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ABBREVIATIONS AND ACRONYMS

µg/l	Microgram per litre
µg/m^3	Microgram per Cubic Mater
µM	Micro Meter
%	Percentage
Wt%	Weight by Percent
AIDS	Acquire Immune Deficiency Syndrome
AMSE	American Society for Mechanical Engineering
API	American Petroleum Institute
ASTM	American Society for Testing and Materials International
BASF	Baden Aniline and Soda Factory
BFW	Boiler Feed Water
BAT	Best Available Technology
BCF	Billion Cubic Feet
BOD	Biochemical Oxygen Demand
CHEW	Community Health Workers
CNS	Central Nervous System
Co	Carbon-Monoxide
COD	Chemical Oxygen Demand
COHB	Carboxyl – Haemoglobin
CPI	Corrugate Plate Interceptor
CPT	Cone Penetration Testing
CPU	Central Processing Unit
Cu	Copper
CxHy	Hydrocarbon
DAF	Dissolved Air flocculation
dB	Decibel
DMDS	Di-Methyl D-Sulphide
DO	Dissolved Oxygen
DO	Dissolved Oxygen

DPR	Department of Petroleum Resources
DR	Doctor
EA	Environment Assessment
EAR	Environmental Audit report
EDG	Emergency Diesel Engine
EC	Electrical Conductivity
EER	Environmental Evaluation Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPCL	Eleme Petrochemicals Company Limited
ERP	Emergency Respond Plan
ETP	Effluent Treatment Plant
EU	European Union
FAO	Food and Agricultural Organization
FGN	Federal Government of Nigeria
FMENV	Federal Ministry of Environment
FOT	Federal Ocean Terminal
GB	Giga Byte
GDP	Gross Domestic Product
GFD	Group Focus Discussion
GMT	Greenwich Mean Time
GT	Gas Turbine
H	Hydrogen
H_2S	Hydrogen Sulphide
HCL	Hydrochloric Acid
HDPE	High Density Polyethylene
HIA	Health Impact Assessment
HIV	Human Immunodeficiency Virus
HNO_3	Nitric Acid
HQ	Head Quarters
HSE	Health Safety and Environment

HTS	High Temperature Shift
HUB	Hydrocarbon Utilizing Bacteria
HUF	Hydrocarbon Utilizing Fungi
IEFCL	Indorama Eleme Fertilizer Company Limited
IITA	International Institute of Tropical Agriculture
ISO	International Organization for Standard
Kg	Kilogram
Kg/cm^2	Kilogram per centimetre squared
Kg/hr	Kilogram per hour
KN/M^2	Kilo Newton Per Meter Square
Kpa	Kilo Per Annum
KODrum	Knock out Drum
kWh/t	Kilowatt hour per ton
LGA	Local Government Area
LLDPE	Linear Low Density Polyethylene
L	Litre
LTS	Low temperature Shift
N	Nitrogen
NH_3	Ammonia
MC	Master of Ceremony
MDEA	Methyl Di Ethyl Amine
MDG	Millennium Development Goal
mg/l	Milligram per litre
MLSS	Mixed Liquor Suspended Solid
MPN	Most Probable Number
mmg/m^3	Milligram per cubic meter
mg/m^3	Milligram per meter cube
MSDS	Material Safety Data Sheet
MTPD	Metric Tons Per day
MW	Mega Watt

NAFCON	National Fertilizer Company of Nigeria
NCC	Nature Conservancy Council
NE	North-east
NEPA	National Electric Power Authority
NESREA	National Environmental Standards Regulatory Agency
NG	Natural Gas
NGL	Natural Gas Liquid
NGO	Non-Governmental Organization
NH_3	Ammonia
NDDC	Niger Delta development Commission
NNPC	Nigerian National Petroleum Company
NOx	Nitrogen Oxide
NPC	Nigeria Population Commission
NW	North-west
OUE	Odour threshold Unit set by the European Union
O_2	Oxygen
^oC	Degree Celsius
PAC	Project Actualization Committee
PVC	Polyvinyl Chloride
pH	Potency of Hydrogen
PHCN	Power Holding Company of Nigeria
PID	Pelvic Inflammatory Disease
PIU	Project Implementation Unit
PP	Polymerization of Propylene
PPM	Part Per million
PPMV	Part per million by volume
PPP	Public Private Partnership
PSU/NCAR	Pennsylvania State University/National Center for Atmospheric Research
PTDC	Plastic Technology Development Centre
PVC	Polyvinyl chloride
RAM	Random Access Memory

RSME	Rivers State Ministry of Environment
RSPM	Respiratory Suspended Particulate Matter
SE	South-east
SOx	Sulphur Oxide
SPDC	Shell Petroleum Development Company
SPM	Suspended Particulate Matter
SPSS	Statistical Package for Social Science
SPT	Standard Penetration Test
STI	Sexual Transmitted Infection
SW	South-west
SWC	Storm Water channel
TDS	Total Dissolve Oxygen
TF	Total Fungi
THC	Total Hydrocarbon Content
TCLP	Toxicity Character Leaching Procedure
TOE	Tons of Oil Equivalent
TOR	Terms of Reference
TSPM	Total Suspended Particulate Matter
UES	Uniform Effluent Standard
USD	United State Dollar
Vol	Volume
VOC	Volatile Organic Compound
WHO	World Health Organization
WMO	World Meteorological Organization
WTP	Water Treatment Plant
ZnO	Zinc oxide

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EXECUTIVE SUMMARY

Proponent

Indorama Eleme Fertilizer and Chemicals Limited (IEFCL) is a company organized and existing under the laws of Nigeria, with its registered office at Indorama Petrochemicals Complex, Eleme, Port Harcourt, Rivers State, Nigeria. IEFCL manufactures 2300 MTPD Ammonia & 4000 MTPD Urea Fertilizer (IEFCL-Train 1) at its Eleme manufacturing complex. IEFCL is undertaking the development of IEFCL-Train2 fertilizer project to increase the production of Urea adjacent to the IEFCL-Train 1 within the existing manufacturing Indorama complex at Eleme.

Need for the EIA

This project has been categorized as category one project by the Federal Ministry of Environment (FMENV), who confirmed the need to conduct a full blown EIA.

Terms of reference (TOR)

The Terms of Reference for this Environmental Impact Assessment (EIA) study include the following:

- Determination of the baseline environmental profile in and around the proposed project site.
- Rendering a qualitative and quantitative description of the physical, chemical, biological and social environments relevant to the project.
- Documentation of significant signposts, including the identification of potential impact and risks of the project on the surrounding environment at large.
- Recommendations and implementation of strategies to eliminate or reduce identified adverse impacts and risks
- Production of an Environmental Impact Assessment (EIA) report with effective Environmental and Social Management Plan (ESMP)

EIA Objectives

The objectives of the EIA are:

- Assessment of the state of the environment
- Establishment of environmental issues and factors associated with the proposed fertilizer project.
- Assessment and forecast of all possible and potential impacts of the proposed project on components of the environment in terms of magnitude and importance.
- Evaluation of project alternatives and identification of the option having least potential environmental impact.
- To describe the physical, chemical, biological and socio-economic features of the environment potentially affected by the Project and identifying the environmentally sensitive areas within the project area.
- Identifying the environmental impacts (both positive and negative) which may occur in the design, construction, commissioning, operation and decommissioning phases of the project.
- To superimpose all aspects of the project on the environment and evaluate the overall impacts of the project on the environment.
- To recommend any measures that could be used to avoid, and if not avoidable, mitigate/ameliorate any negative hazardous impacts as well as promote beneficial effects of the project.
- To use results of the investigations to develop project specific ameliorating plans/measures during execution.
- To define an Action Plan, which foresees the adoption of an Environmental and Social Management System (ESMS) for the project lifespan as defined by the Equator Principle no.4
- To serve as an advance notification to the regulatory agencies especially the Federal Ministry of Environment.
- To provide necessary answers to questions from stakeholders, host communities, regulators and other interested parties.

Scope of work of the EIA

The scope of the EIA included review of laws, regulations and guidelines (National and International), fieldwork, laboratory analysis, literature research to assess the impacts expected and mitigation/compensation measures against negative impacts. In order to achieve this, informal and formal consultations were held with all interested parties.

Based on the body of work described above, the EIA Report including comprehensive project/social and environment components description and an Environmental and Social Management Plan has been prepared and submitted to FMENV, the esteemed federal regulatory authority to process the report.

Regulatory Framework

The Legal basis for environmental permitting, applicable National and International Legislative and Administrative framework including international laws and conventions pertaining to this industry were reviewed and documented. The EIA Report was drafted taking into account the following national and international documents also:

- Guidance on EIA, EIS review, June 2001, European Commission;
- Equator Principles, June 2013, Equator Principles Association;
- International Finance Corporation (IFC) Sustainability Framework, 2012 Edition, Performance Standards;
- Environmental, Health and Safety Guidelines, April 30 2007, World Bank and IFC;
- Environmental, Health and Safety Guidelines for Nitrogenous Fertilizer production, April 30 2007, World Bank and IFC;
- EIA Procedural Guidelines, 1995, Federal Environmental Protection Agency of Nigeria;
- EIA Sectoral Guidelines, Oil and Gas Industry Projects, Sub-sectoral Guidelines for Petrochemicals, 1995, Federal Environmental Protection Agency of Nigeria;
- EIA Sectoral Guideline, Manufacturing Industry
- Environmental Impact Assessment Act 86 of 1992
- Rivers State Environmental Protection Agencies Edict No 2 1994

- Rivers State Noise Control Edict, 1985
- Rivers State Waste Management Agency Law No.2, 2014
- Pollution Compensation Tax Edict, 1994

Justification of the project

The gross imbalance in the supply and demand of fertilizer for agricultural productivity in Nigeria goes to support the need to establish fertilizer plants. The use of Natural gas for production of fertilizer will support Federal Government's Gas Revolution Policy on alternative uses for natural gas instead of the wasteful practice of flaring.

The project will help achieve the objectives of the federal gas revolution programme providing necessary infrastructure for natural gas based industries, thereby boosting the Nigerian agricultural sector by providing the most crucial agricultural input. The current economic diversification and agricultural policies of Nigeria promotes the responsible use of green revolution technologies namely fertilizer, in the efforts to achieve food security and for generating exportable surplus of farm products in a market-friendly way.

Urea is the most important nitrogen based fertilizer worldwide and is not considered hazardous or toxic.

The project will also contribute to increase the competitiveness of local and regional agriculture by enabling the sale of fertilizers at competitive prices.

Project Alternative

In determining the project options, issues such as ease of availability of raw materials, choice of appropriate location and best available technology for producing the products were reviewed. These formed the basis of suggesting that the chosen project option of sitting the project in the already prepared Indorama complex and the use of the latest energy efficient technology is the most appropriate solution for the development of the project.

Project Location

The project is located geographically within 4°49'N and Longitude 7°6'E. Maps of Nigeria, Rivers State and study area around Indorama complex, together with the plot plan of Indorama complex, were used to illustrate the proposed location of Ammonia and Urea Plants in Eleme (the Host community).

Project Description

To simplify the understanding of how the final product Granular Urea will be produced from the parent raw material, which is natural gas, block diagrams starting from the desulphurization of the natural gas, catalytic steam reformation of the gas into hydrogen, carbon dioxide and carbon-monoxide, catalytically shift conversion of carbon monoxide to carbon dioxide, selective adsorption of carbon dioxide and synthesis of ammonia from balance gas containing hydrogen and nitrogen were used. Ammonia and Carbon dioxide sets the stage for chemical reactions in Urea plant to end up with Granular Urea product.

The project entails the building of the following two process plants:

- Ammonia Plant for the production of 2300 MTPD of Ammonia;
- Urea Plant for the production of 4000 MTPD of Urea.

The project design shall be suitable for 30 years of operation with planned turn around maintenance every 3 years or longer. Design capacity is considered for an on stream days of 330 days/year. IEFCL has engaged Technology licensors /EPC Contractors for undertaking front end engineering design (FEED) & getting firm bids employing state of the art technology, optimum energy consumption & most environment friendly process.

For the purpose of the Environmental Impact Assessment, conservative approach has been adopted and highest levels of emission and discharge have been taken into account for pollutant dispersal monitoring. However the emissions of the new plants will be in compliance with the applicable International standards/requirements, in particular concerning the Nitrogenous Fertilizer production.

The proposed project shall be supplied with the utilities ((e.g. electric energy, waste water treatment etc.) from within the Indorama manufacturing complex where adequate utilities generation equipment shall be added.

Environmental and Social Baseline

Ecology

The objectives of the study was to examine the potential impacts that might be associated with the establishment of the IEFCL-Train2 fertilizer plant on the ecology of the area with emphasis on the vegetation (flora) and wildlife (fauna) in the area. In view of the aforementioned, the study area is classified under the Eleme Okrika industrial belt. However, in the study of ecology which covered thematic region of 5km radius, a total of 13 tree/shrub species within 12 families with Elaeisguinensis being the only common species and Apocynaceae being an occasional family was observed in the area. Similarly, a total of 18 herbaceous species occurred in the area within nine families. On the other hand, a total of 21 faunal species were observed to be found in the area and they comprised of mammals, rodents, wild ruminants, reptiles and aves. Invariably, the plant health conditions were also analyzed and it was ascertained that the vegetation in the area was in good condition in spite of a few diseases symptoms that were associated in the area. Environmental management plan proffered for the project will ensure yearly monitoring of the ecology of the influenced area of the project

HYDROBIOLOGY

Phytoplankton

The phytoplankton communities were represented by four taxonomic groups in the dry and wet seasons. The groups are: Bacillariophyceae (diatoms), Chlorophyceae (green algae), Cyanophyceae (blue green algae) and Euglenophyceae. Forty-eight (48) species were identified with the Bacillariophyceae dominating the phytoplankton community in the wet season and Cyanophyceae in the dry season. The seasonal changes in the species composition and population density maybe attributed to the changing environmental conditions. Results of the ecological indices (Shannon-Weiner index) suggest effect of anthropogenic activity (sand mining) in both climatic regimes. The analytical results of the surface water lends credence to this finding. The order of

dominance was as follows: Bacillariophyceae >> Chlorophyceae >> Cyanophyceae >> Euglenophyceae (Wet season); Cyanophyceae >> Bacillariophyceae >> Chlorophyceae (Dry season).

Zooplankton

The zooplankton community comprised of Copepoda, Rotifera, Tintinidae, Cladocera and Cichlidae in the wet and dry season. A total of 4 species were identified in the dry season and 15 species in the wet season. The Rotifers were the most dominant zooplankton taxonomic group representing about 72.14% and 42.86% in the dry and wet season. The dominance of Rotifers maybe attributed to the presence of sediments in suspension in the surface water bodies. This suggest that the surface water body is stressed between both seasons, as result of the intense sand mining. In increasing order, the dominance pattern of the zooplankton community were Rotifera >> Copepoda >> Tintinidae (Dry season); Rotifera >> Copepoda >> Cladocera >> Cichlidae (Wet season).

Benthic invertebrates

The Benthic invertebrates were represented by three taxonomic groups in the wet and dry season. The taxonomic groups are Oligochaeta, Insecta and Nauplii comprising of 4 taxa in the dry season and 10 taxa in the wet season. The insect dominated the benthic fauna community with a percentage composition of 75% in the dry season and 52.38% in the wet season. The dominance of Insecta is not uncommon in freshwater ecosystems as it has been reported to tolerate extreme conditions and high competitive capacity. The Shannon-Weiner diversity index suggests disturbed sediments in both climatic regimes. In increasing order, the dominance pattern of the benthic fauna were Insecta >> Oligochaeta (Dry season); Insecta >> Oligochaeta >> Nauplii (Wet season).

Ambient air

The Ambient Air Quality, Noise and Meteorology study was conducted in the month of September in the wet season, while secondary data for previous studies conducted in the area were used for dry season analysis. The exercise was carried out in compliance with statutory requirements and in line with national and international policy on the protection and conservation of the environment. Monitoring locations within and

outside the project area were chosen for the air quality study, an hourly mean monitoring was carried out for 8 hours as recommended by Federal Ministry of Environment (FMEnv) and the United States Environment Protection Agency (USEPA). Baseline results were compared with FMEnv and the National Ambient Air Quality Standards (NAAQS).

The air quality study exercise was conducted using air monitoring equipment, while noise levels were measured using portable noise instrument. The parameters measured during ambient air study are: CO, SO_2, NO_2, H_2S, THC, VOC, NH_3 and particulate matter (TSP, PM_{10} and $PM_{2.5}$); meteorological parameters monitored are, temperature, relative humidity, wind speed, and wind direction.

A total of nine (9) sampling locations were selected for the assessment of the existing ambient air quality status of the project area. Measurement of baseline concentration levels of particulate matter (TSP, PM_{10} and $PM_{2.5}$), sulphur dioxide, nitrogen dioxide, carbon monoxide, hydrogen sulphide, ammonia, total hydrocarbons and VOCs was established. It was observed that average values of particulate matter (TSP, PM_{10} and $PM_{2.5}$) for all monitoring locations were well within FMEnv, IFC and NAAQS limits. The average concentrations of SO_2 and NO_2 were well below statuary limits in both seasons. The mean concentrations of CO, H_2S, NH_3, VOCs and THC were low (below both FMENV permissible limits) for all monitoring locations in the project zone.

Baseline concentrations of SO_2, NO_2 and H_2S were generally low in both seasons. Mean concentrations of NH_3 was 0.10±0.13µg/m^3 in wet season and 0.30±0.12µg/m^3 in dry season. The average concentration of total suspended particulate matter (TSP) was 26.7±16.79 µg/m^3 in wet season and 86.7±14.37µg/m^3in the dry season. The mean concentration of particulate matter PM_{10} was 17.9±10.81µg/m^3 in the wet season and 41.1±3.88µg/m^3 in the dry season; while the average concentration of particulate matter $PM_{2.5}$ was 8.8±6.09µg/m^3 in the wet season and 18.4±2.39µg/m^3 in the dry season.

Baseline measurement showed that concentrations of air pollutants in the area are generally low. These values are well below the FMEnv guidelines and represent baseline condition of the study area.

The environmental baseline describing the pre-construction air quality of the project area has been conducted through intensive measurements of air pollutants in the project area. Existing air quality in the study area is controlled by local weather condition and particularly the strength of the North-East and South-West trade winds that are prevalent in the area during the dry and wet seasons respectively.

Noise

The average noise level in the wet season was 55.5±7.98 dB(A), while the average noise level measured within the project area was 61.4±9.42 dB(A) in the dry season. The measured noise level values are well below the FMEnv guidelines and represent baseline noise level of the study area.

Waste management

Indorama utilizes the 4R (Reduce, Reuse and Recycle and Recover) as a basic principle of its waste management policy. The proposed Ammonia and Urea Plant IEFCL-Train 2 will use the existing incinerators at site for incineration of inenarrable wastes. New waste segregation units will be built for IEFCL-Train2 plants where solid waste will be segregated into properly labeled receptacles according to the types of waste from where it will be collected for final disposal. There is a dedicated scrap yard where large volume of waste is temporarily kept before reuse, recycling or disposal. Waste manifest, waste tracking, waste vendor certificate verification and vendor reassessment, waste quality assessment before final disposal are the quality control measures that will be used to assess the efficiency of the waste management scheme for the proposed project.

Effluent treatment

Effluent streams comprising sewage, process waste water, and blow down are collected into dedicated pits and pumped via pipelines to respective treatment units where it undergoes processes such as hydrolysis, stripping, neutralization, demineralization, and equalization. The quality assessment of treated effluent is assured at Inside battery limit (ISBL) treated effluent pit and at Effluent treatment plant (ETP) before final disposal.

Stack emissions

Gaseous emission will be minimized by the plant process design including scrubbing and final emissions will be discharged via stacks. Most of the gaseous emissions from the plant will be normal atmospheric components - nitrogen, oxygen, carbon dioxide, water vapour and inert gases - that will be discharged via stack at an appropriate height.

Soil

Soil Sampling

Composite soil samples were collected at two depths: 0-15cm (Topsoil) and 15 – 30cm (Subsoil) with the aid of Dutch stainless steel hand auger from Seven (7) sites at different locations within the proposed project area and two control sites outside the project area. A total number of Eighteen (18) soil samples were collected.

Morphological properties

The soils of the study area are coarse grained, gravelly, locally fine-grained, poorly sorted, subangular to well rounded (Assez,1975). Ojanuga et al (1981) stated that the genesis of these soils have resulted from cycles of soil formation which alternated with cycles of erosion in the mid tertiary to Holocene era in Nigeria. Soil consistency as observed during the field exercise were between wet (slightly sticky and non sticky) and moist (friable), while soil colour were between black (10YR2/1), Dark red (2.5/YR3/6), Brown (10YR5/3) and Strong brown (7.5YR4/6). The topography of the study area were relatively flat with some gentle slope as observsed around station one (SS1- Okulu Aleto).

Physiochemical properties

The textural classification of the two soil depths within the study area and control site was predominantly fine-grained fairly consolidated Loamy Sand, Sandy Loam and Sandy Clay Loam soil (using the soil particle size matrix), with considerably low clay content.

The soil reaction falls within acidic pH range of 4.70–5.6 (5.22 ± 0.39) for topsoil and 4.30 -6.80 (5.37 ± 1.03) for subsoil indicating that the soil is slightly acidic, which is typical of a Niger Delta soil. The Organic matter content of the soil ranged from 0.09-0.21 at the topsoil, while the subsoil ranged from 0.08 – 0.16% indicating low organic matter

content of both topsoil and subsoil according to FAO (1990) classification, which also reflected in the Total Organic Carbon results recorded during this study

Total Nitrogen levels ranged between 0.08 -0.39% and 0.08 – 0.27%for both the top and sub soil respectively indicating that Medium to high soil fertility according to FAO (1990) classification of soil

Microbiology

The total population of total heterotrophic bacteria (THB) ranged from $0.52x10^4$ to $4.50x10^4$(cfu/g) for topsoil and $1.50x10^4$ to $3.95x10^4$(cfu/g) for subsoil; total heterotrophic fungi (THF) ranged from $0.15x10^4$– $1.59x10^4$(cfu/g) for topsoil and $0.45x10^4$– $2.00x10^4$(cfu/g) for subsoil. The population of total hydrocarbon utilizing bacteria (THUB) ranged from $0.25x10^4$– $1.96x10^4$(cfu/g) for topsoil and $0.37x10^4$– $1.99x10^4$(cfu/g) for subsoil, and the total hydrocarbon utilizing fungi (THUF) ranged from $0.64x10^4$– $3.00x10^4$(cfu/g) for topsoil and $0.22x10^4$– $3.50x10^4$(cfu/g) for subsoil,

Heavy metal

Heavy metals analysis in the soil samples revealed Iron (Fe) having the highest concentration (Mean 6847.25mg/kg topsoil and 6685.20mg/kg subsoil), while mercury (Hg) and Vanadium (v) were below detection limit.

Conclusively, soils of the area with the exception of some localized variations are characterized by the following very good physical features, poor inherent fertility status, low degree of acidity Low cation exchange capacity FAO (1990) and Predominant sandy texture

Surface Water

The water body is a fresh water body with pH slightly acidic at the upstream which is typical of the Niger delta surface water bodies. The pH during the rainy season fieldwork (2017) ranged from 6.80 to 6.95 and 6.55 – 6.60 at the control stations compared to 6.73 to 8.24 and 7.10 for control station for dry season. All parameters analyzed during study show compliance to existing regulatory standard.

Sediment

The color of the sediment samples ranged from black to dark grey coloration. The silt fraction was higher than the sand and clay content making the sediment Silty in texture. Nutrients are adequate to support the healthy growth of benthic population. The concentrations of nutrients in sediment around the study area are indicated below; Sulphate concentrations varied from 51.8 to 483.5 mg/kg and 185.7 to 362.7 mg/kg for rainy season (September 2017), nitrate content ranged from 2.64 to 19.23 mg/kg and 8.22 to 10.4 mg/kg control stations for rainy season. Total Petroleum Hydrocarbon was low for all samples taken 9.62 to 18.22 mg/kg and control stations with 2.90 to 4.76 mg/kg for rainy season.

Socio Economic and Cultural Environment

The IEFCL-Train2 project will generate a lot of interest and expectations from the host communities. For investigating the socio economic component a dedicated questionnaire and focused group of interviews were the primary means of data collection. Four communities in two local government areas of Rivers State of Nigeria where surveyed for this study. The communities are Agbonchia, Aleto and Akpajo in Eleme Local Government Area and Elelenwo in Obio/Akpor. The people of Eleme claim a common ancestry, language and ethnicity. Elelenwo is of Ikwerre origin. Among Aleto and Agbonchia settlements, there are also three family units, respectively Okerewa, Njuru and Akpankpan. Okerewa is studied under Aleto, while Njuru and Akpakpan are covered under Agbonchia.

The total population of the four communities surveyed in this study is 66,614 in 2010 (Field survey and National Population Commission Publication 1996). The Federal Government of Nigeria (2007) estimates that the annual growth rate of population in Rivers State is 3.4% which is close to the situation in the study area as 3.5% in 2016. There are more male population (57%) than female (43%). The study also revealed that 0-14 years of age represent 41%, working age represent 59%. This implies that the study area has high population dependency burden. Under the working class 48% are self-employed, 21% are Government workers, 12% are company workers while 19% are unemployed. Under the category of self-employed 56% are business men and

contractors, those involved in farming represents 29%, trading 12% and others 3%. The mean daily income in the study area is 700 Naira which is slightly above the National monthly minimum wage of 18,000 Naira.

Large industrial complexes prior to the entry of Indorama in the region have not attracted medium manufacturing industries to utilize their products in the area. This lack of backward integration permeates to the level of small aspiring entrepreneur. As reflected in the occupation structure, people either farm, work for government or do small business. Outside the large industries in Eleme local government area, the other common enterprises are contractors, vendors, welding/ fabrication workshops, sand mining, and traditional food processers.

The farming system is a limited form of shifting cultivation whereby a land is cleared and cultivated for several years until productivity diminishes; it is then abandoned until natural processes regenerate the soil. The fallow period was up to 7 years about 30 years ago, it reduced to about 4 years 10 years ago, but now the farms are rarely left fallow. Farming tools and inputs are also basic. Seedlings are obtained from the previous year's harvest. Cutlasses, hoes and spade make up the farming tools. Mechanization is non-existent.

The sole source of domestic water supply is shallow boreholes. The water tables in the study areas are close to the surface and water can be tapped at 10m in most cases from the first aquifer.

Movement from one place to another is by road in the communities studied and major means of transportation is motor, bicycles, 2-stroke tri-cycles (popularly called Keke-NAPEP and buses). All the study communities are big enough to require some sort of internal transport which is met through the use of tricycles. In Aleto and Agbonchia motor bikes are the most important means of internal transport. Every community in the study area has a model primary school. All the communities also have a secondary school. Adult literacy rate in the study communities is commendable.

Energy demand in the study area is for lighting, cooking, and driving machines (including automobile). The experience during the fieldwork is that all energy types are in short supply. Electric power is erratic and there are occasions when they receive only a few hours of power in a week. The petroleum based fuel are scarce and expensive, like kerosene and cooking gas for domestic use, which gives credence to the dependents of wood as a major source of domestic fuel.

Most respondents live in own houses. Majority of the houses are constructed with concrete blocks and roofed with corrugated iron sheets. Other types of houses reported by respondents are concrete blocks roofed with iron sheets, earth block and iron sheets, and the traditional wattle and mud houses roofed with thatch or iron sheets. The average households is between eight/nine persons.

Four activities dominate the cultural calendar of communities in the study area namely; wrestling, traditional marriages, new yam festival and dances. The only surviving historical forest as a result of rapid industrialization in the area is the Onura forest. Social Affiliation in the societies includes politics, co-operatives, social clubs, education, religion and cultural associations. Dispute over land boundary and ownership is the primary cause of intra and inter communal conflicts in the study settlements. The courts are the main avenue for dispute resolution.

Traffic Survey

The four communities in the study area are traversed by two major highways: the East – West Road that begins from Warri and end in Eket and the Port Harcourt – Aba Expressway.

A survey of the existing traffic volume on the East- West Road (Direction from Akpajo to Port Harcourt) indicated that Indorama complex will affect traffic volume during the peak hours of 8:00am to 9:00am and 5:00pm to 6:00 pm. In view of the findings, traffic management plan has been instituted by Indorama.

Health Assessment

The Health Assessment of the project area was conducted in and around the facilities and the communities to determine the baseline characteristics of the health status of

the project area against which future impacts of the project can be compared. Secondly to determine the probable/potential impacts of the project on the health of the workers within the IEFCL facility, the people around the communities (Agbonchia, Aleto, Akpajo, and Elelenwo) so as to determine the type of intervention/s needed to ameliorate these negative potential impacts. These communities were sampled by the health personnel to obtain information regarding mortality and morbidity rates, types of health hazards, most prevalent diseases, disease vectors, nutrition, health facility infrastructure capability and usage, average family size, sexual reproductive health, immunization status and coverage, sewage and waste management system, air quality, water quality, radiation sources and levels. The state of health delivery facilities/services in the area is below standards expected of an urban area. The principal communicable diseases in the area are Malaria, Diarrhea, skin rashes, upper respiratory tract infections and STIs. While prevalent non-communicable diseases in the area are hypertension, food poisoning and occupational injury.

Associated and Potential Impacts

Associated and potential impacts evaluation for the project was based on the results of technical studies, together with established facts in relevant literatures, perceptions and evaluations of stakeholders, project characteristics and general observations obtained during field data gathering.

For all project phases (Construction, including recruitment phase and site preparation, Operation & Maintenance and Decommissioning) activities that can affect the environmental and social components have been identified, together with potential and associated impacts. Also the Health & Safety issues have been similarly considered.

Occasionally hydrocarbon odor is perceived in the study area; traffic volume variations & associated issues are experienced. Positive impacts include capacity development, job opportunities and vendor patronage for host communities and increase economic activities in the study area in particular.

Cumulative Impacts

The proposed project will be sited in the existing Indorama complex, where already IEFCL-Train1 operate in addition to other plants. Therefore the cumulative impact assessment was conducted to ascertain the combined effect of the operating unit & proposed project to the valued environmental component (VECs) immediate to this facility in order to proffer mitigation measure. Based on the individual impact assessment for the projects, majority of the cumulative impacts would occur during the operational phase only, as construction is not expected to coincide with any other construction within the Indorama complex. Most of the cumulative effects would occur, when there is an overlap of activities. These activities will be taking place within an area of about 2 km^2 radius.

The cumulative positive impacts identified are

- Business Opportunity/Economic enhancement
- Skills acquisition
- Increase in revenue for the Government, Community and Indorama

The cumulative negative impacts identified are:

- Increase in cost of living/Inflation during construction
- Increase in potential for road traffic volume
- Stress on existing security structures during construction

The significance rating of each of these impacts has been obtained through the process of impact identification, ranking and quantification, in each of the project phases.

The evaluation of impacts in the different phases of the initiative considered the predicted implementation of the above mentioned actions and it is briefly reported hereinafter.

Mitigative Measures

Various mitigation measure, (technical and administrative) are proffered specific to environmental problems that may arise during construction, operations and even

abandonment and decommissioning stage. An environmental and social management system will be adopted to help enhance the results of the mitigation measures.

Construction Phase

During construction phase IEFCL will put in place all the necessary measures to ensure health of workers and environmental safeguard and to minimize the risk of possible incidental events.

The slight increase in dust emissions from construction activities will be properly addressed by spraying water at construction sites to reduce powder dispersion, when construction is carried out in dry season.

The construction activities will be carried out, also, in accordance with applicable regulations on noise.

Increment in vehicular movements will occur during construction phase, however, the Project will have minor effects on the existing vehicular transit on main road axes around Indorama complex, because of adherence to IEFCL's Traffic Management Plan.

Temporary and occasional impacts on vibrations are expected, but considering the distance of sensible receptors between the Indorama complex and the host communities, occasional vibration will have no impact on the receptor.

Risk of ground water/soil contamination due to accidental spills during construction activities is a minor concern that will be minimized through the adoption of dedicated management measures into the ESMS.

The construction activities will take into account the soil geological and geotechnical characteristics avoiding the execution of the main foundations during the wet season in order to exclude possible soil erosion concerns.

Construction areas are located inside the industrial complex under the control of Indorama, without using virgin land. During this phase, IEFCL will make adequate accommodation arrangements for expatriates to reduce pressure on local houses.

Minor impacts on wildlife are expected and time limited, associated to diurnal hours. Current fruition of the existing fauna will not change.

Waste production during construction phase will be managed by the procedures and facilities already existing in the Indorama complex. The excavated soil not reusable for geotechnical reasons will be directed to appropriate external authorized landfills.

A population increase in the near host communities associated to the realization of the Project is expected. Dedicated policies and actions will be adopted by IEFCL to safeguard the host communities from impacts due to the influx of workers, however the host communities will particularly benefit of the increase of both direct and indirect employment.

Operation Phase

During the operation phase, IEFCL will put in place all the necessary measures to ensure health of workers and environmental safeguards to minimize the risk of possible incidental events.

No significant effects are expected on air quality during operation phase, since the pollutants concentrations at ground level at the INDORAMA complex after the operation of the new Fertilizer plants will be in compliance with air quality regulatory/standards guidelines and within the limits of occupational exposure. No cases of odor annoyance are expected due to NH_3 emission since facility to burn off Ammonia has been incorporated.

The project will not add to air emissions that will negatively affect the existing quality of vegetation around the complex.

Moreover, fugitive emissions and emissions can occur in upset situations only (e.g. emissions from ammonia storage flare) and in case of such emissions adequate flaring facilities have been provided. Such incidents shall be well managed by a dedicated Management Systems.

Night-time vehicular movements will be minimized up to extent possible.

IEFCL will ensure that the operation of the new plants will be in accordance with applicable regulations on noise.

Water effluents going to existing retention pond and to Okulu Stream will increase due to the operation of the new Fertilizer Plant. This is not likely to generate an additional deterioration of surface water and its hydrobiology/sediment because ccompliance with regulatory limits at discharge point will be ensured after the operation of the new Fertilizer Plant.

As a consequence, no variation in existing surface water quality likely to modify the characteristics of surrounding vegetation is expected.

The water consumption by new project will not affect the water table. The ground water recharge rate and the existing ground water flows will remain same. The risk of ground water/soil contamination due to accidental spills during operation will be minimized through the adoption of dedicated management measures.

The project may have negative Health Impact on the host communities around IEFCL complex due to the influx of workers who are possible carriers of some communicable diseases. The same population increment in the near host communities will be managed in a proper manner to safeguard the health of host communities through the various health intervention programs organized by IEFCL HSE and Health Department. IEFCL will construct new residential facilities inside the complex for expatriate staff only.

Also an acceptable increase of vehicular traffic is expected and will be adequately managed in order to minimize possible socio economic impacts and potential associated hazards. There are no socio-economic activities that are going to be negatively affected by the project and the installation of new units will not interfere with cultural/social elements present in the study area.

The initiative will not modify the existing microclimatic conditions of the site considering also the expected increment of aqueous vapor emissions in atmosphere from Cooling Towers.

The catalytic steam reformation of Natural gas (major raw material) produces CO2 among other gases which used for synthesis of NH_3. The technology of using CO_2 and NH_3 to produce Urea prevents CO_2, a greenhouse gas, been emitted into the atmosphere. Optimal use of Natural gas for the production of fertilizer in this project will reduce the release of associated greenhouse gases, being emitted in to the atmosphere due to gas flaring from the oil production fields.

Environmental Management Plan (MP)

IEFCL has defined a plan for managing the proposed project and associated impacts related to environmental and social impact and occupational health and safety concerns. The MP includes strategies to enable proactive resolutions of the environmental and social impacts expected, procedures for training, development of adequate capacity; plans for monitoring environmental, social, occupational and health issues as well as

management of the effects of the impacts and minimization of the risks, parameters to be measured/monitored, frequency and location of monitoring.

The plan is aimed at adopting an Environmental and Social Management System in accordance with the IFC Performance Standard no° 1.

The ESMS adopted at IEFCL is based on the best practices adopted in the same kind of industries globally. The systems and procedures practiced at IEFCL are in line with globally accepted international standards, like ISO 14001, OHSAS 18001 etc. The IEFCL-Train2 project is an expansion of IEFCL-Train1 and the same systems and procedures will be extended to new plants.

Decommissioning Phase

At the end of the life span of the project, or otherwise, if proponent and or government decides to decommission the project, a plan would be drawn by the proponent and approved by all concerned Regulators and stakeholders before the plan is executed. All possible measures will be taken in order to ensure health of workers and environmental safeguard and to minimize the risk of possible incidental events during decommissioning phase. IEFCL commits itself to restore the environmental conditions existing before the realization of the IEFCL-Train2 Fertilizer Plant project.

Conclusion

Evaluation of EIA data, found that the project is environmentally feasible and will not cause serious effect to the environment, considering that the existing and proposed mitigation measures are implemented. Residual issues associated with the project are expected to be minor and not likely to have long-term significance on the environment.

Recommendation

Mitigation and compensation measures are to be addressed according to the proposed action plan. All its monitoring programs are to be religiously implemented and periodically reviewed and revised as necessary to take into consideration changes made to the project during its operation. Vibrant and dynamic company-community relations need to be maintained to ensure sustainability of the project.

ACKNOWLEDGEMENT

The management of Indorama Eleme Fertilizer and Chemical Ltd (IEFCL) wishes to acknowledge the opportunity granted by the Government of Federal Republic of Nigeria through the Ministry of Environment to conduct this EIA for the proposed IEFCL-Train2 fertilizer plant in the Indorama complex, Eleme.

We appreciate the cordial working relationships we had with the Federal Ministry of Environment, the Rivers State Ministry of Environment, during consultation and fieldwork. The Eleme Local Government Council and the Traditional Head of Eleme Kingdom, during the field data gathering exercise and the stakeholder's engagements.

Thank you,

Management of IEFCL