ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF THE PROPOSED EXTENSION ONE PLANTATION EXPANSION PROJECT AT OVIA-SOUTHWEST LOCAL GOVERNMENT AREA, EDO STATE, NIGERIA

BY

OKOMU OIL PALM COMPANY PLC

FINAL REPORT

NOVEMBER 2017

Environmental Impact Assessment (EIA) of the Proposed Extension One Plantation Expansion Project at Ovia- Southwest Local Government Area, Edo State, Nigeria

By Okomu Oil Palm Company Plc

Submitted to;

Federal Ministry of Environment, Abuja

Final Report

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TABLE OF CONTENT

LIST OF TABLES

Fig. No. **LIST OF FIGURES**

Map No. **LIST OF MAPS**

Plate No. **LIST OF PLATES**

LIST OF ANNEXURE/APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

AGO	Automotive Gas Oil
ALARP	As Low As Reasonably Practicable
ARCN	Agricultural Research Institute of Nigeria
ARKH	Arakhuan
BA	Basal Area
BSR	Basal Stem Rot
BASEL	Convention on trans-boundary movement of hazardous waste
BOD	Biochemical Oxygen Demand
BP	Rubber clone
CH_4	Methane gas
CITES	Convention for Prevention of International Trade in Endangered Species
CBD	Convention on Biological Diversity
cm	Centimeter
CO	Carbon monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
CPM	Counts Per Miinute
DCD	Development Control Department
dB(A)	Decibel ('A' Weighting)
DTS	Downward Tapping System
E	East
EFB	Empty Fruit Bunch
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
ERP	Emergency Response Plan
ESA	Environmentally Sensitive Areas
ESRI	Environmental Systems Research Institute
E-W	East to West
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
FFB	Fresh Fruit Bunches
FMARD	Federal Ministry of Agriculture and Rural Development
FMEnv	Federal Ministry of Environment
FEPA	Federal Environmental Protection Agency
FSC	Forest Stewardship Council
GDA	Gender Development Action
GIS	Geographical Information System

GPS	Global Positioning System
GT	Gondang Tapen (Origin of Rubber clone)
Ha	Hectare
HARBEL	Harbel, Liberia (Origin of Rubber Clone)
HCVF	High Conservation Value Forest
HDPE	High Density Polyethylene
H_2S	Hydrogen Sulphide
Hr	Hour
HSE	Health Safety and Environment
IDW	Inverse Distance Weighting
ISO	International Organization for Standardization
ITD	Inter Tropical Discontinuity
IPO	Initial Public Offer
IFC	International Finance Corporation
IPA	Impact Producing Activities
IRCA	Institute de Recherches sur le caoutchouc, Ivory Coast
IUCN	International Union for Conservation of Nature and Natural Resources
KII	Key Informant Interview
Kg	Kilogram
L	Litre
LGA	Local Government Area
LDPE	Low Density Polyethylene
m	Meter
mm	Millimeter
MDG	Millennium Development Goals
N-S	North to South
NGO	Non-governmental Organization
NCF	Nigerian Conservation Foundation
NESREA	National Environmental Standards and Regulations Enforcement Agency
NEEDS	National Economic Empowerment & Development strategy
NES	Nigerian Environmental Society
NIFOR	Nigerian Institute for Oil palm Research
N	Naira
ND	Not determined
NO_x	Oxides of Nitrogen
NO_3	Nitrate
NE	North-East
NW	North-West
OOPC	Okomu Oil Palm Company
OKNP	Okomu National Park

O_2	Oxygen
POME	Palm Oil Mill Effluent
PS	Performance Standards
PKC	Palm Kernel Cake
PPE	Personal Protective Equipment
PCB	Poly Chloro Bi-phenyls
PO_4	Phosphate
PM	Particulate Matter
RH	Relative humidity
RSPO	Roundtable on Sustainable Palm Oil
RRIM	Rubber clone
RRIN	Rubber Research Institute Of Nigeria
SIA	Social Impact Assessment
SE	South-East
SW	South-West
STD	Sexually Transmitted Disease
SPM	Suspended Particulate Matter
SHOC	Safe Handling of Chemical
SO_x	Oxides of Sulphur
ToR	Terms of Reference
TJIR	Tjirandji Indonesia Rubber (Origin of Rubber Clone)
UNDESA-	United Nations Department of Economics and Social Affairs
UNFCCC	United Nations Framework Convention on Climate Change
UNCCD	United Nations Convention on Combating Desertification
UTM	Universal Transverse Mercator
UTS	Upward Tapping System
Vs	Versus
VOC	Volatile Organic Carbon
WEDEN	Women Empowerment and Development Network (WEDEN)
WHO	World Health Organization
Yr	Year

WEIGHTS AND MEASURES

kVA (kilovolt-ampere) – 1,000 volt-amperes
kW (kilowatt) – 1,000 watts
kWh (kilowatt-hour) – 1,000 watts-hour
MW (megawatt) – 1,000,000 watts
W (watt) – unit of active power
T (Ton) – 1,000 kilogram

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EXECUTIVE SUMMARY (ES)

ES 1.0 Purpose and Need for the Project

The Okomu Oil Palm Company Plc is a public limited liability company with corporate head office located at Okomu-Udo, Ovia Southwest Local Government Area, Edo State, Nigeria. The company specializes in plantation development and production of special palm oil, palm kernel oil and palm kernel cake. It started operation in 1976 as a Federal Government project and was privatized in 1990. The then Bendel State government granted the company a total concession of about 15,000 hectares within Okomu Forest Reserve in 1978. About 12,000 hectares of the total concession at the Main estate has been developed into oil palm and rubber plantations.

The proposed plantation development project is an undertaking by the company to support the Edo State government in its agricultural transformation agenda. By so doing, the proposed development project will create additional job opportunities and assist in accelerated rural development.

In order to meet the above needs, the Okomu Oil Palm Company Plc proposes to develop the existing Extension One formally owned by Iyayi group of company located at the north eastern part of the Okomu Forest Reserve.

As a requirement of the environmental laws and regulations, an EIA application form and Project description were submitted to the Federal Ministry of Environment (FMEnv). Based on the initial assessment of the submission and subsequent site visit by the officials of FMEnv, the proposed plantation development at Extension One was classified as Category I EIA.

ES 2.0 The Proponent and Project Proposal

The Okomu Oil Palm Company Plcis a public limited liability company. Its corporate head office is located at the company's Main estate at Udo-Okomu, Edo State, Nigeria.

The company has over 6,000 shareholders, both foreign (Socfinco, 60%) and Nigerian (individual and institutional, 40%), and its shares are being actively traded in the Nigerian Stock Exchange.

The Okomu Oil Palm Company Plc employs about 1658 people of whichabout 692 are permanent staff and about 966 are contract workers.

The company is an agro-industrial establishment and specialises in the cultivation of oil palm and rubber and also in the extraction of special palm oil, palm kernel oil, palm kernel cakeand processing of cup lump into crumb rubber. Its major activities and operations presently comprise (i) Oil palm plantations of 9,734 hectares of which 8,313 are mature; (ii) Rubber plantations of 8,668.8 hectares of which 5,578 are mature(iii) A palm oil mill with a capacity of 30 tonnes fresh fruit bunches/hour; (iv) A palm kernel crushing plant with a capacity of 60M tonnes/day.

The company currently operates plantations in Edo, with aggregate holdings of about 33,000 hectares. It now desires to develop its Extension One plantation in Edo State. When the plantation development project is completed, it will increase the productivity of the plantation, boost the aggregate production and profitability of the company. It will also boost and enhance provision of rural infrastructure to the host communities.

ES 3.0 Proposed Project Location and Description

The proposed project area is located in Ovia Southwest Local Government Area, between longitude 6º16.870'E and 6º23.514'E and latitude 5º19.922'N and 5º25.723'N.

The area which is about 6,150ha is situated at the north eastern part of the Okomu Forest Reserve and shares boundaries with the Okomu National Park at its west and the Osse River Rubber Plantation Estate (also the Michelin Rubber Company now known as Rubber Estate Nigeria Limited RENL) at the north. The location of the project site is within the Okomu forest reserve for which concession has been given to the company to develop into plantation in Ovia Southwest Local Government Area. Apart from the oil palm and rubber plantations, the other proposed land uses include roads, housing, and workshop, powerhouse, and conservation areas. The total project area is about 6,100 hectares out of which 3,000 hectares is to be developed into oil palm and rubber.

The vegetation of the project site is that of degraded secondary forest. The proposed development will therefore involve the clearing of degraded secondary forests of about 900 hectares (30%) and farmlands of about 2100 hectares (70%). The proposed plantation development will be carried out in phases, with the first planting intended for 2013 and subsequent plantings phased over eight years to terminate in 2020. The average rate of planting is estimated between 400-450 hectares per year.

The planting materials to be used for the oil palm planting and rubber planting will be sourced locally and partly imported. The planting materials will be the types that are very well adapted to the Nigerian environment and local conditions. The products of the plantation which is fresh fruit bunches (FFB) and cup lump are intended to be harvested and tapped from the plantation and transported to the Main Estate of the company for processing. The operations of the project will therefore not generate industrial liquid waste (effluent). The bulk of the waste arising from the operations of the project will be essentially organic waste that will be managed by recycling within the plantation.

ES 4.0 EIA Study Procedure

The EIA study was carried out after due consultation with the Federal Ministry of Environment (FMEnv), and in accordance with the Ministry's Procedural Guidelines, and Terms of Reference (TOR) and scope of work, approved by the Ministry.

ES 5.0 Verification by the FMEnv

The FMEnv visited the proposed plantation development project site in order to verify the proposals and statements in the Okomu Oil Palm Company Plc's application for an environmental impact assessment permit.

ES 6.0 Consultations with and Participation by Stakeholders

The Stakeholders identified were: (i) Federal Ministry of Environment (FMEnv), Abuja (ii) Ministry of Environment and Public Utilities, Edo State; (iii) Ovia Southwest Local Government Area; (iv) Project host communities; (v) Migrant farmers.

The objective of the consultation was to inform and educate stakeholders on details of the project, its justification, discuss the scope of study and the project's potential and associated environmental impacts, and obtain their views and comments. The summary of the communities' assessment of the likely environmental impacts of the proposed project was that the proposed project would largely have insignificant adverse impacts.

ES 7.0 Project Justification, Envisaged Sustainability and Alternatives Considered

The proposed project will complement considerably both the FMARD Transformation Agenda and the economic transformation strategy and plans of the country. Justification is therefore found for the proposed plantation (oil palm and rubber) development in its potential to: i) Add value to the existing production of the company, ii) Provide direct employment, iii) Create additional jobs, iv) Contribute to the socio-economic development of neighboring communities, and iv) Increased economic benefits to the nation.

The alternatives considered were: (i) Do nothing option"; (ii) Alternative project location; (iii) Alternative plantation expansion methods; (iv) Smallholder development alternative; (v) Third Party Services. Of all the alternatives considered, the full development of the project as planned is favoured.

The project will be financed from the company's yearly turnover and profits. The financial performance of the company has improved considerably. Okomu Oil Palm Company Plc is listed on the Nigerian Stock Exchange. The financial performance of the company over the years would enable it to execute and sustain the project operations. The estimated cost of the project is N2.3 billion Nigerian Naira.

Technically, best hands and agricultural practices shall be employed to carry out the project to ensure its technical sustainability while environmental sustainability will be attained through Okomu Oil Palm Company Plc internal Environmental Management System (EMS) that is already in place. The economic life span of an oil palm plantation is about 20-25 years and rubber plantation about 35-40 years or more after which the palm trees and rubber trees are felled and then replanted. With proper upkeep, the oil palm and rubber tree can produce for more than two decades. The envisaged upkeep practices include routine ring weeding, pruning, slashing and fertilizer application.

ES 8.0 Relevant Environmental Laws, Decrees, Regulations and Edicts

The following laws and regulations apply to the proposed plantation development project: (i) National Policy on Environment (FEPA, 1989); (ii) EIA Act Cap E12 LFN, 2004; (iii) National Guidelines and Standards for Environmental Pollution Control in Nigeria, (FEPA,1991); (iv) National Effluent Limitations Regulations S.I.8 (FEPA,1991); (v) National Pollution Abatement in Industries and Facilities Generating Wastes Regulations S.I.9 (FEPA,1991); (vi) S.I.15 National Environmental Protection (Management of Solid and Hazardous Wastes Regulations 1991; (vii) Environmental Edicts of Edo States' Ministry of Environment and Public Utilities; (viii) Edo State Environmental Waste Management Board Edicts/Mandate; (ix) Local Government Area Mandate on environmental sanitation and solid waste management; (x) Factory Act 1990 (2004); (xi) Nigerian Land Use Act, 1978; (xii) The Nigerian Urban and Regional Planning Laws.

ES 9.0 Existing Baseline Environment

The biophysical and human socio-economic environments that might be impacted by the proposed project were ascertained from field data gathering within the spatial boundaries of the study area which is about 5 km from project boundaries, previous natural resources and environmental studies and in-house environmental records of the company spanning both the dry and wet seasons. Rainfall, temperature and sunshine hours (1995-2014),wind speed and direction, relative humidity and atmospheric pressure were obtained from meteorological record of the Okomu Oil Palm Company Plc.

Automatic reading equipment was employed to determine air quality, north and south of the project site. The concentrations of SO_2, H_2S, CO, CO_2, NO_X, VOC were all below the limits set by FMEnv. The concentrations of particulate matters are also below the set limit, showing clean, unpolluted ambient air in the locations. The noise level was well below the community noise exposure level of 60dBA.

The groundwater quality is good and free from pollution. The water samples from nearby sources have all the physico-chemical and microbiological parameters within the permissible limits recommended by WHO and FMENV for wholesome water. Similarly, the surface water (Arakhuan stream) quality is also good with all the physico-chemical and microbiological parameters within the tolerable limits by FMENV.

The geology of the area falls within the areas of sedimentary rocks lying in the Benin basin or trough of sedimentation, with ferralitic and ferralsolic soils which are predominantly reddish brown to reddish yellow in colour, and the soil zone is of the southern belt forest soils type which are laterite soils. They are the most intensively leached and coarse tropical soils. They are strongly acidic, of deep porous sandy loams or loamy sands, with the clay content increasing gradually with depth.

The laboratory results on the soil samples showed that the pH in the top soil (0–20cm) ranged between 5.0 and 6.4 with an average of 5.7 while the pH in the subsoil (20-40cm) ranged between 5.0 and 6.8 with a mean of 5.9. This suggests that the pH across the profile pits (12 Nos.) is generally slightly acidic to acidic.

The texture of surface soil is Sandy loam, the average contents of sand, clay and silt are 87.8%, 7.6% and 6.6% respectively. The soils are generally sandy at the surface (0- 20 cm), and loamy sand/sandy clay loam at the sub soil (20-40 cm).

The soil organic carbon (OC) and total nitrogen (TN) decreased with increasing soil depth in all the profiles. The soil OC was very high at the surface layer (0-15 cm) of the soils with the exception of Profile 9 where the OC was low at the surface. Litter accumulation at the surface may be responsible for the high soil OC. However, the OC contents of the soil at about 15 cm downward were generally low. This is an indication that litter incorporation beyond a thin surface layer had not been taking place on the field.

Similar to OC, soil TN was high at the surface but low immediately after the organic layer. The low TN suggests that application of nitrogenous fertilizer is essential especially in the first three years of oil palm establishment.

Exchangeable Cations: The effective cation exchange capacity (ECEC) decreased with increasing soil depth in all the profile pits except in Profile 11 where the ECEC increased from 38 cm to 98 cm soil depth (Table 21). The soil potassium is very low (Jacquemard, 1998) at all the profile pits. As K is paramount for economic yield of oil palm, application of K containing fertilizer is necessary. Across the soil depths, the soil Mg was at the medium range but at Profiles 1, 2 and 7, Mg was at the medium range only at the surface. Also, since application of K containing fertilizer may induce Mg deficiency (Opeke, 2005), application of Mg containing fertilizer alongside is, therefore, necessary. The soil available P was between low to medium range except in Pit 5 where available P was very high across the soil profile depths. Generally, the effective cation exchange capacity is low.

Soil micronutrients: the micronutrients (Cu, Zn, Fe and Mn) in the soils are low. As Cu deficiency may occur in some soils, application of Cu containing fertilizer should be considered.

The dominant species of the concession include*Musangacecropioides, Diospyrosspp, Rauvolfiavomitoria, Zanthoxyllumzanthoxyloides, Mitragynastipulosa, Lophiraalata, Cleistopholis patens, StrombosiasppFicusspp, Albiziaspp* and *Alchorneacordifolia.* These are mixture of both successional and steady state species which are indications that the habitats could be highly improved upon if adequate management action could be put in place for sustainable forest utilization.

The survey of large mammals revealed the presence of six different mammal species within the extension one concession Area. This consisted of all the suspected *S. nanus, P. porcus, C. civetta, Cephalophus spp., T. scriptus and C.*

Although African leopard and golden cat tracks and signs were searched for throughout the survey period, no indication of their presence was found within any of the proposed extension one area visited.

In the social impact assessment of the fivemigrant communities (Hassan Camp, Fatai Camp, Oluwo Camp, Olomu Camp and Sunday Camp) under survey, it was discovered that the five communities were migrant Yoruba farmers mostly from Osun State of Nigeria and they were aware that the land belongs to Okomu Oil Palm Company Plc. All the migrant communities do not have access roads; observation and photographs revealed that the only road that leads to the communities was the plantation road created by the company. There is no access to potable water and electricity does not exist at all in any of these communities.

Three of the five migrant communities have since been compensated and disengaged from the proposed extension One while the other two still contest the land with the company. But the Okomu Oil Palm Company Plc has in return expressed their commitment to the adjoining communities of Asamara, Gbole-Uba, Umalagidi and Evbo-Iruebo in line with the company's community development policy.

In addition to field data gathering, all the relevant environmental parameters including air quality, noise level, air temperature, vegetation type, plant form/species and socio-economic were updated in December 2015 and 14th to 27th June 2016. This is to make up for any changes that might have occurred between the previous data gathering and now as the environment is dynamic.

The groundwater quality is good and free from pollution. Except for pH that is generally low, all other physico-chemical and microbiological parameters fall within the permissible limits recommended by WHO and FMENV for wholesome water as presented in the Table 4-11.

The results of the physical and chemical analyses including Total Hydrocarbon, Salinity and pesticide content are good except for pH that is generally low. The colour of $ARKH_3$ and $ARKH_2$ are slightly higher than their respective limits and should not pose any problem for the receiving water as presented in Table 4-12.

For air quality, the result of measurements conducted around the facility, the concentrations of particulatematterandgasesobtained were within the regulatorylimits foreachparameter. Thehumidityandtemperature were alsoconducive for smooth operation as presented in Table 4-13.

ES 10.0 Landuse Update

Oil palm and Rubber at various stages of growth constituted the dominant vegetation during the update assessment carried out in June 2016. These two crops have been extensively grown which now constituted the largest land use (about 3,000 hectares) followed by conservation plot (about 1,000 hectares).

The oil palm and rubber plots are planted with *Puerariaphaseoloides*, a cover crop, which should enhance soil conservation (Plate 4-11). This is a good management option, particularly, because mechanical land clearing seems inevitable or preferred at OOPC.

In the undisturbed forest of Okomu, which is about 125 years old (HCV assessment at Main and Extension One estates, 2015), common trees include *Ceibapentandra*, *Pogaoleosa*, *Antiarisafricana*, *Anonidiummanii*, *Enantiachlorantha*, *Musangacecropiodes*, *Strombosiapustulata*, *Celtiszenkeri* and *Diospyrosalboflavescenes* (Ghuman and Lal, 1987).

ES 11.0 Significant Potential and Associated Environmental Impacts

The major/significant anticipated impacts arising from the development and operation of the proposed plantation development project were examined and considered at four phases including: (i) Pre Construction; (ii) Construction; (iii) Operation and Maintenance; (iv) Decommissioning and Abandonment.

The significant impacts of the proposed project include: 1.)Plantation boundary demarcation, Opening of roads and tracks, Site Forest Clearing and Maintenance of Tracks and Roads; 2.)Vegetation and Spoil Disposal; 3.)Ploughing, Grading and Levelling of Tracks and Roads; 4.)Increased Transportation and Use of Machinery during Land Preparation; 5.) Weeding; 6.) Pesticides Application; 7.) Fertilizer Application.

ES 12.0 Mitigation Measures

Mitigation measures are defined for the identified significant associated and potential impacts based on the following criteria:

- **Prevention –** design and management measures for ensuring that significant potential impacts and risks do not occur,
- **Reduction –** operational and management measures for ensuring that the effects or consequences of those significant associated and potential impacts that cannot be prevented are reduced to a level as low as reasonably practical (ALARP)
- **Control -** Operational and management measures for ensuring that residual associated impacts are reduced to a level as low as reasonably practical (ALARP).

However, most of the significant environmental impacts that can likely arise from the construction and operation of the proposed Extension One plantation expansion project can be mitigated once appropriate precautions are in place as defined in Tables 6-1 to 6-3.

ES 13.0 Proposed Environmental Management Plan (EMP)

All mitigation measures will be adhered to by the Environment, Health and Safety (HSE) department of the company; (i) Emissions testing and reporting must be done in accordance with the regulatory requirements and record submitted to FMEnv; (ii) Fire prevention precautions must be in place as required by the State Fire Service; (iii) All firefighting equipment will be inspected and maintained regularly; (iv) The occupational health, safety and environmental policies shall be implemented; vii) Capacity building programme for plantation staff including awareness, in-plant training, seminars, workshops and short courses shall be undertaken regularly to enhance the implementation of the EMP.

For the plantation development project, the environmental monitoring programme would cover a number of parameters including meteorology, ambient air quality, surface water quality, groundwater quality and noise levels. All these would be monitored by the Federal Ministry of Environment.

The schedule of EMP detailing impact, mitigation measures, actions to be taken and the persons responsible for mitigation actions has also been drawn. It will equally be monitored for compliance.

ES 14.0 Decommissioning

The approaches to the decommissioning of the plantation project would involve the combination of assets recovery, dismantling, demolition, decontamination and remediation.

ES 15.0 Conclusion

The EIA process demonstrates that the plantation development project will fully comply with legislative requirements in Nigeria and other relevant international regulations applicable to the planned activities and operations. The proposed project will result in substantial economic benefits for Nigeria through Employment opportunities generation in particular during the construction and operation phases.

This EIA also indicates that discharges including gaseous emissions and noise are expected from the operation of the plantation development project. However, any such discharges, which can be considered as potential sources of adverse environmental effects, can be fully managed through preventive actions and mitigating measures. This means that no significant negative impact on the natural, health and social environmental sensitivities of the project area is expected to result from discharges, let alone the occurrence of a residual impact.

There would appear to be no legal, administrative, natural and socio-economic limitations to prevent the plantation development project from going ahead as proposed by the Okomu Oil Palm Company Plc. The project shall be implemented in accordance with the proposed environmental management plan (EMP).

An EMP involving environmental management and supervision organizations, and environmental monitoring has been established to ensure theenvironmental performance of the Project. To ensure successful implementation of thesemeasures, the EMP covers major relevant aspects such as institutional arrangement forenvironmental management and supervision and environmental monitoring. Withimplementation of the mitigation measures defined in the EIA and EMP, all the likely adverseenvironmental impacts associated with the project will be prevented, eliminated, or minimizedto an environmentally acceptable level.

The Project is environmentally sound, and will promote balanced and environmentally sustainable operation of the Okomu Oil Palm Company Plc. It is therefore recommended that the Okomu Oil Palm Company Plc should implement the proposed plantation development project at extension one by fulfilling its obligations as outlined in the respective social and environmental management plans in this report.

CHAPTER ONE

1.0 INTRODUCTION

1.1 History and Business of Okomu Oil Palm Company Plc

The proponent of the proposed rubber and oil palm plantation expansion project; The Okomu Oil Palm Company Plc (OOPC Plc) is an agricultural and food-processing company located at Okomu-Udo, Ovia Southwest Local Government Area, Edo State, Nigeria. The company specializes in plantation development and production of special palm oil, palm kernel oil and palm kernel cake. It started operation in 1976 as a Federal Government project and was privatized in 1990. The then Bendel State government granted the company a total concession of about 15,000 hectares within the Okomu forest reserve in 1978. About 12,000 hectares of the total concession at the main estate has been developed into oil palm and rubber plantations.

In addition to the above holding the company acquired about 6000 hectares of land called Extension I, east of the Okomu National Park. The land had been partly developed into rubber plantation when it was acquired. The company intends to expand the existing development by planting about 4000 hectares of the land with rubber and oil palm.

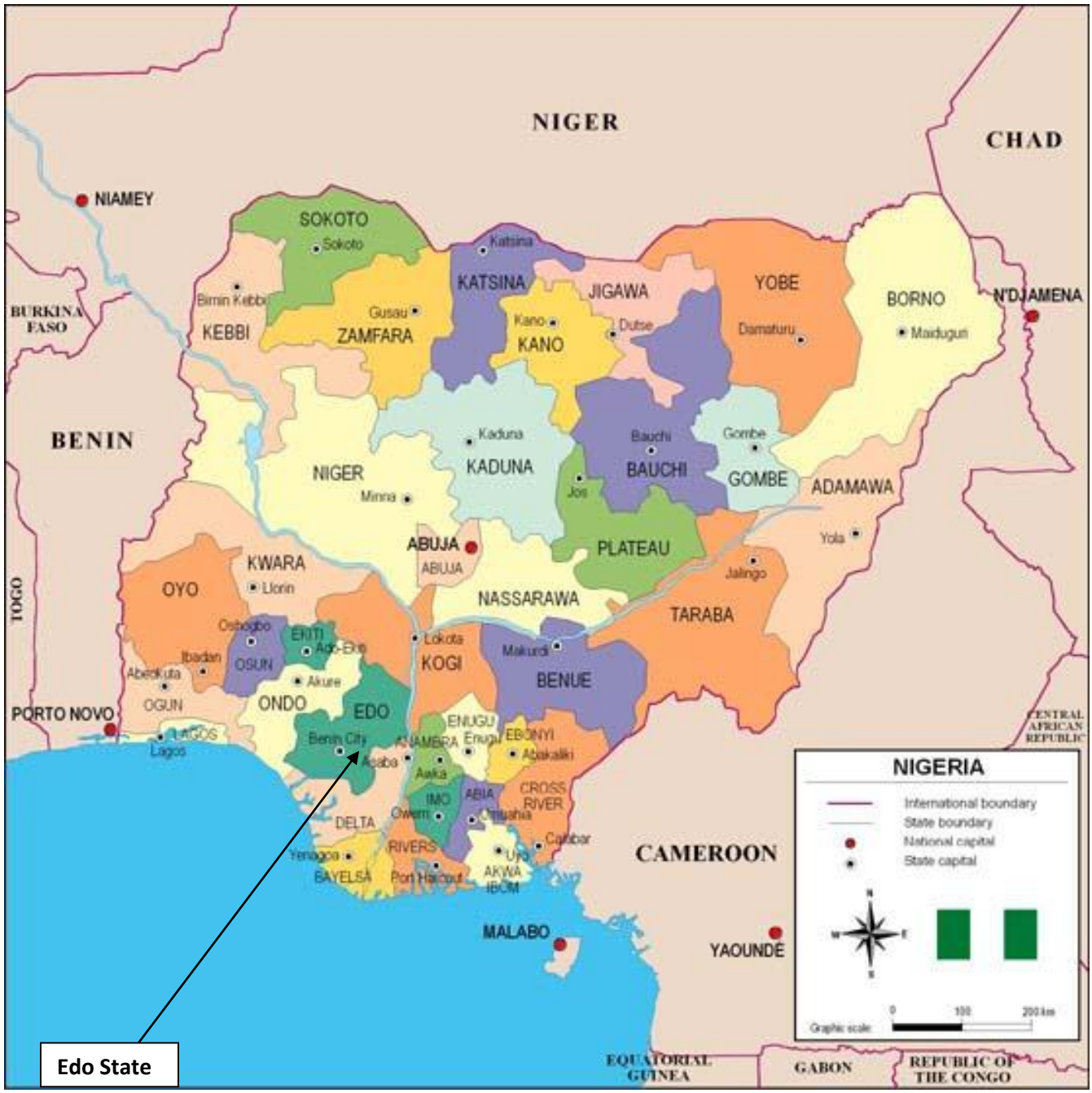
The Okomu Oil Palm Company Plc has over 12,000 individual and institutional shareholders, both Nigerian (40%) and foreign (60%). The company employs about 1,280 permanent workers including expatriates and Nigerians.

1.2 Location and Access to Head Office

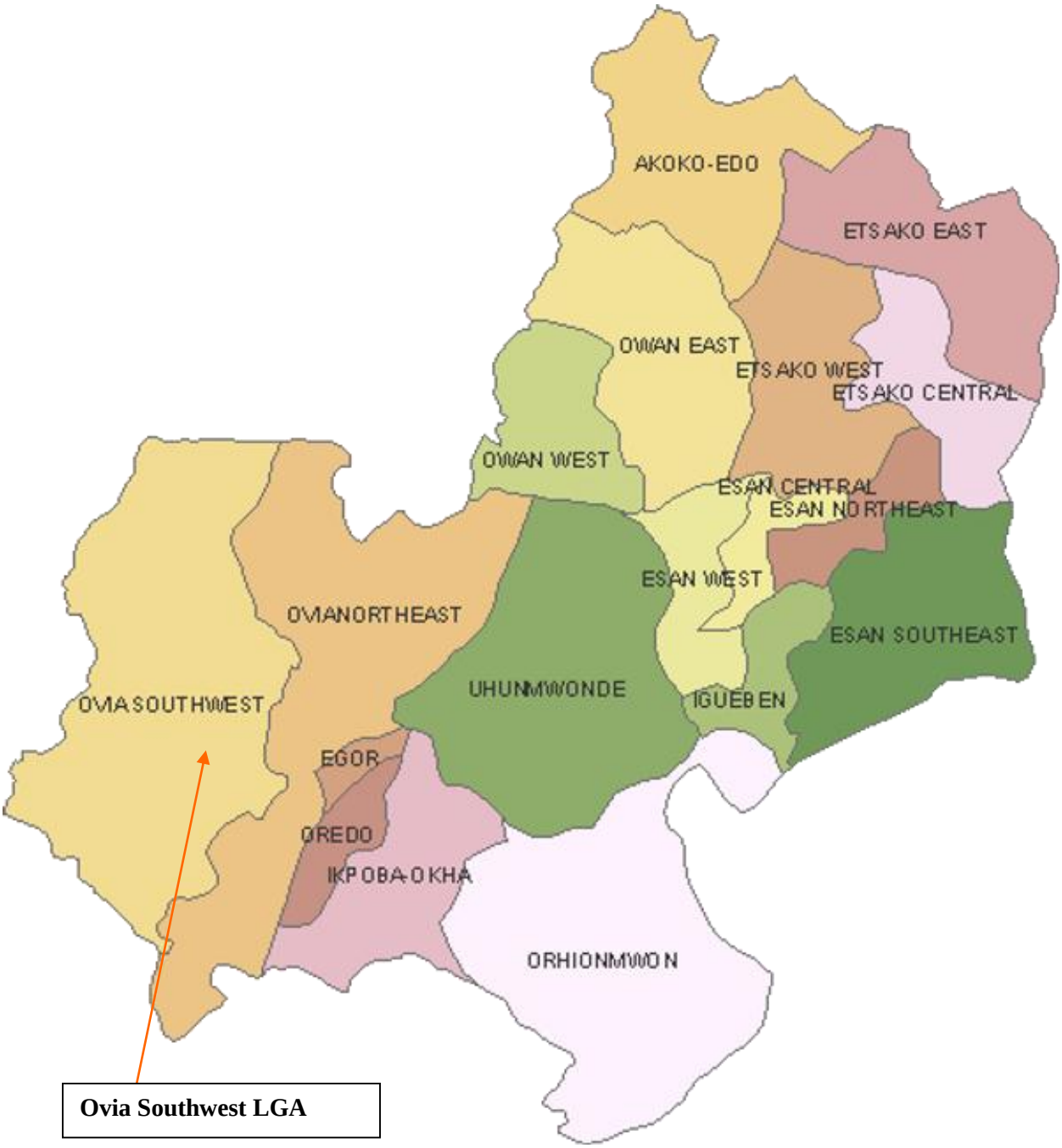
The company's head office is located at Okomu-Udo in Ovia Southwest Local Government Area of Edo State, Nigeria. The company is accessible through a network of roads from Lagos and Benin City. It lies between latitude $5^0$07' and $5^0$25' E and longitude $6^0$18' and $6^0$26' N. (see Maps 1-1 and 1-2: Location Map).

1.3 Activities

The company undertakes plantation agriculture involving the growing of oil palm (*Elaeis guineensis*) and the processing of Fresh Fruit Bunches (FFB) into special palm oil. The company is also involved in the planting and tapping of rubber (*Hevea Brasiliensis*). The major activities of the company include the operations in the oil palm plantation, palm oil mill, rubber plantation and rubber factory.



Map 1-1: Map of Nigeria showing Edo State



Map 1-2: Map of Edo State showing Ovia Southwest LGA

1.4 Mission Statement of The Okomu Oil Palm Company Plc

"To be Nigeria's leading agribusiness, through the efficient and effective management of our various plantations by a highly motivated workforce, working in harmony with other stakeholders, and continuously returning favourable results to our shareholders".

1.5 Literature Review on the Rubber Industry

Brief Description of Natural Rubber

The rubber tree, *Hevea brasiliensis*, is a perennial crop that is capable of being exploited for 35 years. The plant thrives in rainforest regions of the lowland tropics with temperatures between 21–35ºC and a well distributed rainfall of 2,000mm/year or more. Well-drained soils with a pH of 4.5 to 6.0 have been found suitable. It takes 6–7 years for the tree to get to maturity. Rubber latex, which oozes out when the tree is wounded (or tapped), can be processed into solid rubber or liquid rubber (known as latex concentrate).

Historical Development of Natural Rubber Industry

The advent of vulcanization 1n 1839 led to rubber tree being taken to other continents for commercial cultivation. Hevea seedlings were introduced into Nigeria in 1895 from Brazil and by 1903 the first rubber estate was established in Sakponba in Edo State. In 1906 the second estate sprang at Adiaba in Cross RiverState. Between 1948 and 1967 there was already a strong nucleus of plantations at 30,000 ha. This was complemented by a large smallholder sector at 205,000 ha. However, the rapid growth of the oil industry was matched by an equally rapid decline in the agricultural sector, which led, eventually, to almost complete cessation in the planting and replanting of rubber.

Natural Rubber (NR) seedlings were introduced into Nigeria from Brazil in 1895. Today, clones with improved yield and disease resistance have been developed. Treated rubber wood has also found acceptance as timber for furniture thereby increasing the profitability of rubber production. Processing of rubber has witnessed tremendous improvement over the years. Unfortunately, a lot of rubber farms were abandoned especially in the smallholder sector leading to a dearth of rawmaterials in the country's over-capacity of rubber processing. About 45 factories have been established to date but only 5 are functional due mainly to insufficiency of raw materials and machine breakdowns. Presently, the total land area planted to rubber in Nigeria is 144,199 hectares. A total of 48,199 ha representing 33.4% of planted

area are estate rubber while 96,000 hectare, representing 66.6% are held inthe smallholdings. Most of the smallholdings have either been abandoned or replaced with crops such as the oil palm; the remainder is lost to urbanization.

About 84% of the total hectrage is above 35 years signaling chaos in the industry since the economic life of rubber tree is 35–40 years. Cropping system in the estate rubber plantations is basically sole cropping while intercropping with food crops is practiced in smallholdings at the early stages of establishment of rubber before canopy closure. The popular clones in the country are RRIM, GT, BP, NIG Series, HARBEL, IRCA, and TJIR series. Inorganic fertilizer (e.g. NPK) are applied periodically to the rubber trees. Some estates use herbicides in the control of weeds. Factors affecting production can be classified into field and processing constraints. The field constraints include over-aged trees; land acquisition problems, scarcity of planting materials/inputs, high cost of labour, dearth of technical/extension support, and slow rate of development of new estates/replanting.

On the other hand, processing constraints such as low capacity utilization, inadequate power supply, unavailability of spare parts, ageing equipment, inadequate government support, dwindling exchange rate and over-dependence on foreign equipment have been identified. The national demand for the commodity is 45,000 tons per annum. Natural rubber production in the country as at December 2003 is 95,456 tons. The figure is expected to be higher this year as a result of the favourable NR prices since year 2002 and tremendous increase in China's demand for the commodity. Rubber lumps or coagula sell for between N45,000–N60,000/ton while crumb rubber prices range from N150,000 -N170,000/ton. At the international market, the price of crumb rubber ranges from US$1,000–US$1,300/ton. Rubber producing countries are now placing a lot of emphasis on the down-stream sector of the industry for the purposes of adding value to the commodity and increasing domestic consumption.

Cultivation

Rubber is generally cultivated in large plantations. Rubber latex is extracted from rubber trees. The economic life period of rubber trees in plantations is around 35-40 years – up to 7 years of immature phase and about 25 years of productive phase.

The soil requirement of the plant is generally well-drained weathered soil consisting of laterite, lateritic types, sedimentary types, nonlateritic red or alluvial soils.

The climatic conditions for optimum growth of rubber trees consist of (a) rainfall of around 250 cm evenly distributed without any marked dry season and with at least 100 rainy days per year (b) temperature range of about 20°C to 34°C with a monthly mean of 25°C to 28°C (c) high atmospheric humidity of around 80% (d) bright sunshine amounting to about 2000 hours per year at the rate of 6 hours per day throughout the year and (e) absence of strong winds.

Many high-yielding clones have been developed for commercial planting. These clones yield more than 2,000 kilograms of dry rubber per hectare per year, when grown under ideal conditions.

Collection

In places like Kerala, where coconuts are in abundance, the half shell of coconut is used as the collection container for the latex but glazed pottery or aluminium or plastic cups are more common elsewhere. The cups are supported by a wire that encircles the tree. This wire incorporates a spring so it can stretch as the tree grows. The latex is led into the cup by a galvanised "spout" knocked into the bark. Tapping normally takes place early in the morning, when the internal pressure of the tree is highest. A good tapper can tap a tree every 20 seconds on a standard half-spiral system, and a common daily "task" size is between 450 and 650 trees. Trees are usually tapped alternate or third daily, although there are many variations in timing, length and number of cuts. The latex, which contains 25–40% dry rubber, is in the bark, so the tapper must avoid cutting right through to the wood or the growing cambial layer will be damaged and the renewing bark will be badly deformed, making later tapping difficult. It is usual to tap a pannel at least twice, sometimes three times, during the trees' life. The economic life of the tree depends on how well the tapping is carried out, as the critical factor is bark consumption. A standard in Malaysia for alternate daily tapping is 25 cm (vertical) bark consumption per year. The latex tubes in the bark ascend in a spiral to the right. For this reason, tapping cuts usually ascend to the left to cut more tubes.

The trees will drip latex for about four hours, stopping as latex coagulates naturally on the tapping cut, thus blocking the latex tubes in the bark. Tappers usually rest and have a meal after finishing their tapping work, then start collecting the latex at about midday. Some trees will continue to drip after the collection and this leads to a small amount of cup lump which is collected at the next tapping. The latex that coagulates on the cut is also collected as tree lace. Tree lace and cup lump together account for 10–20% of the dry rubber produced.

The latex will coagulate in cup if kept for long. The latex has to be collected before coagulation. The collected latex is transferred in to coagulation tanks for the preparation of dry rubber or transferred into air-tight containers with sieving for ammoniation. Ammoniation is necessary to preserve the latex in colloidal state for long.

Latex is generally processed into either latex concentrate for manufacture of dipped goods or it can be coagulated under controlled, clean conditions using formic acid. The coagulated latex can then be processed into the higher grade technically specified block rubbers such as TSR3L or TSRCV or used to produce Ribbed Smoke Sheet grades.

Naturally coagulated rubber (cup lump) is used in the manufacture of TSR10 and TSR20 grade rubbers. The processing of the rubber for these grades is basically a size reduction and cleaning process to remove contamination and prepare the material for the final stage drying. The dried material is then baled and palletized for shipment.

The use of rubber is widespread, ranging from household to industrial products, entering the production stream at the intermediate stage or as final products. Tires and tubes are the largest consumers of rubber. The remaining 44% are taken up by the general rubber goods (GRG) sector, which includes all products except tires and tubes.

Uses of Natural Rubber

The usage of rubber is related to its property. The predominant property of solid rubber is its elastic behaviour or deformation by compression or tension. The tyre industry is the major consumer of natural rubber. The remainder is used for a great variety of industrial and consumer products such as automobile engine/bridge mounts, window profiles, hand gloves, carpet underlays and floor/car mats. Natural Rubber is also used to make medical accessories (e.g. gloves, catheters etc), machinery spares, balloons, condoms, etc. The rubber wood is used for furniture, particle board and fuel. Rubber seed oil is used for alkyd resins, which find applications in the paint, putty, soap, fat liquors, skin cream and hair shampoo industries.

Present Developmental Status

There is a lot of improvement in the process technology of rubber, all of which is geared towards efficient processing methods and good packaging/presentation of

the commodity. Clones with higher yields and improved resistance to diseases and wind have also been developed. Intercropping is now practiced to increase incomes for the farmer in the first 3–5 years of planting before canopy closure. More recently, the Asian producers have spearheaded the breeding of clones with good wood properties. The emergence and acceptance of rubber wood as timber has added to the profitability of natural rubber. Rubber seed oil is also finding uses in a variety of applications. Development has been very slow in the area of increasing the hectrage planted to rubber. The active rubber estates (Michelin, Pamol, Okomu, etc) have made huge investments in the planting and replanting of rubber. Pockets of smallholdings around the country have made some plantings too.

Literature Review on the Oil Palm Industry

The Oil Palm

The oil palm is one of the agricultural tree crops in Nigeria. It is the highest yielding oil crop in the World. It produces on the average 4-5 tonnes of oil per hectare per year, about 10 times the yield of soyabean. There are two definite species namely; *Elaeise guineensis* **Jacq.** from Africa and E. *Melanococa* **Gaertner** from South America. Palm oil is also produced from specie called *Attalea maripa* **Carl Friedrich Philipp von Martius** from South America and Trinidad and Tobago.

The oil palms (*Elaeis*) comprise two species of the Arecaceae, or palm family. They are used in commercial agriculture in the production of palm oil. The African Oil Palm *Elaeis guineensis* is native to west Africa, occurring between Angola and Gambia, while the American Oil Palm *Elaeis oleifera* is native to tropical Central America and South America. The generic name is derived from the Greek for oil, *elaion*, while the species name refers to its country of origin.

Mature trees are single-stemmed, and grow to 20 m tall. The leaves are pinnate, and reach between 3-5 m long. A young tree produces about 30 leaves a year. Established trees over 10 years produce about 20 leaves a year. The flowers are produced in dense clusters; each individual flower is small, with three sepals and three petals.

The palm fruit takes five to six months to mature from pollination to maturity. The palm fruit is reddish, about the size of a large plum and grows in large bunches. Each fruit is made up of an oily, fleshy outer layer (the pericarp), with a single seed

(the palm kernel), also rich in oil. When ripe, each bunch of fruit weighs 40-50 kilogrammes.

Oil is extracted from both the pulp of the fruit (palm oil, an edible oil) and the kernel (palm kernel oil, used in foods and for soap manufacture). For every 100 kilograms of fruit bunches, typically 22 kilograms of palm oil and 1.6 kilograms of palm kernel oil can be extracted. The high oil yield of oil palm trees (as high as 7,250 liters per hectare per year) has made it a common cooking ingredient in southeast Asia and the tropical belt of Africa. Its increasing use in the commercial food industry in other parts of the world is buoyed by its cheaper pricing, the high oxidative stability of the refined product and high levels of natural antioxidants.
Since palm oil contains more saturated fats than oils made from canola, corn, linseed, soybeans, safflower, and sunflowers, it can withstand extreme deep-frying heat and resists oxidation.

Planting
For each hectare of oil palm, which is harvested year-round, the annual production averages 10 tonnes of fruit, which yields 3,000 kg of pericarp oil, and 750 kg of seed kernels, which yield 250 kg of high quality palm kernel oil as well as 500 kg of kernel meal. Palm fronds and kernel meal are processed for use as livestock feed.

All modern, commercial planting material consists of tenera palms or DxP hybrids, which are obtained by crossing thick-shelled dura with shell-less pisifera. Although common commercial pre-germinated seed is as thick-shelled as the dura mother tree, the resulting tree will produce thin-shelled tenera fruit. An alternative to pre-germinated seed, once constraints to mass production are overcome, is tissue-cultured or “clonal” palms which provide “true copies” of high yielding DxP palms.

It is essential for an oil palm nursery to have an uninterrupted supply of clean water and topsoil which is both well-structured and sufficiently deep to accommodate three rounds of on-site bag-filling. Approximately 35 ha can grow enough seedlings over a three-year period to plant a 5,000 ha plantation. Pre-nursery seedlings must be watered daily. Whenever rainfall is less than 10 mm per day, irrigation is required, and the system must be capable of uniformly applying 6.5 mm water per day.
Pre-nursery seedlings in the four-leaf stage of development (10 to 14 weeks after planting) are usually transplanted to the main nursery, after their gradual adjustment

to full sunlight and rigid selection process. During culling, seedlings that have "grassy", "crinkled", "twisted", or "rolled" leaves are discarded.

Weeds growing in the polybags must be carefully pulled out. Herbicides should not be used. Numerous insects (e.g., ants, armyworm, bagworm, aphids, thrips, mites, grasshoppers, mealybugs) and vertebrates (e.g., rats, squirrels, porcupine, wild boar, monkeys) are pests in oil palm nurseries and must be carefully identified before control measures are implemented. After eight months in the nursery, normal healthy plants should be 0.8–1 m in height and display 5 to 8 functional leaves.

Oil Palm Plantations Development

The proper approach to oil palm development begins with the establishment of leguminous cover plants, immediately following land clearing. It helps prevent soil erosion and surface run-off, improve soil structure and palm root development, increase the response to mineral fertilizer in later years, and reduce the danger of micronutrient deficiencies. Leguminous cover plants also help prevent outbreaks of Oryctes beetles, which nest in exposed decomposing vegetation. Both phosphorus and potassium fertilizers are needed to maximize the leguminous cover plants' symbiotic nitrogen fixation potential of approximately 200 kg nitrogen/ha/yr and are applied to most soils at 115 to 300 kg phosphorous oxide/ha and 35 to 60 kg potassium oxide/ha. Young palms are severely set back where grasses are allowed to dominate the inter-row vegetation, particularly on poor soils where the correction of nutrient deficiencies is difficult and costly.

Crop nutrient

Nutrient uptake is low during the first year but increases steeply between year one and year three (when harvesting commences) and stabilizes around years five to six. Early applications of fertilizer, better planting material, more rigid culling has led to a dramatic increase in early yields in third to sixth years from planting. In regions without any serious drop in rainfall, yields of over 25 tonnes of fresh fruit bunches per hectare have been achieved in the second year of harvesting.

Nitrogen deficiency is usually associated with conditions of water-logging, heavy weed infestation and topsoil erosion. Symptoms are a general paling and stiffening of the pinnae which lose their glossy lustre. Extended deficiency will reduce the number of effective fruit bunches produced as well as the bunch size.
Phosphorous deficient leaves do not show specific symptoms but frond length, bunch size and trunk diameter are all reduced.

Potassium deficiency is very common and is the major yield constraint in sandy or peaty soils. The most frequent symptom is "confluent orange spotting". Pale green spots appear on the pinnae of older leaves; as the deficiency intensifies, the spots turn orange or reddish-orange and desiccation sets in, starting from the tips and outer margins of the pinnae. Other symptoms are "orange blotch" and "mid-crown yellowing". In soils having a low water holding capacity (sands and peats) potassium deficiency can lead to a rapid, premature desiccation of fronds.

Copper deficiency is common on deep peat soils and occurs also on very sandy soils. It appears initially as whitish yellow mottling of younger fronds. As the deficiency intensifies, yellow, mottled, inter-veinal stripes appear and rusty, brown spots develop on the distal end of leaflets. Affected fronds and leaflets are stunted and leaflets dry up. On sandy soils, palms recover rapidly after a basal application of 50 grams of copper sulphate. On peat soils, lasting correction of copper deficiency is difficult, as applied copper sulphate is rendered unavailable. A promising method to correct copper deficiency on peat soil is to mix copper sulphate with clay soil and to form tennis-ball sized “copper mudballs” that are placed around the palm and that provide a slow-release source of available copper.

Healthy, well selected seedlings are a pre-condition for early and sustained high yield. In most cases granular multinutrient compound fertilizers are the preferred nutrient source for seedlings in the nursery. Where sub-soil is used to fill the polybags, extra dressings of Kieserite may be required (10-15 g every 6 to 8 weeks). Where compound fertilizers are not available, equivalent quantities of straight materials should be used.

To maintain good fertilizer response and high yields in older palms (selective) thinning is often necessary.

Disease

Basal stem rot, caused by the fungus ganoderma, is the most serious disease of oil palm in Malaysia and Indonesia. Previously, research on basal stem rot was hampered by the failure to artificially infect oil palm with the fungus. Although Ganoderma had been associated with BSR (Thompson, 1931), proof of its pathogenicity to satisfy Koch’s postulate was only achieved in the early 1990s by inoculating oil palm seedling roots (Ariffin and Idris, 1991) or by using rubber wood blocks (Khairuddin, 1990). A reliable and quick technique for testing the pathogenicity of the Ganoderma fungus by inoculating oil palm germinated seeds.

This fatal disease can lead to losses as much as 80% after repeated planting cycles.

Ganoderma produces enzymes that degrade the oil palm tissue and affect the infected oil palm xylem thus causing serious problems to the distribution of water and other nutrients to the top of the palm tree. Ganoderma infection is well defined by its lesion in the stem. The cross section of infected palm stem shows that the lesion appears as a light brown area of rotting tissue with a distinctive irregularly shaped darker band at the borders of this area. The infected tissue becomes as an ashen-grey powdery and if the palm remains standing, the infected trunk rapidly becomes hollow.

In a 2007 study in Portugal, scientists suggest control of ganoderma on oil palms would benefit from further consideration of the process as one of white rot. Ganoderma are extraordinary organisms capable exclusively of degrading lignin to carbon dioxide and water: celluloses are then available as nutrients for the fungus. It is necessary to consider this mode of attack as a white rot involving lignin biodegradation, for integrated control. The existing literature does not report this area and appears to be concerned particularly with the mode of spread and molecular biology of ganoderma. The white rot perception opens up new fields in breeding/selecting for resistant cultivars of oil palms with high lignin content, ensuring the conditions for lignin decomposition are reduced, and simply sealing damaged oil palms to stop decay. It is likely that spread is by spores rather than roots. The knowledge gained can be employed in the rapid degradation of oil palm waste on the plantation floor by inoculating suitable fungi, and/or treating the waste more appropriately (e.g. chipping and spreading over the floor rather than windrowing).

Endophytic bacteria are organisms inhabiting plant organs that at some time in their life cycle can colonize the internal plant tissues without causing apparent harm to the host. Introducing endophytic bacteria to the roots to control plant disease is to manipulate the indigenous bacterial communities of the roots in a manner, which leads to enhanced suppression of soil-born pathogens. The use of endophytic bacteria should thus be preferred to other biological control agents as they are internal colonizers, with better ability to compete within the vascular systems, limiting Ganoderma for both nutrients and space during its proliferation.
Two bacterial isolates Burkholderia cepacia(B3) and Pseudomonas aeruginosa(P3) were selected for evaluation in the glasshouse for their efficacy in enhancing growth and subsequent suppression of the spread of BSR in oil palm seedlings.

Little leaf syndrome has not been fully explained but has often been confused with Boron deficiency. The growing point is damaged, sometimes by Oryctes beetle. Small, distorted leaves that resemble Boron deficiency emerge. This is often followed by secondary pathogenic infections in the spear that can lead to spear rot and palm death.

Palm oil production

Fruit of oil palm tree

The oil palm originated in West Africa but has since been planted successfully in tropical regions within 20 degrees of the equator. There is evidence of palm oil use in Ancient Egypt. In the Republic of the Congo, or Congo Brazzaville, precisely in the Northern part, not far from Ouesso, local people produce this oil by hand. They harvest the fruit, boil it to let the water part evaporate, then they press what is left in order to collect the reddish, orange colored oil.

In 1995, Malaysia was the world's largest producer with 51% of world production. Since 2007, Indonesia emerged the world's largest producer of palm oil producing approximately 50% of world palm oil volume. Worldwide palm oil production during the 2005-2006 growing season was 39.8 million metric tons, of which 4.3 million tons was in the form of palm kernel oil. It is thus by far the most widely-produced tropical oil, and constitutes thirty percent of total edible oil production worldwide.

Carbon balance

Oil palm production has been documented as a cause of substantial and often irreversible damage to the natural environment. Its impacts include: deforestation, habitat loss of critically endangered species, and a significant increase in greenhouse gas emissions.

The pollution is exacerbated because many rainforests in Indonesia and Malaysia lie atop peat bogs that store great quantities of carbon that are released when the forests are cut down and the bogs drained to make way for the palm oil plantations.

Environmental groups such as Greenpeace claim that the deforestation caused by making way for oil palm plantations is far more damaging for the climate than the benefits gained by switching to biofuel. Fresh land clearances, especially in Borneo, are contentious for their environmental impact. NGOs and many international bodies are now warning that, despite thousands of square kilometres of land

standing unplanted in Indonesia, tropical hardwood forests are being cleared for palm oil plantations.

Furthermore, as the remaining unprotected lowland forest dwindles, developers are looking to plant peat swamp land, using drainage that unlocks the carbon held in their trees, and begins an oxidation process of the peat which can release 5,000 to 10,000 years worth of stored carbon. Drained peat is also at very high risk of forest fire, and there is a clear record of fire being used to clear vegetation for oil palm development in Indonesia. Drought and man-made clearances have led to massive uncontrolled forest fires over recent years, covering parts of Southeast Asia in haze and leading to an international crisis with Malaysia. These fires have been variously blamed on a government with little ability to enforce its own laws while impoverished small farmers and large plantation owners illegally burn and clear forests and peat lands to reap the developmental benefits of environmentally-valuable land.

Many of the major companies in the vegetable oil economy participate in the Roundtable on Sustainable Palm Oil, which is trying to address this problem. In 2008 Unilever, a member of the group, committed to use only oil palm oil which is certified as sustainable, by ensuring that the large companies and smallholders that supply it convert to sustainable production by 2015.

Meanwhile, much of the recent investment in new palm plantations for biofuel has been part-funded through carbon credit projects through the Clean Development Mechanism; however the reputational risk associated with unsustainable palm plantations in Indonesia has now made many funds wary of investing there.

Palm biomass as fuel

Some scientists and companies are going beyond using just the oil, and are proposing to convert fronds, empty fruit bunches and palm kernel shells harvested from oil palm plantations into renewable electricity, cellulosic ethanol, biogas, biohydrogen and bioplastic. Thus, by using both the biomass from the plantation as well as the processing residues from palm oil production (fibers, kernel shells, palm oil mill effluent), bioenergy from palm plantations can have an effect on reducing greenhouse gas emissions. Examples of these production techniques have been registered as projects under the Kyoto Protocol's Clean Development Mechanism.

By using palm biomass to generate renewable energy, fuels and biodegradable products, both the energy balance and the greenhouse gas emissions balance for palm biodiesel is improved. For every tonne of palm oil produced from fresh fruit bunches, a farmer harvests around 6 tonnes of waste palm fronds, 1 tonne of palm trunks, 5 tonnes of empty fruit bunches, 1 tonne of press fiber (from the mesocarp of the fruit), half a tonne of palm kernel endocarp, 250 kg of palm kernel press cake, and 100 tonnes of palm oil mill effluent. Oil palm plantations incinerate biomass to generate power for palm oil mills. Oil palm plantations yield large amount of biomass that can be recycled into medium density fibreboards and light furniture. In efforts to reduce greenhouse gas emissions, scientists treat palm oil mill effluent to extract biogas. After purification, biogas can substitute for natural gas for use at factories. Anaerobic treatment of palm oil mill effluent, practiced in Malaysia and Indonesia, results in domination of *Methanosaeta concilii*. It plays an important role in methane production from acetate and the optimum condition for its growth should be considered to harvest biogas as renewable fuel.

Unfortunately, palm oil has detrimental effects on the environment and is not considered to be a sustainable biofuel. The deforestation occurring throughout Malaysia and Indonesia as a result of the growing demand for this plant has made scarce natural habitats for Orangutan and other rainforest dwellers. More carbon is released during the life cycle of a palm oil plant to its use as a biofuel than is emitted by the same volume of fossil fuels.

1.6 Legal and Administrative Policy Framework

Nigeria has enacted a comprehensive policy and legal framework for environmental assessment and management. The country has policies, legislation, and strategies in place to manage the protected facilities, to satisfy its international obligations, and to protect the quality of the environment for the health and well-being of its citizens. The hierarchy ofpolicies and legislative provisions for environmental management in Nigeria is comprised of different enactments ranging from the Constitution to international treaties, and to environment and resource protection laws.

A fundamental principle of the Nigerian environmental policy is that economic development must be in harmony with the extraction and utilization of natural resources and that air, water, and soil pollution will be controlled.

The applicable Domestic environmental laws and regulations are as follows:

1.6.1 National Legislation

The National legislation applicable to this project includes:

- Environmental Impact Assessment (EIA) Act, Cap E12 LFN 2004.
- The National Policy On Environment, 1989
- National Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991
- Harmful waste (criminal provision) Act 42 of 1988
- S.I.8 National Environmental Protection (Effluent Limitation) Regulations 1991
- S.I.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations 1991
- National Guidelines for Environmental Audit in Nigeria, 1999
- National Guidelines on Environmental Management System in Nigeria 1999.
- National Environmental Standards and Regulations Enforcement Agency (NESREA), 2007.
- Hazardous and Solid Waste Management Regulations S.1.9., 1991
- S.I.15 National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations 1991
- Factory Act CAP. F1 L.F.N. 2004
- Land Use Act, Cap L5, 2004
- The Nigerian Urban and Regional Planning Law

Environmental Impact Assessment (EIA) Act, Cap E12 LFN 2004

EIA Act was promulgated in 1992. It makes environmental impact assessment (EIA) mandatory for all new major projects. Therefore, an EIA permit is required for the proposed project.

National Guidelines and Standards for Environmental Pollution Control in Nigeria 1991

This schedule deals with the control of industrial effluent discharge, gaseous emissions and hazardous wastes, so also noise pollution control. This schedule established environmental guidelines and standards for the abatement and control of all forms of pollution.

The proposed project would therefore have to ensure that any discharges into the land, water and atmosphere are of acceptable quality to ensure that there are no legal repercussions under this schedule.

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

These Regulations give the parameters in industrial gaseous emissions and wastewater (effluents) and their limitations, concentration and standards for discharge into land, atmosphere and receiving surface waters.

The proposed project would therefore have to ensure that any discharges into the land, water and atmosphere are of acceptable quality to ensure that there are no legal repercussions under this schedule.

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

This regulation requires every industry to install anti pollution/pollution abatement equipment to treat effluent discharges and gaseous emissions to the standards and limits prescribed in Regulation S.I.8, 1991.

S.I.15 National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations 1991

This regulation requires that all steps that are necessary must be taken for the effective management of solid and hazardous wastes in order to safeguard public health, ensure that waste is collected, stored, transported, recycled, reused or disposed in an environmentally sound manner and promote safety standards in relation to such waste.

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

NESREA was established by the Federal Government of Nigeria as a Parastatas of the FMEnv in July 30, 2007. The Agency is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria. The applicable NESREA regulations to the proposed project include:

- *National Environmental (Sanitation and Waste Control) Regulations, 2009 (S.I.28)*

  The purpose of these regulations is the adoption of sustainable and environment friendly practices in environmental sanitation and waste management to

minimize pollution. The provisions of the regulations state that a person in care, management or control of any industrial facility shall:

(a) Provide educational and pictorial signs to direct persons where they can drop waste.
(b) Provide receptacles for recyclable materials in appropriate and easily accessible locations.
(c) Keep the premises, drains and all public or private lands, street, lanes, walkways; beaches or docks within 5 meters of the boundary of the property free from litter at all times.
(d) Ensure that discarded materials are regularly collected and disposed of sanitarily.
(e) Ensure that recyclable materials are properly packed and neatly stacked.
(f) Ensure sorting and segregation of solid waste at source.

- *National Environmental (Noise Standards and Control) Regulations, 2009 (S.I.35)*

The purpose of these regulations is to ensure maintenance of a healthy environment for all people in Nigeria, the tranquility of their surroundings and their psychological well-being by regulating noise levels and generally, to elevate the standard of living of the people. The regulations among others state the permissible noise levels to which a person may be exposed; control and mitigation of noise; permits for noise emissions in excess of permissible levels; and enforcement.

Factories Act CAPS F1 L.F.N. 2004

The regulations for Health, Safety and Welfare are under this act. This act also requires that: Before any person occupies or uses as a factory any premises which were not so occupied at the commencement of this Decree, he shall apply for the registration of such premises by sending to the Director of Factory an application containing the particulars set out in Schedule 1 to this Decree.

Any person who has not been issued a certificate of registration as aforesaid occupies or uses as a factory any premises that have not been registered as a factory shall be guilty of an offence.

Land Use Act, Cap L5, 2004

The Nigerian Land Use Act 1978 was promulgated in March 1978. It vests all land in each state of the federation (except land already vested in the Federal

Government or its agencies) in the Governor of the state. It makes the state Government the authority for allocating land in all urban areas for residential, agricultural commercial and other purposes while it confers similar powers regarding non-urban areas on the Local Government in such area. The Governor of a state can revoke a Right of occupancy (statutory customary) for overriding public interest.

The Nigerian Urban and Regional Planning Law

Decree 88 of 1992 established a Development Control Department (DCD) charged with the responsibility for matters relating to development, control and implementation of physical development plans at Federal, State, and Local Government levels within their respective jurisdictions.

1.7 International Agreements and Protocols

Nigeria has acceded to a number of international environmental conventions and the key ones are presented in Table 1-1. The applicable international environmental agreements and protocols include:

- The Montreal Protocol
- The Basel Convention
- The Framework Convention on Climate Change
- The Convention for The Prevention of International Trade in Endangered Species (CITES)
- Convention on Biological Diversity (CBD)

The Montreal Protocol

This protocol discourages the use of substances that deplete the ozone layer and promotes the synthesis of new and environment-friendly products.

The Basel Convention

This convention deals with the control of Trans–boundary movement of Hazardous Waste and Substances among member countries.

The Framework Convention on Climate Change

This convention requires member countries to stabilize atmospheric concentrations of greenhouse gases at levels that will prevent human activities from interfering dangerously with the global climate change.

The Convention for the Prevention of International Trade in Endangered Species (CITES)

The trade involving certain wild animals and plants whose numbers are considered to be endangered is been regulated by this convention

Convention on Biological Diversity (CBD)

This convention deals with the conservation of biodiversity, the sustainable use of its component and the fair and equitable sharing of the resulting benefits.

Table 1-1: International Environmental Conventions Signed by Nigeria

Convention	**Year of Accession**
African Convention on the Conservation of Nature and Natural Resources	1968
Convention on Biological Diversity CBD)	1993
UN Framework Convention on Climate Change (UNFCCC)	1994
Kyoto Protocol	1999
UN Convention on Combating Desertification (UNCCD)	1996
Convention on the Protection of Wetlands of International Importance (RAMSAR)	1998
Vienna Convention for the Protection of the Ozone Layer	1996
Montreal Protocol (regulating substances that deplete the ozone layer)	1996
Convention on International Trade in Endangered Species of Fauna and Flora (CITES)	1996
Convention on Trans-boundary Movement of Hazardous Waste (BASEL)	1997
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	2000
Stockholm Convention on Persistent Organic Pollutants (POPs)	2004
World Heritage Convention	1990
Convention on the Conservation of Migratory Species of Wild Animals (BONN Convention)	1979
International Union for the Conservation of Nature and Natural Resources (IUCN)	1956
The Equator Principles III	2013

1.8 Institutions and Regulatory Agencies

- Federal Ministry of Environment
- Federal Ministry of Agriculture and Rural Development (FMARD)
- Agricultural Research Council of Nigeria (ARCN)
- Nigeria Institute for Oil Palm Research (NIFOR)
- Rubber Research Institute of Nigeria (RRIN)
- Edo State Ministry of Environment and Public Utilities
- Edo State Environmental and Waste Management Board
- Ministry of Agriculture and Natural Resources, Edo State
- Ministry of Lands and Surveys, Edo State
- Edo State Fire Service

- Ministry of Health, Edo State
- Department of Environment, Ovia Southwest Local Government Area of Edo State, Nigeria.

Federal Ministry of Environment

The Federal Ministry of Environment is the apex body with the broad mandate to regulate and protect the environment in Nigeria. The Ministry has enacted a number of environmental laws and regulations. In addition, Nigeria is party to some international agreements; protocols and conventions on Environment and is bound by their provisions and requirements.

Federal Ministry of Agriculture and Rural Development(FMARD)

The Federal Ministry of Agriculture and Rural Development (FMARD), is a Ministry of the Nigerian government that regulates agricultural research, agriculture and natural resources, forestry and veterinary research all over Nigeria. Established in 1966, the Ministry has the responsibility of optimizing agriculture and integrating rural development for the transformation of the Nigerian economy, with a view to attaining food security and positioning Nigeria as a net food exporter for socio-economic development.

Agricultural Research Council of Nigeria(ARCN)

The Agricultural Research Council of Nigeria dedicates itself to achieving significant improvements in agricultural productivity, marketing and competitiveness by generating appropriate technologies and policy options, promoting innovation, establishing a knowledge management capacity and strengthening the agricultural research system.

Nigeria Institute for Oilpalm Research (NIFOR)

Government agency mandated to research into the genetic improvement, production and processing of oil palm, raphia date, coconut and ornamental palms.

Rubber Research Institute of Nigeria (RRIN)

RRIN is the only government agency in the country mandated to conduct research into production and development of Natural Rubber (NR), gum arabic and other latex-producing plants of economic importance.

Edo State Ministry of Environment and Public Utilities

The Edo State Ministry of Environment and Public Utilities is the arm of government responsible for regulating the environment in Edo State of Nigeria. Depending on certain peculiarities of the state, the Ministry has made and established its own laws and environmental standards, which are not inconsistent with Federal laws.

Edo State Environmental and Waste Management Board

This Board is under the Governor's Office with a mandate for waste management and environmental sanitation.

Department of Forestry and Natural Resources, Edo State

The Forestry Department of the Edo State Ministry of Environment and Public Utilities has responsibility for forest resources management, forest reserves and wildlife conservation in the state.

Ministry of Lands and Surveys, Edo State

The Ministry of Lands and Surveys deals with land issues, plans and controls development, establishes residential, commercial and industrial layouts and execute in the state the Nigerian Urban and Regional Planning law.

Ovia Southwest Local Government Area

The Department of Environment, Ovia Southwest Local Government Area of Edo State, Nigeria is the tier of government that is responsible for regulating and monitoring the environment at the local level especially the aspects of health and sanitation inspection of business premises to ensure that they conform to set standards.

1.9 Non-Governmental Organizations (NGOs)

- Nigerian Conservation Foundation (NCF)
- Nigerian Environmental Society (NES)
- Human Right and Rural Development Organisation of Nigeria
- Grasssroot Development Initiative
- Vision 1 Health
- Women Empowerment and Development Network (WEDEN)
- Gender Development Action (GDA)

Nigerian Conservation Foundation (NCF)

The Nigerian Conservation Foundation (NCF) is Nigeria's foremost non-governmental organisation dedicated to the promotion of nature conservation.

Formed in 1980 and registered in 1982 as a Charitable Trust (No. 1917), it's ultimate goal is to stop and eventually reverse the accelerating degradation of Nigeria's natural environment and to help build a future in which humans live in harmony with nature.

Nigerian Environmental Society (NES)

The Nigerian Environmental Society (NES), with headquarters in Lagos, is incorporated in Nigeria as a professional, non-profit making, non-governmental Organisation which is committed to the protection, development and sustenance of the environment and to the promotion of the profession of Environmental Science and Engineering, both in theory and in practice. The NES has been in forefront of the vanguard of environmental protection and resource conservation.

1.10 International Finance Corporation (IFC) Performance Standards (PS)

Other international guidelines that guide this development project include IFC Performance Standards such as:

- PS 1− Assessment and Management of Environmental and social Risks and Impacts.
- PS 2- Labor and Working Conditions
- PS 3− Resource Efficiency and Pollution Prevention
- PS 4− Community Health, Safety and Security
- PS 5− Land Acquisition and Involuntary Resettlement
- PS 6−Biodiversity Conservation and Sustainable Management of Living Natural Resource
- PS 7 – Indigenous People
- PS 8− Cultural Heritage
- IFC Environmental, Health and Safety Guidelines for Plantation Crop Production.

1.11 Roundtable on Sustainable Palm Oil – Principles and Criteria

RSPO is a not-for-profit association that unites stakeholders from seven sectors of the palm oil industry - oil palm producers, palm oil processors or traders, consumer goods manufacturers, retailers, banks and investors, environmental or nature conservation NGOs and social or developmental NGOs - to develop and implement global standards for sustainable palm oil. This is achieved via eight principles as follows:

- Principle 1: Commitment to transparency
- Principle 2: Compliance with applicable laws and regulations

- Principle 3: Commitment to long-term economic and financial viability
  Principle 4: Use of appropriate best practices by growers and millers
  Principle 5: Environmental responsibility and conservation of natural resources and biodiversity
- Principle 6: Responsible consideration of employees, and of individuals and communities affected by growers and mills
- Principle 7: Responsible development of new plantings
- Principle 8: Commitment to continual improvement in key areas of activity

1.12 Forest Stewardship Council (FSC) Principles and Criteria

The FSC Principles & Criteria (P&C) describe the essential elements or rules of environmentally appropriate, socially beneficial and economically viable forest management. There are ten principles setting out this vision; each principle is supported by several criteria that provide a way of judging whether the principle has been met in practice. All the ten principles and criteria must be applied in any forest management unit before it can receive FSC certification. The Principles & Criteria apply to all forest types and to all areas within the management unit included in the scope of the certificate. The P&C are applicable worldwide and relevant to forest areas and different ecosystems, as well as cultural, political and legal systems. This means that they are not specific to any particular country or region. The 10 Principles setting the rules for responsible forest management include:

- Principle 1: Compliance with laws and FSC Principles – to comply with all laws, regulations, treaties, conventions and agreements, together with all FSC Principles and Criteria.
- Principle 2: Tenure and use rights and responsibilities – to define, document and legally establish long-term tenure and use rights.
- Principle 3: Indigenous peoples‟ rights – to identify and uphold indigenous peoples‟ rights of ownership and use of land and resources.
- Principle 4: Community relations and worker's rights – to maintain or enhance forest workers' and local communities‟ social and economic well-being.
- Principle 5: Benefits from the forest – to maintain or enhance long term economic, social and environmental benefits from the forest.
- Principle 6: Environmental impact – to maintain or restore the ecosystem, its biodiversity, resources and landscapes.

- Principle 7: Management plan – to have a management plan, implemented, monitored and documented.
- Principle 8: Monitoring and assessment – to demonstrate progress towards management objectives.
- Principle 9: Maintenance of high conservation value forests – to maintain or enhance the attributes which define such forests.
- Principle 10: Plantations – to plan and manage plantations in accordance with FSC Principles and Criteria.

1.13 Environmental Impact Assessment Procedural Guidelines

In response to the promulgation of the EIA Act No. 86 of 1992, an Environmental Impact Assessment Procedure for Nigeria was produced by the former Federal Environmental Protection Agency (FEPA, 1995). The procedure indicates the steps to be followed from project conception to commissioning in order to ensure that the project is implemented with maximum consideration for the environment.

The procedure for EIA involves the project proposal stage where the project proponent notifies the Ministry of Environment of the proposed project in writing. The project proposal is to contain all relevant information on the project and a land-use map.

This stage is followed by the screening phase, when the Ministry will carry out an Initial Environmental Examination and assign the project into categories based on the following criteria: magnitude; extent or scope; duration and frequency; risk; significance; mitigation measures available for associated and potential environmental impacts. The location of the project in Environmentally Sensitive Areas is also an important criterion in the project categorization. The area categorized as Environmentally Sensitive Areas (ESAs) include: coral reefs, mangrove swamps, small islands, tropical rain forests, areas with erosion prone soils, natural conservation areas, watersheds, wetlands etc.

There are three categories (I, II and III) in Ministry of Environment's guidelines.

Category I projects are subjected to full scale EIA, and it consists among others: Petroleum projects such as Oil and Gas fields development; construction of offshore pipeline in excess of 50 kilometres in length; construction of Oil and Gas separation, processing, handling and storage facilities, and large scale construction of depots for storage of petroleum products.

Projects listed in category II may not require a full-scale EIA except when the project is located in an Environmentally Sensitive Area (ESA) and in this case the project will be assigned top category I. The requirement for category II projects is a partial EIA. Also, mitigation measures or changes in project design (depending on the nature and magnitude of the environmental impacts) as well as further actions, may be required from the proponent. Category II projects include reforestation/afforestation projects, land and soil management, small scale irrigation and drainage, mini hydro-power development, small-scale development of petroleum or related activities, etc.

Category III projects are expected to have essential beneficial impacts on the environment. For projects in this category, the Ministry of Environment will issue an Environmental Impact Statement (EIS). Projects in this category include; family program, institutional development, environmental awareness projects, etc.

Another stage of erstwhile FEPA'S$_S$ EIA procedure is the scoping stage, the main feature of which is that the proponent will be required to submit a Terms of Reference (ToR) for the proposed EIA study. In some cases, the Ministry may demand a Preliminary Assessment Report, and any additional information from the proponent to assist in vetting the scope and the ToR of the proposed EIA study. This stage is followed by actual implementation of the EIA study; Preparation of Draft Final and Final Reports; Review process and Approval/Certification.

This project is an expansion of the existing palm oil and rubber plantations and will be subjected to a full scale EIA/Public Review (Category I).

1.14 Okomu Oil Palm Company Plc IMS Policy

The **OKOMU OIL PALM COMPANY PLC** is committed to:

- Providing customers with high Quality products and services which meet requirements and are fit for their purpose.
- Compliance with all applicable laws, regulations, standards and other requirements related to our activities, products and services and their environmental aspects.
- Enhancing the skills of management and staff through review and actively pursuing an on-going training policy, the objective of which is to prepare staff to perform their work more effectively.

- Promoting the culture of continual improvement of the Quality and Environmental processes and the philosophy of getting things "right first time".
- Advocating the adoption of prudent Quality and Environmental principles to our vendors, suppliers and customers. Reduce and eliminate the generation of waste and emissions at the source and make all efforts to recycle when practical.
- Pledging ourselves to the prudent and sustainable use of the earth's resources and the protection of the natural environment while we strive to fulfill our corporate mission of contributing to enhance prosperity for all.
- Promoting the Integrated Management System and continually improving its effectiveness through the use of the Quality and Environmental Policy, Quality/Environmental objectives, audit results, analysis of data, corrective and preventive actions and management review.
- Communicating this policy to all persons working for or on behalf of the organization.

The Managing Director confirms the commitment and support, along with that of all employees and those working on behalf of the company, to the above policy statement and the effective application and continual improvement of the Integrated Management System.

1.15 Objectives of Environmental Impact Assessment

The main objective of the EIA is to principally identify the environmental consequences of the operations and activities of the Oil Palm and Rubber development project. The EIA covers the whole environment from the biotic to abiotic (physical), socio-economic and health aspects of the resident company workers and members of the host communities. Furthermore, the EIA is also to establish baseline data of the proposed project site to aid decision making process and serve as future reference. In this circumstance therefore, and for the purposes of compliance with Federal Environmental Laws, it is required that the Okomu Oil Palm Company Plc as a responsible corporate organization should conduct an Environmental Impact Assessment on their proposed projects. This would serve to adequately analyze the site, identify any environmental impacts and define

framework for contingency plans and mitigation and abatement measures for impacts.

In Nigeria, the legal instruments relevant for the protection of the environment are contained in FEPA (now Federal Ministry of Environment) regulations. Some State governments also made few enactments that are not inconsistent with the Federal laws. In consonance with these laws, Okomu Oil Palm Company Plc should:

- Develop, Implement and maintain an environmental policy that would enhance the environmental performance of its corporate activities.
- Aim and pursue compliance with existing environmental legislation, identify any non-compliance and endeavour to remedy such non-compliance.
- Develop and maintain environmental awareness of its employees, contractors and any such external parties involved in their corporate activities.
- Improve its corporate image through environmental responsibilities.
- Work in partnership with regulatory agencies for better environment.
- Pay special attention to sustainable development through incorporation of environmental concerns into any development projects.
- Minimize litigation that may arise from environmental non-performance of their projects' activities.

1.16 Terms of Reference (ToR)

The detailed Terms of Reference as approved by the Federal Ministry of Environment are provided in Annexure I.

1.17 Structure of the Report

The report is presented in eight chapters. Chapter One is Introduction with relevant information about the proponent, background information on the project and statutory regulatory requirements. Chapter Two presents the Justification for the project and the project alternatives, while the detailed Description of the proposed project is provided in Chapter Three. The Baseline environmental and socio-economic statuses of the proposed project areas as well as the stakeholders' consultation process are presented in Chapter Four. The Assessment of potential environmental impacts and the mitigation measures are articulated in Chapters Five and Six respectively. The Environmental management plan and decommissioning is presented in Chapter Seven, while lastly, the Conclusion is presented in Chapter Eight.

1.18 Declaration

The Okomu Oil Palm Company Plc as a corporate organization and the operator of this project on behalf of herself, the project contractors and other partners hereby declares her intention to undertake this rubber and oil palm plantation expansion project. In line with her corporate policy and compliance with all applicable national, state and local government laws, regulations and or by-laws, the Okomu Oil Palm Company Plc takes full responsibility for the protection of the environment within the project area.

This EIA report has been prepared by **FOREMOST DEVELOPMENT SERVICES LIMITED** on behalf of **THE OKOMU OIL PALM COMPANY PLC** in line with statutory requirements, guidelines and standards for plantation crop development and Federal Ministry of Environment is recognised as the sole regulatory authority on EIA.

CHAPTER TWO

2.0 PROJECT JUSTIFICATION AND ALTERNATIVES

2.1 The Proposal

The Okomu Oil Palm Company Plc has been planting oil palm and rubber since 1978 and 1998 respectively and has established over 12000 ha and 6000 ha plantations to each crop. The company plans to upgrade the capacity of its palm oil mill to 60 tons FFB/hr and has also established a rubber processing factory of 6,000 tons per annum. The capacities of the two processing facilities are grossly underutilized because the crops harvested from both oil palm and rubber plantations cannot satisfy their throughput. In the circumstance, considerable loss of revenue including foreign exchange from rubber export is being incurred.

In order to address this situation, the company proposes to expand the sizes of the oil palm and rubber plantations by undertaking new plantings at Extension One. The new plantings being proposed at Extension One are estimated at about 500 ha for oil palm and 2525 ha for rubber.

As a requirement of the environmental laws and regulations, a permit application and project description were submitted to the Federal Ministry of Environment. And based on the initial assessment by the Ministry, the proposed expansion at Extension One was classified as Category I requiring the full EIA process.

2.2 Purpose and Need for the Project

The Okomu Oil Palm Company Plc (OOPC) has been planting oil palm (*Elaiese)* since 1978 and rubber (*Hevea*) since 1998. The company in addition acquired an existing plantation with both mature and immature trees in 2000. This plantation is referred to as Extension One. At the time of acquisition, Extension One already had rubber trees planted and cup lumps harvested from it.

The company plans to expand the capacity of its palm oil mill from 30tons FFB/Hr to 60tons FFB/Hr and to increase the capacity further. It has also completed and put into operation its state of the art rubber processing factory of 6000 tons per annum capacity. The present experience is that of idle capacities at both the palm oil mill and the rubber factory because the FFB and cup lumps harvested from the oil palm and rubber plantations respectively could not satisfy the capacities of the two processing facilities. This situation has adverse implication for the total annual turnover of the company.

In order to address these problems, OOPC proposes to establish new plantings of both oil palm and rubber at Extension One. By so doing, the company should be able to harvest more FFB and cup lumps to process. This would further increase the total annual income and help to meet the company's financial obligations to its shareholders, as well as corporate social responsibilities.

This EIA is being conducted in accordance with the Terms of Reference approved by FMEnv (See Annexure I). It covers the range of activities and undertakings at the different developmental stages of the project.

2.3 Objectives

As part of the Federal Government of Nigeria's effort to revamp the agriculture sector,ensure food security, diversify the economy and enhance foreign exchange earnings, the FMARD embarked on a Transformation Agenda with a focus on the development of agricultural value chains, including the provision and availability of improved inputs (seeds and fertilizer), increased productivity andproduction, as well as the establishment of staple crop processing zones. It also addresses reduction in post-harvest losses, improving linkages with industry with respect to backward integration, as well as access to financial services and markets. The TransformationAgenda targets rural communities particularly women, youth and farmers associations as well as improving rural institution and infrastructure. The transformation agenda sets out to create over 3.5 million jobs from rice, cassava, sorghum and cotton value chains, with many more jobs to come from other value chains under implementation.

The programme aims to provide over 300 Billion Naira (US$ 2 billion) of additional income in the hands of Nigerian farmers. Over 60 Billion Naira (US$ 380 million) is to be injected into the economy from the substitution of 20% of bread wheat flour with cassava flour. Nigeria would therefore be enabled to be food secure by increasing production of key staples.

An important component of the transformation agenda is the Oil Palm Transformation Agenda, which has the specific objectives of (i) Increase vegetable oil production through the increase of oil palm production and processing in order to cancel the supply deficit which is annually met through import. (ii) Increase the yield and productivity of both the unorganized and organized plantings. (iii) Arouse greater interest and concern for engagement in competitive market activities within

the oil palm value chain. (iv) Create employment for youth and reduce poverty in affected states.

The ongoing investments by the company, including the proposed oil palm and rubber plantation expansion at Extension I could be seen as the company's contribution and support aimed at achieving the objectives of the agricultural and economic transformation agenda of the Nigerian government.

2.4 Cost of the Project

The project which is about 200 years life span and economic life of 25-35 years is being valued at about N2.3 billion.A large proportion of this fund will be injected into the local economy through various contracts and subcontracts. In addition, employment opportunities at various phases of the project, for skilled, semi-skilled and unskilled labour would be available. The project will also bring about additional revenue generation to the government in terms of various taxes and levies that will be paid into government coffers.

2.5 Justification/Project Benefits

The proposed project will complement considerably the economic transformation strategy and plans of the country. Justification is therefore found for the proposed oil palm and rubber plantation expansion in its potential to:

- Add value to the existing production of the company
- Provide direct employment
- Create additional jobs
- Contribute to the socio-economic development of neighboring communities
- Contribute to foreign exchange earnings of the country.

2.6 Envisaged Sustainability

In order to achieve the desirable sustainability of the proposed extension oneplantation expansion project, OOPC Plc will develop and operate the project based on industry best practices, applying especially the IFC Performance Standards and the Principles and Criteria of the Roundtable on Sustainable Palm Oil (RSPO). In effect, OOPC Plc will strive continually to implement its Health, Safety and Environment Policy. In so doing, the following aspects of the project sustainability are therefore envisaged:

2.6.1 Financial Sustainability

The planning and management of operations and production activities will aim at long-term financial and economic viability of the project. This will be achieved through sound agronomic and management practices to attain high productivity and premium quality of products.

In addition, the project will be financed from the company's annual turnover and profits, which has been impressive and promising in the last five years. The company recorded a revenue of N6,087,836,000.00 with profit after tax of N5,290,046,000.00 in year 2010. The financial performance of the company has since improved considerably. For the year ended December 2014, the revenue was N8,655,718,000.00, while the profit after tax was N1,570,137,000.00. OOPC Plc is listed on the Nigerian Stock Exchange. The financial performance of the company over the years would enable it to execute and sustain the proposed extension one plantation expansion project operations.

2.6.2 Technical Sustainability

The company will leverage on its expertise and experience in plantation development and operation in Edo State, other parts of Africa and Asia to ensure that the proposed plantation expansion enjoys sound technical complements from design to implementation and operation. Such practices will include adequate practices to maintain, and improve long-term soil fertility and minimize and control soil erosion. They will also effectively manage pests, diseases and weeds such as to minimize the use of pesticides. In addition, the planting material will be of the highest quality available. Also the nursery management and plantation upkeep standards will be optimized sustainably.

Essentially, best hands and best management practices will be employed to carry out the project. Importantly, all staff and workers will be competent and adequately trained to ensure the technical sustainability of the proposed project.

2.6.3 Environmental Sustainability

The on and off-site impacts of the plantation activities will continually be assessed and managed. Biodiversity will be conserved through the understanding of the flora and fauna and the habitats that exist inside and around the proposed plantation and through the implementation of the existing policy to conserve biodiversity. In addition, the use of fire in land clearing and land preparation will be largely

avoided, whilst strategies to reduce air and water pollution will be implemented. Essentially, the bulk of the solid waste to be generated will be disposed by recycling in the plantation.

2.6.4 Social Sustainability

An assessment of the social impacts of the proposed extension one plantation expansion project will be carried out and the results and social action plan will be implemented to ensure that the desirable support and harmony is established between the project and the communities. The necessary mechanisms will be put in place to facilitate communication with the communities, including proper documentation and resolution of conflicts and grievances.

2.7 Project Alternatives

The development of both oil palm and rubber plantations essentially involves the removal and transformation of existing vegetation into mono crops of oil palm and rubber. The plantation development will involve the planting of highly adaptable and high yielding types of oil palm and clones of rubber respectively. In this section, alternatives to the proposed project are discussed including the "do nothing" alternative.

2.7.1 The "Do Nothing Alternative"

The "do nothing" alternative would mean that OOPC Plc should continue to operate without the option of optimizing the potential of its processing facilities.

This option is unacceptable when one considers the substantial net financial, economic and social benefits that will accrue to OOPC Plc, the neighbouring communities and the national economy with the prospects of optimizing the capacities of the processing facilities.

2.7.2 Alternative Location

The option of alternative location means the undertaking of new plantings of oil palm and rubber at a different location. This option is undesirable because the prospect of acquiring new land in the neighbourhood is low and where possible, it may take relatively long time and expensive. Moreover, establishing the plantation at a different location would mean that it would require travelling longer distances to deliver raw materials to the palm oil mill and rubber factory.

2.7.3 Alternative Plantation Expansion Methods

For large scale expansion of oil palm and rubber plantations, the alternative development methods that could be adopted are:

2.7.3.1 Smallholder Development

It is possible to divide the land into small units for small farmers to develop. This option is not favoured because the yields of smallholder operations are much lower than the standard estate operations. The aggregate production of the smallholders will be relatively lower and capacities of the processing facilities will remain under utilized.

2.7.3.2 Third Party Services

This is the option of relying on contractors to supply FFB and cup lumps to the company. This option is not favoured because it is unreliable and prone to sabotage.

2.7.3.3 Preferred Option

Of all the alternatives considered, the full development of the project as being proposed is the preferred option.

CHAPTER THREE

PROJECT/PROCESS DESCRIPTION

3.0 Brief Project/Process Description

The proposed project is an expansion of the existing development at the Extension I project site of the company. The proposed development is meant to increase the existing planted areas to rubber and oil palm to achieve a total planted area of about 3000 hectares out of total land area of about 6000 hectares.

The location of the project site is within the Okomu forest reserve for which concession has been given to the company to develop into plantation and is covered by statutory certificate of occupancy. Apart from the rubber and oil palm plantations, the other proposed land uses include roads housing, workshop, powerhouse, and conservation areas.

The vegetation of the project site is that of degraded forest with remnants of natural riparian forest. The proposed development will therefore involve the clearing of degraded forests and farmlands. However, it is intended to conserve the riparian forest, hence the vegetation at minimum of 100 meters on each side of the main river and other streams traversing the land will be conserved.

The proposed development will be done in phases, with the first planting intended for 2012 and subsequent plantings phased over eight years to terminate in 2020. The average rate of planting is estimated between 400-450 hectares per year.

The planting materials to be used for both the rubber and oil palm plantings will be sourced from the Rubber Research Institute of Nigeria (RRIN) and the Nigerian Institute for Oil Palm Research (NIFOR). The types and varieties of the planting materials are very well adapted to the Nigerian environment and local conditions.

The products of the plantations including fresh fruit bunches (FFB) and cup lumps are intended to be harvested from the plantations and transported to the main estate of the company for processing. The operations of the project will therefore not generate industrial liquid waste (effluent). The bulk of the waste arising from the operations of the project will be essentially organic waste that will be managed and recycled within the plantation.

3.1 New Plantation and Activities

3.1.1 Location

The area known as Extension One is located between geographic coordinates of longitude 6º17.369'E and 6º23.514'E and latitude 5º19.922'N and 5º25.723'N. The area which is about 6,119ha is situated at the north eastern part of the Okomu Forest Reserve and shares boundaries with the Okomu National Park at its west and the Osse River Rubber Plantation Estate (also the Michelin Rubber Company) at the north.

3.1.2 Planting Plan

The total area of about 3,000 hectares is planned for phased planting spread over seven years as follows:

YEAR	HA	CROP
2012	550	Oil Palm
2013	425	Rubber
2014	425	Rubber
2015	450	Rubber
2016	450	Rubber
2017	475	Rubber
2018	250	Rubber
Total	**3,025**	

3.2 Activities

3.2.1 Rubber Nursery Activities and Management

Rubber seeds lose viability very rapidly if left in the field. The seeds are therefore picked up daily during the seed fall season and quickly transported to nurseries for germination and planting. Planting materials for establishing rubber plantations are generated in ground and polybag nurseries.

Ground nursery

Ground nurseries are established for the production of budded stumps, stumped buddings and budwood.

Selection of site

1. The site should have good accessibility for supervision and transport of materials.
2. A good soil depth of at least 75 cm is essential
3. Loamy soils are ideal
4. A well-drained level area is ideal. Undulating lands are also suitable if adequate soil conservation measures are adopted
5. Contour terracing is done where the slope is in excess of two per cent
6. Waterlogged areas should be avoided and water table should be sufficiently low to allow sufficient soil depth for root development
7. Shade-free areas are preferred
8. Land with a history of intensive cropping needs proper build up of the nutrient status to the satisfactory level

The rubber nursery site at Okomu OPC has been carefully selected and has met all the criteria for site selection.

Preparation of nursery beds

1. Dig to a depth of 60-75 cm. Stones, stumps, roots, etc. present in the soil are removed and the soil is brought to a fine tilth
2. Beds should be 90 to 120 cm wide and of convenient length. In the level lands, raised beds are made with footpaths of about 45 cm width between the beds. In undulating lands, beds are prepared along the contours, one below the other
3. At the time of preparation of nursery beds, 25 kg of compost or well-rotten cattle manure and 3.5 kg of powdered rock phosphate (20% P2O5) are incorporated for every 100 m2 of nursery bed.

The rubber nursery has been established in newly cleared forest areas rich in organic matter, thus, there was no need applying compost or cattle manure

Seed germination beds

1. A well-drained area with moderate shade is the ideal site for germination beds
2. Level beds of 90 cm width and convenient length are prepared with walking space in between. The beds should be raised 10-15 cm above the soil surface to avoid water-logging
3. A free-draining friable material like river sand, spread above the bed to a thickness of 5 cm, is used as the medium for germination. Seeds are washed

thoroughly to remove charcoal and other packing debris and spread over the bed in a single layer touching one another and pressed gently into the sand

4. In order to prevent loss of too much moisture from the rooting medium, the beds are covered with a thin layer of gunny bag, coir matting or similar material. A high level of moisture is maintained in the bed by evenly sprinkling water early in the mornings and late in the evenings
5. Germination of the seeds starts within 6-7 days after sowing. The beds should be inspected daily and the germinated seeds picked up and collected in a bucket containing water as soon as the radicle emerges for planting in the nursery beds or main field. Seeds, which do not germinate within two to three weeks, should be discarded

Planting in nursery

1. Small holes enough to accommodate the seeds in a horizontal position and approximately 5 cm deep are made.
2. The seeds are carefully placed in the holes with the radicle pointing downwards and covered with soil.
3. The sprouted seeds should be planted when the young root is less than 2 cm long
4. The common spacing adopted are:

   - ✓ Seedling stumps: 30 x 30 cm
   - ✓ Green-budded stumps: 23 x 23 cm
   - ✓ brown-budded stumps: 30 x 30 cm or staggered pairs of rows 60 cm apart and 23 cm between plants
   - ✓ Stumped buddings: 60 x 60 cm, 90 x 30 cm, 90 x 60 cm or 90 x 90 cm
   - ✓ Soil core plants: 35 x 35 cm, 38 x 30 cm or 60 x 60 cm.
   - ✓ Budwood nursery: 90 x 60 cm or 120 x 60 cm

Nursery for seedlings and budded stumps

The nursery beds should always be kept free of weeds. Three rounds of weeding are needed. The first weeding is done just before application of the first dose of fertilizers and the second weeding before the second dose. The third round of weeding is done just before commencement of budding during May or June. The first round of manual weeding can be replaced with the application of pre-emergence herbicides. After the final preparation of the nursery beds, diuron at the rate of 2.5 kg per ha in 700 L water is sprayed on the beds and germinated seeds planted five days later.

Mulching is an important operation to be followed in seedling nurseries before the beginning of the summer season and after the second round of fertilizer application. Natural materials such as tree loppings, dry leaves, undergrowth from forests, grass cuttings and cut cover crop material are commonly used after they are dried. A single round of good mulching in December is adequate. Black polythene sheets properly anchored to the soil to prevent them from being blown away by wind can also be used for mulching. Spreading a thin layer of soil above the sheet is an effective way to achieve this.

During the dry period, which usually extends from December to April, the nurseries should be irrigated. In large nurseries, overhead sprinkler irrigation systems are ideal. Daily watering is preferred during the initial weeks. Later, the frequency of irrigation can be reduced to once in two or three days.

Budwood nursery

Buds required for budgrafting are collected from budwood obtained from plants raised specifically for this purpose.

Budwood nurseries are of two types:

1. Brown budwood nursery (produces brown buds)
2. Green budwood nursery (produces green buds)

After cleaning and levelling, soil is first dug to a depth of 45-60 cm. Planting can be done with polybag plants, budded stumps or seed at stake followed by budding. For green bud shoot nursery the spacing is 1 m x 1 m or 80 cm x 90 cm. Proper fertilizer application may be carried out to ensure good growth. Other agronomic practices such as irrigation, mulching, weeding, shading, protection against diseases and pests are followed in a similar manner as for seedling nursery.

During the first year of planting, only one shoot is allowed to grow. About 1 m of brown budwood can be obtained from this after one year.

From the second year, two or three shoots are allowed to develop on a plant depending on the spacing adopted. To remove the leaves present in the brown-coloured budwood, the leaflets are first removed by clipping the tip of the leaf stalk. After about one week, the leaf stalk dries and falls off.

Budwood is then harvested by sawing off, leaving about 15 cm at the base. From this portion shoots develop in the subsequent season.

Green bud shoot plants are shaped from brown budwood plants. For this, a well-established brown budwood plant is first cut back at a height of about 75 cm. A

number of shoots emerge below the cut end. Among these, only 3-5 most vigorous ones are retained and the rest removed. When these shoots have grown and produced brown wood to a length of about 5 cm, they are pruned at the point where the brown colour ends so as to produce more branches. Two to three most vigorous branches are retained on each shoot and the others cut off. When these secondary branches develop brown colour at the basal 5 cm, they are again pruned. New branches arise from these and give the budwood plant a bushy appearance. For producing green shoots, all the branches of a green bud shoot plant (also called source bush) are pruned. The new branches arising are harvested when one whorl of leaves develop. The harvested budwood is cut into pieces of convenient length before being taken to the nursery beds for budding.

Polybag nursery

Planting materials in polybags can be prepared by two different methods.

1. Budded stumps can be planted in polybag and the scion allowed to develop till they are ready for planting in the field.
2. Germinated seeds are planted in polybags and bud-grafted when 5-6 month old.

The roots of budded stumps can be treated with indole butyric acid (IBA), a hormone that enhances root growth. Dipping root in cow dung slurry before planting enhances root development.

Plate 3-1: Rubber Nursery showing clones in fibre for root development

Planting in polybags

Polythene bags of lay-flat dimension 55-60 cm length and 25-30 cm width which can hold about 8-10 kg soil, are usually used for raising plants up to two to three whorl stage. For producing plants of 6-7 whorls, larger bags of 65 cm x 35 cm size and holding about 23 kg soil should be used.

In order to facilitate drainage, sufficient number of holes should be punched on the lower half of the bags. Low density polyethylene (LDPE) sheet of 400 gauge and 500 gauge thickness are usually used for making small bags and large bags respectively. Bags made of high density polyethylene (HDPE) sheets can also be used for this purpose. However, such bags are likely to deteriorate when exposed to sunlight for long periods.

Soils with clay-loam texture, good structure and friability are ideal for this purpose. The fertile topsoil collected after removing the surface vegetation and leaf litter is ideal for filling the bags. While filling, the bag should be gently tapped to ensure compact filling of soil without leaving air spaces. The bag is filled up to about 2 cm below the brim.

Powdered rock phosphate at the rate of 25 g for small bags and 75 g for large bags is mixed with the top layer of soil. The filled bags can be kept in the nursery either in trenches or on the ground supported with wooden poles. After placing the bag in the trench, the excavated soil is filled in the gap between them. The remaining soil is mounted around the bags.

Planting of budded stumps or sprouted seeds is undertaken thereafter. When budded stumps are used, the bud patch should face the footpaths to facilitate growth of sprouts.

Regular cultural operations like manuring, watering, weeding, shading and plant protection are adopted. Application of N-P-K-Mg 10-10-4-1.5 mixture is done at monthly intervals. During the first month, 10 g of the mixture is given per bag which is gradually increased to 30 g in four months time.

Watering should be done soon after manuring. During dry periods, irrigation should be done regularly. Watering can be done manually in small nurseries, however, at the Okomu OPC nursery, sprinklers and drip irrigation systemsare used.

Plate 3-2: Rubber Nursery

3.2.2 Maintenance Activities

General maintenance done on the rubber plantations include weed control, fertilizing and disease eradication plants.

Weed control

The area of rubber plantations, both plants have not produced (TBM) and the plant already produces (TM) should be free of weeds such as reed, Mekania, Eupatorium, etc. so that plants can grow well. To achieve this, weeding in the first year is based on the age of the plant.

Fertilization programs

In addition to the basic fertilizer that has been given at the time of planting, fertilizing program on an ongoing basis in rubber should be done with a balanced dose of twice a year. Fertilization schedule in which I semeseter in January / February and in the second half of July / August. A week before fertilization, gawangan first raked and cleaned the disc plants. Granting SP-36 is usually done two weeks ahead of urea and KCl.

Plant Disease Eradication

Gum disease often cause economic losses in the rubber plantation. Losses resulting not only in the form of yield loss due to crop damage, but also the cost incurred in efforts to control. Therefore, control measures in an integrated and efficient in order to minimize losses from the disease needs to be done. Over 25 types of disease damage in rubber plantations. The disease can be classified based on the value of economic losses caused. Plant diseases commonly found in rubber plantations are:

White root fungus (Rigidoporus microporus)

White root disease caused by a fungus Rigidoporus microporus (Rigidoporus lignosus). These diseases cause damage to the plant roots. Symptoms on leaves look pale or yellow leaf tips and edges folded inward. Then the autumn leaves and twigs into dead ends. There are times when formed young leaves, or flowers and fruits earlier. On plant roots seem ill threads of white mushrooms and a bit thick (rizomorf). Mushrooms sometimes forming a cap-like fruit bodies yellowish orange at the base of the plant roots. In severe attacks, the plant roots to rot so easily uprooted plants and dead. Death often propagate plants on neighboring plants. Transmission of the fungus usually takes place through root contacts into tunggultunggul healthy plants, the remaining root or roots of plants diseased plants. White root disease is common in the age of 1-5 years of rubber planting, especially in the bush, many of the remaining stump or roots of plants and in loose or sandy soil.

3.2.3 Tapping/Harvest

The production of latex from rubber trees in addition determined by the state soil and plant growth, superior clones, are also influenced by the techniques and tapping management. If all three criteria can be met, it is expected that the rubber plant at the age of 5-6 years have met the criteria for tapping mature. Criteria, among others, when mature tapping girth circumference at a height of 130 cm from the ground have achieved a minimum of 45 cm. If 60% of the population of plants have met these criteria, then the crop is harvested.

High aperture tapping

High aperture tapping, either by the system leads down (Down ward tapping system, DTS) as well as tapping into the above system (Upward tapping system, UTS) is 130 cm measured from the ground.

The exposure time of tapping

The exposure time of tapping is 2 times a year ie, on (a) the beginning of the rainy season (June) and (b) the beginning of the intensification of lead (in October). Therefore, it does not automatically mature plants that have been intercepted and directly tapped, but must wait on the arrival time.

The slope of the slice tapping

In general, the early lead, starting with a wedge angle of 400 leads from the horizontal line. On the bottom lead system, a large angle will become smaller slices of up to 300 when approaching "elephant foot" (the former linkage grafting). In the system leads to the top, the corner will be getting bigger slices.

The transition of plants from the TMB to the TM

Theoretically, if supported by a healthy condition and good growth, plants have met the criteria of a mature rubber tapping at the age of 5-6 years. With reference to these standards, means starting at the age of 6 years of rubber can be said to have a generating plant or TM.

Tapping System

Today tapping system has been developed by combining low-intensity tapping with Ethrel stimulation during the cycle tappers. For rubber, given the socio-economic conditions of farmers, it is recommended using conventional tapping system.

3.3 Oil Palm Nursery Activities and Management

When seedlings have formed about 5 leaves the seedlings are transplanted to new black polythene bags, 40 cm x 50 cm, partly filled with light topsoil. At transplanting, the old bag is split and seedling with a ball of soil around the roots is put in the new soil carefully. The bags are placed very close together at 90 cm x 90 cm. They are each supplied with a thin line of water pipe. Mulch, using pieces of empty fruit bunched, is placed on the ground between the bags (Plate 3-3). One or two large spoonfuls of fertilizer containing NPK and Mg are applied to the soil in each bag once in 6 months.

Loose seedlings are consolidated. The seedlings are observed and examined for disease symptoms and pests (i.e. phyto-sanitary observation) and poorly developed and unhealthy ones are removed (culling).

For the period of nursery life (11-15 months) maintenance activities include:

- Mulching
- Watering (irrigation)
- Weeding
- Application with DECIS, an organophosphorus insecticide
- Fertilizer application: boiler ash, muriate of potash, urea, PKC and NPK once every 6 months
- Consolidation of loose seedlings
- Phyto-sanitary observations
- Culling.

Plate 3-3: Oil Palm Nursery

3.3.1 Preparation for Field Planting

Activities include:

- New plantation boundary demarcation
- Study of topography of the new plantation
- Plantation design and general layout
- Drainage design
- Road design and length to carry of bunches by harvesters to the road side; collection roads will be laid straight and in an N-S direction and connect with sub-main E-W roads.
- Opening of roads and tracks. Trees will be felled, shrubs and weeds completely cleared for vehicular access and to allow lining and holing to be carried out.
- Under brushing: the bush/farmlands/swamp forests will be cleared with cutlasses and axes
- Stacking, stumping and re-stacking

The land will be cleared of trees and bush well in advance of the planting season, that is, in dry season before the beginning of the rainy season.

3.3.2 Planting/Transplanting to the Field

Activities include:

- Tracing 1st and 2nd
- Blocking out; plantation will be subdivided into blocks.
- Peg preparation.
- Lining.
- Cover crop will be sown inter-row to prevent establishment of other weeds, to check soil erosion and add nitrogen to soil.
- Holing; holes about 60cm deep and 60cm wide will be dug and spaced out at intervals of 9m in a triangular pattern and parallel rows.
- Transportation of well-watered seedlings and distribution into holes.
- At the planting site, the bottom of the black polybag will be cut out and removed, the seedling placed in the hole, then the side of the bag will be split and the polybag carefully removed. The space around the seedling will be filled with rich topsoil with added fertilizer and firmed down well.

- Weeding to bare ground around planted seedling of 1 metre radius (ring weeding).
- Protecting seedlings against mice and rats with wire netting.
- Regular detection of seedling for diseases to enable quick response (phyto-sanitary supervision).
- Replacement of dead seedlings.

3.3.3 Operational/Maintenance of Oil Palm Plantation

- Weeding, particularly to remove guinea grass, and weeds such as *Sida acuta*, *chromolaena odorata* (siam weed), e.t.c.
- Consolidation (due to wind effect) of seedlings
- Rodent control
- Ablation; to increase yield of the first harvesting years by removal by hand of the first female inflorescences appearing on young palms
- Removal of abnormal plants by felling
- Replacement of dead palms
- Fertilizer/mulch application; EFBs, muriate of potash, urea, PKC and NPK
- Removal of dead leaves
- Pruning, to enable viewing of ripening of bunches in the crown
- Maintenance of roads and tracks
- Regular detection of nutrient deficiencies, diseases of adult palms, insect pest such as the West African oil palm leaf miner and the red spider mite. The agrochemicals to be used are those that are not on the banned list of FMEnv and the quantities are to be determined based on disease/pest attack.
- Fire control; plantation is protected from spreading of bush burning from outside the estate by having wide earth roads; dry fronds are removed. No bush burning is practiced at Okomu OPC.
- Harvesting: the best tool for harvesting at age 3 to 10 years is a chisel with a blade about 10cm wide. Sharp cutlasses can also be used. The leaf bases, below the mature, ripe bunches, are cut and leaves (fronds) removed to expose the stalk of the fruit bunch, which is then sliced through with the cutlass or chisel. Tall and very tall trees are harvested with a pole/long handle with a curved sharp/hooked knife attached at the tip
- Collection; bunches are normally carried in basins from the field to collecting points on the roadside and then manually loaded into tractors or tractor-drawn receptacles.

3.4 Other key Project Components

This include road demarcation of about 50km earth road, construction of residential quarters ,workshop and powerhouse which will have land intake of about 10 hectares and conservation area of 750 hectares (about 25%). Another project component is irrigation water for the nursery which is basically from borehole water.

3.5 Waste Management

The consultant requested Okomu Oil Palm Company Plc to provide details of the project such as project description and the waste management that shall be put in place, in particular, a comprehensive description of activities at preconstruction, construction, operational and abandonment phases of project. During site visits, the waste management practices were observed and the company's internal environmental management system (EMS) was ascertained.

3.5.1 Waste Classification

The wide range of waste that will be generated by the plantation crop development project during construction and operation phases are classified into solid waste, liquid waste and gaseous emissions.

3.5.2 Waste Generation and Sources

The largest amount of solid waste will be generated from the field which are mostly organic in nature, but the residential area will generate the liquid waste, while the bulk of the gaseous emission comes from the powerhouse and during land preparation from heavy machinery. The waste profile is presented in Table 3-1.

3.5.3 Solid Waste Handling

Storage:At all the points of waste generation, waste bins will be provided for the immediate storage of solid waste. Provision would also be made for sorting and segregation of waste at the point of generation. There is an existing storage site (solid waste dumpsite) for all types of waste on the estate which is going to be fenced. Moreso, there exist waste management plans where wealth shall be generated from wastes as much as it is practicable.

Collection and Transfer: Waste collection and transfer would include the provision of a truck to collect and transport the collected waste to a designated dumpsite.

Disposal: The solid waste collected would be transported and disposed of at the dumpsite. There is an existing solid waste dumpsite on the estate. The existing dumpsite has enough capacity to service the project.

3.5.4 Liquid Waste Handling

Wastewater: Wastewater will be channelled into soak-away pits attached to every building.

Storm water: Rainstorm water will be collected in channels and led into natural drainage lines and vegetation.

Table 3-1: Waste Profile of the Proposed Plantation Expansion Projectat Extension One

Project Phase	**Waste Characterization**		
	Solid	**Liquid**	**Gaseous**
Development *(Land Preparation)*	❑ Soil and vegetation ❑ Shrubs ❑ Food Waste ❑ Spoilt farm equipment ❑ Organic materials	❑ Engine oil ❑ Spent oil	❑ Fugitive Dust ❑ Suspended Particulate ❑ Carbon dioxide ❑ Carbon monoxide ❑ Greenhouse Gases
Development *(Planting)*	❑ Seedling Polybags ❑ Dust ❑ Polythene bags ❑ Paper	❑ Spent Oil	❑ Fugitive Dust ❑ Suspended Particulate ❑ Carbon dioxide ❑ Carbon monoxide ❑ Greenhouse Gases
Operations *(Field Maintenance)*	❑ Dust ❑ Agrochemical containers ❑ Fertilizer bags ❑ Used drums and buckets	❑ Wastewater	❑ Fugitive Dust ❑ Suspended Particulate ❑ Carbon dioxide ❑ Carbon monoxide
Operations *(Harvesting and Tapping)*	❑ Papers/plastics/glass ❑ Scrap office equipment ❑ Used latex cups ❑ Cup hangers ❑ Spout ❑ Used drums and buckets ❑ Syringes ❑ Cotton wool and Bandages ❑ Hand gloves ❑ Empty injection bottles ❑ Sanitary pads	❑ Wastewater ❑ Expired drugs ❑ Wastewater ❑ Blood	❑ Carbon dioxide ❑ Carbon monoxide ❑ Fumes ❑ Carbon dioxide ❑ Carbon monoxide ❑ Fumes

(Clinic) *(Residences)*	❑ Nylons ❑ Expired drugs ❑ Cloths ❑ Nylon ❑ Spoilt food ❑ Leaves ❑ Charcoal ❑ Ashes ❑ Plastics & Glass Bottles ❑ Cans and Papers	❑ Wastewater	❑ Carbon dioxide ❑ Aerosols ❑ Carbon monoxide ❑ Vapour
Operation *(Offices)*	❑ Papers ❑ Hardware and scraps ❑ Plastics ❑ Metals	❑ Wastewater	❑ Carbon dioxide
Operation *(Stores)*	❑ Papers, ❑ Plastics ❑ Nylon ❑ Wood ❑ Hand gloves & Nose masks	❑ Wastewater	❑ Carbon dioxide ❑ Chemical fumes ❑ Fumes/Vapour
Operation *(Powerhouse)*	❑ Plastics ❑ Empty cans ❑ Electric cables	❑ Wastewater ❑ Spilled Oil ❑ Spent Oil	❑ Suspended Particulate ❑ Carbon dioxide ❑ Carbon monoxide ❑ Greenhouse Gases

3.5.5 Waste Re-use/Re-cycling

As much as possible, waste will be minimized. A place will be designated for keeping all reusable waste.

3.5.6 Waste Manifest and Tracking

A manifest system will be established and record kept appropriately ensuring that waste is tracked from "cradle to grave".

3.6 Waste Management Plan

No waste shall be discharged into any wetland without adequate treatment.

Table 3-2 shows the proposed waste management plan to be put in place.

Table 3-2: Waste Management Plan for Proposed Plantation Expansion Project at Extension One

Type of Waste	Waste From	Waste Management Option			Disposal	
		Reduce	Re-use	Recycle	Forest/ Swamp	Land
Gaseous	Heavy duty machines (Land Preparation)	Installation of appropriate filters to exhaust pipe			-	-
Noise	Machinery, generators and Turbine	Installation of appropriate noise Reducing devices			-	-
Liquid	Residential Areas (Wastewater)	-	-	-	None	Soak-away pits attached to buildings.
	Sanitary from Toilets	-	Used in the field	-	None	Appropriately designed Septic tanks
	Oil traps				None	Trapping of oil using retention trays
Solid	Domestic waste	Collected and taken to the dumpsite				-
	Plantation Crop leaves, shrubs, palm fronts, tree back.	Remained in the field as manure				-
	Hazardous wastes such as empty agrochemical containers	Taken away by the manufactures and/or suppliers as part of agreement deal.				-

- Waste management option

None: Not discharged into/disposed off in the habitat

3.7 Decommissioning and Abandonment Phase

3.7.1 Oil Palm Life Cycle

The life cycles of rubber and oil palm are presented as follows:

Element	Rubber	Oil Palm
Nursery	15-18 Months	11-15 Months
First Harvest	72-80 Months	32-38 Months
Peak Yield	12-18 Years	5-10 Years
Economic Life	30-35 Years	20-25 Years
Life Span	200 Years	200 Years

3.7.2 Decommissioning and Abandonment

Rubber and Oil palm plantations exist for many decades, even centuries. The ownership of a plantation may change but total abandonment is not common. However, a number of factors that may lead to decommissioning and abandonment include:

- Lack of experience and knowledge of operational activities
- Use of out-dated management principle and practices
- Top management sharp financial malpractices
- Non-payment of workers' salaries
- Neglect of host communities

3.8 Project Schedule

Schedule of activities to be carried out from 1st quarter 2012 to fourth quarter 2018 is provided in Section 3.1.2 and also below:

Activities	2010	2011	2012	2013	2014	2015	2016	2017	2018
EIA Process									
Plantation boundary demarcation									
Opening of roads and tracks									
Site clearing									
Stacking, stumping and restacking									
Disposal of vegetation									
Tracing and blocking out									
Peg preparation									
Cover crop sowing									
Holing and transplanting of seedlings									
Consolidation of seedlings									
Protection of planted seedlings									
Upkeep									
Construction of additional housing and Powerhouse									
Establishment of Conservation Area									

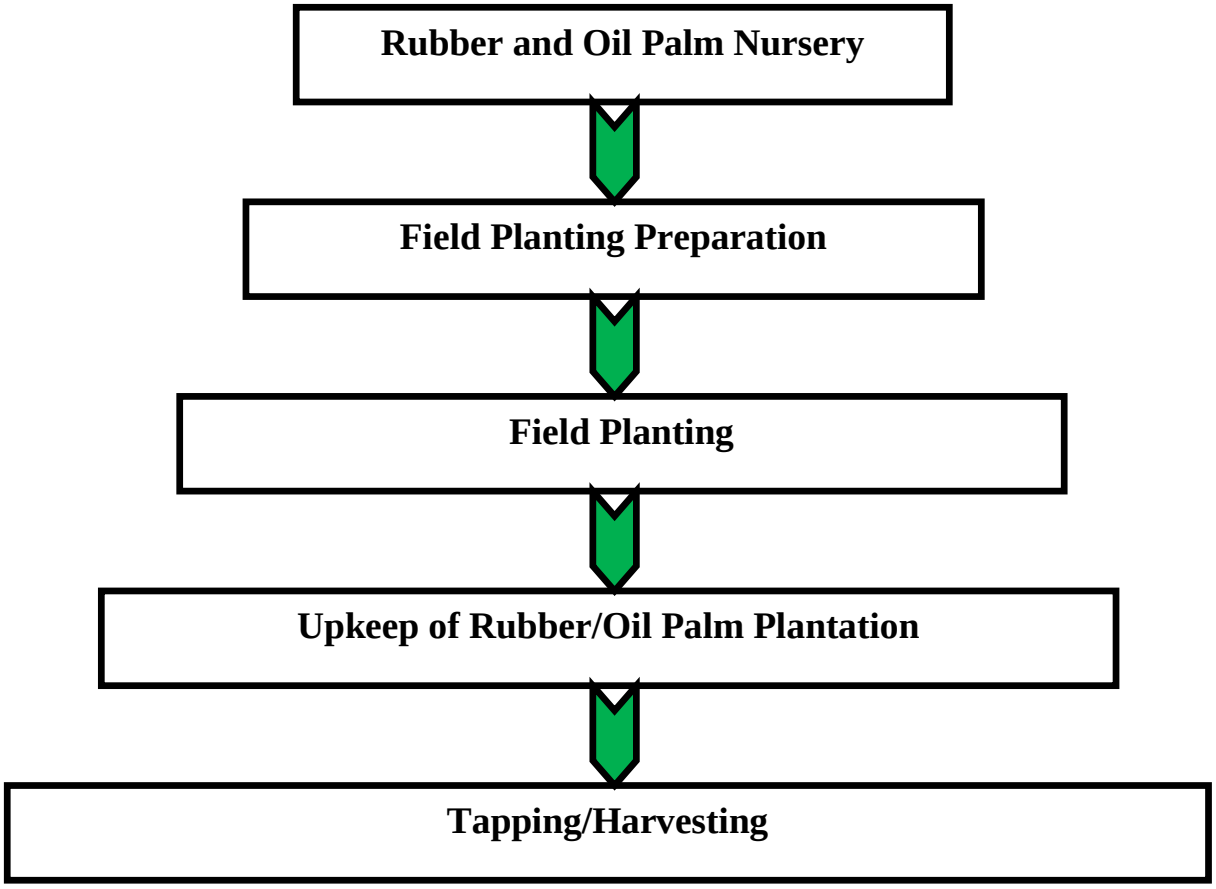


Figure 3-1: Project Schematics/Layout

CHAPTER FOUR

4.0 DESCRIPTION OF THE EXISTING ENVIRONMENT (BASELINE)

4.1 Methodology

4.1.1 Data Acquisition From Literature

a. The bulk of the information on the project area was obtained from previous studies including biodiversity studies for vegetation and large mammals, socio-economic study and the soil survey and land evaluation of Extension I.

b. Background information on the oil palm industry and rubber industry in Nigeria was obtained from the Nigerian Institute for Oil Palm Research (NIFOR) and the Rubber Research Institute of Nigeria (RRIN)and other technical notes from the Agriculture and/or Plantation department of the Okomu Oil Palm Company Plc.

c. The relevant institutional, legal and regulatory framework was obtained from publications by the regulatory agencies and ministries.

d. The other related data were sourced from the company's environmental audit and environmental monitoring reports covering the project site in the last eight years.

e. Proforest: Assessment of High Conservation Values in Parts of Okomu's Extension I Concession, Ovia Southwest Local Government Area, Edo State, Nigeria.

4.2 Period of Field Data Gatherings

Preliminary field study and actual data gathering, covering all the seasons actually started in 2009 as part of the environmental management system of the Okomu Oil Palm Company Plc. However, for the EIA proper, after completing the scoping, the first (dry) season field data gathering started on 10th January 2012 to 20th February 2012, both days inclusive. The second and wet season field work took place from 10th September 2012 to 21st September 2012, both days inclusive. Data on socio-economic characterstics, land use and soil survey were obtained between November 2009 and March 2010.

In addition to field data gathering, all the relevant environmental parameters including air quality, noise level, air temperature, vegetation type, plant

form/species and socio-economic were updated and/or validated in December 2015 and 14th to 27th June 2016. This is to make up for any changes that might have occurred between the previous data gathering and now as the environment is dynamic.

4.2.1 Sampling Points and Control

Sampling and observation points were established across the plantation land covering the existing developed part and the part proposed for expansion. At each sampling location, the GPS location was taken and all the relevant environmental parameters including air quality, noise level, air temperature, soil, vegetation type, plant form/species and their densities, terrestrial fauna particularly invertebrate species and densities were sampled or observed. Wildlife, especially large mammals were also directly and indirectly observed.

The sampling locations were within the spatial boundaries of the study area which is about 5 km from project boundaries, while the control sampling points were appropriately located both within and outside the project boundaries. The sampling points are presented in Table 4-1a and Table 4-1b, while they are illustrated in Map 4-1a and Map 4-1b respectively.

Table 4-1a: Sampling Points and Control Location

Sample Points	Coordinates – 31N		Elevation (m)	Environmental Component
	(UTM Easting)	(UTM Northing)		
OKM_{exq1} (Control Point)	**0746250.33**	**0687875.25**	**81**	**Groundwater**
OKM_{exn2}	0746665.97	0688549.61	87	Groundwater
OKM_3	0746637.62	0688446.61	87	Groundwater
SP1 (Control Point)	**0762421**	**0699221**	**68**	**Biodiversity Study; Flora and Fauna**
SP2	0764395	0700587	65	Biodiversity Study; Flora and Fauna
SP3	0763162	0702221	75	Biodiversity Study; Flora and Fauna
SP4	0761956	0702466	70	Biodiversity Study; Flora and Fauna
SP5	0762659	0704076	81	Biodiversity Study; Flora and Fauna
SP6	0763348	0704548	81	Biodiversity Study; Flora and Fauna
SP7	0765175	0704647	85	Biodiversity Study; Flora and Fauna
SP8	0765320	0705031	91	Biodiversity Study; Flora

				and Fauna
SP9	0766915	0703894	36	Biodiversity Study; Flora and Fauna
SP10	0766817	0703659	42	Biodiversity Study; Flora and Fauna
SP11	0766962	0701687	26	Biodiversity Study; Flora and Fauna
SP12	0765096	0702218	68	Biodiversity Study; Flora and Fauna
SP13	0765166	0702737	76	Biodiversity Study; Flora and Fauna
SP14	0764030	0702396	74	Biodiversity Study; Flora and Fauna
SP15	0762623	0707100	75	Biodiversity Study; Flora and Fauna
SP16	0745303.01	0685943.05	12	Arakhuan upstream Biodiversity Study; Flora and Fauna, Air and Noise
SP17	0745800.31	0684042.35	22	Arakhuan downstream Biodiversity Study; Flora and Fauna, Air and Noise

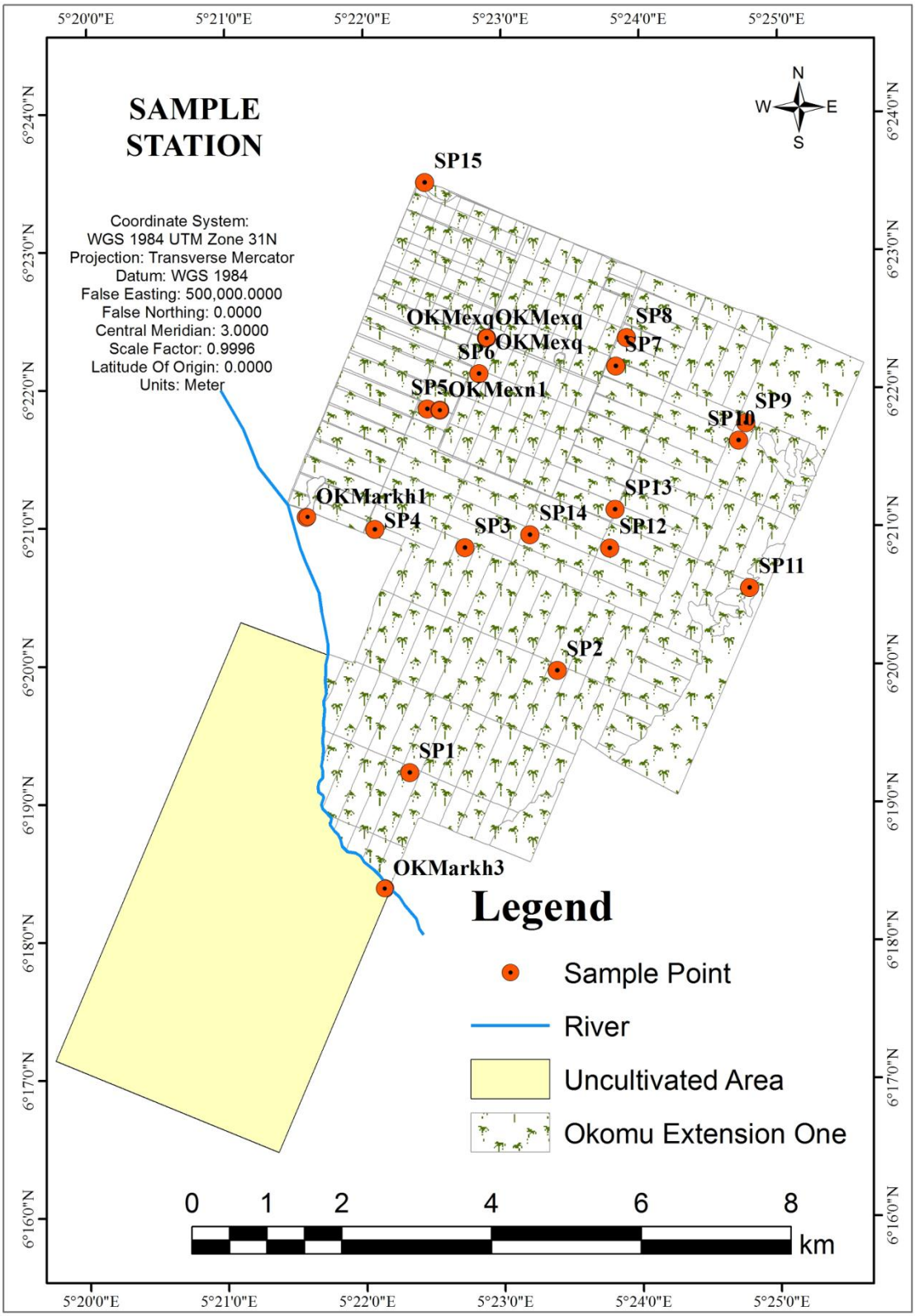
Source: Okomu OPC – EIA Field work, 2011, 2015 and 2016

Table 4-1b: Sampling Points Location – Soil Profiles

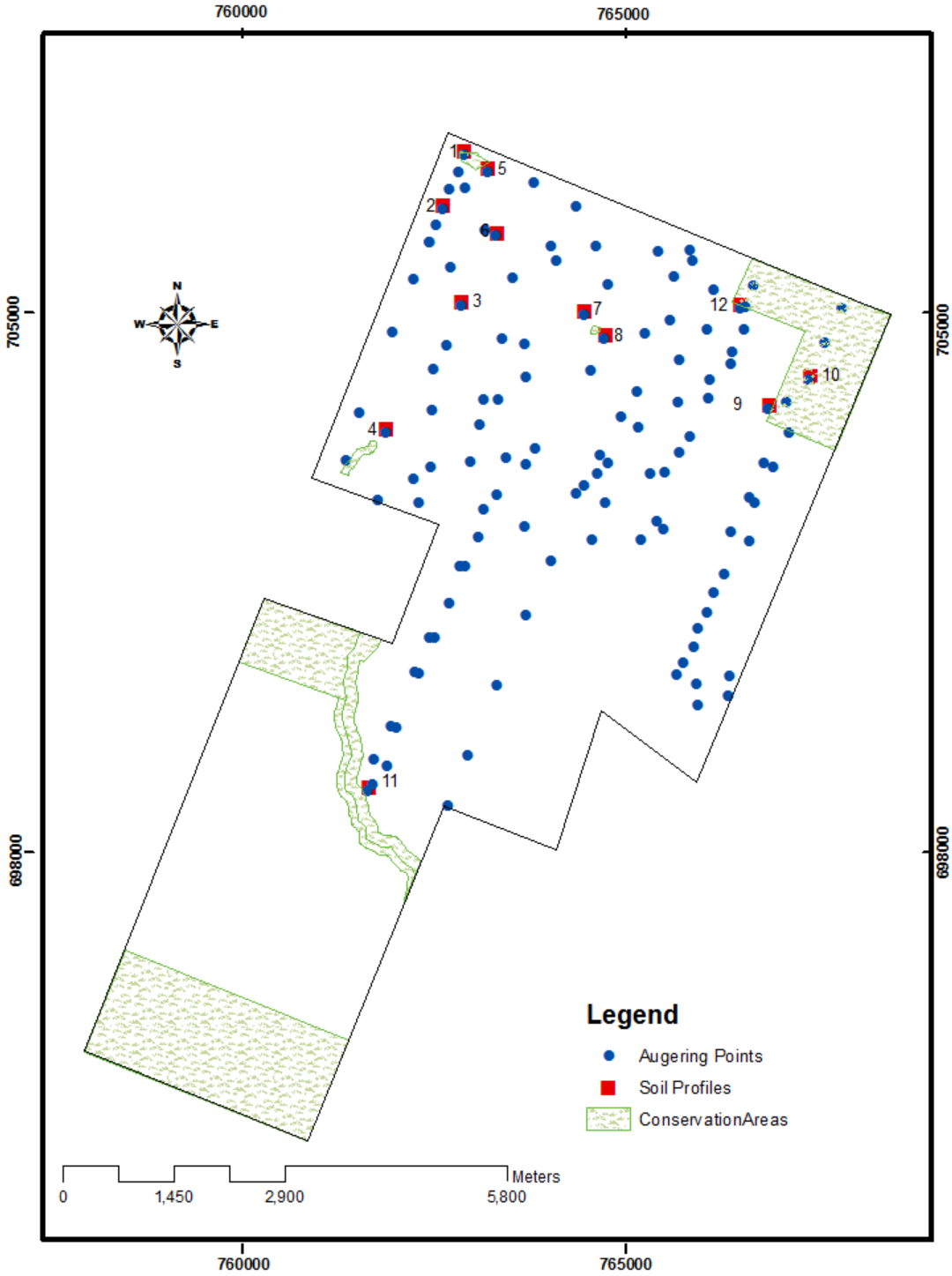
SoilProfile No.	Location		
	Longitude(^{O}E)	Latitude(^{O}N)	Vegetation/ LandUse
1	5.373595	6.391562	Rubber
2	5.371028	6.385187	Rubber
3	5.376373	6.389532	OilPalm(2003)
4	5.377317	6.381988	OilPalm
5	5.3876	6.372675	Grasses
6	5.389977	6.369857	Rubber
7	5.373185	6.373863	Rubber
8	5.364268	6.359018	
9	5.40596	6.373412	OilPalm
10	5.361968	6.316863	Forest/Plantain/Cassava
11	5.40917	6.36154	Forest/Cocoa/Plantain
12	5.41404	6.36499	OilPalm

Source: Okomu OPC – EIA Field work, 2012

The distribution of the soil profile pits and auger points are illustrated in Map 4-1b, while their locations are provided in Table 4-1b above.



Map 4-1a:Locations of Sampling Points



Map 4-1b:Locations of Augering Points and Soil Profiles

Wet Season

In the wet season study period, sampling was carried out at exactly same locations as those of the dry season. The previous dry season locations had been marked and in the wet season sampling, they were confirmed with the aid of the GPS (eTred Legend Garmin model)

Control Locations

Two control locations were stationed along the riparian forest/buffer vegetation within the proponent plantation.

4.3 Terrestrial Ecology

4.3.1 Air Quality and Noise Level

a) Air Temperature

For air temperature and humidity of ambient conditions, a digital thermometer, Fisher Scientific Hygrometer was used.

b) Radiation

A radiation survey meter known as Biorad Radiation and Contamination Survey Monitor, was used in detection and determination of any radiation in milliard (mR) counts per minutes (CPM).

c) Gases

In-situ determination of the gases was carried out using portable gas analyzers. The ambient air was monitored using GasTech GT402 to measure the concentration of CO, O_2, Non-methane hydrocarbons, and H_2S. BWT Gas Alert was used to determine the concentration of NO_2 and Ogawa Air Samplers were used for the sampling of SO_2 and subsequently analysed in the laboratory to determine the concentration of the gas.

d) Suspended Particulate Matter, (SPM)

PPM 1055 Hand-held Aerosol Monitor was used to determine Suspended Particulate Matter (SPM).

e) Noise level measurement

Sound level was measured at same point as that for air quality. A CEL-254 Sound level meter was first calibrated and re-checked before determining the sound level. The reading was allowed to stabilize before recording in decibel units {dB(A)}.

4.3.2 Climate and Meteorology

The meteorological data were obtained from the meteorological station of the company, both at Extension I and the main estate. The data included those for rainfall, temperature, relative humidity, sunshine hours and raining days.

4.3.3 Soil

A full soil survey and land evaluation was conducted in December 2010 and it covered about 4000 hectares of land north of the Arakhuan stream that is intended for cultivation. The soil survey and land evaluation was carried out using the procedure of the FAO (see Appendix A).

4.3.4 Biodiversity

The ecological methods employed were based on Maxwell (1971), Bennett and Humphries (1977), Wratten and Fry (1980) and Southwood (1992). Line transect system of sampling was employed (Slingsby and Cook, 1989; Southwood, 1992) and on the following guidance documents (HCV Report by Proforest; December 2015):

1. Brown, E., N. Dudley, A. Lindhe, D.R. Muhtaman, C. Stewart, and T. Synnott (eds.). 2013 (October).Common Guidance for the identification of High Conservation Values.HCV Resource Network. https://www.hcvnetwork.org/resources/cg-identification-sep-2014-english
2. Brown, E. and M.J.M. Senior. 2014 (September).Common Guidance for the Management and Monitoring of HCVs. HCV Resource Network. . https://www.hcvnetwork.org/resources/cg-management-and-monitoring-2014-english
3. The HCV Assessment Manual prepared by Proforest for the HCV-RN.

Several other information sources have been used (see references) including the relatively recent reference: ZSL's Guide (ZSL, 2013) to Conserving HCV Species and Habitats in West African Oil Palm Landscapes. Others include an interpretation of global HCVF toolkit for use in Ghana published by WWF (Rayden et. al., 2006) and a similar version for Gabon (Stewart and Rayden, 2008).

4.3.5 Vegetation:

A central recce line that runs zigzag, dividing the area diagonally into two with an estimated distance of 32.6km was cut from north to southern end of the area. Its zigzag style did allow the line to touch the east and west end of the area at certain points and perpendicular to the major stream –Arakhuan allowing the vegetation team to survey representative sample of habitat types.

Inventory of tree species and other plant forms were carried out along the recce route wherever there were relics of forest patches, logged over vegetation and old or seemingly abandoned farmlands. This inventory started where the route continued on the 17t of December, 2009 at 6.35^0N, 5.37^0E where a total of forty (40) temporary plots of one hectare (1ha) size each were randomly enumerated within the remaining uncultivated vegetation along the central zigzag transect line.

4.3.6 Wildlife

Data collection took place from 7.00am to 3.00pm everyday between the 14th and 20th of December 2009. The survey route followed predetermined bearing approximately on a straight line direction on available roads, trails and foot path and when none is available $\pm 30^o$ either direction of the desired bearing, a trail is cut with a cutlass for navigation. Along the survey route, all evidences of wildlife especially of large mammals were recorded including dung, footprint, feeding evidence, debarking and other signs of their activities. For every observation made, related information is also noted such as the type of sign; age; species; time of day; vegetation; geographic coordinates and additional notes was made for unusual observations.

4.4 Aquatic Biology

4.4.1 Rivers

The Arakhuan stream originates outside the west boundary. It traverses the land running southward and cutting through the eastern boundary. The flow of the Arakhuan stream is somewhat seasonal and irregular. It is mostly sub-surface flow, thus limiting its aquatic activities.

(a) Water Chemistry:

i. Two (2Nos.) 2 litres white plastic kegs were filled with river water by collecting water just below the surface. The kegs were put in Cooling Boxes containing ice blocks for subsequent determination of physico-chemical characteristics.

ii. Water from just below the river surface was similarly collected with the aid of a fresh plastic bucket from which some water was poured into a 400ml beaker. This was used for direct determination of pH, conductivity and dissolved oxygen on location (on-site).

iii. Two fresh 500ml glass-stoppered bottles were filled with the water and wrapped in aluminium foil and also put in the ice-chest coolers for subsequent determination of hydrocarbon content.

iv. A 250ml glass bottle was lowered just below the river surface and filled with water. After tipping off a small quantity of water, dissolved oxygen was fixed using Winkler's reagent ampoules A (colourless) and B (brownish) and the bottle stoppered with glass stopper. Dissolved Oxygen was thus determined directly with a hand-held Salinometer and by Winkler's method.

v. Temperature of the water was determined using the VWR 2000 Digital Thermometer. The thermometer electrode meter was immersed below the water surface for about 5 minutes before taking the reading.

The environmental monitoring at Okomu Oil Palm Company Plc include the sampling of surface river(Arakhuan stream) both upstream and downstream on quarterly basis. The results, of laboratory analyses of surface river samples for dry and wet seasons are presented in Table 4-2a and Table 4-2b below.

Table 4-2a:Physico-chemical and Biochemical Analyses Results of Arakhuan Stream at OOPC Extension One (Dry Season, January 12th, 2012)

PARAMETER/UNIT	FMENv.	ARAKHUAN STREAM	
		OKM_{ARKH2} UPSTREAM N 0745303.01 E 0685943.05 (CONTROL)	**OKM_{ARKH3} DOWNSTREAM N 0745800.31 E 0684042.35**
Appearance	Colourless & Clear	Slightly Turbid	Colourless with particles
Colour (PCU)		40.00	0.75
Turbidity (FTU)		45.00	20.00
Conductivity (µs/cm)		165.00	85.00
pH	6.5-9.5	6.82	6.60
Acidity (mg/L)		10.02	15.03
Alkalinity (mg/L)		32.16	45.65
Total Hardness (mg/L)	500.00	8.06	15.80
Calcium Hardness (mg/L)	300.00	8.06	13.43
Magnesium Hardness (mg/L)	200.00	ND	2.37
Total Solids (mg/L)	1,000.00	120.00	80.00
Total Suspended Solids (mg/L)	ND	5.00	5.00
Total Dissolved Solids (mg/L)		115.00	75.00
Phosphate (mg/L)		ND	0.33
Nitrate (mg/L)		ND	ND
Sulphate (mg/L)	100.00	6.08	7.10
Chloride (mg/L)	250.00	11.23	10.05
Sodium Chloride		18.65	16.58
Dissolved Oxygen (mg/L)		4.05	3.85
METALS (mg/L)			
Iron	0.30	0.41	0.06
Lead	0.01	ND	ND
Copper	2.00	0.04	0.04
Nickel	0.02	ND	ND
Cadmium	0.003	ND	ND
Zinc	3.00	0.11	0.11
Chromium	0.05	ND	ND
Manganese	0.40	ND	0.04

Note: ND = Non – Detectable

Comment:

The overall quality of the water sample analysed does not satisfy WHO Standards for drinking water quality due to its slightly turbid appearance, high total suspended solids value and Iron metal content.

Table 4-2b:Physico-chemical and Biochemical Analyses Results of Arakhuan Stream at OOPC Extension One (Wet Season, September 20th, 2012)

PARAMETER/UNIT	FMENv.	ARAKHUAN STREAM	
		OKM_{ARKH2} Inlet N 0745303.01 E 0685943.05 (CONTROL)	**OKM_{ARKH3} Outlet N 0745800.31 E 0684042.35**
Appearance	Colourless & Clear	Colourless & clear	Colourless and clear
Colour (PCU)		ND	ND
Turbidity (FTU)		ND	ND
Conductivity (µs/cm)		60.00	85.00
pH	6.5-9.5	6.55	6.70
Acidity (mg/L)		13.15	13.15
Alkalinity (mg/L)		24.55	38.53
Total Hardness (mg/L)	500.00	32.55	55.00
Calcium Hardness (mg/L)	300.00	22.00	30.05
Magnesium Hardness (mg/L)	200.00	20.55	25.95
Total Solids (mg/L)	1,000.00	40.00	70
Total Suspended Solids (mg/L)	ND	ND	ND
Total Dissolved Solids (mg/L)		40.00	70
Phosphate (mg/L)		ND	0.32
Nitrate (mg/L)		ND	ND
Sulphate (mg/L)	100.00	2.09	0.39
Chloride (mg/L)	250.00	10.30	7.75
Sodium Chloride		16.35	13.14
Dissolved Oxygen (mg/L)		4.30	4.59
METALS (mg/L)			
Iron	0.30	ND	ND
Lead	0.01	ND	ND
Copper	2.00	0.03	0.03
Nickel	0.02	ND	ND
Cadmium	0.003	ND	ND
Zinc	3.00	0.23	0.30
Chromium	0.05	ND	ND
Manganese	0.40	0.22	0.21

Note: ND = Non – Detectable

Comment:

The overall quality of the water sample analysed satisfy WHO Standards for drinking water quality.

b) Other Physical Characteristics:

Transparency of the river was determined with the aid of a black and white heavy Secchi disc. The speed or water current was determined by timing a very light floating white paper.

c) Sediment Sampling:

Sediment was collected with a medium size van Veen grab into two fresh polythene bags, one for physico-chemical determination and the other for microbiological determination and kept in the ice-chest cooler.

d) Plankton:

A 55µg mesh-size plankton net was used to collect plankton. The net was towed while inside the river (shallow) with its open end held at the surface of the fast flowing water against the direction of water flow for about 5 minutes. Collected plankton was preserved in 4% formalin in properly labelled and coded wide-mouth specimen container.

e) Benthos:

Sieved sediment did not contain benthos. The sediments were almost pure sand hence no in-fauna benthos were present. The bottom edges of the river were sampled with a pond net. No in-fauna benthos was also found.

f) Fisheries Resources In the Freshwater River

At the Arakhuan stream sampling point, basket fish traps were set. These were examined every two days for the duration of the field work in both seasons (dry and wet). However, neither fingerlings nor table size of any fish species were present in the freshwater.

4.5 Baseline Socio-Economic Environment

The proposed project site is very far away from any external or host community. However, a community of migrant farmers illegally occupy part of the land in five camps. Notices have been served to these farmers to vacate the land. Nevertheless, a baseline socio-economic survey was carried out in September 2009 to December 2009.

A combination of primary data collection techniques were used for the survey. These included in-depth interviews, using a checklist of questions that were held with key informants in the camps to gather baseline information on the current socio-economic conditions of the migrants. The key informants interviewed included the head/founders of the camps or their representative.

In addition, a structured questionnaire was employed to gather information from the key informants in the camps. Household surveys were also conducted, to obtain the demographic profile of the communities. Survey team members walked through the camps and made direct inquiry from heads of households on the number of occupants in the house. Visit by the survey team members to the five camps and farmlands located in Extension One, enhanced, direct observation of the situation on ground.

All the households in each of the settlements were interviewed. Before visiting the households in each of the settlements, at least two general meetings were held with the people. In each settlement the first meeting was held with the chiefs and other members of the camp who were available at such times. Many more of the villagers however attended the second meeting which was actually when the interview and household surveys were conducted.

During the first meeting at Hassan Camp, more than fifty people were present, at Fatai camp about 20 people were present, while at the remaining three camps about 10 people were present. However during the second meetings, virtually every member of the camp was present, except those who have travelled out of the camp and could not be contacted by the camp leadership.

Prior to the field work for the survey, Hassan camp had been identified as the oldest and biggest settlement in Extension One. It was therefore good reason to start the survey from there. Also, because the other settlements sprang up from the Hassan Camp, it was possible to get the initial information about the other settlements from there.

4.6 Laboratory Analysis

a) Water Chemistry:

The physico-chemical characteristics of the borehole and surface waters were determined using the standard methods and equipment shown in Table 4-3.

b) Soil Permeability:

Permeability was determined using a falling head Permeameter in which water was passed through a soil sample and the hydraulic gradient and quantity of water flowing into/through the sample were measured. The geology/hydrogeology of the proposed site was also examined as explained in section 4.7.6.

(c) Microbiology:

Total heterotrophic counts of bacteria were determined in different agar media: Nutrient, MacConkey and Mineral Salt. For hydrocarbon utilizing bacteria, Mineral Salt Agar was used to isolate the degraders. After the sample had been spread on the medium, a sterile filter was soaked in crude oil and placed on the top cover of the Petri dish and incubated for 4 to 14 days during which the vapour from the crude oil came in contact with the micro-organisms and the growth observed indicated that they were hydrocarbon degrader.

d) Benthos and Plankton

Invertebrates were identified with the aid of Quigley (1977) and Macan (1960) and the fish with the aid of Holden and Reed (1991).

All plankton samples, on settling were concentrated to 10ml and aliquots of this were investigated in several microscope fields under a binocular M11 Wild microscope as described by Lackey (1938). Identification and counting of phytoplankton were done using Davis (1958), Kendey (1964) and Patrick and Reimer (1966-1975) and zooplankton by Davies (1958) and Olaniyan (1975). Plankton counts were recorded as number of cells or filaments per ml of sample.

Table 4-3: Summary of Analytical Methods and Equipment Employed in Laboratory Analysis of Water Sediment and Soil Samples.

Parameters	Equipment/Technique
pH	VWR 2000 pH/ Temperature/Electrode Potential Meter
Temperature ^0C	VWR 2000 pH/ Temperature/Electrode
Conductivity (mS/cm)	Potential Meter
Salinity $^0/_{00}$	Salinometer
Dissolved Oxygen, mg/l	DO meter and Winkler's reagents
Turbidity, NTU	Turbidity Meter
Biochemical Oxygen Demand,mg/l	Hach BOD track
Chemical Oxygen Demand, mg/l	Hach COD track
Nitrate, mg/l	Hanna H1 8733 Meter
Phosphate, mg/l	Colorimetry with phenoldisulphionic acid
Sulphate, mg/l	Colorimetry with molybdenum blue solution
Oil and Grease, mg/l	Turbidimetry and photometry
Total Dissolved Solid, mg/l	Gravimetry after drying to constant weight
Total Suspended Solid, mg/l	Gravimetry after drying to constant weight
Heavy Metals (ppm)	AAS, UNICAM 939, after digestion
Soil Permeability	Falling head permeability test
Soil Hydrogeology	Digital ABEM SAS 300c Resistivity Meter via Schlumberger Array Configuration

4.7 THE EXISTING ENVIRONMENT

4.7.1 The Project Site

4.7.1.1 Location

The area known as Extension One is located within geographic coordinates from top left at 6º23.514'E, 5º22.399'N, to top right at 6º22.165'E 5º25.723'N; bottom left at 6º17.369'E, 5º19.922'N while at the bottom right is 6º16.870'E 5º21.552'N. The area which is about 6,150ha is situated at the north eastern part of the Okomu Forest Reserve and shares boundaries with the OkomuNational Park at its west and the Osse River Rubber Plantation Estate (also the Michelin Rubber Company) at the north.

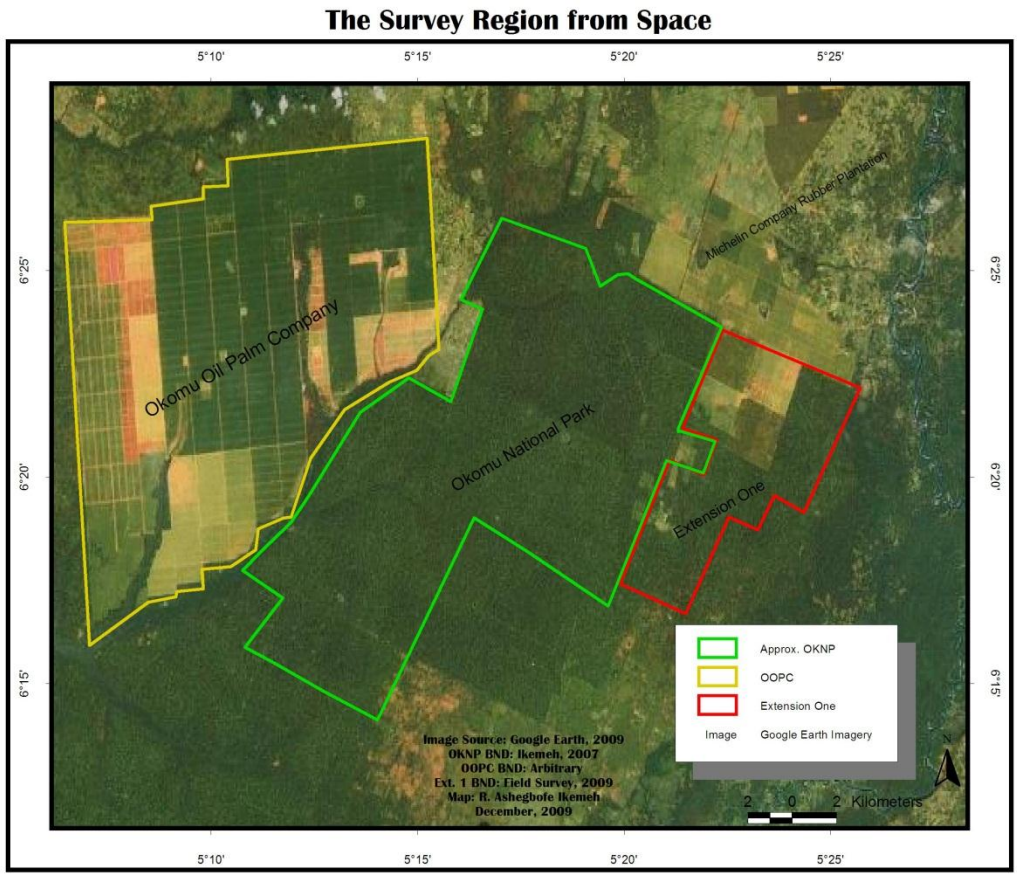


Figure 4-1: Satellite Imagery of Okomu Forest Reserve showing project location

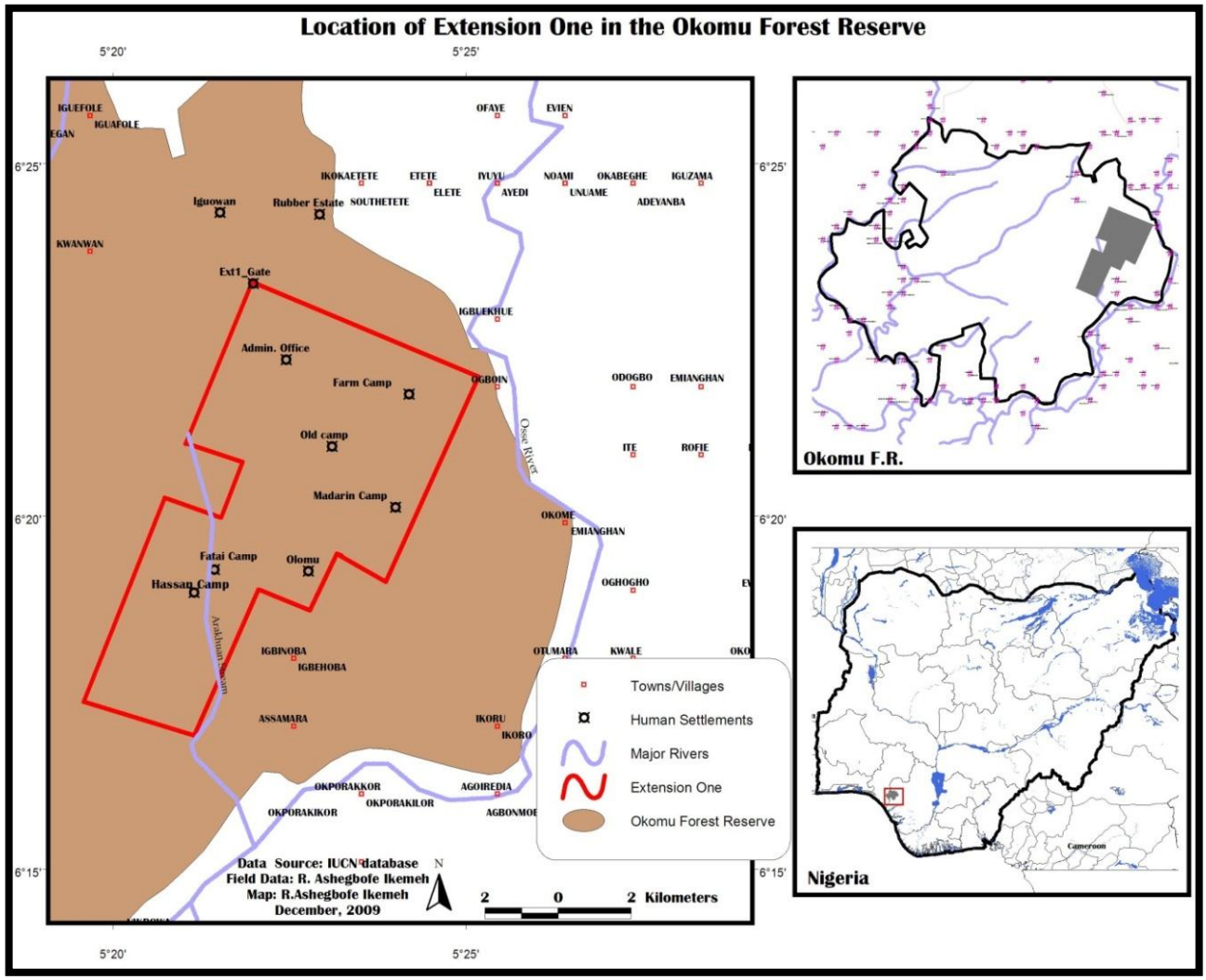


Figure 4-2: Extension One in the Okomu Forest Reserve

4.7.2 Ambient Water Quality

The groundwater quality is good and free from pollution. The water samples from the project's water sources have all physico-chemical and microbiological parameters within the permissible limits recommended by WHO and FMENV for wholesome water.

The environmental monitoring at Okomu Oil Palm Company Plc includes the sampling of groundwater on quarterly basis. The results, over two seasons, of laboratory analyses of borehole water samples are presented in Tables 4-4a and Table 4-4b for dry and wet seasons respectively.

Table 4-4a: Laboratory Analysis Results of Borehole water at Extension One (Dry Season, January 13th, 2012)

PARAMETER/UNIT	WHO/FMENv.	BOREHOLE WATER		
		OKM_1- CONTROL N 0746637.62 E 0688446.61	**OKM_2 N 0746250.33 E 0687875.25**	**$OKMM_3$ N06^{0}21'48.7" E005^{0}22'37.5"**
Appearance	Colourless & clear	Colourless & clear	Colourless & Clear	Colourless & Clear
Colour (PCU)		ND	ND	ND
Turbidity (FTU)		ND	ND	ND
Conductivity (µs/cm)		79.00	90.00	79.00
pH	6.5-9.5	7.15	6.95	6.55
Acidity (mg/L)		10.02	10.05	20.05
Alkalinity (mg/L)		25.38	48.24	35.14
Total Hardness (mg/L)	500.00	3.15	15.75	5.90
Calcium Hardness (mg/L)	300.00	2.60	10.74	4.55
Magnesium Hardness (mg/L)	200.00	0.55	5.01	1.35
Total Solids (mg/L)	1,000.00	68.00	61.00	69.00
Total Suspended Solids (mg/L)	ND	ND	ND	ND
Total Dissolved Solids (mg/L)		68.00	61.00	69.00
Phosphate (mg/L)		ND	ND	ND
Nitrate (mg/L)		ND	ND	ND
Sulphate (mg/L)	100.00	6.80	6.48	6.80
Chloride (mg/L)	250.00	8.60	10.29	8.82
Sodium Chloride		13.95	16.98	14.56
METALS (mg/L)				
Iron	0.30	0.01	0.02	0.01
Lead	0.01	ND	ND	ND
Copper	2.00	0.03	0.04	0.03
Nickel	0.02	ND	ND	ND
Cadmium	0.003	ND	ND	ND
Zinc	3.00	0.08	0.18	0.10
Chromium	0.05	ND	ND	ND
Manganese	0.40	ND	ND	ND
MICROBIOLOGY RESULTS				
Total Plate Count (cfu/ml)	-	36	14	Nil
Faecal coliforms Count (Cfu/mL)	-	Nil	Nil	Nil
Pseudomonas Count (Cfu/mL)	-	Nil	Nil	Nil
Coliform Count (cfu/100ml)	10	MPN (100ml) Lower Upper <2 -	MPN (100ml) Lower Upper <2 -	MPN (100ml) Lower Upper <2 -

Note: ND = Non – Detectable

Comment:

The overall quality of the water sample analysed satisfy WHO Standards for drinking water quality. Sample is within WHO and FMEnv standards for drinking water quality.Microbiologically, sample contains no growth

Table 4-4b: Laboratory Analysis Results of Borehole water at Extension One (Wet Season, September 20th, 2012)

PARAMETER/UNIT	WHO/FMENv.	BOREHOLE WATER		
		OKM_1- CONTROL N 0746637.62 E 0688446.61	**OKM_2 N 0746250.33 E 0687875.25**	**$OKMM_3$ N06^{0}21'48.7" E005^{0}22'37.5"**
Appearance	Colourless & clear	Colourless & clear	Colourless & Clear	Colourless & Clear
Colour (PCU)		ND	ND	ND
Turbidity (FTU)		ND	ND	ND
Conductivity (µs/cm)		65.00	85.00	65.00
pH	6.5-9.5	6.60	6.65	6.53
Acidity (mg/L)		10.02	10.05	10.05
Alkalinity (mg/L)		25.75	38.55	30.15
Total Hardness (mg/L)	500.00	10.05	10.55	10.55
Calcium Hardness (mg/L)	300.00	10.05	10.55	10.55
Magnesium Hardness (mg/L)	200.00	ND	ND	ND
Total Solids (mg/L)	1,000.00	55.00	65.00	55.00
Total Suspended Solids (mg/L)	ND	ND	ND	ND
Total Dissolved Solids (mg/L)		55.00	65.00	55.00
Phosphate (mg/L)		ND	ND	ND
Nitrate (mg/L)		ND	ND	ND
Sulphate (mg/L)	100.00	8.05	6.05	5.60
Chloride (mg/L)	250.00	8.33	10.05	9.15
Sodium Chloride		13.75	16.58	15.10
METALS (mg/L)				
Iron	0.30	ND	ND	ND
Lead	0.01	ND	ND	ND
Copper	2.00	0.01	0.03	0.03
Nickel	0.02	ND	ND	ND
Cadmium	0.003	ND	ND	ND
Zinc	3.00	0.04	0.08	0.06
Chromium	0.05	ND	ND	ND
Manganese	0.40	ND	ND	ND
MICROBIOLOGY RESULTS				
Total Plate Count (cfu/ml)	-	10	10	5
Faecal coliforms Count (Cfu/mL)	-	Nil	Nil	Nil
Pseudomonas Count (Cfu/mL)	-	Nil	Nil	Nil
Coliform Count (cfu/100ml)	10	MPN (100ml) Lower Upper <2 -	MPN (100ml) Lower Upper <2 -	MPN (100ml) Lower Upper <2 -

Note: ND = Non – Detectable

Comment:
The overall quality of the water sample satisfy WHO Standards for drinking water quality.

4.7.3 Air Emission and Ambient Air Quality

The emission sources and air emission potential of the proposed project area include:

Sources	Location	Air Emission
Point Source	Powerhouse, and solid waste dumpsite	NOx, SO_2, CO, PM, VOCs, CH_4, dioxin
Fugitive	Nursery, earth roads, unpaved ground	PM, Nox, Sox, CO
Mobile Sources	Tractors, Machinery	NOx, SO_2, CO, PM, VOCs
Greenhouse Gases	Powerhouse, and solid waste dumpsite	CO, CO_2, CH_4,

The ambient air quality determination is done at OOPC on quarterly basis, using an air analyzer. The results over two seasons in 2012 (dry and wet seasons) are presented in Table 4-5.

Table 4-5: Results of Air Quality Measurement – 2 seasons (June and December-2012)

Location	CONTROL	Extension One (Dry season-January 2012)	Extension One (Wet season-September 2012)	FMEnv. Limit
Coordinate	N 0745303.01	N 0746665.97	N 0746250.33	
	E 0685943.05	E 0688549.61	E 0687875.25	
SPM	13	74	340	250
Temperature, ^oC	34.7	31.5	30	Ambient
Humidity (%)	38	68	69	-
H_2S, ppm	<0.1	<0.1	<0.1	-
HC, (ppm)	<0.1	<1.0	<1.0	-
CO, (ppm)	<1.0	1.0	1.0	10
SO_2, (ppm)	<0.1	<0.01	<0.01	0.1
NO_2, (ppm)	<0.01	0.08	0.03	0.04 – 0.06
O_2, (%)	21.0	20.8	20.8	21.0
VOC	<0.01			

Based on the result of measurements conducted around the facility, the concentrations of particulate matter and gases obtained were within the regulatory limits for each parameter. The humidity and temperature were also satisfactory compared to theStandards.

4.7.4 Acoustic Environment

A digital sound level meter is used to measure the noise levels at different locations/workplaces within the extension one estate. This is usually done as part of the routine environmental monitoring system or after major repairs. The results show that all the noise levels are within the permissible limit of 90dBA. Also, the The results of the noise measurements are presented in Table 4-6.

Table 4-6: Noise Levels [dB(A)] at Workplaces

Locations	Powerhouse	Nearest Residential Building	Entrance	10maway	20maway	30m away
Dry Season (January 2012)	102.4	73.2	84.4	80.2	76.6	74.8
Wet Season (September 2012)	85.6	65.7	76.6	72.8	71.8	68.8
Noise Levels [dB(A)] (June 2016)	87.8	65.5	68.6	66.1	67.4	58.2
FMEnv (8-Hr) Exposure Limit	**90dB(A)**					

Source: Extension One EIA study; 2012 and 2016

4.7.5 Climate and Meteorology

4.7.5.1 Rainfall

The average annual rainfall at the main Okomu Oil Palm Plantation between 2004 and 2016 was 2187 mm (Figure 4-3). Annual rainfall ranged from 1510.4 mm in 2004 to 2804.8 mm in 2007. Based on the data, and those reported by Salako and Ghuman (1995), and Akinnifesi and Salako (1997) from data collected at the International Institute of Tropical Agriculture station situated in the main Okomu Oil Palm Plantation between 1986 and 1991, it can be stated that average annual rainfall in the area is about 2000 mm.

Rainfall is substantial between April and October, as the minimum rainfall in each month generally reached 90 mm. From these records and others in literature, rainfall peak is obtained in July. Thus, the distribution of rainfall is unimodal with the possibility of a maximum monthly rainfall of about 750 mm. The range between 1995 and 2012 was 74-107.0 rain days. This covers the range also observed between 1986 and 1991 by Salako and Ghuman (1995) and Akinnifesi and Salako (1997).

Rainfall in Okomu is highly erosive (Salako and Ghuman, 1995; Salako, 2010). The data in Table4-7corroborates the findings of Salako (2010) that the effect of climate change in tropical areas might not necessarily be with regards to reduction of rainfall but possible concentration of more rains in fewer rain days, resulting in flooding and soil erosion.

Table 4-7: Monthly Rainfall at OOPC Estate (2004–September 2016)

Year (mm)	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
2004	4.3	32.3	46.3	156.2	174.4	175.3	233.9	239.0	253.0	92.3	103.4	0.0	**1,510.4**
2005	0.0	21.2	68.4	97.3	59.4	340.3	661.1	102.0	204.4	249.8	52.9	0.0	**1,856.8**
2006	13.4	11.4	80.2	107.9	330.5	274.6	331.4	277.9	425.6	326.6	13.3	0.0	**2,192.8**
2007	0.0	74.3	123.9	304.6	236.4	384.0	487.1	288.2	324.4	496.5	85.4	0.0	**2,804.8**
2008	0.7	6.7	59.8	159.7	237.0	305.1	409.7	190.4	270.0	179.0	22.0	0.0	**1,840.1**
2009	0.0	61.9	65.4	217.2	291.0	312.7	373.5	205.1	336.6	404.4	146.4	10.0	**2,424.2**
2010	120.2	84.4	72.5	134.6	198.1	341.0	299.3	452.1	332.8	233.3	89.0	41.9	**2,399.2**
2011	0.0	34.2	29.2	172.1	188.7	473.0	445.6	327.0	324.7	264.3	17.2	0.0	**2,276.0**
2012	0.0	38.7	67.3	137.4	129.6	321.5	544.6	78.3	226.0	155.2	74.6	11.0	**1,784.2**
2013	35.8	19.7	64.8	164.7	304.5	195.4	297.7	84.8	473.4	157.0	40.5	21.8	**1,860.1**
2014	3.5	23.9	152.9	88.5	190.5	142.2	345.5	388.8	411.8	520.0	84.6	0.5	**2,352.7**
2015	0.0	79.6	215.3	67.8	165.6	283.4	209.6	370.9	663.5	293.1	8.9	9.9	**2,367.6**
2016	4.4	3.3	182.2	179.4	189.8	330.1	308.3	321.1	567.1				**2,085.7**
Av.11years	**14.8**	**38.3**	**98.5**	**152.6**	**210.1**	**308.6**	**392.8**	**257.2**	**380.0**	**298.1**	**57.7**	**9.5**	**2,187.0**
Min	**0.0**	**3.3**	**29.2**	**67.8**	**59.4**	**142.2**	**209.6**	**78.3**	**204.4**	**155.2**	**8.9**	**0.0**	**-**
Median	**0.4**	**29.1**	**70.5**	**148.6**	**194.3**	**317.1**	**359.5**	**283.1**	**334.7**	**264.3**	**52.9**	**5.2**	**2,059.5**
Average	**14.8**	**38.3**	**98.5**	**152.6**	**210.1**	**308.6**	**392.8**	**257.2**	**380.0**	**298.1**	**57.7**	**9.5**	**2,218.3**
Max	**120.2**	**84.4**	**215.3**	**304.6**	**330.5**	**473.0**	**661.1**	**452.1**	**663.5**	**520.0**	**146.4**	**41.9**	**-**

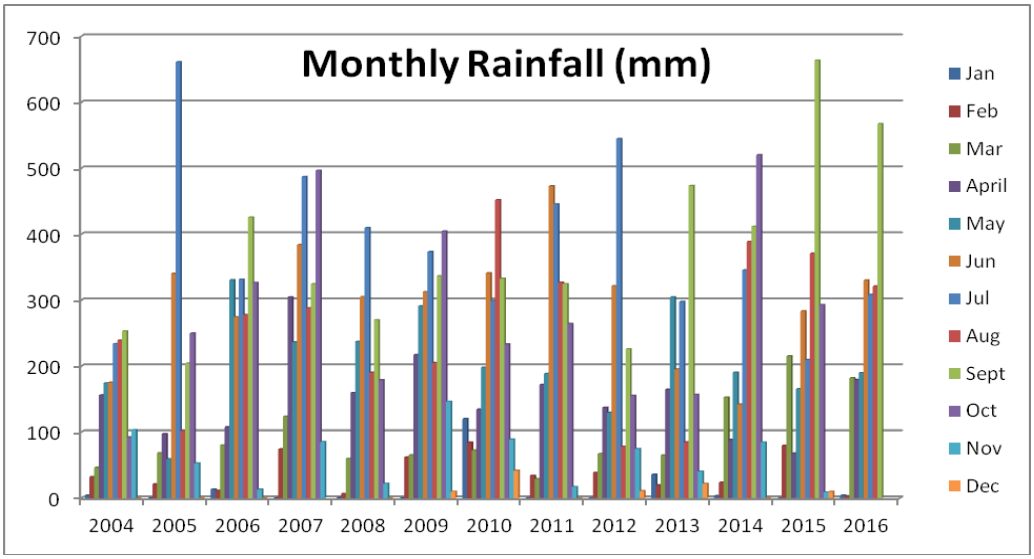


Figure 4-3: Monthly Rainfall at OOPC (2004 – September 2016)

Source: OOPC Agric Office, 2016

4.7.5.2 Temperatures

The apparent movement of the sun, wind direction and speed as well as land configuration influence the temperature of an area. The mean monthly ambient air temperatures at OOPC range from 18.61°C in January to 36.09°C also in January. The average annual (2015) data of temperature at the OOPC weather station range from 27.81^{0}C to 31.93^{0}C as presented in Table 4-8, while the graphical illustration is shown in Figure 4-4.

Table 4-8: Average Annual Temperatures (^{0}C) at OOPC Estate (2004–September 2016)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average Minimum	21	24	22	22	20	24	22	22	22	22	23	22	23
Average Maximum	30	30	32	33	27	30	32	31	30	32	31	32	29
Minimum Absolute	20	21	21	20	19	24	20	20	20	20	22	20	21
Maximum Absolute	32	33	35	38	36	31	36	35	34	37	33	34	32

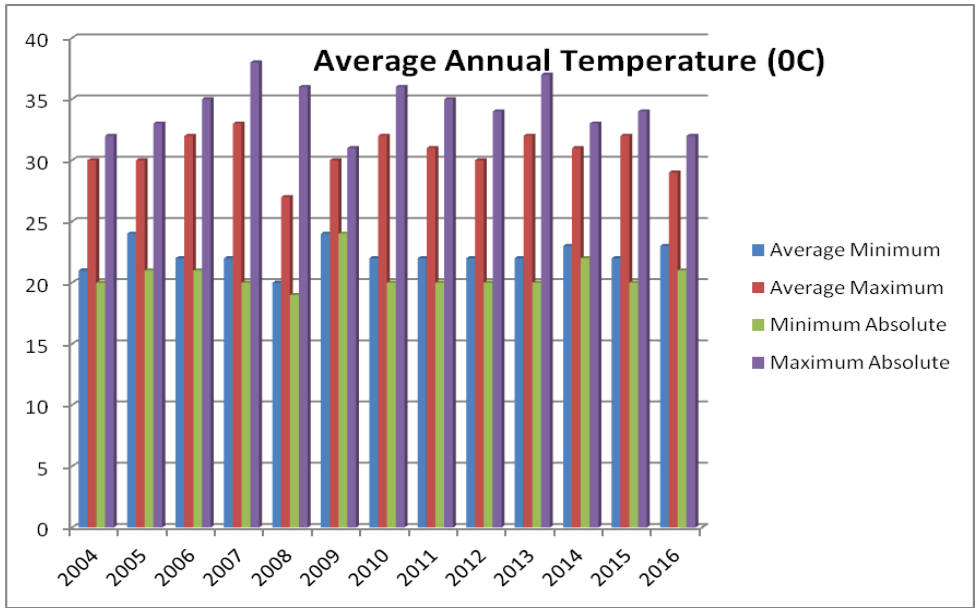


Figure 4-4: Average Annual Temperature at OOPC (2004 and 2016)

Source: OOPC Agric Office, 2016

4.7.5.3 Sunshine Duration and Wind Speed

The mean monthly sunshine hour at OOPC for the period 2004 to September 2016 range between 32 hours in August to 209 hours in December . The average annual (2004-September 2016) data of sunshine at the OOPC weather station is presented in Table 4-9, while the graphical illustration is shown in Figure 4-5.

Table 4-9: Monthly Sunshine (Hr) at OOPC Estate (2004-September 2016)

Year	J	F	M	A	M	J	J	A	S	O	N	D	AVG
2004	202	178	147	135	173	184	101	77	148	189	186	175	**158**
2005	135	140	141	139	66	119	53	94	114	155	216	171	**129**
2006	157	172	168	194	135	145	125	97	63	136	200	184	**148**
2007	138	199	142	152	224	112	101	98	65	135	215	217	**150**
2008	138	119	239	155	142	264	119	42	75	135	77	177	**147**
2009	157	195	169	158	155	123	126	66	120	130	159	199	**146**
2010	158	219	106	182	152	133	121	87	73	121	197	197	**146**
2011	105	203	176	205	139	79	38	84	97	102	223	196	**137**
2012	134	149	168	132	163	111	73	96	101	153	184	199	**139**
2013	172	195	192	145	132	81	59	68	67	161	157	209	**137**
2014	186	137	138	139	131	74	52	56	57	123	185	200	**123**
2015	164	170	118	119	144	68	62	43	36	148	190	175	**120**
2016	139	75	149	144	120	73	59	32	105				**100**
Av.11years	**148.6**	**164.4**	**158.8**	**155.3**	**141.9**	**115.2**	**82.3**	**71.9**	**81.6**	**136.4**	**182.1**	**193.1**	**135.0**
Min	**105.0**	**75.0**	**106.0**	**119.0**	**66.0**	**68.0**	**38.0**	**32.0**	**36.0**	**102.0**	**77.0**	**171.0**	**-**
Median	**148.0**	**171.0**	**158.5**	**148.5**	**140.5**	**111.5**	**67.5**	**76.0**	**73.0**	**135.5**	**190.0**	**197.0**	**1,617.0**
Average	**148.6**	**164.4**	**158.8**	**155.3**	**141.9**	**115.2**	**82.3**	**71.9**	**81.6**	**136.4**	**182.1**	**193.1**	**1,631.7**
Max	**186.0**	**219.0**	**239.0**	**205.0**	**224.0**	**264.0**	**126.0**	**98.0**	**120.0**	**161.0**	**223.0**	**217.0**	**-**

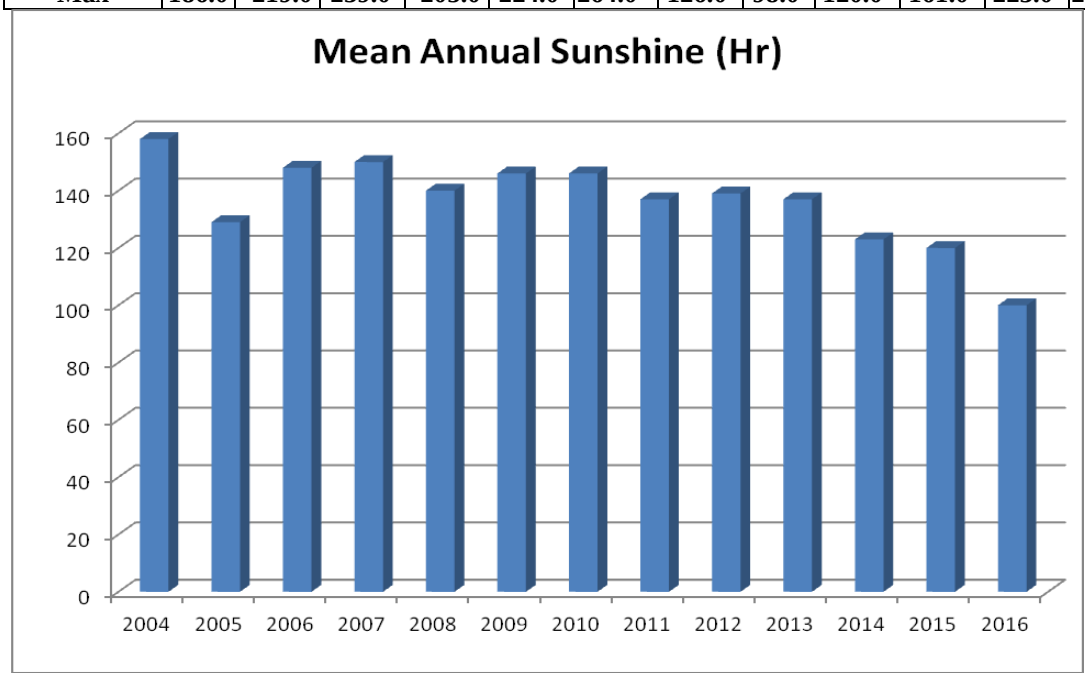


Figure 4-5: Mean Annual Sunshine hour at OOPC (2004-September 2016)

Source: OOPC Agric Office, 2016

4.7.6 Geology and Geomorphology

Extension I is underlain by the Benin formation or coastal plain sands. The geologic strata are made up of sandy sediments interbedded with layers of fine-grained clay. The geomorphology of the site revealed forms which range from slightly undulating plains to steep slopes. Through these landscapes, run streams and rivers, which could be ephemeral or perennial.

The elevations observed in Extension I with the use of a Geographic Positioning System (GPS) during this survey ranged from 19-107 m. The data have been used to develop an elevation map for the site. The eastern and southwestern parts of Extension I are generally flat, while the northwestern part and central area are undulating. These geomorphic forms have implications for the drainage and hydrology of the site.

4.7.7 Hydrology and Drainage

There are small, perennial and non-perennial streams in Extension I. Some of these are linked with the lowlands indicated by the elevation map (Fig 4-6). There is a tendency for surface water and subsurface soil water to flow or drain eastward and southward in the field. Although, this is established with the elevation map, the course of Arakhuan stream and Osse River support this observation. Thus, most of plots earmarked for development in 2012 and 2013 (ERM, 2010) may be affected by transient flooding at the peak of the rains, but this should not be prolonged. Drainage of excess water within 1 m depth should be considered during the rainy season within these plots.

Reference or potential evapo-transpiration ranged from 53 to 161 mm month^{-1} (Akinnifesi and Salako, 1997). Annually, this was 970 mm using the pan evaporation method. The rainfall surplus was about 2-5 times more than the deficit. Throughfall (water reaching the soil under tree canopies) under natural forest was 53% of rainfall, and could be as much as 90% of rainfall with monoculture such as oil palm or rubber.

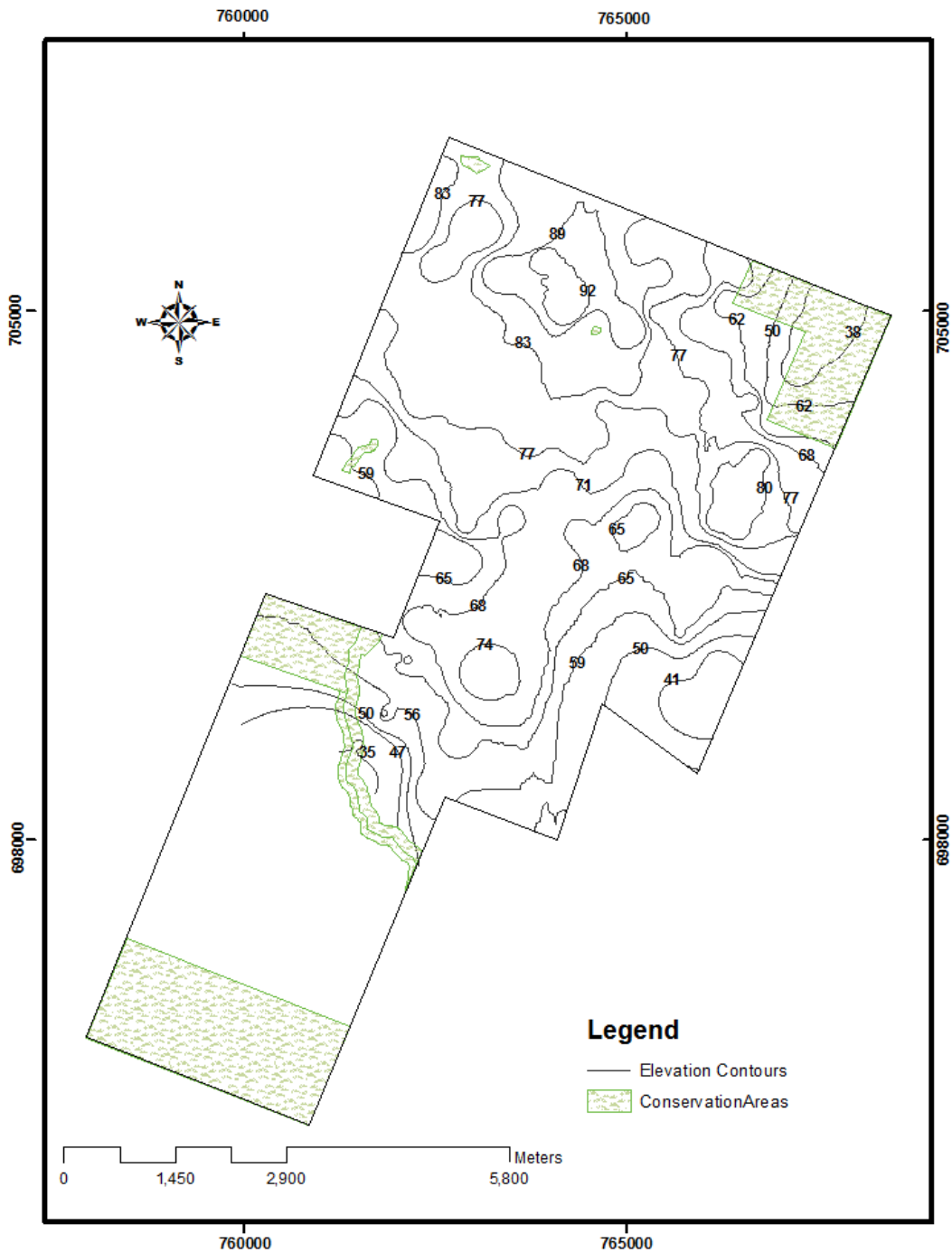


Figure 4-6: Elevation Map of Extension I Developed Based on GPS Data Collected in December 2011

After cultivation for two years, water infiltration in soils cleared mechanically with shear blade could be as high as 47 cm h^{-1}, though this was far lower than 240 cm h^{-1} observed for land that was cleared manually (IITA/UNU/OSU, 1989). Runoff is minimal, except if the soil is degraded, and/or located on a slope. The high erosivity of the rain at the site also predisposes the area to soil erosion and runoff, when the vegetal cover is removed. Dependence on groundwater by the Okomu community throughout the year suggests that groundwater recharge is adequate.

There is water surplus from rainfall for the cultivation of oil palm and rubber in Extension One. Chances is, however, very high that most of the surplus is lost through runoff and excessive drainage of soils. This can be minimized by improving the efficient utilization of water by the tree crops and ensuring reasonable water retention in soils. In this regard, retention of soil organic matter and adequate use of inorganic nutrients is important. Plots with potential risk of flooding will require additional drainage options during transient flooding.

4.7.8 Vegetation and Land Use

Oil palm at various stages of growth constituted the dominant vegetation during the survey carried out in December 2010 (Table 4-10). Rubber is also extensively grown as a monocrop, although croplands owned by the communities living around Extension I constituted the second largest land use. These crop lands are largely poorly maintained and are mainly located in areas already earmarked for development by OOPC in 2012 and 2013. The growth of crops such as cocoa, plantain and cassava in these areas prone to transient flooding suggests that the period of flooding was not detrimental to crop growth, and the sites can be improved with better management. The poor maintenance of some cocoa farms at the site might be related to land tenure and other socio-economic factors (ERM, 2010).

Some of the oil palm plots are planted with *Pueraria phaseoloides*, a cover crop, which would enhance soil conservation (Plate 4-1). This is a good management option, particularly, because mechanical land clearing seems inevitable or preferred at OOPC. There are also limited areas with hydromorphic characteristics, with peculiarity in vegetal cover.

In the undisturbed forest of Okomu, which is about 125 years old, common trees include *Ceiba pentandra*, *Poga oleosa*, *Antiaris africana*, *Anonidium manii*, *Enantia chlorantha*, *Musanga cecropiodes*, *Strombosia pustulata*, *Celtis*

*zenkeri*and *Diospyros alboflavescenes* (Ghuman and Lal, 1987). It is clear that there is a lot of human interference in the vegetation of Extension I. Thus, about 90% of the area has been disturbed on the surface, giving rise to the extensive presence of plowed topsoil (horizon) in Extension I.

Table 4-10: Analysis of Vegetal Cover and Land Use on Extension I

Land use	Area (ha)	% Covered	Land use Category	Area (ha)	% Covered
Secondary forest	450	11	Forest	450	11
Forest regrowth + cassava	50	1			
Forest `regrowth+ Cocoa+ Plantain	75	2			
Forest+ Plantain	575	14			
Forest+ Plantain+ Cassava	50	1			
Forest +Cocoa+ Cassava	50	1	Croplands with major regrowth	800	19
Plantain + Cassava	25	1			
Rubber- 22 years	246	6			
Rubber- 19 years	187	5			
Rubber- 17 years	64	2			
Rubber- 12 years	238.4	6	Rubber	735.4	18
Oil palm- 7 years	275.44	7			
Oil palm- 6 years	315.5	8			
Oil palm- 5 years	41.86	1			
Oil palm- 1 year	576.27	14			
Oil palm-1 year + Pueraria	200	5			
Oil Palm-1 year + Regrowth	175	4			
Oil palm- nursery	13	0	Oil Palm	1597.07	39
Cocoa	325	8			
Cocoa+Plantain	175	4	Croplands well maintained	500	12
Swamps	15	0.36	Hydromorphic area	15	0.36
Regrowths (Weeds)	25	1	Regrowth	25	1

Plate 4-1: Vegetal Cover and Land Use on Extension I

4.7.9 Update of Necessary Environmental Parameters

Relevant environmental parameters including groundwater quality, surface water quality (Arakhuan river), air quality, noise level, vegetation type and socio-economic were updated in December 2015 and 14th to 27th June 2016 as follow:

4.7.9.1 Groundwater Quality

The groundwater quality is good and free from pollution. Except for pH that is generally acidic, all other physico-chemical and microbiological parameters fall within the permissible limits recommended by WHO and FMENV for wholesome water as presented in the Table 4-11 below:

Table 4-11: Laboratory Results of Physico-chemical and Microbiological Analysis of Groundwater sample at Extension One (N074663762 : E0688446.61, N0746250.33 : E0687875.25, N06^{0}21'48.7'': E005^{0}22'37.5'')

PARAMETER/UNIT	NIS554:2007	OKM_{EXTQ1} Extension One Quarters	OKM_{EXTN2} Extension One Nursery 2	OKM_{EXTN3} Extension One Nursery 1
Appearance	Clear and colourless water	Clear and colourless water	Clear andcolourlessw ater	Clear andcolourlessw ater
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Taste	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
pH@25^{O}C	6.5-8.5	4.38	4.02	3.74
Temperature,^{O}C	Ambient	30.1	30.0	30.2
Conductivity, □S/cm	1000	21.6	32.7	23.5
ElectrodePotential,mV	-	42	81	77
Colour,Pt-Co	15	<1.0	<1.0	<1.0
Turbidity, NTU	5	<1.0	<1.0	<1.0
TotalSolids,mg/L	-	10.8	15.7	11.7
TotalDissolved solids,mg/L	500	10.8	15.7	11.7
TotalSuspended Solids,mg/L	-	<1.0	<1.0	<1.0
TotalHardness,mg/LCaCO3	150	6.0	4.0	7.0
TotalAlkalinity,mg/L	-	3.80	4.75	3.80
Totalacidity,mg/L	-	2.18	5.66	13.1
Calcium,mg/L	-	0.60	0.80	0.80
Magnesium,mg/L	2.0	1.34	0.49	1.22
Chloride,mg/L	250	1.72	8.60	1.72
Residualchlorine,mg/L	0.2-0.25	<0.1	<0.1	<0.1
Fluoride,mg/L	1.5	<0.1	<0.1	<0.1
Nitrate,mg/L	50	0.13	0.13	0.13
Nitrite,mg/L	0.2	0.09	0.01	0.01
Sulphate,mg/L	100	<1.0	1.0	1.0
Phosphate,mg/L	-	0.2	<0.1	<0.1
Freecarbondioxide,mg/L	-	1.91	4.97	11.6
Iron(total),mg/L	0.3	0.01	0.01	0.03
Lead, mg/L	0.01	<0.001	<0.001	<0.001
Arsenic,mg/L	0.01	<0.001	<0.001	<0.001
Manganese,mg/L	0.2	<0.001	<0.001	<0.001
Copper, mg/L	1.0	<0.001	<0.001	<0.001
Cadmium,mg/L	0. 03	<0.001	<0.001	<0.001
Chromium,mg/L	0.05	<0.001	<0.001	<0.001
HydrogenSulphide,mg/L	0.05	<0.01	<0.01	<0.001
Totalcoliformcount,CFU/mL	10	Nil	Nil	Nil
Faecalcoliform(E.coli),CFU/100mL	Nil	Nil	Nil	Nil
Clostridium perfringens,CFU/100mL	Nil	Nil	Nil	Nil
Salmonella/Shigella sp.,CFU/100mL	Nil	Nil	Nil	Nil
Staphylococcus sp.,CFU/100mL	Nil	Nil	Nil	Nil
Pseudomonasaureus,CFU/100mL	Nil	Nil	Nil	Nil
Total platecount,CFU/100mL	10^2	Nil	Nil	Nil

4.7.9.2 Surface Water Quality

Two (2 Nos.) samples (upstream and downstream) were taken from Arakhuan river during the update exercise and later analyzed in the laboratory to check that the river have not been polluted by the activities of the company. The results of the physical and chemical analyses including Total Hydrocarbon, Salinity and pesticide content are good except for pH that is generally acidic. The colour of $ARKH_3$ and $ARKH_2$ are slightly higher than their respective limits and should not pose any problem for the receiving water as presented in Table 4-12 below.

Table 4-12: Laboratory Results of Physico-chemical and Microbiological Analysis of Surface water sample at Extension One

PARAMETER/UNIT	METHOD	$ARKH_2$ N0745303.0	$ARKH_3$ N0745800	FMEnv.
Appearance		Colouless with Particles		
Odour		Unobjectionable		
pH	ELECTROMETRIC	4.44	4.86	6-9
Temperature, ^oC	THERMOMETER	30.2	30.2	Ambient
Conductivity, µS/cm	APHA2510-B	18.2	18.2	2000
Electrode Potential,mV	ELECTROMETRIC	48	10	-
Colour,Pt-Co	APHA2120-C	14.0	21.0	7.0
Turbidity,NTU	APHA2130-B	3.0	6.0	10
Total Solids,mg/L	APHA2540-B	13.1	10.1	-
Total Dissolved solids,mg/L	APHA2540-C	9.10	9.10	1000
Total SuspendedSolids,mg/L	APHA2540-D	4.0	1.0	30
Total Hardness,mg/LCaCO3	APHA2340-C	7.0	7.0	-
TotalAlkalinity,mg/L	APHA2320-B	13.1	4.5	-
Totalacidity,mg/L	APHA2310-B	6.1	3.1	-
Calcium,mg/LasCa	APHA3500-B	0.4	0.6	-
Magnesium,mg/LasMg	APHA3500-B	1.5	1.3	-
Chloride,mg/L	APHA4500-B	1.7	1.7	200
Nitrate,mg/L	APHA4500-NO_3^--B	0.6	0.5	50
Nitrite,mg/L	APHA4500-NO_2^--B	0.17	0.13	0.3
Sulphate,mg/L	APHA4500-E	2.0	2.0	250
Phosphate,mg/L	APHA4500-C	0.2	0.1	-
Iron(total),mg/L	APHA3500-B	0.03	0.06	20
Lead,mg/L	APHA3500-Pb-B	<0.01	<0.01	<1.0
Copper,mg/L	APHA3500-Cu-B	<0.01	<0.01	<1.0
Manganese,mg/L	APHA3500-Mn-B	<0.01	<0.01	0.10
Cadmium,mg/L	APHA3500-Cd-B	<0.01	<0.01	<1.0

Table 4-12 contn'd

PARAMETER/UNIT	METHOD	ARKH2 N0745303.01 E0685943.05	ARKH3 N0745800.31 E0684042.35	FMEnv.
Nickel,mg/L	APHA3500-Ni-B	<0.01	<0.01	<1.0
Cobalt,mg/L	APHA3500-Co-B	<0.01	<0.01	<1.0
Arsenic,mg/L	APHA3500-As-B	<0.01	<0.01	<1.0
Chemical Oxygen Demand,mg/L	APHA5220-D	20.0	17.0	80
Biochemical Oxygen Demand,mg/L	APHA5210-B	9.4	7.9	30
Dissolved Oxygen,mg/L	APHA4500-G	18.2	10.6	>2.0
Salinity,‰	APHA4500-B	<0.01	<0.01	-
Total Hydrocarbon,mg/L		<0.01	<0.01	
Pesticides,mg/L		<0.01	<0.01	
Total coliform count,MPN/mL	APHA9225-D	0	0	10^2
Faecal coliform (E.coli), CFU/mL	APHA9222-D	0	0	-
Total plate count,CFU/mL	APHA9215-B	2	1	10^4

4.7.9.3 Air Quality

The ambient air quality was determined in-situ during the update exercise. The full results and methodology are presented in ***Appendix B***. Parts of the results are presented in Table 4-13. However, based on the result of measurements conducted around the facility, the concentrations of particulate matter and gases obtained were within the regulatory limits for each parameter. The humidity and temperature were also conducive for smooth operation.

Table 4-13: Parts of Air Quality for the Third Quarter 2016

Parameter	LOCATION	FMEnv. Limit
	Extension One Powerhouse	
Coordinate	N06º22.444'	
	E005º22.913'	
Elevation, (m)	87	
SPM, (µg/m3)	43.8	**250**
Temp (ºF)	29.3	**Ambient**
Humidity	74	**Ambient**
Carbon monoxide(ppm)	<1.0	**10**
Carbon-dioxide (%)	0.43	**Ambient**
Hydrocarbon (%)	<0.1	**-**
VOC, ppm	<0.01	**-**

Source: ECM, September 2016

4.7.10 Non-Resident Farmers

Efforts were made to identify if there are farmers, not living on Extension One but have their farms inside of it. The indications are that people of Mile 3 are likely to have farms (yams, plantains and cocoa) at the southern most section, while the people of Nikrowa are also known to farm (plantains) substantially inside and outside of the eastern boundary. However, due to lack of access at the time of survey, it was not possible to make direct contact with the two settlements. The people of Ashamara, Akande and Bisi Camps are sure that their people do not farm on Extension One. But earlier investigation had it that they have cocoa farms of about 8 acres. For the people of Malagidi, it was not possible to determine the direction or location of their settlement, but it was said by the people of Akande camp that the Malagidi people are most unlikely to have farms inside Extension One.

The immediate area to the east of Column C of Extension One is being substantially farmed by the staff of Extension One. Some people from Udo also have farms there. They plant mainly plantains and cassava.

4.8 Biodiversity Surveys

4.8.1 Large Mammals

4.8.1.1 Survey Methods and Approach

Five main areas of activity were considered in the techniques employed for this survey. They included mapping, sampling, data collection, data processing and data analysis.

4.8.1.2 Mapping

Mapping of the area was a pragmatic approach in responding to the challenge of the unavailability of relevant reference maps for use in the field therefore, mapping of the survey area became necessary first to prepare an appropriate sampling design (subsection 4.8.1.3) and navigate the survey area, secondly to ground-truth the SPOT satellite imagery of the survey region provided. Using the administrative maps, satellite imagery maps and boundary surveyors' map of 1992 as well as the knowledge of some old staff of the OOPC to identify boundary pillars on the ground, geographic coordinates was derived for some edge points of the survey area (see Figure 4-7). These pillar locations were then used to identify the boundary of the survey area on the ground using the 1992 surveyors map as guide to determine the distance and bearing from one edge to another edge point or pillars labeled PBC in the map. These points were uploaded into a GPS 60CSx, representing the boundary of Extension One on the ground.

In the field, travel reconnaissance survey technique was employed to move from one identified pillar to another, with the GPS track set to log in geographic coordinates every 100m walked. Observations were also recorded along the boundary noting available wildlife signs such as footprints, dungs and paths.

4.8.1.3 Sampling Design

Since it was not possible to generate automated distance sampling lines across the survey area using conventional computer programs employed by most conservation research scientist such as DISTANCE, due to the unavailability of geographic coordinates of the survey area, an arbitrary zig-zag line was drawn across the survey area guided by the intersection of the sides of the area's angles. The sampling line measuring a total distance of 36.37km was drawn to traverse the survey area so that results derived were not biased and that the probability of sampling a good representation of the area was achieved.

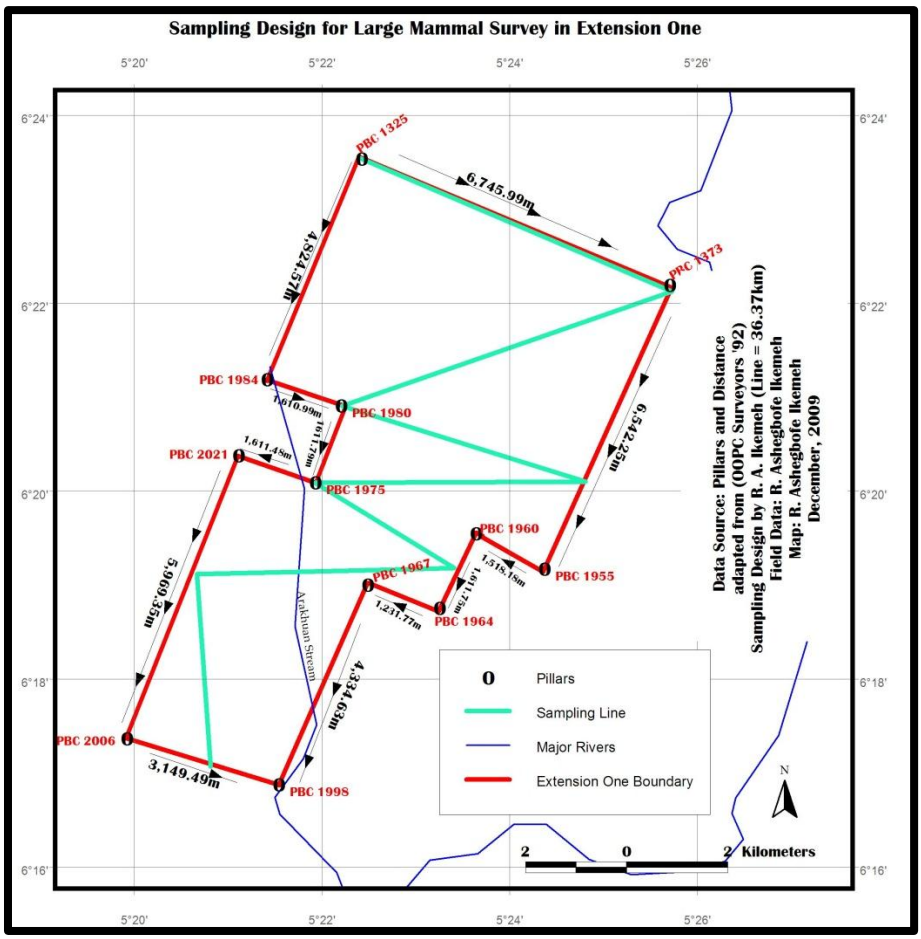


Figure 4-7: Geographic Coordinates of some edge points of the Survey Area

4.8.1.4 Data Collection

Data collection took place from 7.00am to 3.00pm everyday between the 14th and 20th of December 2009. The survey route followed predetermined bearing approximately on a straight line direction on available roads, trails and foot path and when none is available ±30° either direction of the desired bearing, a trail is cut with a cutlass for navigation. Along the survey route, all evidences of wildlife especially of large mammals were recorded including dung, footprint, feeding evidence, debarking and other signs of their activities. For every observation made, related information is also noted such as the type of sign; age; species; time of day; vegetation; geographic coordinates and additional notes was made for unusual observations.

4.8.1.5 Data Processing and Analysis

Geographical Information Systems (GIS) analysis was performed with available data using Arcview™ 3.3, Spatial Analyst and Image Analyst software (Environmental Systems Research Institute (ESRI), California, U.S.A) in data processing and analysis. Satellite images of the study area were utilized for the survey; primarily, Public-domain imagery from Google earth 2009 and commercially available hi-resolution multi-spectral SPOT satellite imagery acquired in 2008 was used in the field to validate ground-truthing results and was also used to assess land/land cover in the survey area. Vector layer data for rivers, roads, administrative boundaries and national boundaries were taken from those available on the IUCN database. Standardization of geographic projections was ensured. All map data sets were analyzed in a geographic projection using decimal degree units and Universal Transverse Mercator (UTM).

Similarly, unsupervised clustering - maximum-likelihood classification and on-screen digitizing were performed to obtain land cover/land use analysis. In creating abundance and distribution maps with survey results, interpolation was performed to estimate the values of data points, using Inverse Distance Weighting (IDW) to extrapolate data beyond point locations recorded in the field.

4.8.2 Limitations of the Survey

The unavailability of reference maps as mentioned in preceding subsection posed great difficulty in ascertaining the coverage of the survey area on the ground thus using up time for data collection on confirming boundary pillars and so on. Available maps were old and out-dated; the most recent maps were not geo-coordinated and so could not be used to derive point locations for navigation on the ground. In addition, since the survey was conducted in the dry season, when the ground is dry and substrate had become hard so that footprints of mammals

are not visibly marked and therefore difficult to detect, there was very little data collected from animal tracks except in the wetland areas.

4.8.3 Results and Interpretations

A total of 47.02km was circuited within and along the boundary of the survey area. 32.6km was travelled on foot recording available evidences of large mammals and 49 observational incidences occurred during this time. Recce have been labeled in this report based on the consecutive days in which they were conducted on the 32.6km travelled within Extension One along a zig-zag direction north to south (Figure 4-8). Other distances covered and observations made were along routes travelled during the mapping process.

In addition, interviews were conducted with local residents and some plantation workers to gather information on what species occur in the survey area and the frequency in which they were sighted – although this did not yield much result, it was useful for confirming observations made in the field.

4.8.4 HCV Assessment

OKNP shares its eastern boundary with Extension One and is known to support representative populations of these species. Table 4-20 below list some mammalian species in OKNP.

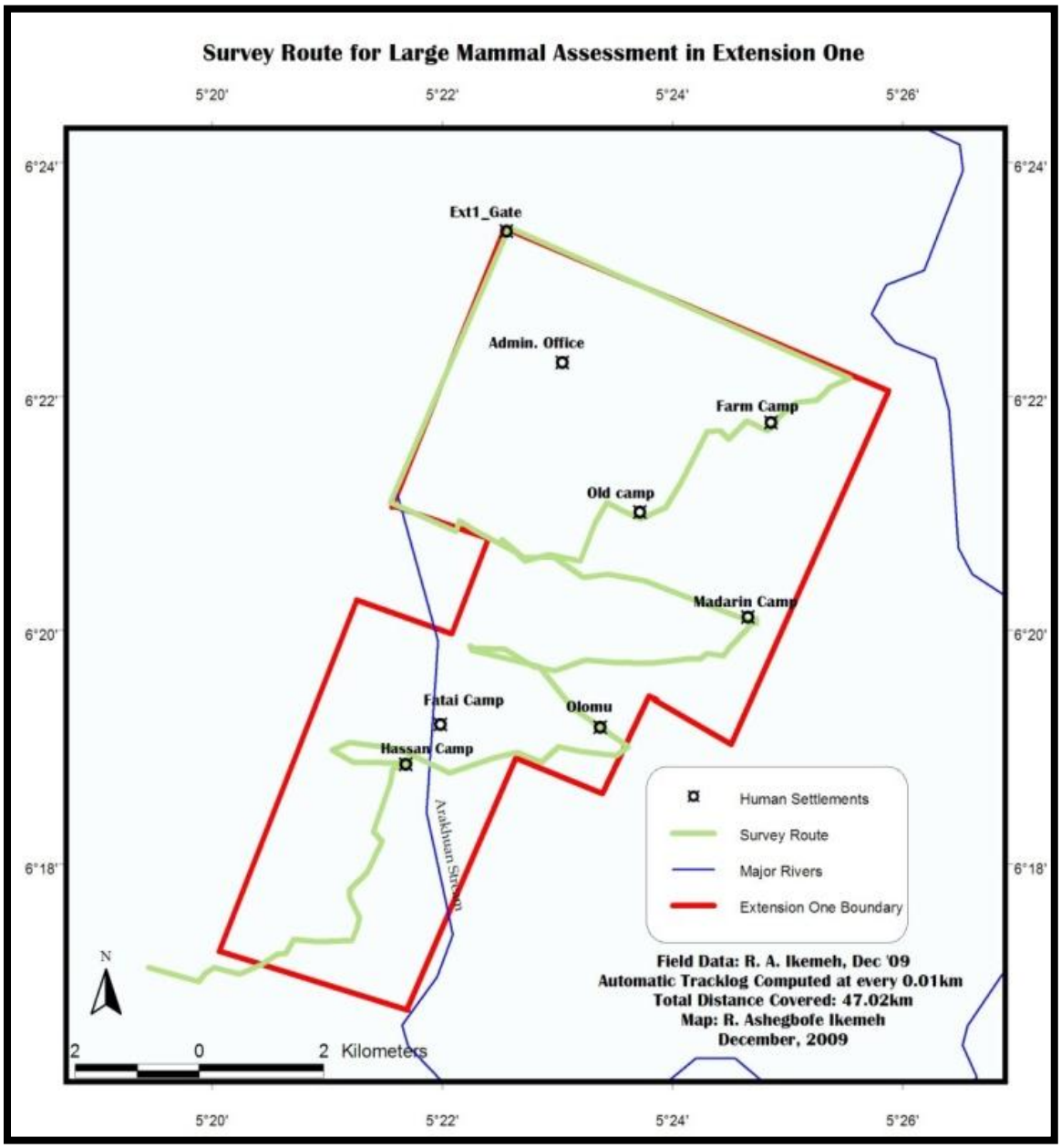


Figure 4-8:Survey Route for Mammal Assessment in Extension I

Table 4-14: List of Some Mammalian Species Occurring in the Okomu National Park

Family	Species	Common Name	IUCN class	Source
	Cercopithecus erythrogaster	White-throated Monkey	NT	Greengrass, 2006; Ikemeh, 2007
Cercopithecidae	*Cercopithecus mona*	Mona Monkey	LC	Greengrass, 2006; Ikemeh, 2007
Cercopithecidae *Cercopithecidae*	*Cercopithecus nictitans*	Putty-nosed Monkey	LC	Greengrass, 2006; Ikemeh, 2007
	Cercocebus torquatus	Red-capped Mangabey	LC	Greengrass, 2006; Ikemeh, 2007
Pongidae	*Pan troglodytes ellioti*	Nigerian-Cameroon Chimpanzee	EN	Greengrass, 2006;
Lorisidae	*Perodicticus potto*	Potto	LC	Kingdon, 1997
Galagidae	*Galagoides demidovii*	Demidoff's Galago	LC	Kingdon, 1997
Bovidae	*Synerus caffer nanus*	AfricanForestBuffalo	LC	Kingdon, 1997
Tragelaphini	*Tragelaphus scriptus*	Bushbuck	LC	Kingdon, 1997; Ikemeh, 2007
	Tragelaphus spekei	Sitatunga	LC	Kingdon, 1997
Tragelaphini	*Cephalophus maxwelli*	Maxwell's Duiker	LC	Kingdon, 1997, Ikemeh, 2007
Antilopinae	*Cephalophus sylvicultor*	Yellow-backed Duiker	LC	Kingdon, 1997
Antilopinae	*Cephalophus niger*	Black Duiker	LC (R)	Kingdon, 1997
Antilopinae *Suidae*	*Potamochoerus porcus*	Red River Hog	LC	Kingdon, 1997; Ikemeh, 2007
Tragulidae	*Hyemoschus aquaticus*	Water Chevrotain	LC	Kingdon, 1997;
Elephantidae	*Loxodonta africana cyclotis*	AfricanForest Elephant	NT	Ikemeh, 2007
Procaviidae	*Dendrohyrax dorsalis*	Western Tree - Hyrax	LC	Ikemeh, 2007
Felidae	*Panthera pardus pardus*	Leopard	NT	Ikemeh, 2007
Felidae	*Caracal aurata*	African Golden Cat	NT	Ikemeh, 2007
	Civettictis civetta	African Civet	LC	Ikemeh, 2007
Viverridae	*Genetta tigrina poensis*	Forest Genet	LC	Happold 1987, Kingdon, 1997
Viverridae	*Nandinia binotata*	African Palm Civet	LC	Happold, 1987; Kingdon, 1997
Viverridae *Herpestidae*	*Atilax paludinosus*	Marsh Mongoose	LC	Happold, 1987; Kingdon, 1997
Herpestidae	*Crossarchus obscurus*	Cusimanse Mongoose	LC	Happold, 1987; Kingdon, 1997
Hystricidae	*Atherurus africanus*	Brush-tailed Porcupine	LC	Kingdon, 1997
Thryonomidae	*Thryonomys swinderianus*	Marsh Cane Rat	LC	Happold, 1987
Manidae	*Phataginus tricuspis*	Tree Pangolin	LC	Kingdon, 1997
Soricidae	*Crocidura nigeriae*	Nigerian Musk Shrew	LC	Happold, 1987
Vespertilionidae	*Chalinolobus Beatrix*	Beatrix Bat	LC (R)	Happold, 1987

IUCN classification – LC = Least Concern; NT = Near Threatened; EN = Endangered; VU = Vulnerable; CR = Critically Endangered * (R) = Rare

Accordingly, under the IUCN red list classification, one species – Nigerian - Cameroon Chimpanzee is on the endangered list and four species – White-throated Monkey, African Forest Elephant, Leopard and African Golden Cat, are classified as Near Threatened. However, none of these species of mammals were observed in Extension One except for one field observation of scats belonging to either the leopard or the African golden cat which was not confirmed due to the level of degeneration of the available evidence. Chimpanzees were reportedly present in the area but the last sighting made by a locale in the Olomu camp was in 1992 when he had observed 2 individuals inside the swamp forest close to the camp.

4.8.5 Large Mammal Observations

The Table 4-15 below summarizes the observations of large mammals in the survey area. For the purpose of this report, 'large mammals' refers to mammalian species with body size (head and body length excluding tail length) of ≥ 30cm (excluding mammals in the order *Rodentia*) as adult individuals.

Table 4-15: Checklist of Large Mammal Species

Species	Common name	IUCN Class.	Observation	Types of Observation	Nos. of Obs.
Synerus caffer nanus	Forest Buffalo	LC	√	D, F	7
Tragelaphus scriptus	Bushbuck	LC	√	D, F, FE	9
Cephalophus spp	Duiker	LC	√	D, F, Sg	8
Potamochoerus porcus	Red River Hog	LC	√	F, FE	15
Cercopithecus mona	Mona Monkey	LC	√	Vo	1
Civettictis civetta	African Civet	LC	√	D, F	8
Panthera pardus pardus	African leopard	NT	unconfirmed	D	1
Caracal aurata	Golden Cat	NT	unconfirmed	D	

IUCN classification – LC = Least Concern; NT = Near Threatened; EN = Endangered; VU = Vulnerable; CR = Critically Endangered. Types of Observation – D = Dung; F = Footprint; FE = Feeding Evidence; Vo = Vocalization; Sg = Direct Observation.

4.8.6 Encounter Rates, Distribution and Relative Abundance

The mean encounter rate of large mammals was generally very low. Red river hogs and African civets were encountered 0.36 per kilometer walked in the survey area while duikers and bushbuck were 0.22 and 0.16/km respectively while the observation of mona monkeys was only 0.03/km.

Table 4-16: Encounter Rates Along recce Routes

Recce ID	Distance	*S.nanus*	*P.porcus*	*C.civetta*	*Cephalophus spp*	*T.scriptus*	*C.mona*
1	9.2	0.11	0.87	0.11	0.00	0.11	0.00
2	9.5	0.42	0.00	0.00	0.32	0.21	0.11
3	8.7	0.00	0.00	0.00	0.00	0.11	0.00
4	5.2	0.00	0.58	1.35	0.58	0.19	0.00
Mean Encounters		0.13	0.36	0.36	0.22	0.16	0.03

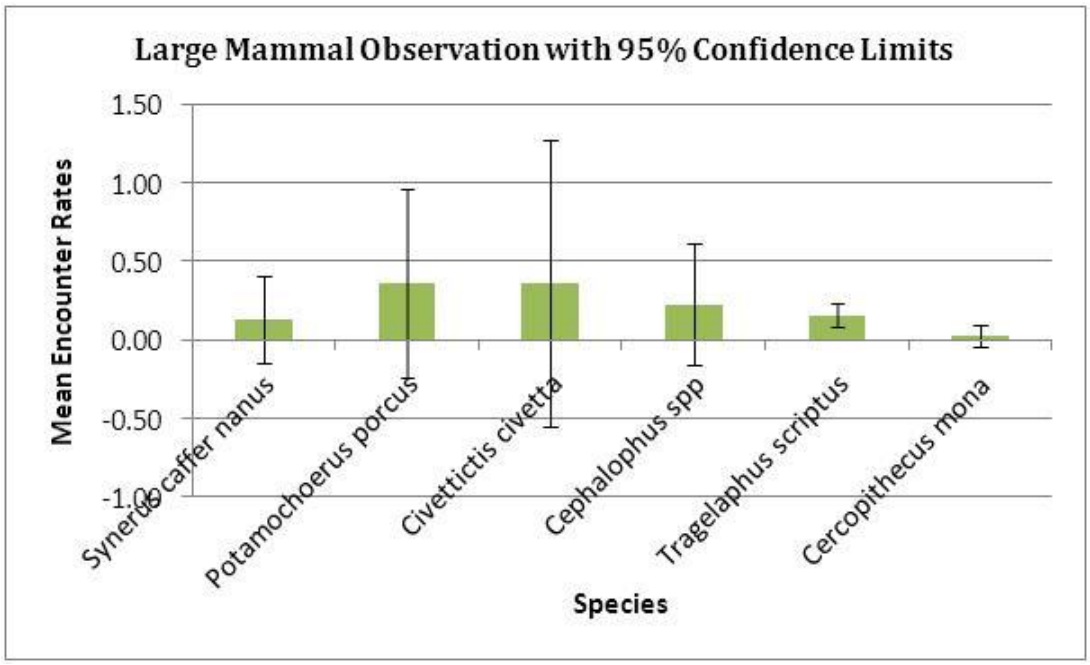


Figure 4-9: Encounter Rates of Large Mammal in Extension One

Similarly, the distributions of large mammals reflect their preference for forest habitat, therefore most species occurrences were restricted to small fragments of forest remaining in the area especially in the south and north - eastwards. Red river hogs were observed mostly in the swamp forest north-east of the area. One observation was made in the southern part of the survey area along an active timber road of a scat belonging to one of the large carnivores known in the Okomu area – the Leopard and the African Golden Cat but identification of the species that deposited the scat could not be confirmed. The most reliable method of determining the species that deposited the scat is in its diameter measurement as described in White & Edwards, 2000 but because the scat had been sun baked and dispersed, diameter measurements could not be achieved.

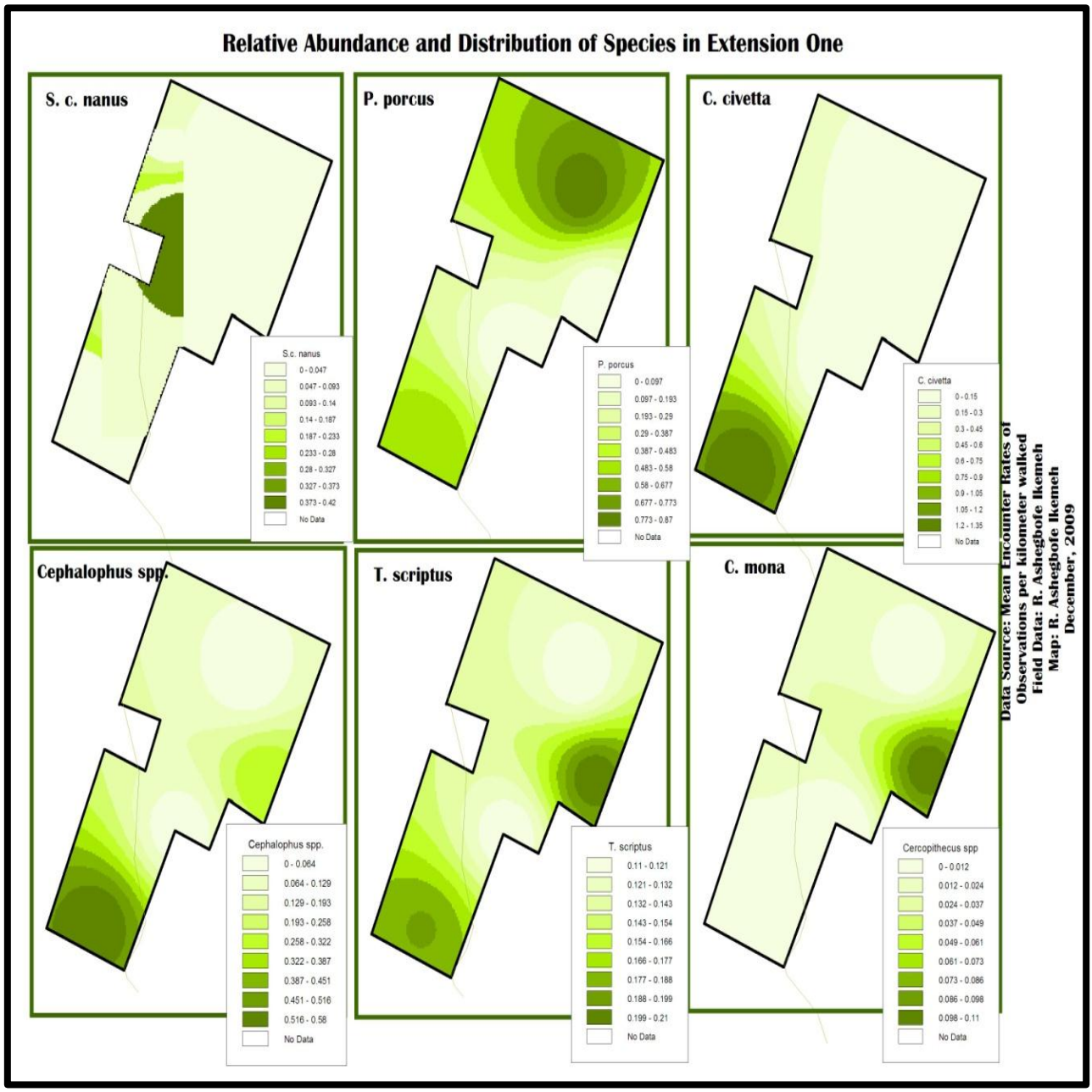


Figure 4-10: Relative Abundance and Distribution of Species in Extension One

4.8.7 Current Threats

The most significant threat facing any wildlife occurring in Extension One is habitat loss and the remnant forest habitat is of very low quality. An extensive area has already been converted to cocoa farms and the cultivation of other crops. For this reason, specific data was not collected for the observations of farming or related activities as threats facing wildlife in the area. However, with every observation of large mammal recorded, a corresponding entry of habitat type of species occurrence was made. Analysis of this result shows that large mammal

occurred mostly in forest habitat and most species observed showed preference for degraded forests of dense undergrowth vegetation containing few large trees or perhaps observations of large mammals was high in this habitat type because of its proximity to the Okomu National Park or because it is the most extensive natural forest type in the area.

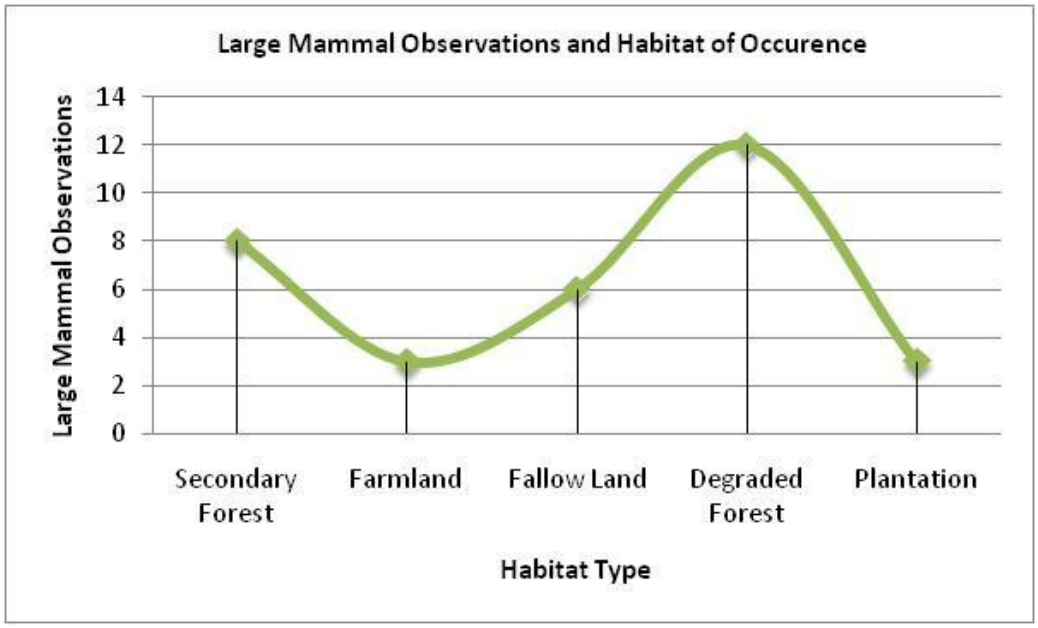


Figure 4-11: Large Mammal Observations and Habitat of Occurrence

Observations of logging and hunting were noted and while logging was carried out in the north east and southern part of the survey area, hunting was the most direct and prevalent threat observed compared to logging. Locals set traps in their farms and in the forest; other related signs observed include used shotgun cartridges and carbide. A hunter was encountered on one occasion along the boundary between Extension One and Michelin rubber plantation, he mentioned that bush meat is rare in the area and only the small mammals such as porcupines were remaining and to hunt even antelopes would take several kilometers walk into the forest pointing in the south-westwards directions.

Table 4-17: Field Data of Hunting Observations

Recce ID	*Nos. of hunting Obs.*	*Types of Observation*	*Mean ER*
1	3	Cg, Cb	0.33
2	7	S, Cg, Cb	0.74
3	8	T, S, Cg	0.92
4	5	T, Cg	0.96

***Types of Observations: T =Trap; S = Snare; Cg = Spent Catridge; Cb = Carbide.**

4.8.8 Status of Large Mammals in Extension One

The status (presence, relative abundance and distribution) of 6 species of large mammals described in the preceding sub-sections varied considerably. Although, the intensity of human activities, habitat type and availability water sources can be regarded as determining factors to species presence/absence and occupancy in the area.

Buffalo (*Synerus caffer nanus*)

Fresh evidences of the buffalo were observed inside the existing oil palm plantations and in the cocoa farms west of the survey area. However, it is doubtful if buffalos are resident in Extension One, even though there is abundant grass in some of the cultivated fields that attracts the buffalo, intensive human pressure in the survey area can be a major deterrent. Some of the plantation workers and hunters interviewed corroborate this observation as most of them believe that buffalos most times wander into Extension One to either feed or are in search of food but are unlikely to occupy the area.

Red River Hog (*Potamochoerus porcus*)

Observations of red river hogs reached 1.2 per kilometer walked in the north-eastern part of the survey area with significant encounter rate in the southern part of Extension One. There is no doubt that this species occur in the survey area as they favour impenetrable vegetation and swampy areas. Furthermore, they show high habitat tolerability and sometimes seem to prefer living in abandoned farmlands where they can root for tubers; however, they also appear to avoid human dominated areas as is evident from their absence in the central part of Extension One.

African Civet (*Civettictis civetta*)

African Civet was observed only in the southern part of the survey area. As opportunistic omnivores, it is rather surprising that no observation was made in

the oil palm plantations. Notwithstanding, analysis of their droppings examined in this southern section of the survey area still showed evidences of their feeding on the oil palm pulp, possibly from local oil palm farms found in these parts (Pers. Obs. 2007). African civets are known to survive in human modified landscapes and the dense undergrowth of the vegetation in the southern part of the survey area seems ideal for this species.

Antelopes (*Cephalophus spp., T.scriptus*)
Duikers and Bushbucks were observed in all habitat types in the survey area except for the oil palm plantations where very few observations were made in general. In other words, they occurred in cocoa farms and especially in fallow areas. This is characteristic of antelope species as they are probably one of the widest ranging species of wildlife. Although, they do not exhibit particular habitat preference in their behavior but in most disturbed forest landscapes, they appear to prefer dense vegetation/ area of secondary regrowth.

Mona Monkey (*Cercopithecus mona)*
There was only one observation of this species made during the course of the survey and it occurred inside the dense vegetation of degraded forest at the eastern part of Extension One where road construction for the plantation was ongoing. It is not certain if this observation can suggest the presence of a large group resident in the area, although locals living within the survey area claim they are about the only species of primates often sighted in Extension One. Mona monkeys are the most common species of primates found in much of the forests in southern Nigeria and they appear to have survived in areas where other primates cannot, occurring in human dominated landscapes.

4.8.9 Conclusions and Recommendations

A large area of natural forest has already being converted to agricultural lands and other non-forest land-cover types, small remnant secondary forest remains in the north-east and in the southern parts of the reserves, possibly covering about 5% of the entire land area. As this land conversion is expected to continue with the cultivation of oil palm plantations, the fate of wildlife species remaining in the area still hangs on the balance as one of the main causes leading species to enter into the higher endangered categories, is the destruction of their habitats.

The environmental impacts of oil palm production are recognizable and extensive literatures have been published on this subject; water production decreases, the soil structure and composition is modified, the abundance of fauna and flora and

their species' composition are altered (WRM, 2001), more so, larger mammals are driven into even smaller ranges. However, environmental change is an inevitable outcome of most economic activity, but the magnitude to which any economic activity affects the physical environment depends upon the value one attaches to different aspects of the environment.

4.8.10 HCVF Criteria

The absence of existing information to show that High Conservation Value species of mammals are resident in Extension One indicates that the survey area does not meet the Forest Stewardship Council (FSC) criteria for a High Conservation Value Forest (HCVF); considering two out of six criteria that relates to wildlife occurring in an area:

- ***HCV1. Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).***
- ***HCV2. Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.***

There was no observation of an endangered species nor of species of global, regional or national importance, although, there was evidence of the possible occurrence of leopard or African golden cat which are globally Near-Threatened species, nonetheless, this does not suggest that these species are resident in the area or that viable populations use the area especially since the viability of leopard populations as most carnivores, is chiefly a function of prey abundance (Marker & Dickman 2005).

Moreover, the cumulative encounter rate of large mammal species in general was 1.4 per kilometer walked and does not suggest that significant numbers or concentrations of any species exist in relation to the whole land area covered by Extension One. However, in parts of the survey area, survey results suggests that some mammal species exist in natural patterns of distribution and abundance, specifically, the Red River Hog occurring in the north-eastern swamp forest area and the African Civet as well as antelopes which occur in the southern part of the area. Evidently, significant fragments of forest in the north-east and the regenerating vegetation in the south have allowed these species to thrive.

4.8.11 Okomu Forest Ecosystem and Values

The Okomu forest is a bio-diverse ecosystem and contains unique wildlife composition, including the endangered Nigerian-Cameroon Chimpanzee, the near-endemic white-throated monkey, Leopard and Elephants. Plants species of high economic importance can still be found in the area including bamboo, rattans, rubber, mahogany and the iroko. Although the level of endemism is low, wildlife species is diverse; at least 40 species of mammals are known to inhabit the area. There is a record of 231 species of birds some of which are of global importance which makes the area one of Nigeria's 27 Important Bird Areas (IBA) with a significant number of Guineo-Congolian forest endemics and at least two globally Near-Threatened species, Grey Parrot *Psittacus erithacus* and Yellow-casqued Hornbill *Ceratogymna elata*.

Furthermore, the forest sustains the watershed system, prevents erosion and flooding, provide habitat for commercially valuable NTFPs such as rattans (*Laccospermas ecundiflorum),* bamboo, and chewing *stick* (*Garcinia manii and Masscularia acuminata*); as well as provide recreational and aesthetic enjoyment to people including ecological maintenance and protection.

4.8.12 Wildlife of Importance

Five species of mammals occur in the adjoining OkomuNational park that are of regional conservation concern, two are of global importance and their conservation must be a priority in any environmental action plan to be carried out in their range besides the general no hunting rule.

Chimpanzees

The Nigerian – Cameroon Chimpanzee *P.t. ellioti* is the most threatened chimpanzee subspecies, with the smallest distribution and smallest population. Chimpanzees are found predominantly in moist and dry forests, and forest galleries. They are omnivorous, and their diet is highly variable according to individual populations and seasons. Fruit comprises about half the diet, but leaves, bark, and stems are also important. Mammals comprise a small but significant component of the diet of many populations. Chimpanzees form social communities of 5 to 150 animals (Oates et al, 2008).

No observations of chimpanzees were made in Extension One but they have been confirmed resident at the Okomu National Park (Greengrass, 2006). One local report of chimpanzees suggested that they might have occurred in Extension One

until the mid-1990s. Nonetheless, it cannot be dismissed that these chimpanzees may occasionally range from the park especially to feed.

White throated Monkey

The White-throated Monkey was once considered extinct due to constant hunting for the fur of its unique red belly and white front legs. The White-throated Monkey is usually a frugivore but insects, leaves, and crops are also in its diet. It usually lives in small groups of four to five individual monkeys however, there have been groups of 30 discovered and in rare cases, some males wander alone. It is arboreal, living in moist tropical forest and the wettest parts of dry tropical forest, however it can also be found in secondary bush and old farmland (Oates et al, 2008). The White-throated monkey remains the flagship species of the OkomuNational Park, even after it has been down listed from vulnerable to Near Threatened in 2008, it is still a species endemic to the region.

Elephants

Poaching for ivory and meat has traditionally been the major cause of the elephants' decline. Although illegal hunting may remain a significant factor in some areas, currently the most important perceived threat is the loss and fragmentation of habitat caused by ongoing human population expansion and land conversion. A specific manifestation of this trend is human-elephant conflict, which further aggravates the threat to elephant populations (Blanc, 2008). Elephants may be classified as near-threatened globally by the IUCN but nationwide and in West Africa, the species is vulnerable to extinction. A carcass of an elephant was discovered in the middle of a lake during a wildlife survey in 2007 under rather mysterious causes (Ikemeh, 2007), using methods described in White & Edwards, 2000 to determine elephant age, indicated that it was unlikely to have died from old age, in other words, death causes may range from hunting to illness.

African Golden Cat

Listed as Near Threatened as it seems reasonable to believe that the species could have declined on the order of 20% over the course of the last 15 years across its range, due mainly to the impact of habitat loss, hunting and loss of prey base, particularly in West Africa. Loss of habitat is an obvious threat to this species. Deforestation has destroyed suitable habitat and driven declines of prey species in large areas of the African golden cat range, particularly in West and East Africa (Nowell and Jackson 1996; Ray and Butynski in press). An additional threat stems from the bush meat trade, which figures largely in the region's economy, and is

depleting populations of the prey base of the African golden cat. There appears to be little direct hunting of golden cats (Nowell and Jackson 1996). However, they may be trapped incidentally in wire snares: Included on CITES Appendix II. Hunting of this species is prohibited in ….Nigeria (Henschel et al, 2008).

Leopard

The African leopard *Panthera pardus pardus* is a top predator in the African rainforest and has remarkable habitat tolerability than any carnivore i.e. it occurs in most habitat types and adapts quickly to habitat modifications. The Leopard is classified as Near Threatened on the IUCN red list, the species population declines chiefly due to the decline in wild prey base and hunting.

4.8.13 Monitoring and Best Practices

- The OOPC should sustainably manage the remaining forest and plantations according to the standards of the most stringent certification schemes (e.g. Forest Stewardship Council (FSC) or RSPO principles and criteria)

- The company should establish partnership with a reputable conservation organization/group to collectively explore opportunities for integrating biodiversity management into the company's EMS due to the sensitive location of its operation sites to the Okomu National Park.

- The Okomu Oil Palm Company within its EMS may also set aside a percentage of profit as trust fund that would be used for studies, projects and surveys (among others) that examines wildlife, biodiversity and environmental conservation or promotional activities that is related to the palm oil production and biodiversity management.

- The conservation partners should be able to develop tools to measure changes in biodiversity including identification of appropriate indicator mechanism for detecting impact of the industry's operation on wildlife species.

- Gallery forests along the major stream – Arakhuan that cuts across the center of Extension One into the eastern edge of Okomu National Park should be reserved from any form of land use (at least 1km on either side of the river) to provide corridor and ensure some form of habitat

- connectivity with the habitat of the OKNP so as to preserve wildlife range connections.

- A representative fragment of the swamp forest north-east of the reserve should be conserved not only for biodiversity but also for delivering the joint benefits of wetlands which include regulating/stabilizing the river flow and they function as filters for pollutants and fertilizers – expected byproducts of oil palm cultivation and refining.

- The implications of oil palm production is not only limited to habitat loss but potential impact of the plantation stems from the management of its operation e.g. solid oil wastes, palm fiber and shells, palm oil mill effluent, use of petroleum-based pesticides, herbicides, and fertilizers have negative impacts on the ecosystem and this should be monitored and sustainably managed to prevent pollution especially of the watershed which is shared with the OKNP to prevent death of species.

  *Oil palm can be cultivated in a manner that helps mitigate climate change, preserves biodiversity, and brings economic opportunities to desperately poor rural populations (*WWF).

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4.8.14 Vegetation

4.8.14.1 Initial Biodiversity Study (Vegetation)

This is a report on a vegetation study carried out between the 16 th and 20th of December, 2009 to establish the presence/absence, distribution and status of High Conservation Value (HCV) habitats if any existing in a relatively new operational area of the Okomu Oil Palm Company (OOPC) known as Extension One. The study was conducted to gather baseline information on habitats and flora species of global, regional and national conservation importance for the preparation of an Environmental and Social Action Plan (ESAP) to improve the environmental sustainability of oil palm cultivation and enhance the conservation of resident natural resources and biodiversity.

4.8.14.2 Sampling

Considering the area of land covered by Extension One and the time-frame specified for the survey, the rapid assessment technique employed for the large mammal survey was adopted. A central recce line that runs zigzag, dividing the area diagonally into two with an estimated distance of 32.6km was cut from north to southern end of the area.Its zigzag style did allow the line to touch the east and west end of the area at certain points and perpendicular to the major stream -Arakhuan allowing the vegetation team to survey representative sample of habitat types in the.

Inventory of tree species and other plant forms were carried out along the recce route wherever there were relics of forest patches, logged over vegetation and old or seemingly abandoned farmland. This inventory started where the route continued on the 17t of December, 2009 at 6.35°N, 5.37°E where a total of forty (40) temporary plots of one hectare (1ha) size each were randomly enumerated within the remaining uncultivated vegetation along the central zigzag transect line, unfortunately two (2)

plots fell outside the study area's boundary because there was no reference map to work with at the time of the survey. This is estimated to have covered at least one percent (1%) of the existing, yet to be cultivated vegetation, abandoned farms and plantation. Data on the vegetation type north of the study area are derived from observations made during the large mammal survey.

4.8.14.3 Tree Inventory

Along the recce route and in each plot, inventory of flowering plants mainly of tree form and common undergrowth were conducted. All tree species having a diameter at breast height (dbh) ≤ 10cm within a demarcated one hectare plot were identified and its dbh, and total height was measured while the canopy size was occularly estimated. Checklist and abundance of the dominant undergrowth was created. It was extremely difficult to conduct absolute count under the field condition, thus, the dominant and (or) competing species were recorded in each plot including information on its geographic coordinates and land cover/land use patterns.

4.8.14.4 Abundance Estimation

Data collected was analyzed in order to calculate abundance of each species, total volume of trees in the area and per species.

The formula used in estimating the abundance of each species is as shown below.

$A=(n/N) * 100$

Where A= Abundance, expressed as a percentage of N

N= Quantity of a particular species

N= Total quantity of species encounteredwhilerelativeabundance

(RA) isexpressed as:

$RA= \sum n/(t*a)$

Where n= total quantity of a particular species during the survey
t = Period of survey
a = Area of survey

Structure of the vegetation was estimated by stratifying the tree height. The trees were divided into two strata i.e the dominant (A) and sub stratum B. Height of the tree were used as indicator of strata delineation (A ≥ 10m; B ≥ 5m ≤ 10m). Brief descriptions of each area being mapped and inventoried are stated in order to give strength to the estimated profile. Resolution on the Conservation Value of the Forests identified was based on the results of aforementioned analysis and criteria provided by Proforest tool kit.

4.8.14.5 GIS Analyses

Arcview™ GIS3.3, Spatial Analyst and Image Analyst softwares(Environmental Systems Research Institute(ESRI), Carlifornia, U.S.A) were used in image dataprocessing, analysis and classification. Commercially available multi-spectral, hi-resolution SPOT satellite imagery of the study area acquired in 2008 (Figure 4-12) was used directly to evaluate the land cover and land use in the study area and to classify vegetation, categorizing vegetation and non-vegetation classes in the study area.

Using the 3-band SPOT data, the accuracy of two types of supervised classifications was tested for mapping 4 unsupervised classes and 2 unsupervised classes. An attempt was also made to compare the differences between the two classification and results from ground truthing.

The Scene of the study area is enclosed in black polygon; forested areas are shown in deep purple patches, degraded forests and/or farmlands are the light purple areas while bare land surfaces such as settlements, road networks and inselbergs are shown as light green patches.

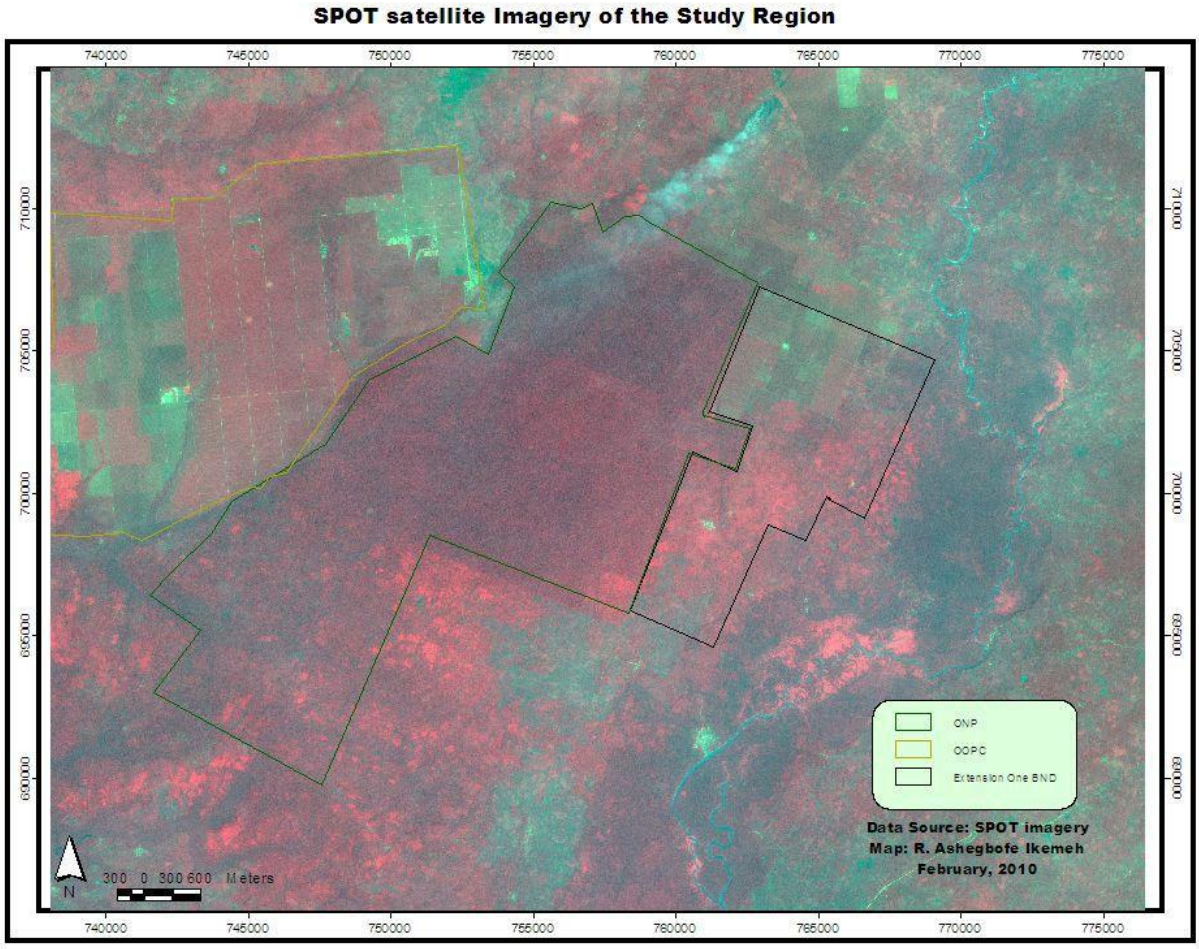


Figure 4-12: High-Resolution SPOT Satellite Imagery 2008.

4.8.15 Results and Interpretations

HCVF Identification

Twenty (20) tree species of High Conservation Value were identified in the study area. Four (4) are listed under Schedule One of the National Biodiversity Action Plan. Alstonia congensis was the most frequently observed species with relative abundance of 0.65/ha with *Afzelia Africana, Cordia milleni and Chlorophora excelsa* being 0.3, 0.28 and 0.2 respectively. *Chlorophora excelsa* was the most abundant species observed of tree species listed under schedule one. *Allanblackia floribunda*, *Garcinia cola* and *Mansonia altisima* are among tree species observed on the list having one (1) observation each.

Table 4-18 : Tree Species of HCV observed in the Study Site

Name of Plant	Dbh (m)	Basal Area (m^2)	Volume (m^3)	Freq	Abundance	Rel.Abundance(ha)	CITES/BAP
Afzelia Africana	4.971	61(13.42)	3.9	87.48	0.3	Schedule 2	
Allanblackia floribunda	0.56	25(0.44)	10.99		0.29	0.025	Schedule 1
Alstonia congensis	10.10	9(21.21)	9.55	42.78		0.65	Schedule 2
Brachystegia eurycoma	0.48	19(0.38)	7.16		0.29	0.025	Schedule 2
Chlorophora excelsa	4.772	19(27.38)	3.75	110.25		0.2	Schedule 1
Cordia milleni	3.821	60(14.55)	3	44.97	0.275	Schedule 2	
Diospyros alboflavescens	0.23	9(0.18)	1.63		0.29	0.025	Schedule 2
Entandophragma angolensis	1.95	85(21.25)	1.53	34.36	0.025	Schedule 2	
Fagara zanthoxyloides	1.26	69(13.8)	0.99	14.69		0.025	Schedule 2
Garcinia cola	1.34	82 (27.33)	1.05	29.63	0.075	Schedule 1	
Irvingia gabonensis	0.24	9(0.18)	1.69		0.29	0.025	Schedule 2
Khaya ivorensis	1.13	56 (28.00)	0.89		0.86	0.075	Schedule 2
Lophira alata	0.65	37(0.51)	18.89	0.29	0.025	Schedule 2	
Mansonia altisima	2.991	02(20.40)	2.35	0.29	0.025	Schedule 1	

Pterocarpus soyauxii	0.32	12(0.25)	3.02	0.29	0.025	Schedule 2
Pterocarpus erinaceus	0.93	36 (18.00)	0.72	0.29	0.025	Schedule 2
Pterocarpus mildbraedii	1.13	61(15.25)	0.89	0.56	0.05	Schedule 2
Rauvolvia vomitoria	0.39	14 (7.00)	0.31	1.14	0.1	Schedule 2
Strombosia pistulata	1.18	60 (15.00)	0.92	0.29	0.025	Schedule 2
Terminalia superba	3.87	121(20.16)	3.03	0.86	0.075	Schedule 2

4.8.16 Species Diversity, Status and Abundance

Tree Inventory

Seventy four (74) tree species were enumerated during the assessment. The result of tree inventory conducted showed that *Musanga cecropioides* had the highest frequency of occurrence (59); total dbh (15.10); total height (687.00m); total basal area (11.86m^2) in the area. In terms of frequency of occurrence, *Cleistopholis patens* (31) had the highest after *Musanga cecropioides* while *Alstonia congensis, Ceiba pentandra,, Afzelia africana and Cordia millenii* were observed on 26, 18, 12 and 11 sampling occasions. The butt size of the trees measured by their diameter at breast height (dbh) indicated that *A. congensis* with 26 tree stands had the highest (10.10m) after *M. cecropioides* and higher than *Cleistopholis patens* that has 31 tree stands, followed by *Ceiba pentandra* (6.89m), *Milicia excelsa* (4.77m) *and Nauclea diderichii* (3.08).Height of the trees was expressed as total and average height of each species. For a clear explanation of the vegetation structure, average height of the trees as used. Height of the trees in the sampled area ranging from 6.00m – 37.00m at the upper extreme of the range are *Lophira alata* (37.00), *Cedrella odorata and Gossweilerodendron balsamiferun* (32.00m). While at the lower end of the range are Irvingia *gabonensis, Diospyros alboflavescens* (9.00 each*), Theobroma cacao* (8.00), *Baphia nitida* (7.00) *and Myrianthus arboreus* (6.00). As stated earlier the total volume of wood biomass (1859.84m3) estimated is not of commercial quantity moreso it is from 40 hectares of land. But at the species level, *Alstonia congensis* had the highest volume (242.78m3) and was followed by *Musanga cecropioides* (159.63m2) *Ceiba pentendra* (127.28m3), *Chlorophora excelsa* (110.25m3). Trees with the least wood volume are *Albizia coriara, funtumia africana, Irvingia gabonensis* and several others with wood volume less than 2.00m3.

Musanga cecropioides also had the highest abundance value (16.81%) of the (351) total stand enumerated. This was followed by *Cleistopholis patens* (8.84%); *Alstonia congensis* (7.41%); *Ceiba pentandra* (5.13%); *Afzelia Africana* (3.42%). Others that had an abundance value above 1% are *Albizia ferruginea; Anthocleista vogelli;Chlorophora excelsa; Cordia Millenii* etc. Those whose values are below 1% forms the majority of the tree species encountered in the area. In terms of the relative abundance estimate of trees in the area assessed, *Musanga cecropioides* had the highest abundance (1.48stand/ha) followed by *Cleistopholis patens* (0.78stand/ha). Species with the least relative abundance are *Entandophragma candolei, Pterocarpus soyauxii, Lovoa trichilioides* and several

others with relative abundance of 0.03stand/ha. The pattern of relative abundance estimates shows that none of the tree species observed has stocking density that can be regarded as viable and in commercial quantity.

Undergrowth

Nine (9) species of plants identified in the area were classified as undergrowth. This was because their stem size or heights were found to be below those selected for trees. Moreover, they are usually found in the forest floor with heights ≤ 2m. They fall within the categories of plant form described as herbs (Keay, 1964) except *Alcornea chordifolia* that is a shrub that can grow taller and beyond 2m especially when it is not disturbed in a forest gap. *Lacosperma spp (Rattan)* and *Piper guineensis* are the species that are neither Shrubs nor herbs but are climbers and are found among the understorey vegetation identified in the study area.

Considering the undergrowth population within the remaining patches of secondary forest in Extension One, *Alcornea chordifolia* had the highest frequency of occurrence (22) and abundance (36.05%) with the least found in *Aframomum danielli and Cycads spp* (3.28% each) .As regards dominance and distribution on plot basis, *Thaumatococcus danielli* was found dominating the forest floor and form the bulk of forest undergrowth in plots 1-5. Understoreys of plot 6-9 were jointly occupied *Thaumatococcus daniellii* and *Chromolaena odorata* while plots 17 -21 were covered and dominated by *Aframomum spp, Rattan* and several climbers like *Piper guinensis.*

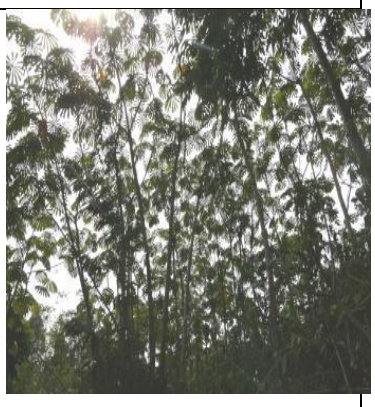
4.8.17 GIS Data Validations

Ground truthing results was verified on the SPOT satellite imagery acquired in 2008 and suggests that the remotely sensed satellite data is a good representation of the vegetation available on ground. However, owing to the fact that some farmlands were only recently abandoned ≥ 6 months ago where the invasive weed *Chromolaena odorata* has populated the farm areas giving the appearance of young secondary bush.

Notwithstanding, the land features indicated on the satellite imagery is consistent with the observations made during the survey and serves as a reliable indicator of habitat distribution in the study area. For example plots that fell within the riparian vegetation along the Arakhuan stream that cuts through the study area at the south was observed as having dense forest cover with the with dominant undergrowth of *Aframomum spp*, rattan and several climbers like *Piper spp*. The Table below

summarizes the plots established in the study area, location and description of habitats observed in the area with available photographic examples of these habitats.

Table 4-19: Description of Plots and Habitats

Plots covered	Latitude (N)	Longitude (E)	Habitat Description	Photographic Reference
1 – 5	06º.20'.819"	005º.22'.487"	Old abandoned plantation of cocoa and plantain that has been taken over by secondary vegetation dominated by Musanga, and understorey of Thaumatococus.	
6	06º.20.620"	005º.23.002"	Old farmland that has been under fallow for almost a decade, overgrown by trees like Musanga, as well as undergrowth such as chromolaena, Thaumatococus etc	
7 – 9	06º.20.577"	005º.23.140"	Same as in plot 6	
10 - 13	06º.20.549"	005º.23.524"	Logged over vegetation with a secondary forest outlook dominated by early colonizers like Musanga, Alcornea, Mitragyna and several undergrowth like Thaumatococus etc	
14	06º.20.302"	005º.24.115"	Same as in 7-9 but with additional undergrowth of Chromolaena under Musanga.	

15 – 16	06º.20.264”	005º.24.188”	Dense forest cover as in 10-13	
17 – 20	06º.20.213”	005º.24.500”	Very thick forest cover with the same status as in 10-13 but with dominant undergrowth of Aframomum spp, rattan and several climbers like Piper spp.	
21	06º.19.956”	005º.24.344”	Same as in 17-20.	
22 – 23	06º.19.870”	005º.23.814”	Old abandoned farmland dotted by left over trees and colonizers like Musanga and undergrowth of Chromolaena	
24 – 25	06º.19.834”	005º.23.441”	Secondary forest regrowth with rattan and colonizers like Musanga, Mitragyna etc	
26 – 32	06º.24.457”	005º.16.228”	Abandoned farmland with secondary forest regrowth and understorey of Thaumatococus, Piper etc with signs of continuous logging activities.	
33	06º.17.214”	005º.20.079”	Same as 26-32	
34 – 40	06º.17.500”	005º.21.082”	Same as 26-32	

4.8.18 Land Cover and Land Use

Land cover and land use types in the study area was analyzed using two (2) image classification types of the SPOT satellite imagery provided by ERM. The results of these classification efforts are meant to provide information on the spatial extent and cumulative area covered by each vegetation class identified in Extension One. The imagery was first classified under 6 vegetation classes and subsequently under 2 vegetation classes to create 2 distinct vegetation types – forest cover and non-forest cover land types. However, because certain land cover types share the same spectral properties, GIS analysis of this nature constrains the individual demarcation of different land cover types identified on the ground, for example, since matured rubber trees managed as a plantation have dense forest cover as matured secondary forest, the spectral response from the satellite become similar. Notwithstanding, an attempt has been made to describe each land cover type obtainable in the study area (Table 4-20).

Table 4-20: Description of Land Cover and Land Use Types in the Study Area

Land Cover Types	Descriptions
Secondary Forests	Land area of natural forest with small and medium- sized trees and often dense understorey with moderately closed canopy.
Rubber Plantation	Land cultivated with rubber and managed as plantation often with closed canopy and sparse understorey.
Fallow Land	Land under fallow from previous cultivation/clearing by people with open canopy and dense undergrowth of mostly weed where the evidence of food crops sometimes persists.
Degraded Forests	Land area of natural forest (secondary regrowth) with dense undergrowth containing very few large trees.
Oil Palm	Land cultivated with oil palm and managed as a plantation less than 10 years old with dense understorey and open canopy
Matured Cocoa Farms	Land area cultivated with cocoa at least 10 years old with no understorey and closed canopy.
Other Farmlands	Land area cultivated with one or more food crops by people. In this case, containing cassava, plantain and sometimes intercropped with cocoa.
Bare lands	Land that includes areas of settlements, roads and shrub lands

Rubber Plantation

SecondaryForest

Young Oil Palm Plantation

FallowLand

Settlements

Mature Cocoa Farm

Other Farmland

Degraded Forest

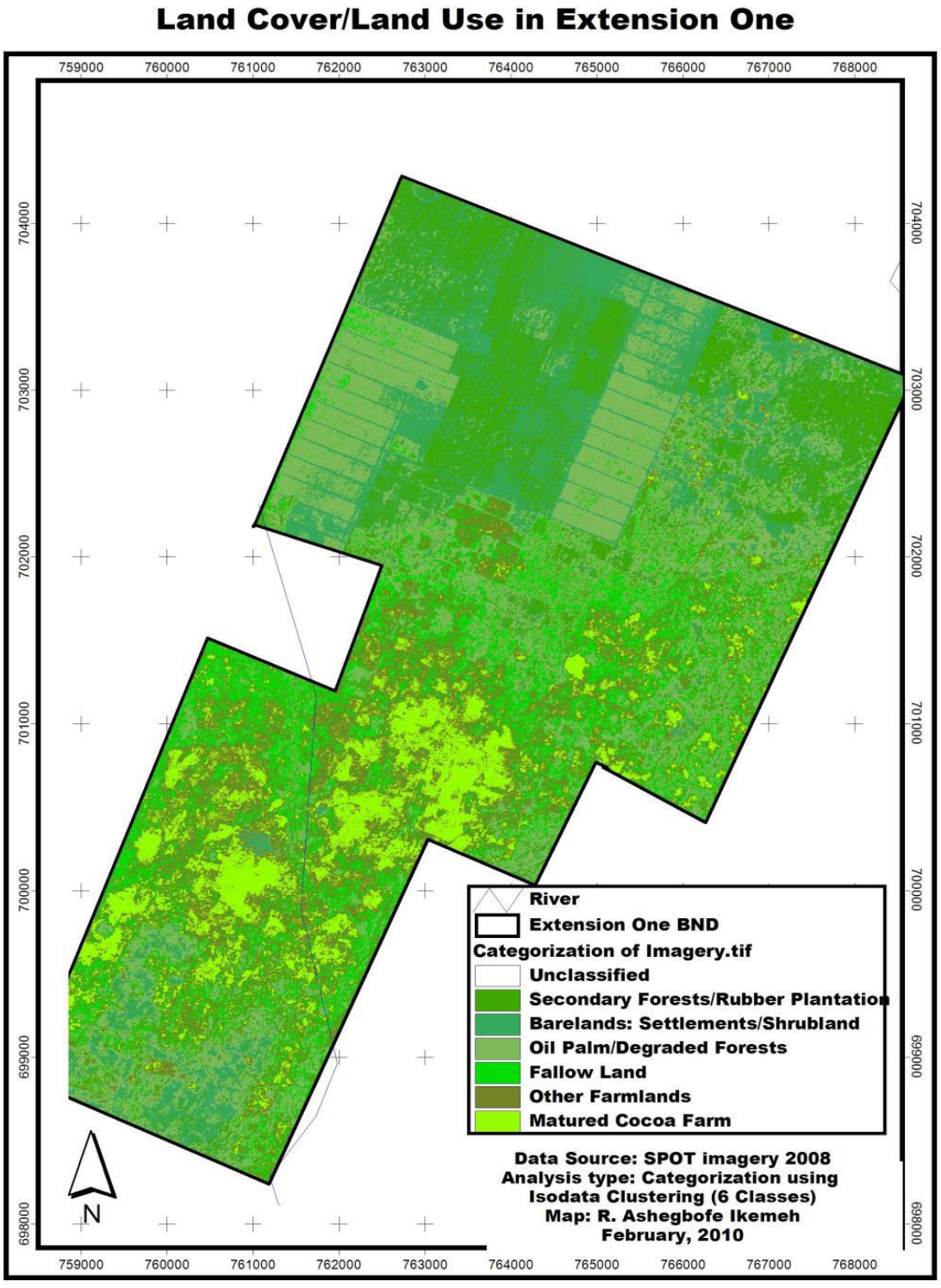


Figure 4-13: Land Use/Land Cover in Extension One

The six vegetation classes' categorization of the satellite imagery suggest that the cumulative area covered by matured cocoa farms and other farmlands of 1817.21ha makes farmlands the most extensive type of land cover in the survey area and oil palms/degraded forests covers 24.2% of the total land area of Extension One (see Table 4-21).

Table 4-21: Results of Classification of Satellite Imagery in 6 categories

LCLU Type	**%**	Ha	**Km2**
Secondary Forests/Rubber Plantation	13.88	854.18	8.5
Bare lands: Settlements/Shrub land	15.82	973.62	9.7
Oil Palm/Degraded Forests	24.24	1491.79	14.9
Fallow Land	16.54	1018.08	10.1
Other Farmlands	19.56	1203.89	12
Matured Cocoa Farms	9.96	613.32	6.1

Table 4-22: Results of Classification in 2 categories

LCLU Type	**%**	**ha**	**km2**
Forests/Tree Plantation	57.64	3547.81	35.5
Non-Forest land	42.36	2607.09	26.1

Furthermore, results from the classification of the satellite imagery under two vegetation classes indicate that forest cover was the most predominant land cover type in the area including tree plantations covering 57.6% of the study area while non-forest land was 42.36. Therefore, it can be assumed that going by results of the survey natural forest makes up about 20% of Extension One including the gallery forest along the Arakhuan Stream.

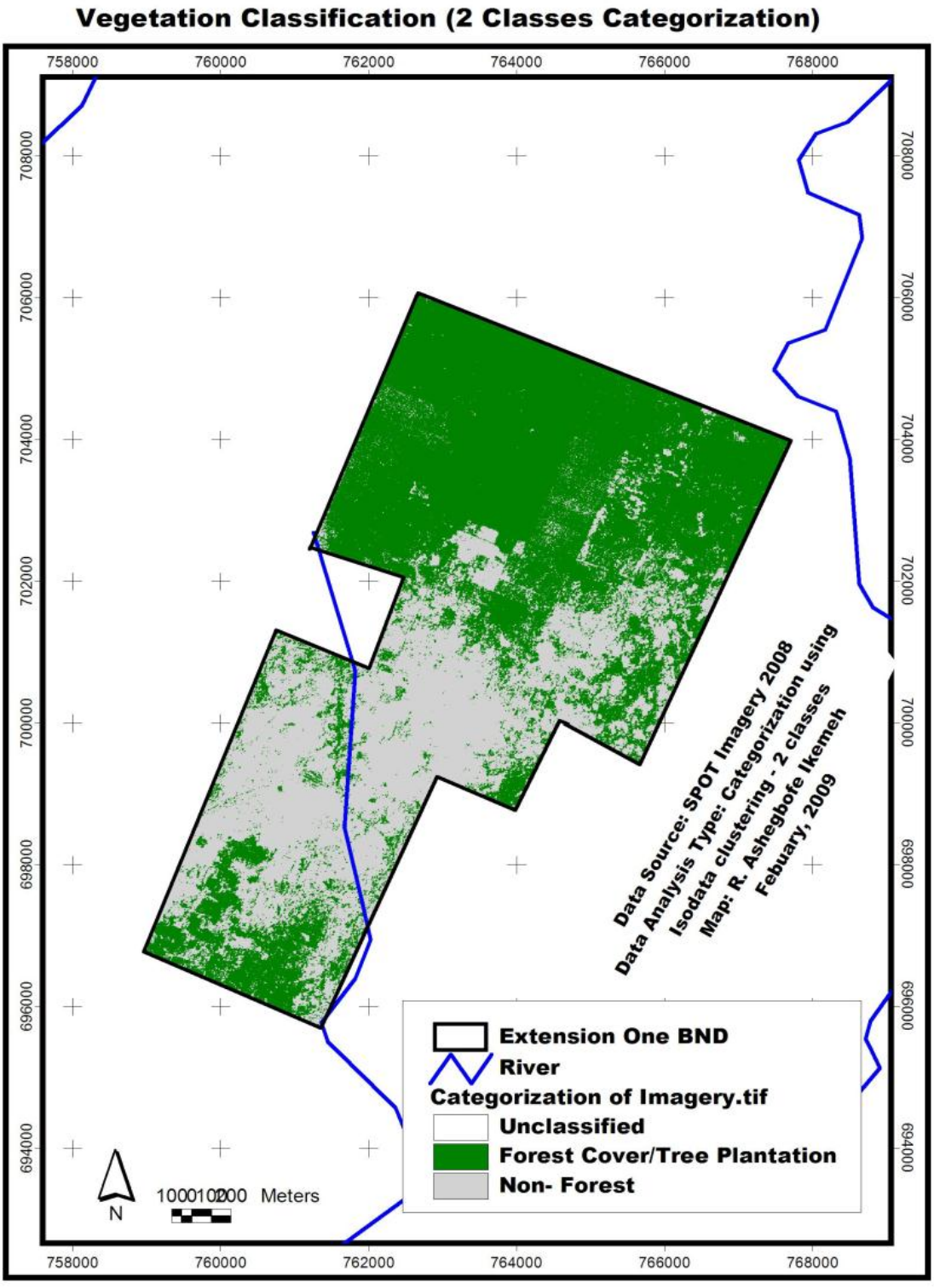


Figure 4-13: Vegetation – Two Classes Categorization

4.9 Discussions

4.9.1 Forest Profile

The study area was observed to have been under tremendous anthropogenic pressure from timber extraction for a long time. The present state of the vegetation is of logged over secondary rainforest ecosystem. The forest seems to have the potential for quick succession if it is allowed to do so. But continuous logging and other forest resource extraction including farming activities has not allowed the succession process to take its course. An indication of previous disturbance and commencement of succession is the presence of *Alcornea cordifolia, Chromolaena odorata and Musa sapientum* as undergrowth in the area. Presence of *M. sapientum and Theobroma cacao* within the old and abandoned farm forest indicated that the area had been cultivated in the past. Furthermore, *Alcornea cordifolia and Chromolaena odorata* have been classified as early colonizers of disturbed ecosystem (Keay, 1990; Kang et al, 1990); they sprout naturally and sporadically over any logged or disturbedecosystem where primary forest cover is removed. They help in rejuvenation of lost and recycling of the available soil nutrient. Their presence in Extension One moreover in quantities that allow them to be ranked among the dominant undergrowth is an evidence of ecosystem disturbance and the commencement of succession after the forest cover has been removed.

More than half of the total land area is currently under one form of cultivation of cash crops or arables and plantation. The existing secondary rainforest in the area is limited to the north-eastern and southern axis of the area while very large expanse within the central sector of the area is under cocoa and plantain farms. These areas are also dotted by camps of mostly immigrant Yoruba farmers who have reportedly been settling in the area for twenty (20) years. Some of such camps are Hassan, Fatai Olomu and Madarin which are all within the mid sector and eastern end of Extension One where most farms were observed.

On the whole the forest profile is of a secondary, highly disturbed rainforest densely populated by shrubs and climbers as undergrowth and dotted sparsely with different species of trees whose density is far below commercial quantity. The forest community is presently dominated by *Musanga cecropioides*, a species of tree that is regarded as early colonizer of logged pristine forest. The undergrowth too is a mixture of shrubs and plants in the same category as *Musanga cecropioides*. Shrubs such as *Aframomum melegueta, Chromolaena odorata, Thaumatococus danielli and Alcornea cordifolia* form the majority of

understorey plants while *Piper guinensis and Rattan spp* are the dominant climbers within the forest floor in plots examined.

4.9.2 Stocking Density and Abundance

Total number of species by stand enumerated in the forty (1ha) plot sampled are not up to the stocks of a hectare of well-managed, undisturbed rainforest (Bada and Okojie, 2002) and thus cannot be regarded to be of commercial quantity. The same applies to volume estimation of the trees species encountered. Total basal area of the trees within the 40ha plot is 93.70m2 with a total wood volume of 1,859.84m3.This volume of wood from such area of land falls short of expectation in terms of wood supply in commercial quantity.

Deforestation through unguided logging and farming has impacted greatly on the area. Some valuable timber species that were abundant within the Okomu Forest Reserve according to the report of Keay and Standford (1964) are either nonexistent presently or are having very low stocking density or relative abundance in the area now. Keay, (1990) listed *Strombosia pistulata, Chlorophora excelsa, Antiaris africana, Entandophragma angolensis, Khaya ivorensis, Pterocarpus soyauxii, Lovoa trichilioides* etc as some of the common tree species within the reserve area. But many of these species presently can be described as rare in the area because their relative abundance value fall less below 0.1stand/ha. The species that were reported as abundant in the area and probably still remain so are *Alstonia congensis, Ceiba pentandra, Pentachlethra macrophylla and Piptadeniastrum africanum.* Their abundance value in the area may be because of their low preference by timber merchant. The woods have been described as white with low strength property. The exploitation of these species are perhaps due to their medicinal values to man.

Clearing of the forest and replacing it with cocoa coupled with indiscriminate logging of the forest without recourse to the need for succession had impacted negatively on biodiversity of the area. This has led to the invasion of the logged over site and abandoned farmlands by colonizers such as Musanga cecropioides, Harungana madagascariensis, Cleistopholis patens, Anthocleista vogellii etc, all of which incidentally had relative abundance greater than 0.1stand/ha during this survey.

Trees that are meant to be conserved based on the recommendation of the National Biodiversity Action Plan (2001), those species in schedule I are declared protected from all forms of exploitation while those in schedule II can be exploited sustainably under close supervision and by the permission of an

appropriate regulating agency. But such agency only exists at national level while there is none in the states under which forest reserves are administered. Thus, there has not been any effective regulation of resources to be exploited nor protected; instead it appears to be a case of indiscriminate exploitation of trees, such that the density has greatly reduced almost to local extinction.

4.9.3 HCVF Appraisal

In order to determine whether Extension One can be classified as High Conservation Value Forest (HCVF), the assessment done in terms of the presence/absence and abundance of tree species of High Conservation Value (HCV) indicates that the area does not fulfill the criteria for a HCVF under the stipulated body of knowledge enumerated in the ProForest toolkit. This is further aggravated by the current level of informal farming activities going on within the study area. Considering the four cardinal elements specified for the identification of biodiversity value of an area in theProForest tool kit, the area could not pass as HCV 1 and 2 due to the low concentration or the abundance of species listed and encountered in the area. Though the tree species in the area are few and naturally occurring but they are not unaffected by recent anthropogenic activities as it was reported in the preceding sub-section that the forest is a logged over secondary rainforest that is still experiencing logging of economic trees. Even if the forest is capable of self-regeneration and succession as observed, the extent of current use and threats if it continues unabated may hinder the ability of the forest to support the recovering process.

HCV1. Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).

HCV 2: Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.

In terms of environmental or social services, the area does not contain a critical watershed; neither does it contain recreational area or sites of resources harvested by local people. No existing site was observed either as religious or culturally significant area. No sacred groove was discovered, neither was there burial sites nor praying ground and this is probably due to the fact that most human occupants in the area are immigrants attracted to the Okomu Forest Reserve by the prospects of employment in the plantations and the defunct African Timber and Plywood Company since the early 1920s (Ikemeh, 2007). Considering

provision of essential fuel, food, fodder and medicines or building materials. The forest may be able to provide food and medicinal service, but if an alternative exists for the local communities then the issueof the forest being HCV may not be a compulsion. Some of the tree species such as *Dacryodes edulis; Treculia africana; Blighia sapida;Irvingia gabonensi Brachstegia eurycoma etc*. though wild, but produce edible fruits which may be useful to the local people and contribute to food security in the area. Farming of arables and deliberate cultivation of some of these wild fruit may be an alternative for the local communities but since the local people within the area are migrants that do not seem to be permanent residents, this criterion is also not valid.

Plantations of cocoa and plantain are the most significant forms of human occupation in the area besides logging which is ongoing in the small fragments of remnant forest in Extension One. Species listed in Appendix 1 of HCV report did not appear to contain any endemic species and the species that are listed in CITES as endangered in Nigeria are not present in quantities that can be regarded as viable for protection or conservation. Since these are the basic requirements for an area to qualify as HCVF, the verdict from the survey results shows that Extension One not meet the criteria for a HCVF or as a biodiversity hotspot (Appendix C)

Notwithstanding, the proximity of Extension One to the Okomu National Park, which is a IUCN category II protected area, makes Extension One a rather sensitive site to conservation.

4.10 Conclusions and Recommendations

The results of the survey show that Extension One contains very poor habitat owed mostly to the combined negative impacts from timber extraction and farming which have depleted the vegetal forest cover and reduced the diversity of the forest resources tremendously. Existing forest cover is sparsely populated by economic species but densely populated by colonizers which usually die out in their climax. In reference to the criteria in the ProForest toolkit which was first defined by the Forest Stewardship Council (FSC), Extension One cannot be established as a HCVF, but certain parts of the area especially riparian vegetation along the Arakhuan stream, the swamp forest of the north-eastern part of the concession including the southern edge should be set aside for conservation. The justification for this is enumerated in the succeeding sub-sections:

Habitat Conservation

What can be considered as priority action plan in the area of biodiversity conservation for the OOPC management is to determine and decide on how much land is required for conservation and the location of these areas that would be left unplanted. However, depending on the level of commitment of the company to mitigate thenegative effects of its operations, it is ideal that at least 10% of the area (including area legally ineligible for planting such as the riparian habitat and the wetlands) should be left unplanted and actively managed for conservation purposes. However, currently, very little is known about the best structure for habitat conservation. It is likely to vary with species, corridor width, composition, management plan and arrangement. For this, priority should be placed on further research in the area. However, habitat corridors do not have to follow rivers and do not necessarily need to be contiguous strips of land. They could be also consist of a string of habitat islands that species move between when they consider it safe, or a combination of the two (Maddox et al, 2007).

Habitat Corridors are an Essential Part of Land-Use Planning

The results of the large mammal survey suggest that the degraded forest and swamp habitats also found within the study site were shown to have high value for certain mammal species, despite being long distances from the National Park. This is significant not just for oil palm plantation management but also for conservation and land-use planning on a much larger scale. The adjoining Okomu National Park of 213km^2 is already thought to be insufficient to protect many species especially forest elephants and chimpanzees living inside the park. If degraded habitats can be made to retain conservation value for certain species, the added habitat and potential connectivity between protected areas could provide key linkages and greatly increase the potential for both the maintenance of ecosystem services and conservation of wildlife (Maddox et al, 2007). The remaining forest in its present form especially at the southern end of the area and along the Arakhuan stream is a good refuge for vertebrates and several other fauna species if left undisturbed henceforth. Eventhoughthe vegetation of the study area has been altered from its natural climatic state through logging, clearing and agriculture does not mean it is completely valueless. In some circumstances and locations such as is the case with Extension One, the area can fulfill essential functions connecting habitat to an area of higher value. In another scenario, the degraded habitats may contain handy as they it begins to regenerate.

Habitat Maintenance

The first step in maintaining the remaining natural ecosystem in Extension One not just for the conservation of biodiversity but also for the ecosystem services it provides for all, is to use the information obtained in this surveys to make improvements of the landscape, engaging with key stakeholders to persuade them to use their collaborative influence to bring change especially with the management of the Okomu National Park. Local support is also essential land use plans and establishing conservation priorities. Secondly and equally important is to engage local conservation non-governmental organizations/groups in the collaborative process. Long-term scientific/conservation research and monitoring are required to provide the raw information needed for change, and to highlight the basic requirements for ecosystem sustainability, during the planting and management of the oil palm plantation.

4.11 CONSULTATION WITH AND PARTICIPATION BY STAKEHOLDERS

4.11.1 Introduction

In the EIA process, consultation with and participation by stakeholders is a very important activity. EIA is not EIA without consultation and participation by stakeholders. It is a continuous activity in the EIA process, taking place in early stages prior to the decision on the action to be taken on the project. The decision may be made by the proponent (e.g. choices between various alternatives), jointly by the proponent and the decision-making and environmental regulators (screening and scooping decisions) and the public on whether or not to allow the project or proposal proceed (Wood, 1996). The stakeholders include the adjoining communities, to the proposed project location, environmental regulatory agencies, governmental ministries and parastatals, local governments, non-governmental organizations (NGOs) and persons having interest and concerns on the conservation of the areas where development will take place (Fig. 4-15).

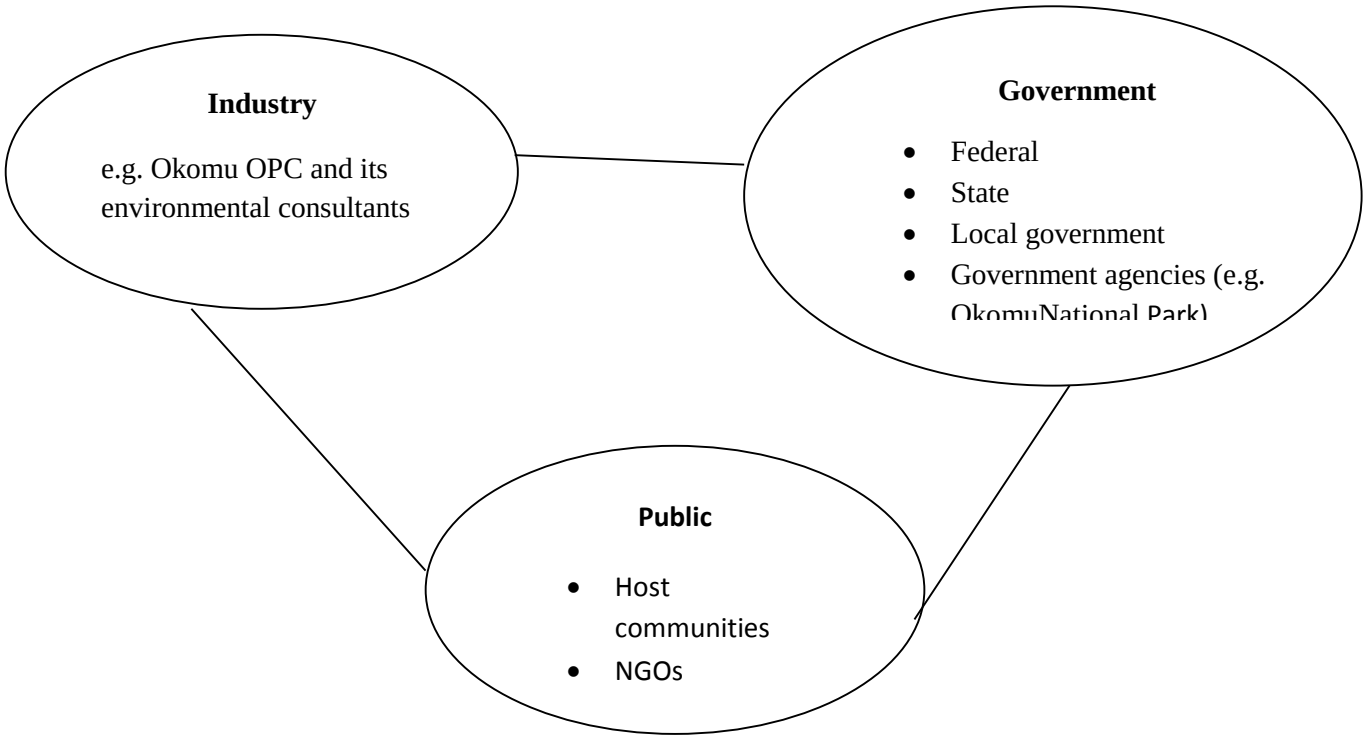


Fig. 4-15:Stakeholders' interrelationship in the activities for an EIA study

4.11.2 Objectives

The specific objectives of the consultation and participation process are to:

- Inform and educate stakeholders about the project
- Obtain stakeholders view on the project as it may affect the existing conditions of the environment of the area
- Assist in scoping of activities to be included in the study
- Resolve conflicts relating to the project
- Identify problems, concerns and needs of adjoining communities
- Establish a coordinal link between the proponent (Okomu OPC) and the communities

4.11.3 Consultations with Stakeholders

4.11.3.1 Institutional

a. Federal Ministry of Environment, FMEnv

The Federal Ministry of Environment, FMEnv, at Abuja was consulted in screening process or initial environmental examination (IEE) in order to categorize the project. Also at application for an EIA study by the Company, the Terms of Reference and Scope of the study to be carried out were submitted, 10 July 2010, to the FMEnv for vetting and approval. The FMEnv carried out verification visit on 9 October 2010 and subsequently approved the TOR for the EIA study. Regular contacts were made with the FMEnv at Abuja and sometimes with the Edo state Zonal office in Benin City.

In similar vein, contacts and consultations were made with the following government agencies:

a. OkomuNational Park, Udo, Ovia Southwest LGA, EdoState

b Ministries of Environment and Public Utilities, Benin City.

c Ministry of Agriculture and Natural Resources, Benin City

d Ovia Southwest LGA, Iguobazuwa, Edo State

4.11.3.2 Communities

The Okomu Oil palm Company Plc uses its community engagement platform and mechanism to hold regular meetings with the adjoining communities of Asamara, Gbole-Uba, Umalagidi and Evbo-Iruebo. The company also holds regular engagement meetings with the migrant squatter communities including Hassan Camp, Fatai Camp, Oluwo Camp, Olomu Camp and Sunday Camp.

The community engagement meetings presented the opportunity for the EIA consultants to present and explain the rubber and oil palm expansion project to the understanding of the communities. The concerns of the communities were noted and the company received some immediate requests from the communities for consideration.

The engagement and EIA consultation meetings with the communities were held under cordial atmosphere. The attendance record and photographs of some of the meetings are presented in Appendix D

4.11.4 Levels of Community Organizations Consulted

(a) Adjoining Communities (Gbole-Uba, Umalagidi, Evbo-Iruebo)

Each of the adjoining communities is represented at the joint community engagement and consultation meetings. The meetings usually hold at the administrative block of Extension I and the communities have representations including CDA executives and the youth association members.

(b) Migrant/Squatter Communities (Hassan, Fatai, Olomu, Oluwo, Sunday Camps)

All the camps are represented by their respective camp heads, youth association members and appointed members of the communities, who attend by rotation. All the camps attend meetings jointly, the engagement and consultation meetings usually hold at the administration block of Extension One.

Plate 4-2: Cross section of representatives from adjoining communities

Plate 4-3: Cross section of leaders of the Migrant/Squatter Communities

4.11.5 Baseline Socioeconomic Situations

A baseline socioeconomic study was conducted in 2009 within 5km spatial boundary to the proposed project to determine the baseline situation on socioeconomic activities in Extension I. The study essentially related to the migrant farmers within the boundaries of Extension I only. The migrant farmers have established farms and settlements on the land without the permission of Okomu Oil Palm Company Plc. The description and findings of the study are as follows:

4.11.5.1 Description of Survey Area/Location

Information gathered from community meeting held in Hassan camp at the onset of field survey revealed that there are six settlements/camps in Extension One. These are, Hassan, Fatai, Olomu, Sunday, Oluwo and Bisi camps. However, from direct visits to the various camps, it was discovered that Bisi camp is outside Extension One.

In the assessment of the five camps in Extension One, Hassan is the largest of all, both in terms of area coverage and population. It is also the oldest, existing since 1991. The locations of the camps within Extension One are as shown on Table 4-23 below.

Table 4-23: Location of the Camps

S/N	Name of Camps	Location (By GPS)
1.	Hassan	N06^{0}18.998’
		E005^{0}21.452’
2.	Fatai	N06^{0}19.176’
		E005^{0}21.819’
3.	Olomu	N06^{0}19.611’
		E005^{0}24.060’
4.	Sunday	N06^{0}19.279’
		E005^{0}23.226’
5.	Oluwo	N06^{0}19.734’ E005^{0}24.151

Source: Field Survey, 2009

The survey area generally has a rough terrain. The camps are linked to each other by farm paths or tracks which make vehicular access difficult and almost impossible in the raining season. The camps are best accessible by motorcycles in the raining season. There is a laterite road that links the camps to the outside world through OOPC and Osse River Estate plantations, but the road is equally rough and best accessed by four wheel drive, trucks and heavy duty vehicles in the raining season. The access to the camps is better in the dry season when both heavy and light vehicles are able to enter the camps, commuting people and evacuating farm produce.

Plate 4-4: “Roads” inside Extension One

Plate 4-5: Plank Bridge over Arakhuan River

The vegetation is typically rainforest. The settlers would appear to have cleared about 1,500 hectares for their farming activities. The prevalent crops by the settlers include cocoa, plantain, orange, cassava and yams. Cocoa is however their principal crop, representing about 70% - 80% of the crops grown.

4.11.5.2 Demographic and Historical Information

4.11.5.2.1 Origin of Settlements

The first settler, Mr. Hassan Ejire (founder of Hassan Camp) came into the area in 1991. He is an indigene of OsunState in South-West Nigeria. He was followed by many other settlers, especially from the Yoruba speaking states of South Western Nigeria; Oyo, Ondo, Osun, Ogun, Ekiti and Lagos. There are also migrants from other parts of the Country. These include Cross River, Delta, Kwara and TarabaStates. There are few indigenous Benin people of Edo State also in the area. 90% of the migrants in all the camps are Yoruba.

Each of the camp was named after the first settler/founder. Hassan camp is named after Mr. Hassan Ejire, and Fatai Camp is named after Mr. Fatai Oyelade. Sunday, Oluwo and Olomu are also named after their founders.

4.11.5.2.2 Population

Household enumeration indicates that there are 320 houses in all the five villages/camps. The total population of migrants in Extension One is 2193. See Table 4-24 and Figures 4-16 and 4-17 below.

Table 4-24: Total Household and Population Distribution

S/N	Camps	Household Number	Population Number	Average no/household
1.	Hassan	218	1630	7.47
2.	Fatai	33	214	6.48
3.	Olomu	18	73	4.05
4.	Sunday	29	178	6.13
5.	Oluwo	22	98	4.45
TOTAL		**320**	**2193**	

Source: EIA Field Survey, 2009

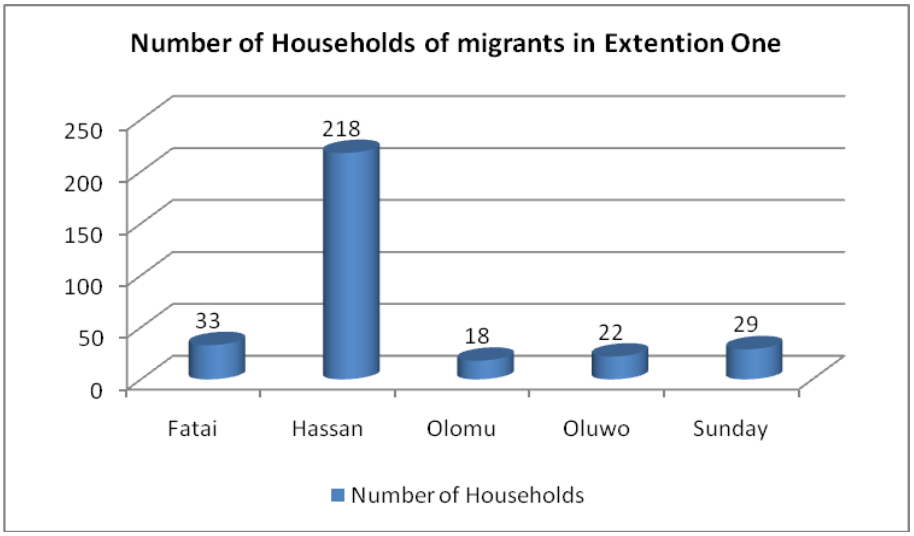


Figure 4-16: Total Number of Household of Migrants (Source: Field Survey, 2009)

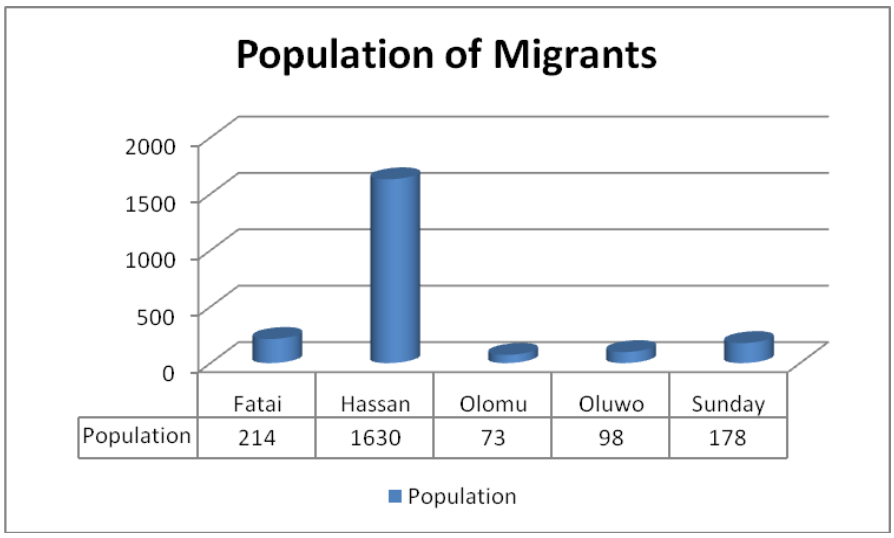


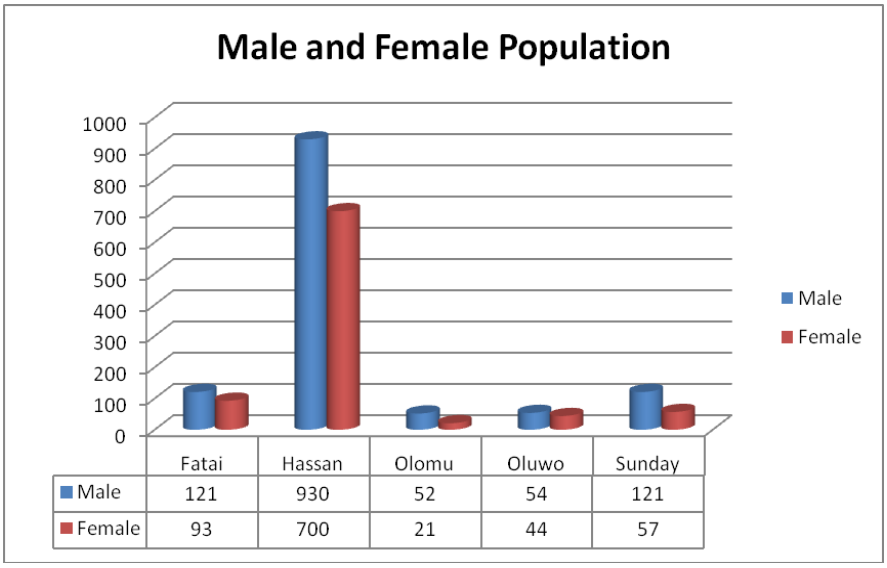
Figure 4-17: Population Distributions of Migrants (Source: Field Survey, 2009)

The total number of people in each building is taken as one household. This in some cases includes not only the nuclear or extended family, but also tenants in the houses.

4.11.5.2.3 Sex Distribution of Respondents

There are a total 1278 males and 915 females in all the camps.

Figures 4-18, 4-19 and Table 4-25.



Figures 4-18: Sex Distribution of Respondents according to Camps

(Source: Field Survey, 2009)

Table 4-25: Distribution of Respondents

S/N	Camps	Male Population	Female Population	Male : female ratio
1.	Hassan	930	700	1.32:1
2.	Fatai	121	93	1.30:1
3.	Olomu	52	21	2.47:1
4.	Sunday	121	57	2.12:1
5.	Oluwo	54	44	1.23:1
TOTAL		1278 (58.3%)	915 (42.7%)	1.39:1

Source: Field Survey, 2009

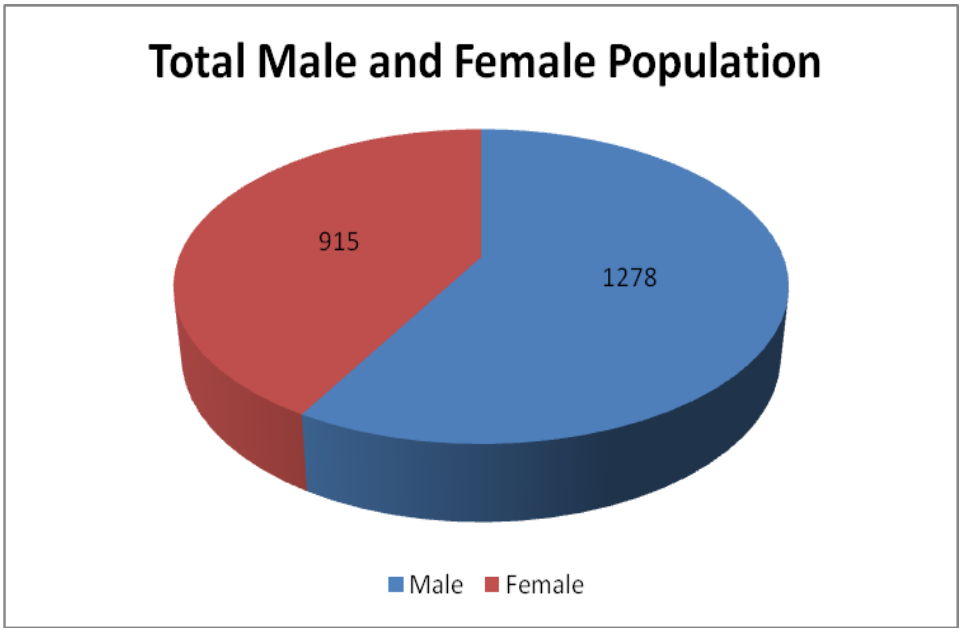


Figure 4-: Sex Distribution of Respondents

Source: Field Survey, 2009

4.11.5.2.4 Age Distribution of Respondents

The age distribution of the respondents shows that the 58.46% of the respondents are 21 years old and above. These set of people are the majority in labour force of the community working with the older generation. The remaining 41.54% are 20 years old and below. It is however not impossible that the age group, 0-20 years, has been over estimated. This is because the survey was conducted at a time when school children were on vacation. Most children of school age, especially secondary school, who were at the camp during the survey,

do not reside in the camp, but only came for holidays. Though the people were told not include such children on holidays in the population figures, it is possible that some of them did not follow this directive.

Most of the youth below the age of 21 are actually in school. The people stated that they give the education of the children top priority. Hence, they send them back to their home states for schooling. However, there are those below age of 21 who are already in the labour force, while some of the farmers are older than 65 years. Such farmers, though not active as they used to be on the farm, still work on the farms. Table 4-26 and Figure 4-20 below give the total age distribution of the five camps.

Table 4-26: Age Distribution of Migrants

Age Group	Population	Percentage
0-10	515	23.48
11-20	396	18.06
21-30	583	26.58
31-40	434	19.79
41+	265	12.08
Total	**2193**	**100**

Source: Field Survey, 2009

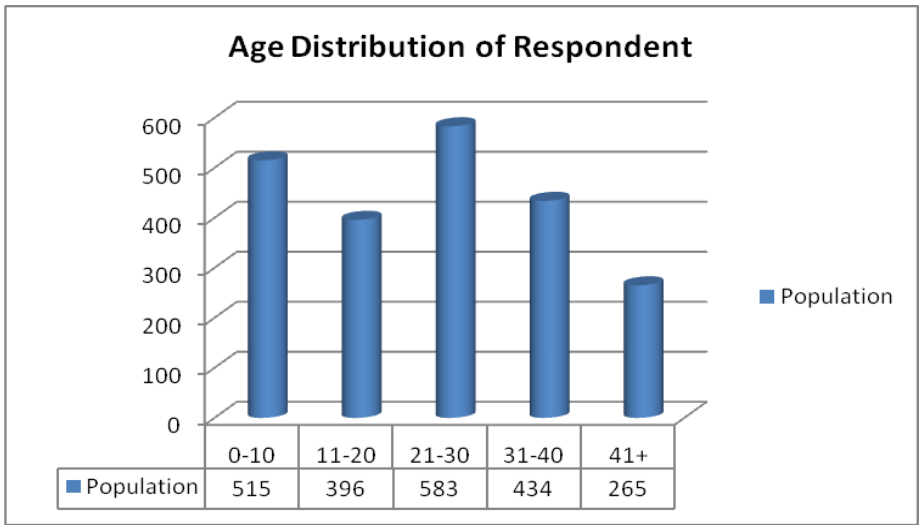


Figure 4-20: Age Distribution of Migrants (Source: Field Survey, 2009)

4.11.5.2.5 Ethnic Group of Migrants

The migrants in the five camps are from various ethnic groups in Nigeria. However, they all gave the same reasons for leaving their places of origin. All the settlers claimed they migrated from their

places of origin in search of a better means of livelihood. According to a respondent in Hassan Camp.

"We are illiterate, and cannot do office work, but we are good cocoa farmers and needed lots of land to farm in. In the course of searching for land, we heard there was vacant land in Edo, and we came here".

Only a few migrants agreed they were farmers before they left their home towns. Majority of them were artisans, mechanics, bricklayers, carpenters, and involved in other artisanal jobs.

They had to leave their previous places/home towns when they found it difficult to make a living from their regular job. They are from various ethnic groups and States in Nigeria such as Yoruba from the SouthwestStates, CrossRivers, Delta, TarabaStates, and very few respondents are from the indigenous EdoState. More than 90% of the migrants are Yoruba of South-West Nigeria.

No migrant group is discriminated against, especially in the process of decision making in all camps. They claim they do not discriminate against any specific group of people, but ostracizes/discriminates against anyone, indigenes or non indigenes, that go against camp norms.

4.11.5.3 Administrative/Social Cultural Institutions

All the camps have their administrative heads, who were the founders and first settlers in their respective camps. They are called "Baale", a Yoruba word for head of a community. It is only in Hassan camp that a standing leadership structure is in place. In Hassan camp, after the *Baale*, the second level leadership hierarchy is made up of a group of people, who assist the *Baale* in administering in the camp. The group is headed by a chairman, who can easily be referred to as the second-in–command to the *Baale.* The third level leadership hierarchy is the youth leadership; these are a group of youths that represent the interest of youths within the camp administrative structure.

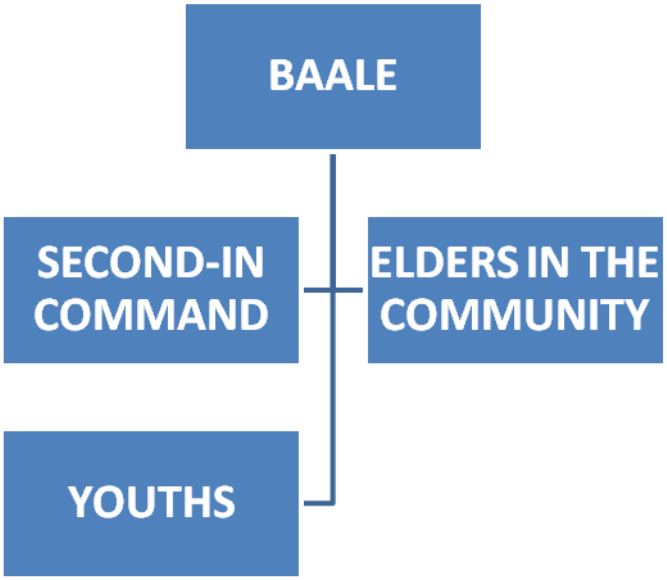


Figure 4-21: Organogram of Hassan Camp

However, in all the other four camps, there are no such well defined administrative structures. The *Baale* ofother camps *are* only assisted by relevant individuals, to administer all the camps and situations, as the need arises. The key elements of the structure and administration of the Hassan Camp is presented in Figure 4-21 above.

All the respondents in the camps reported, that they have not felt the impact of the State and Ovia South West Local Government Area (LGA), which they belong to. They belong to the Nikrowa Ward, but claimed that Ijaw speaking people of EdoState dominate the Ward. With the exception of the Children Immunization programmes, they have not felt the impact of the two levels of government in any way. However, they were enumerated during the 2006 National Census exercises. The chalk marks of census enumerators are still on the mud walls of some of the houses. They were also called out to vote, during the 2003 and 2007 general elections.

The settlers do not have common socio-cultural institutions binding them. Relationships are usually fluid and exist for the period of time an occasion like Census or elections demands. There are no socio-cultural institutions such as town-mate group, religion-based groups, cooperative societies or any other CBOs. The relationship in this regard is laissez–faire, with individual freedom of choice and action. And in terms of political affiliation, they reported that generally, they always go along with the Benin people of the State. They claimed that

they always vote for any party that the Benin people belong to. Few respondents mentioned that they were members of a ruling political party.

4.11.5.4 Economy: Primary Occupations/Livelihoods

The economy of these camps is essentially agrarian. Virtually all of the settlers are farmers. A few of them however who are involved in one farming activity or the other, provide services such as motorcycle repairs, carpentry, bricklaying, tailoring and other minor artisanal jobs, servicing the needs of the villagers. In addition, a few of the women are into trading, agro-processing and other artisanal works such as hair dressing.

The farmers plant cocoa, which is their main cash crop. A stretch of about 4km Cocoa farms is observed on the way to the camps. In addition, they plant oil palm, oranges, plantain and arable crops such as maize, cassava and yam. Cocoa, which is their major source of livelihood, is a life crop that could yield for up to 25-30 years. It was observed that most of the cocoa plantations of the settlers are relatively young plants. As reported by the farmers, most of the cocoa farms are between 8-12 years. This implies there is still much life (cash) in the cocoa plantations.

Plate 4-6:Cocoa Farm

The farmers reported that they are not into activities such as hunting, logging and fishing. Hunting is prohibited in the camps. They sometimes encounter some animals such as the buffalo (Syncerca

cafer) , bush pig (*Potamochoerus porcus*) but the migrants are aware of the closeness of the OkomuNational Park, and do not hunt such animals. Rearing of domestic animals like goats and sheep do not go along with their farming. They explained that such animals will eat up their crops. Some households do rear fowls and get their egg supply from the chickens.

None of the inhabitants are into any formal occupation, such as office or technical jobs in an institution or company.

4.11.5.5 Land use and ownership

The settlers within Extension One use the land only for farming. They do not use the land for any other economic activities. They acknowledge the fact that the land belongs to OOPC. The leadership in each of the camp allocates lands to new entrants into their camps. No payment in cash or kind is made for the allocation of land to village members. The land is transferable to other members of the family of the individual the land was allocated to. The land reverts back to the community if it is no longer used by the farmer or any member of his or her family. This arrangement allows the village leaders to monitor the activities of the people within their camps.

It was reported in all the five camps, that the Ijaws in Inikorogha, southeast of Hassan Camp, Asamara, and Igbinoba, in the northeast of Hassan Camp, always force them (migrants) to pay rent to them ("landlords"). The request is made annually or at any time the Ijaws are in need of money. Often times, the Ijaws come harassing and assaulting the settlers with dangerous weapons, such as guns, axes and cutlasses to extort money from them, and claim to be the owners of the land. The settler/migrants reported that even though they know that the land belongs to OOPC, they have resolved not to fight the Ijaws, because they are non-indigenes of the State.

4.11.5.6 Infrastructure

The migrants in the camps have managed to survive on minimal infrastructural development.

4.11.5.6.1 Housing

There are a total of 320 houses in all the camps. The distribution by camp is shown below in Table 4-27.

Table 4-27: Number of Houses in the Camps.

		Number of Houses	Number of Houses without Zinc Roofs
1.	Hassan	**S/N**	**Camps**
2.	Fatai	33	3
3.	Olomu	18	4
4.	Sunday	29	5
5.	Oluwo	22	22
TOTAL		320	36

Source: Field Survey, 2009

Thirty-Six (36) of the houses are without zinc roofs. All the 22 houses in Oluwo camp are without zinc roof. This is because Oluwo camp is a new break-away camp from Sunday camp. Oluwo inhabitants left Sunday camp to establish their camp in April 2009. They are therefore yet to put more secured buildings in place.

The buildings in the other camps are made of mud and relatively strong structures. Most of the houses are not plastered with cement.

Plate 4-7: Two views of a typical house at Hassan Camp

4.11.5.6.2 Water

There are no hand dug wells or boreholes in any of the camps. None of the camps have potable water supply. They get their water supply for domestic use from the nearby streams. They also supplement the stream water with rainwater. Out of the three streams available to the Hassan camp, only one is seasonal. This seasonal stream is shared by Hassan and Fatai camps. Ironically, the stream dries up during the rainy season!

Plate 4-8: Arakhuan Stream, stagnant in the wet season, flowing in the dry season

4.11.5.6.3 Sanitation Facilities

Pit toilets and nearby bushes are frequently used for disposing human waste. Only some houses in Hassan Camp have pit toilets attached to their houses. In all other camps they depend on the nearby bushes.

4.11.5.6.4 Electricity

None of the camps is connected to the National grid, or Rural Electricity Board. A few of the inhabitants have low capacity generating plants, which allow them to charge the batteries of cell phones and watch some hours of television.

4.11.5.6.5 Roads

The settlements are linked by farm paths that are more easily accessible by trekking and use of motorcycles. Farm paths are very rough and demand a lot of care to access even with a motorcycle (Plate 4-9) There is however a network of earth roads within Extension One and Osse River Rubber Estate that link the camp to the nearest town-Udo. The roads were constructed by the two companies. As a result of the rain, the roads are in a bad state of disrepair.

Plate 4-9: Road that link the camp to the nearest town-Udo

4.11.5.6.6 Health Care Facilities

There are no hospitals/ clinics in any of the camps. The settlers have to travel to the nearest towns, Udo, Iguobazuwa and Okada, to access medical facilities. However there are itinerant drug vendors who attend to the medical need of the people. On the average it takes about two hours and One thousand, four hundred Nigerian Naira (N1400.00) from any of the camp to get to the nearest town, Udo and return back to the camp.

4.11.5.6.7 Educational Facilities

Only Hassan camp has a private Nursery/Primary School. The School is called 'Turn to Bright Private Nursery and Primary School'. Classes are conducted in the Church building in the camp. All the other four camps do not have any form of school. This often delays their children from starting school early enough. The settlers reported that they always send their children of school age, back to their home town for education.

4.11.5.6.8 Mobile Phone Coverage

All the camps have partial mobile phone coverage. No network is consistent in any of the camps. Network for MTN is enhanced in Hassan camp by the use of antennas.

4.11.5.7 Cultural/Sacred Sites

All the camp reported that they do not have any cultural/sacred sites. There are no shrines, sacred or forbidden forest or graves. All the camps refer to the Okomu National Park as the only 'no-go' area for them.

4.11.5.8 Information Sources in the Community

The migrants' major source of information is the radio. A number of farmers in all the camps have radio sets, which enhances their access to information. In addition, a few of the farmers have television sets. These two sources of information are complimented by news brought back by other settlers who commute between the camps and their home towns.

4.11.5.9 Presence of Non-Governmental Organizations

There is no presence of any Non-Governmental Organization (NGO) in any of the camps. The migrants claimed that they have never experienced the services of NGOs.

The farmers on their part are not organized into any viable farmers group or associations. There are also no Faith-Based Organizations (FBO) operating to develop the camps.

4.11.5.10 Places of Worship

There is one Mosque and two Churches (Cherubim and Seraphim and the Last day Apostolic) at Hassan Camp serving as places of worship. Moslems seem to be more in population than Christians in all the camps.

Plate 4-10: Mosque and Church respectively at Hassan Camp

4.11.5.11 Settlements Outside Extension One

There exist a number of settlements outside of Extension One, but proximal to it. These include Inikorogha (farther southeast), Mile 3 (south), Ashamara, Malagidi and Akande Camps (east of Hassan camp) and Bisi Camp (southeast of Hassan Camp). The relative locations of these camps are shown in Table 4-28 below:

Table 4-28: Locations of the Camps Outside Extension One

S/N	Name of Camps	Location (By GPS)	Distance (km)
1.	Asamara	N06^{0}18.279’	>10
		E005^{0}22.908’	
2.	Akande	N06^{0}18.169’	>10
		E005^{0}23.136’	
3.	Bisi	N06^{0}17.675’	>10
		E005^{0}22.258’	
4.	Inikorogha	No Access	>10
		No GPS Reading	
5.	Mile 3	No Access	>10
		No GPS Reading	
6.	Malagidi	No Access	>10
		No GPS Reading	

4.11.5.12 Demographic and socioeconomic context

Edo state had a population of 3.2 million and population density of 184 people/sq km according to the official census of 2006. Although more recent figures are not available, Edo State’s population and population density will now be considerably higher, and given that the state’s population density in 2006 was considerably higher than the national average (152 people/sq km), current population density in the state most probably exceeds 200 people per square km. Population and demographic information for the camps inside Extension one concession is presented in Table 4-24 and session 4.11.5.2.

More importantly, all the migrant farmers within extension One concession except Hassan camp have been properly disengaged.

Inikorogha is the largest settlement southeast of Extension One (outside extension One). The inhabitants of Inikorogha are the Ijaws who are riverine fishing people spread right across the freshwater swamps, mangroves and the coastal areas of southern Nigeria from Lagos east to Calabar in the Cross River State and beyond.

4.11.6 Issues and Concerns of Communities

At each meeting, the EIA consultants informed the communities' members that:

i. The EIA study was being done in connection with the proposal by Okomu OPC Plc to expand its plantings at Extension I to cover the undeveloped parts of the company's land including secondary forests and farmlands.
ii. Planting will not be done on identified natural micro habitat, swamps and riparian forests.
iii. The company has observed that some of the community members have farms on the Extension I land. Such farms will be cleared but the company will allow the owners to harvest their crops in the season.
iv. In view of the very large area of forest/farmlands (more than 1000 ha in each) to be used for the expansion programme, the FMEnv was expected to screen the project for EIA categorization.
v. The EIA consultants; Foremost Development Services Limited had been commissioned by Okomu OPC to carry out the EIA study. The study team would take air, water, vegetation and soil samples, covering the entire expansion area.
vi. It was necessary for the EIA consultants to inform and notify the communities before commencement of EIA study fieldwork.
vii. The EIA consultants will carry the communities along on the progress being made on the EIA study.

The communities actively participated cooperated during field data gathering in the ecological baseline study and responded well to the structured socio-economic questionnaires.

The issues and concerns of communities expressed during consultations and meetings with the EIA consultant are summarized in Table 4-29.

Table 4-29: Issues and concerns of communities adjoining Extension One

Communities	Issues and Concerns	Responses to Issues and Concerns
(Gbole-Uba, Umalagidi, Evbo-Iruebo)	The communities asked for assurances that their farmlands would not be affected in the expansion programme. They have farms on or close to the borders of Extension I. The communities also expressed concerns over their access roads, which run through Extension I. The communities asked for closer ties with Okomu OPC and appealed to the company to assist them with provision of social amenities. They also asked that their youths be considered for job opportunities on the project.	The company gave assurances that no farmlands outside the official boundary of Extension I will be affected in the expansion works. The communities also assured that no communities would be land-locked. They would be allowed access to their respective communities through the Extension I roads. However, it is incumbent on them to respect all the road traffic and safety rules of the company. The company also promised that it would consider suitably qualified members of the communities and offer them employment appropriately. Okomu OPC requested from the communities a peaceful and harmonious relationship. The company also advised the communities to process their registration and recognition as CDA with the Ovia Southwest LGA. The company promised to relate and offer assistance to the communities through the CDAs.

Table 4-30: Issues and concerns of Migrant/Squatter Communities

Migrant Communities	Issues and Concerns	Responses to Issues and Concerns
(Hassan, Fatai, Olomu, Oluwo, Sunday Camps)	The communities expressed concerns over the fate of their cocoa farms and houses. They asked if it was possible to spare their cocoa farms in the development. They also asked for more time to harvest their crops in the event that their farmlands will be cleared.	The company reminded the communities that they were only allowed to plant arable crops and have been warned several times against planting permanent crops. The company granted the communities an initial one year period for them to harvest and remove their crops. An extra one year was later granted. In addition, the company offered the communities the consideration of the southern portion of Extension I for them to relocate their houses and establish new farms. The company promised to assist the communities with provision of social amenities if they accept to relocate to the part of Extension I south of the Arakhuan river. Up to date, a cumulative three-year period has been granted the communities as grace period to harvest their crops and relocate either entirely from Extension I or to the south of Arakhuan river on Extension I.

4.11.7 Environment Problems of the Communities

During consultation with the communities, observations during field data gathering and the responses in structured questionnaire, the major environmental problems of each community were assessed. The main problems were:

- Deforestation; occasioned by farming activities
- Wildlife disappearance
- Soil erosion

4.11.8 Communities' Assessment of the Environmental Impact of the Proposed Extension I Plantation Expansion Project

The communities expressed their own opinion of how the proposed expansion project would impact their environment as presented in Table 4-31.

Table 4-31: Summary of communities' assessment of environmental impact of the Proposed Plantation Expansion Project at Extension One

Components	Adverse/Positive/Beneficial/Increase/ Decrease/No effect
Population of community	Slight increase, temporary effect
Age/sex distribution	No effect
Culture; traditional administration	No effect
Sacred shrines	No effect
Religious worship	No effect
Sacred forest	No effect
Festivals	No effect
Ethnic composition	No effect
Fisheries	No effect
Forests	Adverse: deforestation
Wildlife	Adverse: disappearance
Medicinal plants	Adverse
Soil	Possible soil erosion
Water bodies	No effect
Employment opportunities	Positive
Income	Positive (adjoining Communities)/Adverse (migrant communities)
Occupation wages	Positive
Other companies in community	No effect
Education	No effect
Housing	No effect (adjoining communities)/Adverse (migrant communities)
Settlement pattern	No effect
Flooding	No effect
Air quality and noise level	No effect
Water quality	No effect
Health	No effect

4.11.9 Government Stakeholders

A dedicated government stakeholders meeting was held to present the proposed Extension I expansion project to the relevant government agencies in EdoState. The agenda of the meeting was to analyse and discuss the potential environmental and social problems that are associated with the proposed development. The meeting was held at the Excalibur Hotel in Benin City and the government stakeholders that participated included:

- Federal Ministry of Environment (EdoState Zonal Office)
- Ministry of Environment and Public Utilities, Benin City
- Ministry of Agriculture and Natural Resources, Benin City
- OkomuNational Park
- Ministry of Lands and Survey, Benin City
- Ministry of Home Affairs

The government stakeholders welcomed the proposed expansion project and requested Edo State Government to deploy its machinery to eject and evacuate the migrant farmers/squatters on Extension One. The Notes on the stakeholders meeting is presented in Appendix D

4.12 Land Use Update

4.12 .1 Vegetation Type

Oil palm and Rubber at various stages of growth constituted the dominant vegetation during the update assessment carried out in June 2016. These two crops have been extensively grown which now constituted the largest land use (about 3,000 hectares) followed by conservation plot (about 1,000 hectares).

The oil palm and rubber plots are planted with *Pueraria phaseoloides*, a cover crop, which would enhance soil conservation (Plate 4-11). This is a good management option, particularly, because mechanical land clearing seems inevitable or preferred at OOPC.

In the undisturbed forest of Okomu, which is about 125 years old (HCV assessment at Main and Extension One estates, 2015), common trees include *Ceiba pentandra*, *Poga oleosa*, *Antiaris africana*, *Anonidium manii*, *Enantia chlorantha*, *Musanga cecropiodes*, *Strombosia pustulata*, *Celtis zenkeri* and *Diospyros alboflavescenes* (Ghuman and Lal, 1987).

Young Oil Palm

Young Rubber

Unplanted area covered with pruireira

Conservation Plot [Riparian Forest]

Buffer zone between plantation field and conservation plot

Data gathering during field work [2016]

Plate 4-11: Present Vegetal Cover and Land Use at Extension I

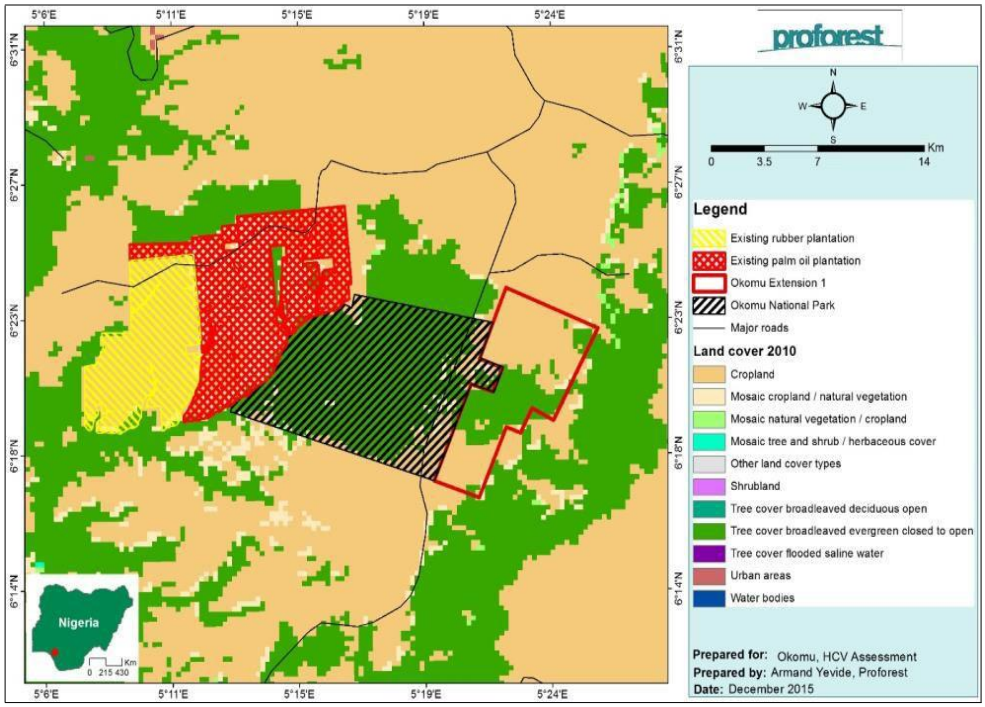


Figure 4-22: Landcover map of ExtensionI concession and its immediate environs including the ONP.NB:Most of the natural vegetation in the middle of the Extension I concession has been replaced with rubber plantation.

Source: Proforest HCV Assessment (2015)

4.12.2 HCV overview and references used

High Conservation Values (HCVs) refer to biological, ecological, social or cultural values considered outstandingly significant or critically important at the national, regional or global level and which require special measures for their maintenance and/or enhancement. The HCV concept aims to identify whether these values are present and to develop appropriate management and monitoring strategies to maintain and/or enhance the values. The concept was originally developed in 1999 by the Forest Stewardship Council (FSC) and has since been widely used in the context of FSC certification for sustainable forestry. The HCV approach was adopted by the RSPO and incorporated into the RSPO's first P&Cs in 2005.The six categories of HCVs and their definitions are listed below.

HCV Definitions

HCV 1: Concentrations of biological diversity including endemic species, and rare,threatened or endangered (RTE) species that are significant at global, regional or national levels.

HCV 2: Largel and scape-level ecosystems and ecosystem mosaics that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance.

HCV 3: Rare, threatened, or endangered ecosystems, habitats or refugia.

HCV 4: Basic ecosystem services in critical situations including protection of water catchments and control of erosion of vulnerable soils and slopes.

HCV 5: Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for example for livelihoods, health, nutrition, water), identified through engagement with these communities or indigenous peoples.

HCV 6: Sites, resources, habitats and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological,economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples, identified through engagement with these local communities or indigenous peoples.

The areas of natural vegetation in the assessment area is characterised by lowland swamp forest and riparian vegetation located in the north-eastern corner of the concession and a tiny patch of degraded forest located between the rubber plantation and the swamp forest in the north-east. This patch of forest is representative of a degraded semi-deciduous, humid, lowland rainforest type of

south-western Nigeria. Freshwater swamp forests are also found along the Erudu River (also referred to as the Umalegidi Creek), which flows southwards from the swamp forest, along the eastern border of the concession.

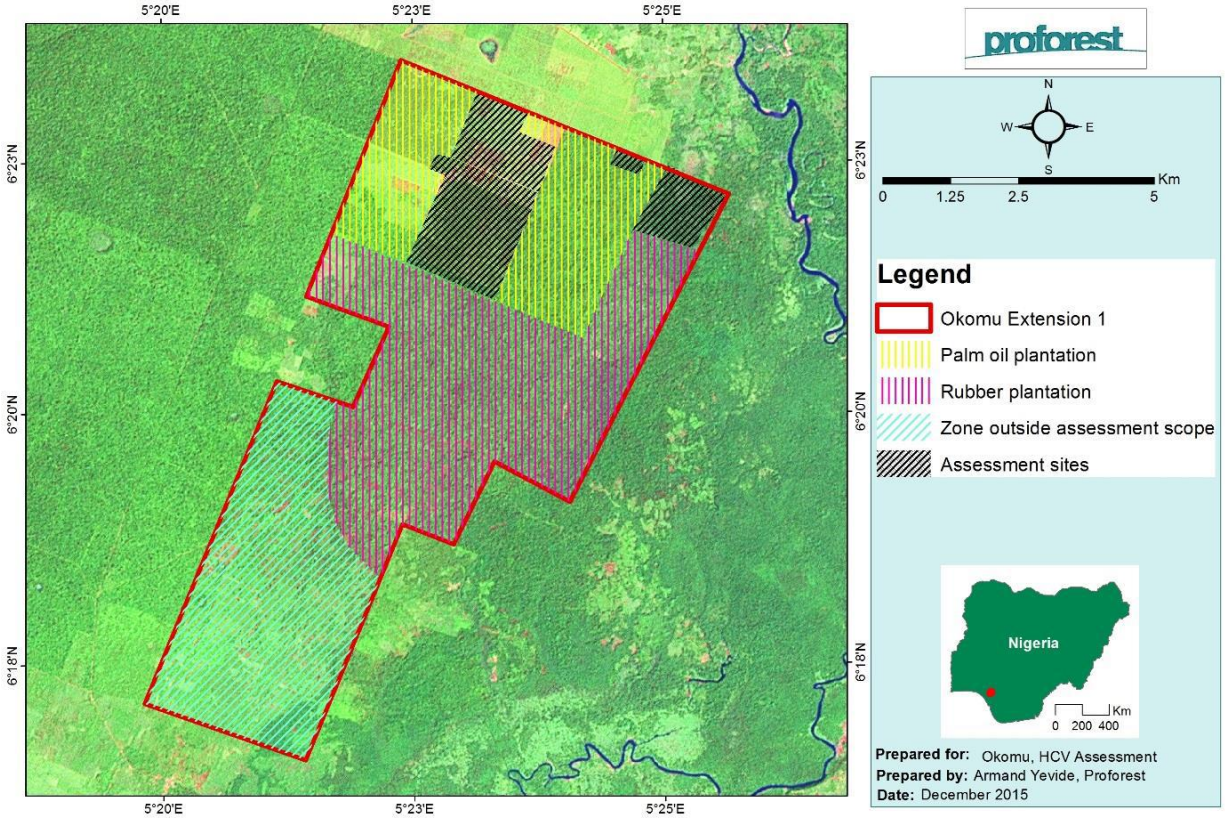


Figure 4-23: Assessment areas (shaded black) within the Okomu Extension I concession. The sites consist of the block in the north-eastern corner, the double block of rubber flanked by oil palm and the tiny patch between the rubber and the degraded swamp forest

Source: Proforest HCV Assessment (2015)

The patch of swamp forest in the north-eastern portion is evidently degraded, being selectively logged and under pressure from agricultural encroachment. However, it still retains variable, closed canopy in some areas (although several of the large emergent canopy trees have been removed). There are several economically important species as well as a relatively high degree of faunal biodiversity including an impressive variety of birds. Table 4-32 below indicates land-use types in the assessment area.

Table 4-32: Land-use type and activities in the assessment area

Land-usetype	Activity
Rubberand Oil Palm Plantation	Monoculturesofrubberand oil palm invariousstagesofgrowthand development.
Forest Patches	Slightlydegradedandmoderatelydegradedforestpatches.The slightlydegradedforesthadacontinuousuppercanopywhile themoderatelydegradedforestshadapatchycanopywithsmall gapsinterruptingthecanopyandseveralemergenttrees.
Riparian Vegetation	Assemblageofplanthabitatsandcommunitiesalongthemargins andbanksofwaterbodies(riversandstreams),characterizedby riverinevegetationandhydrophilicplants.Theseareasare constantlyinundatedformostpartsoftheyear.

CHAPTER FIVE

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROPOSED PROJECT

5.0 ASSOCIATED AND POTENTIAL IMPACTS

5.1 Introduction

The primary intention of this EIA is to identify the associated and potential impacts of the proposed project and to develop options for mitigating the negative impacts that have been so identified to enhancing the positive impacts. In this section of the report therefore, we present concise information on the impacts that have been so identified as having the likelihood of accompanying the implementation of the project.

The potential environmental impacts were evaluated by considering the anticipated effects ozf the proposed project on the existing physical, chemical, biological, health and social conditions of the environment.

At an earlier stage in this study, an environmental screening and scoping exercise was carried out, the process employed was a combination of desk study, site visitation, and consultations with stakeholders. From this, an overview of the potential impacts, the choice of the appropriate field analysis and likely mitigation measures and the monitoring programme were examined.

This chapter presents an overview of the impact assessment methodology as well as results of impact screening followed by detailed qualitative and quantitative impact assessments. Their inclusion does not mean they would necessarily occur or cannot be successfully mitigated.

The boundaries (spatial and temporary) of this EIA study were determined through the scoping process involving consultations with stakeholders, social, economic and health studies. The project phases that would impact on the environment were identified as:

- Pre construction activities
- Construction
- Operation and maintenance
- Decommissioning

5.2. Methodology of impact assessment

5.2.1 Overall methodology

The overall methodology comprises of five steps as follows:

Step 1

- Identification and description of project phase.
- Associated activities and their possible interactions with environmental, social and health components.

Step 2

Preliminary identification of potential impacts on environmental, social and health components

Step 3

- Screening for impact significance
- Elimination of activity of environmental interactions producing no effect;
- Selection of focus impacts for further assessments

Step 4

Detailed assessment of selected focus impacts in terms of:

- Nature- positive or negative, direct or indirect
- Magnitude-qualitative and quantitative
- Areal extent-qualitative and quantitative
- Frequency
- Receptor sensitivity
- Duration including reversibility
- Cumulative effects

Step 5

- Final assessment and assignment of overall impact significance levels based on step 4 results and application of objective impact severity criteria and likelihood;
- Identification of impacts requiring mitigation.

The analysis of impacts covers the following aspects of the project activities described in ***chapter 3***

For each activity, potentially affected environmental media are identified and the nature of the effects are qualified and quantified.

5.2.2 Preliminary Identification and Screening

In accordance with recommended impact assessment approaches, the first level of impact assessment involves the preliminary identification and screening of potential environmental impacts by anticipating activity – environment interactions. This requires a thorough understanding of the project activities (project description), the project setting (the environmental description), and the interaction with environmental components. A modified Leopold matrix (Leopold, 1971) was used for the identification and screening. The matrix shows project activities against environmental (biophysical, social and health) components, and supports a methodical, comprehensive, and objective identification of the impacts each project activity may have on each biophysical, social, and health component.

Impact identification is based on Wathern (1988), who defines an impact as ":having both spatial and temporal components and can be described as the change in an environmental parameter over a specified period within a defined area, resulting from a particular activity compared with the situation which would have occurred had the activity not been initiated.

To further guide the identification and screening of impacts using the matrix, established environmental impact indicators or indices are developed for each of the environmental interaction categories. Impact indicators are the observable or measurable parameters of each environmental component that can be directly or indirectly linked to changes in environmental conditions. .

The integrated impact assessment is conducted with consideration of environmental, social and health elements, some procedures specific to each element were used in the process as relevant to the study.

5.3 Checklist of Environmental Indicators

(a) Biophysical (Natural and Physical)

The major indicators are:

- Climate and meteorology
- Air quality
- Noise travel
- Surface waters (Arakhuan Stream)
- Ground water

- Geology and geomorphology
- Soil/soil erosion/physico-chemical characteristics
- Drainage pattern/flooding
- Unique physical features/aesthetics
- Vegetation, forestry and economic crops/plants
- Terrestrial fauna and wildlife
- Fisheries

(b) Socio-Economic

- Land use
- Community population and ethnicity
- Employment and income
- Culture and religion
- Infrastructure provision
- Health
- Education
- Traditional administration
- Community

5.4 Project and Associated Activities at Rubber and Oil palm Plantations (Cultivation and Management)

The major activities at Rubber and Oil Palm planting will be:

a. Preparation of Proposed Site - The activities include:

- Plantation boundary demarcation
- Opening of roads and tracks
- Site forest clearing
- Stacking, stumping and restacking
- Disposal of vegetation

b. Planting/Transplanting To The Field

- Tracing and blocking out
- Peg preparation
- Cover crop sowing
- Holing and transplanting of seedlings
- Consolidation of seedlings
- Protection of planted seedlings

c. Operation and Maintenance

- Weeding
- Fertilizer application
- Mulching
- Pruning of fronds
- Maintenance of tracks and roads
- Tapping and collection of cup lumps
- Harvesting and collection of fruit bunches

d. Decommissioning and Abandonment

- Laying off workers
- Lack of care of plantation
- Abandonment of equipment, vehicles and chemicals

5.5 Evaluation of Potential Impacts of Individual Project Activities

Bush/Farmland/Forest Clearing

Secondary forest, existing arable farms and some economic crops will be destroyed. Economic trees such as cocoa, old rubber and some medicinal plants present in the areas will be destroyed. Some siltation of rivers may occur if planting activities extend to river banks. These changes in the ecosystem may adversely affect some aquatic life. However, Okomu-OPC Plc will not plant right down to the river banks

Wildlife such as the giant African land snail and amphibians in the sites may be killed. Snakes and mammals will relocate/emigrate to unfamiliar territories and some may get killed in the process. Birds may relocate or emigrate. However, it is anticipated that most of the affected animals will relocate to the OkomuNational Park. A number of tall trees will be retained on the land to maintain the natural habitat for some birds.

Bush/forest clearing and exposure of land to windstorm will increase the potential for soil erosion and very high rate of evaporative groundwater loss in the areas. The erosion-control, cooling, shading and watershed-protection effect which trees give will be lost. However, the planting of cover crops immediately after land clearing will minimize the potential for soil erosion to a great extent. In addition, these activities will give employment opportunities for unskilled/casual labour in the communities.

Vegetation and Soil Disposal

Soil accumulated during stumping and felled vegetation will have to be removed and deposited somewhere. Accumulation of soil spoils, if not removed, may alter water drainage pattern and reduce landscape beauty. At Okomu-OPC Plc, zero burning is technique that is practiced in the agricultural operations that normally involves burning. The disposal of the vegetation and soil spoils will therefore give opportunity for employment in the neighbouring communities.

Grading and Levelling of Tracks and Roads

There is the possibility of initiation of erosion of the topsoil in the affected area. These activities however, give employment opportunities for labour.

Increased Transportation and use of Heavy Machinery during Land/Field Preparation

Wildlife presence in the affected area may be reduced due to unusual and frequent high level noises from tractors and chain saws. During the raining season, the access earth roads/tracks may be rendered impassable due to activity of heavy machinery. The activities attract employment opportunities.

Cover Crop Sowing

Growing oil rubber and oil palm needs protection against competition, soil depletion, diseases and pest. Leguminous cover crops spread quickly and prevent other herbs from establishing, help to supply nitrogen nutrient and prevent erosion. *Calopogonium mucunoides, Centrosema pubescens and pueraria phaseoloides* are the cover crops grown. The activity gives employment opportunities and has no adverse environmental impacts.

Weeding

Once the leguminous cover crops have established, it becomes difficult for unwanted weeds to establish. The young rubber and palm trees have small developing roots and will suffer greatly if they have to compete in their development stages with other plants. The area around the young trees, approximately, about 2-3m radius is cleared – called **ring weeding.** This activity gives employment and has no adverse environmental impacts.

In mature plantations, unwanted weeds are removed from the ground cover by hand/manual clearing with cutlasses. There is then the problem of disposal of removed weeds. These are allowed to gradually rot. Many invertebrate fauna may be killed during or after weeding. Weeding removes the cover for wildlife such as amphibians, snakes, skinks and small mammals. Predator birds such as the black

kites and owls increase in the numbers in recently weeded plantations to locate exposed and moving prey. Manual weeding gives employment opportunities.

Herbicides, Fungicides and Insecticides Application

The integrated pest control approach to pest control is adopted at Okomu-OPC. The use of pesticides in plantation operation is therefore minimal and the possibility of carriage of residue from the plantation to the Arakhuan Stream is extremely remote.

Constant Phytosanitary Supervision

All parts of the plantations are checked daily for detection of bacteria, fungal diseases, insects and rodent pests. Rough levels of infestations are recorded. Affected trees or leaves are immediately removed. Dead/dying trees are removed. Wire netting around young oil palms and wire traps are used for controlling rodent pests. Constant phyto-sanitary inspection reduces the need for use of herbicides, fungicides, insecticides and rodenticides. It also provides employment opportunities.

Fertilizer Application

In order to increase production per unit area, fertilizer is applied both at the nursery and the plantation. The types of fertilizer that are applied include NPK, MOP, SSP and MgO. Not all nutrients added to the soil as fertilizer are taken up by growing plants. Residues (NO3, PO4) may remain in the soil and end up in surface waters through storm water runoffs to be leached out of the soil and enter the groundwater. High nitrate level in drinking water sources cause health risks particularly in children. It reacts with haemoglobin causing methehaemoglobinema which impairs respiratory gases transport.

At Okomu-OPC, the boiler ash and EFB from the mill can make excellent fertilizer and are applied widely throughout the entire plantation. The possibility of high levels of nitrites and nitrates in groundwater is very remote.

Fronds Pruning, Harvesting and Collection of Fruit Bunches

During harvesting, fronds are pruned. This helps to give easy access to the ripe fruit bunches as well as keep the oil palm stem clean of hanging dead and decaying leaves. The fronds are left on the ground to add organic matter to the soil. The pruning of fronds, harvesting and collection of fruit bunches are activities which provide employment for more workers.

Mulching

A mulch is any material used to cover the surface of the soil in order to reduce loss of soil water by evaporation. At Okomu-OPC, palm fronds and empty fruit bunches are applied as mulches in the nurseries and plantations. Mulching with plant materials helps to increase soil fertility when these plants decay. It also helps prevent soil erosion by protecting the soil from the erosive effects of the wind and rain.

5.6 Decommissioning and Abandonment

- Permanent and casual workers will be laid off resulting in loss of employment and income. This can itself give rise to strained relations between workers/community and the company.
- The plantation will no longer be regularly and properly maintained. No weeding activities, pest control, maintenance of roads and tracks, no pruning of oil palm trees. There will be great economic loss to company, shareholders and the nation. The plantation will become densely populated by weeds, pests, invertebrate faunas and small to medium size wildlife.
- Equipment and Materials Abandonment, Abandoned trucks and other farm machinery will blight the workshop premises. This is also an economic loss to the Company and its shareholders.

5.7 Screening Project – Environmental Interactions Criteria

The criteria used in categorizing the various impacts are shown in Table 5-1.

Table 5-1: Criteria for Impact Categorization

Type	**Positive/Beneficial or Negative/Adverse**
Severity	Minor/ very low/ insignificant, moderate, high/ major/ very significant
Prevalence	Likely extent of the impact
Duration	Long term (>12 months), short term (<12 months or intermittent)
Importance	Economic, social and cultural values attached to the undisturbed project

Severity is classified as shown in Table 5-2 below.

Table 5-2: Criteria for Rating Magnitude, Duration and Severity of Environmental Impacts

Severity of Impact	Description/Quantification
1. Impact on Sensitive Habitats e.g. wetlands; forest reserve	
Very High, 5 points	Very severe long term adverse effects; more than 20% of the habitat area will be destroyed or damaged.
High, 4 points	Major long term adverse effects: 1 – 2% of the habitat area will be destroyed or damaged
Moderate, 3 points	Moderate adverse effects: 0.25 – 1% of the habitat area will be destroyed or damaged
Low, 2 points	Minor adverse effects: 0.02 – 0.025% of the habitat area will be destroyed or damaged
Very Low, 1 point	Negligible to minor adverse effects: 0.02% of the habitat area will be destroyed or damaged
2. Impacts on Water Quality (Rivers and Streams)	
Very High	Water quality parameters change significantly by several orders of magnitude: toxic trace metals or hydrocarbons exceed FMEnv's safe levels; changes persists for months or longer.
High	Water quality parameters change significantly by one or two orders of magnitude: toxic trace metals or hydrocarbons exceed FMEnv's safe levels; changes persist for months or longer.
Moderate	Statistically significant changes in water quality parameters which persists for several weeks.
Low	Some measures of water quality deviate significantly from ambient measures but are quickly (within 1-2 days) restored to normal.
Very Low	Normal measures of water quality such as dissolved oxygen content, salinity, temperature, trace metal concentrations and hydrocarbon levels show no statistically significant changes from ambient conditions.
3. Impacts on Air Quality and Noise	
Very High	Significant increase in levels of criteria pollutants. Significant effects on public health and welfare are expected.
High	Increase in levels of criteria pollutants likely to pose hazards to public

	health and welfare.
Moderate	Increase in levels of criteria pollutants moderate and unlikely to pose hazards to public health and welfare.
Low	Increase in levels of criteria pollutants unlikely to pose hazards to public health and welfare.
Very Low	Increase in levels of criteria pollutants does not pose hazards to public health and welfare.
4. Impacts on Cultural/Archaeological Resources	
Very high	An interaction between a cultural resource/archaeological site and an impact producing factor occurs and results in the loss of unique cultural/archaeological information.
Moderate	The interaction occurs and results in the loss of cultural/archaeological data that are not significant.
Low	The results are temporary and reversible.
Very Low	Little damaging interaction between an impact producing factor and cultural resource/archaeological site occurs.
5. Impacts on Local Employment, Income, and Population	
Very High	10% or greater annual growth in employment, payroll, population.
High	7-9% annual growth in employment, payroll, population.
Moderate	4-6% annual growth in employment, payroll, population.
Low	2-3% annual growth in employment, payroll, population.
Very Low	1% or less annual growth in employment, payroll, population.
6. Impacts on Community Infrastructure	
Very High	Potentially major long-term effects on community services and facilities indicated by a 10% or more increase in the infrastructure.
High	The effect is indicated by a 3-9.9% increase/decrease
Moderate	The effect is indicated by a 1.5-2.9% increase/decrease
Low	Minor effects on community services and facilities: indicated by a 0.5-

	1.4% increase/decrease
Very Low	Negligible to minor effects on community services and facilities: indicated by a less than 0.5% increase/decrease,
7. Impacts on Wildlife/Forestry	
Very High	A specie, population, community or assemblage of wildlife will be harmed, as a result of habitat area destroyed or disturbed, to the extent that recovery of that particular entity may not occur.
High	A significant interference with ecological relationships. This usually involves the mortality or alteration of a noticeable segment of the population, community or assemblage.
Moderate	A short-term interference with ecological relationships. Although some species may sustain substantial losses, other species will sustain low losses, and the ecological mix will not be altered.
Low	A few species may sustain low losses, but any interference with ecological relationships will not be evident.
Very Low	Loss of a few individuals but no interference with ecological relationships.

5.8 Leopold Matrix Screening

The modified Leopold impact matrix consists of a horizontal list of biophysical, social and health environmental components that could be affected by the proposed project activities versus a vertical list of project activities, which represent environmental aspects, or "sources of impact", associated with each project phase. Environmental aspects are elements of an activity that can or will interact with the biophysical, social and health conditions within the area of influence.

Entries in the matrix cells represent the nature and preliminary ranking of the severity of the impact. Ranking of the severity is based on the following scale and symbols:

- Major: 2
- Minor: 1
- Negligible or no effect: - (a dash)
- Positive: +

Table 5-3 gives the criteria for rating an impact, the scores awarded to each criterion/severity category, and Table 5-4 gives the matrix obtained.

Table 5-3: Scores awarded to magnitude, duration and each severity category

EFFECTS	SCORES
A major long term effect (Very high)	points (in a square)
A major short term effect (High)	4 points
A moderate long term effect (Moderate)	3 points
A moderate short term effect (Low)	2 points
A minor effect in magnitude and duration (Very Low)	1 point (in a square)
No impact/interaction	0 point/Blank square
Positive impact	+ added in front of a number
Negative impact	- added in front of a number

For this preliminary impact assessment stage, the impacts are defined as follows:

A Major impact is one that would affect a large (higher than 40%) amount of a resource/receptor and or have a relatively large footprint and persist for a long time or is irreversible;

A Minor impact is one that could either affect a large (as defined above) or moderate (less than 40%) amount of an affected resource/receptor, has a mid to long term effect (1 to 10 years) but is most likely reversible;

A Negligible impact is one that may occur but based on experience, available scientific information and expert knowledge will have no measurable effect on the environmental component;

A Positive impact is one that add a measurable benefit to the immediate and larger project environment including its social, culktural and health dimensioins.

All number entries denote negative impacts. Cells with both positive sign (+) and numbers indicate that the specific activity and environmental interaction will potentially result in both positive and negative impact. All potential impacts, whether likely or unlikely are also considered at this stage. The likelihood of an

impact is further assessed in the detailed impact evaluation. The identification of and screebning of an impact relies on the following:

- Available knowledge of product activity
- Documented impacts of similar projects in similar environment
- Consultation with experts
- Professional judgment
- Result of earlier environmental studies carried out in the Lagos lagoon area.

Spatial boundaries of interaction were decided based on specialist knowledge and documented experience of the specific activity on environmental interaction.

5.9 Detailed Assessment of Impact

The preliminary identification and screening of environmental impact resulted in a group of focus impacts (impacts ranked 1 and 2) which were further assessed in terms of severity and significance. Impact severity and significance criteria used at this next stage relied on a number of resources and tools including the following:

- FMEnv EIA guidelines;
- Overlaying project component on maps of existing conditions to identify potential impact areas and issues
- Environmental baseline studies
- Results of earlier studies carried out in the area; experience from similar projects in Nigeria and elsewhere.
- Published and unpublished documents (such as the World Bank environmental assessment source book; relevant IFC performance standards, and other authoritative texts on performing environmental impact assessment) providing guidance on performing impact analysis for industrial development activities;
- UNEP EIA training resources manual (1996);
- European Commission guidance on EIA/EIS review (European Commission, 2001)

5.10 Impact Severity and Significance Evaluation

The overall methodology for assessing impacts of activities associated with the proposed project involves establishing impact indicators, and evaluating the potential effects of project activities on each project specific impact indicator. Impacts may be positive (beneficial) or adverse (detrimental). Impact indicators

are easily identifiable environmental or socio-economic components that would readily indicate changes in environmental or socio-economic conditions. For the purpose of this project, the impact indicators selected are shown in Table 5-1.
In order to facilitate the process of impact assessment, a tabular checklist was developed from information provided by the client, to highlight the major activities and the key concerns in the project location.

5.11 Impact Severity Evaluation Criteria

To objectively review those issues warranting consideration as potential impacts (previously identified as focus areas) and to determine the likely significance of those impacts when compared to baseline conditions, certain significance criteria were developed. This EIA uses the significance criteria to evaluate impacts, which enables systematic identification and focus on those resources and receptors most likely to be impacted by the proposed project. These significance criteria were applied to all potential impacts initially identified during the screening process to determine whether they would likely be P:ositive, Negligible, Minor, Moderate, or Major. Those issues determined to be inconsequential or not applicable based on the significance criteria were eliminated or "screened out" from further consideration. This impact severity assessment takes into account three main areas of significance criteria: temporal factors, areal extent, and magnitude of the impact. The components of each of these primary criteria are described below, I'e., temporal factors include duration, frequency, and reversibility. In addition to the three main significance criteria, supplementary factors were considered as part of the overall impacts severity assessment, sensitivity of the receptor, indirect or secondary influences, and Cumulative effects.

Eligible is used in some instances and a negligible rating should be considered in deriving the overall impact severity. The term is omitted from the impact assessment matrix table that follows this section, but the criteria are described in the preceding text. The following describes the severity rating criteria.

5.12 Magnitude

Magnitude is defined as the quantitative intensity of the impact, and can be measured as the percentage of a resource or a population within the area of influence that may be affected by an impact. The definitions of "high", "medium", and "low" with respect to magnitude may vary depending upon the specific receptor. The magnitude of an impact is characterized as follows:

- High –large amount of the resources or population is affected; easily observable and measurable effect;
- Medium – moderate amount of the resource or population is affected; generally measurable and observable effect;
- Low – small amount of the resource or population is affected; low magnitude impact may be within the range of normal variation of background conditions:
- Negligible – amount of resource or population affected is unnoticeable or immeasurably small.

Magnitude may also be defined with respect to quantitative or semi – quantitative criteria, if available and applicable, (e.g., level of noise as decibels). The magnitude of an impact is characterized as follows:

- High –greater than the quantitative or semi – quantitative criteria
- Medium – at the quantitative or semi – quantitative criteria
- Low – less than the quantitative or semi – quantitative criteria
- Negligible – impact not detected or at background levels.

5.13 Duration

Duration is defined as the time that is estimated for a population or resource to return to pre – impact/baseline conditions. The duration is calculated from the time the impact begins, which may coincide with the start of the activity that caused the impact.

The duration of an impact is characterized as follows:

- High –long –term impact (recovery would not occur within ten years)
- Medium –moderate –term impact (recovery time between one year and ten years)
- Low –short –term impact (recovery time within less than one year)
- Negligible –impact or recovery time is very short or immediate characterization of the duration of an impact as low, medium, or high includes consideration of the degree of reversibility of the impact. Impacts for which the duration is classified as high, as defined above, are considered irreversible impacts

5.14 Frequency

Frequency is defined as the number of times an impact is expected to occur over the life of the project the frequency of an impact is characterized as follows:

- High-impact will occur continuously throughout the life of the project (e.g, continuous waste water process)
- Medium-impact will occur intermittently over the life of the project(e.g, blow down, and venting)
- Low-impact will occur rarely or a very limited number of times (e.g construction impacts)

There is no "negligible" category for frequency because impacts with no frequency would not occur, and were screened out.

5.15 Extent

Areal Extent refers to the potential geographic range of an impact and quantified in units of area affected (e.g, hectares). The areal extent is classified as follows:

High-impact has influence well beyond the project environment to the regional or even global environment.

Medium-impact limited to the general vicinity of the project site/study area.

Low-impact limited to the immediate area of the activity of occurrence.

Negligible-impact limited to a very small part of the activity area

5.16 Sensitivity

Sensitivity refers to economic, social, and/or environmental/ecological relevance of the receptor, including the intrinsic sensitivity of the resource, reliance on the receptor by people for sustenance, livelihood, cultural significance or economic activity, and to the importance of direct impacts to persons associated with the resource.

The sensitivity criterion also refers to potential impacts to Environmentally Sensitive Areas (ESAs) and impacts on species, with effects including loss of endangered species introduction of invasive species, and similar environmental/ecological impacts. The intrinsic sensitivities of a receptor species and actions that after then function of the receptor are also considered. Sensitivity is characterized as follows:

High – receptor is of high economic, social, and/or environmental relevance and or has an intrinsic sensitivity (including vulnerability and exposure) to the specific impact (e.g. water resources).

Medium- receptor is of moderate economic, social, and/or environmental relevance and is not particularly vulnerable and/or exposed to the impact.

Negligible –receptor is not of economic, social and/or environmental relevance or is not sensitive to impact.

5.17 Impact Significance

The following section describes the method by which the overall impact severity rating and associated impact significance is derived.

Impact Severity Rating

To reach an overall impact severity rating for each impact assessed, the five impact severity criteria above are aggregated using impact severity matrices. Aggregation is at three levels.

First, magnitude and areal extent are combined to arrive at a rating for the Impact Quantum while duration and frequency are aggregated to give the overall temporal effects.

Impact Quantum and Temporal Effects are then combined and their resulting aggregate assessed in terms of sensitivity to arrive at the overall impact severity.

Impact Likelihood

To further assess the significance of the severity associated with each potential negative impact identified in the previous section, a likelihood criterion is applied to each negative impact. The likelihood criteria are used to determine whether negative impacts can be prevented or mitigated or if they are unavoidable.

It should be noted that the likelihood criteria are applied to the likelihood of the impact occurring and not of the activity occurring. Thus the overall severity rating (significance) of a negative environmental impact is a function of its severity as earlier defined and the likelihood of occurrence as defined in the table.

Overall Impact Significance

The overall impact significance is indicated by the position on the impact significance matrix. Impacts with a high likelihood of occurrence and consequence have a high significance rating. These high-significance impacts

become high priority for further evaluation or management action (e.g, design, change or mitigation). Impacts that are moderate are of medium priority; There are also activities with low impacts. Other impacts are positive or beneficial impacts. The criteria and severity matrix set forth in this section are applicable to all the types of events and impacts identified.

Table 5-4: Matrix for Identification of Significant Activity Impacts of the Proposed Plantation Expansion Project on the Environment

ENVIRONMENTAL COMPONENTS	PROJECT ACTIVITY PHASES																				
	Site Preparation						Transplanting/ Planting				Upkeep & Harvesting								Ancillary Facility	Decommission and Abandonment		
	Boundary Demarcation	Opening of Roads and Tracks	Land Clearing/Preparation	Stumping and Stacking	Vegetation & Soil Disposal	Heavy Machinery Use/Traffic	Tracing/Pegging/Lining	Cover Crop Establishment	Hole Digging	Seedling Planting	Weed Control	Fertilizer Application	Gaseous Emission	Pest Control	Phytosanitary Inspection	Pruning	Harvesting & Fruit Collection	Mulching	Construction of Housing, Workshop and Powerhouse	Laying off Staff	Lack of care of plantation	Equipment/Chemicals
Air Quality							-2	-2	-2			-3							-2			
Noise level		-2					-2	-2	-2			-3							-2			
Vegetation												-2										
Terrestrial Inverts.												-2							-2			
Wildlife												-2										
ArakhuanRiver Quality																						
Groundwater														-3								
Soil/Land Pollution		-1	-1						-2	-2	-2			-4	-2							
Landuse/Landscape										-1				-3	-1				+2			
Drainage																			-1			
Demography									-1													
Employment/Income	+3	+3	+1						+3													
Culture/Religion																						
Health/Accidents		-1	-2				-2		-2		-2	-3		-3	-2							

Infrastructure																			-1			
Community Relations	+3																			-3	-2	
Economic loss																				-3	-2	

KEY: + Positive impact
- Negative impact
Moderate short term effect (Low) = 2 points
Major short term effect (High) = 4 points
No impact = Blank Square
Minor effect, (very low) = 1 point in square
Moderate long term effect (Moderate) = 3 points
Major long term effect (Very high) = 5 points

5.18 Description of Impacts

5.18.1 Significant Impacts

The proposed Extension One plantation expansion project by **Okomu Oil Palm Company Plc** offers a number of potential beneficial impacts to the host communities of the project site and area beyond. These effects shall be enhanced throughout the duration of the project. Improved and more secured plantation development would benefit a broad range of individuals, communities and businesses throughout Nigeria. The project will substantially improve agricultural development by improving palm oil and specialty fats and oils production n that will continuously provide job opportunities for teeming youths in Nigeria.

In addition, the project will contribute to achieving some of the objectives of the Federal Ministries of Agriculture & Rural Development and Trade & Investment which include securing the social and economic benefits of an efficient Agricultural and Investment sector; considerably increasing Palm oil production to meeting its annual requirement in the country.

Moreover, the project will provide employment opportunities for qualified Nigerians (skilled, semi –skilled and unskilled) from the immediate project area and beyond. The employment opportunity will lead to acquisition of new skills and introduction of all manners of income generating spillover effects.
Other potential benefits of the project include:

- Add value to the existing production of the company
- Provide direct employment
- Create additional jobs
- Contribute to the socio-economic development of neighboring communities

5.18.2 Significant Negative Impacts

In this section, only activity-receptor relationships resulting in impact significance **above 'low'** are presented and discussed to understand how additional mitigation measures beyond those incorporated in the project design could help bring down the residual impacts to 'low' in the least. In the analysis, the environmental receptors are considered singly or collectively along with the corresponding planned project activities.

5.18.2.1 Evaluation of Potential Impacts of Project Activities

5.18.2.1.1 Plantation boundary demarcation, Opening of roads and tracks, Site forest clearing and Maintenance of tracks and roads.

Existing farms and unharvested agricultural and economic crops and trees will be destroyed. Economic trees such as timber, raffia palms, cane plant, many trees that produce edible fruits and seeds, alligator pepper, large wide leaves for wrapping kolanuts and food items and some medicinal plants present in the area will be destroyed. Some areas of the fresh water swamps may be lost. Some siltation of rivers may occur if planting activities extend to river banks. These changes in the ecosystem may adversely affect some shellfish and finfish. However, Okomu Oil Palm Company will retain and maintain at least 50 meters of buffer vegetation on both sides of the river.

Wildlife such as the giant African land snail and amphibians in the sites may be killed. Snakes and mammals will relocate/emigrate to unfamiliar territories and some may get killed in the process. Birds will relocate or emigrate. Bush/forest clearing and exposure of land to wind and storm water will increase the potential for soil erosion and very high rate of evaporative groundwater loss in the area. The erosion control, cooling, shading and watershed-protection effect which trees provide will therefore be lost. However, the planting of cover crop immediately after land clearing will minimize the erosion to a great extent. However, these activities will give employment for unskilled labour in the communities around the project area.

5.18.2.1.2 Vegetation and Spoil Disposal

Soil accumulated during harrowing and stumping and felled vegetation will have to be removed and deposited somewhere. Accumulation of soil spoils, if not removed, may alter water drainage pattern and reduce landscape beauty. Disposal of the vegetation and soil spoils will give opportunity for employment in the communities.

5.18.2.1.3 Ploughing, Grading and Levelling of Tracks and Roads

There is the possibility of initiation of erosion because the topsoil in the affected areas is loose and coarse-grained.

5.18.2.1.4 Increased Transportation and use of Heavy Machinery during Land Preparation

Wildlife presence in the affected area may be reduced due to unusual and frequent high level noise from tractor-drawn ploughs and harrows and chain saws. During the raining season, the access earth roads/tracks may be rendered inaccessible due to activity of these vehicles.

5.18.2.1.5 Weeding

In mature oil palm plantation, unwanted weeds are removed from the ground cover by manual clearing with cutlass. There is then the problem of disposal of removed weeds which are therefore allowed to gradually decay or rot. Many invertebrate fauna may be killed during or after weeding. Weeding removes the cover for wildlife such as amphibians, snakes and small mammals. Predator birds such as the black kites and owls increase in numbers in recently weeded plantations to locate exposed and moving prey.

5.18.2.1.6 Herbicides, Fungicides and Insecticides Application.

Okomu Oil Palm Company Plc uses Decis Organophosphate insecticide in the nursery only. The possibility of carriage of residue from the nursery to Arakhuan River is extremely remote.

5.18.2.1.7 Fertilizer Application

In order to increase productivity of oil palm fruit bunches per unit area, fertilizers are applied at various stages. At the nursery, in each bag of soils, fertilizers are applied such as NPK, borax, potash, sulphate of ammonia. Ashes of burnt kernel shells from boiler furnace are also applied as fertilizers. Not all nutrients added to the soil as fertilizers are taken up by the growing palm. Residues (NO_3, PO_4) may remain in the soil and end up in surface waters through storm water runoffs or be leached out of the soil and enter groundwater. High nitrate level in drinking water sources cause health risks particularly in children. It reacts with haemoglobin causing methehaemoglobinema which impairs respiratory gases transport. Nitrites and nitrates can form nitrosamines, which are carcinogenic, mutagenic and tetratogenic (Odiete, 1999). At Okomu Oil Palm Company Plc, the ashes from the boiler furnace and palm kernel cake make excellent fertilizers and are applied widely throughout the entire plantation. Nursery seedlings are transferred with the soil in the bags during planting and transplanting. Therefore, the possibility of high levels of nitrite and nitrates in groundwater is very remote.

5.18.2.1.8 Decommissioning and Abandonment

- Permanent and casual workers will be laid off resulting in loss of employment and income, although severance payment will also be made to permanent workers. But this can itself give rise to strained relations between workers/community and the company.
- The plantation will no longer be regularly and properly maintained including no weeding, no pest control, no maintenance of roads and tracks, no pruning of palm fronts. There will be great economic loss to the company and shareholders and the nation. The plantation will become

densely populated by weeds, pests and many invertebrates' fauna and small to medium size wildlife.

- The land area might need to be restored back to its original state and this includes felling the palm trees as well as planting trees. This will portend a great economic loss to the company in addition to the already incurred losses.
- Removal of equipment and ancillary facilities such as chemicals, ploughs, tractors, harrows, trucks and other farm machinery will generate excessive noise and also a potential for accident.
- Return of land area to State Government which can generate conflicts between the host communities and the local authority.

5.18.3 Social and Environmental impacts

The social and environmental impacts of oil palm cultivation are highly controversial topics. There are multiple sources highlighting the positive and negative aspects of this industry. Oil palm is a valuable economic crop and provides a major source of employment. It allows many small landholders to participate in the cash economy and also often results in the upgrade of the infrastructure (schools, roads, and telecommunications) within that area. However, there are cases where native customary lands have been appropriated by oil palm plantations without any form of consultation or compensation, leading to social conflict between the plantations and local residents. In some cases oil palm plantations are dependent on imported labour or illegal immigrants, and there are some concerns about the employment conditions and social impacts of these practices.

Biodiversity loss (including the potential extinction of charismatic species) is one of the most serious negative effects of oil palm cultivation. Large areas of already threatened tropical rainforest often need to be cleared to make way for plantations, especially in South-East Asia where there is a lack of enforcement of forest protection laws. The impact of oil palm plantations on the environment is dependent on multiple factors, including the existence and compliance to environmental legislation, the pre-establishment habitat and corporate responsibility. In some states where oil palm is established there had been little enforcement of environmental legislation leading to encroachment of plantations into protected areas, encroachment into riparian strips, open burning of plantation wastesand release of palm mill pollutants such as palm oil mill effluent (POME) in the environment. Some of these states have recognised the need for increased environmental protection and this is resulting in more environmental friendly practices. Among those approaches is anaerobic treatment of POME. POME can be a

good source for biogas (CH4) production and electricity generation. Anaerobic treatment of POME has been practiced in Malaysia and Indonesia. Like most wastewater sludge, anaerobic treatment of POME results in domination of *Methanosaeta concilii*. It plays an important role in methane production from acetate and the optimum condition for its growth should be considered to harvest biogas as renewable fuel.

Demand for palm oil has increased in recent years due to its use as a biofuel, but recognition that this increases the environmental impact of cultivation as well as causing a food vs. fuel issue has forced some developed nations to reconsider their policies on biofuel to improve standards and ensure sustainability. However, critics point out that even companies signed up to the Roundtable on Sustainable Palm Oil continue to engage in environmentally damaging practices and that using palm oil as biofuel is perverse because it encourages the conversion of natural habitats such as forests and peatlands, releasing large quantities of greenhouse gases.

5.18.4 Significant Impact Producing Activities

Based on a score of -4 point to -2 (i.e. -4, -3 and -2) as shown in Table 5-4, the significant impact producing activities (IPA_S) are as follow:

- Plantation boundary demarcation which may be a source of conflict with the migrant/settler communities.
- Opening of roads and tracks in swampy areas will initially adversely impact water quality of freshwater swamps; it will provide access roads to farms of communities and provide opportunity for employment during construction and maintenance phases of the project.
- Site Forest clearing will produce many beneficial and adverse impacts.
- Stacking, Stumping and restacking; this may create huge cavities in the soil and become a source of soil erosion.
- Peg Preparation; this will impact negatively on both wildlife fauna and flora.
- Holing and transplanting seedlings; it can impact negatively in terms of safety of workers if not handled carefully.
- Weeding in young plantation and manual removal of unwanted weeds with cutlass in mature planting.
- Fertilizer Application; In Okomu Oil Palm Company Plc, mainly ash from boiler is applied. Also, other chemical fertilizer application may affect groundwater as a result of runoffs and leaching. Others include;
- Pruning, harvesting and collection of fruit bunches

- Use of diesel machinery and powered generators for electricity generator
- Transportation of Fresh Fruit Bunches (FFB) to the Palm Oil Mill at the Main Estate for processing
- Laying off workers/Severance Payment
- Lack of care of plantation
- Decommissioning and abandonment have three main activities which will produce adverse impacts as listed in section *5.18.2.1.8*.

5.18.5 Cumulative Impacts

Cumulative impacts are changes to the environment that are caused by an activity in combination with other past, present and future human activities. (GSI, 2003]. The concept of cumulative effects is an important one. It holds that, while impacts may be small individually, the overall impact of all environmental changes affecting the receptors taken together can be significant. When a resource is nearing its tolerance threshold, a small change can push it over. The objective of the cumulative impact assessment is to identify those environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities associated with this and/or other projects, result in a larger and more significant impact[s].

5.18.5.1 Project Specific Cumulative Effects' Assessment

This section evaluates the cumulative effects of the individual impacts evaluated in the preceding sections.

5.18.5.1.1 Land Based Traffic

It is envisioned that land based traffic will also increase as a result of the proposed project. Land based traffic is expected to increase mainly during the operation phase to allow the FFB collected in the field to be processed at Obaretin estate. Activities at the project site during construction will however be varied and limited to the construction phase. The proposed project will result in a negligible impact on traffic, circulation and parking at the project site and its vicinity. It would be unlikely that the rate of motor vehicle accidents would increase due to the project. No additional cumulative transportation impacts would result from the proposed action. Therefore it is anticipated that no long term environmental impact will be forthwith in considering the land based traffic.

5.18.5.1.2 Public Services

There would be no impact to public services under the proposed project action. The project will not introduce any additional long-term population or employment into the area, and thus, would not result in any additional demand for police or fire services or the need for new or altered facilities. No damage to roadways is expected beyond that which would be considered normal wear and tear and it is basically within the company's land concession. Therefore, the proposed project would result in negligible impact on public utilities.

5.18.5.1.3 Employment Opportunities

There will be some beneficial impacts that are cumulative that are in the employment sector. During the operational phase of the project, the plantation will employ workers – all Nigerian. Positive cumulative social benefits include gainful employment and tax being paid to government coffer.

5.18.6 Known Overall Impacts of Large Oil Palm and Rubber Plantation Cultivation and Management

These include:

- Loss of resources of lowland rainforest and land for indigenous people
- Transformation of the forest into a monoculture farm
- Many insects and insect pests flourish in Oil Palm plantation due to absence of natural enemies.
- Loss/disappearance/displacement of many wildlife species.
- Employment and income generation will be enhanced
- Pollution of the soil and adjacent surface water and groundwater by pesticides and excessive use of fertilizers.
- Build up of dry and decaying fronds and other organic matter under plantation posing a fire hazard.
- Rapid spread of unwanted weeds.

CHAPTER SIX

6.0 MITIGATION MEASURES

The rationale for impact quantification and significance has earlier been discussed in the previous chapter. The results indicate the various components would be impacted positively or negatively. In order to preserve the present integrity of the environment certain steps have been recommended to mitigate or control the major negative impacts identified in this study. The control/mitigation measures have been based on the baseline conditions with regards to the biophysical environment, socio-economic and health status of the host communities. Also considered were the project activities and their envisaged impacts and concerns of stakeholders during consultation meetings and socio-economic/health status of the host communities.

Mitigation measures are defined for the identified significant associated and potential impacts based on the following criteria:

- **Prevention –** design and management measures for ensuring that significant potential impacts and risks do not occur,
- **Reduction –** operational and management measures for ensuring that the effects or consequences of those significant associated and potential impacts that cannot be prevented are reduced to a level as low as reasonably practical (ALARP)
- **Control -** Operational and management measures for ensuring that residual associated impacts are reduced to a level as low as reasonably practical (ALARP).

Most of the significant environmental impacts that can likely arise from the construction and operation of the proposed rubber factory can be mitigated once appropriate precautions are in place. The following tables define the environmental impacts, their sources and the recommended mitigation measures.

Table 6-1: Summary of Impact and Mitigation measures (Pre-Construction Phase)

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Pre-construction preparation phase	***Land Degradation on or near sensitive habitats.***	Sitting the project on a sloping land may result in higher erosion potential. As a result of soil erosion, soil particles will be transported by run-off water and sediments will be fed into river system. Increased sediment load will induce migration of aquatic fauna. Degradation of sensitive habitats will result in loss of biodiversity and displacement of indigenous species.	There will be side pits excavated at intervals to collect soil particles including sediments to avoid sediment load of water bodies. Planting of cover crops (prureira and mucuna) on the exposed portions of the land.	High
	Air quality	Dust and gaseous emissions from land preparation leading to high suspended particulates in the atmosphere.	**OOPC Plc** shall ensure the following - Low-emission/high efficiency engines shall be used - Movement of men and materials shall be properly coordinated to optimize vehicle use and resultant emissions - Dust and particulate barriers shall be used during operation - Avoid burning on site (i.e. zero burning)	Low

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Pre-construction preparation phase	**Noise and vibration**	Noise emissions generated by heavy-duty vehicles and workers activities and resultant hearing impairment on site workers.	**OOPC Plc** shall ensure the following - Noise attenuation measures such as installation of acoustic mufflers on large engines and equipment; - Hearing protection shall be provided and usage enforced for workers on site.	Low
	Water Quality and Hydrology	Increased receiving water body turbidity from runoff from the plantation.	**OOPC Plc** shall ensure the following - Stack demolition materials properly to reduce turbidity effect on surface runoffs; - Adequate contingency measures shall be put in place to contain accidental spills, ensure spill containment equipment shall be available on site.	Low
	Solid Waste	- Solid waste constituting aesthetic nuisance - Sewage nuisance	**OOPC Plc** shall ensure the following - Waste are contained and removed regularly by her own waste management plan already in place.	Low
	Hostility	Land acquisition and proper take-over Conflicts between the migrants and the local people	**OOPC Plc** shall ensure the following - Conflict resolution mechanism is instituted - Employ as much local labour as possible - Adequate stakeholders forum and information shall be given to communication,	High

Table 6-2: Summary of Impact and Mitigation measures (Construction Phase)

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Construction phase	**Air quality**	• Dust and gaseous emissions from land preparation leading to high suspended particulates in the atmosphere • Emission of CO and green house gases	**OOPC Plc** shall ensure the following - Access roads and exposed ground are regularly wetted in a manner that effectively keeps down the dust. -Movement of men and materials will be properly coordinated to optimize vehicle use and resultant emissions. -Workers on the site are issued with dust masks during dry and windy conditions. -Low-emission/high efficiency engines shall be used -Vehicles and machines are properly maintained and serviced. -Vegetation and combustible waste must not be burned on the site.	Low
	Noise and vibration	Noise emissions generated by construction activities and resultant hearing impairment on site workers.	-construction activities that will generate disturbing sounds shall be restricted to normal working hours. -Noise attenuation measures such as installation of acoustic mufflers, on large engines and equipment; -Hearing protection shall be provided for workers on site.	Medium

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Construction phase	**Water Quality and Hydrology**	Improper storage and handling of, hydrocarbons, fuel and other chemicals would inevitably result in spillage during construction activities	**OOPC Plc** shall ensure the following -Put in place adequate contingency measures to curtail accidental spills and ensure spill containment equipment shall be available at the construction site -In order to reduce ground contamination, an impervious sump or container shall be placed under the spigots of fuel drums to collect drippings. -Re-fuelling and maintenance of heavy construction vehicles at the site, shall be done at specified areas or makeshift "depots" where measures are in place to deal with spillages and temporary storage of oily wastes. Preferably these depots shall be located in an area that would ultimately be permanently paved (e.g parking lots) thereby covering any contaminated soil. -A thick layer of sawdust or absorbent would be used to absorb any spillages. Subsequently, this layer shall be removed for proper disposal. In the event of a large spill, the latter must be cleaned up immediately by excavating the contaminated soil and removing it in a secure vehicle to an approved disposal site	Low

	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
	Erosion	Exposed soils which could leave them vulnerable to erosion.	**OOPC Plc** shall ensure the following -Where possible, phase the site clearance exercise so as to reduce the amount of exposed soil at any given time -Deliberately re-cover exposed soils with plants and other appropriate species (prureira and mukuna) as soon as possible -Temporarily bund and redirect exposed soil and redirect flows from heavy runoff areas that threaten to erode -Monitor areas of exposed soil during periods of heavy rainfall throughout the construction phase of the project - Construction of trap pits to collect top soils from being washed away.	Low
Construction phase	**Safety**	-Accidents, Vehicular, slips, falls, trips etc -Hearing impairment due to exposure to noise of heavy machineries -Improper storage and handling of hazardous materials (e.g agrochemicals, lubricants, fuels, etc), are potential health hazards workers	**OOPC Plc** shall ensure the following **Wearing of ear protection.** -Safe storage areas shall be identified and retaining structures constructed prior to the arrival of material. -Hazardous materials (e.g. agrochemicals, fuels) shall be properly stored in appropriate containers and these shall be safely locked away. Conspicuous warning signs (e.g. 'No Smoking') shall be posted around hazardous waste storage and handling facilities	Low

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
	Waste Management	-Wastes constitute aesthetic issues for the project area -Accumulated wastes could lead to contamination of soil/groundwater and breeding grounds for vectors and rodents	**OOPC Plc** shall ensure the following -A site waste management plan although already in place shall be prepared prior to project commencement. This shall include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal sites, and system for supervision and monitoring. -Preparation and implementation of the plan shall be the responsibility of **OOPC Plc** with the system being monitored independently. -Waste generation shall be properly contained to avoid contamination of groundwater.	Low
	Sewage	- Feacal aesthetic issues for the project area - Spillage of septic liquor	**OOPC Plc** shall ensure the following -Onsite toilets shall be made available for use	High
	Socio-economics	-Sexual laxity disruption -Youth militancy/unemployment/grievances	**OOPC Plc** shall ensure the following -Public enlightenment about potential health risks (STDs) -Facilitate education/enlightenment about the project and its nature	High

Table 6-3: Summary of Impact and Mitigation measures(Operation phase)

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Operation phase	**Air quality**	Fugitive emissions from tanks used to store petroleum and other hydrocarbon products -Combustion emissions from exhausts from machines e.g. pumps power generating sets	**OOPC Plc** shall ensure the following -All flanges and vents shall be properly tightened to reduce fugitive emissions. -All systems shall be properly checked to ensure there are no leakages or losses -All machinery and vehicles for the project shall have high efficiency burner to reduce emission of noxious gases. -Avoid all forms of burning (zero burning)	Low
	Solid waste and sewage	-Waste runoff flowing into the surface waters -Solid waste constituting aesthetic nuisance -Sewage nuisance	**OOPC Plc** shall ensure the following Waste are contained and removed regularly by her own waste management plan already in place.	Low
		-Carcinogenic/Toxic -Chemical hazards: corrosive substances -Poor chemical handling -Asphyxiating atmosphere	**OOPC Plc** shall ensure the following Guideline on safe handling of chemicals (SHOC) and appropriate PPE are provided	High

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Operation phase	**Solid waste and sewage**	-Wrong use of PPE -Inadequate PPE	**OOPC Plc** shall ensure -Awareness training -Sufficient PPE are provided	High
		-Inadequate equipment/surface guard on equipment -Low awareness	**OOPC Plc** shall ensure -Equipment specification are made available -Provision of adequate training to workers -Provision of warning signs to workers and commuters	High
	Spills of hazardous materials Accidental spills or release of potentially hazardous solvents.	Possible public health hazard if staff and the public come into contact with hazardous materials.	It must be ensured that all storage and disposal areas are well maintained to prevent accidental release of hazardous materials. All storage would be provided with secondary containment and there should be provision for spill contingency plan and containment equipment. The Emergency Response Plan will address potential spills and workers will be trained on the actions that are to be taken if such an event were to occur.	Low

Activity phase	Environmental Aspects	Type of Impact	Mitigation measures	Impact Rating
Operation phase	***Oil/Fuel Spills*** Oil spills can occur within and outside the powerhouse, and the fuel and lubricant storage area.	Oil/fuel can enter the drainage system and either contaminates the effluent treatment facility or if released to the environment, it can contaminate land and water.	The fuel storage tanks will be surrounded by a bund wall to contain up to 1.5 times the total storage capacity in case of a spill. All wash down from inside the powerhouse will be directed to a sump equipped with an oil/water separator to trap and filter oil from wastewater before it is discharged to the drains. Arrangements for the proper disposal of the waste oil collected in the oil/water separator will be made. An emergency response plan will be developed with detailed procedures for preventing and handling spills.	Low
	Water Quality and Hydrology	Increased receiving water body turbidity from runoff from the plantation.	**OOPC Plc** shall ensure the following - Stack demolition materials properly to reduce turbidity effect on surface runoffs; - Adequate contingency measures shall be put in place to contain accidental spills, ensure spill containment equipment shall be available on site. - Quarterly monitoring of surface river (Arakhuan River) to ensure that eutrophication does not arise.	Low

6.1 Cost Implications Associated with Mitigation Measures

6.1.1 Construction (Land preparation, Planting and Maintenance)

The mitigation measures for land preparation, planting, maintenance (construction phase) would be included as line items in the Bills of Quantities in the tender document so that the bidders are sure to cost these items and can be held accountable for them during construction. It is not possible to estimate these costs as they will vary depending on the contractor, the number of workers, and condition of farm implements to be used.

6.1.2 Operation (Harvesting)

The activities and equipment that will have costs associated with them are listed below in Table 6-4.

Table 6-4: Cost Implications associated with Mitigation Measures

MITIGATION MEASURES	COST IMPLICATIONS
Pollution abatement equipment.	This cost will be included in the cost of the project.
Bund wall surrounding the fuel dump to contain up to 1.5 times the fuel storage capacity in case of a spill.	Cost will be included as a line item in the Bills of Quantities for the project build-up.
All the necessary farm implements	Not possible to estimate these costs.
Personal Protective Equipment (PPE) for the persons handling hazardous materials.	This cost will be part of the running cost of the plantation and cannot be determined at this point. All contracts relating to supply, handling and management of hazardous materials must have provisions for this, i.e. personnel being attired with PPE.

CHAPTER SEVEN

7.0 ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN (ESMP)

Environmental monitoring will be required to monitor the effectiveness of the mitigation measures and to report to the regulatory agencies. Through sound environmental management, many avoidable adverse impacts from the construction and operation of the oil palm and rubber plantation crop development can be prevented.

7.1 Environmental Management and Monitoring – Construction

- All mitigation measures outlined in Table 6-2 will be adhered to by the contractor.
- The project coordinator/engineer will be responsible for ensuring that the mitigation measures are implemented.

7.2 Environmental Management and Monitoring – Operation

The following environmental management and monitoring measures will be implemented during operation of the oil palm and rubber plantation project:

- All mitigation measures outlined in the Table 6-3 will be adhered to by the Environment, Health and Safety department of the company.
- Emissions testing and reporting must be done in accordance with the regulatory requirements and record submitted to FMEnv.
- The quality of the receiving river must be monitored regularly in accordance with regulatory requirement and the report submitted to the FMEnv.
- Fire prevention precautions must be in place as required by the State Fire Service.
- All fire fighting equipment will be inspected and maintained regularly.
- Regular inspections will be conducted to verify the integrity of the fuel tanks. Written procedures governing the operation of the fuel tanks and precautions to be taken will be developed.
- An organizational structure shall be developed to implement the EMP, and personnel including the environment manager, lab technologist, production and maintenance engineer and the company's environmental consultants will be involved in the implementation of the EMP.

- The occupational health, safety and environmental policies shall be implemented.
- Capacity building programme for staff including awareness, in-plant training, seminars, workshops and short courses shall be undertaken regularly to enhance the implementation of the EMP.

7.3 Environmental Monitoring Programme

An environmental monitoring programme is required to set out the means to determine whether or not the project operates in line with the environmental quality standards established by the FMEnv. For the Oil Palm and Rubber plantation project, the monitoring programme would cover a number of parameters including meteorology, ambient air quality, surface water quality, groundwater quality and noise levels. The monitoring programme is scheduled in Table 7-1.

Table 7-1: Schedule of Environmental Monitoring

Parameter	Variables	Period
Meteorology	Rainfall, temperature, Wind Speed, Sunshine Hours, relative humidity, atmosphere pressure and wind direction	Daily
Surface water quality	pH, Sediment load, NO_3, Heavy metals, Oil and Grease	Quarterly
Groundwater quality	pH, BOD, COD, microbiology	Quarterly
Ambient Air Quality	CO_2, CO, NO_x, SO_x, VOC, Particulate	Quarterly
Noise Levels	Noise generating Facilities	Periodically

7.3.1 Overall Waste Management

No waste shall be discharged into any wetland without adequate treatment. Table 7-2 shows the proposed waste management plan to be put in place.

Table 7-2:Proposed Waste Management Plan for OOPC'S Proposed Plantation Expansion Project.

Type of Waste	Waste From	Waste Management Option			Disposal	
		Reduce	Re-use	Recycle	Forest/ Swamp	Land
Gaseous	Generators	Installation of appropriate filters and scrubbers			-	-
Noise	Machineries and Generators	Installation of appropriate noise Reducing devices			-	-
Liquid	Sanitary from Toilets				None	Septic tanks
	Oil leakages from AGO storage tanks		Trapped		None	Oil retention tray and containment bunds
	Oil traps		Trapped			Oil retention
Solid	Plantation materials e.g. mostly polythene bags				None	Dumpsite waiting for evacuation
	Domestic waste	Collected and taken to the dumpsite				

None: Not discharged into/ disposed off in the habitat

7.4 Emergency Response Plan

An emergency is any unplanned occurrence caused by either natural or man-made events which can lead to deaths, significant injuries, cessation of operations, physical or environmental damage and economic losses. Numerous events can lead to emergencies. These include:

- Fires
- Floods
- Communications failure
- Chemical spills
- Oil Spills
- Structural failure
- Civil disturbance

Emergency management is therefore critical to planning, mitigating, responding and recovering from the potential impacts of these events.

The emergency management process however is very site specific and varies according to type of operations, geographic location, proximity to neighbouring communities and the history of such occurrences. Therefore, one of the first stages in developing an Emergency Response Plan (ERP) would be the identification of the potential hazards or threats to the facility, organisation or operation based on the above mentioned factors.

The Emergency Response Plan must be documented and cover all the areas mentioned above. In addition;

- The plan must identify the person(s) responsible for Emergencies and Safety. This person will keep the documentation updated (at least annually) and ensure that it is disseminated to all relevant persons.

- The plan must speak to the preparatory actions that must be taken in case of emergencies with forewarning such as hurricanes and responsibilities must be assigned.

- The plan should include actions that must be taken when a spill, riot or fire occurs. A safe area (muster) must be designated for persons to congregate during an emergency.

- A system must be in place to account for all staff members in an emergency with the appropriate responsibilities assigned.
- Drills must be conducted on a specified frequency (for example 3 times for the year for fire).
- The plan must include for fire fighting equipment to be checked on a specified frequency by a competent entity.
- The plan must address cleanup measures after the emergency.

The Emergency Response Plan must be developed in consultation with FMEnv to ensure that it meets their requirements. The Emergency Response Plan for the plantation will form a part of the overall Emergency Response Plan for the company.

7.5 Decommissioning

7.5.1 Decommissioning of Oil Palm and Rubber Plantation

The approaches to the decommissioning of the oil palm and rubber plantation would involve the combination of the following activities/options:

7.5.2 Asset Recovery

This would be achieved through a reputable decommissioning services company. The company would offer to purchase the complete process unit or sale of the plantation. Assets recovery would be done such as to achieve maximum return for the assets within the specified time.

7.5.3 Dismantling

This is applicable to either the removal of installations or the 'un-building' of structures. Dismantling is generally achieved by a careful reversal of the construction process. Dismantling will be done to optimize asset recovery.

7.5.4 Demolition

Demolition usually applies to structures and plant which have reached the end of their working life, and must be carried out with a high degree of knowledge and expertise. The demolition techniques used include conventional, remote mechanical and the use of controlled explosive charges. However, demolition will not be applicable here as plantation crops can be destroyed and ancillary facilities can be dismantled, while the buildings can be converted for other uses.

7.5.5 Decontamination

Contamination and pollution of the soil and buildings can often be a major problem for those decommissioning industrial premises. The contamination may be in various forms i.e. solid, liquid, vapour, gas or powder. This contamination can be present in the air or on surfaces such as plant items or building fabric. Decontamination will be done according to procedure that will be approved beforehand by FMEnv.

7.5.6 *Remediation*

Ground remediation and regeneration package will form an integral part of the services to be performed by the company to be appointed for decommissioning.

7.6 Decommissioning Procedure

A decommissioning service company will be contracted to undertake the decommissioning. The company will prepare and submit a manual articulating the procedure and methodology of decommissioning, including approach, type of waste and disposal method. The procedure will be such as to minimize the adverse impacts associated with decommissioning and will be approved by FMEnv before commencement of decommissioning.

7.7 Possible Adverse Impacts on the Environment and Protection Measures

The significant environmental impacts and the mitigation measures that are associated with the decommissioning of the Oil Palm and rubber plantation are presented in Table 7-3 below.

Table 7-3: Environmental Management Plan for the Proposed Plantation Expansion Project

Activity Phase	Potential Impact	Action that shall Be taken	Responsibility for Mitigating Action	Monitoring of Mitigation/Impacts	
				Activity to be monitored	Timing & Frequency
Construction and Operation Phase	Excavated soil disposal	Efficient and constant removal from site	Agric Coordinator Supervisor; Site Engineer	Persistent accumulation	Daily and during site preparation
	Accidents from heavy machinery movement and assemblage	a) Operators must wear PPE b) Traffic control into/out of site.	Maintenance Engineer/Site Engineer	Influx of machine and material movement into the site	Daily; Duration of site preparation and.
	Siltation of rivers	Creation of buffer Zone of about 100m along river banks	Agric Coordinator/HSE department	Non compliance and poor plantation maintenance practices	Throughout project life span.
	Water/Land Pollution from plantation maintenance.	a) Creation of buffer zone of about 100m along river banks.	Agric Coordinator/HSE department	Non compliance and poor plantation maintenance practices	Throughout project life span.
	Particulate emissions to the atmosphere from all point operation sources	Particulates emission from generators shall be monitored fortnightly	Maintenance Engineer.	Particulates in smoke	During operation fortnightly

Activity Phase	Potential Impact	Action that shall Be taken	Responsibility for Mitigating Action	Monitoring of Mitigation/Impacts	
				Activity to be monitored	Timing & Frequency
Construction and Operation Phase	Disruption of natural environment inside the ONPS	Non application of hazardous substances to the field 100m from the buffer zone	Agric Coordinator/ HSE Department	Non compliance and poor plantation maintenance practices	During operation.
	Water quality and other aquatic impacts	Quarterly analysis of borehole water and surface river.	HSE Department	Drinking water parameters	Quarterly analysis during operations
	Noise and Vibration	Site noise shall be minimized by implementing good working practices, installing acoustic mufflers in large machines. Equipment shall be maintained in good order	Maintenance Manager	Excess of 90dBA levels at all work places and the powerhouse	Quarterly measurement an when desirable
	Occupational Health effects on workers	OOPC shall develop & implement its Occupational Health and Safety Policy to address hazards to workers	Managing Director/HSE Committee	Non compliance and poor housekeeping practices	Daily
	Fire Hazards inside the plantation	Creation of fire belt along the plantation boundaries and constitution of fire surveillance team.	Agric Coordinator/HSE department	Burning activity around adjoining farms	Especially during dry season

Activity Phase	Potential Impact	Action that shall Be taken	Responsibility for Mitigating Action	Monitoring of Mitigation/Impacts	
				Activity to be monitored	Timing & Frequency
Decommissioning Phase	***Air Pollutants*** Generation of dust during plantation crop destruction and also residues retained on the inner surface of the machinery may pose a health risk to the persons dismantling the plantation crops and its ancillary facilities. This risk could spread to the residences if particulates and PM_{10} in the residues are allowed to become airborne through a failure to contain the contaminated parts. Pollutants of particular concern in the residues include PCBs, dioxins and heavy metals.	Decontamination will be done according to procedure that will be approved beforehand by FMEnv	Maintenance Engineer/Site Engineer	**C**ontamination and pollution of the soil	During decommissioning exercise

Activity Phase	Potential Impact	Action that shall Be taken	Responsibility for Mitigating Action	Monitoring of Mitigation/Impacts	
				Activity to be monitored	Timing & Frequency
Decommissioning Phase	***Noise*** The dismantling and demolition of the plantation crops and its ancillary facilities will generate minimal noise.	Decontamination will be done according to procedure that will be approved beforehand by FMEnv	Maintenance Engineer/Site Engineer	**C**ontamination and pollution of the soil	During decommissioning exercise
	Wastewater Though quantities of wastewater may be small, this needs to be appropriately contained to prevent release into any nearby waterways or leaching into soil.	Decontamination will be done according to procedure that will be approved beforehand by FMEnv	Maintenance Engineer/Site Engineer	**C**ontamination and pollution of the soil	During decommissioning exercise
	Solid Waste Large quantities of plantation trees of which are organic in nature pose no problems but the small quantities of steel, metal, wooden and concrete waste will be accumulated after demolition and dismantling of the machinery of PCBs, dioxins and heavy metals.	Decontamination will be done according to procedure that will be approved beforehand by FMEnv	Maintenance Engineer/Site Engineer	**C**ontamination and pollution of the soil	During decommissioning exercise

CHAPTER EIGHT

8.0 CONCLUSION AND RECOMMENDATION

The EIA process demonstrates that the oil palm and rubber development project will fully comply with legislative requirements in Nigeria and other relevant international regulations applicable to the planned activities and operations.

The oil palm and rubber development project will result in substantial economic benefits for Nigeria through Employment opportunities generation in particular during the construction and operation phases.

This EIA also indicates that discharges including gaseous emissions and noise are expected from the operation of the oil palm and rubber development project. However, any such discharges, which can be considered as potential sources of adverse environmental effects, can be fully managed through preventive actions and mitigating measures. This means that no significant negative impact on the natural, health and social environmental sensitivities of the project area is expected to result from discharges, let alone the occurrence of a residual impact.

The existing environmental management programme of Okomu Oil Palm Company Plc has put in place good waste management system, which will fully integrate the oil palm and rubber development waste management requirement.

There would appear to be no legal, administrative, natural and socio-economic limitations to prevent the project from going ahead as proposed by Okomu Oil Palm Company Plc. The project shall be implemented in accordance with the proposed environmental management plan presented in Chapter Seven.

The stakeholders shall be carried along throughout the development, implementation and operation of the project.

The proposed project is therefore recommended to the Federal Ministry of Environment for approval.

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