.	FMEnv.	•M&E-PIU; ESS-PIU; SSS-PIU; PS-PIU; Supervisor	Consultant
7.	Building stakeholders' capacity in safeguards management	ESS-PIU	•SSS-PIU; PS-PIU	• Consultant •NGOs • Other qualified

No	Steps/Activities	Responsible	Collaboration	Service Provider
				public institutions • The Bank
8.	Independent evaluation of the safeguards performance (Audit)	ESS-PIU	• SSS-PIU; PS-PIU	• Consultant

*The Bank= AfDB

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

The Federal Government of Nigeria

Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the Country. It has the responsibility for ESIA implementation and approval under the EIA Act. It has developed specific guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures when the project commences. And they can issue directives to the project on specific actions related to the environment in the project area. The Ministry involves the States typically and sometimes local governments in this responsibility depending on the particular activity.

Benue State Ministry of Water Resources and Environment

The Environment department of the ministry manages both human and industrial waste, protect and conserve the environment as well as enforce laws on environment in the state.

Project Implementation Unit (PIU)

The PIU is a unit established by the proponent responsible for the end-to-end delivery of any SAPZ project in Benue State, including planning, feasibility, ESIA, engineering, procurement and construction (EPC). Furthermore, the PIU shall ensure:

- Proper implementation of the ESMP
- Supervise the EPC contractor in conjunction with the Owner Engineers in Project Department to ensure implementation of management measures.
- Implementation of community-approved projects financed through the EPC contractors.
- Production of monitoring reports to appropriate government authorities, Ministry of Agriculture and the contractor in charge of the project.

Benue State Ministry of Agriculture and Natural Resources

Benue State Ministry of Agriculture and Natural Resources is primarily responsible for planning, formulation, implementation and coordination of agricultural policies of the State. The Ministry is the implementation agency for this project. Hence, it has the overall responsibility for its success.

Benue State Ministry of Physical Planning and Urban Development (renewal) (BSMPPUD)

The Bureau's core mandate is to strengthen land administration, acquire, prepare, allocate and register all land transactions, and physically plan non-urban centres in the State. The Bureau Benue state Ministry of Physical Planning and Urban Development (renewal) (BSMPPUD) has is an agency under the Ministry's supervision.

The functions of the Agency include:

- Land acquisition
- Compensation
- Land allocation
- Processing of Certificates of Occupancy for production and collection
- Registration of land transaction
- Change of land use purpose
- The merger of land titles
- Renewal of land ownership (Re-grant)
- Conversion of land titles
- Non-urban services (planning recommendation, building plan approval)
- Geographical information services
- Project management of metropolitan and other Urban Roads

Benue State Environmental Protection Agency (BSEPA)

The agencies are responsible for preparing and updating periodic master plans for the development of environmental science and technology and advise the government of the financial and material required for the implementation of such programs; to establish a mechanism to predict ecological disasters; identify the problems of drainage and sewage systems and carry out measures to improve, protect and remedy their ecosystems, also protection and development of the environment and also ensuring a healthy environment.

Benue State Ministry of Trade and Investment

This ministry is responsible for creating a conducive environment for the promotion of Investment and development of Sustainable Industries and Trade, with a view to diversifying and growing the economy, creating wealth and employment, so that there is prosperity for all.

Benue State Ministry of Transport (BSMT)

The significant roles of the Ministry are;

- To formulate and implement effective policies regarding road transportation to ensure that adequate road safety measures are implemented across the State.
- To co-ordinate the creation of motor parks, identification and development of railways and river transportation.
- To ensure effective and efficient movement of goods and services that will enhance socio-economic growth throughout the states.

Benue State Ministry of Health/Women Affairs and Social Development (BSMH/WASD):

The responsibilities of the Ministries in the State are to facilitate efforts in providing micro credits to the disadvantaged women from donor agencies (UNICEF, UNFPA), strengthen the capacity of caregivers, OVC, NCOS, and CSO sensitise Abia women on the issues of child rights, HIV/AIDS, harmful traditional practices initiate programs that promote the economic empowerment of women provide decent health care delivery, in reducing maternal mortality and morbidity by collaborating with the Ministry of health and also strengthen the child's parliament through seminars exchange programmes, debates, radio/TV shows.

Benue State Ministry of Land Survey Housing and Urban Planning (BSMLSHUP)

The Ministry is vested with the authority of land administration. They are also charged with the survey of state lands, determination of land use and control, compensations, housing policies and urban development. The Ministry is also responsible for the supervision of the PIU, mapping and surveying, registration of title to lands, development and maintenance of open spaces.

Local Government Areas (LGAs)

The project is located at Makurdi LGA. This LGA is involved in the ESIA approval process. According to the national EIA requirement, the LGA will have representatives in the panel that will review the report and advise the Minister to make decisions on the project.

The Customary District Councils

The Zaki (traditional head of chiefdom) has an essential role in the project concerning mobilising the community members to support the project, grievance redress, peace and security of personnel, equipment, and facilities to be installed. Close contact and regular consultation shall be maintained with customary chiefs throughout the life of the project.

Witness NGO

To enhance transparency and trust from PACs, it is suggested that a witness NGO, recognised and credible in the project area, be retained, through a public proposal and selection process, to provide independent advice, and report on ESMP implementation and management, focusing on consultation activities, corporate social responsibilities/related activities and grievances management. This NGO could be a recognised and credible Human Right advocacy group or an NGO active in rural, environmental, social or development.

This outside look will ensure that proper procedure and stated ESMP processes are followed, that PACs grievances are well taken care of, and that PACs are treated with fairness. This model of supervision is consistent with best practice nationally and internationally. It will ensure that the process is fair and equitable with net positive benefits for the PACs. It also minimises grievances.

Contractor Environmental Manager

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU, will be responsible for daily management onsite and the respect of management measures from the ESMP. This manager will regularly report to the environment and social expert of the PIU during the entire construction period.

Contractors must hold all necessary licenses and permits before the work begins. It will occur to provide to the PIU all of the required legal documents, among which the signed agreements with owners, authorisations for borrow pits and temporary storage sites, etc.

Communities (Community Liaison Officers)

Leaders and traditional institutions of the affected communities will assist in public sensitisation effort to advance the implementation of ESMP.

7.4 Communication

After the transfer of operation, the state government will maintain a formal communication procedure with the regulatory authorities and communities. The E & S Manager in the PIU is responsible for transmitting HSE issues to and from regulatory authorities whenever required. Meetings will be held, as needed, between the state government and the appropriate regulatory agency and community

representatives to review ESMP implementation, health and safety issues and community relationships during implementation performance, areas of concern and emerging issues. Dealings will be transparent, and stakeholders will have access to personnel and information to address concerns raised.

The Project will develop and implement a grievance mechanism whereby community members can raise any issues of concern. Grievances may be verbal or written and usually either specific claims for damages/injury or complaints or suggestions about how the Project is being implemented. When a grievance has been brought to the Project team's attention, it will be logged and evaluated. The person or group with the grievance must present grounds for making a complaint or claiming loss to make a proper and informed evaluation.

Where a complaint or claim is considered valid, steps are required to be undertaken to rectify the issue or agree on compensation for the loss. In all cases, the decision made and the reason for the decision will be communicated to the relevant stakeholders and recorded. Where there remains disagreement on the outcome, an arbitration proceeding may be required to be overseen by a third party (e.g. government official). Local community stakeholders will be informed on how to implement the grievance procedures.

7.5 Documentation

The Ministry of agriculture and natural resources for the operation phase will control HSE documentation, including management plans, associated procedures, checklists, forms, and reports. All records will be kept onsite and backed up at several off-site locations (including secure cloud storage facilities). Records will be held in both hard copy and soft copy formats. And all documents will be archived for the life of the project.

Furthermore, the document control procedure by the Ministry will describe the processes that the Project will employ for official communication of both hardcopy and electronic (through the internet) document deliverables. In addition, it will explain the requirement for electronic filing and posting and the assignment of document tracking and control numbers (including revision codes).

The E & S Manager of PIU is responsible for maintaining a master list of applicable HSE documents and ensuring that this list is communicated to the appropriate parties. The HSE Coordinator is responsible for providing notice to the affected parties of changes or revisions to documents, issuing revised copies, and checking that the information is communicated within that party's organisation appropriately.

The subcontractors will be required to develop a system for maintaining and controlling its HSE documentation and describe these systems in their respective HSE plans.

7.6 Operational Control Procedures

Each significant impact identified in the ESIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement, and record-keeping to avoid or reduce impacts. Operational controls are regularly monitored for compliance and effectiveness through a monitoring and auditing procedure described in the ESMP.

Operational control procedures will be reviewed and, where appropriate, amended to include instructions for planning and minimising impacts or reference relevant documents that address impact avoidance and mitigation.

7.6.1 Managing Changes to Project Activities

Changes in the Project may occur due to unanticipated situations. Adaptive changes may also occur during the final design, commissioning or even operations. The establishment of the agro-industrial park will implement a formal procedure to manage changes in the project that will apply to all project activities.

The procedure's objective is to ensure that the impact of changes on the health and safety of personnel, the environment, plant and shared equipment are identified and assessed before changes are being implemented. The management of change procedure will ensure that:

- proposed changes have a sound technical, safety, environmental, and commercial justification;
- changes are reviewed by competent personnel, and the impact of changes is reflected in documentation, including operating procedures and drawings;
- hazards resulting from changes that alter the conditions assessed in the ESIA have been identified and evaluated, and the impact(s) of changes do not adversely affect the management of health, safety or the environment;
- changes are communicated to personnel who are provided with the necessary skills, via training, to implement changes effectively; and
- the appropriate Agriculture Ministry person(s) accepts the responsibility for the change.

As information regarding the uncertainties becomes available, the Project ESMP will be updated to include that information in subsequent revisions. Environmental and social, and engineering feasibility and cost considerations will be considered when choosing between possible alternatives.

7.6.2 Emergency Preparedness and Response

The Ministry of Agriculture and natural development will prepare plans and procedures to identify the potential for and respond to environmental accidents and health and safety emergencies and prevent and mitigate potentially adverse ecological and social impacts that may be associated with them.

The Ministry will review emergency preparedness and response daily and after any accidents or emergencies to ensure that lessons learnt to inform continuous improvement.

Emergency exercises will be undertaken regularly to confirm the adequacy of response strategies.

Investigations of accidents or incidents will follow formal documented procedures.

7.6.3 Checking and Corrective Actions

Checking includes inspections and monitoring and audit activities to confirm the proper implementation of checking systems and the effectiveness of mitigations. Corrective actions include response to out-of-control situations, non-compliances, and non-conformances. Measures also include those intended to improve performance.

7.6.4 Monitoring

Monitoring will be conducted to ensure compliance with regulatory requirements and evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the ESMP Tables 7.2 and 7.3 respectively.

Monitoring methodologies or processes must be put in place to ensure the efficacy of the mitigation measures identified in the ESIA. Monitoring methodologies should be established to address the following:

- Alteration to the biological, chemical, physical, social and health characteristics of the recipient environment;
- Alterations in the interactions between project activities and environmental and social sensitivities, and interactions among the various sensitivities;
- Monitor the effectiveness of the mitigation and enhancement measures;
- Determination of long term and residual effects;
- Identification of Project-specific cumulative environmental and social effects, if applicable;
- The quarterly FMEnv. monitoring shall be performed with the involvement of the communities. This joint monitoring will support good community relations by creating trust and involvement;

- At the construction site, inspections should be performed on human resources procedures, occupational health, safety and security risks management, emergency planning and the open water on malaria larvae; and
- The recruitment, human resources procedures, HSE training and awareness of the labour force in the construction as well as the operation phase should be monitored to know their origin in line with the local content plan and the level of knowledge and awareness on the code of conduct, STD prevention and occupational H&S measures.

The FMEnv guidelines require an environmental monitoring plan as part of an ESIA. The monitoring program aims to ensure that the negative environmental and social impacts identified in this ESIA are effectively mitigated in the construction and operation stages of the Project.

7.6.5 Auditing

Beyond the regular inspection and monitoring activities conducted, audits will be carried out by the state ministry to ensure compliance with regulatory requirements as well as their HSE standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff, and the results shall be reported to the state ministry of agriculture and natural resources to be addressed.

The audit will include a review of compliance with the requirements of the ESIA and ESMP and have, at a minimum, the following:

- completeness of HSE documentation, including planning documents and inspection records;
- conformance with monitoring requirements;
- efficacy of activities to address any non-conformance with monitoring requirements; and
- training activities and record keeping.

There will be a cycle of audits into specific areas of the Project. The frequency of audits will be risk-based and will vary with the Project stage, and will depend on the results of previous audits.

A regulatory compliance audit is a mandatory requirement to be carried out by an independent accredited consultant every three years during the operation phase and the reports submitted to the Federal Ministry of Environment.

7.6.6 Corrective action

Investigating a 'near-miss or actual incident after it can be used to obtain valuable lessons and information that can be used to prevent similar or more severe occurrences in the future.

The Ministry will implement a formal non-compliance and corrective action tracking procedure to investigate the causes of and identify corrective actions to accidents or environmental or social non-

compliances. This will ensure coordinated action from EPC Contractor and its subcontractors. The HSE coordinator will be responsible for keeping records of corrective actions and overseeing the modification of environmental or social protection procedures or training programs to avoid repetition of non-conformances and non-compliances.

7.6.7 Reporting

Throughout the project, the Ministry will keep the regulatory authorities informed of the Project performance concerning HSE matters by way of written status reports and face-to-face meetings. They will prepare a report on environmental and social performance and submit it to FMEnv. The frequency of this reporting will be determined by FMEnv, in a letter of approval of the project. These reports are prepared as part of the requirements for impact mitigation monitoring carried out by FMEnv. and BSMEnvNR.

If required, the Ministry will provide appropriate HSE-related activities, including internal inspection records, training records, and reports to the relevant authorities.

Subcontractors are also required to provide HSE performance reporting to the Ministry regularly through weekly and monthly reports. These will be used as inputs to the above.

7.7 Grievance Mechanisms

During the implementation of the ESMP, it is possible that disputes/disagreements between the project developer and the PACs will occur. There are significant challenges associated with grievance redress, especially in projects of this magnitude. A grievance procedure based on community grievance resolution channels and regulatory agencies shall be used.

7.7.1 Customary Mediation

All the communities affected by this project have internal mechanisms for resolving disputes through the customary chiefdoms. Such customary avenues should provide a first culturally appropriate grievance procedure to facilitate formal or informal grievance resolution.

The PIU shall set up a Customary Grievance Redress Committee in each community to address complaints. Project Affected Persons (PAPs)' complaints should first be lodged verbally or written in the grievance register through the customary chief, who in turn will invite the PIU. The PIU and the traditional leaders, and other Councils Chiefs will try to resolve the issue amicably. If the complaint cannot be resolved at thislevel or the plaintiff is not satisfied with the settlement proposed, the matter should be reported to the regulatory agencies.

7.7.2 Regulatory Agencies

The FMEnv and BSMEnvNR have the statutory responsibility for oversight and monitoring the implementation of the ESMP. The agencies shall pronounce judgment on any environmental complaint or dispute reported to them based on regulatory requirements. At this stage, if the plaintiff is still not satisfied with the settlement, he/she can then proceed to the official legal procedures.

7.7.3 Courts of Law

The judicial process under applicable laws will be followed, and the law courts will pass binding judgment on the matter.

7.7.4 Grievance Resolution Procedures

The first level is the Village Chief (Zaki) and the PIU: The aggrieved person shall first report the matter to the Village Chief for resolution. Issues that can be resolved at this level include community quota, boundary issues, etc. The type of issues to report to the PIU for possible adjudication have perceived damage to property or means of livelihood, incorrect PAP data, infidelity to ESMP and corporate social responsibilities, etc. If the issue is not resolved at this stage, it can then be escalated to customary mediation. If still no acceptable resolution is achieved, the parties may choose to go to the regulatory agencies and, after that, to the court under the laws of the Federal Republic of Nigeria. Figure 7.4 illustrates the procedure for grievance resolution.

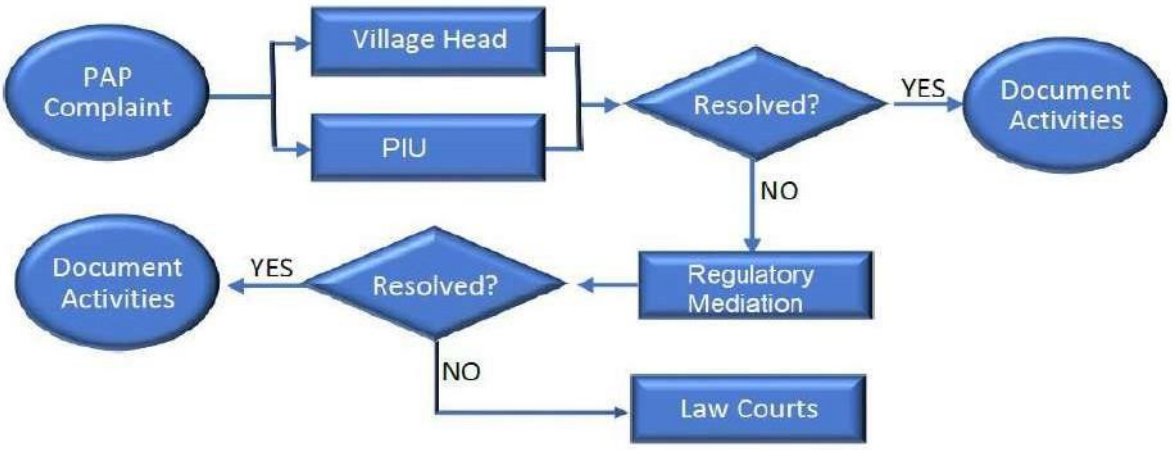

Figure 7.4: Grievance Resolution Procedures

7.8 Proposed Management Plan

The Environmental and Social mitigation/enhancement measures and the responsibilities for implementation are in Tables 7.2&7.3 respectively. The EPC contractor has responsibility for implementing the mitigation actions during the construction phase. The budget for implementation shall be included in the EPC contract as part of the overall construction cost.

The monitoring plan in Tables 7.4 and 7.5 contain details of responsibilities, parameters to be monitored. Monitoring methods and standards/targets as well as locations and monitoring frequency. The cost estimates cover costs of analyses of samples (where required), travelling expenses and regulatory costs. The budget for environmental and social monitoring during construction (Table 7.4) shall be added to the EPC contract budget. The EPC Contractor shall be required to disburse when needed, as may be directed by the Project Manager.

The budget for the monitoring during operations shall be provided by the Ministry's management in its annual budgeting process and administered directly by the appropriate authorities responsible for ensuring mitigation actions are implemented effectively. The Ministry shall adopt these measures and impose as contractual conditions on the up takers renting the sheds. Additional detailed policies and specific plans have been developed to support the implementation.

Table 7.2 Responsibilities for Implementation and Monitoring of Mitigation Measure (Preconstruction/Construction Phase)

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality/ Climate change	Localised impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NOx, CO_2, PM) Elevated dusted levels in nearby communities result from the dust raised by vehicle movements, wind, and handling of dusty material. GHG emissions that could add to climate change effects	Affected communities in the area of influence	High	- Maintain and operate all vehicles and equipment engines under manufacturers recommendations - Restrict clearance to project footprint - Dust minimisation measures shall be implemented, including watering the construction areas, including the road surfaces before construction. - Soil stockpiles and stores of friable material will be covered to reduce the potential for fugitive emissions of dust where possible. - Vehicles carrying friable materials will be enclosed or sheeted. - Loading, unloading and handling of dusty materials will only be carried out in designated areas. - Workers would be provided with dust protection PPE.	Medium	EPC Contractor	AfDB-PIU	FMENV, Markurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Effective preventative maintenance established to ensure all construction equipment is maintained in good working order not to produce an inordinate/excessive amount of exhaust emissions. Construction machinery will not be allowed to remain in idle mode over extended periods. Use ozone-depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane, and halogenated hydro Bromo fluorocarbons (HBFCs) will not be permitted.				
Noise, vibration & EMF	Nuisance noise from construction activities	Affected communities in the area of influence	High	Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings	Medium	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
		Construction workers		Select 'low noise' equipment or methods of work Restrict construction activities to day-time Avoid dropping materials from height, where practicable. Avoid metal-to-metal contact on equipment. Activities producing excessive noise levels will be restricted to the day-time, and equipment typically producing high levels of noise will be suppressed or screened when working within a distance of some 200 m from any sensitive noise receptors (particularly along access road alignments) Near places of worship, construction				BMWR& Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				producing nuisance level noise be minimised or rescheduled so as not to occur on a locally recognised religious day. This is particularly relevant along the access road alignment. Work areas will be organised and operated to restrict noise levels not to exceed recommended thresholds at the nearest sensitive receptor during everyday activities. As current noise levels in and around the project area already exceed this threshold value, the project will strive not to cause more than a 3dB increase in measured ambient levels during normal activities. Advance notice will be given to communities if short-term noisy construction activities occur, which could cause these levels to be exceeded.				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Measures to minimise noise during construction will include: • locating and orientating equipment to maximise the distance and to direct noise emissions away from sensitive areas; • using buildings, earthworks and material stockpiles as noise barriers where possible, and • turning off equipment when not in use. A preventative maintenance program established for equipment and vehicles to not emit excessive noise or vibration due to inadequate maintenance or damage Personnel will be made aware of the importance of minimising noise and the				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				required measures in this regard.				
Soils, geology and land-use	-Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation, etc	The soil on the construction site	High	Construction of foundations to be undertaken in the dry season. Backfill foundation pits by the excavated soils, which will resemble the order of the original soil layers. Protect excavated soil materials from erosion. Ensure that the land is physically restored (include re-vegetation where possible) before the next rainy season. Accidental spills from machine maintenance shall be managed appropriately. Develop project-specific waste management plan and ensure proper	Medium	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				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 Slope stability measures will be incorporated, such as benching and installing erosion protection features such as silt barriers and sedimentation ponds.				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				The land area to be cleared will be kept to the minimum necessary to prevent soil disturbance outside the streams. Other surface water bodies will be protected where practicable to provide natural attenuation of flows. In areas of ground clearance, topsoil will be stripped and salvaged as much as possible.				
				Implement adequate site drainage on the construction yard to allow for the directed flow of surface water off-site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. Install oil/water separators and silt traps before effluent leaves the site.				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Minimise bare ground and stockpiles to avoid silt runoff. Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas). Remove all water accumulation within bunds using manually controlled positive lift pumps, not gravity drains. Regular checking and maintenance of all plant and equipment to minimise 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. Set up and apply procedure regarding dealing with contaminated soils.				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Develop and implement a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly. Spreadsheet underneath the tower structure before starting any painting activity.				
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater The exploitation of water resources (e.g. casting of foundations) sourced from nearby water	Local groundwater-well, borehole and Fete River	Medium	Groundwater shall be used for construction in place of surface water. Rivers and streams shall not be dammed for water abstraction. Accidental spills from machine maintenance shall be managed appropriately. Continuous training of workers on HSE protocols	Minor	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	bodies through tanks.			Conducting daily safety briefings using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas Refueling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies and provided with secondary containment measures. The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills/leaks and take necessary measures to prevent materials from falling into the river.				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Water for construction will be sourced from project boreholes. Water use will be monitored and recorded to maximise the efficiency of water use and minimise waste. Re-use of water will be undertaken where practical and safe.				
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities Vegetation clearing will cause habitat disturbances that could create suitable conditions for	Flora and fauna and habitat in the area of influence	Medium	Restrict construction activities, including vehicle movements and material storage in the project area Promote the use of existing access roads for machinery and vehicle movements Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control.	Minor			

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	invasive species to spread and loss of grazing fields for herds. Loss of species that offer Provisioning Services			Workers would be advised not to be killed in the unlikely event animals are encountered but instead caught and released into a similar environment. Vegetation clearing will be confined to the immediate construction site.				
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	Medium	Develop a code of behaviours for workers All workers to receive training on community relations and code of behaviour. Employ workers majorly from host communities	Minor	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Management practices aimed at eliminating disease vector breeding sites. Awareness/health campaigns shall include other infectious diseases such as dysentery and cholera. Enhance ongoing consultations with local communities (with good representation) to create continuous dialogue, trust and planning of community development activities. Co-ordinate Stakeholder Engagement of all partners of the industrial site, prepare and implement Stakeholder Engagement Plan Develop a health plan to address potential health issues				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Initiate /enforce corporate health awareness programs for malaria, AIDS, etc.) Provide site medical personnel to attend to emergencies 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 the emergency response plan. Ensure availability of first aid facilities onsite				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				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 Develop and implement safe food storage and handling practices				
Employment and economy	Creation of temporary jobs for residents and Nigerian nationals with skilled trades Supply chain opportunities for Nigerian companies that can provide goods and services	Residents of affected communities, Nigerian nationals, Nigerian companies and local SMEs	Positive	Prepare a local content plan to facilitate identifying and selecting qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities	Positive	EPC Contractor	AfDB-PIU	FMENV, Markurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	needed by the company							
Infrastructure	An influx of outside workers may pose additional pressure on social infrastructure, like medical costs, emergency services, water supply, solid waste management.	Affected communities in the area of influence	Medium	Co-ordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. Install proper and independent facilities at the construction site for water supply, sanitation, solid, liquid waste, medical services, fire-fighting equipment etc., so that pressure on community infrastructure is limited. Funding of local community projects to compensate for impacts.	Minor	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and BMWR& Env
Traffic congestion	Risk of road Accidents and Kidnapping Traffic Congestion	Workers and people in the affected communities	Medium	Implement a traffic safety plan including design of access point, signalisation, speed limits, training of drivers, use of traffic guards, procedures for the transport of oversized loads (e.g., engines),	Minor	EPC Contractor	AfDB-PIU	FMENV, and Makurdi LGA Council BMWR&

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Maintain a log of traffic-related incidents, sensitisation of road users and people living close to the construction site. All vehicles are certified road/water worthy before being mobilised for work activities. Compliance with all roads safety transport rules, including speed limits Competency training and certification of drivers before mobilisation. Limit movement to day time only. Setting and enforcing speed limits of 100km/hr (major roads) 40-60km/hr (built-up areas) and 10-30km/hr				Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				(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 Co-ordinate 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 the shortest time practicable. Develop appropriate strategies to minimise the need for transportation of supplies				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Ensure compliance with all applicable laws, such as maximum load restriction and speed limits Community consultations and meetings on the ongoing road works and related hazards will be held. Active sites will be sealed off from the public using reflective tapes and cones; where necessary, road diversions will be created. Road safety initiatives will be developed and implemented, including: Ensuring that only qualified (licensed) drivers operate machinery; Enforcing speed limits and traffic control measures in appropriate locations; Implementing road safety signage;				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Installing speed control devices such as governors on trucks.				
Visual amenities	Visual effects	Project area	Medium	Restore temporal work zones after construction Maintain orderliness in the work area Proper handling (treatment and disposal) of generated waste	Minor	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and BMWR&Env
Workplace Health and Safety	Risk of workplace accidents and hazards	Workers at the construction site	High	Develop project-specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training and certifications to be followed by all workers, including subcontractors. Especially slip-trip and fall hazards and electrocution need attention. A local hiring office (or offices) to be set up for use by all contractors to advertise positions, receive applications, and	Medium	EPC Contractor	AfDB-PIU	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				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 before commencement of work. Ensure SHE briefings, job hazards identification and controls, before the 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				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Limit work activities to day-time only. Ensure availability of first aid facilities onsite Ensure retainer clinics are engaged and site medical personnel are available in case of accidents. Maintain a 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				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				with storage areas and prohibit activities (such as smoking) that can ignite storage tanks Designate no-smoking and smoke areas Hold SHE meetings and talks on fire hazard design work area to internationally acceptable standards The contractor will be required to submit an OHS management plan. Workers will be provided with all the required PPE. Toolbox talks will be carried out daily on safe work practices and other OHS issues.				

Table 7.3 Responsibilities for Implementation and Monitoring of Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Exposure to emissions from vehicles (PM10, NO_2/NOx, SOx), Gaseous release from power generating sets Odour from wastewater effluents and agro-processing processes Elevated dusted levels in nearby communities as a result of dust raised by vehicle movements, wind, and handling of dusty material	Workers on-site, communities within the industrial park	High	Dust minimisation measures shall be implemented, including watering of the access road. Speed limits will be implemented and enforced. Proper treatment of wastewater before releasing to the environment Effective preventative maintenance established to ensure all vehicles and machinery are maintained in good working order and do not adversely impact air quality due to inadequate care or	Medium	Prospective private investors	Benue state Ministry of Agric	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				damage. There are long term plans in place to implement renewable energy generation options to reduce or eliminate dependence on fossil fuel generators; and Use ozone-depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane, and halogenated hydro Bromo fluorocarbons (HBFCs) shall not be permitted.				

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Noise and vibration	Noise from: processing activities emanating from the rented sheds; generating sets; workers, sellers, etc.	Affected communities	High	Provision of noise protection PPE for use in noisy areas of the facility. Noisy machinery (e.g. generators) will be housed/ screened where possible to contain the sound to a limited area. Workers in noisy areas will not be allowed to work for more than 8hours at a time in the noisy environment. The use of PPE shall be fully ensured	Medium	Prospective private investors	Benue state Ministry of Agric	FMENV, Makurdi LGA Council and BMWR&Env
Soils, geology	Potential contamination of soil from accidental release of	Soils around the industrial	Medium	Appropriate flow diversion and erosion control structures,	Minor	Prospective private	Benue state Ministry of	FMENV, Makurdi

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
and land-use	hazardous or contaminating material, as well as from discharge of untreated wastewater effluents Compaction due to vehicular movement in conveying raw materials and finished products to and from the industrial park, respectively.	park		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 maintenance Implementation of the 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		investors	Agric	LGA Council and BMWR&Env.

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				where possible When a transfer has to take place, ensure it is effected inlined and secured areas where containment is possible Educate personnel on hydrocarbon and chemical handling risks/hazards through SHE briefings/toolbox meetings				
Community/Occupational Health, Safety and Security	External safety risks of electrocutions, bush fires, shed/ building collapse, air/noise pollution, pest infestations resulting from processing activities, and work-related injuries occurring, particularly as workers may not be familiar with	Affected communities	Moderate	- Workers will be provided with all the required PPE. - Worker induction, followed by regular training on operational and safety issues, will be conducted throughout employment	Minor	Prospective private investors	Benue state Ministry of Agric	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	the operational methods and machinery.			- Toolbox talks will be carried out daily on safe work practices and other OHS issues. - First aid facilities will be available in all work areas - Medical facilities will be available to all workers. Ensure environmental cleanliness of the agro-processing sheds				
Impact on economy and livelihood	Improved production of food and agro/agro-allied products	State/National level	Positive	beneficial impacts and shall be enhanced by sustaining the project through adequate and effective maintenance activities as well as complying with the federal government's policies and laws on agro-industrial park operation	Positive	Prospective private investors	Benue state Ministry of Agric	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Waste generation from different sheds in the industrial park	Release of wastewater effluents Generation of solid wastes from processing activities Spent/used oils	The industrial park and its surroundings	High	Waste bins will be provided in all facility areas to dispose of the various types of wastes generated by the project. These bins will be marked to facilitate waste segregation for collection, transportation and disposal. Separation of domestic and hazardous waste at the source shall be strictly enforced. Where possible, wastes will be reused or recycled. Burning of waste will not be permitted. All personnel will be trained	Medium	Prospective private investors	Benue state Ministry of Agric	FMENV, Makurdi LGA Council and BMWR&Env

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				in the appropriate management of waste according to the WMP. Wastewater effluents shall be appropriately treated before releasing them into the environment. Waste oils generated by the project (vehicles and machinery) will be collected and stored in sealed containers and arrangements made with companies who can use them in their operations or manage their disposal.				
Emergency Response	Loss of life, injury, damage to equipment, fire outbreaks, building collapse	In the industrial park	Medium	-Implementation of Emergency Response Plan - Awareness-raising among	Minor	Prospective private investors	Benue state Ministry of Agric	FMENV, Makurdi LGA

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
and Disaster Management				workers - Monitoring of potential situations leading to disaster.				Council and BMWR&Env

Table 7.4: Environmental and Social Monitoring Plan during Construction Phase

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
Air quality	SO_2, NOx, CO_2, CO, VOC, PM	Visual inspection of construction sites, access roads; verification of equipment and machinery Ambient air quality measurements	Avoid significant degradation of baseline conditions. WHO and national ambient air quality standards, FMEnv standards	Agro-Industrial Park(Phase 2 of the industrial area Makurdi) and the surrounding	Monthly	AfDB - PIU	800,000	650,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
				area				
Noise & vibration	Noise Levels	Noise level measurements	Avoid significant degradation of baseline conditions. WHO and FMEnv. noise standards	Agro-Industrial Parkand the surrounding area	Monthly	AfDB - PIU	800,000	650,000
Soils integrity	Visual signs of contamination Status of drainages, bund walls, stockpiles, etc	Visual inspection of the construction site	Avoid the use of erosive processes or control them Reduce soil compaction Avoid soil profile structure destruction Avoid any soil contaminations	Soils in and around the Agro-Industrial Park	Quarterly	AfDB - PIU	1,800,000	1,200,000
	Soil biological,	Sampling and analyses of	Avoid significant	Soils in and	Quarterly	AfDB -		

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
	physical and chemical properties	soils	degradation of baseline conditions. FMENV soil quality standards	around the Agro-Industrial park		PIU		
Water quality	Water Physico-chemical and microbiological - pH, temperature, TSS, turbidity, phosphorus, metals, sulphate, BOD, COD, coliform, fungi, etc.	Analysis of surface and groundwater samples Visual detection of pollution signs (presence of oil, waste, etc.)	Avoid significant degradation of baseline conditions WHO and FMEnv water quality standards	Fete river	Twice a year	AfDB - PIU	1,200,000	1,000,000
Aquatic ecology	Same as water quality Fish catch yield	Visual inspection of rivers and streams Interview with fishermen	Avoid equipment and vehicle movements in rivers and streams.					

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
Vegetation integrity and Fauna protection	Vegetation cover Pictorial comparison (before and after) Fauna species, age, number of individuals sighted	Visual inspection of construction sites and access roads	Avoid significant degradation outside the project footprint. Protection of flora species with conservation status Avoid habitat loss and disturbances for local fauna	Flora and Fauna community in Industrial Parkand the surrounding area	Once during vegetation removal in the project site	AfDB - PIU	350,000	500,000
Visual amenities Land planning and use	Orderliness and cleanliness of sites disturbance outside project footprint	Visual inspection of construction sites and access roads	Good housekeeping practice Site clearance activities to be restricted to the minimum required area. Provision of the predefined route, barriers or boundary markings to prevent the incursion of machinery and workers into neighbouring	Project site	Quarterly	AfDB - PIU	350,000	100,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
			areas					
Stakeholder relations Management	No complaints/ concerns received Status of grievance resolutions	Interview neighbouring communities Stakeholder meetings Inspection of complaints/grievance logbook	Grievances are resolved effectively Complaints and issues are addressed timely	Neighboring communities	Quarterly	AfDB - PIU	3,200,000	750,000
Health, Safety and Security	Incidences	Inspection and review of incidence log	ILO requirements and Factories Act minimum labour standards	Construction site	Quarterly	AfDB - PIU	350,000	430,000
Employment and economy	Proportion of employees from the local communities materials procured from community	Inspect employee records Random interview with workers on site Inspection of procurement records	Semi-skilled and non-skilled labour employed from the PACs Materials available in the communities are used Made in Nigeria products	Construction site	Quarterly	AfDB - PIU	700,000	-

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
	members made in Nigeria materials used	Interview with suppliers and vendors	are utilised, except where not available					

Table 7.5 Environmental and Social Monitoring Plan during Operations Phase

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
Air quality	SO_2, NOx, CO_2, CO, VOC, PM,	Visual inspection of substations and access roads; verification of equipment and machinery records Ambient air quality measurements	Avoid significant degradation of baseline conditions. WHO and national ambient air quality standards (FMEnv.)	Agro-industrial park	Bi-Annually	BMWR&Env -HSE Dept	550,000	500,000
Noise quality	Noise Levels	Noise level measurements	Avoid significant degradation of baseline conditions. WHO and FMEnv. noise standards	Agro-industrial park	Bi-Annually	BMWR&Env -HSE Dept	880,000	1,000,000
Soils integrity	Visual signs of	Visual inspection of substation sites and	Avoid the use of erosive	Soils in and around the	Bi-Annually	BMWR&Env -HSE	1,000,000	850,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
	contamination Status of drainages, bund walls, stockpiles, etc	access roads	processes or control them Reduce soil compaction Avoid soil profile structure destruction Avoid any soil contaminations	Agro-industrial park		Dept		
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Avoid significant degradation of baseline conditions. FMEnv soil quality standards	Soils in and around the Agro-industrial park	Bi-Annually	BMWR&Env -HSE Dept		
Stakeholder relations Management	Number of complaints/ concerns received Status of grievance	Interview neighbouring communities	Grievances are resolved effectively Complaints and issues are	Neighboring communities	As need arises	BMWR&Env -HSE Dept	2,500,000	1,200,000

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
	resolutions	Stakeholder meetings Inspection of complaints/grievance logbook	addressed timely					
Health, Safety and Security	Incidences	Inspection and review of incidence log		Agro-industrial park	Bi-Annually	BMWR&Env -HSE Dept	350,000	500,000
Employment and economy	Proportion of employees from the local communities materials procured from community members made in Nigeria	Inspect employee records Random interview with workers Inspection of procurement records Interview with suppliers and vendors	Semi-skilled and non-skilled labour employed from the PACs Made in Nigeria products are utilised, except where not available ILO requirements and Factories Act minimum	Agro-industrial park	As need arises	BMWR&Env -HSE Dept	200,000	-

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates/year (NGN) for monitoring	Cost Estimates/year (NGN) for mitigation
	materials used		labour standards					
Training and capacity building	Training need assessment Training Attendance and Participation Skill Acquisition Community Awareness	Surveys and interviews Attendance Records Skill assessment test Community Perception Surveys	Compliance with Regulatory Requirements Percentage Improvement in Skill Community Awareness Levels	Town halls and strategic centers in project communities	Quarterly	BSMEnv-	8,000,000	10,000,000

7.9 Management Sub-Plans/Programs

The ESIA study trigger development of specific management plans to wit;

- Air Quality Management Plan
- Waste Management Plan;
- Community Health and Safety Management Plan
- Traffic/journey Management Plan
- Construction management plan

Each plan outlines developmental and implementable procedures as part of the overarching ESMS developed and implemented by the Ministry of Agriculture and Natural Resources, Benue State and the Contractor, as applicable.

Furthermore, the Contractor is required to develop and implement the following Construction triggered Management Plan:

- Soil and Erosion Management Plan;
- Update the Traffic Management Plan;
- Training and Skill Transfer Program;
- Worker's Health and Safety Management Plan;
- Rehabilitation and Re-vegetation Plan;
- Environmental and Social Code of Conduct;
- Contractors' GRM for Communities and Workers;
- Method Statements, including, but not limited to: erosion control, water crossing, work in heights, and others that the ESCMM may require

The Contractor will draft these specific management plans based on the requirements presented in this ESMP and submitted to the Ministry of Agriculture and Natural Resources for approval in consultation with AfDB before activity kick-off.

7.9.2 Air Quality and Climate Change Adaptive Management Program

Justification and Objectives

Generation of particulate matter and emission of GHGs is expected across all phases of the project. When superimposed on the ambient condition, baseline levels above regulatory limits for some

microenvironment are likely. This plan is aimed at controlling GHG emissions and PM generation across all the project phases. The 50year operational period before decommissioning makes it untenable to have included decommissioning in the Plan.

Legal Framework

Legislative safeguards for air quality in Nigeria are enshrined in FEPA 1999 and FMEnv. 2004 document on regulatory limits.

Actions and Implementation Schedule

Tables 7.6 provide applicable control and actionable mitigation measures during the pre-construction, construction and operation phases (various applicable activities were spelt out in Table 7.6) to reduce GHG and PMs' emission footprint. It also provides in-built design systems to achieve emission reduction. Implementation of the spelt-out mitigation measures shall address GHG emissions and PM generation concerns.

Table 7.6: Air quality and climate change adaptation management program – actions, description and implementation schedule

Control and Mitigation Actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
Control emissions of dust and pollutant gases	Movement of men and machinery to be planned to avoid residential areas, hospitals and schools as practicably possible	Preconstruction/Construction phases	Contractor	FMEnv.
	Schedule maintenance of machinery shall be strictly adhered to avoid the release of avoidable noxious gases. Scheduled daily equipment working hours, operator's training program and weekly safety briefings shall be factors in the internal monitoring system.	During the construction and operation phase	Contractor and BMWR&Env - HSE Dept	FMEnv.
	Minimisations of hauling distances by sourcing construction materials nearby as much as possible. An allowable 0.2- 0.4 m space is left unloaded for any construction materials carrying trucks.			

	Enforcement of speed limits where necessary.			
	Trucks carrying dusty materials needed to be adequately covered;			
	Stockpiles of granular materials need to be waterproofed, protected or sprinkled with water constantly.			
	Water use as dust suppressants shall be employed in every work front with unpaved surfaces twice per week in wet seasons and daily during dry seasons.	Whenever need arises	Contractor	FMEnv.
	The construction laydown area shall be sprinkled with water twice a week during wet seasons and daily during dry seasons.		Contractor	FMEnv.

Follow-up Monitoring on Mitigation effectiveness and Grievance Receipt

Air quality monitoring actions shall be developed in less than 1km to residential areas and 2km to hospitals and schools. Parameters to be measures are CO, CO_2, SOX, NOX and CH_4. A bi-weekly frequency monitoring is planned during construction and quarterly during the operation phase.

FMEnv Air sampling methods adopted in Chapter 6 (Result Interpretation)

Table 7.7 summarises the follow-up and monitoring actions and the implementation schedule.

Table 7.7 Air quality management program - follow-up and monitoring actions, description and implementation schedule

Follow-up or Monitoring Action	Description	Implementation schedule
Periodic air quality monitoring	Air quality monitoring stations shall be established at the defined threshold distances near three sensitive receptors, Homes, schools and hospitals.	Bi-weekly during construction and quarterly during operation
Air quality monitoring in response to	If complaints from the local population regarding air quality are registered,	When necessary

complaints	(i) Corrective actions for simple complaints such as the need for an additional or more frequent watering program for dust control, traffic speed issues shall be implemented ASAP and (ii) Air quality monitoring will be undertaken near the affected sensitive receptors to verify the ambient air quality levels and define additional mitigation if required.	

Corrective Actions

If the air quality values recorded exceed FMEnv. regulatory limits, or if complaints from the local communities are lodged, causal factors for such elevated concentrations shall be identified and corrected. High concentrations typically result from failure to adhere to any or some of the mitigation measures listed in Tables 7.2 and 7.3.

In the event of non-compliance, additional mitigation measures shall be defined on a case by case basis ranging from a warning, verifiable shreds of evidence of vehicle having been serviced and increase frequency of training and safety briefings.

A monitoring campaign will be undertaken in areas where non-compliances were recorded to verify the resolution of the issue.

Reporting

Performance Indicators

Table 7.8 lists the performance indicators to be monitored for the Air Quality Management Program:

Table 7.8 Performance indicators for Air Quality Management Program

Indicator	Target	Trend
Number of TPM exceeded during periodic monitoring	<10% of monitored sites with recorded elevated concentrations above FMEnv standard	% of recorded TPM concentrations above FMEnv. regulatory limits decreases bi-weekly
Concentrations of SOX, CO, CO_2, CH_4 exceeds FMEnv regulatory limit during	<10% of monitored sites should exceed FMEnv	% of recorded measured gases decreases bi-weekly

Indicator	Target	Trend
periodic monitoring	regulatory limits	
Number of community complaints regarding air quality	1 complaint per month per near sensitive receptor	Number of complaints decreases bi-weekly
Number of verification monitoring campaigns in response to complaints	Equal to the number of complaints	NA
Number of additional air quality mitigation measures undertaken in response to complaints	Equal to or greater than the number of complaints	NA

Note NA. – Not Applicable.

The performance indicators results shall be compiled quarterly

Reports

Table 7.9 summarise the documental records that will be kept to control the execution of this specific environmental management program. These documents will be prepared, archived and maintained by the PIU.

Table 7.9– Record Documents for the Air Quality Management Program

Document Title	Document Type	Frequency of Record or Report
Record of periodic air quality monitoring	Record	Quarterly
Record of air quality associated community complaints	Record	On occurrence
Record of air quality monitoring in response to complaints and mitigation responses	Record	On occurrence
Performance Report	Report	Quarterly

7.9.2 Waste Management Plan

Objectives

The purpose of this plan is to guide personnel and Contractors on the management of miscellaneous hazardous and non-hazardous waste generated during the Life of the Project, particularly during construction and operation phases.

The waste management approach focuses on implementing the three "R"s (Reduce, Reuse and Recycle) as the Federal Ministry of Environment defines. Waste management comprises the collection, conditioning, transportation and deposition at a legally designated final place.

Adequate waste management is essential to prevent soil and water resources contamination. It is also vital to maintain workers and indigenes' community and occupational health by avoiding the proliferation of pests and diseases.

The present program considers the Nigerian and AfDB/Benue State Ministry of Agric EHS General Guidelines.

Scope and Responsibilities

These procedures apply to those units and their personnel involved in the management of hazardous and non-hazardous wastes. The Waste Management Plan applies to all pre-construction, construction and operation activities.

The responsibility for implementing the proposed waste management actions and procedures falls with the various contractors involved in the Project's construction phase, which will need to use the guidelines provided in this plan to develop specific waste management procedures applicable to their activities. The Benue State Ministry of Agriculture is responsible for auditing the Contractors' activities to ensure that best practice waste management procedures are being followed.

Availability of Waste Disposal Facilities

The development of this plan and its upgrade by the Contractor took/shall consider the availability of waste facilities in Benue State.

Waste management in the project area is the responsibility of the Waste Management and Sanitation Board in Benue and the State Environmental Protection Agency. No public landfills exist in the Project area, rather many municipal waste sites.

Waste Management Actions

Table 7.10 below summarises the proposed waste management actions.

Table 7.10 – Waste management actions

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
Prepare waste inventory	Prepare an inventory of any hazardous and non-hazardous waste Classify the waste; Define sources, volumes and indicate the appropriate final destination for each type of waste, considering the region's specifications in question regarding the availability of waste treatment and disposal facilities.	Pre-construction phase	Contractor	PIU
Reduce waste production	Working sites must be kept clean, neat and tidy at all times; Avoid leaving garbage unattended to avoid attracting pests and nocturnal carnivores; Implement daily cleaning routines to minimise waste; Promote the recycling and recovery of waste in coordination with municipal authorities Use materials that can be reused easily; List and estimate the volume of waste that can be reused, recycled or re-process (example, wood scraps, soils, none used materials); Ensure that the quantities of materials on site are as accurate as possible to avoid surpluses resulting in waste.	During construction and operation phases	Contractor and Benue State waste management Agency	PIU, FMEnv.
Non-hazardous	Provide specific colour coded containers of appropriate sizes (according to the expected waste volume) to place	During construction		

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
waste segregation	waste in different working areas. The segregation will be carried out as close as possible to the place of production. These shall ensure adequate hygiene and sealing conditions; Strictly prohibit littering with plastic or other wastes by all project personnel; Provide different containers for each type of waste that can be reused, recycled or re-processed. Containers will be identified according to their categorisation and classification, allowing to identifying its contents; Waste segregation must be carried out accordingly, ensuring that waste does not exceed the top of containers; The containers must be constructed of an appropriate material to prevent leakage, clean and permanently closed; All produced waste will be sorted according to its type. Workers will initially do waste segregation; Produced waste will be removed daily and temporarily stored in Temporary Storage Facilities until transported to the final destination.	and operation phases	Contractor and Benue State waste management Agency	PIU, FMEnv.
Temporary	Non-hazardous waste must be temporarily stored, before the final destination, at only one designated area. This area must be duly delimited and signed ("Waste Storage Area"). The area should have a firm waterproof	During construction and operation	Contractor and Benue State waste	PIU, FMEnv.

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
storage facilities for non-hazardous waste	base protected from the ingress of stormwater from surrounding areas. It must also have an effective drainage system to an impervious spillage collection area, where any spillage can be recovered and suitably treated. This area must be restricted and should not be accessible to unauthorised persons. The containers should not be easily corrodible but rodent-resistant, insect-resistant and have handles at the sides and tight-fitting overlapping covers. Inert waste may be stored in the open without the need for a waterproofing floor in a designated and delimited area; Location of waste Temporary Storage Facilities must be at least 50m from watercourses and ground depressions; Maintain a good organisation of space and cleaning of waste storage areas; Waste materials that can be reused by the community, such as removed soil and stones, cut wood and other building materials, could be made available for pick up in an orderly fashion and with proper safety arrangements.	phases	management Agency	
	Before transport, an FMEnv certified laboratory shall confirm it to be non-hazardous. If approved as non-hazardous, a waste manifest detailing content, volume, the generating company should be produced in	During construction and operation	Contractor and Benue State waste	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
Non-hazardous waste final destination	duplicate and a copy handed to the driver. The transport of waste must be carried out in an appropriate vehicle, capable of containing the trash, and in good operating condition. These vehicles must be easily washable; Transfer operations of waste containers must be carried out safely: without compromising its segregation, and without causing leaks or spills and originating dust; The final destination and transport of waste are the responsibility of the Contractor; The final destination and transport of waste must be agreed upon and authorised by the State waste management authorities. The necessary licenses must be obtained; Prohibit the burial or dump of any type of waste in an unauthorised location Use accredited waste vendors from affected states Prohibit waste incineration; Non-hazardous waste will be removed weekly; PIU and the Contractor will agree on and document the final disposal site for the waste, ensuring that it meets FMEnv, the Benue States and AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS) requirements, and will keep	phases	management Agency	

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
	records of the delivery of the waste at such facilities.			
Hazardous waste segregation	Provide containers for the segregation of hazardous waste, ensuring that waste does not exceed the top of containers and have an appropriate size. Containers will be made of appropriate material so that their content does not damage them or permit toxic substances formation. They shall ensure adequate hygiene and sealing; Provide different colour coded containers for each type of hazardous waste to be produced. Hazardous waste will not be mixed with other types of waste; Containers will be placed on wooden pallets or plastic pails; Maintain containers clean and permanently closed; All produced waste will be sorted and placed in the corresponding container.	During construction and operation phases	Contractor and Benue State waste management Agency	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
Temporary Storage Facilities for Hazardous waste	Hazardous waste will not be stored at the work fronts and must be transported daily to Temporary Storage Facilities built for this purpose or hired through a certified service provider; Hazardous waste must be temporarily stored, before the final destination, at only one designated area. This area must be duly delimited and signed ("Hazardous Waste Storage Area") as restricted access. The area must be roofed, adequately ventilated and have an impervious surface floor; Location of the Waste Temporary Storage Facilities must be away (100 m) from watercourses and ground depressions; No smoking will be allowed in the vicinity of a hazardous waste storage area. Place appropriate symbolic signage (No smoking, No naked light and danger); Provide extinguishers near the waste storage areas; Maintain a good organisation of space and cleaning of waste storage areas.	During construction and operation phases	Contractor and Benue State waste management Agency	PIU, FMEnv
Transport of Hazardous Waste	The transporting vehicle/medium within the generation site must be waterproof and of high mechanical stability. The vehicle must display the hazard sign, the remedial measures/first aid sign during accidental discharge, telephone number of contact person(s) to be	During construction and operation phases	Contractor and Benue State waste management	PIU, FMEnv

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
	boldly inscribed on the vehicle. The transport of hazardous waste within the facilities up to the storage location will be made, resorting to appropriate equipment or vehicles capable of containing the waste and in good operating conditions. These vehicles must be easily washable. The transport vehicle will be dully identified with signs for the transportation of hazardous material; Hazardous waste must be transported (internal transportation) in containers. The transport must have steel clamps for securing the containers and guarantee safe transport; Hazardous waste transport can be evacuated from the designated site by entities licensed by appropriate authorities. When the hazardous waste is collected, a manifest, in four copies, will be completed, indicating the quantities, quality and destination of the collected waste; one copy is kept by the waste generating entity, another copy is maintained by the waste transporting entity, the third copy is kept by the entity receiving the product and the fourth copy is sent to the Benue State Environmental Protection Agency (BSEPA). Provide the workers responsible for handling hazardous waste with adequate PPE (workwear, gloves, boots, and masks).		Agency	

Waste management actions	Description	Implementation Schedule	Responsibility for Implemen*tation	Supervision
Hazardous Waste Final Destination	The final disposal of hazardous waste will be made at an infrastructure licensed by BSEPA for storage, treatment or final disposal of hazardous waste. Whenever possible, enforcement of the buyback policy with the suppliers should be invoked.	During construction and operation phases	Contractor and Benue State waste management Agency	PIU, FMEnv
Workers training	Workers must be briefed on the behavioural aspect of waste reduction. The use of disposable products (such as plates or plastic or paper cups, products with excessive packaging) will be limited as much as possible, and the use of reusable products will be promoted; Workers must be trained on the classification, correct sorting and handling of waste; Workers responsible for hazardous waste handling must be trained on the classification, correct sorting, handling and transport of hazardous waste. Workers must be briefed on the use of personal protection equipment.	During construction and operation phases	Contractor and Benue State waste management Agency	PIU, FMEnv

Follow-up Actions

Table 7.11 summarises the follow-up or systematic or periodic verification actions proposed for waste management.

Table 7.11 – Waste Management Follow-up Actions

Follow-up or verification action	Description
Inspection of the waste storage areas	Perform daily visual inspections of the hazardous and non-hazardous waste storage areas to verify if the existing containers are adequate to the volume of waste produced and the correct waste sorting and conditioning is being carried out. Also, ensure zero spill processes is continually in place and that any accidental spill is promptly contained and clean-up operations instituted immediately. Verify the integrity of the containers and other environmental control systems/equipment.
Inspection of working areas	Perform daily visual assessment of work areas for organisational sanctity and site cleanliness
Verification of final disposal sites	Undertake annual due diligence visits to the final disposal sites to confirm that final elimination is in compliant with applicable Benue State Ministry of Agriculture and Natural Resources, FMEnv and AfDB environmental and social safeguards guidelines detailed in its Integrated Safeguards Standards (ISS)

Remedial Actions

Table 7.12 summarises the corrective actions and their implementation schedule.

Table 7.12 – Waste Management Plan - corrective actions, description and implementation schedule

Corrective Actions	Description	Implementation Schedule
Spill mitigation actions	Removal of substances accumulated in the spill containment trays sinks; Repair or change the damaged container that leaks.	When applicable
Response to complaints	In response to workers or community complaints about odours or pest's proliferation, increase waste collection frequency.	When applicable

Corrective action for improper waste storage	Provide or increase the quantities of proper containers in the storage areas where waste increases are evident. Increase the frequency of waste collection.	When applicable
Corrective action for littering and illegal dumping	Increase awareness about waste management.	When applicable

Performance and Reporting

Table 7.13 lists the performance indicators to be monitored for the Waste Management Plan.

Table 7.13 – Performance indicators for Waste Management Plan

Indicator	Target	Trend
Weekly volume of waste produced, by type (hazardous and non-hazardous)	Volumes will be recorded. No target is applicable (as volumes will depend on activity).	Volume of waste per workday decreases quarterly (showing efforts to reduce waste production)
Weekly volume of waste transported to final deposition	Equal to the weekly volume of waste produced.	NA
Number of improper waste management procedures detected	< 5 per quarter	Number of events decreases quarterly
Number of adopted corrective actions in response to detection of improper waste management procedures	Equal to the number of improper waste management procedures detected	NA.

Note NA. – Not Applicable.

The performance indicator results will be determined weekly and compiled in quarterly reports, as indicated in the following section.

Reports

The following table summarises the documental records that will be kept to control the execution of the waste management plan. These documents will be prepared, archived, and maintained by the contractor to document the plan's implementation results.

Table 7.14 – Record documents for the Waste Management Plan

Document Title	Document Type	Frequency of Record or Report
Weekly volume of waste produced, by type	Record	Weekly
Weekly volume of waste by category transported to final deposition	Record	Weekly
Weekly volume of waste	Record	Monthly

recycled or reused		
Record improper waste management procedures detected and remediation actions undertaken	Record	Weekly
Performance Report	Report	Quarterly

7.9.3 Community Health and Safety and Gender Management Plan

Objectives

The construction and operation of the Agro-industrial park could increase community health and safety hazards due to increased light, noise and dust emissions, increased traffic, workforce mobilisation, population influx and security personnel. Management of these risks will require implementing the mitigation measures proposed in chapter seven of this report regarding these issues, compiled in this Community Health and Safety Management Plan.

Scope and Responsibilities

Together with the state ministry of agriculture, PIU is responsible for implementing all mitigation and management measures. Note that much of the mitigation will involve strong participation of the Contractor through the development of additional management plans and the management of day-to-day activities in the park, as detailed here. However, the PIU and the state ministry will continuously guide and supervise the Contractor in all issues related to engagement with communities and minimise impacts on their health and safety.

Proposed Actions and Implementation Schedule

Table 7.15 presents the main actions for implementing the Community Health and Safety and Gender Management Plan.

Table 7.15 – Community Health and Safety and Gender Management Plan actions, description and implementation schedule

Actions	Description	Implementation Schedule	Responsibility	Supervision

Actions	Description	Implementation Schedule	Responsibility	Supervision
Minimise hazard risk to communities from Project traffic	The Contractor will develop, and submit for PIU and FMEnv. approval, an updated Traffic Management Plan detailing the management procedures and mitigation measures to minimise traffic-related hazard risks to communities. The Plan will include the mitigation provided hereunder: The movement of vehicles shall be limited to pre-approved routes. These will be defined to avoid crossing residential areas, schools or hospitals whenever feasible; Speed limits not exceeding 30 km/h will be set for heavy vehicles moving in unavoidable sensitive receptors (schools, hospitals and homes) and 60km/h on paved roads. Drivers shall be trained onset speed limits and safe driving. Install temporary official traffic signs on local roads around the work fronts before and during the execution of the works together with local transit authorities; Consult with community on traffic restrictions and schedule, provide alternative connectivity where needed, and conduct regular driver and community traffic safety awareness programs; Use operated traffic control in vital sensitive areas and crossings, especially near any places where people in general and children in particular congregate; Manage traffic and machinery to avoid accidents involving domestic animals and cattle. Provide for animal crossings and access to watering sites, if needed.	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv.

Actions	Description	Implementation Schedule	Responsibility	Supervision
	Reroute traffic or limit access if required, in coordination with communities and local authorities.			
Minimise noise nuisance on communities	Noisy activities, especially during construction activities, will be limited to the daytime period (between 08:00 and 05:00) and working weekdays, avoiding working during the night-time and on weekends, whenever near residential areas; The contractor will avoid placing fixed equipment in proximity to sensitive receptors; Use of portable screens during construction where possible; if noise complaints are received from local communities in the morning or evening periods, despite compliance with the previous measures,	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv.

Actions	Description	Implementation Schedule	Responsibility	Supervision
	and if the ensuing investigation confirms the noise impact, effect further reduction in work schedule. In such cases, the work schedule will be defined in a participatory manner, through consultation with affected communities;			
Ensure good practices in labour management and minimise risks of social conflicts with the workforce	The Contractor will develop and implement a Local Recruitment and Working Conditions Plan, which will include the following principles: Create mechanisms to ensure that the recruitment and hiring procedures are conducted in a transparent and just manner, are co-ordinated with the community leaders and LGA Administration, maximise local employment, including women and young workers and transfer technical skills to the local labour force; Forbid workers from hunting or buying bush meat. Inform workers of these restrictions in the induction sessions and enforce and monitor them appropriately. Give priority to hire local workers, provided applicants have the necessary skills; Employment opportunities will be adequately advertised so as not to limit application opportunities; The process of contracting staff will be transparent and follow pre-established and acceptable criteria. It shall follow a co ordinated procedure with local leaders that aim to maximise opportunities for the local workforce; Avoid hiring at the gate – establish local and regional recruitment centres and provide pick up points for applicants from communities;	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv

Actions	Description	Implementation Schedule	Responsibility	Supervision
	Ensure respect for local labour laws and worker rights, and together with the labour policy, Health and Safety Management Plan, ensure safe and fair working conditions; Develop and implement a worker's grievance management system.			
Minimise risks of social conflicts with workforce	Policy and sanctions against violence or exploitation, including of a sexual nature (for example, the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favours or other forms of humiliating, degrading or exploitative behaviour); Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behaviour with children, limiting interactions with children, and ensuring their safety in project areas); Policy and sanctions against sexual relations with	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv.

Actions	Description	Implementation Schedule	Responsibility	Supervision
	anyone under the age of 18 (except if married before employment); Description of disciplinary measures for infringement of the code and company rules. If workers are found to be in contravention of the CoC, which the Contractor will explain to them and require them to sign at the commencement of their contract, workers must face proportionate disciplinary procedures; Failure to keep by these standards will be stated in the contracts as grounds for contract termination. Inform all hired workers of these restrictions and the possible consequences of breaking them. The Contractor will further be expected to: Publicise the CoC in settlements potentially around the project area. This will help ensure that the residents are aware of behaviours expected of construction staffers; Provide schedule and transportation that allows workers to visit their families or to have leisure time at reasonable intervals. The Contractor will require its subcontractors to subscribe and adhere to this code and diligently supervise its implementation at all levels, including engaging the community in confidentially and actively identifying any inappropriate behaviour.			

Actions	Description	Implementation Schedule	Responsibility	Supervision
GBV/SEA prevention and response framework	PIU, Contractor and the state ministry will work together to assess risks and identify and implement prevention continuously, response and referral processes involving Sexual Exploitation and Abuse / Gender-Based Violence (SEA/GBV). The prevention mechanisms will focus on: training of PIU, Contractor and the ministry of agriculture personnel, (ii) community and worker awareness, (iii) making available safe and confidential channels of communication and complaints, and (iv) a referral system and mechanism for survivors of GBV/SEA; PIU, together with the State Ministry of Agriculture, will develop and implement a GBV/SEA prevention and response framework that will address the following elements: How the project will put in place the necessary protocols and mechanisms to address the SEA/GBV risks; How to handle any GBV incidents that may arise;	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv.

Actions	Description	Implementation Schedule	Responsibility	Supervision
GBV/SEA prevention and response framework	A policy against GBV/SEA, including a CoC and agreed sanctions. The contractor and consultants will provide these as part of the Contractor ESMP. Have all employees of contractors (including sub-contractors), supervision consultants and other consultants with a footprint on the ground in the project area sign CoCs; For purposes of the construction and operational phases of the project, develop an induction program, including a CoC, for all workers directly related to the project. Specific arrangements for the project by which GBV risks will be addressed, including: Awareness Raising Strategy, which describes how workers, local communities and Project personnel will be sensitised to SEA/GBV risks, and the worker's responsibilities under the CoC; Referral Pathway: Identification of qualified GBV service providers (NGOs) and setting up a referral pathway so GBV survivors will be referred, and the services will be available (health, legal, psychosocial, safety planning, etc.); Establish a SEA/GBV Accountability and Response Framework, to be finalised with input from the contractor, which will include at a minimum: Allegation Procedures: How the project will provide information to employees and the community on how to report cases of SEA/GBV, CoC breaches to the GRM; SEA/GBV Allegation Procedures to report SEA/GBV issues to service providers and	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv

Actions	Description	Implementation Schedule	Responsibility	Supervision
	internally for case accountability procedures which will lay out confidentiality requirements for dealing with cases; Mechanisms to hold accountable alleged perpetrators associated with the Project; Disciplinary action for violation of the CoC by workers. Such measures must be determined and carried out in a manner that is consistent with local labour legislation and applicable industrial agreements; The supervision consultant TOR and the training plan will include provisions to promote monitoring and reporting on the implementation and effectiveness of the SEA/GBV Action Plan to prevent and mitigate SEA/GBV risks associated with the project; Reporting on the Framework implementation will be done monthly.			
	Together with the state ministry of agriculture, the contractor will develop a Security Management Plan detailing the security arrangements to be deployed at the industrial park. This plan will be compliant with AfDB operational safeguards (see chapter 2)			

Actions	Description	Implementation Schedule	Responsibility	Supervision
Minimise community security hazards due to interaction with security personnel	This plan will include mandatory training for all security personnel, in what regards human rights, proportionate force use and adherence to contractor's code of conduct; NCSDC will supply security; PIU will make an effort to engage with the authorities so that any engagement with the communities complies with the Voluntary Principles on Security and Human Rights.	Across all project phases	Contractor and Ministry of Agric-HSE Dept	PIU, FMEnv

7.9.4 Traffic Management Program

Justification and Objectives

The Project is expected to generate relatively high volumes of traffic across all phases of the project. Therefore, it is essential to ensure that traffic is managed to facilitate efficiency and provide the safety of personnel and the local community. The vehicular traffic generated as a result of the Project requires management on the site itself and insofar as traffic impacts may be experienced along with local road networks and urban/residential areas. The outline TMP has also been prepared for identifying appropriate and safe methods of access for traffic to the industrial park.

Objectives of TMP

The objectives of this outline TMP are to:

- Outline minimum road safety measures to be undertaken at site access/exit locations, during the works and including approaches to such access/egress locations;
- Demonstrate to the developer, contractor and supplier the need to adhere to the relevant guidance documentation for such works; and
- Provide the basis for preparing a final TMP by the contractor appointed to carry out the works.

The PIU shall ensure that the contractor manages the construction activities as spelt out under this outline TMP. The contractor will prepare a final TMP that complies fully with the outline TMP.

Objectives and measures are also included for the management, design and construction of the agro-industrial park to control the traffic impacts insofar as it may affect the environment, residents and the public in the area.

The final TMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which the PIU requires.

TRAFFIC MANAGEMENT SIGNAGE

The contractor shall undertake consultation with the relevant authorities to identify and agree on signage requirements. Such signage shall be installed before works commencing on site.

Proposed signage may include warning signs to warn road users of the works access/exit locations and the presence of construction traffic. All signage shall be provided under the Nigerian Highway Code Part 2, Section B - road signs, signals, and markings

In summary, the contractor will be required to ensure that the following elements are implemented:

- Consultation with the relevant authorities to identify and agree to signage requirements;
- Provision of temporary signage indicating site access route and locations for contractors and associated suppliers; and
- Provision of general information signage to inform road users and local communities of the nature and locations of the works, including project contact details.

PROGRAMMING

To reduce impacts on local communities and residents adjacent to the proposed sites, it is suggested that:

- The contractor will be required to liaise with other construction projects and the local authorities to co-ordinate deliveries.
- The contractor, alongside the private investors during the operation phase, will be required to schedule deliveries in such a way that contrasting activities do not run concurrently, e.g. avoiding pouring of concrete on the same day as material deliveries to reduce the possibility of numbers of construction delivery vehicles arriving at project site location simultaneously, resulting in a build-up of traffic on the Makurdi-Naka-Ankpa road network during the construction phase.

- The contractor will be required to schedule deliveries to and from the proposed agro-industrial park such that traffic volume on the Ankpa-Naka Road is kept to a minimum while soliciting for the construction of a new access road connecting phase 1 to phase 2 into the city without passing the Naka Road, by the state government.
- The contractor shall develop a construction phase programme of works in liaison with the relevant local authorities, explicitly considering potential scheduled road repair works. In particular, works should be programmed where possible such that any road repair works factors the traffic plan.
- Heavy Duty trucks deliveries to the agro-industrial park will be suspended on the days of any major traditional festivals or Adaka market days that can cause more significant than usual traffic volumes.
- The contractor will be required to interact with local community members to ensure that deliveries will not conflict with sensitive events.
- Heavy Duty Trucks (HDT) deliveries will avoid passing schools at opening and closing times where it is reasonably practicable.
- Construction activities will be undertaken during daylight hours for all construction stages. It is not anticipated that construction works will be carried out between 6 pm and 6 am.

LICENSING

The PIU and contractor shall ensure that:

- All Project vehicles comply with relevant traffic and transport licensing requirements (such as licensing requirements relating to the transportation of oversized loads or hazardous materials, including hazardous waste).
- All vehicular drivers used during the Project shall have the requisite licenses to operate any vehicle (or machinery) operated by them on the Site or any public roads.
- All Project vehicles shall have valid roadworthy certificates and licenses.

Routing and direction of traffic and site access

The movement of all vehicles to and from the industrial park shall be along designated Federal roads, state roads and site access roads. Most materials for the construction works shall be transported to

Makurdi metropolis. In contrast, pre-fabricated steels will be transported by road from Port-Harcourt to Warri, by train from Warri to Ajaokuta, then through the Ankpa-Naka Road to the industrial park. The contractor and PIU shall determine the most appropriate route for large Project vehicles (such as HDT, Light Duty Trucks and buses) transporting equipment, materials and employees (along public roads) to and from the industrial park in consultation with the FRSC, local road traffic authorities and the local community. A copy of the approved routes must be maintained on Site together with this Plan (A responsibility of the Contractor and his Site Manager).

Any anticipated or scheduled traffic delays occasioned by Project vehicles (such as abnormal loads, i.e. the transformers) shall be co-ordinated with FRSC and local traffic authorities in advance.

RECOMMENDED TRAFFIC MANAGEMENT SPEED LIMITS

Adherence to posted / legal speed limits will be emphasised to all staff/suppliers and contractors during induction training.

Drivers of construction vehicles / HDTs will be advised that vehicular movements in sensitive locations, such as local community areas, shall be restricted to 60 km/h. A speed limit of 30 km/h shall be implemented for construction traffic in sensitive areas such as school locations. Such recommended speed limits will only apply to construction traffic and shall not apply to general traffic. It is not proposed to signpost such speed limits in the interest of clarity for local road users.

ROAD CLEANING

The works contract requires that the contractor carry out sweeping road operations to remove any project-related dirt and material deposited on the road network by construction/delivery vehicles. Road Sweepers will dispose of the generated material to the licensed municipal waste facility around the site.

VEHICLE CLEANING

The works contract shall require that the main contractor provide wheel washing facilities and any other necessary measures to remove mud and organic material from vehicles exiting tower construction sites. In addition, the cleaning of delivery trucks such as concrete delivery trucks shall be carried out at the laydown area.

ROAD CONDITION

The extent of the heavy vehicle traffic movements and the nature of the load may create problems of:

- Fugitive losses from wheels, trailers or tailgates; and
- Localised areas of subgrade and wearing surface failure.

The contractors shall ensure that:

- Loads of materials leaving each site will be evaluated and covered if considered necessary to minimise potential dust impacts during transportation.
- The transportation contractor shall take all reasonable measures while transporting the waste or any other materials likely to cause fugitive losses from a vehicle during transportation to and from the site, including but not limited to: (i) Covering of all waste or material with suitably secured tarpaulin/ covers to prevent loss; and (ii) utilisation of enclosed units to prevent loss.

The roads forming part of the haul routes will be monitored visually throughout the construction period.

In addition, the contractor shall, in conjunction with the PIU:

Undertake additional inspections and reviews of the roads forming the haul routes one month before the construction phase to record the condition of these roads at that particular time.

Such surveys shall comprise, as a minimum, a review of video footage taken at that time, which shall confirm the condition of the road corridor immediately before the commencement of construction. This shall include video footage of the road wearing course, the appearance and condition of boundary treatments and the condition of any overhead services that will be crossed. Visual inspections and photographic surveys will be undertaken of bridges and culverts that are along the haul roads.

Where requested by the local authority before the commencement of construction operations, pavement condition surveys will also be carried along roads forming part of the haul route. These will record the baseline structural condition of the road being surveyed immediately before construction.

Throughout the project life cycle, ongoing visual inspections and monitoring of the haul roads will be undertaken to ensure any damage caused by construction traffic is recorded and that the relevant local authority is notified. Arrangements will be made to repair any such damage to an appropriate standard promptly such that any disruption is minimised.

Upon completion of the construction of the proposed development, the surveys carried out at the pre-construction phase shall be repeated, and a comparison of the pre and post-construction surveys carried out as well as for the operation phase. Where such comparative assessments identify a section of road as

having been damaged or deteriorated due to construction/operation traffic, the road will be repaired to the pre-construction standard or better by the State Government.

ROAD CLOSURES

During the works, it is not envisaged that road closures will be required. In areas where existing carriageways are narrow, it is envisaged that Traffic Management measures such as temporary traffic lights will be utilised to facilitate traffic.

However, it is envisaged that temporary road closures will be required at guarding locations for removal following construction. These closures will be short, with road closure times and appropriate measures to be agreed upon with the FRSC and other relevant stakeholders before removing guarding. It is envisaged that road closures will be undertaken between 6 pm -6 am when traffic volumes are at their lowest, subject to agreement with the FRSC and other relevant stakeholders.

ENFORCEMENT OF TRAFFIC MANAGEMENT PLAN

All project staff, private investors and material suppliers will be required to adhere to the final TMP. As outlined above, the principal contractor shall agree and implement monitoring measures to confirm the effectiveness of the TMP, and compliance will be monitored by the resident engineer on behalf of the Benue State Ministry of Agriculture and Natural resources. Regular inspections/spot checks will also be carried out to ensure that all project staff, private investors and material suppliers follow the agreed measures adopted in the TMP.

DETAILS OF WORKING HOURS AND DAYS

Construction of the proposed development is envisaged to be undertaken during daylight hours for all construction stages. It is not anticipated that construction works will be carried out on Bank Holidays or in hours of darkness.

PEDESTRIAN AND PASSENGER SAFETY

All construction personnel transported to and from the Site shall be safely accommodated inappropriate passenger vehicles. No employee shall be transported on the back of open trucks. The Contractor's Construction Safety Officer shall ensure that this requirement is adhered to at all times.

All vehicles transporting employees shall be appropriately maintained and shall not carry more passengers than the number of persons for whom seating accommodation is provided.

Assembly points for local construction workers embarking passenger vehicles shall be located a safe distance from areas/routes of high vehicle traffic. Those residing in hotels shall be picked up daily from their various hotels. Roads and areas used by construction vehicles shall, as far as possible, be avoided by all personnel. Designated pedestrian routes shall be demarcated where appropriate.

Vehicle and pedestrian safety shall be emphasised in the Safety Induction Training required to be provided by the Contractor. All employees, construction personnel and private investors shall be trained and informed as to the dangers and risks posed by construction and other traffic; such training shall also include appropriate precautionary measures required to be undertaken to facilitate safe and efficient traffic management (e.g. checking for traffic before crossing roadways and utilising designated pedestrian routes). Drivers shall be adequately trained to recognise and avoid road hazards, vehicle maintenance, and safety requirements.

EMERGENCY PROCEDURES DURING CONSTRUCTION

The contractor shall ensure that unobstructed access is provided to all emergency vehicles along all routes and site accesses.

The contractor shall provide the contractor's personnel responsible for construction traffic management to the local authorities and emergency services agencies.

In the case of an emergency, the following procedure shall be followed:

- Emergency Services will be contacted immediately by dialling the emergency contact line provided;
- The caller will give exact details of the emergency/incident to the emergency line operator to allow them to assess the situation and respond adequately;
- The emergency will then be reported to the Site Team Supervisors and the Safety Officer;
- All construction/operation traffic shall be notified of the incident (where such occurs off-site);
- Where required, appointed site first aiders will attend the emergency immediately; and
- The Safety Officer will ensure that the emergency services are en route.

COMMUNICATION

The contractor shall ensure that close communication with the relevant local authorities and the emergency services shall be maintained throughout the construction phase. Such communications shall include:

- Submissions of proposed traffic management measures for comment and approval;
- Ongoing reporting relating to the condition of the road network and updates to construction programming; and
- Information relating to local and community events could conflict with proposed traffic management measures and construction traffic to implement alternative measures to avoid such conflicts.

The contractor shall also ensure that the local community is informed of proposed traffic management measures before their implementation. Such information shall be disseminated by sensitisation and delivering leaflets/flyers to houses in the affected areas. Sensitisation shall be done in local, pidgin and English languages. The flyers shall contain contact information for public members to obtain additional information and provide other knowledge such as local events, traditional festivals, and religious celebrations, which may conflict with proposed traffic management measures.

Construction and Operation Methodologies

The contractor shall consider the construction methodology as detailed in chapter four of this report to prepare the final TMP.

- The contractor shall provide detailed traffic management arrangements for all construction stages and submit them for approval to the relevant local authorities and the FRSC.
- The contractor shall submit for approval to the state ministry of Agriculture and the Local Authority, as part of their final TMP, details concerning construction/operation staff vehicle pooling and parking.
- This Traffic Management Plan (TMP) will form part of the construction contract and is designed to reduce possible impacts during the construction of the proposed industrial park.
- The outline TMP shall be used by the appointed contractor as a basis for the preparation of a final TMP and shall detail, at a minimum, the items described in this outline TMP and any subsequent requirements of the FRSC and local authorities.
- The ministry of agriculture's PIU shall ensure that the contractor manages the construction activities under this outline TMP and shall ensure that any planning conditions are incorporated into the final TMP prepared by the appointed works contractor.

7.9.5 Construction management Plan (CMP)

Justification and Objectives

Unsustainable construction activities will have adverse health, social and environmental effects. It may eventually halt the project implementation processes. This plan, therefore, outlines the ministry's approach to managing the execution of the proposed agro-industrial park. The Plan covers site establishment, logistics and the process of managing the overall local environment. It seeks to ensure that the works cause the minimum practicable disruption to residents, including achieving a safe working and living environment. The Plan shall enable contractors to understand the nature of the scope of their works and the various construction activities associated with the development.

This Plan will be used as the template for developing the construction phase health and safety plan, in tandem with the construction method statement. Many of the matters identified will be developed in more detail and dealt with at the appropriate construction stage by detailed site-based method statements. Method statements will be prepared and agreed upon for all major site operations before the commencement of relevant works. This is mainly for the groundwork excavation and structural works.

Communication

The ministry of agriculture seeks to maintain good relationships with the project community. Such relations are significantly assisted by good communication and by keeping the host community and appropriate third parties regularly informed of site activities likely impacts adjoining residents. The contractors and the management team will be receptive to all reasonable concerns of the local community. They will demonstrate a considerate and professional approach to maintain a well-balanced relationship with the local public during project execution.

Notices shall be posted on the site hoarding to keep locals advised of anticipated events, the works' general progress, and any requirements for any abnormal works. Appropriate signage and information boards will be displayed on the hoarding.

Considerate Constructors Scheme

In selecting the appropriate constructors, the ministry shall assess their project track record and management procedures to ensure the capability to deliver a project safely and with minimum practicable disruption and inconvenience to the environment and residents. The appointed constructor will be registered and comply with the requirements of the Considerate Constructors Scheme for the duration of the project. The works will be carried out under the Considerate Constructors Scheme and in such a way as to minimise the impact on the local environment and amenities.

Throughout the works, the constructors will be required to provide relevant method statements and risk assessments. Benchmarking against relevant Key Performance Indicators will be used to monitor the constructor's performance against the qualities in this plan. A contact board will be displayed outside the site providing contact details. This will include names and telephone numbers of key construction staff so that the general public can make contact should they have cause to do so.

A complaints/contact book will be kept on-site, which will be used to record details of any complaints. This will include the name of the person making the complaint, the date, time and nature of the complaint and the action necessary to resolve the complaint. The constructor and the site manager will regularly review the complaints book to ensure that any complaints are dealt with and resolved promptly.

Site Establishment

The space available within the proposed site will be utilised to store construction materials and security post, which will enable the execution of the project development. An on-site borehole will be used for all construction water demands, while the contractors will provide on-site power. Access will be maintained for the duration of the works via the front entrance from Ankpa-Naka Express Road. A parking lot will be created on-site to accommodate delivery Lorries and to restrict parking along the road.

A mobile concrete pump may be positioned on-site during large volume concrete works, and the parking bays on the site shall be suspended for these specific activities. All necessary permits and licenses will be obtained at the appropriate time from the Federal Ministry of Works (FMW) and Benue state Ministry of Work (BSMW). During the excavation for foundations, the excavation spoil will be borrowed to skips on the road. During bulk excavation for shed buildings, there may be a continuous transfer of excavation spoil to muck away Lorries.

Construction work

As part of the CMP, construction work on-site will be carefully managed to minimise disruption to workers' baseline social and environmental condition and incidence. All activities on site will be undertaken with appropriate regard paid to:

Working Hours

Working hours will be 07.00 – 17.00 Monday to Saturday only, under the National Building Code of Nigeria (NBCN) most recent Construction Practice –2006. They shall be no work on Sundays and public holidays.

Fire and Emergency Procedures

Contact names and telephone numbers will be made available in 'out of hours' emergencies relating to the site. This information will be displayed on the hoarding. The constructor shall implement procedures to protect the area from fire. The site manager shall assess the degree of fire risk and formulate a Site Fire Safety Plan, which will be updated as necessary as the works progress and will also include the following:

- Hot Work Permit regime.
- Installation of the site fire-fighting equipment, e.g. establishing fire points and installing and maintaining fire extinguishers etc.
- Evacuation alarm.
- Material storage and waste control.
- Fire Brigade access.

Security

All site personnel will have to sign in on arrival and sign out before leaving the site. This will be incorporated into the Site Rules and included as part of the site induction process.

The front hoarding will be regularly inspected to ensure that it remains secure. All hoardings will remain closed when the site is not operational. The access gate to the site will be controlled to only allow access for authorised personnel.

Health and Safety

A Construction Health and Safety Plan will be prepared for the works under the Construction design and management (CDM) regulations, 2015. Risk Assessments will be developed and agreed upon. Sub-constructors' detailed method statements will also be produced, and safe work methods established for each element of the works.

Site inductions will be held for all new site personnel to establish the site rules and enforce safety procedures. All site personnel will be required to read the emergency procedures when signing in for the first time and sign to the effect that they have read the procedures. These will include any relevant communal issues.

Scaffolding

As already noted, scaffolding will be required for the construction of the storehouse. Scaffolding will be used to provide workers with a safe temporary work platform. It will be planned, erected, inspected and

tagged by competent persons. It will be regularly reviewed to ensure no risks to safety and compliance with HSE regulations' requirements.

Good Housekeeping

The site will be kept in a clean and safe condition. The following practices shall be maintained:

- The areas adjacent to the site will be regularly inspected and any site rubbish removed.
- The adjacent road and pavement will be kept clean.
- The perimeter hoarding will be repainted from time to time and will be kept in a neat and tidy condition.
- Any graffiti will be quickly removed from the hoardings.
- Offloading will generally be direct from vehicles onto the site.
- Materials will not be stored on public footpaths or roads.
- Waste and rubbish will be regularly removed from the site and not allowed to accumulate to cause a safety or fire hazard.
- Welfare facilities will be provided within site to discourage operatives from frequenting the interface between the site and public areas.

Environmental Matters

The selected constructor shall operate an environmental policy in which supports the following values to:

- Conduct their activities with proper regard to the protection of the environment.
- Comply with all relevant regulatory and legislative requirements and codes of practice.
- Communicate with local communities to ensure the work causes the minimum disturbance and disruption.
- Ensure that staff have a good understanding of the environmental impacts of construction work and minimise these impacts.
- Ensure their suppliers and sub-constructors apply similar standards to their work.
- During the early stages of the project, the constructor shall carry out the following activities will be carried out to deal with environmental management:

✓ Prepare a Project Environmental Plan.

✓ Prepare and consult with the client and statutory authorities to obtain relevant approved licences and consents.

- ✓ Prepare a Site Waste Management Plan and consult with supply chain partners and the design team to design out or minimise waste.

Waste and Material Management

A site waste management plan has been drafted (see Section 8.9.2).

Dust, Noise and Vibration

Detailed AQMP has been proposed in Section 8.9.1. But as per a matter of good practice in construction, the following practicable mitigate shall be observed:

Dust

- ✓ Adjacent road surfaces will be frequently swept clean;
- ✓ All loads delivered to or collected from the site will be covered where appropriate;
- ✓ All road vehicles will be requested to comply with set emission standards;
- ✓ Skips will be securely covered
- ✓ The air quality within the site will be continually monitored.

Noise and Vibration

- ✓ The constructor shall take reasonable steps to minimise any noise disruption to adjacent residence and fauna habitats.
- ✓ Operatives working in noisy areas will be monitored to ensure they are wearing the necessary protective equipment and not exceeding their permitted exposure periods.
- ✓ An electrically operated plant will be used where practical.
- ✓ Try to ensure all plant used on the site is effectively silenced.
- ✓ No externally audible radios or other audio equipment will be allowed on site.

7.10 INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING

7.10.1 Identification of Capacity Needs

The first step in pursuing capacity building will be to identify the capacity needs of the various stakeholders. Table 7.20 shows the current safeguards staff strength of the two (2) main implementing ministries of the proposed project. The major capacity issues have to do with skill sets and the availability of and exposure to the use of appropriate modern technologies (including GPS) within the main implementing agencies (Federal Ministry of Environment, Benue State Ministry of agriculture and natural

resources). The environmental and social safeguards staff of the implementing agencies are grossly inadequate (see Table 7.20 below), lack the full complement of the variety of skill sets (e.g., Social and Environmental Safeguards Specialists) needed to perform their functions, and are highly under-resourced with respect to the equipment and modern technologies needed to perform their required functions and roles effectively and efficiently.

Table 7.20: TRAINING MODULES AND PROPOSED PARTICIPANTS

Agency	**No. of Staff**	**Years of safeguards experience**	**Previous safeguards training**	**Self-rank capacity to perform safeguards function (low = 1, High = 5)**	**Comments**
Federal Ministry of Environment	200-450	Over 20yrs	Yes	7	On full-time schedule
Benue State ministry of Agriculture and Natural resources	80-250	Over 15yrs	Yes	3	On full-time schedule

Some additional training would be required and some hand-held equipment such as noise monitors, particulate matter (PM_{10}) monitors and SOx, NOx and CO_2 monitors. In addition, a computer-based monitoring system to facilitate rapid tracking of project activities and for quick generation of various kinds of reports will be required. Training will be categorized along specific thematic areas and targeted at various stakeholders at various levels in the agencies. Where relevant, expertise will be drawn from regulators to inform on key issues. The trainings should be provided in collaboration with the AFDB. The capacity building will include training workshops, field visits and production of guidance reports and tools. The following training programmes are recommended:

Table 7:21 TRAINING MODULES AND PROPOSED PARTICIPANTS

Module No	**Training module content**	**participants**	**Training entity**	**Duration**
1	AFDB safeguards requirements for the	PCU Safeguard Officer,	AFDB safeguards	

	BENUE STATE SPECIAL AGRO-PROCESSING ZONE AND ASSOCIATED INFRASTRUCTURE project, roles and responsibilities	Safeguards Specialists, PIU Safeguard Persons,	specialist	
2	• Screening Checklist, •Completion of EA registration forms	Agency safeguard persons	AFDB safeguards specialist	
3	• Preparation of Environmental and Social Management Plans •Grievance redress registration and resolution forms	Contractors, Supervising engineers, Sub metro and Zonal Council directors	AFDB Safeguards specialist	

The main recipients for training will be the safeguard focal persons. We expect the training to filter down to community level through the Sub metro and Zonal Council officers. These latter officers will have the primary responsibility to involve the communities in the interventions and will therefore require some training to be effective. Their focus will be on the exposure to environmental and social management plans prepared for the sub projects. The communities will be encouraged to be adequately represented at this training sessions as well.

The training may be organized in collaboration with the regional EPA and will be in the form of seminars and workshops.

The possibility of decentralizing the training sessions will be explored so that the safeguard personnel may have session's specific to their activities. Large numbers of participants at specific training sessions will be avoided. The implementation of the training and awareness creation will be timely and therefore planned during the early stages of the Program. Periodically, during the execution of the projects the safeguard persons may congregate to share ideas and learn lessons from each other. It is expected that participants would at the end of the training be in a position to deal more effectively with difficult environmental and social challenges that they may come across.

Production of guidelines and tools

The ESMP provides guidelines to mitigate adverse environmental and social impacts arising out project implementation. Training manuals and checklists are required to assist safeguard focal points to carry out their functions. Such checklist and manuals will include those designed for environmental and social screening of projects.

Budgetary provisions

The awareness creation, capacity improvement and training workshops as well as some logistic support expenses for key stakeholders involved in the implementation of proposed interventions is estimated as presented in Tables 7.4-7.5. The costs of hiring of consultants for preparation of subproject ESIAs/ESMPs/PERs should be determined later and included in the budgets of subprojects when the quantity of the safeguards instruments to be prepared become clearer.

CHAPTER EIGHT: DECOMMISSIONING/ ABANDONMENT

8.1 Decommissioning/Abandonment

8.1.1 Decommissioning/Closure

Most development projects have useful lives, beyond which they are no longer economically viable either as a result of competing technology or irredeemable unforeseen circumstances. Upon the completion of useful life cycle, there is a need to abandon and/or decommission such projects. Planning abandonment activities in advance is the key to a safe, environmentally friendly, and efficient decommissioning/abandonment programme in accordance with the Nigerian regulatory requirements. Furthermore, removal must be carried out with due regard for protection of the immediate environment. Therefore, adequate plans will be put in place to decommission the agro-industrial park in a cost-effective and environmentally-friendly manner.

8.1.2 Plan Structure

A decommissioning plan incorporating the reclamation plan shall be submitted to Federal Ministry of Environment before the cessation of the agro-industrial park operations. The Decommissioning Plan shall:

- Nominate the end use(s) of all lands affected by the project
- Nominate the end use(s) of all buildings, houses and other infrastructure components;
- Describe the steps to make the area safe;
- Describe the type and duration of post decommissioning monitoring.

The fate of each of the project infrastructure listed will be dependent upon the nominated end land uses, which will be agreed with the local communities and the federal government agencies. These items will then be set out in detail within the final decommissioning plan to be presented to the Federal Ministry of Environment before the cessation of the agro-industrial park operations (if and when it becomes necessary).

8.1.3 Reporting

A Post Decommissioning Report shall be prepared as required by statutory regulations and submitted to regulators. The report will provide the following details.

- Overview of decommissioned facilities.
- Details of methods used for decommissioning.
- Nature of decommissioning (whole or partial).
- Records of consultation meetings.
- Details of recyclable/reusable facility components.
- Decontaminated facilities.
- Decommissioning schedule.
- State of the surrounding environment.
- Waste Management Plan.
- Plans for restoration/remediation where necessary.

CHAPTER NINE: CONCLUSION

The Environmental and Social Impact Assessment (ESIA) of the proposed agro industrial park has been carried out in line with statutory requirements for environmental management in Nigeria and as such ensures that potential environmental, social and health impacts of the project are fully appraised. This ESIA report has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost-effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. A management plan that would be effective throughout the projects life cycle has also been put in place to assure environmental sustainability of the project.

The environmental baseline condition of the project area which was carried out based on a one season (wet) data, supplented with dry season secondary data (NEPZA 2019) showed that the physical, chemical and biological characteristics as well as meteorological, climatic and hydrological characteristics were generally consistent with previous studies carried out within the environment with some few exceptions. Also documented were unique assemblages of wild flora and fauna species with abundances that relate to the nutrients and chemical composition of the ecosystems.

The identified adverse impacts of the proposed project include potential; air and noise pollution, soil, sediment, groundwater water and surface water contamination from accidental discharges of effluent, workplace accidents, traffic, community conflict, migratory and raptor avian species, IUCN plant species. Consequently, cost-effective mitigation/ amelioration measures have been designed to ensure that these impacts are prevented, reduced or controlled to as low as reasonably practicable in order to ensure conservation of biodiversity in the area and enhance continual compliance with environmental standards and requirements in Nigeria. It is understood that the project will result in substantial social and economic benefit for Nigeria. The EMP developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation.

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 the project.

Conclusively, the Project Implementing Entity (PIU), and any institution participating in the implementation, will not issue a Request for Proposal (RFP) of any activity subject to Environmental and Social Impact Assessment (ESIA), without the insertion of the construction phase's Environmental and

Social Management Plan (ESMP). It will also not authorize the works to commence before the contractor's ESMP (C-ESMP) has been approved and integrated into the overall planning of the works.

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Annexure 1- ESIA Registration

GOVERNMENT OF BENUE STATE OF NIGERIA

OFFICE OF THE HONORABLE COMMISSIONER

Ref No. .....

Ministry of Agriculture & Natural Resources

PMB 12038, Makurdi, Benue State

Date: 14 April 2021

The Honorable Minister, Environment
Federal Ministry of Environment
Mabushi, Abuja FCT

Attention:
The Director
Environment Assessment
Environment House, Abuja, Nigeria

Sir,

LETTER OF INTRODUCTION

I write on behalf of the Benue State Government to introduce **Mifor Consult Nigeria Limited** as the Environment Consultant for the Special Agro-Industrial Processing Zones Project (SAPZ) in Benue State

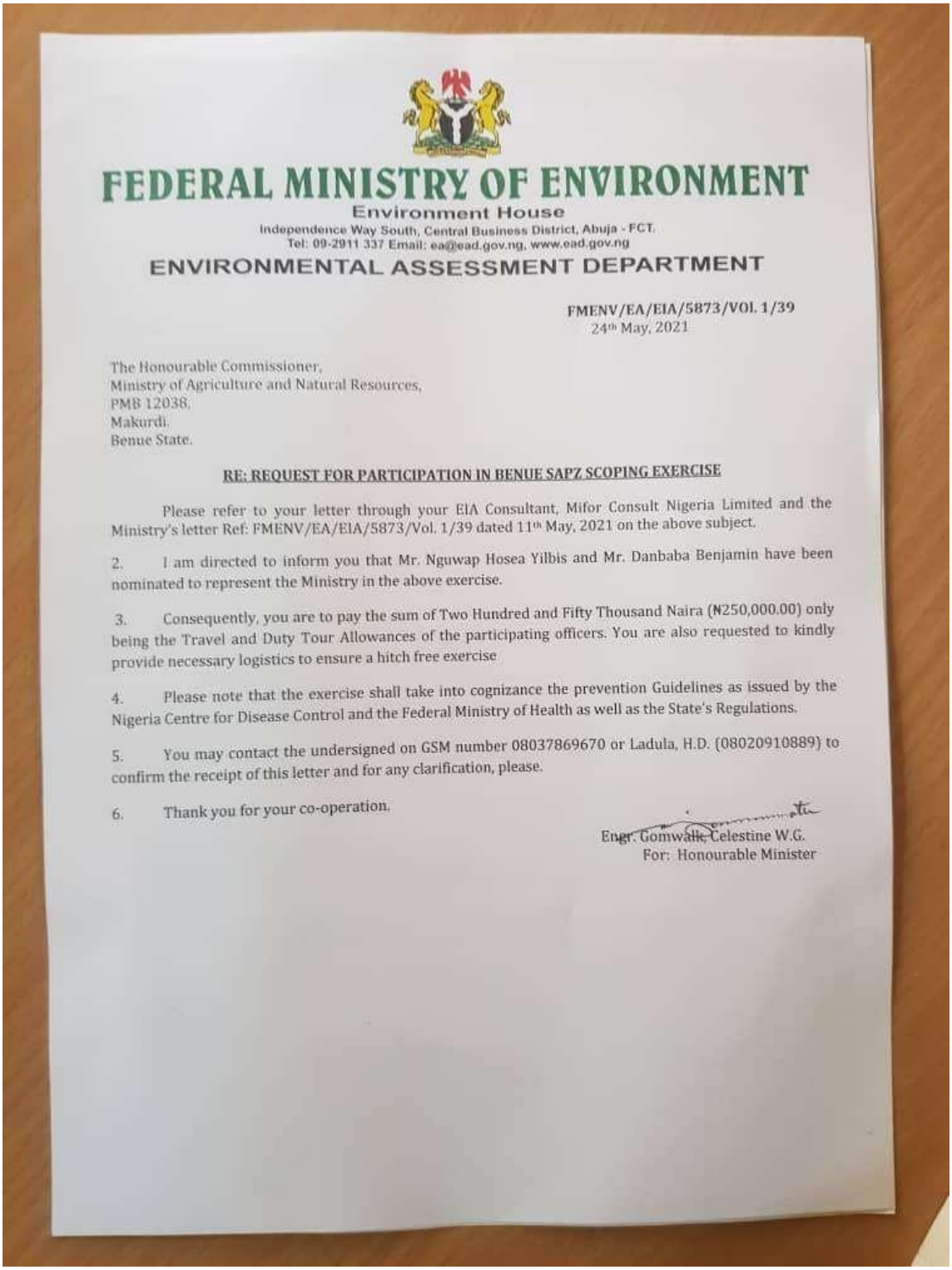
By this introduction, please accord **Joseph K. Ebigwai** the needed cooperation, assistance and privileges as the lead representative of **Mifor Consult Nigeria Limited**

Kindly accept my highest regards.

Yours faithfully,

Timothy A. Ijir, Ph.D.
Honorable Commissioner

Annexure 2: Evidence of Scoping Exercise



FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Tel: 09-2911 337 Email: ea@ead.gov.ng, www.ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMENV/EA/EIA/5873/VOL 1/39
24th May, 2021

The Honourable Commissioner,
Ministry of Agriculture and Natural Resources,
PMB 12038,
Makurdi.
Benue State.

RE: REQUEST FOR PARTICIPATION IN BENUE SAPZ SCOPING EXERCISE

Please refer to your letter through your EIA Consultant, Mifor Consult Nigeria Limited and the Ministry's letter Ref: FMENV/EA/EIA/5873/Vol. 1/39 dated 11th May, 2021 on the above subject.

2. I am directed to inform you that Mr. Nguwap Hosea Yilbis and Mr. Danbaba Benjamin have been nominated to represent the Ministry in the above exercise.

3. Consequently, you are to pay the sum of Two Hundred and Fifty Thousand Naira (₦250,000.00) only being the Travel and Duty Tour Allowances of the participating officers. You are also requested to kindly provide necessary logistics to ensure a hitch free exercise

4. Please note that the exercise shall take into cognizance the prevention Guidelines as issued by the Nigeria Centre for Disease Control and the Federal Ministry of Health as well as the State's Regulations.

5. You may contact the undersigned on GSM number 08037869670 or Ladula, H.D. (08020910889) to confirm the receipt of this letter and for any clarification, please.

6. Thank you for your co-operation.

Engr. Gomwalk Celestine W.G.
For: Honourable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Tel: 09-2911 337 www.environment.gov.ng, ea-environment.org
ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMENV/EA/EIA/5873/VOL 1/50
7th June, 2021

The Honourable Commissioner,
Ministry of Agriculture and Natural Resources,
PMB 12038,
Makurdi.
Benue State.

RE: APPLICATION FOR REGISTRATION OF EIA OF PROPOSED SPECIAL AGRO-INDUSTRIAL PROCESSING ZONES PROJECT IN BENUE STATE

Please refer to the Ministry's letter Ref: FMENV/EA/EIA/5873/Vol. 1/39 dated 11th May, 2021 requesting you to carry out data gathering and the laboratory analysis exercise for the above project.

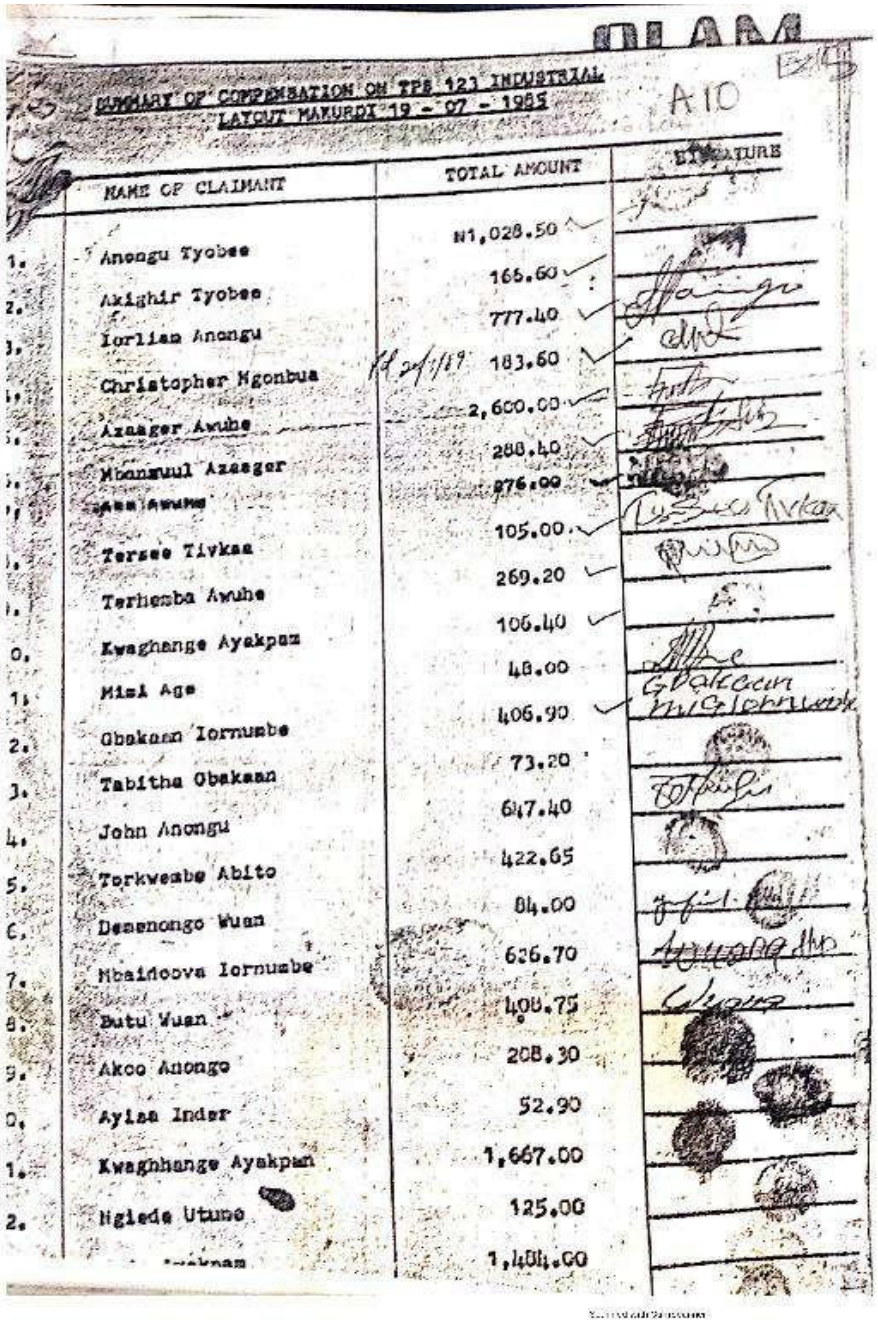
2. I am directed to inform you to proceed with the laboratory analyses of the samples collected during the data gathering exercise. Please note that the laboratory analysis of the samples must be carried out in a FMEnv accredited laboratory and shall be witnessed by officials of the Ministry. You are also requested to ensure full quality assurance/quality control (QA/QC) measures for the laboratory analysis in line with standard practices and notify the Ministry in good time to enable adequate participation in the exercise.

3. You may contact the undersigned on GSM number 08037869670 or Ladula, H.D. (08020910889) to confirm the receipt of this letter and for any clarification, please.

4. Thank you for your co-operation.

Engr. Gomwalk, Celestine W.G.
For: Honourable Minister

Annexure 3: Evidence of Compensation

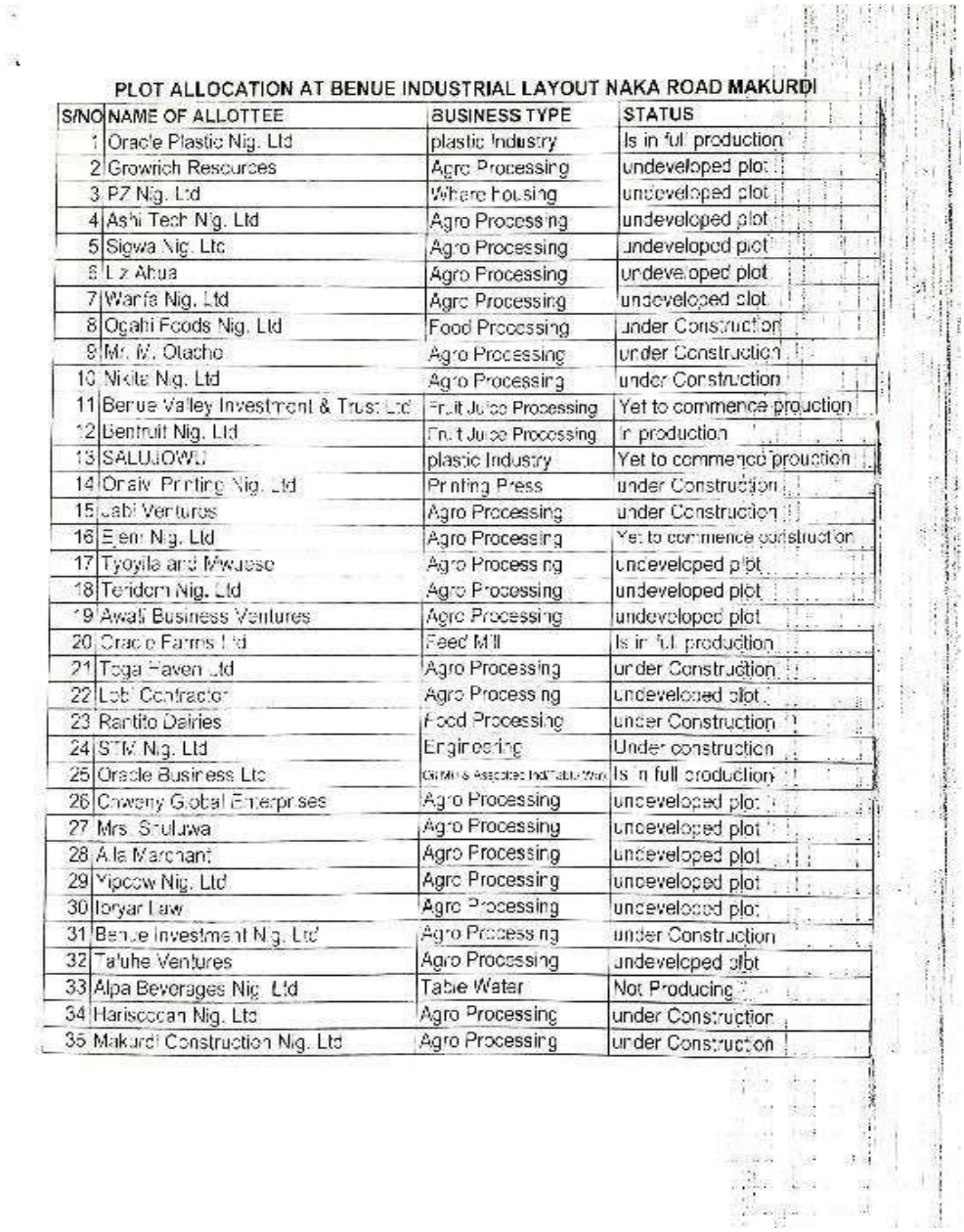


SUMMARY OF COMPENSATION ON TPS 123 INDUSTRIAL LAYOUT MAKURDI 19 - 07 - 1985

A10

	NAME OF CLAIMANT	TOTAL AMOUNT	SIGNATURE
1.	Anongu Tyobee	N1,028.50	
2.	Akighir Tyobee	166.60	
3.	Iorliam Anongu	777.40	
4.	Christopher Ngonbua	183.60	
5.	Azaager Awuhe	2,600.00	
6.	Mbanmuul Azaager	288.40	
7.	[illegible] Awuhe	276.00	
8.	Tersee Tivkaa	105.00	
9.	Terhemba Awuhe	269.20	
10.	Kwaghange Ayakpan	106.40	
11.	Misi Age	48.00	
12.	Obakaan Iornumbe	406.90	
13.	Tabitha Obakaan	73.20	
14.	John Anongu	647.40	
15.	Terkweabe Abito	422.65	
16.	Demenongo Wuan	84.00	
17.	Mbaidoova Iornumbe	636.70	
18.	Butu Wuan	408.75	
19.	Akoo Anongo	208.30	
20.	Ayisa Inder	52.90	
21.	Kwaghhange Ayakpan	1,667.00	
22.	Ngiede Utume	125.00	
	[illegible]	1,404.00	

Annexure 4: List of Allotees in the Park



PLOT ALLOCATION AT BENUE INDUSTRIAL LAYOUT NAKA ROAD MAKURDI

S/NO	NAME OF ALLOTTEE	BUSINESS TYPE	STATUS
1	Oracle Plastic Nig. Ltd	plastic Industry	Is in ful production
2	Growrich Resources	Agro Processing	undeveloped plot
3	PZ Nig. Ltd	Where Housing	undeveloped plot
4	Ashi Tech Nig. Ltd	Agro Processing	undeveloped plot
5	Sigwa Nig. Ltd	Agro Processing	undeveloped plot
6	Liz Ahua	Agro Processing	undeveloped plot
7	Warife Nig. Ltd	Agro Processing	undeveloped plot
8	Ogahi Foods Nig. Ltd	Food Processing	under Construction
9	Mr. M. Otache	Agro Processing	under Construction
10	Nikita Nig. Ltd	Agro Processing	under Construction
11	Benue Valley Investment & Trust Ltd	Fruit Juice Processing	Yet to commence production
12	Benfruit Nig. Ltd	Fruit Juice Processing	In production
13	SALUJOWU	plastic Industry	Yet to commence production
14	Oraiv Printing Nig. Ltd	Printing Press	under Construction
15	Labi Ventures	Agro Processing	under Construction
16	Ejem Nig. Ltd	Agro Processing	Yet to commence construction
17	Tyoyila and Mwuese	Agro Processing	undeveloped plot
18	Teridem Nig. Ltd	Agro Processing	undeveloped plot
19	Awali Business Ventures	Agro Processing	undeveloped plot
20	Oracle Farms Ltd	Feed Mill	Is in ful production
21	Toga Haven Ltd	Agro Processing	under Construction
22	Lobi Contractor	Agro Processing	undeveloped plot
23	Rantito Dairies	Food Processing	under Construction
24	STM Nig. Ltd	Engineering	Under construction
25	Oracle Business Ltd	[illegible]	Is in full production
26	Chweny Global Enterprises	Agro Processing	undeveloped plot
27	Mrs. Shuluwa	Agro Processing	undeveloped plot
28	Ala Marchant	Agro Processing	undeveloped plot
29	Yipcow Nig. Ltd	Agro Processing	undeveloped plot
30	Ioryar Law	Agro Processing	undeveloped plot
31	Benue Investment Nig. Ltd	Agro Processing	under Construction
32	Taluhe Ventures	Agro Processing	undeveloped plot
33	Alpa Beverages Nig. Ltd	Table Water	Not Producing
34	Hariscocan Nig. Ltd	Agro Processing	under Construction
35	Makurdi Construction Nig. Ltd	Agro Processing	under Construction

Annexure 5: List of farmers on site

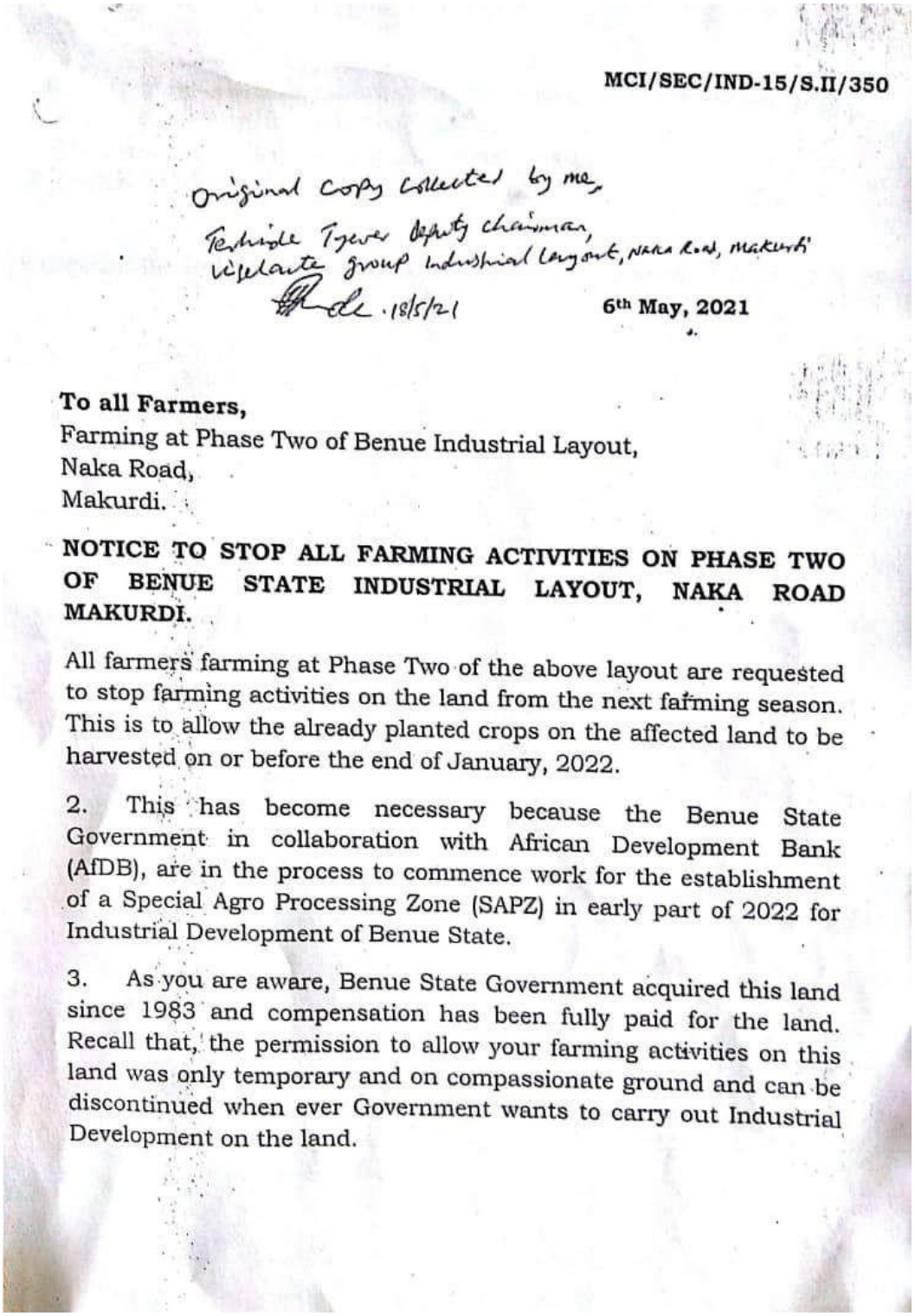
FARMERS REQUESTED TO STOP FARMING ACTIVITIES IN THE NEXT FARMING SEASON (2022) ON THE LAND AT PHASE TWO OF BENUE STATE INDUSTRIAL LAYOUT ALLOCATED FOR THE ESTABLISHMENT OF SPECIAL AGRO PROCESSING ZONE (SAPZ) BY GOVERNMENT

S/NO	NAME	PHONE	SIGNATURE
1,	NYiMAR AMAKi	NO PHONE	MA
2,	ASHIR KOR	09071393493	[signature]
3,	MBANenGEN. ASHiR	08113160038	f.a
4,	SYLUESTER TyoKULA	08111787083	[signature]
5,	GABRIEL NYAm	08064862396	[signature] G.
6,	PATRICIA TAR	NO PHONE	P T
7,	ESTHER UKUSU	08075849275	Tar
8,	EVELYN BULUS	09016650959	[signature]
9,	ZAKi AYAKPAM IJIR.	07037384780	[signature] 21/5/21
10	Teremo Sabina Ruth	08159445536	[signature]
11	Toryira Veronica Nguashe	09037233753	[signature]
12	Teremo Juliana Adoo	07055272174	T.J
13	Terhemba Amachi	08186809063	
14	MLumun ATese	09135643764	M A
15	Eunice Amachi	NO PHONE	E A
16	AONDONgu ATese	08127712798	AH
17	TULE SAmuel	08133923077	[signature]
18	EMMANUEL INEKE	08176352747	[signature]

FARMERS REQUESTED TO STOP FARMING ACTIVITIES IN THE NEXT FARMING SEASON (2022) ON THE LAND AT PHASE TWO OF BENUE STATE INDUSTRIAL LAYOUT ALLOCATED FOR THE ESTABLISHMENT OF SPECIAL AGRO PROCESSING ZONE (SAPZ) BY GOVERNMENT

S/NO	NAME	PHONE	SIGNATURE
19	MBAKELEN AYAKA	08199258525	
20	JOSHEP AKIRR	09050[illegible]51999	J.A
21	MERCY DOOKUMUR UKPE	08077981505	
22	ROSEMARY TERHEMBA	09017525343	
23	JULIANA AYAKA	09016131607	
24	DORATHY IGBAHEE	09018210077	
25	ATSUGOG FRANCIS	07055865046	
26	GIDEON AYAKA	09027421966	
27	CHIA ZUKU	08180562064	
28	ATSAGBA CHISIANA	08074936110	
29	SIMON AYAKA	07058[illegible]274	
30	PHILIP ATEGBA	08136820083	
31	JOSHUA ANURA	08099204771	J.V.
32	TERKUMBI NGUNGU	08047[illegible]916	
33	CHIEF DANIEL UZU	09054561480	
34	PETER UDZO	08187844998	
35.	ELIZABETH AVER SHIMA	08074690155	E.S.
36.	ENDOO AGABI	NO PHONE.	

Annexure 6: Cut-off Dates



MCI/SEC/IND-15/S.II/350

Original Copy Collected by me,
Terhide Tyever Deputy chairman,
Vielante group Industrial Layout, Naka Road, Makurdi
18/5/21

6th May, 2021

To all Farmers,
Farming at Phase Two of Benue Industrial Layout,
Naka Road,
Makurdi.

NOTICE TO STOP ALL FARMING ACTIVITIES ON PHASE TWO OF BENUE STATE INDUSTRIAL LAYOUT, NAKA ROAD MAKURDI.

All farmers farming at Phase Two of the above layout are requested to stop farming activities on the land from the next farming season. This is to allow the already planted crops on the affected land to be harvested on or before the end of January, 2022.

2. This has become necessary because the Benue State Government in collaboration with African Development Bank (AfDB), are in the process to commence work for the establishment of a Special Agro Processing Zone (SAPZ) in early part of 2022 for Industrial Development of Benue State.

3. As you are aware, Benue State Government acquired this land since 1983 and compensation has been fully paid for the land. Recall that, the permission to allow your farming activities on this land was only temporary and on compassionate ground and can be discontinued when ever Government wants to carry out Industrial Development on the land.

Secret

GOVERNMENT OF BENUE STATE OF NIGERIA

In replying, please quote the number and date of this letter.

Ref No. MCI/SEC/IND-15/S.II/350
Ministry of Industry and Cooperatives
P.M.B 102027
State Secretariat, Makurdi,
Benue State, Nigeria
e-mail: mitibenuestate@gmail.com
Date: 6th May, 2021

To all Farmers,
Farming at Phase Two of Benue Industrial Layout,
Naka Road,
Makurdi.

NOTICE TO STOP ALL FARMING ACTIVITIES ON PHASE TWO OF BENUE STATE INDUSTRIAL LAYOUT, NAKA ROAD MAKURDI.

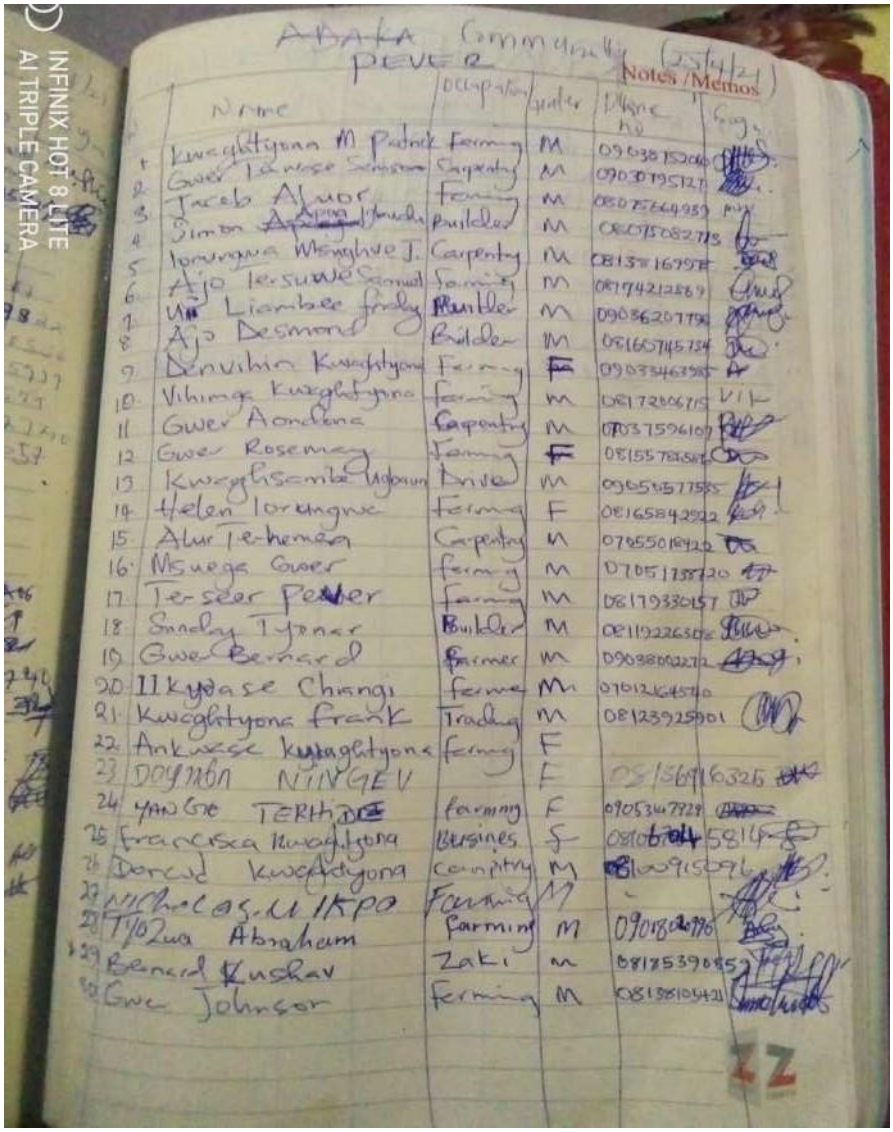
All farmers farming at Phase Two of the above layout are requested to stop farming activities on the land from the next farming season. This is to allow the already planted crops on the affected land to be harvested on or before the end of January, 2022.

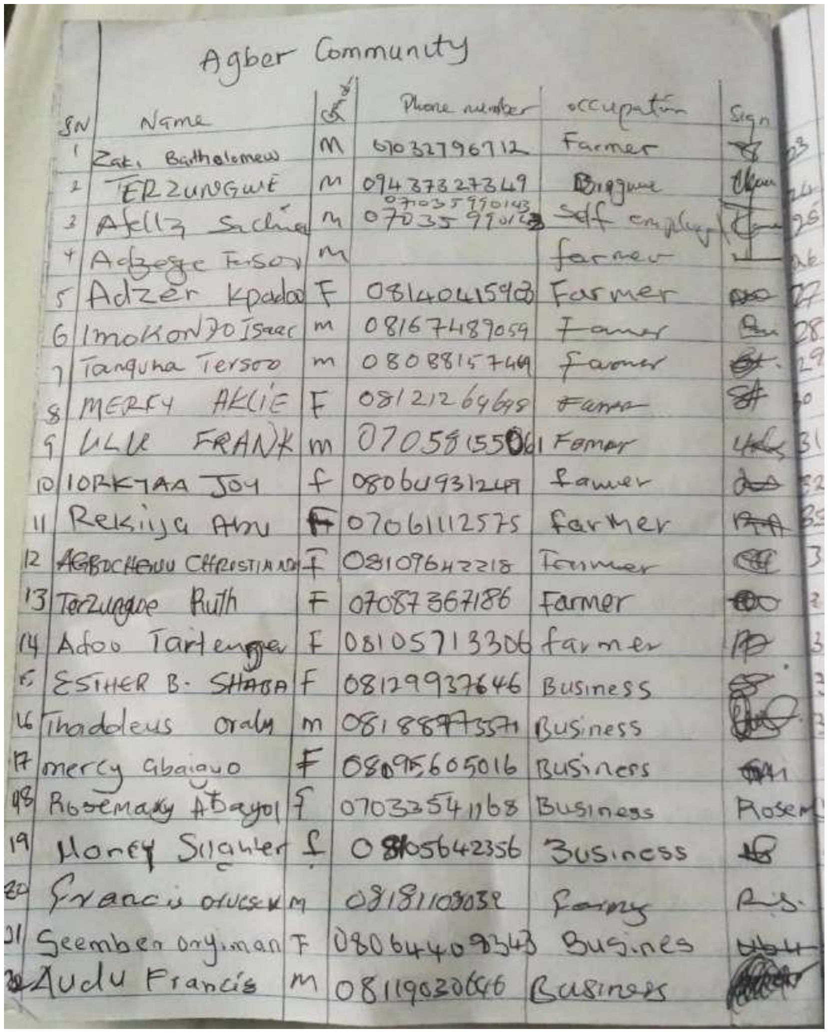
2. This has become necessary because the Benue State Government in collaboration with African Development Bank (AfDB), are in the process to commence work for the establishment of a Special Agro Processing Zone (SAPZ) in early part of 2022 for Industrial Development of Benue State.

3. As you are aware, Benue State Government acquired this land since 1983 and compensation has been fully paid for the land. Recall that, the permission to allow your farming activities on this land was only temporary and on compassionate ground and can be discontinued when ever Government wants to carry out Industrial Development on the land.

Secret

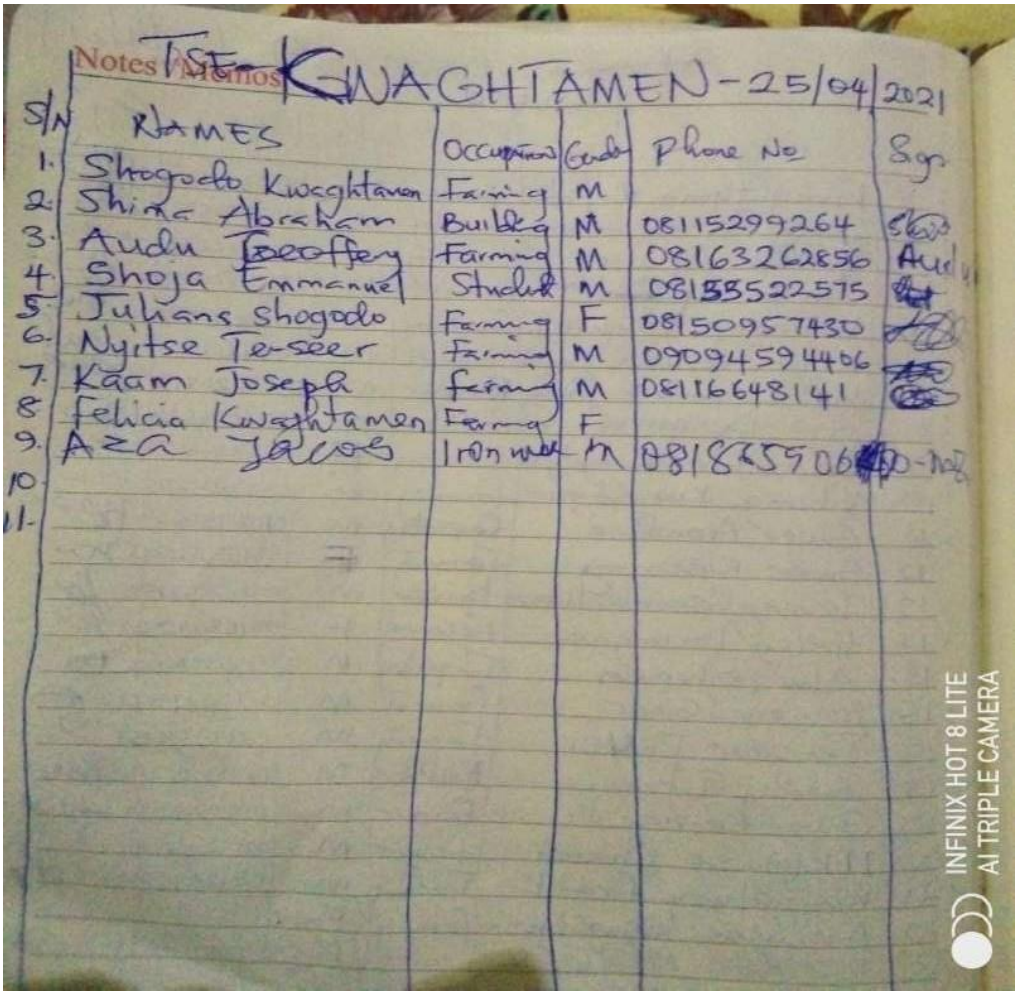
Annexure 7: Attendance List of Stakeholders





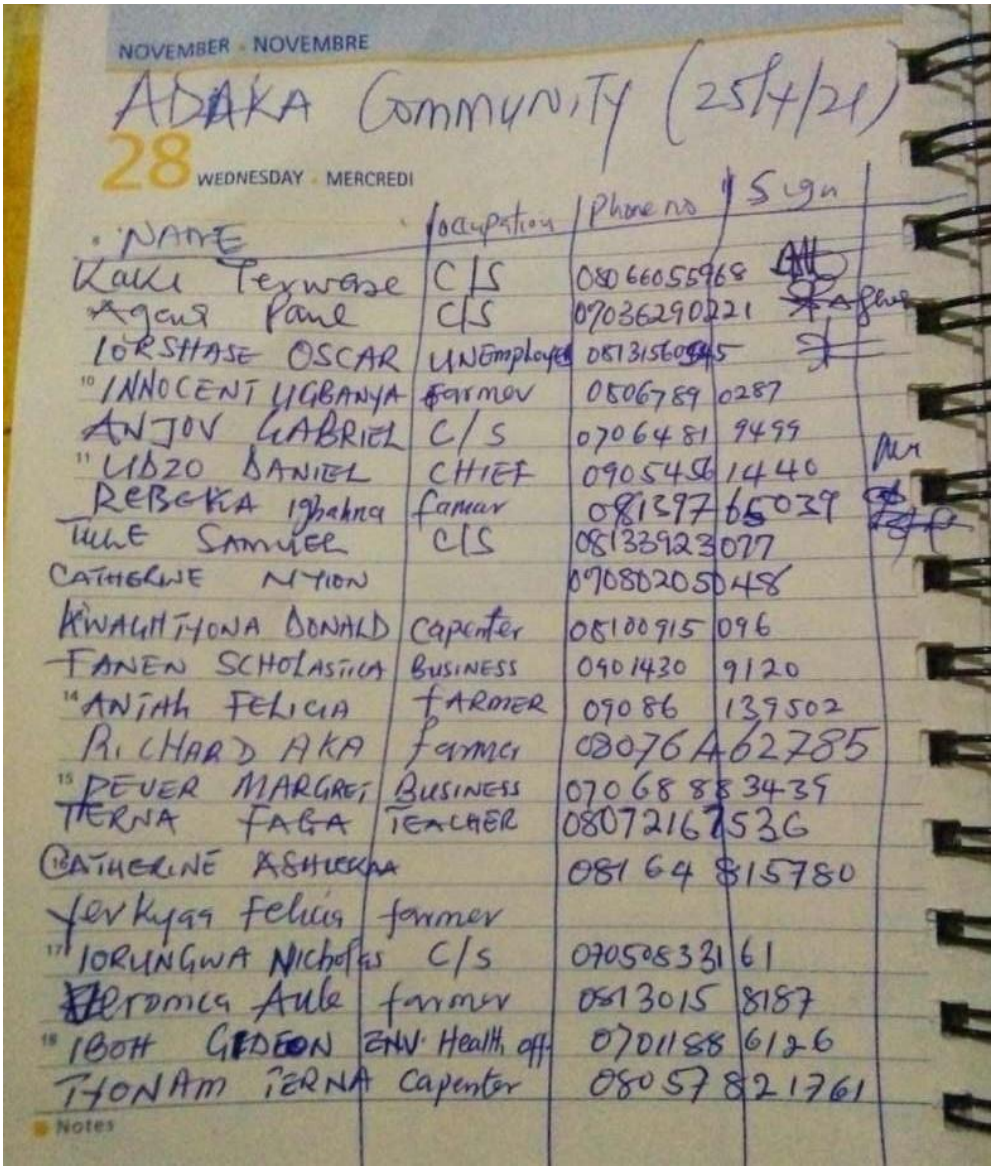
Agber Community

SN	Name	Sex	Phone number	occupation	Sign
1	Zaki Bartholomew	M	07032796712	Farmer	[illegible]
2	TERZUNGWE	M	09437827349	Biggwe	[illegible]
3	Afella Sachia	M	07035990143 07035990143	Self employed	[illegible]
4	Adzege Tersoo	M		farmer	[illegible]
5	Adzer Kpadoo	F	08140415903	Farmer	[illegible]
6	Imokonzo Isaac	m	08167489059	Famer	[illegible]
7	Tanguha Tersoo	m	08088157469	farmer	[illegible]
8	MERCY AKLIE	F	08121264698	Famer	[illegible]
9	ULU FRANK	m	07058155061	Famer	[illegible]
10	IORKYAA JOY	f	08064931249	famer	[illegible]
11	Rekiya Amu	F	07061112575	farmer	[illegible]
12	AGBOCHENU CHRISTIANA	F	08109642218	Farmer	[illegible]
13	Terzungwe Ruth	F	07087367186	Farmer	[illegible]
14	Afoo Tartengea	F	08105713306	farmer	[illegible]
15	ESTHER B. SHABA	F	08129937646	Business	[illegible]
16	Thaddeus Oraly	m	08188973571	Business	[illegible]
17	mercy Gbaiguo	F	08095605016	Business	[illegible]
18	Rosemary Abayol	f	07033541168	Business	Rosem
19	Honey Sughter	f	08105642356	Business	[illegible]
20	Francis Oruese	M	08181108038	Farmy	[illegible]
21	Seember Onyiman	F	08064409343	Busines	[illegible]
22	Audu Francis	M	08119030646	Business	[illegible]



TSE-KWAGHTAMEN - 25/04/2021

S/N	NAMES	Occupation	Gender	Phone No	Sign
1.	Shogodo Kwaghtamen	Farming	M		
2.	Shima Abraham	Building	M	08115299264	
3.	Audu Terroffey	Farming	M	08163262856	
4.	Shoja Emmanuel	Student	M	08155522575	
5.	Juhans Shogodo	Farming	F	08150957430	
6.	Nyitse Ter-seer	Farming	M	09094594406	
7.	Kaam Joseph	Farming	M	08116648141	
8	Felicia Kwaghtamen	Farming	F		
9.	Aza Jacob	Iron work	M	08185590[illegible]	
10.					
11.					



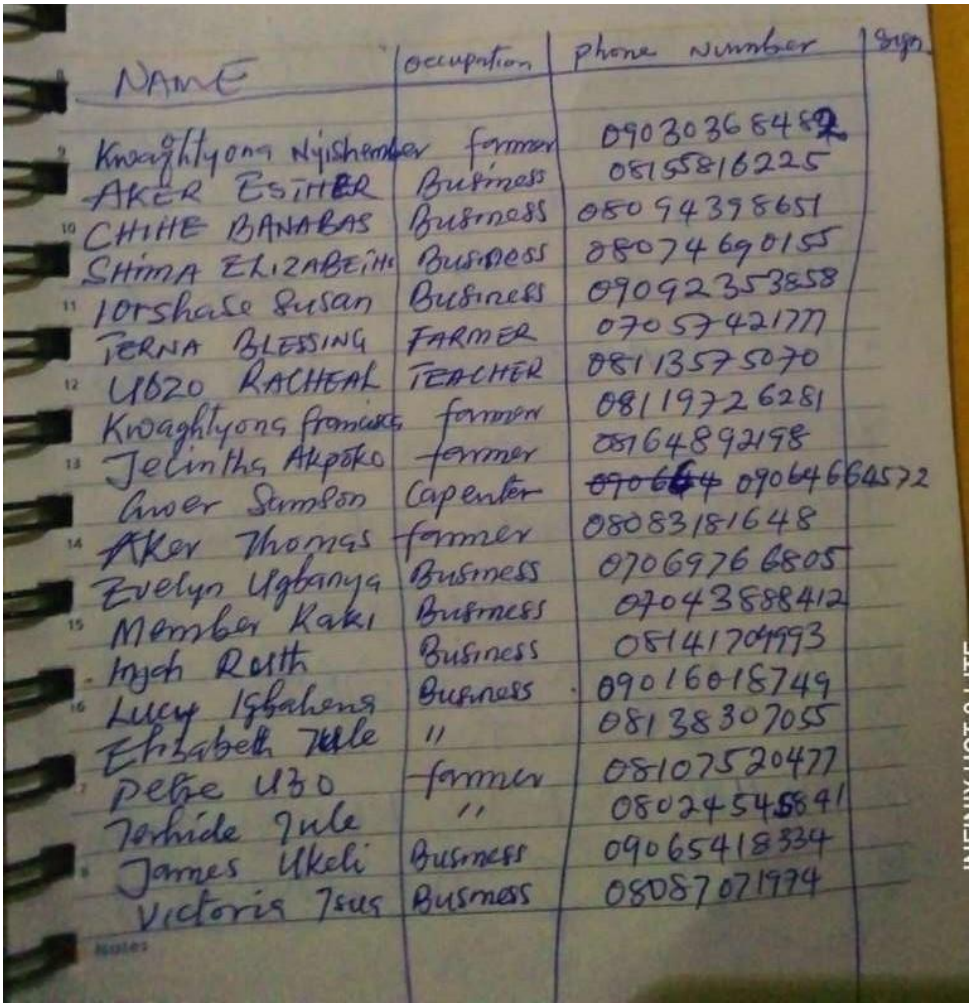
NOVEMBER · NOVEMBRE

ADAKA Community (25/4/21)

28 WEDNESDAY · MERCREDI

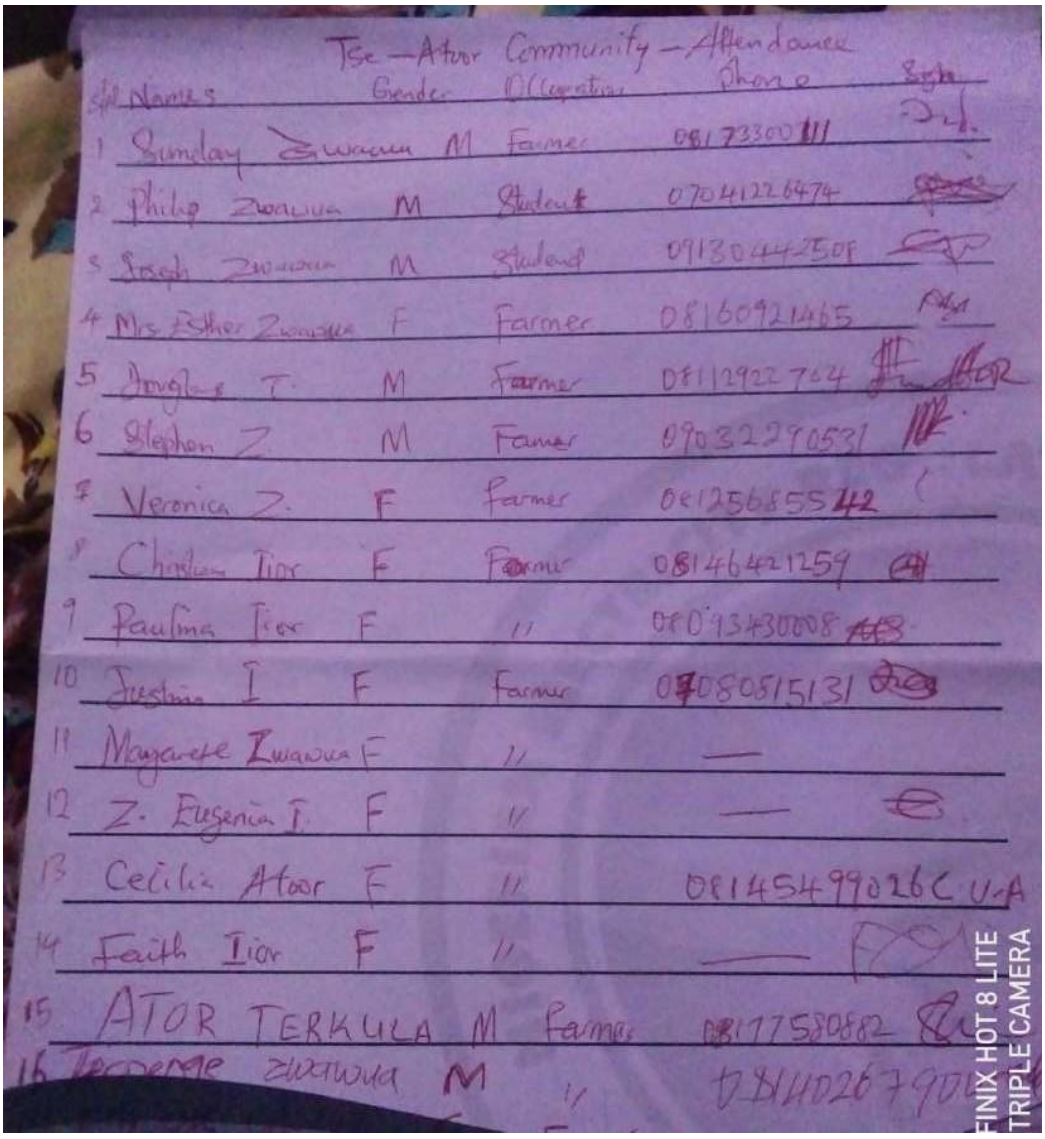
	NAME	Occupation	Phone no	Sign
	Kaka Terwase	C/S	08066055968	
	Agwa Paul	C/S	07036290221	
	LORSHASE OSCAR	UNEmployed	0813156[illegible]5	
10	INNOCENT UGBANYA	farmer	0806789 0287	
	ANJOV GABRIEL	C/S	0706481 9499	
11	UBZO DANIEL	CHIEF	0905456 1440	
	REBEKA Igbaha	farmer	0813976 5039	
	TULE SAMUEL	C/S	08133923077	
	CATHERINE NYION		07080205048	
	KWAGHTYONA DONALD	Carpenter	08100915 096	
	FANEN SCHOLASTICA	BUSINESS	0901430 9120	
14	ANIAH FELICIA	FARMER	0908 6 139502	
	RICHARD AKA	farmer	08076A62785	
15	DEVER MARGRET	BUSINESS	07068883439	
	TERNA FAGA	TEACHER	08072167536	
16	CATHERINE ASHEKNA		081 64 815780	
	Yevkyaa Felicia	farmer		
17	IORUNGWA Nicholas	C/S	07050833161	
	Veronica Aule	farmer	0813015 8187	
18	IBOH GIDEON	ENV. Health off.	07011886126	
	TYONAM TERNA	Carpenter	08057821761	

Notes



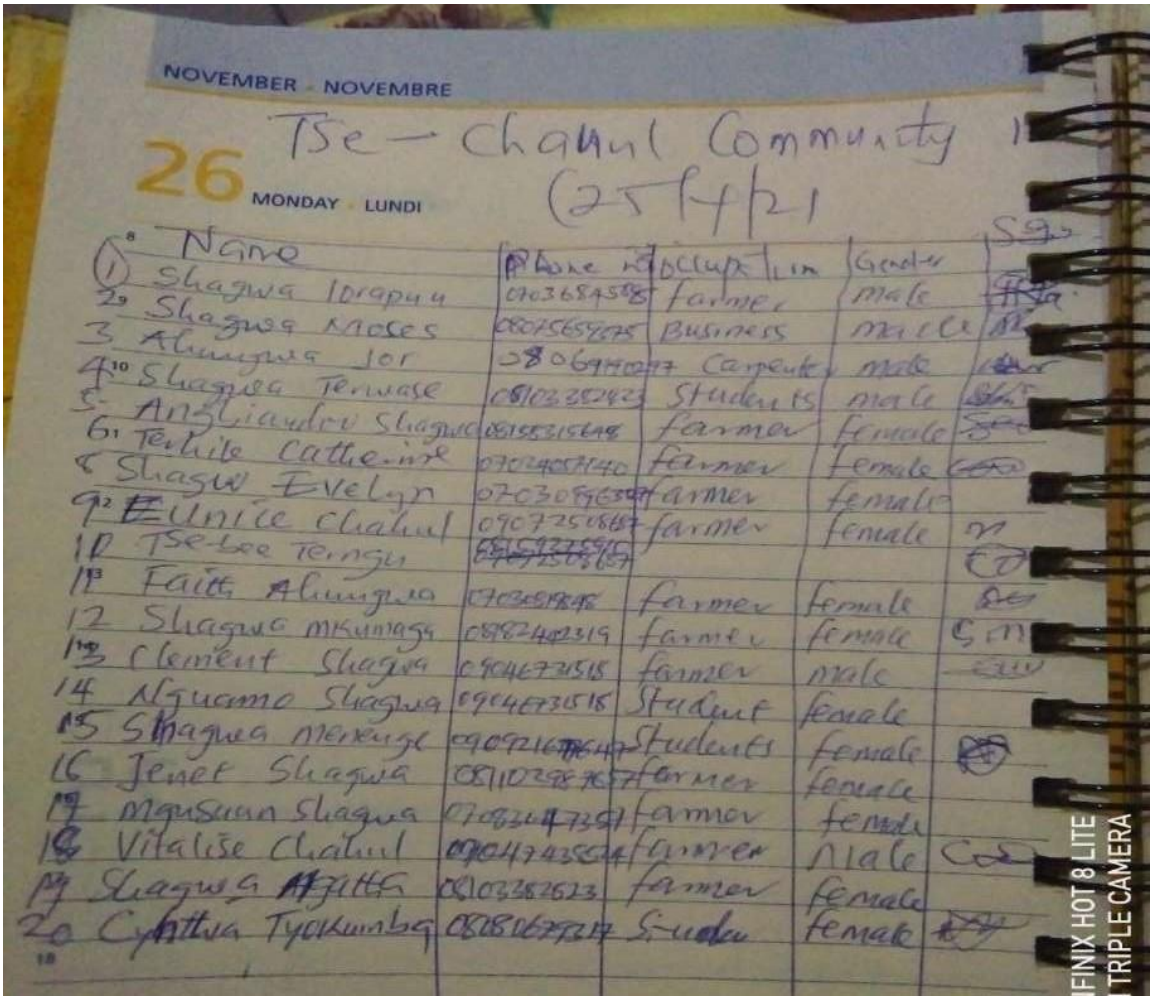
	NAME	occupation	phone Number	Sign
9	Kwaghtyong Nyishenber	farmer	09030364852	
	AKER ESTHER	Business	08155816225	
10	CHIHE BANABAS	Business	08094398651	
	SHIMA ELIZABETH	Business	08074690155	
11	Iortshase Susan	Business	09092353858	
	TERNA BLESSING	FARMER	07057421777	
12	UBZO RACHEAL	TEACHER	08135775070	
	Kwaghtyong francis	farmer	08119726281	
13	Jelintha Akpoko	farmer	08164892198	
	Awer Simson	Capenter	~~09066~~ 09064664572	
14	AKer Thomas	farmer	08083181648	
	Evelyn Ugbanya	Business	07069766805	
15	Member Kaki	Business	07043888412	
	Ingoh Ruth	Business	08141704993	
16	Lucy Igbahena	Business	09016018749	
	Elizabeth Jule	11	08138307055	
17	Pebe Ubo	farmer	08107520477	
	Tohide Jule	11	08024545841	
18	James Ukeli	Business	09065418334	
	Victoria Isus	Busness	08087071974	

Notes



Tse—Ator Community—Attendance

S/N	Names	Gender	Occupation	Phone	Sign
1	Sunday Zwaava	M	Farmer	08173300111	
2	Philip Zwaava	M	Student	07041226474	
3	Joseph Zwaava	M	Student	09130442501	
4	Mrs Esther Zwaava	F	Farmer	08160921465	
5	Douglas T.	M	Farmer	08112922704	
6	Stephen Z.	M	Farmer	09032290531	
7	Veronica Z.	F	Farmer	08125685542	
8	Christian Tior	F	Farmer	08146421259	
9	Paulina Tior	F	//	08093430008	
10	Justina I	F	Farmer	07080515131	
11	Magarete Zwaava	F	//	—	
12	Z. Eugenia I.	F	//	—	
13	Cecilia Ator	F	//	08145499026	
14	Faith Tior	F	//	—	
15	ATOR TERKULA	M	Farmer	08177580882	
16	Terdeme Zwaava	M	//	08140267904	



NOVEMBER - NOVEMBRE

26 MONDAY - LUNDI

Tse-Chahul Community
(25/4/21

	Name	Phone number	Occupation	Gender	
1	Shagwa Idrapu	0703684588	farmer	male	
2	Shagwa Moses	0801565675	Business	male	
3	Alungwa Jor	08069	Carpenter	male	
4	Shagwa Terwase	08103	Students	male	
5	Angliandov Shagwa	0815	farmer	female	
6	Terhile Catherine	0701	farmer	female	
7	Shagw Evelyn	0703	farmer	female	
8	Unice Chahul	0907	farmer	female	
9	Tse-Lee Terngu	0907			
10	Faith Alungwa	0703	farmer	female	
11	Shagwa Mkumaga	0882	farmer	female	
12	Clement Shagwa	0904	farmer	male	
13	Nguama Shagwa	0904	Student	female	
14	Shagwa Mercy	0907	Students	female	
15	Jenet Shagwa	0811	farmer	female	
16	Mgusuan Shagwa	0703	farmer	female	
17	Vitalise Chahul	0904	farmer	Male	
18	Shagwa Agatha	0803	farmer	female	
19	Cynthia Tyokumbo	0818	Student	female	

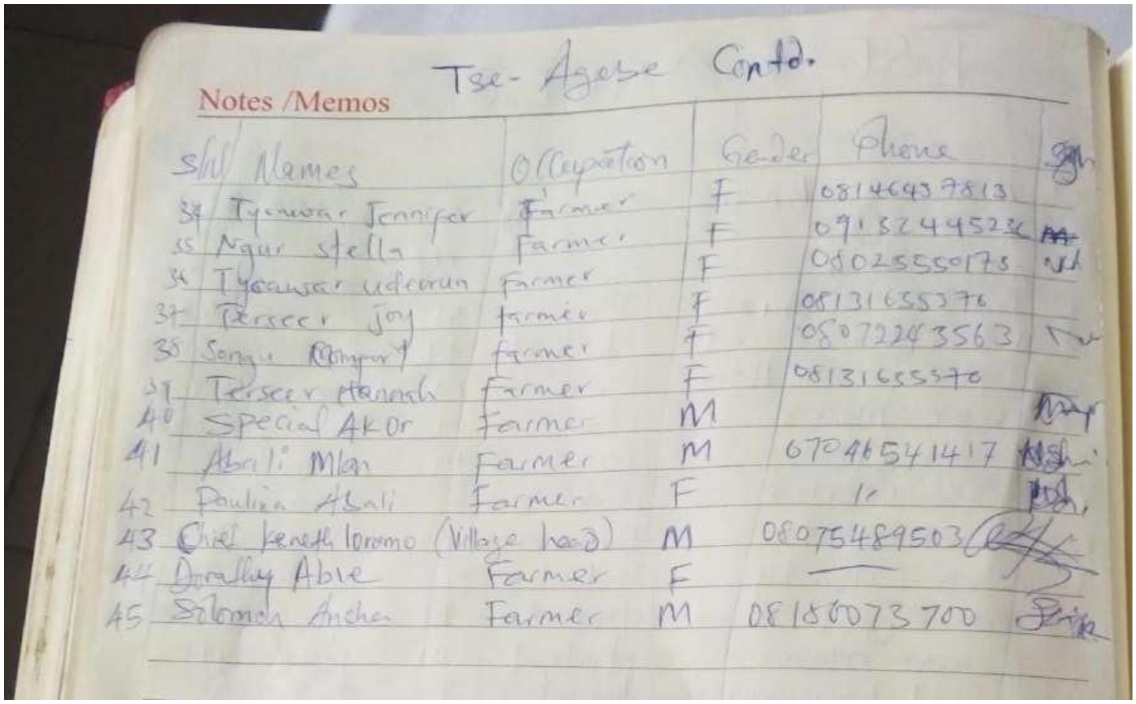
Tse - Igbum

S/N	Name	Gender	Phone number	Occupation	Sign
1	Dajodu [illegible]	m	08065136237	farmer	
2	Dugeri Paul	m	08064607556	BUSINESS	
3	Fred Adeke	m	07066015366	Builder / Business man	
4	Orkper Rebecca	F	08057705837	Farmer	
5	GBEV AUGUSTINE	m	09152214026	farmer	
6	Orkper Enoch	m	08169726221	farmer	
7	Orkper Wilson	m	07086670011	farmer	
8	Tsikende Whishima	m	07054471506	Farmer	
9	Orkper Epherem	m	08104027647	Farmer	
10	Iorjua Kelvin	m	07084847745	Farmer	
11	Ioryessu Rosemary	F	[illegible]612300	Farmer	
12	Tor Godwin C	m	09035130978	Farmer	
13	Ioryaasu Rosemary C	F	08103886369	Farmer	
14	ANGBIANDUE MONICA H	F	07054917024	STUDENT	
15	Iingusoru Johnson J.	F	08062569948	Busnesswoman	
16	IORTYOSU AONDOFA K.	M	08062569948	STUDENT	
17	Tor Terungwa	m	07080464429	Farmer	
18	Tor Samuel	m	08080599686	Student	
19	DULLEY EVELYN	F	07068426774	Farmer	
20	Kwaghngu Jemima	[illegible]	08037577104	farmer	
21	Koko Solomon	m	08064111974	Farmer	
22	Koko Queen	F	08126162222	Business	
[illegible]	Blessing matthew	F	09053155890	Farmer	

Iorbee Community 26-04-2021

Notes /Memos

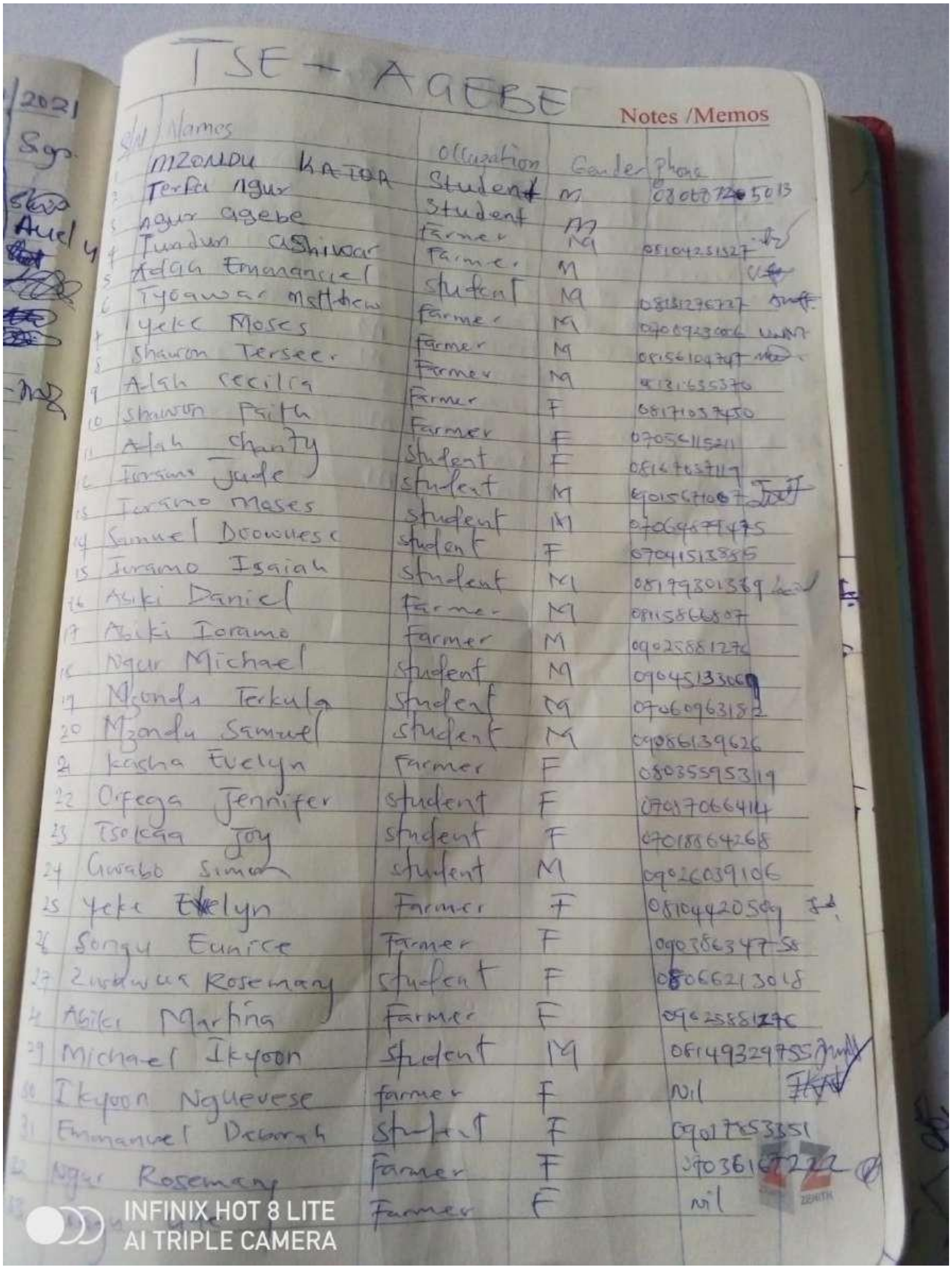
S/N	Names	Occupation	Gender	Phone	Sign
1	Chief David Iorbee	Village head			
2	Justine Aondoakaa	Driver (Professional)	M	08084405913	[illegible]
3	Joseph Ngija	Electrician	M	[illegible]331280	[illegible]
4	Orraa Benedict	"; Farmer	M	08101395081	[illegible]
5	Ujah David	Mason	M	08155707013	[illegible]
6	Bem Iorfa	Driver	M	07065414713	[illegible]
7	Ojeph Adzua	Mason/Farming	M	08138970985	[illegible]
8	Shaagee David	G S M repair	M	08104463355	[illegible]
9	Emmanuel Kwaghtover	Bussiness man	M	0701728[illegible]	[illegible]
10	Nguifan Adigyuve	Health worker	F	08166975624	[illegible]
11	Gerasha Veronica	Health worker	F	07055713175	[illegible]
12	Precious Esonwune	Fast food	F	09061310884	[illegible]
13	Udoka Esonwune	Okada man	M	07034372141	[illegible]
14	Apeugba Josephine	Bussiness	F	0706413507	[illegible]
15	El Israel	Student	M	09068548146	[illegible]
16	Shaagee David	G.S.M repair	M	09017288001	[illegible]
17	Rose Kuningon	Farmer	F	08117716385	[illegible]
18	Avon Celina	Farmer	F	09013711543	[illegible]
19	Katherine Iorbee	Farmer	F	08138027477	[illegible]
20	Lydia Bibi	Farmer	F	08078868085	
21	Iorbee Helen	Student	F	0813429[illegible]	[illegible]
22	Iorbee Mary	Student	F	07025878505	[illegible]
23	Endurance Ogbu	Barbing	M	08161728241	[illegible]
24	Patrick Ogbu	Shoe making	M	07164800905	
25	Emmanuel Iorbee	Driving	M	08117801273	[illegible]
26	Dancel Iorbee	Student	M	08127059055	[illegible]
27	Promise Ogbu	Student	F	0[illegible]13645978	
	Theophilious Iorudu	Student	M	09052966939	



Notes /Memos

Tse- Agese Contd.

S/N	Names	Occupation	Gender	Phone	Sign
34	Tyonwar Jennifer	Farmer	F	08146497813	
35	Ngur stella	Farmer	F	09132449236	
36	Tyoawsar udeorun	Farmer	F	08025550173	
37	Terseer joy	farmer	F	08131635376	
38	Sangu Comfort	farmer	F	08072243563	
39	Terseer Hannah	Farmer	F	08131635570	
40	Special Akor	Farmer	M		
41	Abali Mlan	Farmer	M	07046541417	
42	Paulina Abali	Farmer	F	"	
43	Chief keneth loromo (Village head)		M	08075489503	
44	Dorathy Able	Farmer	F	—	
45	Solomon Anchen	Farmer	M	08180073700	



TSE – AGEBE

Notes /Memos

S/N	Names	Occupation	Gender	Phone
1	MZONDU KATOR	Student	M	08087720 5013
2	Terfa Ngur	Student	M	
3	Ngur agebe	Farmer	M	
4	Tundun Ashiwar	Farmer	M	08104231327
5	Adah Emmanuel	Farmer	M	
6	Tyoawar Matthew	student	M	08131276727
7	Yeke Moses	farmer	M	09060923006
8	Shaum Tersee	Farmer	M	08156104747
9	Adah cecilia	Farmer	M	9131635370
10	Shawon Faith	Farmer	F	08171037450
11	Adah Charity	Farmer	F	07055115211
12	Iorsims Jude	Student	F	08167037117
13	Ioramo Moses	student	M	09015671007
14	Samuel Deoowese	student	M	07069579475
15	Ioramo Isaiah	student	F	07041513885
16	Asiki Daniel	student	M	08199301389
17	Asiki Ioramo	Farmer	M	08115866807
18	Ngur Michael	Farmer	M	09025881276
19	Mzondu Terkula	student	M	09045133069
20	Mzondu Samuel	student	M	07060963182
21	Kasha Evelyn	student	M	09086139626
22	Ofega Jennifer	Farmer	F	08035595319
23	Tsekaa Joy	student	F	07017066414
24	Gwabo Simon	student	F	07018864268
25	Yeke Evelyn	student	M	09026039106
26	Songu Eunice	Farmer	F	08104420599
27	Zwawua Rosemary	Farmer	F	09038634758
28	Asiki Martina	student	F	08066213018
29	Michael Ikyoon	Farmer	F	09025881276
30	Ikyoon Nguevese	student	M	08149329755
31	Emmanuel Deborah	farmer	F	Nil
32	Ngur Rosemary	student	F	09017853351
33	[illegible]	Farmer	F	07036167222
		Farmer	F	nil

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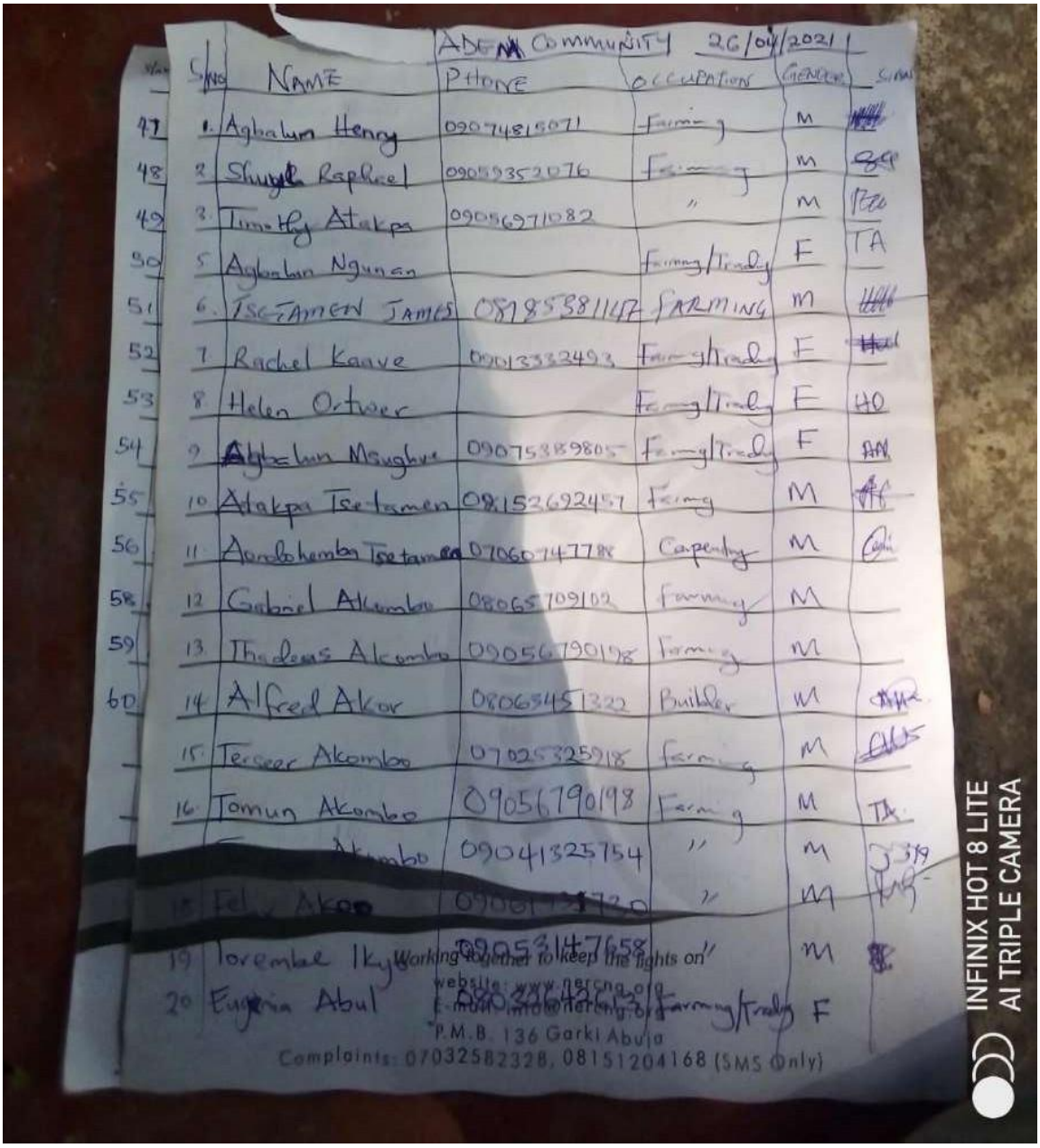
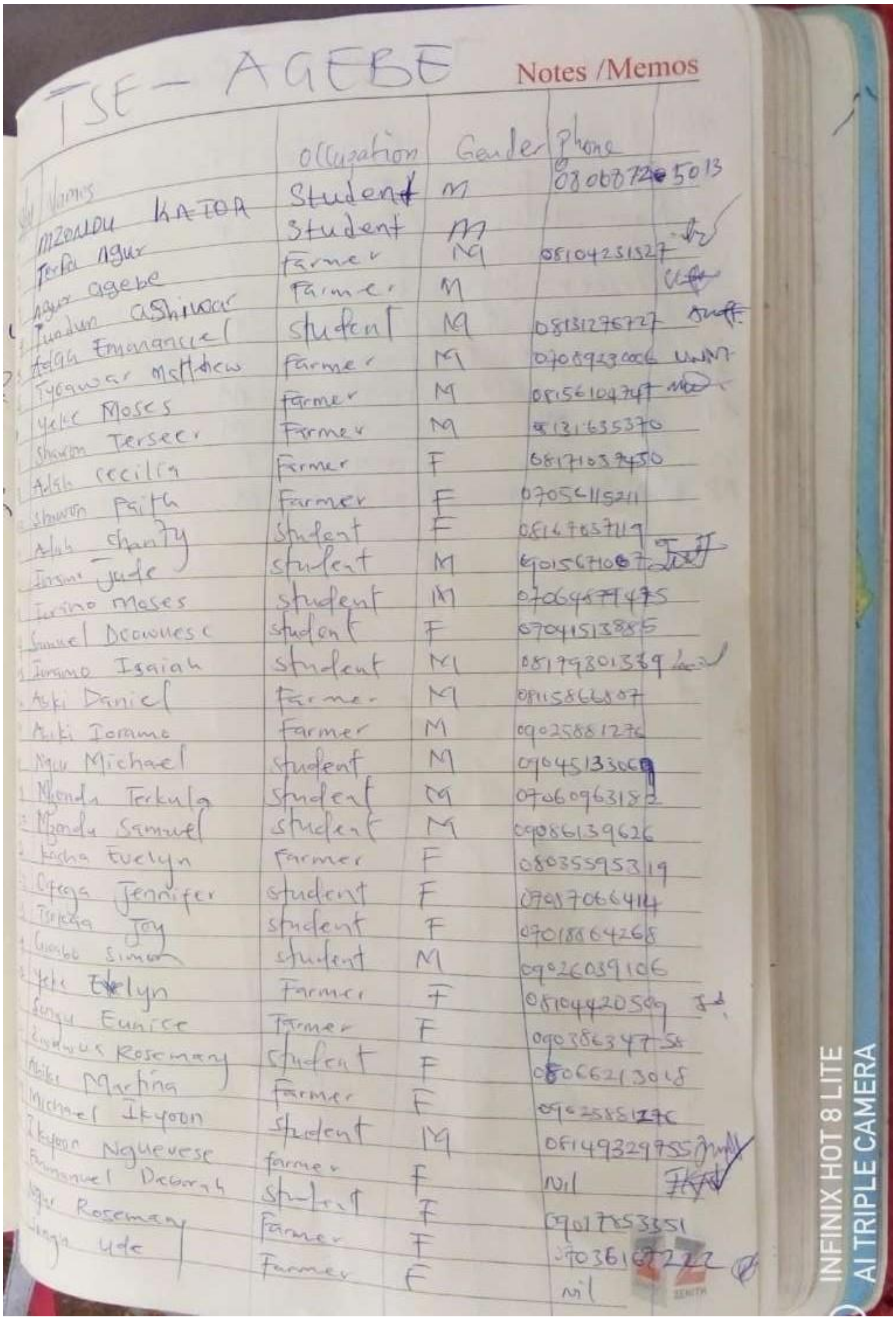


ADE Community 26/04/2021

S/No	NAME	Phone	Occupation	Gender	S/No
1.	Agbalun Henry	09074815071	Farming	M	
2.	Shuyla Raphael	09059352076	Farming	M	
3.	Timothy Atakpa	09056971082	"	M	
5	Agbalun Ngunan		Farming/Trading	F	TA
6.	ISEYAMEN JAMES	08185881147	FARMING	M	
7	Rachel Kaave	09013333493	Farming/Trading	F	
8	Helen Ortser		Farming/Trading	F	HO
9	Agbalun Msughve	09075889805	Farming/Trading	F	
10	Atakpa Iseyamen	08152692457	Farming	M	
11	Agbalumba Iseyamen	07060747788	Carpentry	M	
12	Gabriel Akembo	08065709102	Farming	M	
13	Thadeus Akembo	09056790198	Farming	M	
14	Alfred Akor	08065451322	Builder	M	
15.	Terseer Akembo	07025325918	Farming	M	
16.	Tomun Akembo	09056790198	Farming	M	TA
	Akembo	09041325754	"	M	
	Felix Akor	09061	"	M	
19	Iorembe Iky	09053147658		M	
20	Eugenia Abul	080	Farming/Trading	F	

Working together to keep the lights on"
website: www.nercng.org
E-mail: info@nercng.org
P.M.B. 136 Garki Abuja
Complaints: 07032582328, 08151204168 (SMS Only)

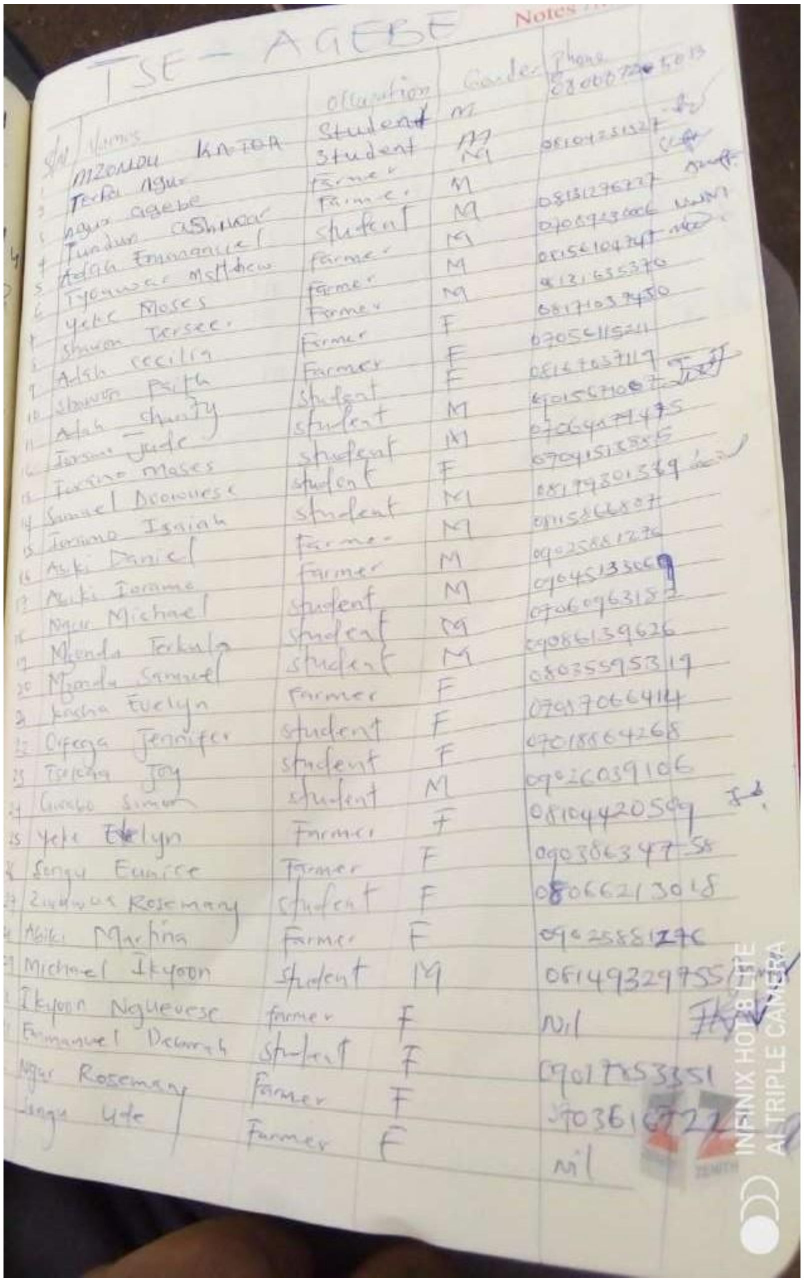
INFINIX HOT 8 LITE
AI TRIPLE CAMERA



TSE – AGEBE

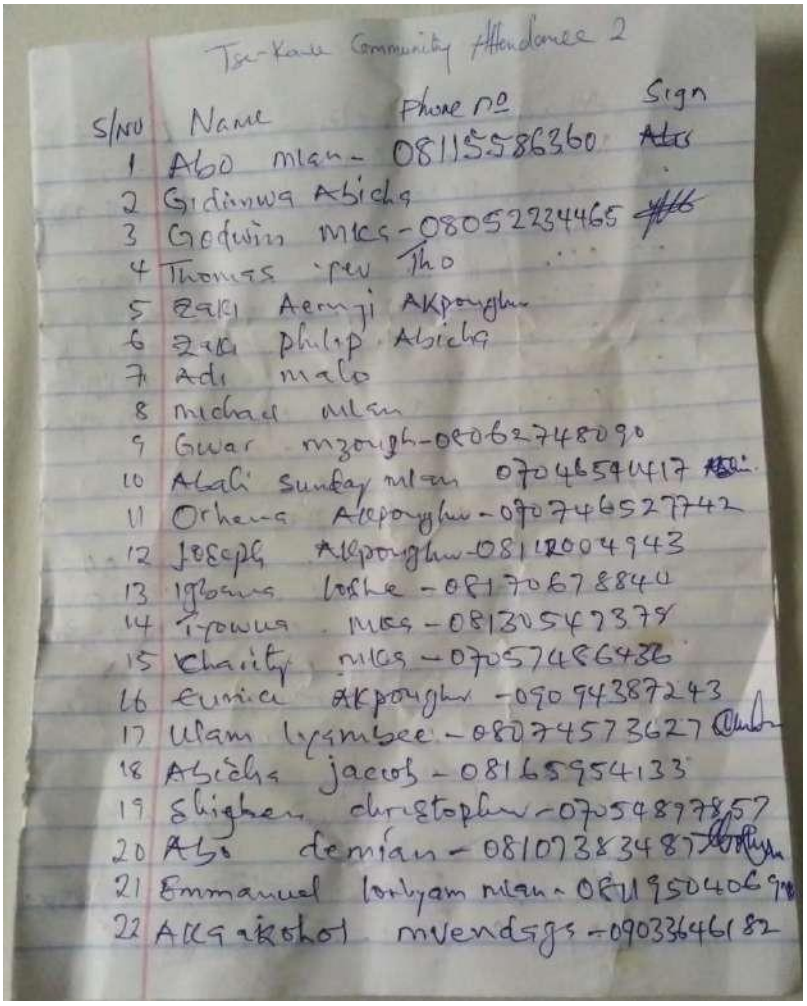
Notes /Memos

Names	Occupation	Gender	Phone
Mzondu Kator	Student	M	08068726 5013
Terfa Agur	Student	M	
Agur agebe	Farmer	M	08104231527
Tundun Ashiwar	Farmer	M	
Adah Emmanuel	Student	M	08131276727
Tyoawar Matthew	Farmer	M	07089233006
Yake Moses	Farmer	M	08156104747
Sharon Tersee	Farmer	M	8131635370
Adah Cecilia	Farmer	F	08171039450
Shawon Faith	Farmer	F	07056115211
Adah Charity	Student	F	08164657119
Iorsime Jude	Student	M	09015671007
Iorsimo Moses	Student	M	07064979475
Samuel Doowuese	Student	F	07041513885
Iorsimo Isaiah	Student	M	08199801339
Aski Daniel	Farmer	M	0811586807
Aiki Iorome	Farmer	M	09025881276
Ngu Michael	Student	M	09045133069
Mtonda Terkula	Student	M	07060963182
Mzonda Samuel	Student	M	09086139626
Kasha Evelyn	Farmer	F	08035595319
Ofega Jennifer	Student	F	07017066414
Tsekaa Joy	Student	F	07018864268
Gwabo Simon	Student	M	09026039106
Yeke Evelyn	Farmer	F	08104420599
Sengu Eunice	Farmer	F	09038634775
Zugwus Rosemary	Student	F	08066213018
Abiki Martina	Farmer	F	0902588127c
Michael Ikyoon	Student	M	08149329755
Ikyoon Nguevese	Farmer	F	Nil
Emmanuel Deborah	Student	F	09017853351
Agur Rosemary	Farmer	F	07036167222
Iangia Ude	Farmer	F	nil



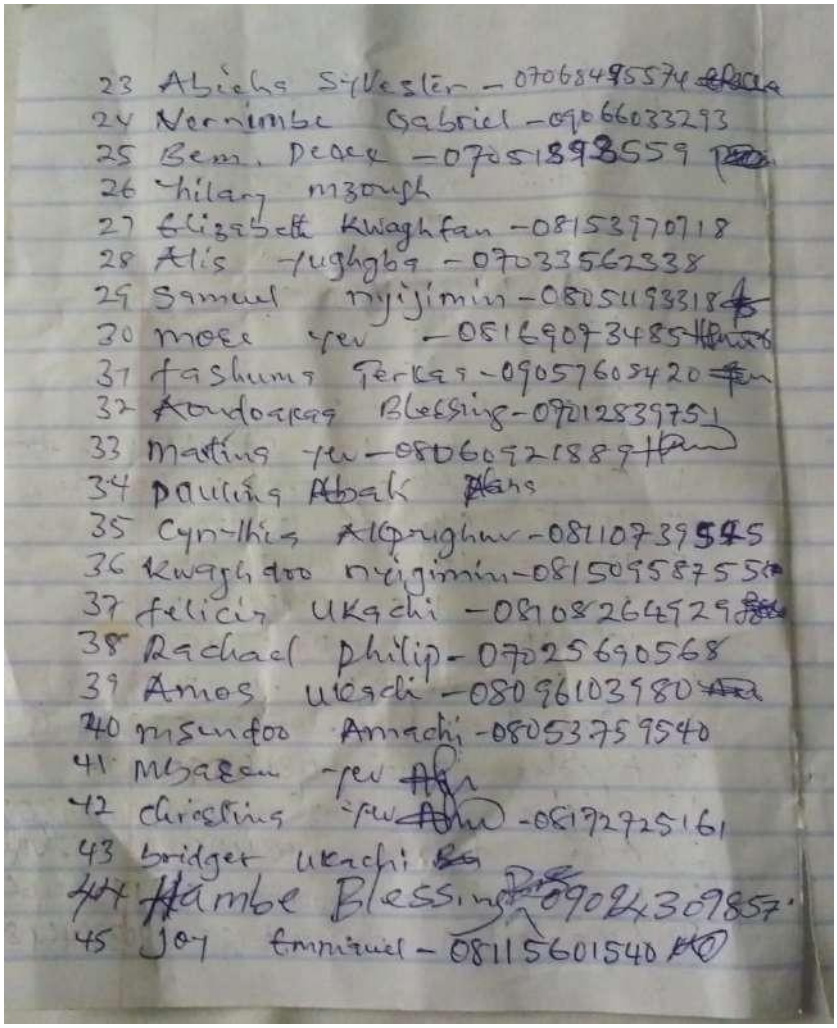
TSE – AGEBE 08000720?5013

S/N	Names	Occupation	Gender	Phone
1	Mzondu Kator	Student	M	
2	Terfa Ngur	Student	M	
3	Ngur Agebe	Farmer	M	
4	Tundun Ashwar	Farmer	M	08104251327
5	Adah Emmanuel	student	M	08131296277
6	Tyoqwar Matthew	farmer	M	07089239006
7	Yeke Moses	farmer	M	08156104747
8	Shawon Tersee	Farmer	M	08131635370
9	Adah Cecilia	Farmer	F	08171039450
10	Shawon Faith	Farmer	F	07056115211
11	Adah Charity	Student	F	08167037117
12	Iorsase Jude	student	M	07015671007
13	Torkuno Moses	student	M	07064974475
14	Samuel Doowuese	student	F	07041513885
15	Iorumo Isaiah	student	M	08179801589
16	Asiki Daniel	Farmer	M	09115866807
17	Asiki Iorume	farmer	M	09025881276
18	Ngur Michael	student	M	09045133069
19	Mzondu Terkula	student	M	07060963182
20	Mzondu Samuel	student	M	09086139626
21	Kasha Evelyn	Farmer	F	08035595317
22	Ofega Jennifer	student	F	07037066414
23	Tsekaa Joy	student	F	07018864268
24	Gambo Simon	student	M	09026039106
25	Yeke Evelyn	Farmer	F	08104420509
26	Sengu Eunice	Farmer	F	09038634775
27	Zuawua Rosemary	student	F	08066213018
28	Asiki Martina	Farmer	F	09025881276
29	Michael Ikyoon	student	M	08149329755
30	Ikyoon Nguevese	farmer	F	Nil
31	Emmanuel Deborah	student	F	09017853351
	Ngur Rosemary	Farmer	F	09036167722
	Sengu Ude	Farmer	F	nil

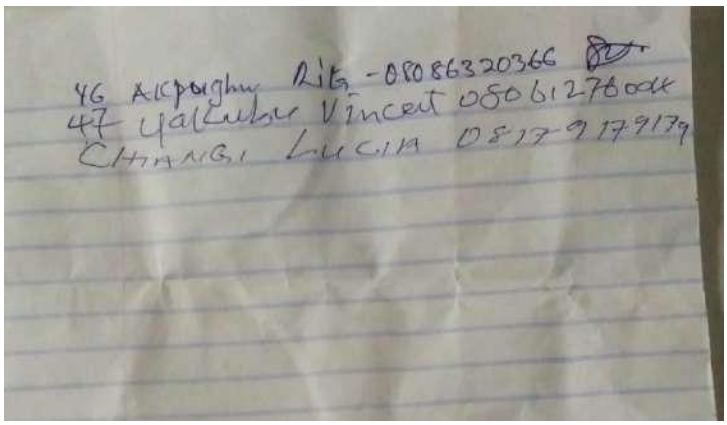


Tse-Kaa Community Attendance 2

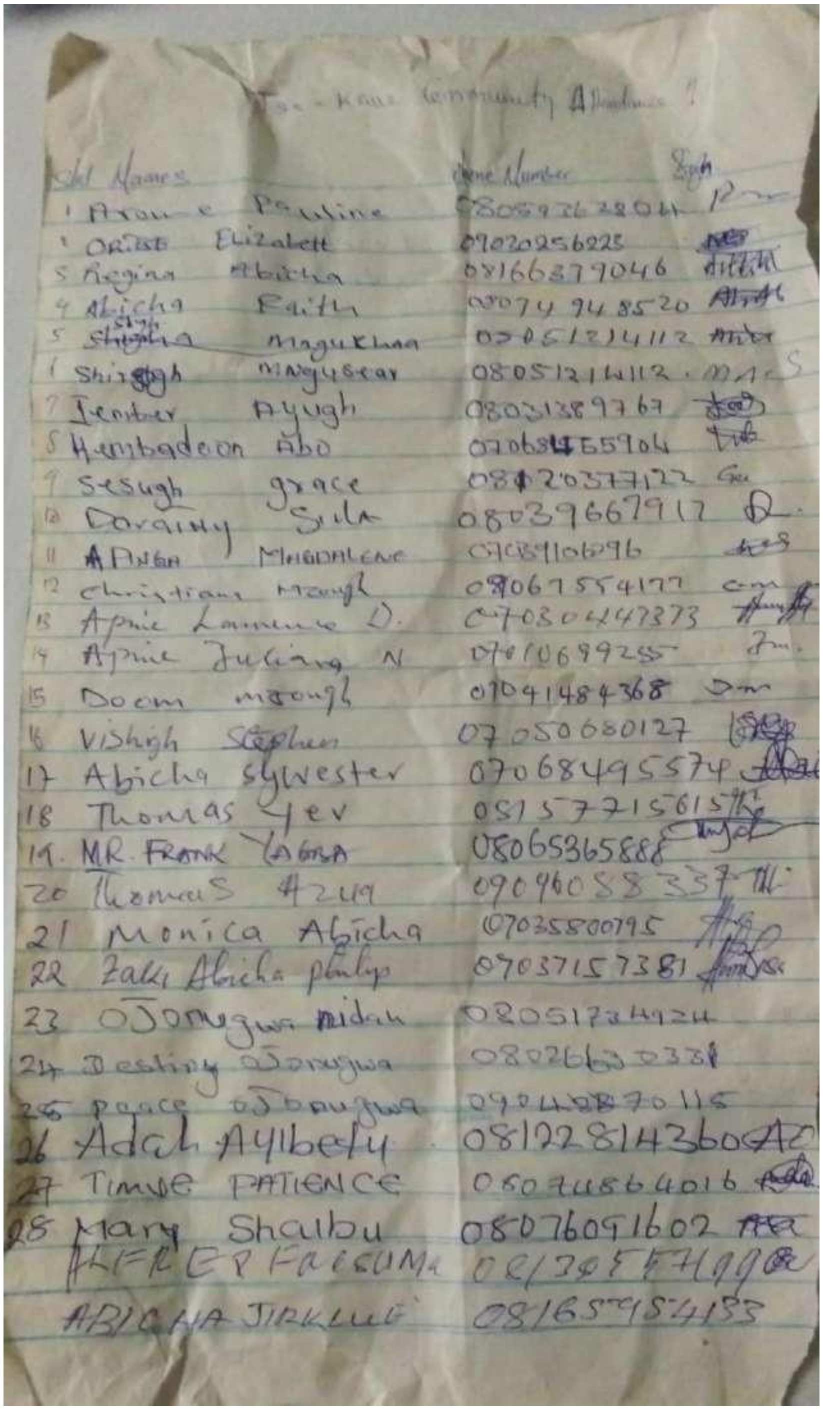
S/NO	Name	Phone no	Sign
1	Abo mlan	08115586360	
2	Gidinwa Abicha		
3	Godwin mics	08052234465	
4	Thomas rev	Tho	
5	Zaki Aemji	Akpoughu	
6	Zaki philip	Abicha	
7	Adi malo		
8	michael mlan		
9	Gwar mzough	08062748090	
10	Akaki sunday mlan	07046544417	
11	Orhena	Akpoughu	07074652742
12	Joseph	Akpoughu	08112004943
13	Igbana	Iorhe	08170678840
14	Tyowua	mics	08130547379
15	Charity	mics	07057486436
16	Eunice	Akpoughu	09094387243
17	Ulam Iyambee		08074573627
18	Abicha	jacob	08165954133
19	Shigher	christopher	07054877857
20	Abo	demian	08107383487
21	Emmanuel	Iorhyam mlan	08119504069
22	Akaakohol	mvendega	09033646182



23 Abiche Sylvester - 07068495574
24 Nernimbe Gabriel - 09066033293
25 Bem. Peace - 07051893559
26 Hilary mzough
27 Elizabeth Kwaghfan - 08153970718
28 Alis Tughgba - 07033562338
29 Samuel nyijimin - 08051933184
30 Mose yev - 08169073485
31 Tashuma Terkas - 09057603420
32 Aondoakaa Blessing - 09121839751
33 Martins yev - 08060921887
34 Pauling Abak
35 Cynthia Akpughw - 08110739545
36 Kwaghdoo nyijimin - 08150958755
37 felicia Ukachi - 08108264529
38 Rachael philip - 07025690568
39 Amos Ukachi - 08096103980
40 msendoo Amachi - 08053759540
41 Mbaeun yev
42 christina yev - 08172725161
43 bridget Ukachi
44 Hambe Blessing - 09024309857
45 Joy Emmanuel - 08115601540

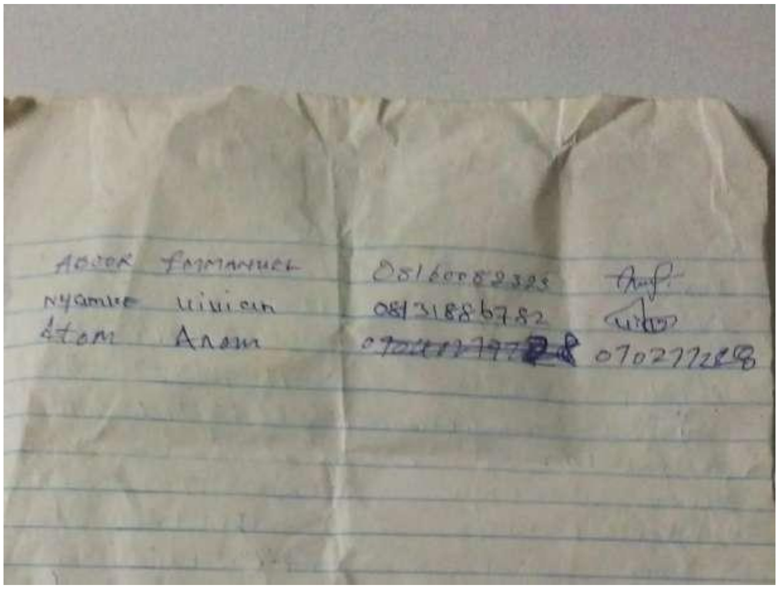


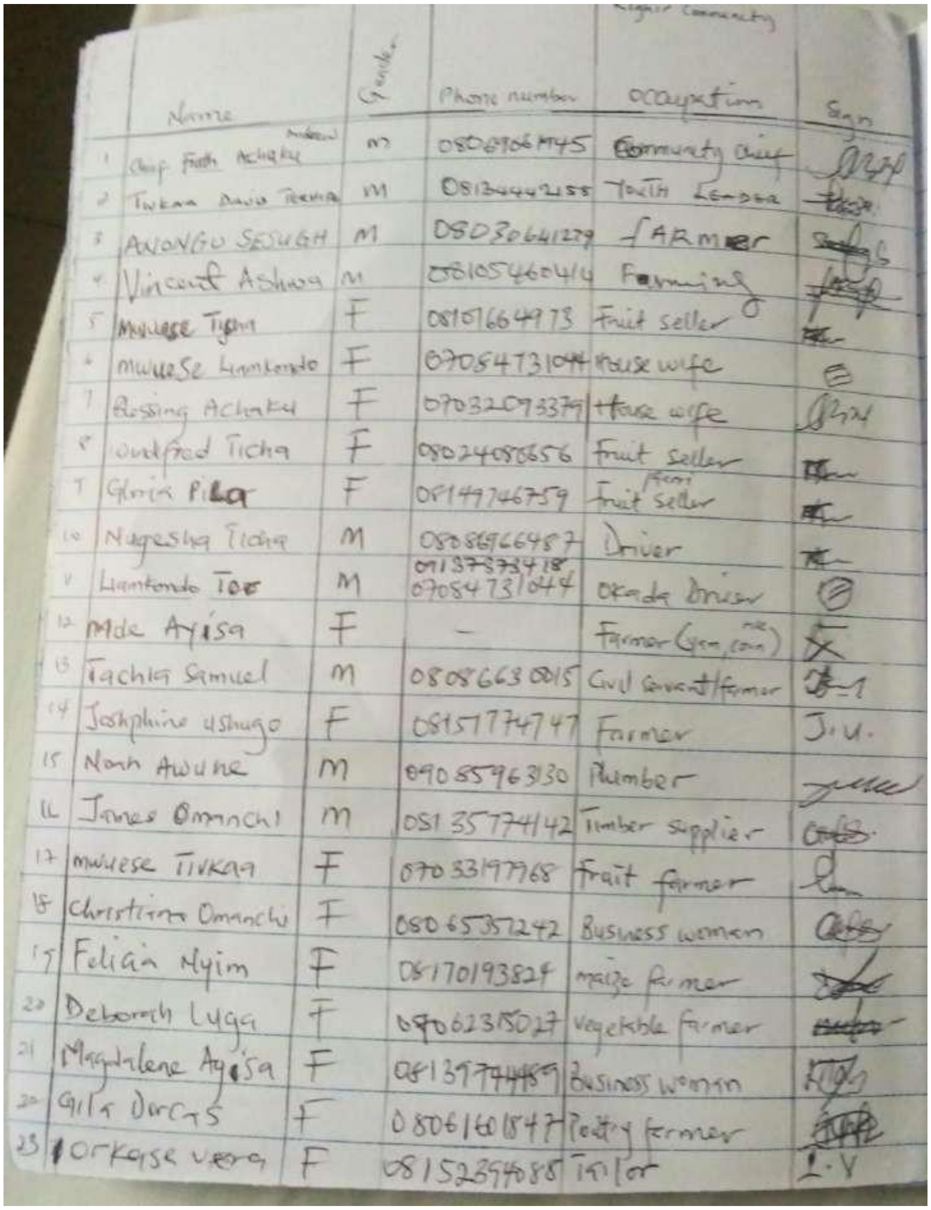
46 Akpughw Rita - 08086320366
47 Yakubu Vincent 08061278044
CHIANGI LUCIA 08179179179



Tse-Kaue Community Attendance

S/N	Names	Phone Number	Sign
1	Aroume Pauline	08059362802[illegible]	[illegible]
2	Oriste Elizabeth	07020256225	[illegible]
3	Regina Abicha	08166379046	[illegible]
4	Abicha Faith	09074948520	[illegible]
5	Shiagh Magukhaa	07051214112	[illegible]
6	Shirgh Mngusear	08051214112	M.A.S
7	Iember Ayugh	08031389767	[illegible]
8	Hembadoon Abo	07068455904	[illegible]
9	Sesugh grace	08120377122	Gu
10	Doraimy Sila	08039667917	[illegible]
11	Afaga Magdalene	07039106296	[illegible]
12	Christiana Mzough	08067554177	[illegible]
13	Apaie Lawrence D.	07030447373	[illegible]
14	Apaie Juliana N	07010699255	[illegible]
15	Doom Msough	07041484368	[illegible]
16	Vishigh Stephen	07050680127	[illegible]
17	Abicha Sylvester	07068495574	[illegible]
18	Thomas Yev	08157721561	[illegible]
19.	MR. FRANK YAGBA	08065365888	[illegible]
20	Thomas Azua	09096058337	[illegible]
21	Monica Abicha	07035800795	[illegible]
22	Zaki Abicha philip	07037157381	[illegible]
23	Ojonugwa Aidah	08051734924	
24	Destiny Ojonugwa	08026630338	
25	peace Ojonugwa	09044870115	
26	Adah Ayibefu	08122814360	A[illegible]
27	Timve PATIENCE	08074864016	[illegible]
28	Mary Shaibu	08076091602	[illegible]
	ALFRED FAESUMA	08139557499	[illegible]
	ABICHA JIRKULE	08165954133	

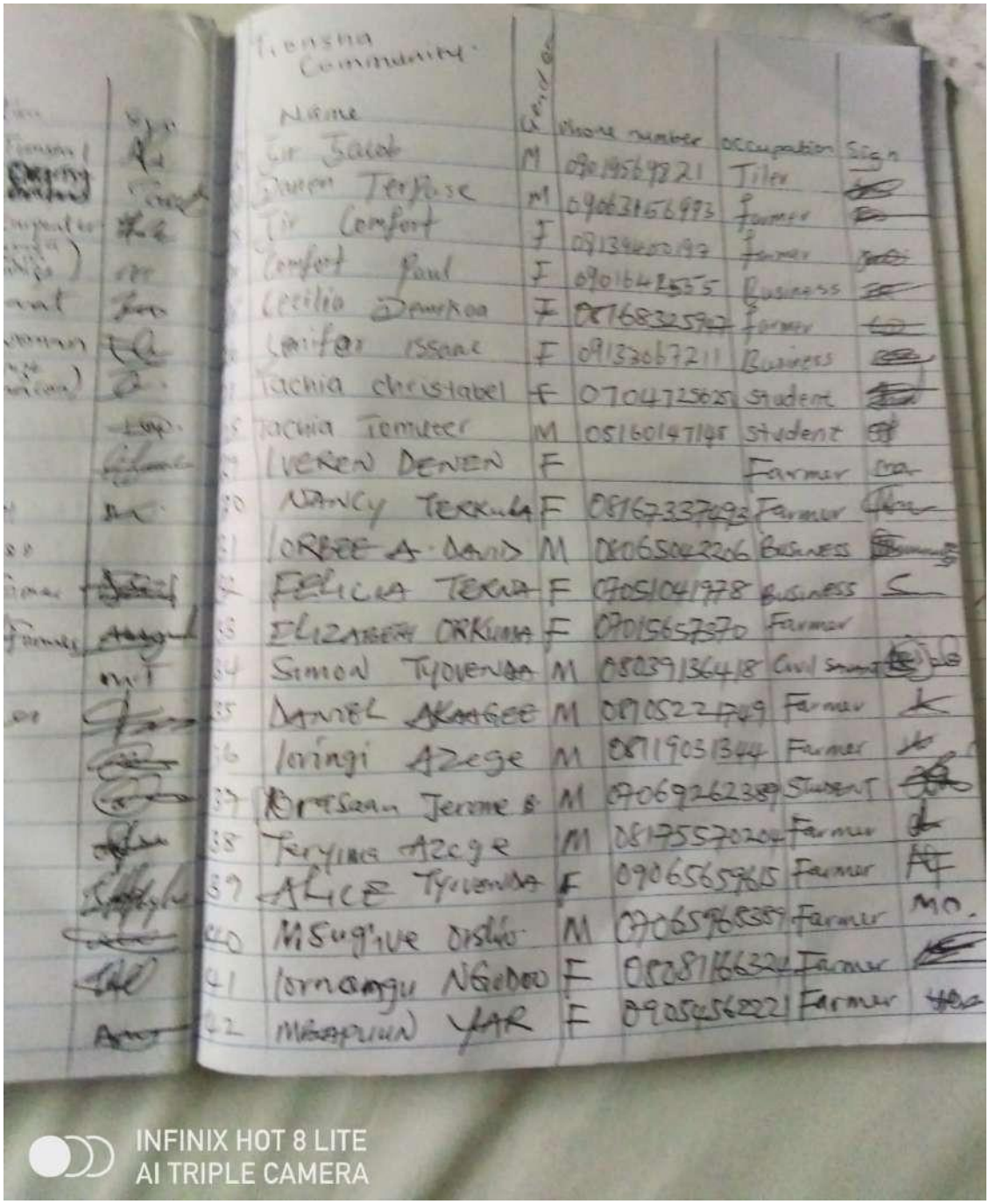

ABOOK EMMANUEL 08160082323
Nyamue Vivian 08131886782
Atom Anom 07027728



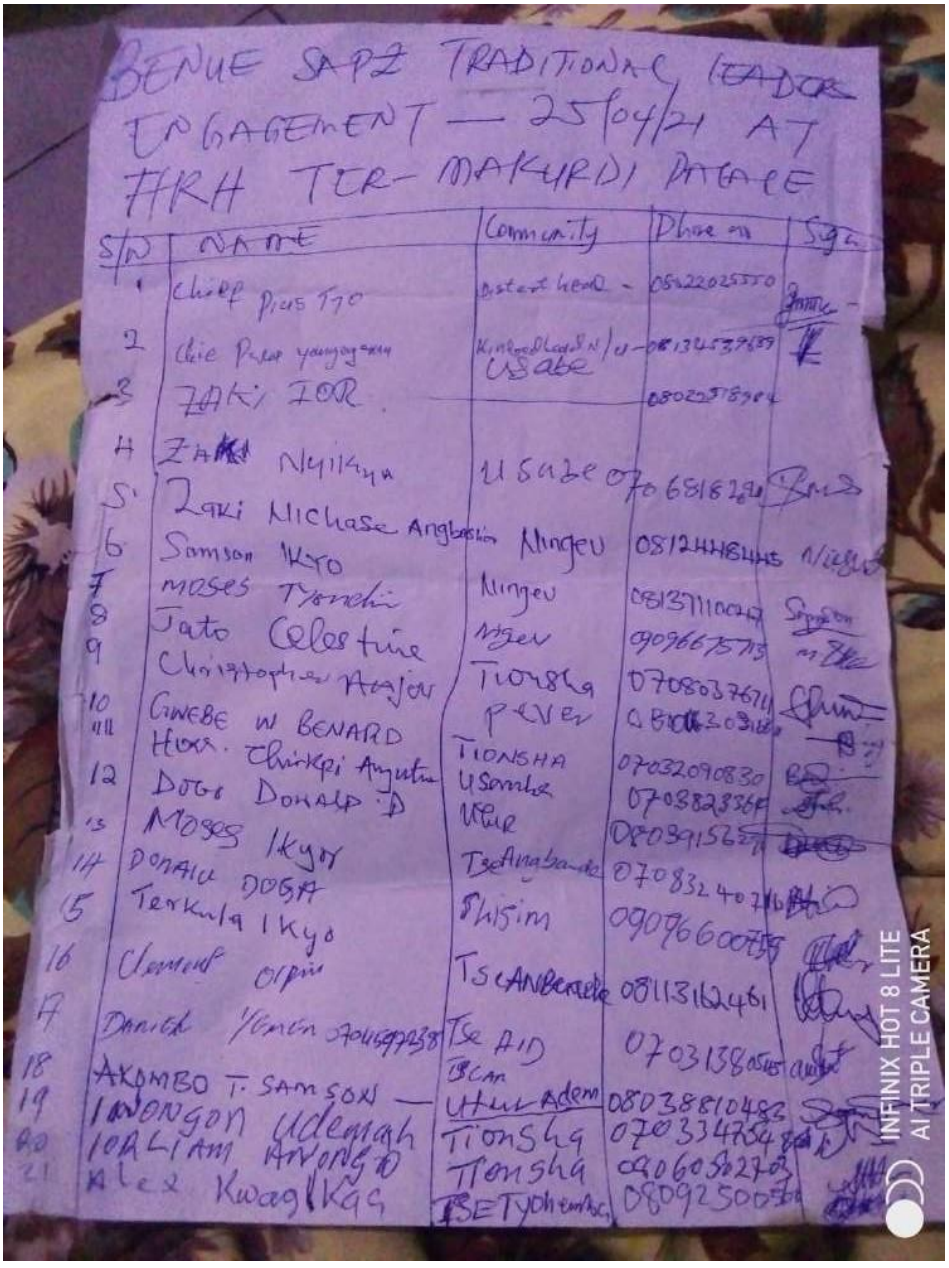
	Name	Gender	Phone number	Occupation	Sign
1	Chief Faith Achaku	M	08069061145	Community chief	[illegible]
2	Tyokaa David Terhemba	M	08134442155	Youth Leader	[illegible]
3	AVONGU SESUGH	M	08030641279	FARMer	[illegible]
4	Vincent Ashwa	M	08105460414	Farming	[illegible]
5	Mwuese Tyona	F	08101664973	Fruit seller	[illegible]
6	mwuese Liamkondo	F	07084731044	House wife	[illegible]
7	Blessing Achaku	F	07032073379	House wife	[illegible]
8	Winifred Ticha	F	08024080656	Fruit seller	[illegible]
9	Gloria Pila	F	08149746759	Fruit seller	[illegible]
10	Nygesha Ticha	M	08088966487	Driver	[illegible]
11	Liamkondo Tor	M	09137373418 07084731044	Okada Driver	[illegible]
12	Mde Ayisa	F	–	Farmer (yam, corn, rice)	X
13	Tachia Samuel	M	08086630015	Civil servant/farmer	[illegible]
14	Joshphine ushugo	F	08151774747	Farmer	J.U.
15	Noah Awune	M	09085963130	Plumber	[illegible]
16	James Omnchi	M	08135774142	Timber supplier	[illegible]
17	mwuese Tivkaa	F	07033197768	Fruit farmer	[illegible]
18	Christiana Omnchi	F	08065357242	Business women	[illegible]
19	Felicia Nyim	F	08170193824	maize farmer	[illegible]
20	Deborah Lyga	F	09062315027	Vegetable farmer	[illegible]
21	Magdalene Ayisa	F	08139774459	Business woman	[illegible]
22	Gila Dorcas	F	08061601847	Poultry farmer	[illegible]
23	Iorkase Vera	F	08152394088	Tailor	I.V

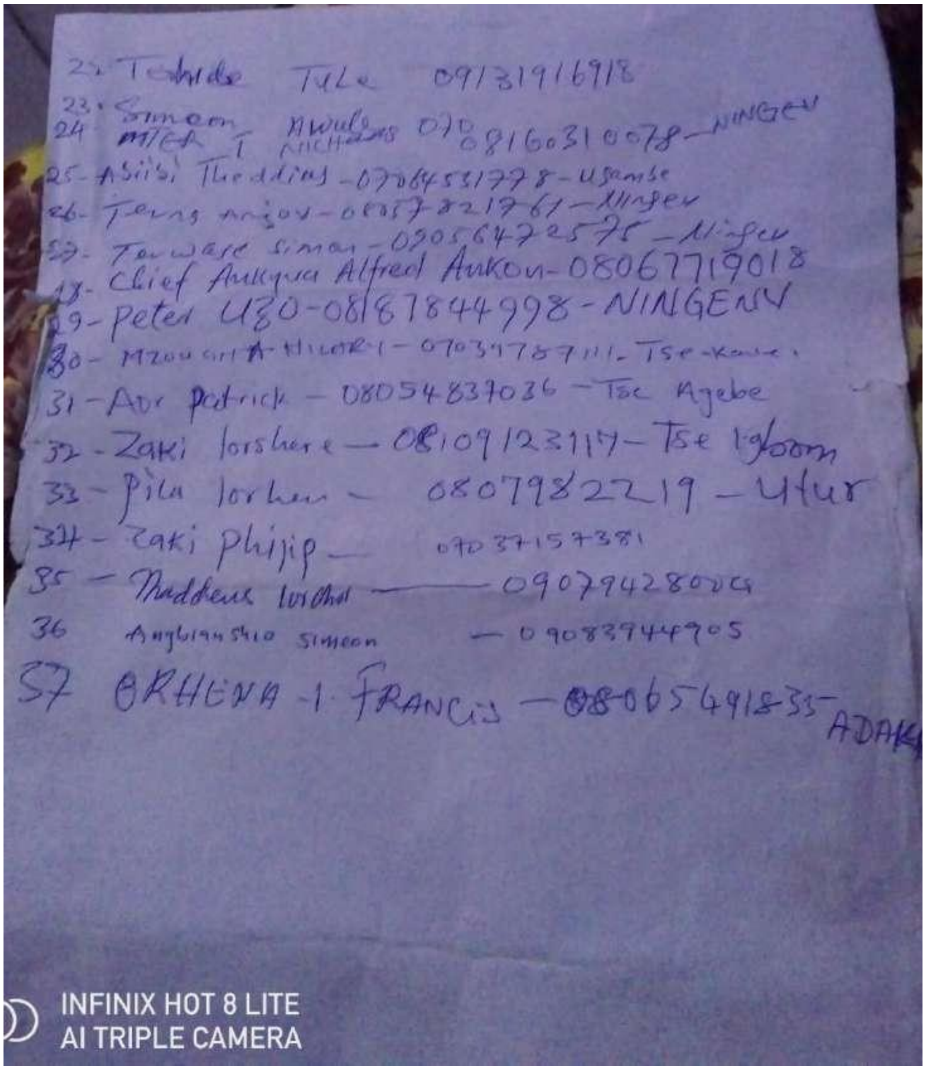
Kighir Community

	Name	Gender	Phone number	Occupation	Signature
24	Gilat T. Gila	M	08088350952	Rice farmer	[illegible]
25	Yasuf, Joshua	M	08146019657	Poultry Farmer	[illegible]
26	Igbazenda Robert	M	07052858834	Farmer	[illegible]
27	Yusuf A. Mary	F	08133933842	poultry farmer	[illegible]
28	Esther Onazi	F	08136347557	Business woman	[illegible]
29	John Mayina	M	08163254943	student	[illegible]
30	Ngunimi Tachia	F	08105460414	farming	[illegible]
31	Mnena Ashimen	F	08105172009	" "	[illegible]
32	GWATZA FELICITY	F	07015297736	Student	[illegible]
33	HASSANA MUHAMD	F	08065129689	Business wom	[illegible]
34	Veronica Abeda	F	08036323319	farmer	[illegible]
35	Liam Konga Hershima	F	08052629439	farming	[illegible]
	Angbiandoo Abaah	F	08064061945	Student	[illegible]


Name
Gender
Phone number
occupation
Sign
INFINIX HOT 8 LITE
AI TRIPLE CAMERA

Annexure: 7.1 List of Traditional Rulers





22. Tahide Tule 09131916918
23. Simeon Awule 070
24 Mter T Nicholas 08160310078 – NINGEV
25 – Asiisi Thaddius – 07064531778 – Usambe
26 – Terng Anjov – 08057821961 – Ningev
27 – Terwase Simon – 09056472575 – Ningev
28 – Chief Anyua Alfred Ankon – 08067719018
29 – Peter Ugo – 08187844998 – NINGENV
30 – Mzuugh Hilary – 07034787111 – Tse-Kave
31 – Aor Patrick – 08054837036 – Tse Agebe
32 – Zaki Iorshere – 08109123117 – Tse Igboom
33 – Pila Iorhen – 080798 2219 – Utur
34 – Zaki Philip – 07037157381
35 – Thaddeus Iorshal – 09079428004
36 Anghiansho Simeon – 09083744905
37 ORHENA I. FRANCIS – 0806549183 – ADAKA

INFINIX HOT 8 LITE
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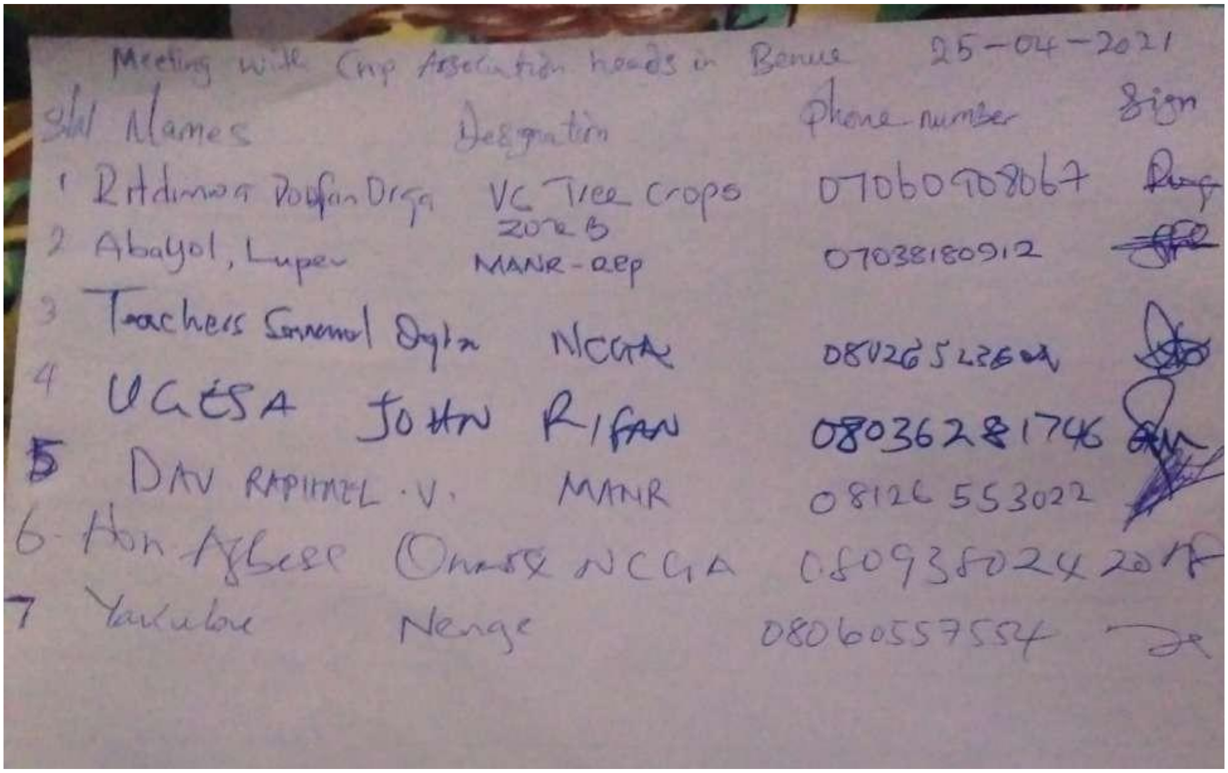
Annexure 7.2: List of Meeting with other associations



Meeting with Crop Association heads in Benue 25-04-2021

S/N	Names	Designation	Phone number	Sign
1	Ritdimma Doofan Orga	VC Tree Crops Zone B	07060908067	[signature]
2	Abayol, Lupev	MANR - Rep	07038180912	[signature]
3	Teachers Samuel Ogbn	NCGA	0802652360	[signature]
4	UGESA	JOHN RIFAN	08036281746	[signature]
5	DAV RAPHAEL. V.	MANR	08126553022	[signature]
6	Hon Agbese Omass	NCGA	08093502420	[signature]
7	Yakubu	Nenge	08060557554	[signature]

Annexure 8 Flora Checklist

SN	Botanical Name	Common Name	IUCN	LF	Family	Species Ecosystem				Abundance
						PS	RS	SS	CS	
1	*Abrus precatorius*	crab's eye	NE	S	papilionoideae	*				13
2	*Abuliton mauritiana*	Country Mallow	NA	C	Malvaceae	*				21
3	*Acanthus montanus*	Mountain Thistle	NE	H	Acanthaceaea	*			*	51
4	*Albizia adianthifolia*	*Flat-crown*	LC	T	Mimosoideae	*				19
5	*Albizia zygia*	West African Albizia	NE	T	Mimosoideae	*				42
6	*Alchornea cordifolia*	Christmas Bush	NE	T	Euphorbiaceae	*				518
7	*Alchornea latifolia*	Aguacatillo	NE	S	Euphorbiaceae	*				85
8	*Allophylus africanus*	African false currant	NE	T	Sapindaceae					74

9	*Alstonia boonei*	stool wood	NE	T	Apocynaceae	*				19
10	*Anchomanes difformis*		NE	S	Areaceae					
11	*Ancylobotrys amoena*		NE	C	Apocynaceae					
12	*Annona senegalensis*	wild custard-apple	NE	S	Annonaceae	*				
13	*Anthocleista djalonensis*	Cabbage tree	NE	T	Loganiaceae	*				19
14	*Anthonotha macr ophylla*	African rosewood	NE	T	Caesalpinoideae	*				49
15	*Asystasia vogeliana*	Eyed pansy	NE	H	Acanthaceae	*				239
16	*Bambusa vulgaris*	Indian bamboo	NE	T	Poaceae	*		*		346
17	*Baphia nitida*	Camwood	LC	S	Papilionoideae	*				6
18	*Berlinia grandiflora*	Berlinia	LC	T	Caeslpinoideae	*				8
19	*Bidens pilosa*	Blackjack	NE	H	Asteraceae					110

20	*Blepharis maderaspatensis*	Creeping *Blepharis*	NE	H	Acanthaceae					189
21	*Blighia sapida*	Ackee	NE	T	Sapindaceae			*		11
22	*Boerhavia diffusa*	Red spiderling	NE	H	*Nyctaginaceae*					
23	*Bridelia micrantha*	Mitserie	LC	T	Euphobiaceae					18
24	*Brillantaisia owariensis*	Bushcow food	LC	S	Acanthaceae					83
25	*Byrsocarpus coccineus*	Short-pod	NE	S	Connaraceae					102
26	*Canarium schweinfurthii*	*African elemi*	NE	T	Burseraceae					16
27	*Carpolobia alba*	poor man's candle	NE	S	Polygalaceae					59
28	*Carpolobia lutea*	cattle stick	NE	S	Polygalaceae					217
29	*Cayratia trifolia*	bush Grape	NE	C	Vitaceae					67
30	*Ceiba pentandra*	Silk Cotton Tree	LC	T	Malvaceae	*	*			6

31	*Chromolaena odorata*	Siam weed	NE	S	Asteraceae	*	*	*		322
32	*Cissus capensis*	Cape grape cissus	NE	C	Virtaceaea					82
33	*Cleistopholis patens*	salt-and-oil tree	NE	T	Annonaceae					14
34	*Cleome ciliata*	Spiderplant	NE	H	Capparidaceae					143
35	*Clerodendrum capitatum*	Gung	NE	S	Verbenaceae					38
36	*Clerodendrum volubile*		NE	C	Verbenaceae					18
37	*Cnestis ferruginea*	horn-of-plenty	NE	S	Connaraceae					16
38	*cola acuminata*	*Cola* nut Tree	NE	T	Sterculaceae	*			*	
39	*Cola gigantean*	Giant Cola	NE	T	Sterculaceae					3
40	*Cola millenii*		NE	S	Sterculaceae					
41	*Cola nitida*	*kola nut tree*	NE	T	Sterculaceae	*			*	
42	*Combretum*	Velvet bush	NE	S	Combretaceae				*	52

	racemosa	willow								
43	*Combretum tomentosum*	Bushwillows	NE	C	Combretaceae					78
44	*Combretum vendae*	Venda bushwillow	NE	S	Combretaceae					65
45	*Commelina diffusa*	Birdbill Dayflower		H	*Commelinaceae*					412
46	*Costus afer*	Bush cane	NE	S	*Costaceae*					525
47	*Crinum jagus*	Swamplily	NE	S	Amaryllidaceae					320
48	*Dalbergia frutescens*		NE	T	Euphobiaceae					15
49	*Dalbergia sissoo*	Indian Rosewood	NE	C	Euphobiaceae					33
50	*Diospyros mespiliformis*	African ebony	NE	T	Ebenaceae					14
51	*Elaeis guineensis*	Oil palm	LC	T	Arecaceae	*				44
52	*Enantia*	African Yellow	NE	S	Annonaceae					14

	chlorantha	Wood								
53	*Ficus exasperata*	Sandpaper fig	NE	S	Moraceae	*	*			20
54	*Ficus mucuso*		NE	T	Moraceae	*				13
55	*Ficus sur*	Cape fig	NE	T	Moraceae	*				
56	*Glyphaea brevis*		NE	S	Tiliaceae					17
57	*Harungana madagascariensis*	Blood tree	NE	T	Clusiaceae					17
58	*Holarrhena floribunda*	False rubber tree	NE	T	Apocyanaceae					16
59	*Irvingia wombolu*	Bitter bush-mango	NE	T	Irvingaceae	*		*		3
	tomentosa									
60	*Keetia venosa*	Raisin-fruit *keetia*	NE	S	Rubiaceae					11
61	*Lasimorpha senegalensis*	swamp arum	LC	S	Araceae					825

62	*Lecaniodiscus cupanioides*		NE	S	Sapindaceae					11
63	*Leea guineensis*		NE	C	Sapindaceae					17
64	*Leptoderris congolensis*		NE	S	papilionaceae					18
65	*Lonchocarpus cyanescens*	indigo vine	NE	S	Papilionaceae					
66	*Lonchocarpus sericeus*	Senegal lilac	NE	S	papilionaceae					12
67	*Margaritaria discoidea*		NE	T	Euphorbiaceae					25
68	*Mitragyna leder mannii*	African linden	VU	T	Rubiaceae					54
69	*Morinda lucida*	Brimstone tree	NE	T	Rubiaceae					21
70	*Musa paradisiaca*	Plantain	NE	T	Musaceae					310
71	*Musa sapientus*	Banana	NE	T	Musaceae					250

72	*Musanga cecropioides*	umbrella tree	NE	T	Moraceae					
73	*Mussaenda elegans*		NE	S	Rubiaceae					17
74	*Newbouldia laevis*	tree of life	NE	T	Bignonaceae	*			*	34
75	*Nymphaea lotus*	water lilies	NE	F	Nymphaeaceae					212
76	*Ouratea flava*		NE	S	Ochnaceae					23
77	*Paullinia pinnata*		NE	C	Sapindaceae					182
78	*Pennisetum purpureum*		NE	H	Poaceae					267
79	*Pentaclethra macrophylla*		NE	T	Mimosoideae					3
80	*Pseudospondias microcarpa*		NE		Anacardiaceae					8
81	*Pycnanthus angolensis*	African nutmeg	NE	T	Myristicaceae					33
82	*Raphia hookeri*		NE	T	Arecacea			*	*	572

83	*Rauvolfia vomitoria*		NE	T	Apocynaceae					15
84	*Sarcocephalus latifolius chevalieri*	African peach	NE	T	Rubiaceae					29
85	*Smilax anceps*		NE	C	Smilaceae					154
86	*Spondias mombin*	Hog plum	NE	T	Anacardaceae			*		11
87	*Spondianthus preussii*		NE	T	Eupbobiaceae					4
88	*Stachytarpheta indica*	Blue porterweed	NE	H	Verbenaceae					162
89	*Sterculia trigacanta*	African tragacanth	NE	T	Malvaceae					18
90	*Tabernaemontana pachysiphon*		NE	S	Apocynaceae					22
91	*Tetracera fagifolia*		NE	S	Dilleniaceae					19
92	*Tetracera indica*		NE	S	Dilleniaceae					30
93	*Tinospora cordifolia*		NE	C	Menispermaceae					11

94	*Tinospora crispa*		NE	C	Menispermaceae					17
95	*Trema orientalis*		NE	T	Ulmaceae					5
96	*Triclisia subcordata*		NE	C	*Menispermaceae*					53
97	*Urena lobate*		NE	S	Malvaceae					267
98	*Zanthoxylum zanthoxyloides*	*Prickly-ash*	NE	S	Rutaceae					72

ANNEXURE 9

CHECKLIST FOR BENTHOS

S/N	Species	Phylum/Division	Group/Class/Order	Family	SD1	SD2	SD3
1	*Pachymelania sp*	Mollusca	Gastropoda	Pachymelaniidae		1	1
2	*Caridina africana*	Arthropoda	Decapoda	Atyidae			1
3	*Nereis* sp	Annelida	Polychaeta	Nereidae		2	

ANNEXURE 10

QA/QC PROTOCOL

DATA GATHERING METHODOLOGY

Fieldwork Approach

A QHSE management system approach was employed in executing the field data gathering campaign. This approach assured that the required data and samples were collected in accordance with agreed requirements (contractual, scientific and regulatory) using the best available equipment, materials and personnel. The approach also assured that the safety and health of personnel, public, environment and assets were not compromised at any time. The key elements of the Mifor Consult Nigeria Limited (MCNL) approach are presented in the following subsections.

Fieldwork Objectives

The objective of the field exercise was to collect ecological and meteorological data that would describe the unique features of the proposed project area through:

- sampling of sediment, water, air , and hydro biological components;
- meteorological data collection; and
- Direct observation of the environment.

Sampling Team

The multidisciplinary team of experts who have been involved in coordinating the project and those who carried out the data gathering exercise are presented below.

Table 1: Team of Experts

S/N	Name	Responsibilities
MCNL Field Sampling Team		
1	Prof JK Ebigwai	Field work coordination, HSE, instrumentation (air quality and in-situ measurements) and sampling

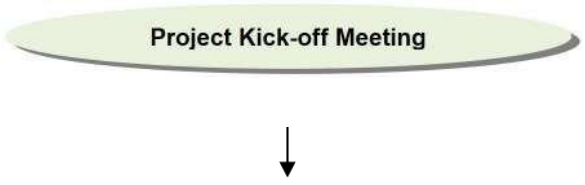
2	Dr Ogege Celestine	Water/plankton/sediment/hydrobiology sampling
3	Dr Okoh Thomas	Biodiversity expert
3	Dr Alo Akintunde	GIS Expert
4	Eyo Archibong	Soil sampling
5	Mr Justin Eyoma	Socio-economics
6	Engr. Alex Ebigwai	Engineer
7	Mr Ferdinand Akomaye	Air quality
8	Dr Ubong Eugene	Fishery studies
9	Dr. Terhide Ujah	Health Expert

Source: MCNL (2021)

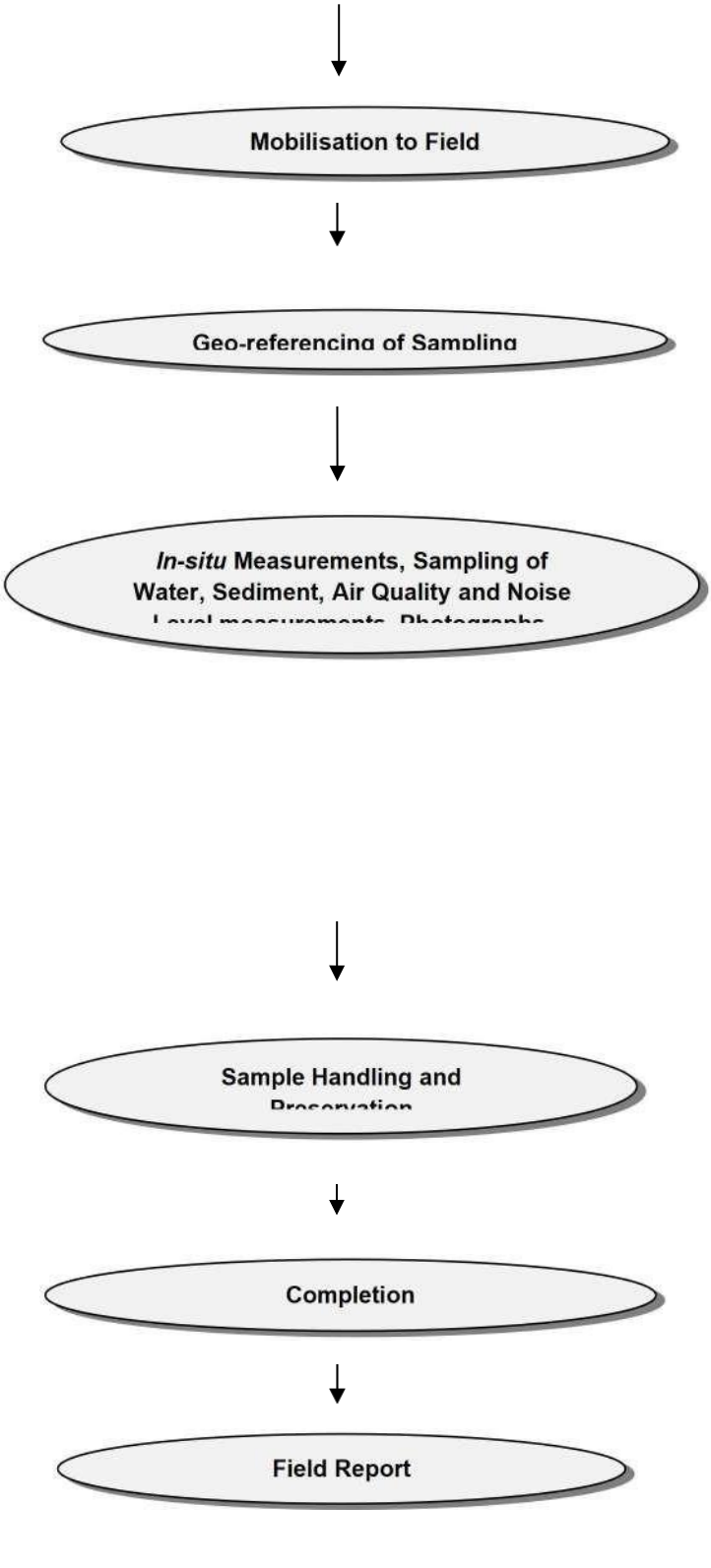
Approach

MCNL applied good quality management system in executing the field data gathering phase of this project. The approach assured that the required data and samples were collected in accordance with agreed requirements (contractual, scientific and regulatory) using best practice, available equipment, materials and personnel. The approach also assured that the safety and health of personnel, stakeholders and the public, environment and assets were not compromised during the data gathering phase of this project.

The work approach adopted for this field data gathering exercise is presented in the flowchart below.




Pre-mobilisation checks


Mobilisation to Field
Geo-referencing of Sampling
In-situ Measurements, Sampling of Water, Sediment, Air Quality and Noise
Sample Handling and
Completion
Field Report

Review of Maps

The maps used for the sampling exercise were provided by MCNL geographic information system (GIS) experts.

Designation of Sampling Points

In order to ensure that the sampling points were accurate and accessible, the designated and geo-referenced sampling points were used to identify established sampling points in the field.

Cleaning of Sampling Materials

In line with MCNL's QHSE prerequisites, all sample containers required for the sampling exercise were cleaned, sterilized and packed. Glass and plastic containers were washed with chromic acid/soap, and then rinsed thoroughly with distilled water. Sample containers were sorted out and labelled, then packed in their ampoules in readiness for sampling. Containers to be used for BOD analyses were packed separately.

HSE/QA Checks

Equipment for field sampling exercise were checked to ensure that they were functional, properly calibrated, fit for the job as well as safe for use by personnel prior to commencement of mobilisation and field work. This check was carried out by MCNL QHSE Manager.

The equipment/materials included PPE, sampling tools, and containers. The equipment deployed and their uses are listed in Table 2.

Table 2: List of Field Equipment and Materials

S/N	EQUIPMENT	USE	QTY
1	Day grab (100kg & 350kg)	Sediment sampling	2
2	Carousel CTD (Conductivity,	In situ sampling	1

S/N	EQUIPMENT	USE	QTY
	Temperature & Depth)		
3	Labels/paper cello tapes	Labelling of sample ID	1000
4	Plastic bowls & spoons, stainless bowls & spoons	Collection of sediment samples	2
5	Leather/ disposable gloves	Handling of equipment and samples	2 pack
6	1-litre Beaker	Quality Control	3
7	0.5 mm sieve	Benthos analyses	2
8	Camera	Photographing	1
9	Plankton nets	For collection of Phytoplankton sampling	2
10	Turbidity meter	In situ measurement of turbidity	1
11	Marine ropes	For securing equipment	2
12	Particulate meter	Air quality measurement	1
13	Pulser noise meter	Air quality measurement	1
14	Relative humidity meter	Air quality measurement	1
15	Universal Analyser MX6	Air quality measurement	1
16	1 no. Laboratory WTW multi-meter	In situ measurement for air quality	1
17	Markers	Labelling	1 pack
18	Distilled water	Quality Control	10l
19	2-litre plastic cans	Water Physico-chemistry sampling	80pcs
20	1-litre plastic cans	Water Physico-chemistry sampling	80pcs

S/N	EQUIPMENT	USE	QTY
21	1-litre glass bottles	Water Physico-chemistry sampling	80pcs
2	50ml plastic McCartney bottle (MCB)	Sediment microbiology sampling	80pcs
23	250ml amber bottles	Water microbiology sampling	80pcs
24	500ml plastic can	Collection of benthic samples	80 pcs
25	Preservatives (Nitric acid, Sulphuric acid, Formaldehyde & Rose Bengal)	Sample preservation	250ml each
26	Forms (Daily project report, Chain of Custody, Daily Toolbox Meeting & Incident/Hazard Forms)	Field document/Quality Control	20 each
27	PPE (Safety shoes, Hard hats, Work vests & Coveralls)	Field work activities	For each person

Source: MCNL (2021)

Mobilisation to Field

Several meetings and discussions were held between the project proponent and MCNL on the work plan, best approach for fieldwork and also to ensure that all sampling requirements and logistics were properly arranged. Meetings broadly covered aspects on safety and work scope description, project objectives, and sampling approach.

Project kick off/HSE meeting was held via Zoom on 21 and 23rd April 2021. Everyone present was briefed on appropriate safety measures and work procedures for the various field activities. These were intended to familiarise the study team on the need to be safety conscious while at work.

Geo-referencing

The sampling stations, which covered the proposed project area and environs were visited, and ecological and meteorological samples collected. Summary of activities and distribution of ecological data collected during the sampling exercise are presented in the main work (see Table 3).

***In-situ* Measurements**

In order to ascertain the actual readings of the parameters taken on the field, *in-situ* measurements were taken for ground and surface water and profiling carried out. The ambient air quality and noise levels were also determined.

Sample Preservation

Sample preservations were performed in accordance with FMEnv. regulatory requirements. It is in line with MCNL's preservation measures on the field that immediately after sampling, each sample was properly labelled, arranged and stored in a temperature regulated freezers and coolers for preservation. However, some of the samples require special methods of preservation. Table below presents the lists of methods used for preservation, handling procedures and storage of the samples collected.

Table 3: Method of Storage and Preservation of Samples

Sediments					
Parameter	**Sample Quantity**	**Container**	**Preservative**	**Holding Time**	**Container Pre-treatment**
General Appearance, Colour, Odour, Depth,	Observation recorded on site in a note book using relevant charts.	-	-	-	-
Metals (Mn, Fe, Cu, Zn, Pb, Ni, Cd, Cr, Hg, Ca, Mg, K, Na, Ba)	1kg	Plastic	Ice below 0°C	6 months	Rinsed with HNO_3

Physico-chemical (%TOC, pH, Particle size,)	1kg	Plastic	Cool below 0°C	28 days	Rinsed with distilled water
Hydrocarbon (TPH, Aliphatic, Aromatic)	200g	Glass	Cool below 0°C	28 days	Rinsed with distilled water
Microbiology (HUB, HUF, THF, THB)	85g	Plastic	Cool below 0°C	28 days	Sterilized
Water Samples					
Parameter	Minimum Sample Volume	Container	Preservative	Holding Time	Container Pre-Treatment
DO, salinity, Turbidity, Conductivity, Temperature, pH	*In-situ* Measurements	-	-	-	-
Metals (Mn, Fe, Cu, Zn, Pb, Ni, Cd, Cr, Hg, Ca, Mg, K, Na, Ba)	1.0l	Plastic	Add 2ml conc. HNO_3 & cool, $4^oC \pm 2^oC$	6months	Rinsed with HNO_3
TPH	1000ml	Glass bottle	Cool, $4^oC \pm 2^oC$ Add 2ml conc. H_2SO_4	7days	Rinsed with distilled water
Microbiology	200ml	Wide	Cool, $4^oC \pm 2^oC$	As soon as	Sterilized

(HUB, HUF, THF, THB)		mouthed glass bottles		possible	
Air and Noise Studies					
Parameter			**Method**		
NO_2, SO_2, CO, H_2S, CH_4, VOC, NH_3, CxHx particulates, Noise			*In-situ* Measurements		

Source: MCNL (2021)

These preservation methods are standard, effective and serve the purpose for which they are employed. Air quality and noise level measurements are best and most conveniently taken *in situ.*

Quality Assurance

Quality Assurance (QA) on all samples collected was carried out to ensure that samples were in compliance with required sampling requirement. All samples and equipment were properly packed, sealed and stored at the end of the sampling exercise.