CHAPTER FIVE

ASSOCIATED AND POTENTIAL IMPACT EVALUATION

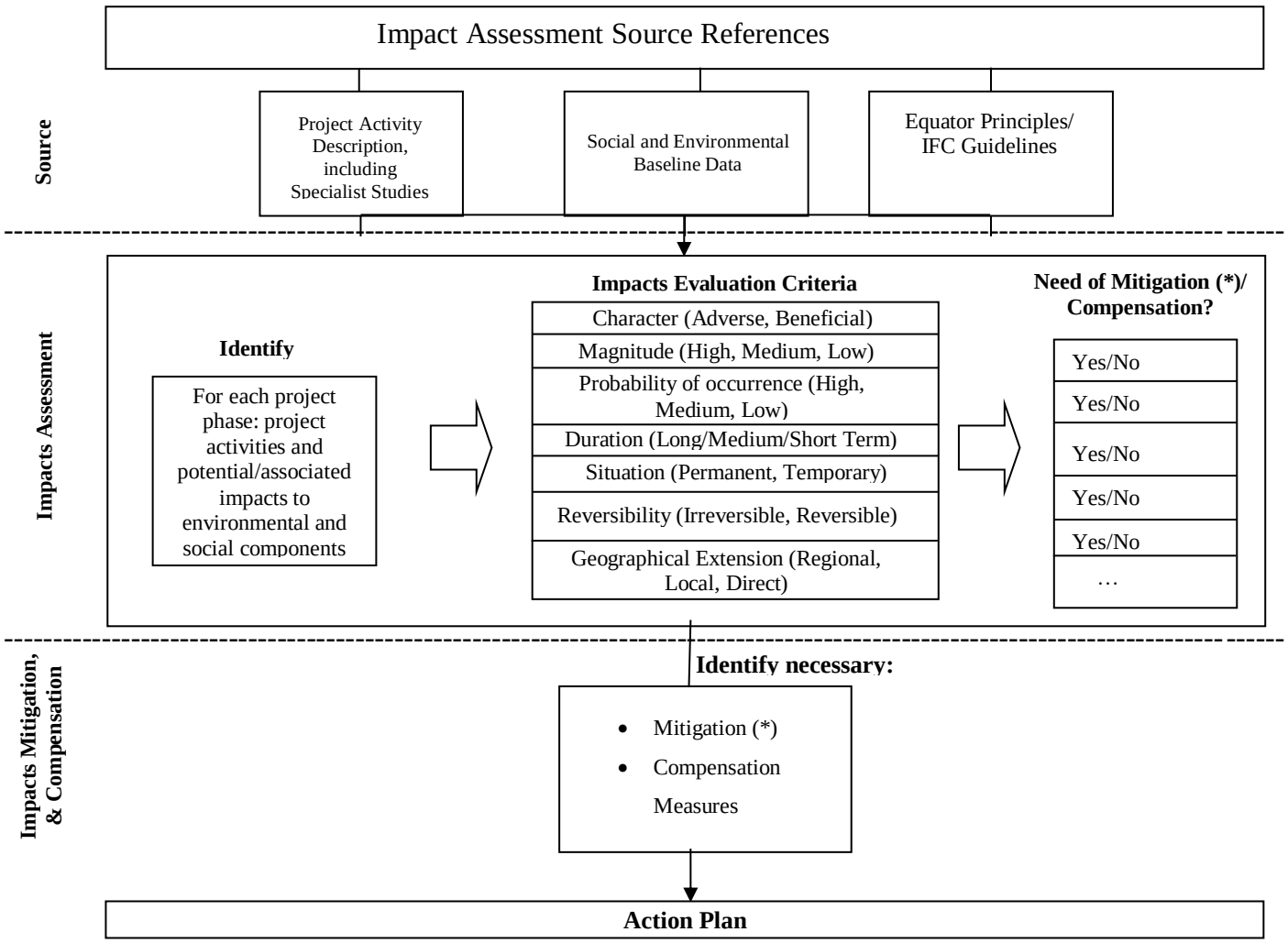
5.1 IMPACT ASSESSMENT METHODOLOGY

This chapter presents the overall assessment of associated and potential environmental and socio-economic impacts of the proposed IEFCL-Train2 fertilizer project within Indorama Complex, Eleme. The associated and potential impact assessment covers all stages of the project. The results of technical studies, together with established facts in relevant literatures, perceptions and evaluations of stakeholders, project characteristics (Chapter Three) and general observations obtained during field data gathering (Chapter Four) were considered in the impact assessments. Due recognition was also given to the stipulated standards of the enabling legislative framework and guidelines for sustainable practices applicable in the Fertilizer manufacturing sector.

Mitigation/Compensation measures to ensure that the Project complies with the above mentioned regulatory standards and guidelines will therefore be enhanced in Chapter Six. In some cases mitigations refer to the implementation of management plans that are described in detail in Chapter Seven.

The methodology adopted in assessing the positive and negative impacts of the proposed project is schematically presented in Figure 5.1.

Figure 5.1: Approach to Impact Assessment for a sustainable project



(*) Mitigation includes also ameliorations as possible changes to the original engineering design and the adoption of management system/program for the different phases of the project.

5.2 LIST OF POTENTIAL AND ASSOCIATED IMPACTS

Potential and associated impacts were identified and evaluated according to the methodology described in the previous paragraph. The final list of positive/negative impacts of the proposed IEFCL-Train2 Fertilizer project is reported in Table 5.1. For each project phase (from construction to decommissioning), activities that can affect the environmental and social components have been identified, together with potential and associated impacts. Also, the Health & Safety issues for workers have been considered. The environmental and social components that are likely to be directly or indirectly affected by each impact are listed, possible significant effects are checked and finally the need and nature of dedicated actions to reduce the expected impacts are identified.

A list of criteria has been used to explain whether a project impact is likely to be significant or not for the associated environmental components. The meaning of terms used (when applicable) to underline the characteristics of the expected impacts referring to different criteria is hereinafter reported:

a. **Character**
   - Positive: beneficial impact for the components affected;
   - Negative: detrimental impact for the components affected.

b. **Geographic Extension**
   - Direct: effects confined to the area directly occupied by the Project;
   - Local: effects beyond the directly Project occupied area but within the limits of the study area under evaluation for the Project;
   - Regional: effects extend beyond the study area under evaluation for the Project.

c. **Duration**
   - Short term: effects will last less than 1 year;
   - Medium term: effects will last between 1 and 5 years;
   - Long term: effects will last more than 5 years.

d. **Magnitude**
   - Low: the effects of an impact will determine a slight variation of the existing component's conditions;

- Medium: the predictable effects are considerably beyond the existing typical conditions, but without exceeding the criteria established in the permissible limits or without disturbing the economic, social and biological parameters within the ranges of natural variability or social tolerance;
- High: the predictable effects will determine a noticeable variation in the conditions of the affected components (e.g. exceeding of permissible limits, detectable change in socio-economic parameters, etc.).

e. Situation:

- Permanent: Impact will be continual;
- Temporary: effects will be confined to a specific period.

f. Probability of occurrence:

- Low: the impact has little probability of occurrence;
- Medium: the impact is possible or likely to occur;
- High: the impact is (almost) certain.

g. Reversibility:

- Reversible: effects of the impact can be reversed to the existing typical conditions;
- Irreversible: effects of the impact will be continual.

A more detailed discussion on the expected quality of the environmental and social components likely to be affected by the realization of the project can be found in following paragraph 5.3.

Table 5.1: List of Associated and Potential Impacts of Proposed Fertilizer Project in IEFCL facility

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
CONSTRUCTION	Recruitment for construction phase	Employment of local labor and award of contracts to members of the host communities	Socio-economic condition	Yes, positive impact with local effects on medium term	No	-
		Inter and intra community conflicts	Socio-economic condition	Yes, negative impact with local effects on medium term	Yes	MI
		Increased cash flow and stimulation of local economies within the Host Communities	Socio-economic condition	Yes, positive impact with local effects on medium term	Yes	CO[2]
		Localized economic benefits from materials supplied by local contractors	Socio-economic condition	Yes, positive impact with local effects on medium term	Yes	MI+CO[3]
		Influx of workers into the host Communities (including possible increase in diseases/mortality)	Socio-economic condition, Health	No, Low probability of occurrence with possible medium and irreversible impacts	Yes	MI+CO

[1] **MI = Mitigation**
CO = Compensation

[2] Dedicated actions are foreseen to ensure the expected improvement in socio-economic conditions will be used by the Host Communities in order to obtain an enduring improvement in the existing living conditions.

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
CONSTRUCTION	Recruitment for construction phase	Socio-cultural conflicts between the construction team and members of the host communities	Socio-economic condition	Yes, medium probability of occurrence with possible medium magnitude local impacts	Yes	MI+CO
	Demobilization after construction is completed	Economic impacts in host communities, from which construction personnel was hired, due to loss of income	Socio-economic condition	Yes, medium empowerment of some host community members	Yes	MI
	All construction phases	Increase in solid/liquid waste production	Land Use, Air Quality, Surface Water, Health, Vegetation and Wildlife, Hydrobiology/Sediment, Socio-economic condition	No, see par. 5.3.13	No	-
		Potential increase of workplace accidents/diseases	Health	Yes, low probability of occurrence with possible negative high magnitude impacts. Direct effects with possible irreversible consequences	Yes	MI
		Loss of biodiversity	Vegetation and Wildlife	Yes, low probability of occurrence with possible negative low magnitude impact. Direct effects with reversible consequences	Yes	MI

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
		Increase in dust, noise and vibration effects	Air Quality, Noise, Vibration, Health	Yes, negative impact with direct and low magnitude effects. For health, low probability of occurrence for low magnitude impacts	Yes	MI
CONSTRUCTION	All construction phases	Stress on existing security structures	Health	Yes, low probability of occurrence with possible high magnitude impact. Direct effects with possible irreversible consequences	Yes	MI
		Risk of spills of hazardous material	Soil, Ground Water, Health, Hydrobiology/Sediment	Yes, low probability of occurrence for local, negative, medium magnitude impacts	Yes	MI
	Mobilization, Transportation of personnel, materials and equipment from/to site by road	Potential increase of traffic accidents	Health, Socio-economic condition	Yes, low probability of occurrence for possible negative high magnitude impacts. Local effects with possible irreversible consequences	Yes	MI+CO
		Air/Noise pollution from increased vehicular movement	Air Quality, Noise, Health, Vegetation and Wildlife	Yes, negative impact with medium term duration and with local, low magnitude effects	Yes	MI

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
	Excavation, Soil consolidation and demarcation, foundation laying and pilling	Soil Erosion	Soil	No, see par. 5.3.5	No	-
CONSTRUCTION	The water accumulation in depressed area	Mosquito breeding ground and Malaria effect	Health	No because fumigation is carried out periodically around buildings	Yes	MI
OPERATIONS AND MAINTENANCE	Recruitment for operation phase	Employment of local labor for general housekeeping	Socio-economic condition	Yes, positive impact with local effects on long term	No	-
		Increased cash flow and stimulation of local economies within the Host Communities	Socio-economic condition	Yes, positive impact with local effects on long term	Yes	CO[3]
		Influx of workers into the host Communities	Socio-economic condition, Health	Yes, low probability of occurrence with possible medium magnitude and irreversible impacts	Yes	MI+CO

[3] Dedicated actions are foreseen to ensure the expected improvement in socio-economic conditions will be used by the Host Communities in order to obtain an enduring improvement in the existing living conditions.

Project Phase	**Project Activities/ Environmental Aspects**	**Potential and Associated Impacts**	**Environmental and Social Component affected**	**Is this likely to result in a Significant effect? Yes/No? – Why?**	**Needs dedicated actions? Yes/No?**	**Nature of Action (MI,CO)[1]**
	Routine Operation & Maintenance of the Fertilizer plants	Degradation of ambient air quality for emissions of air pollutants	Air Quality, Land Use, Socio-economic condition, Health, Vegetation and Wildlife	Yes, low probability of occurrence with possible negative medium magnitude impacts. Local effects with reversible consequences	Yes	MI
OPERATIONS AND MAINTENANCE	Routine Operation & Maintenance of the Fertilizer plants	Noise annoyance	Noise, Health, Vegetation and Wildlife	Yes, low probability of occurrence with possible negative medium magnitude impacts. Local effects with reversible consequences	Yes[4]	MI
		Odor annoyance	Odor, Health, Land Use, Socio-economic condition	Yes, low probability of occurrence with possible negative low magnitude impacts. Local effects with reversible consequences	Yes	MI
		Increase in ground water consumption	Water, Land Use, Socio-economic condition	No, see par. 5.3.4	No	-

[4] IEFCL is committed to ensure the respect of noise regulatory guidelines and standards. Dedicated study will be drafted. If necessary, noise mitigation measures will be implemented.

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
		Increase in solid/liquid waste production	Land Use, Air Quality, Surface Water, Health, Vegetation and Wildlife, Hydrobiology/Sediment, Socio-economic condition	No, see par. 5.3.13	No	-
		Visual Impact of new buildings	Landscape, Land Use, Socio-economic conditions	No, see par. 5.3.6	No	-
OPERATIONS AND MAINTENANCE	Routine Operation & Maintenance of the Fertilizer plants	Increase in greenhouse gases emissions	Climate, Land Use, Vegetation and Wildlife, Hydrobiology/ Sediment	No, see par. 5.3.12	No	-
		Increase in aqueous vapor emissions	Climate, Land Use, Vegetation	No, see par. 5.3.12	No	-
		Increase in emissions of non-ionizing radiations	Health	No, see par. 5.3.9	No	-
		Risk of spills of hazardous material	Soil, Ground Water, Health, Hydrobiology/Sediment	Yes, low probability of occurrence for local, negative, medium magnitude impacts	Yes	MI

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
		Potential increase of workplace accidents/diseases	Health	Yes, low probability of occurrence with possible negative high magnitude impacts. Direct effects with possible irreversible consequences	Yes	MI
		Induced secondary industrial development	Socio-economic condition	Yes, positive impact with regional, long term effects	Yes	MI+CO[5]
OPERATIONS AND MAINTENANCE	Mobilization, Transportation of personnel, materials and final products from/to site by road	Potential increase of traffic accidents	Health, Socio-economic condition	Yes, low probability of occurrence with negative high magnitude impacts. Possible local effects with irreversible consequences	Yes	MI+CO
		Air/Noise pollution from increased vehicular movement	Air Quality, Noise Health, Vegetation and Wildlife	Yes, negative impact with local effects and low magnitude. Long term duration	Yes	MI
	The water accumulation in depressed area	Mosquito breeding ground and Malaria effect	Health	No because fumigation is carried out periodically around buildings	Yes	MI
DECOMMISSIONING	Recruitment for decommissioning phase	Employment of local labor and award of contracts to members of the host communities	Socio-economic condition	As per Construction phase	No	-

[5] Dedicated actions are foreseen to ensure the expected improvement in socio-economic conditions will be used by the Host Communities in order to obtain an enduring improvement in the existing living conditions, as indicated in section 4.10.5.

Project Phase	Project Activities/ Environmental Aspects	Potential and Associated Impacts	Environmental and Social Component affected	Is this likely to result in a Significant effect? Yes/No? – Why?	Needs dedicated actions? Yes/No?	Nature of Action (MI,CO)[1]
		Increased cash flow and stimulation of local economies within the Host Communities	Socio-economic condition	As per Construction phase	Yes	CO[6]
		Localized economic benefits from materials supplies by local contractors	Socio-economic condition	As per Construction phase	Yes	MI+CO[7]
		Influx of workers into the Host Communities (including possible increase in diseases/ mortality)	Socio-economic condition, Health	As per Construction phase	Yes	MI+CO
DECOMMISSIONING	All decommissioning phases	Increase in solid/liquid waste production	Land Use, Air Quality, Surface Water, Health, Vegetation and Wildlife, Hydrobiology/ Sediment, Socio-economic condition	Yes, low probability of occurrence of medium magnitude impacts	Yes	MI
		Potential increase of workplace accidents/diseases	Health	As per Construction phase	Yes	MI
		Increase in dust, noise and vibration effects	Air Quality, Noise, Vibration, Health, Vegetation and Wildlife	As per Excavation and Erection of Structures of Construction phase	Yes	MI

[6] Dedicated actions are foreseen to ensure the expected improvement in socio-economic conditions will be used by the Host Communities in order to obtain an enduring improvement in the existing living conditions.

Project Phase	**Project Activities/ Environmental Aspects**	**Potential and Associated Impacts**	**Environmental and Social Component affected**	**Is this likely to result in a Significant effect? Yes/No? – Why?**	**Needs dedicated actions? Yes/No?**	**Nature of Action (MI,CO)[1]**
		Risk of spills of hazardous material	Soil, Ground Water, Health, Hydrobiology/ Sediment	As per Construction phase	Yes	MI
		Stress on existing security structures	Health	As per Construction phase	Yes	MI
DECOMMISSIONING	Mobilization, Transportation of personnel, materials and equipment from/to site by road	Potential increase of traffic accidents	Health, Socio-economic condition	As per Construction phase	Yes	MI+CO
		Air/Noise pollution from increased vehicular movement	Air Quality, Noise, Health, Vegetation and Wildlife	As per Construction phase	Yes	MI

5.3 EXPECTED QUALITY OF THE ENVIRONMENTAL AND SOCIAL COMPONENTS AFTER THE IMPLEMENTATION OF THE PROJECT

Hereinafter it is provided an evaluation of the expected quality of the environmental and social components after the construction, operation and decommissioning of the proposed IEFCL-Train2 Fertilizer Project. Also, Health & Safety topics have been considered. The discussion presented here are intended to provide insight into the nature, magnitude and duration of the impacts on environmental and social components. Impact assessment considered also the predicted adoption of dedicated actions (see Chapter Six and Chapter Seven for details) to ensure the social and environmental compatibility of the project.

5.3.1 Air Quality

Gaseous emissions to the atmosphere would be generated both during construction and operation of the proposed IEFCL-Train2 plant. Emissions to air may be gaseous or in the form of particles loaded by adsorbed gases. Gaseous emissions may cause air quality impacts on human health particularly where emissions are of harmful gases. The pollutants releases to air would be either direct physical or by chemical reactions and transformation involving operations, combustion of fuels and transportation as well as packaging and loading of materials.

The dust generation during construction activities is much lower in rainy season and during dry season dust can be controlled by water spraying or other management practices. The emissions are short term and localized to the construction site. During operation the impact on air quality is rated as medium with reversible consequence due to use of clean fuel (NG), and installation of low NOx burners.

5.3.2 Noise and Vibrations

The construction of the proposed IEFCL-Train2 Fertilizer Plant is expected to produce a reasonable amount of noise that will have negative impacts on site workers and other sensitive receptors, such as nearby communities in the vicinity of the project corridor. Moderate noise impact from operation facilities may be experienced at night. With mitigation measures in place, as indicated in Chapter Six (Table 6.1), a potential moderate short term impact is predicted as a result of construction activities; while operation activities will constitute long-term noise impacts. Thus, workers are to be provided with

appropriate PPEs, while management encourage shift working system, and other engineering principle to comply with existing Noise limit.

Temporary and occasional impacts on vibrations are expected during the construction phase. Considering the distance between the project site located within Indorama complex premises and receptors, which is approximately 1.5km, there are no sensible receptors that may be affected by vibrations.

For noise and vibrations, workers will be adequately trained and equipped in order to ensure the safety of their activities, as indicated in Section 7.1.1.

5.3.3 Surface water and Hydrobiology/Sediment

The hydro chemical and hydro biological/sediment quality of the receiving water body (Okulu Stream), as presented in the baseline description provided in Chapter Four (4), is at present low making such stream not suitable for drinking or other potential human fruition purposes. The main cause of Okulu Stream deteriorated conditions is associated to illegal sand mining and dredging activities.

The project is not likely to generate an additional deterioration of surface water and its hydrobiology/sediment because:

- compliance with regulatory limits at discharge point will be ensured also after the operation of the new Fertilizer Plant;
- The waste water stream from the Fertilizer Plant will be in accordance with applicable IFC standards (Environmental, Health, and Safety Guidelines for Nitrogenous Fertilizer Production, par. 2.1, Table 2).

5.3.4 Ground water

The new project will determine an increase in ground water consumption from current 1750 m3/h to 2500 m3/h expected. This increment will not affect negatively the ground water potential recharge rate and ground water flows as demonstrated in Chapter 4; Section 4.6.5 Water budget. The soil of the site show five (5) unit of silty clay, clay, clay sand, fine sand and coarse gravel sand. See attached Borehole logs in Appendix-4.7. This is in agreement with the soils in the Niger Delta area which have natural clay –cap capacity that helps in preventing the percolation of liquids to the aquifer. Also, the favorable particle size distribution of the soil with the clay component comprising two third of the

particle distribution and the hydrogeological characteristic of the borehole logs considering the range of key parameters such as porosity, permeability, well discharge rate, water table, flow direction etc. further supports the low-rise potential of the ground water contamination in the study area.

Risk of ground water contamination due to accidental spills is minor because:

- The entire Project will adopt an Environmental Management System aimed at minimizing any possible accidental event is presented in Section 7.1.6.
- The risk of contamination is minimal considering soil characteristics of the area interested by the project (see Appendix 4.6).

5.3.5 Soil

The fertilizer project is planned to be constructed on a plot of land within the Indorama complex in IEFCL facility, which has been compacted and consolidated. There is no vegetation on the plot of land because the soil engineering carried out on it, in preparation for further use. The absence of vegetation on it indicates poor biota. Consequently baseline stations in terms of soil elements on site will not likely change drastically during construction and operations. All the same construction, operation and decommissioning phases will be implemented in accordance with provisions in the Environmental Management Plan to ensure that changes in baseline conditions are discovered on time and corrective measures implemented.

The construction activities will take into account the soil geological and geotechnical characteristics, with particular attention to avoid the execution of construction activities during the wet season in order to exclude possible soil erosion concerns, this will be clearly depicted in the construction works chronogram.

The Project which is designated to be located within an already embarked plot within the IEFCL facility defeated the option of locating the project on an area not hampered with, which would have encouraged impact on natural resources such as vegetation, biodiversity etc.

5.3.6 Land Use

As previously indicated, the Project does not imply consumption of land use outside the areas under IEFCL control and however will not have impacts on the current land uses in the study area (e.g. agricultural land use). The initiative is in compliance with the existing destination of land uses, as established under Land use act, inside the territory. During construction, operation and decommissioning phases, IEFCL will provide residential houses and temporary buildings within Indorama Complex to reduce the need of renting residential accommodation within the host communities which would have caused pressure on available houses in the community.

5.3.7 Job creation and housing for construction workers

The hiring during the construction stages will mainly be done by the EPC Contractor. Indorama Eleme Fertilizer & Chemicals Limited (IEFCL) will also carry out recruitment on its roll during the construction and subsequently for the operation phase of the project. The details of projected manpower recruitment are given in the table below:

Employment Particulars	**Unit of Measurement**	**2018**	**2019**	**2020**	**2021**
EPC Contractor	Number	1500	4000	4000	350
IEFCL	Number	54	200	200	200

All recruitments will be done in compliance to applicable Laws of Federation of Nigeria, which stipulates that Junior Staff positions must be reserved for state indigenous and for senior staff preference must be given to state indigenous if they meet the employment /requirement qualifications.

Mitigation measures for transition from construction to operation

Important mitigation measures for these workers as stated in the Demobilization Plan to be developed include:

- Disengagement benefits including end of Contract Bonus.
- Some persons will be absorbed in to the IEFCL-Train2 Project by means of direct jobs depending on skills.

- Some persons will be absorbed in to the IEFCL-Train2 Project by means of other indirect jobs through sub-contracting such as engagement under security / maintenance contracts and other contracts like loading and unloading, housekeeping, material handling including forklift operations etc.

Provision of Residential/Temporary buildings in the complex

Proponent would or will provide residential houses and temporary buildings within and around the project area

a) **Permanent Buildings**

There are residential buildings in the Complex for expatriate staff – built over an area of 10900 square meters.

b) **Temporary Buildings**

The details of temporary buildings during construction phase are tabulated below:

S. No.	Particulars	No. of Buildings	Total Area (Sq. meter)
1	Residential Buildings / Buildings for other	12	4531
2	Facilities including recreation	6	1324
3	Canteen	2	950
4	Site offices, training Hall and warehouses	7	2980
	Total Area (Square meter)		**9785**

These buildings will service the requirement for engineering / Technical services professionals during the construction. Other workers will be hired from host communities by EPC contractors will be given adequate allowances to off-set accommodation expenses. The corresponding House Accommodation plan, in accordance with international best practices[7], will be developed prior beginning to construction.

5.3.8 Vegetation and Wildlife

[7] Workers' accommodation: processes and standards, A guidance note by IFC and the EBRD, August 2009

Under Fertilizer Plant operating conditions the initiative will not contribute appreciable amount of air pollutants emissions into the atmosphere likely to negatively affect the existing quality of vegetation around the complex. Moreover, the freshwater vegetation around the surface water in the thematic region of the Project has no physical interaction with the IEFCL-Train2 Project and therefore the characteristics of the vegetation will not be modified either during construction or during operational phase.

Similarly, the wildlife composition enumerated in the Ecology study will not experience any change consequent upon IEFCL operations.

5.3.9 Health

The initiative will have minimal negative health impacts on host communities due to movement of persons looking for employment opportunities in the IEFCL-Train2 Project. Some of these persons may be carriers of some communicable diseases. On the part of IEFCL, employment procedure includes robust pre-employment medical examination and after employment, annual medical examination on all staff. All IEFCL contractors are also required to abide by internationally accepted employment rules. For further considerations on potential impacts that could also produce possible effects on the health of host communities, see also paragraphs 5.3.1 (Air Quality), 5.3.2 (Noise and Vibration), 5.3.3 (Surface water and Hydrobiology/Sediment) and 5.3.4 (Ground water). Concerning waste production, the new wastes produced will be managed according to the existing Management System, by using the existing facilities inside the Complex and by optimizing waste recovery whenever possible.

A population increment by the near host communities associated to the realization of the IEFCL-Train2 Project is expected, in particular during construction phase. This increment will be managed in a proper manner as established in the Influx Management Plan (Appendix 7.3) to safeguard the health of host communities deriving from possible exposure to infective / transmissible diseases.

During the construction, operation and decommissioning phases, 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, as indicated in Section 7.2.

During its different phases the project, will also contribute an increase to the existing traffic movements, that will be managed with the purpose of minimizing possible health impacts and the risk of traffic related accidents in the area interested by the project, as presented in the Traffic Management Plan.
In relation to emissions of non-ionizing radiations, minor impacts on human health are expected as a consequence of the present project.

5.3.10 Socio-Economic conditions

The project will determine an increment of both direct and indirect employment during all project phases. Thus, affecting the population of the host communities. The population increment will be of socio-economic benefited to the host communities in the following ways:

- Provide opportunities of employment, follows Rivers State Govt. Policy on employment.
- Increase in income by indigenes of the host community will promote small and medium enterprises.

The population increment will be managed by IEFCL by a proper adjustment of the offer in services both inside and outside the industrial complex, as clearly stated in the Influx Management Plan.

Increased vehicular traffic associated to the development of the project is also expected and will be adequately managed in order to minimize possible socio-economical impacts as indicated in the Traffic Management Plan. The construction of IEFCL-Trains2 Project is expected to add significantly to existing traffic volume on East-West Expressway which is short-term, while during the operation it is expected to contribute minimally to existing traffic volume. This significant increment may or may not negatively affect the quality of existing road services that is currently under repairs by the Federal Government.

All project phases will be managed, wherever possible, involving local stakeholders to avoid/minimize the generation of possible conflicts. Moreover, there are no socio-economic activities that are going to be negatively affected by the project and the new installations of IEFCL-Train2 will not interfere with cultural/social elements present in the study area.

The most significant increase in waste production will be temporary and will occur during the construction phase. This increment will not negatively affect the socio-economic conditions existing in the area, since existing IEPL/IEFCL facilities are capable to adequately manage the additional stream of waste that will be generated by the Project.

5.3.11 Landscape

Installation of the new plants will not cause significant variation of the existing landscape features in the study area and will interest only already industrial areas inside Indorama complex. See appendix 3.1 for trial photographical rendering of IEFCL site after the realization of Fertilizer Plant.

5.3.12 Climate

Considering the morphological features of the site together with the engineering solutions that will be implemented in the detailed engineering design of the project, the project is not expected to modify the existing microclimatic conditions of the site. Localized ambient air quality effects will be proactively addressed.

Concerning CO_2 emissions, the project will use natural gas as raw material, energy resource that is currently unused and largely flared thus contributing to climate change. The CO_2 resulting from reforming of the natural gas, will be used for the manufacturing of the Urea. Thus, it is anticipated that the project will reuse 2.93KT/day CO_2 for the production of Urea which is the totality of the CO_2 generated by the project and that otherwise would have been released to the atmosphere.

5.3.13 Improper Waste Generation

Inadequate management of food waste from camp site during construction and discharge of untreated effluent into the aquatic system, can trigger eutrophication, which will result to algal bloom as well as zooplankton depleting the dissolved oxygen, and increasing the

biochemical oxygen demand (BOD). Other wastes could raise the toxicity level (heavy metals) of the water as well as affecting the food web if untreated waste water are discharged into the surface water. If this scenario happens, the impact is direct, negative, short term, local, reversible and moderate. However, IEFCL has a sound waste management system for Line I which will be also adopted for Line 2.

5.3.14 Contamination of surface soil with used lubricant

Lubricants used for vehicle, heavy equipment and machinery maintenance could result in the contamination of topsoil, which is expected both during construction and operation, if not properly managed. However, the project will have appropriate procedures and systems to prevent the occurrence of soil contamination as stated in Section 7.1.7. This impact is considered direct, negative, short term, local, and reversible with a moderate rating.

5.3.15 Stress on Road infrastructure

The proposed IEFCL-Train2 Fertilizer Plant during operation will result to traffic situation on East-West Expressway, with associated impacts on public safety, transport and access. The Traffic Management Plant for this project has taking into account background traffic associated with existing traffic volumes and addition of traffic generated by the proposed project. Thus, cumulative impacts on road networks and traffic congestion could have a negative effect on public health and safety. IEFCL can manage traffic impacts from its own activities through implementing Traffic Management Plan and other mitigation measures. However, the responsibility to ensure adequate and safe road infrastructure for industries lies in the hands of the Government. Consequently**,** IEFCL would support government initiatives, including detailed traffic studies in its area of operation to determine road network capacity, road integrity, safety hazards and problem intersections in relation to its own operations as this will help to achieve a safe and efficient transport system to the benefit of Indorama Group and the public.

5.4 CUMULATIVE IMPACT ASSESSMENT

The proposed IEFCL-Train2 Fertilizer Plant will be sited in the existing Indorama complex, where already IEFCL-Train1 exists along with other operations including Olefins (NGL Cracker), Polyethylene (PE), Polypropylene (PP) and Captive Power Plant (CPP). Therefore, the cumulative impact assessment of this IEFCL-Train2 in relation to the existing

conditions of the complex surrounding area is important to ascertain the combined effects to the valued environmental components (VECs) and to proffer adequate mitigation measures.

For the development of this analysis, a review of requirements established by the IFC Performance Standards (IFC, 2012) was conducted and applied the methodology established in the Cumulative Impact Assessment and Management guidelines: Guidance for the Private Sector in Emerging Market (IFC, 2013.) The main input of this assessment has been the information contained in this document.

In first instance, there were determined the spatial and temporal limits, establishing as space limits the area of direct influence and indirect defined for the project, within an area of about 2 km^2; whereas, to establish the temporal limit was taken as reference over xx years of operation, due to uncertainties that can be generated in the conditions of the area past this period. It was considered that the construction impacts were limited to the construction period, thus, they were not included in this assessment. Then, a preliminary identification of projects or ventures near the complex was conducted.

Based on the information from consultants of the area and the information on Public Domain as well as informed discussion with neighboring industries, it has been concluded that there are no firm plans for any industrial projects in the neighboring areas. Therefore, the assessment is exclusively for IEFCL Train-2

Valued Environmental Components (VECs)

Valued environmental components (VECs) are defined as fundamental elements of the physical, biological or socio-economic environment, including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use that may be affected by a proposed project.

The selection of the VECs, was based on the identification of those recipients who meet the following criteria:

- can be affected during the time chosen considering the results of the ESIA
- are considered relevant by others (we took into account the views expressed by the stakeholders interviewed during the public consultation.
- can be affected by any of the activities associated with the project within the direct and indirect areas of influence of the project or aspects that may

also influence project outcomes (i.e., wind direction, displacement of people, etc.)
- Analysis of VEC parameters
- Its Positive Impacts (s)
- Its Negative Impact (s)
- Mitigation Measures

Once preliminary list of VECs is obtained, they were analyzed to determine their respective cumulative impact assessment.

The VECs, as identified, are as follows:

- Surface Water - body called Okulu Stream
- Host communities
- Ambient Air Quality
- Ground Water

5.4.1 Surface water

Presently the receiving water body (Okulu Stream) is affected by anthropogenic and Industrial activities.

Negative Impact:

The discharge of untreated effluent generating from IEFCL-Train2 during operation will impact the carrying capacity of the stream in terms of DO, BOD, COD and nutrients. This may further increase the negative effect on the production of aquatic life forms.

Mitigation Measure (positive actions):

Therefore, to avert this negative cumulative impact on the surface water, IEFCL has alternative as follows:

I. All IEFCL-Train2 effluent must be adequately treated before discharging into the Retention Pond
II. Discharged treated effluent must meet National and IFC standards especially for ammonia, BOD as demonstrated in Table 4.7.1 & 4.7.2 respectively of section 4.7 (Surface Water System).

5.4.2 Host communities

The host communities are important VEC as well as stakeholders for IEFCL Train-2 project.

Positive impact:

The host communities shall be opportune to gain employment and directly benefitted from small time service contracts. This will enhance the income levels resulting in cumulative impact in increase in living standards.

The host communities shall be exposed to various latest technology available and consequently trained. This amplifies the skills improvement and up gradation and result in more business opportunities.

Various CSR projects shall be undertaken in the host communities' area as was done during IEFCL Train-1 project tenure. This will improve the overall living culture as well as serve as improvement in lifestyle.

5.4.3 Air Quality

The emission of gases from existing and new plants may cause the smell in ambient air. This could happen during operations due to fugitive emissions and must be avoided as much as possible and practicable.

A dispersion study was conducted and the results are explained in section 4.3 and Table 4.3.4. in Chapter 4.0. The cumulative contribution from all stacks for operating plants are well within the IFC norms for all parameters like SOx(500mg/Nm3), NOx(300mg/Nm3). This is due to state of art technology during design phase and religiously operating the IEPL and IEFCL-Train1 plants according to design and by implementing leak detection and repair program. Further, the NOx emissions from stacks will be controlled by installation of low NOx burners and SOx by using clean fuel (NG). The same philosophy shall be implemented in IEFCL Train-2 for achieving a positive impact on emissions.

Chemical odour will come when leakage shall take place. A specific metric is not available for measuring odour but the state of art technology and the robust preventive maintenance practices ensure that leakages do not take place. Thus, odour issue is not felt for operations of IEPL and IEFCL Train-1.

5.4.4 Ground water

This capital resource is a sensitive component if chemicals and waste materials are allowed to leach/seep into the groundwater. This may happen due to multiple small spills and potential leaks over the time from several different sources. Individually these accidental spills or leaks could be minor, however, cumulatively there could be impacts of high magnitude on the groundwater.

The mitigation to avert this negative cumulative impacts is:

- To ensure the integrity of the walls and bottoms of Chemical storage facility and to ensure the secondary containment.
- Another mitigation measure will focus on ensuring that IEFCL manages water use efficiently by recycling and res-using waste water after treatment for further uses in the process.
- IEFCL will ensure that it keeps to the designed water use so that in the long term the aquifer recharge rate (Chapter 4; 4.6.5) is not affected.
- As indicated in section 5.4 (Cumulative Impact Assessment), there are no future projects in the area indicating IEFCL as sole user. Besides, all Ground Water source for consumption are located inside Indorama Complex.
- **Increase in Groundwater Extraction**
- Coming on-stream of IEFCL-Train2 Fertilizer Project will increase the ground water consumption within the facility, which may affect ground water reservoir. This will be a negative impact on the VEC.

Therefore, as indicated in Section 3.3.3.6, the project will have measures in place to recycle and reuse the process water as much as 80% of water demand to cut down extraction of groundwater from the aquifer. In addition, the hydrogeology study conducted demonstrates that aquifer recharge rate in the study area is 1 mega cubic meter (mcm) per square kilometre. (See section 4.6 for Hydrogeology study and 4.6.5 for Water Budget in Chapter 4.0 for correlated data.)

The cumulative positive and negative impacts also identified and 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.

5.4.5 Cumulative Positive Impacts

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

5.4.6 Cumulative Negative Impacts

Increase in Road Traffic Volume/ Accidents & Incidents/Noise

With construction ongoing at various locations within an area of 2 km2, there would be a cumulative increase in the volume of traffic plying the East-West Expressway as goods,

personnel and equipment are being moved into, out and within the area by road. This may also affect other road users and cause traffic hold-up on the road. This also has the potential to cause an increase in road traffic incidents due to dangerous/reckless driving, breakdown of vehicles, pedestrians and other road hazards. There would also be an increase in the noise level especially along the East-West Expressway and in the construction locations of IEFCL-Train2 Project.

Population Increase

With each influx of construction workers, there would be the attendant increase in camp followers. As the workers for each project would be exclusive to the project it is expected that when the project schedules overlap. The population increase has the potential to change the demographic characteristics of the Eleme area. The environmental management plan stipulates annual socio-economic and health impact studies (SIA and HIA) to help identify any cumulative impact on all the indices that were for management action. But meanwhile interim health education programmes are planned to inform the host communities what to do in-case of emergencies and what health remedial actions are available for them to tap into courtesy of Indorama.

Increase in the cost of living (inflation)

As was observed in other projects (e.g. Bonny NLNG), with each influx of personnel & camp followers for the various projects, there is bound to be a continuous increase in the cost of goods and services, due to an increased demand. This demand would drive competition among the service providers and ensure those businesses with high patronage would be able to increase prices sometimes beyond the limit of the community indigenes, thereby causing inflation. This impact is rated high.

Stress on existing infrastructure & Utilities

Though contractors would provide accommodation, feeding, transport etc. for their workers, the camp followers would utilize those services and infrastructure available within the communities. Thus, there would be cumulative stress on the poor infrastructure and utilities with each influx of camp followers. These are addressed in chapter six – mitigation.

Increase in communicable diseases

With each influx of construction workers & camp followers, the frequency of STIs would increase as well as the chances of individuals contacting different types of infections. The

cumulative effects of different infections in individuals would compromise their health status leading to absence from work, loss of income and, in the extreme case, death.

Awareness programs will be conducted for the host communities to spread the health awareness issues and controls.

A lot of plans are in place to educate workers on keeping safe work and how to relate with the Indigenous communities. These are also expounded in the chapter on mitigation.

Fires and Explosions

The addition of IEFCL-Train2 Fertilizer Plant within the existing Indorama complex may result to cumulative increase in fire and explosions risk due to the storage of concentrated chemicals for IEFCL-Train1, IEPL (Petrochemicals) operations combined and new project as addition. The QRA document shall study and address the cumulative impact of all such critical scenarios. As such, utmost care must be taken while running the two facilities, to cut down on the possibilities of fire outbreak within the facility. The Indorama Emergency management plan and security management plan address all scenario for fire and explosion etc. The project will conduct corresponding HAZOPs and QRAs as part of detailed engineering taking into consideration the impacts to and from nearby facilities. Subsequently, the same shall be evaluated as part of operations-adequacy measures for fire and explosions scenarios.