proforest

High Carbon Stock Assessment Report for Okomu Extension II in Edo State

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About Proforest

Proforest is an independent organisation working with natural resource management and specialising in practical approaches to sustainability. Our expertise covers all aspects of the natural resources sector, from sustainable forestry and agricultural commodities production to responsible sourcing, supply chain management and investment.

Proforest works to transform commodity supply chains and sectors through developing **awareness** about sustainability, helping to generate **commitment** to better practice, supporting **implementation** of these commitments in practice and working with the wider community to increase the positive **impact**.

Proforest Ghana leads on delivery of Proforest activities in West and Central Africa including direct support to companies implementing responsible production, sourcing and investment for agricultural and forest commodities together with long-term programmes to support capacity building and multi-stakeholder initiatives in the region. Proforest also has offices in Brazil, Malaysia and the UK.

Our team comprises specialists in forest management, agricultural commodities such as palm oil, conservation and sustainability initiatives and certification. We have extensive experience in Africa and internationally and can work in English, French and Portuguese.

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Executive Summary

This standalone HCSA assessment has been commissioned by Okomu Oil Palm Company with the of identifying viable areas of forest that should be conserved due to their value as carbon stores, for biodiversity conservation, and as areas for customary use. The specific objectives of the assessment are to identify and map HCS forests in the proposed development area ; identify existing or potential threats to the identified HCS areas and; provide recommendations for the management, monitoring and protection of the HCS forests to ensure that production activities do not negatively impact HCS forest areas. In addition to fieldwork conducted as part of this assessment, data and findings from the ESIA, NPP and HCV assessment reports have been used and referenced in this report.

The PDA is located in the de-reserved areas of Owan North Forest Reserve (ONFR) in Edo State of Nigeria and covers an area of about 500 ha within the Eastern part of the Okomu Extension II concession for which an HCV assessment was conducted by Proforest in 2016 and approved by the High Conservation Value Resource Network (HCVRN). Though the PDA convers only 500 ha and the buffered area is 13,422.9 ha, the final size of the area of interest (AoI) considered for this assessment is 17,045.2 ha.

The report includes a summary of impact assessments (SEAI and HCV) and engagements including the company-led FPIC process which was carried out by a team comprising the Managing Director, Agriculture Coordinator, HSE Manager, Community Liaison Officer and Communication Manager. The process was initiated in 2014 and tentatively concluded with the signing of the FPIC agreement on 29th July 2016.

The Option 3 workflow methodology has been used to carry out the this HCS assessment and involved the use of a 0.01% Sentinel-2A remote sensing product, which was selected due to its provision of multispectral data with 13 bands in the visible, near infrared, and short-wave infrared part of the spectrum with spatial resolution of 10 m, 20 m and 60 m. Various band combination based on the 10 m spatial resolution bands 2, 3, 4, and 8 were used and the true colour image based on the combination of the bands 432 was finally used to perform the vegetation classification.

To perform the land cover classification of the AoI, a segmentation of the satellite image was done using the segment mean shift function in AcrGIS version 10.3 with 19.5, 15, and 4 as spectral detail, spatial detail, and minimum segment size in pixel respectively.

The land cover classification of the AoI revealed that the PDA is in a medium forest landscape as the total forest cover represent about 52% of the AoI. The land cover is dominated by scrubland which represents about 25% of the AoI. The PDA has about 47.2% of forest cover and 16.2% of Young Regenerating Forest. However, apart from forest, the dominant land cover is scrubland with 33.2% of the PDA. The scrubland in the area could qualify as fallow as they are mainly areas abandoned after harvesting or after years of farming to restore soil fertility.

The estimated carbon stock varies from 1.7 tC/ha for the Open Land to 82.9 tC/ha for the High-Density Forest. The estimated carbon stock for the Low-Density Forest and the Young Regenerating Forest were all less than 30 tC/ha. The total carbon stock estimated for the entire proposed concession was 12,657.3 tC.

In order to appraise the existence of statistically significant difference between the carbon stock of the land cover classes, an ANOVA followed by the pairwise Scheffe test was conducted. The Scheffe test has revealed that the High-Density Forest has the highest carbon stock which is significantly different from the carbon stock of the other land cover type except the carbon stock of the Medium Density Forest. However, the carbon stock of the Medium Density Forest was not significantly different from the other land cover classes.

Forest inventory results showed that apart from the Open Land, the density of stems of the other land cover is always greater than the density of tree showing the presence trees with multiple stems. The density of the HDF is the highest (288 trees/ha) while the Open land recorded the lowest density (20 trees/ha). The HDF and the MDF have almost the same average diameter and height. However, there is more dispersion of tree diameter and height around the mean in the MDF than the other land cover classes.

The patch analysis was mainly based on the HCS forest patches of the final land cover classification. A negative buffer of 100 m was used to group the HCS forest patches into High Priority Patch (core area > 100 ha); Medium Priority Patch (core area from 10 to 100 ha) and Low Priority Patch (core area < 10ha). In the AoI, one HPP, and one MPF as well as one LPP were found. The HPP covers more than 50% of the PDA and extended towards the South and the East of the AoI. A 200 m buffer was used to assess connectivity of the MPPs and LPPs to the HPP. It was found that the MPP and several LPPs were connected to the HPP. Given that part of the HPP overlap with the PDA, most of the LPPs were connected to the HPP. However, 2 forest patches in the PDA were more than 200 m away from the HPP and as a result were not connected to the HPP. Connectivity of LPPs and MPP to HPP, and the connectivity of LPPs to MPP as well as a threshold of 0.5 ha size of remaining non-connected LPPs were used to identify the forest patches that will be marked for conservation. The figure below presents the distribution of HCS patches marked for conservation and the potential development area.

The total area of the HCS patches was 297.7 ha while the non-HCS area appropriate for development was 201.8 ha. After the give and take process to ensure contiguous conservation area and practicability of development activities, 97.4 ha of HCS patches was taken for development and 45.1 ha of non-HCS patches was given for conservation to ensure linkages between area marked for conservation. Therefore, the total area marked for conservation was 254.5 ha which represent 49.1% of the PDA while the area for development was 253.9 ha (50.9%).
In view of the results obtained from the assessment conducted, and given the presence of communities in the landscape of the concession, as well as the willingness of the company to develop oil palm plantation in the PDA, the following threats are likely to negatively affect the structure and functioning of the identified HCS forest management areas:

- Accidental clearance and planting of HCS forest by the company;
- Loss of biological diversity present in the HCS forest and disturbance of ecosystem services provided;
- Fragmentation by conversion of forest for plantations and agriculture or fire caused by hunters;
- Logging or timber harvesting as well as NTFPs collection for food, health and other needs;
- Displacement of logging from HCS forest inside concession to outside
- Improved access to HCS forest via improved roads;
- Disturbance during land preparation, road building etc.

Therefore, in order to mitigate or avoid negative impacts to the identified HCS forest management areas, the following management and monitoring measures are proposed:

- Demarcate clearly with signs the boundaries of the HCS forest management areas followed by periodic monitoring (once or twice a week) of the boundaries during the land clearing operation to avoid accidental HCS forest conversion;
- No burning during land preparation which should be monitored once or twice a week during land clearing operations;
- Engage with communities in the landscape on the concession and sensitize them on the importance of the HCS forest identified for the good of people and environment. This could be done through development of trainings which should be periodic and cover various topics aligned with conservation and best management practices as well as the benefits for people and environment;
- Cooperate with communities to agree on allowable low-intensity collection of NTFPs in the HCS forest;
- The company should ban logging, hunting, fire in and around the identified HCS forest. This should be monitored through patrol at least once in a month;
- Existing or new roads leading to the HCS forest should be close or have restricted access to prevent illegal activities such as logging, hunting, farming etc within the HCS forest;
- Establish a co-management committee to develop and monitor permitted community activities in HCS forest management areas;
- Conduct bi-annual monitoring of any changes in size of HCS forest management areas to show zero conversion of the identified HCS forest using remote sensing technics and tools or any appropriate scientific methods.

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1 Introduction

1.1 Purpose and scope of the assessment

In order to comply with the requirements of the RSPO Principles and Criteria (2018) Okomu Oil Palm Company (OOPC) has requested Proforest to carry out a High Carbon Stock (HCS) assessment using the High Carbon Stock Approach (HCSA)[1]. The main purpose of the HCSA is to identify viable areas of forest that should be conserved due to their value as carbon stores, for biodiversity conservation, and as areas for customary use. The broad objective of this assessment is to undertake a comprehensive and participatory assessment of HCS forests in the proposed development area (PDA) and immediate landscape. The specific objectives of the assessment are to:

- Identify and map HCS forests in the PDA.
- Identify existing or potential threats to the HCS areas.
- Provide recommendations for the management, monitoring and protection of the identified HCS forests in the area to ensure that production activities do not negatively impact HCS forest areas.

1.2 HCS overview and references and reports used and

In the HCSA toolkit v2 (Module 3), an integrated HCV-HCSA assessment, reviewed by the HCVRN ALS is required after November 2017. However, for organisations with valid HCV assessments (as in the case of Okomu), the HCSA allows standalone HCSA assessments for 'risk areas', which will be reviewed by the HCSA. There is currently no HCS national interpretation. Therefore, the process to identify HCS forests relied on the following guidance documents:

1. Rosoman, G., Sheun, S.S., Opal, C., Anderson, P., and Trapshah, R., editors, (2017) The HCS Approach Toolkit. Singapore: HCS Approach Steering Group.
2. Integrated HCV-HCSA assessment manual.

In addition to the above, the following reports have been referenced and relevant data and findings incorporated into this assessment report.

- HCV assessment report by Proforest
- ESIA report by Foremost Consultancy
- Draft NPP report by Proforest

[1] It should be noted that an HCV assessment has been completed for the PDA, summary results of which are presented in Section 5 of this report and a public summary available at https://hcvnetwork.org/reports/okomus-extension-2-concession-ovia-nw-and-ohunmwode-local-got-area-edo-state-nigeria-okomu-oil-palm-co-plc/.

1.3 Overview of the proposed plantation development

The PDA is located in the de-reserved areas of Owan North Forest Reserve (ONFR) located in the Edo State of Nigeria at roughly 50 km from Benin City, the capital of the State. It covers an area of about 500 ha within the Eastern part of the Okomu Extension II concession for which an HCV assessment was conducted by Proforest in 2016 and approved by the High Conservation Value Resource Network (HCVRN). The area is largely degraded and dominated by industrial and non-industrial agricultural land in patches of natural vegetation mainly fallow and forest.

1.4 Site description

The PDA is located in the de-reserved areas of Owan North Forest Reserve (ONFR) which as a result of severe degradation is dominated by scrub and agricultural or open land. Figure 1 below shows the location of the PDA.

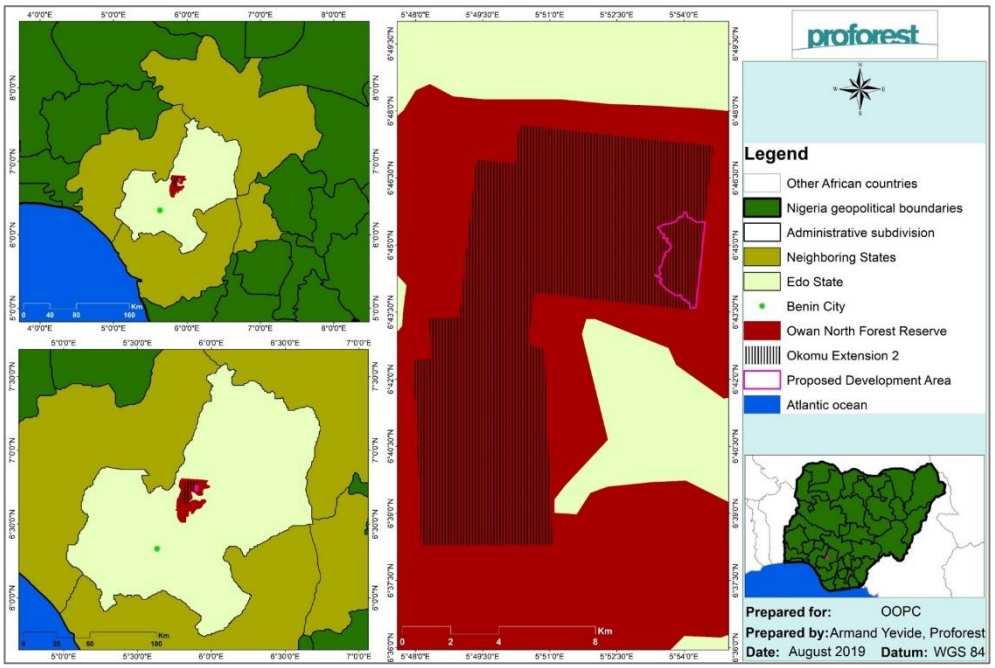

Figure 1: Location of the proposed development area

2 Assessment team and timeline

2.1 Assessment team members and qualifications

The current HCS assessment team members comprise a team of experts from Proforest and local consultants. Table 1 below provides a summary of the roles and expertise of team members.

Table 1: List of the assessment team members

Name	Organisation	Role	Expertise
Dr. S. I. Armand Yevide	Proforest	Team Leader and GIS expert	Forest ecology, GIS, conservation, carbon stock assessment.
Aristotle Boaitey	Proforest	Team member	GIS, natural resources management, community consultation, participatory mapping
Dr. Augustus Asamoah	Proforest	Team member	Ecology, environmental management, wildlife and range management
Dr. Adesoji Akinwumi Adeyemi	University of Ilorin	Local consultant	Forest Inventory, biometrics, remote sensing
Nana Darko Cobbina	Proforest	Team member	Natural resources management, social forestry
Abraham Baffoe	Proforest	Team member	Conservation, ecology, ecosystem services, NRM

2.2 Assessment timeline

The assessment process commenced in February 2019 with proposal request and submission to the OOPC as well as initial engagement. After acceptance of the proposal, engagement with local consultant and preparation of the assessment started. The field study for the HCS assessment commenced on 12nd to 18th May 2019. Data screening commenced immediately after data reception and the analysis and drafting of the report followed. Table 2 below presents a timeline of the HCS assessment.

Table 2: Timeline of the assessment.

Process Steps	Main activities	Timeline							
		FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Pre-assessment	Desk study: Information exchange, Gathering and review of data.								

	Engagement with local consultant								
	Remote sensing data acquisition and initial land cover classification								
Field assessment	Forest inventory and ground truthing data collection								
Data processing and report drafting	Analysis of field data and drafting of report								
Finalisation of report	Finalisation and submission of report								

3 Summary of impact assessments

The social and environmental impact assessments were conducted by Foremost Development Services of Nigeria. The social impact assessment was concluded in December 2015 and the EIA was concluded with interim approval from Federal Ministry of Environment on 22nd September 2015.

The methodology adopted for the socioeconomic study involved triangulation of various sources of data with the use of tools relevant to Participatory Rural Appraisal (PRA) and Socio-Economic Assessment. The steps undertaken to realize the outcomes of the SIA included:

- Scoping: According to the report, this process involved identifying, defining and prioritizing the social components to be addressed during the social impact assessment. The impacts of the proposed Extension II operation were assessed in terms of the following impact criteria:
    - *Scale*: Physical scale/areas which the impact would be felt (local or regional).
    - *Duration*: Length of time the impact would likely be felt (short term, medium term and long term).
    - *Severity*: The intensity of the impact.
    - *Direction*: Whether the impact would be positive (beneficial) or negative (adverse)

The SIA report further states that socio-economic survey and extensive consultative meetings were had with all surrounding communities that could potentially be impacted by the OOPC oil palm plantation development activities were made during the social impact assessment. The stated objectives of these survey and consultative meetings were to provide information about the project to the local people, collect basic socio-economic information about the communities and to identify with the local people potential social impacts of the proposed project. The various community groups (as per their communal governance structures) were represented at these meetings as evidenced in the report. As stated in the report, structured checklists were used to obtain data from internal and external stakeholders such as CBOs and NGOS, and the feedback and concerns raised, incorporated into the final ESIA report.

3.1 Social Impact Assessment

Some of the potential positive socio-economic impacts identified by the SIA of OOPC's extension II concession include creation of employment, introduction of high yielding varieties of oil palm and sustainable management of palm plantation practices, training and capacity building for employees and smallholders revenue to local communities through royalties payment to landlord communities, tax revenue for the Edo state government and commercial opportunities for small and medium scale enterprises including petty trading.

Potential negative impacts identified included loss of farmlands, community conservation and forest product collection areas, food insecurity and increased prices of food products, influx of plantation workers and resultant impacts on social structures, increased exposure to health risks (e.g. HIV), adulteration or destruction of indigenous cultural values.

Suggested measures to mitigate the potential social impacts include proper community engagement, Implementation of FPIC, avoidance of displacement of communities and people, ensuring proper participatory disengagement and payment of compensation to farmers using the land, Prevention of pollution of water resources and corporate social services to communities and diligent implementation of social impact management plan.

3.2 Environmental Impact Assessment

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

The assessment envisaged that land-based traffic would increase as a result of the proposed project especially for transportation of workers and FFB collection from the field to be processed at the mill. Other potential environmental impacts identified were water pollution due to agro-chemical application, sewage from workers camps and pollution from hazardous substances.

Management and mitigation measures proposed for to address the significant potential social and environmental impacts in order to make the proposed Extension II project socially acceptable and beneficial were:

- Implementation of FPIC
- Development and implementation of community engagement plan
- Avoidance of displacement of communities and people.
- Identification, demarcation and appropriate management of traditional conservation areas and other high conservation values in the landscape.
- Prevention of pollution of water resources.
- Ensuring proper participatory disengagement and payment of compensation to farmers using the land.
- Fire prevention programs and zero or controlled burning.
- Corporate social services to communities.
- Provision of healthcare services and HIV prevention.
- Diligent implementation of social impact management plan

The assessment further suggested buffer zones (50- 150m) between planting areas and water bodies as a strategy for the protection and maintenance of riparian buffers/forests.

4 Community engagement / FPIC

4.1 Company-led FPIC

The company-led FPIC was carried out by a team comprising the Managing Director, Agriculture Coordinator, HSE Manager, Community Liaison Officer and Communication Manager. The process was initiated in 2014 and tentatively concluded with the signing of the FPIC agreement on 29th July 2016. The process proceeded in the following overlapping stages:

- Initial consultations and engagement with community stakeholders, involving consultations with all ten affected communities including Ekpan, Oke, Umokpe, Irhue and Orhua (to the east of the concession) and Agbanikaka, Owan, Uhiere, Odigwetwe and Odighi (to the west).
- Sensitization and information provision, including information on communities' legal and customary rights, the legal implications of the proposed project, assessment of costs, benefits and fair distribution and benefit-sharing among others.
- Community-appointed representative (organisations), including Community Development Association, Elders Council, Youth Association, Market Women's Association.
- Participatory mapping, involving community representatives and company surveyors to delineate the boundaries and identify areas of possible boundary overlaps between project and community land. While no boundary issues were raised, the process revealed that two communities (Umokpe and Orhua) are about 10 km away from the boundary. Both communities eventually withdrew from the process due to a lack of interest.
- Provision of legal representation, in the person of F.A. Osifo & Co. (Solicitors), a member of one of the communities, but endorsed by all the other communities as their legal representative. He subsequently participated in all iterative meetings and further negotiations and drafted the FPIC agreement in consultation with the communities and the company's legal representative.
- Iterative meetings
- Engagement and negotiations, with documentation of the process and outcomes.
- Deliberations on compensation, with the understanding that no further compensation will be paid in addition to what was previously paid by A. Hatman (the previous rightsholders of the land).
- Documentation of consent-based agreements
- Signing of consent-based agreements, in a public ceremony well attended by community leaders and government representatives.
- Formation of Joint Implementation Committee (JIC)

- Definition of grievance and dispute resolution as established in the FPIC agreement.

NB: Detailed report of the company-led FPIC process and a summary

4.2 Description of community engagement, participatory mapping activities carried out during assessment

During the HCS assessment for the proposed area to be developed in OOPC's extension II concession, engagements were conducted for three communities closest to the operation and most likely to be impacted by activities within the concession. The communities consulted during the HCS assessment were Oke, Ekpan and Umokpe. The engagements were in the form of meetings with some members of the communities. These are in addition to in-depth extensive and in-depth consultations conducted during the full HCV assessment in 2016. Also, socio-economic surveys and extensive consultative meetings were conducted in 2014 by Foremost with communities around the project area that could be potentially impacted by development activities of OOPC, as part of the social impact assessment.

4.3 Food Security

All communities engaged indicated that the acquisition of the extension II area by OOPC had reduced the land available for locals, especially for farming. Although they indicated that there was still some land available for community use, it was added that further acquisition of land from OOPC in those areas would put pressure on local food sources, as there may not be enough land for food crop farming. The Ekpan community also remarked that they had seen a rise in emigration of locals from the community, a situation they attributed to the reduced availability of farmland.

4.4 Community engagement - summary of key outputs/findings

Participatory mapping was conducted during the full HCV assessment in 2016, to identify community use areas and areas of cultural or spiritual importance to them. Communities engaged during the HCS assessment were selected based on list of communities shared by OOPC and review of Google Earth satellite imagery. In each community, a map showing the boundaries of extension II and the proposed development were presented to community members present. This was used as a guide to the discussion. All 3 communities indicated that Okomu had signed FPIC agreements with them, including some projects to be undertaken for each community. Copies of the agreements were however not available during these meetings. The table below presents the main findings from the community engagements.

Table 3 Summary of outputs of community engagement

Date	Community	Key issues	Assessment team's response
15 May 219	**Oke**	The community indicated that there were ongoing logging activities within the proposed development area of extension II. They indicated that this was being done by some locals because they believed that land taken from them by OOPC was not being used yet.	The team indicated that logging within the area was not permitted as it would negatively impact conservation areas and potential HCS.
15 May 219	**Ekpan**	The Ekpan community similarly indicated that logging was actively being done within the extension II, especially swampy areas with bigger trees. They however added that they assumed that people engaged had the requisite legal permits.	The team indicated that logging within the area was not permitted as it would negatively impact conservation areas and potential HCS.
15 May 219	**Umokpe**	The Umokpe community indicated that the extension II boundaries were well known and demarcated with no signs of encroachment. They however added that Okomu should not try to acquire any more of their land as this would further reduce available land for food crop farming with potential food security issues.	No comment.
		The Umokpe community indicated that they had a shrine within the extension II area, although this was not indicated during the HCV assessment in 2015. They indicated that this was discussed with some management representatives of OOPC, but they later found that the area had been planted without being given the opportunity to transfer it.	The issue was noted and followed up with OOPC management who indicated they would engage Umokpe community to address it.

5 HCV assessment summary

The HCV assessment for OOPC's extension II concession was conducted by Proforest. The assessment was conducted over an 11,416-ha concession located in BC 12 of the de-reserved areas of Owan North Forest Reserve (ONFR) located in the Edo State of Nigeria (3). The HCV-assessed area covered the proposed area for development under the scope of this HCS assessment

The assessment was conducted in 2015 and submitted to the HCV resource network to undergo quality panel review. The assessment was approved as Satisfactory on 25 April 2016, after which a summary was made publicly available via the HCVRN website. The reference documents used to interpret and identify HCVs during the HCV assessment were the HCV National Interpretation (NI) available for Ghana (Rayden, T. et al, 2006) and Gabon (Steward, C, and Rayden, T., 2008).

Participatory mapping was conducted during the HCV assessment in neighbouring communities to help understand and to map out sites and areas with resources of critical traditional and economic importance to the local people. The first part of the participatory mapping was general community meetings where maps of the landscape showing the location of the communities and the boundaries of the concession were presented for the people to identify areas of critical importance to them. The second phase involved the GPS mapping of those areas of critical importance.

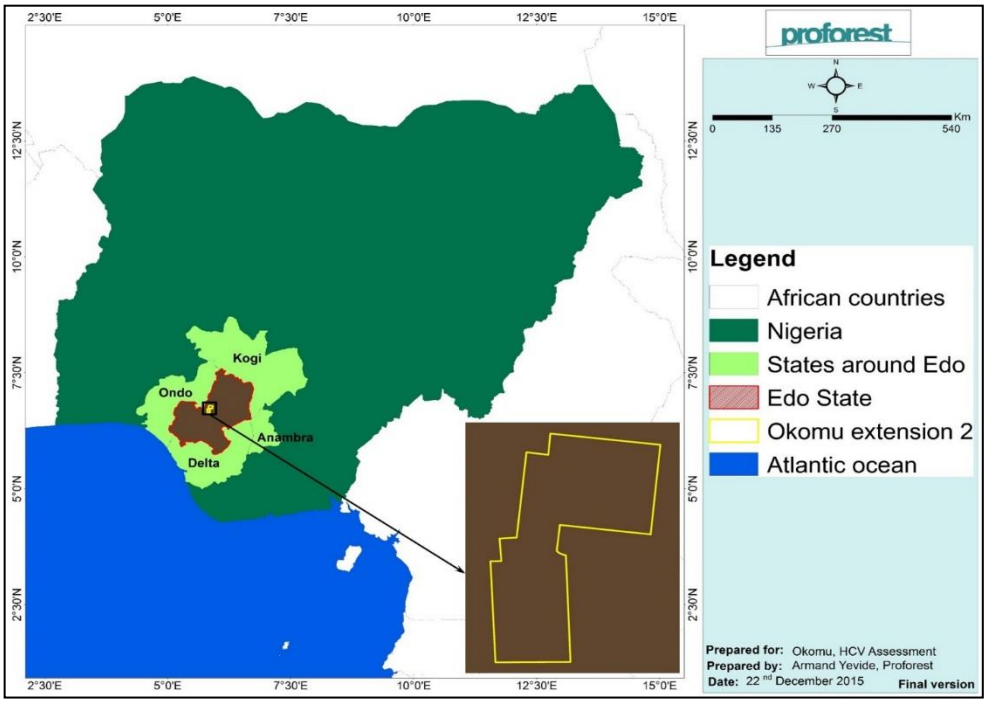

Figure 2 Scope of HCV assessment

5.1 Summary of HCVs present and link to public summary report

The HCV categories found to be present in the extension II concession were HCV 3, HCV 4, HCV 5 and HCV 6. The HCV 3 areas were identified as 2 swamp areas covering a total of 10.1 ha. The first is a permanently wet forest with a total area of 7.1 ha in the southern part of the concession. The second is another wet forest in the northern part covering 3 ha which also contained the only remaining undisturbed forest. The HCV 4 area was identified as all rivers and streams including seasonal ones located in the concession. HCV 5 areas identified included the Jemide River as an important source of protein for the Agbanikaka community as well as 2 pockets of forest (one covering 24 ha near the management quarters and another covering 729 ha to the north-east of the concession). HCV 6 areas included three spiritual or sacred sites (Survival tree for the people of Uhiere, the Odighi for the people of Odigwetue and Odighinoba for the people of Odighi).

The summary of HCVs present in extension II is presented in 4 and 4 below.

Table 4 Summary of HCVs identified in OOPC extension II concession

HCV	Definition	Present	Potentially present	Absent	Approximate area (ha)
1	**Species diversity.** Concentrations of biological diversity including endemic species, and rare, threatened or endangered (RTE) species that are significant at global, regional or national levels.				
2	**Landscape-level ecosystems and mosaics.** Large landscape-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.				
3	**Ecosystems and habitats.** Rare, threatened, or endangered ecosystems, habitats or refugia.				**10.1**
4	**Ecosystem services.** Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes.				**321**
5	**Community needs.** Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for livelihoods, health, nutrition, water, etc...), identified through engagement with these communities or indigenous peoples.				**753**
6	**Cultural values**. 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.				**0.4**

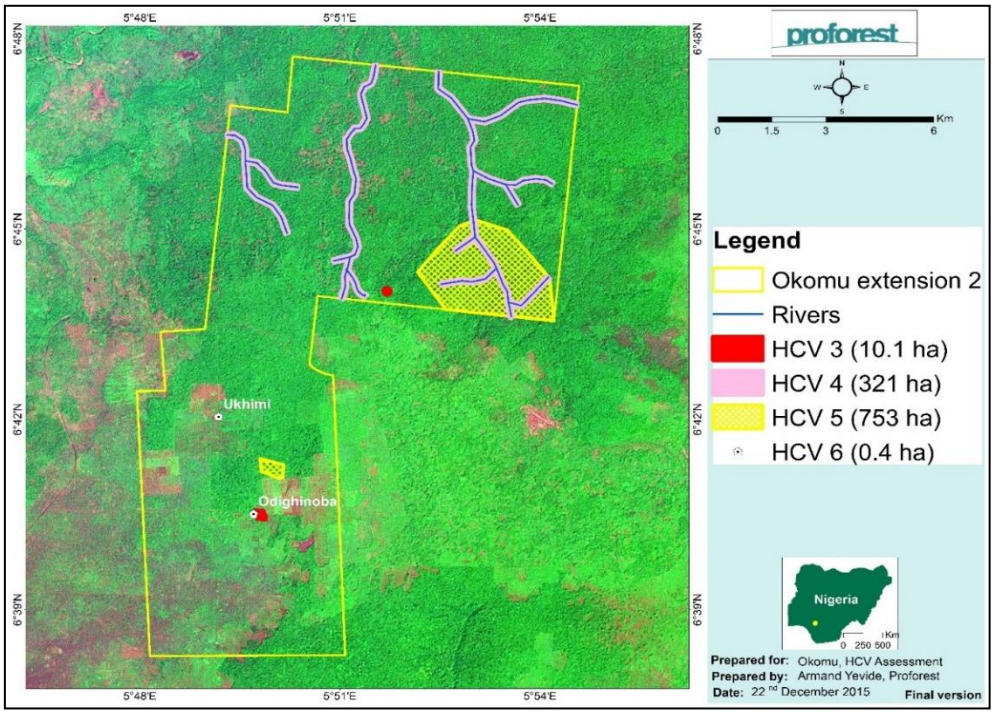

Figure 3 Location of identified HCVs and their management areas

The public summary of the HCV assessment for OOPC's extension II concession is available via https://hcvnetwork.org/reports/okomus-extension-2-concession-ovia-nw-and-ohunmwode-local-got-area-edo-state-nigeria-okomu-oil-palm-co-plc/.

6 Land cover analysis

6.1 Delineation of the Area of Interest (AoI)

Since the PDA which represents the core of the Area of Interest (AoI) is inland without any natural boundaries such as water bodies, or cliff lines, the AoI used for the land cover analysis and for the HCS study was obtained by creating a 5 km buffer zone around the 500 ha of the PDA and converting the obtained buffer into an envelope feature with ArcGIS version 10.3. The 5 km distance was used to comply with HCSA requirement on AoI delineation. Though the PDA convers only 500 ha and the buffered area is 13,422.9 ha, the final size of the used AoI is 17,045.2 ha. The figure below presents the PDA, its 5 km buffer and the AoI.

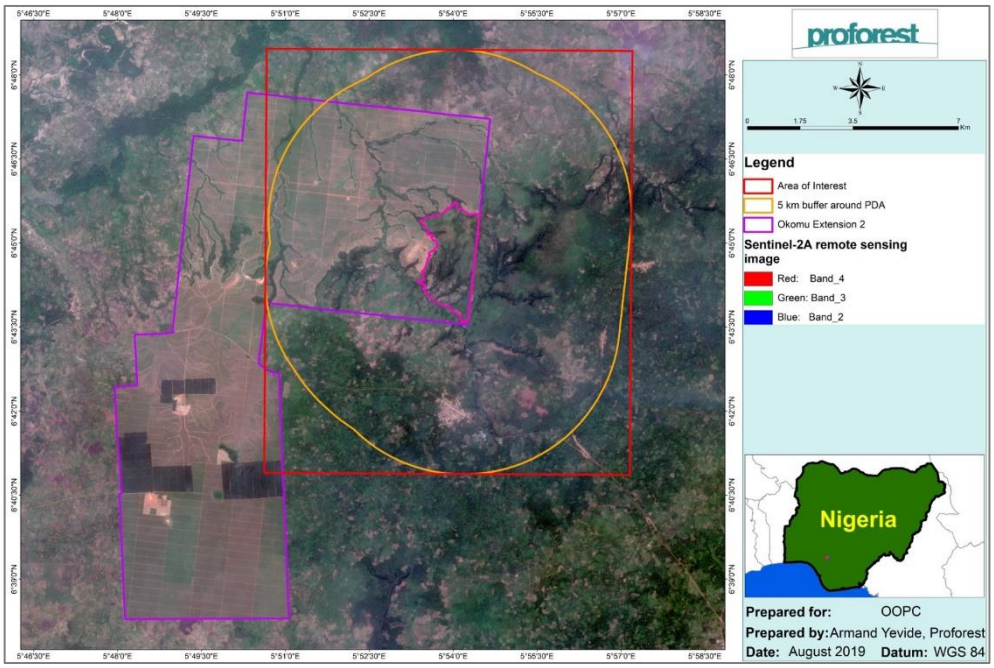

Figure 4: Map showing the PDA in Okomu Extension 2 concession with the AoI.

NB: The Sentinel-2A image is a 10 metres resolution satellite image acquired from the EarthExplorer webpage of the United States Geological Survey (USGS) (http://earthexplorer.usgs.gov/) for the year 2018 (Scene Identifier: L1C_T31NHH_A018380_20181229T100433 acquired on the 29th December 2018).

6.2 Remote sensing image acquisition and characteristics

The methodology in the workflow of the Option 3 was used to carry out the High Carbon Stock assessment. This option was chosen given the challenges of getting LiDAR data for the proposed PDA area.

To carry out the initial land use and land cover classification, a 0.01% Sentinel-2A remote sensing product which was less than a six months old was downloaded from the United States Geological Survey (USGS) which provides through its Earth Explorer website (http://earthexplorer.usgs.gov/) several remote sensing that exist in various types and for various dates. Though various products are available on that platform, Sentinel 2 was chosen because it provides a multispectral data with 13 bands in the visible, near infrared, and short-wave infrared part of the spectrum with spatial resolution of 10 m, 20 m and 60 m. Various band combination based on the 10 m spatial resolution bands 2, 3, 4, and 8 were used and the true colour image based on the combination of the bands 432 was finally used to perform the vegetation classification.

Table 5: Detailed characteristics of the remote sensing products used.

ID	**L1C_T31NHH_A018380_20181229T100433**
Acquisition date	29-DEC-2018
Tile Number	T31NHH
Cloud Cover	0.0107%
Platform	SENTINEL-2A

Processing Level	LEVEL-1C
Datum/Projection	WGS84/UTM 31N

6.3 Land cover classification methodology

To perform the land cover classification of the AoI, a segmentation of the satellite image was done using the segment mean shift function in AcrGIS version 10.3 with 19.5, 15, and 4 as spectral detail, spatial detail, and minimum segment size in pixel respectively. The default value of the spatial detail was maintained while the spectral detail and minimum segment size in pixel were set to ensure a more precise segmentation of the land cover features on the Sentinel-2A image. The expected minimum size of patches is 400 m^2 (0.04 ha) though 20 times smaller than the standard size of forest according to the FAO forest definition which is 0.5 ha. The output raster of the segmentation was submitted to an unsupervised classification followed by a reclassification into 32 classes of the unsupervised classification output. Each of the 32 classes were assigned one of the HCS and non-HCS land cover classes in the table below that presents the description of the land cover classes used and their correspondence to the HCS classes.

Table 6: Description of the land cover classes used.

Land cover classes used	Description	HCS and non-HCS classes
High Density Forest (HDF)	Remnant forest or advanced secondary forest.	High Density Forest
Medium Density Forest (MDF)	Remnant forest that is more disturbed than the HDF.	Medium Density Forest
Low Density Forest (LDF)	Remnant forest-like highly disturb and recovering.	Low Density Forest
Young Regenerating Forest (YRF)	Mostly young re-growth forest, but with occasional patches of older forest within the stratum.	Young Regenerating Forest
Scrubland (SCR)	Vegetated land with some woody regrowth and shrub. This might include some relatively old fallow.	Scrub
Oil Palm Plantation (OPP)	Cultivated oil palm relatively old.	Scrub
Open Land (OL)	Cleared or grassland as well as buildup or urban area. This also includes newly planted oil palm.	Cleared / Open Land

6.4 Land cover outputs

The land cover classification of the AoI revealed that the PDA is in a medium forest landscape as the total forest cover represent about 52% of the AoI. The land cover is dominated by scrubland which represents about 25% of the AoI. The PDA has about 47.2% of forest cover and 16.2% of Young Regenerating Forest

(Figure 6). However, apart from forest, the dominant land cover is scrubland with 33.2% of the PDA. The scrubland in the area could qualify as fallow as they are mainly areas abandoned after harvesting or after years of farming to restore soil fertility.

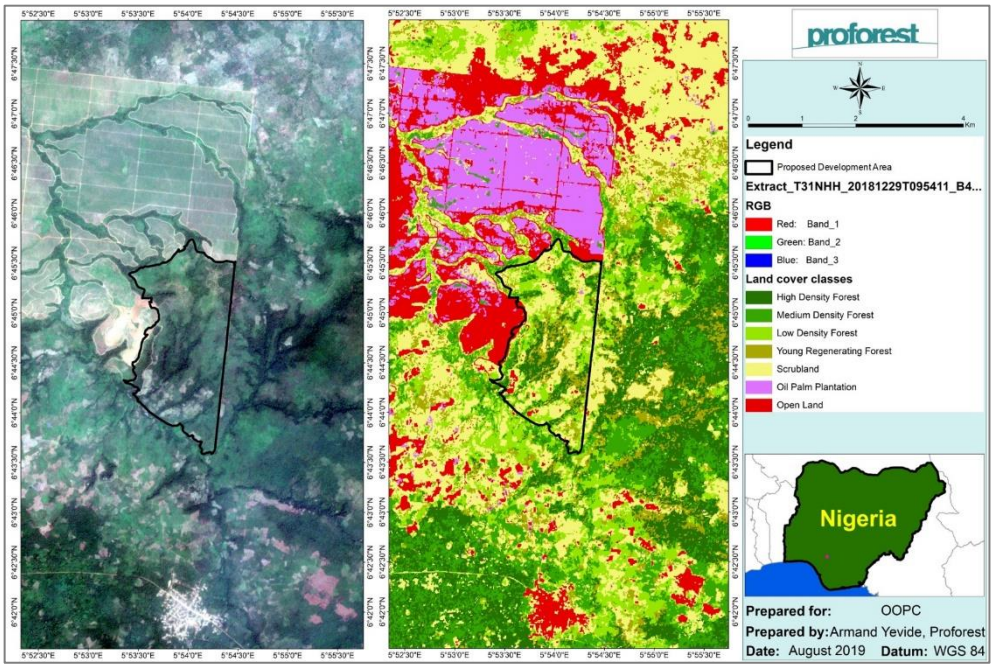

Figure 5: Map showing the result of the initial land cover classification.

NB: The Sentinel-2A image is a 10 metres resolution satellite image acquired from the EarthExplorer webpage of the United States Geological Survey (USGS) (http://earthexplorer.usgs.gov/) for the year 2018 (Scene Identifier: L1C_T31NHH_A018380_20181229T100433 acquired on the 29th December 2018).

Table 7: Size and proportion of HCS and non-HCS classes within the PDA.

Land cover classes	Number of Hectares			% of total concession
	Mineral	Peat	Total	
HCS classes:				
High Density Forest	78.9	0	78.9	15.8
Medium Density Forest	38.5	0	38.5	7.7
Low Density Forest	118.2	0	118.2	23.7
Young Regenerating Forest	80.8	0	80.8	16.2
Sub-total	316.4	0	316.4	63.3
Non-HCS classes:				
Scrubland	165.8	0	165.8	33.2
Oil Palm Plantation	0.7	0	0.7	0.1
Open Land	16.6	0	16.6	3.3
Sub-total	183.2	0	183.2	36.7
TOTAL	499.5	0	499.5	100.0

6.5 Land cover classification accuracy assessment

An independent sample of 350 pixels were randomly selected including a minimum of 50 for each land use and land cover classes to assess the classification accuracy. Google Earth imagery was used to create the independent sample for the accuracy assessment. Error matrices as cross-tabulations of the mapped class vs. the reference class were used to assess the accuracy. Overall accuracy, user's and producer's accuracies, and the Kappa coefficient were then derived from the error matrices. The Kappa coefficient incorporates the off-diagonal elements of the error matrices (i.e., classification errors) and represents agreement obtained after removing the proportion of agreement that could be expected to occur by chance. The overall accuracy was 82.6%.

7 Forest inventory

7.1 Sampling and data collection methodology

The inventory was carried out from 12nd to 18th May 2019. The sampling methodology was developed based on the preliminary or initial land cover classification conducted to ensure adequate sampling effort in each of the main vegetation types within the AoI. In the absence of data to use in the sample size estimation formula, an approximately 1.05% sampling rate was used to determine the sample size in hectare and later converted into number of plots. Plots were randomly distributed within the land cover classes with the aim of more intensive sampling of the forest and scrub classes as the other land cover classes are less important in the HCSA. Though plots were distributed randomly, it was kept a minimum distance of 85 m between plots to ensure independence of sample plots (Figure 7).

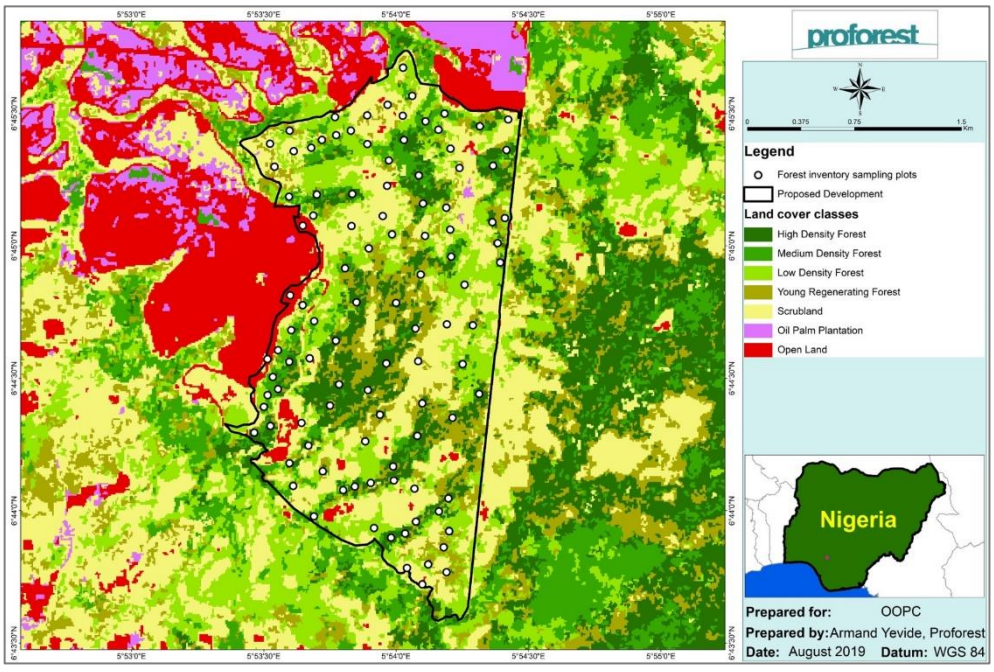

Figure 6: Distribution of the forest inventory plots overlaid with the initial land cover.

The geographical coordinates of the plots (centre of the plots) were extracted and loaded into a GPS Garmin used to navigate to each of the plots. Circular plots of 12.61 m radius (main plots) and 5.64 m radius (sub plots) were laid for the survey of trees beyond 10 cm diameter at breast height (dbh) and for trees above 5 cm dbh respectively (Figure 8).

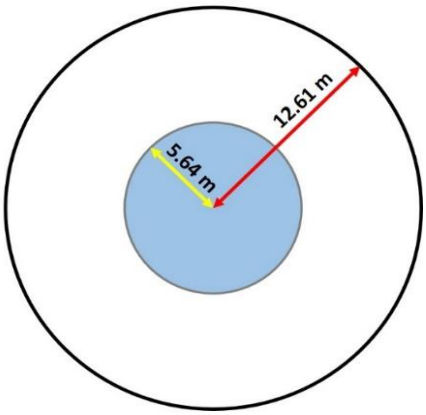

Figure 7: Botanical survey distribution plots and characteristics.

Data collected from the plots included the name of the species, diameter at breast height, and the height as well as any useful observation on the individual tree (whether it was diseased, fruiting, etc.). The diameter was measured with a diameter tape and the height of each individual tree was estimated visually. Each main plot was assigned to one of the land cover classes. Additional information on the land cover types were also collected. When applicable, the pictures of the land cover were taken towards the North, East, South, and West as well as the canopy cover.

Due to accessibility challenges some of the plots were not assessed and other replaced in order to ensure adequate coverage of the land cover classes. Over the expected 105 plots to assess, 100 were surveyed including 7 replaced.

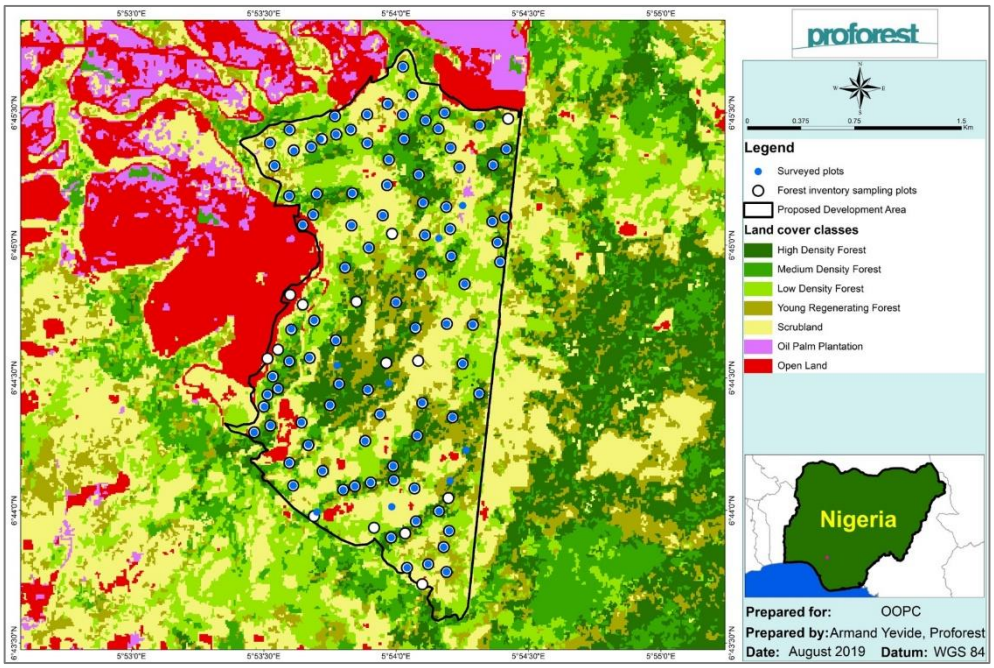

Figure 8: Distribution of the sampling plot and surveyed plots overlaid with the initial land cover.

7.2 Biomass and carbon estimation methodology

There are several approaches developed and used to estimate the total above ground biomass of individual trees or of a given ecosystem. The non-destructive approach (used in this assessment) based on field data collected on living trees and models already built to estimate the biomass they contain is an advancement on the destructive approach which consists in felling trees.

Numerous models have been developed over the course of the years. Some of them are solely diameter-based allometric models while others are diameter and height-based models.

For the current carbon stock estimation, the above ground biomass was estimated using the latest improved allometric model of Chave *et al*. (2014) which uses tree height, stem diameter and wood density as covariates. To deduce carbon content from the biomass, we used the assumption that carbon concentration is about half (47.5%) of the biomass (Whittaker & Likens, 1973; Brown, 1997; Losi *et al*., 2003; Nasi *et al*., 2009). The biomass was estimated for each individual tree (including all stems for multi-stemmed trees) using the equation below:

$$AGB = 0.0673 \times \left(\rho D^2 H\right)^{0.976}$$

Where ***AGB*** is aboveground dry biomass (in kg); ***ρ*** is wood density (in g/cm^3) ***D*** is diameter at breast height (in cm) and ***H*** is the height (in m).

The underground or belowground biomass (BGB) was deduced using the assumption that, for each individual tree, the belowground biomass represents

20.5% of the aboveground biomass (Mokany *et al*., 2006). Therefore, the total biomass was equal to 1.205 * AGB.

Wood density was compiled from the Global Wood Density Database (Chave *et al*., 2009; Zanne *et al*., 2009), and from the African Wood Density Database (Carsan *et al*., 2012). Of the 85-species recorded during the inventory; wood density was available for 51 species (60.0%). For the remaining species not reported in these databases, we used the mean wood density of the matching genus (22 species) or matching family (12 species).

7.3 Statistical analysis methodology

Statistical analyses were conducted to test for statistical differences in carbon stock between HCS land cover classes. After checking the normality and the homoscedasticity of the data, the ANOVA and Scheffe pairwise tests were conducted using SPSS software version 16.0.

7.4 Final land cover class description

After the field work conducted, vegetation ground truthing data collected by the assessment team were used to improve the initial land cover classification conducted prior to the assessment. The figure and table below present the final land cover classes distribution and description.

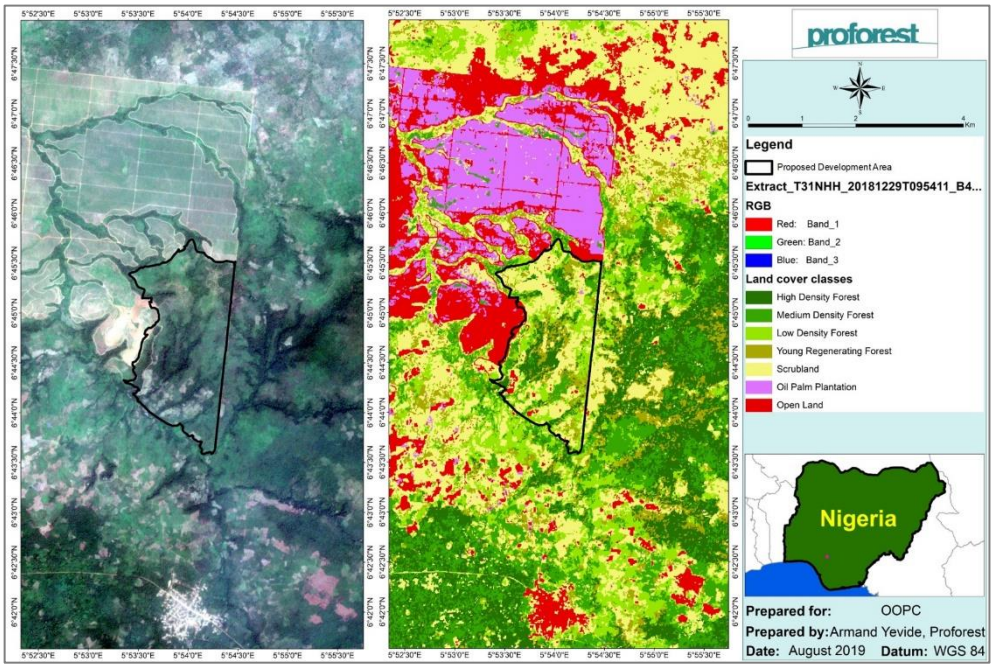

Figure 9: Map showing the result of the final land cover classification.

NB: The Sentinel-2A image is a 10 metres resolution satellite image acquired from the EarthExplorer webpage of the United States Geological Survey (USGS) (http://earthexplorer.usgs.gov/) for the year 2018 (Scene Identifier: L1C_T31NHH_A018380_20181229T100433 acquired on the 29th December 2018).

Table 8: Description of the land cover classes used.

Land cover classes used	Description	HCS and non-HCS classes
High Density Forest (HDF)	Remnant forest or advanced secondary forest. This vegetation type within the PDA is dominated by *Celtis zenkeri* and *Dialium guineense*. The density of tree species is 288 trees/ha.	High Density Forest
Medium Density Forest (MDF)	Remnant forest that is more disturbed than the HDF. This vegetation type within the PDA is dominated by *Dialium guineense* and *Musanga cecropioides*. The density of tree species is 222 trees/ha.	Medium Density Forest
Low Density Forest (LDF)	Remnant forest-like highly disturb and recovering. This vegetation type within the PDA is dominated by *Dialium guineense* and *Ricinodendron heudelotii*. The density of tree species is 157 trees/ha.	Low Density Forest
Young Regenerating Forest (YRF)	Mostly young re-growth forest, but with occasional patches of older forest within the stratum. This vegetation type within the PDA is dominated by *Trema orientalis* and *Musanga cecropioides*. The density of tree species is 120 trees/ha.	Young Regenerating Forest
Scrubland (SCR)	Vegetated land with some woody regrowth and shrub. This might include some relatively old fallow. This vegetation type within the PDA is dominated by *Trema orientalis* and *Vernonia amygdalina*. The density of tree species is 78 trees/ha.	Scrub
Oil Palm Plantation (OPP)	Cultivated oil palm relatively old.	Scrub
Open Land (OL)	Cleared or grassland as well as buildup or urban area. This also includes newly planted oil palm.	Cleared / Open Land

The outputs of the final land cover classification have revealed some reductions of forest area especially the high and the low-density forest against increment of the non-HCS classes areas (scrubland mainly). It was also noticed augmentation of the medium density and the young regenerating forest (Table 9).

Table 9: Size and proportion of HCS and non-HCS classes within the PDA.

Land cover classes	Total Number of Hectares		% of total concession	
	Initial	Final	Initial	Final
HCS classes:				
High Density Forest	78.9	63.8	15.8	12.8
Medium Density Forest	38.5	45.8	7.7	9.2
Low Density Forest	118.2	106.5	23.7	21.3
Young Regenerating Forest	80.8	81.8	16.2	16.4
Sub-total	316.4	297.9	63.3	59.6
Non-HCS classes:				
Scrubland	165.8	184.3	33.2	36.9
Oil Palm Plantation	0.7	0.7	0.1	0.1
Open Land	16.6	16.6	3.3	3.3
Sub-total	183.2	201.6	36.7	40.4
TOTAL	499.5	499.5	100.0	100.0

The pictures below present the appearance of the surveyed land cover classes during the forest inventory within the PDA.

Photo 1: Pictures showing the High Density Forest land cover.

NB: Top = North; Right = East; Bottom = South; Left = West; Centre = skywards

Photo 2: Pictures showing the Medium Density Forest land cover.

NB: Top = North; Right = East; Bottom = South; Left = West; Centre = skywards

Photo 3: Pictures showing the Low Density Forest land cover.

NB: Top = North; Right = East; Bottom = South; Left = West; Centre = skywards

Photo 4: Pictures showing the Young Regenerating Forest land cover.

NB: Top = North; Right = East; Bottom = South; Left = West; Centre = skywards

Photo 5: Pictures showing the Scrubland land cover.

NB: Top = North; Right = East; Bottom = South; Left = West; Centre = skywards

Photo 6: Pictures showing the Open Land cover.

NB: Top = North; Right = East; Bottom = South; Left = West; Centre = skywards

7.5 Carbon stock estimation results

The estimated carbon stock varies from 1.7 tC/ha for the Open Land to 82.9 tC/ha for the High-Density Forest. The estimated carbon stock for the Low-Density Forest and the Young Regenerating Forest were all less than 30 tC/ha. The total carbon stock estimated for the entire proposed concession was 12,657.3 tC.

Table 10: Area, carbon stock mean and confidence intervals for each land cover class.

Land cover class	Area (ha)	%	Number of plots	Average carbon stock (tC/ha)	Standard Error	Confidence limits (90%)		Total carbon stock (tC)
						Lower	Upper	
HDF	63.8	12.8	10	82.9	20.2	37.3	128.5	3796.8
MDF	45.8	9.2	29	47.7	8.3	30.8	64.6	5080.1
LDF	106.5	21.3	18	21.0	3.2	14.1	27.8	1717.8
YRF	81.8	16.4	11	10.6	1.8	6.5	14.7	1953.6
SCR	184.3	36.9	20	6.5	3.1	0.05	13.1	107.9
OL	16.6	3.3	4	1.7	0.6	-0.3	3.7	1.2
OPP	0.7	0.1	NA	NA	NA	NA	NA	NA

In order to appraise the existence of statistically significant difference between the carbon stock of the land cover classes, an ANOVA followed by the pairwise Scheffe test was conducted. The table 11 present the results of the ANOVA and show the existence of statistically significant difference between the carbon stock of the various land cover classes as the probability associated to the analysis was below 0.05. The Scheffe test has revealed that the High-Density Forest has the highest carbon stock which is significantly different from the carbon stock of the other land cover type except the carbon stock of the Medium Density Forest. However, the carbon stock of the Medium Density Forest was not significantly different from the other land cover classes. Therefore, the land cover could be classified into three groups as presented in the Table 12.

Table 11: Results of the ANOVA assessing for differences in carbon stock between the land cover classes.

	Sum of Squares	df	Mean Square	F	P-value
Land cover class	56800.387	5	11360.077	9.843	.000
Residual	99253.004	86	1154.105		
Total	156053.391	91			

Table 12: Results of Scheffe pairwise test for differences in carbon stock between land cover classes.

Pair Conversion	Mean diff	Lower	Upper	P-value
HDF - MDF	35.20397	-7.2320	77.6400	0.170
HDF - LDF	61.91167	16.2718	107.5515	**0.002**
HDF - YRF	72.30591	21.7451	122.8668	**0.001**
HDF - SC	76.35650	31.5391	121.1739	**0.000**
HDF - OL	81.20000	12.7403	149.6597	**0.010**
MDF - LDF	26.70770	-8.0151	61.4305	0.242
MDF - YRF	37.10194	-3.8746	78.0785	0.102
MDF - SC	41.15253	7.5180	74.7871	**0.007**
MDF - OL	45.99603	-15.7244	107.7165	0.276
LDF - YRF	10.39424	-33.8919	54.6804	0.986
LDF - SC	14.44483	-23.1512	52.0408	0.886
LDF - OL	19.28833	-44.6772	83.2539	0.957
YRF - SC	4.05059	-39.3875	47.4887	1.000
YRF - OL	8.89409	-58.6707	76.4589	0.999
SC - OL	4.84350	-58.5379	68.2249	1.000

Table 13: Grouping of the land cover classes based on the Scheffe pairwise comparison.

Land cover classes used	Average carbon stock (tC/ha)	Group
High Density Forest (HDF)	82.9	a
Medium Density Forest (MDF)	47.7	ab
Low Density Forest (LDF)	21.0	b
Young Regenerating Forest (YRF)	10.6	b
Scrubland (SCR)	6.5	b
Open Land (OL)	1.7	b
Oil Palm Plantation (OPP)	NA	

NB: The average carbon stock of the land cover classes with the same letters are not statistically different.

7.6 Forest inventory results

The table below presents some dendrometric characteristics of the land cover. Apart from the Open Land, the density of stems of the other land cover is always greater than the density of tree showing the presence trees with multiple stems. The density of the HDF is the highest (288 trees/ha) while the Open land recorded the lowest density (20 trees/ha). The HDF and the MDF have almost the same average diameter and height. However, there is more dispersion of tree diameter and height around the mean in the MDF than the other land cover classes.

Table 14: Average densities, diameter and height of the land cover classes.

LUL	Density		Diameter		Height	
	Tree	Stems	Average	SD	Average	SD
HDF	288	296	16.5	15.0	9.5	5.0
MDF	222	230	16.3	16.1	9.3	7.7
LDF	157	172	15.8	10.9	9.2	4.7
YRF	120	149	11.4	7.9	7.2	3.8
SC	77	89	8.4	10.3	5.3	2.9
OL	20	20	7.9	9.5	5.4	1.8
OP	NA	NA	NA	NA	NA	NA

8 Forest patch analysis

In the framework of the current assessment, no HCV assessment was included. Therefore, the following patch analysis was mainly based on the HCS forest patches of the final land cover classification. The figure 11 presents the distribution of the HCS forest within the AoI. A negative buffer of 100 m was used to group the HCS forest patches into High Priority Patch (core area > 100 ha); Medium Priority Patch (core area from 10 to 100 ha) and Low Priority Patch (core area < 10ha). In the AoI, one HPP, and one MPF as well as one LPP were found. The HPP covers more than 50% of the PDA and extended towards the South and the East of the AoI. A 200 m buffer was used to assess connectivity of the MPPs and LPPs to the HPP. It was found that the MPP and several LPPs were connected to the HPP. Given that part of the HPP overlap with the PDA, most of the LPPs

were connected to the HPP. However, 2 forest patches in the PDA were more than 200 m away from the HPP and as a result were not connected to the HPP.

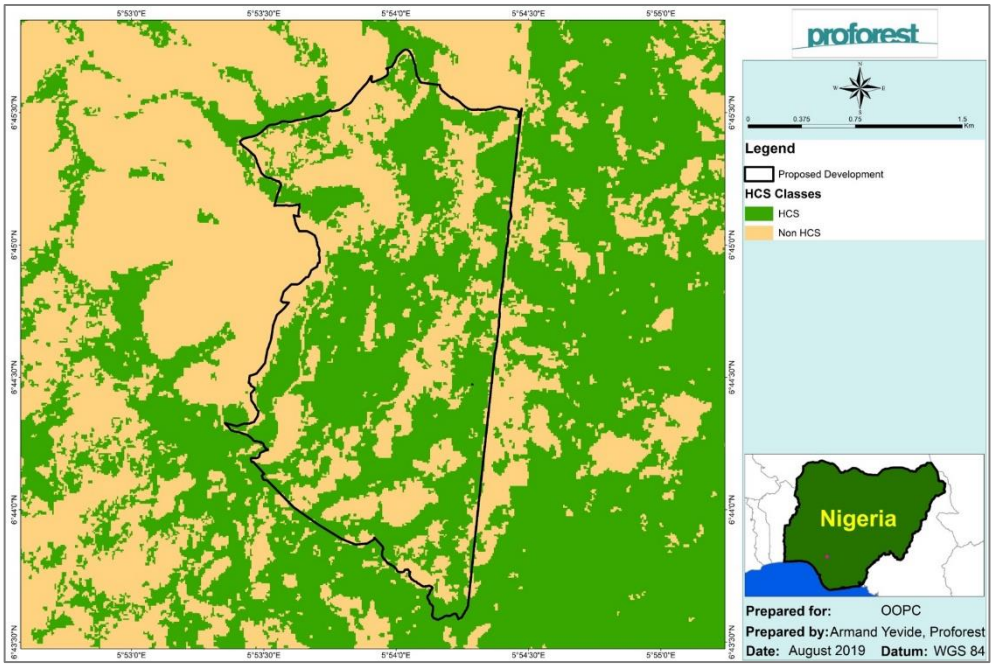

Figure 10: HCS classes merged.

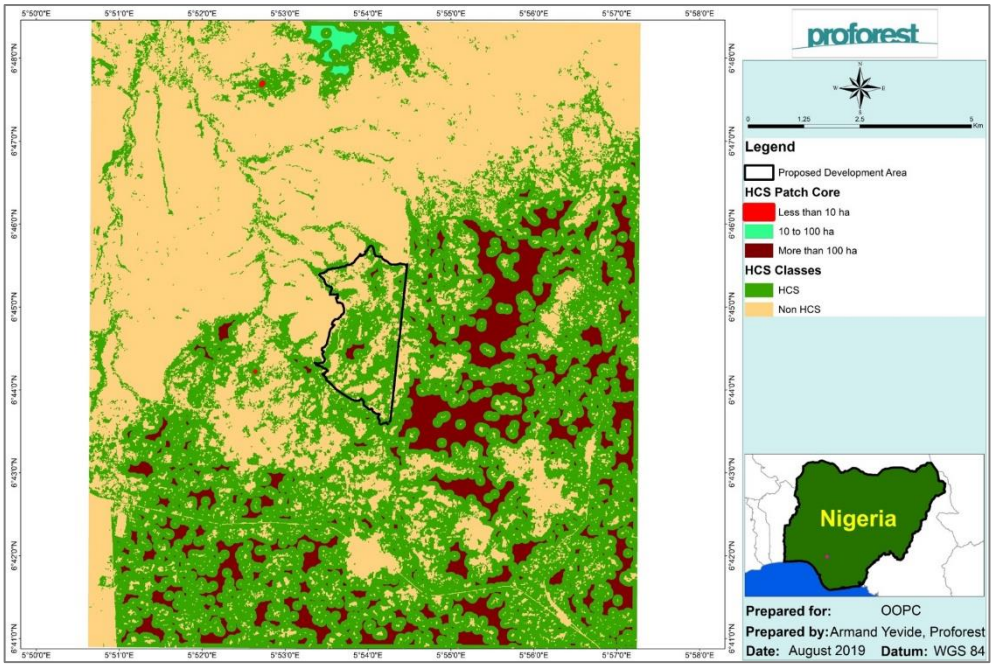

Figure 11: HCS classes and their core area.

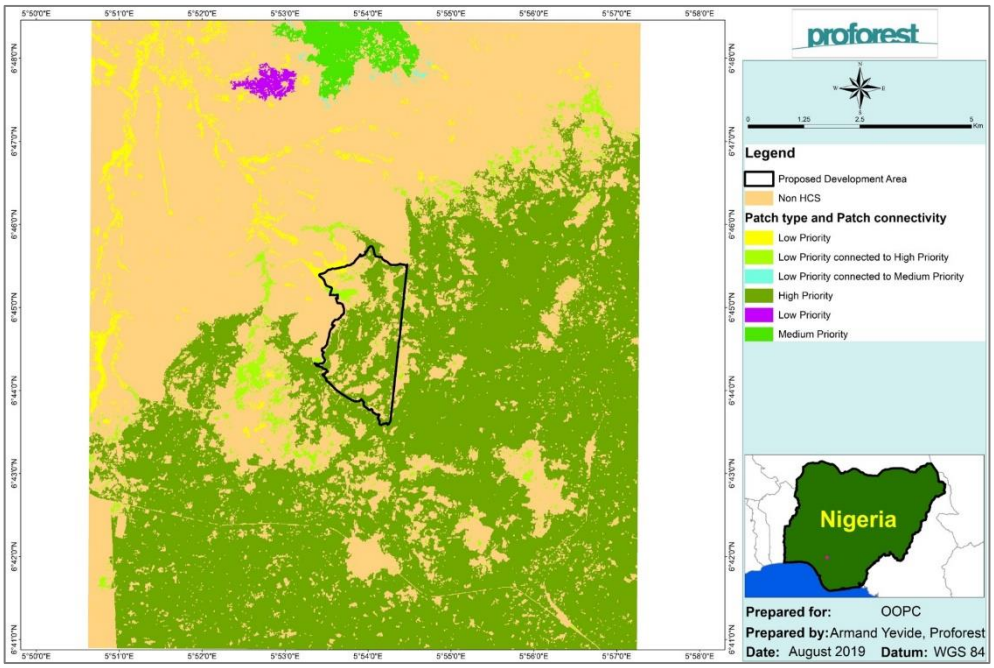

Figure 12: HCS patch type and connectivity.

Connectivity of LPPs and MPP to HPP, and the connectivity of LPPs to MPP as well as the importance of having contiguous conservation area were used to identify forest patches and non-forest patches that will be marked for conservation. The figure below presents the distribution of conservation area and the potential development area as well as the HCS patches taken for development.

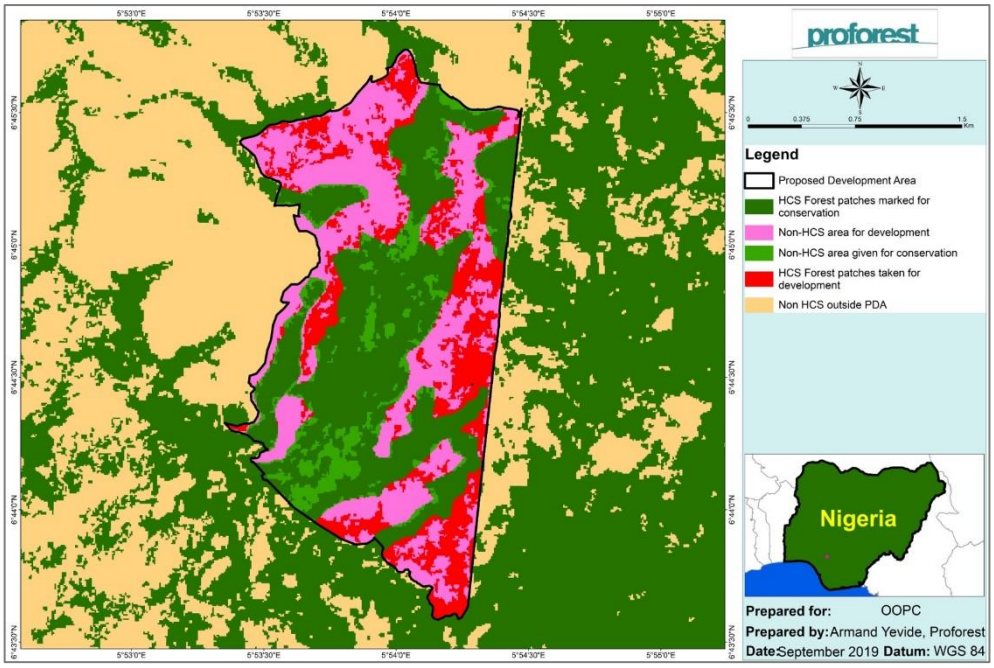

Figure 13: HCS marked for conservation and area to be developed.

The total area of the HCS patches was 297.7 ha while the non-HCS area appropriate for development was 201.8 ha. After the give and take process to ensure contiguous conservation area and practicability of development activities, 97.4 ha of HCS patches was taken for development and 45.1 ha of non-HCS patches was given for conservation to ensure linkages between area marked for conservation. Therefore, the total area marked for conservation was 254.5 ha which represent 49.1% of the PDA while the area for development was 253.9 ha (50.9%).

9 Management and Monitoring recommendations

In view of the results obtained from the assessment conducted, and given the presence of communities in the landscape of the concession, as well as the willingness of the company to develop oil palm plantation in the PDA, the following threats are likely to negatively affect the structure and functioning of the identified HCS forest management areas:

- Accidental clearance and planting of HCS forest by the company;
- Loss of biological diversity present in the HCS forest and disturbance of ecosystem services provided;
- Fragmentation by conversion of forest for plantations and agriculture or fire caused by hunters;
- Logging or timber harvesting as well as NTFPs collection for food, health and other needs;
- Displacement of logging from HCS forest inside concession to outside
- Improved access to HCS forest via improved roads;
- Disturbance during land preparation, road building etc.

Therefore, in order to mitigate or avoid negative impacts to the identified HCS forest management areas, the following management and monitoring measures are proposed:

- Demarcate clearly with signs the boundaries of the HCS forest management areas followed by periodic monitoring (once or twice a week) of the boundaries during the land clearing operation to avoid accidental HCS forest conversion;
- No burning during land preparation which should be monitored once or twice a week during land clearing operations;
- Engage with communities in the landscape on the concession and sensitize them on the importance of the HCS forest identified for the good of people and environment. This could be done through development of trainings which should be periodic and cover various topics aligned with conservation and best management practices as well as the benefits for people and environment;

- Cooperate with communities to agree on allowable low-intensity collection of NTFPs in the HCS forest;
- The company should ban logging, hunting, fire in and around the identified HCS forest. This should be monitored through patrol at least once in a month;
- Existing or new roads leading to the HCS forest should be close or have restricted access to prevent illegal activities such as logging, hunting, farming etc within the HCS forest;
- Establish a co-management committee to develop and monitor permitted community activities in HCS forest management areas;
- Conduct bi-annual monitoring of any changes in size of HCS forest management areas to show zero conversion of the identified HCS forest using remote sensing technics and tools or any appropriate scientific methods.

10 Annex 1: Community engagement supplemental information

10.1 Details of meetings held and findings

Below is a summary of the key outputs of the community engagements and participatory mapping conducted during the assessment in Oke, Ekpan and Umokpe communities.

Oke Community:

A member of the community indicated that per his knowledge of the demarcation of OOPC's boundaries had gone beyond the approved limits. He indicated the supposed area of encroachment on a map of the old Owan forest reserve. The assessment team however confirmed the correct boundary of the concession with original map attached to the Certificate of Occupancy.

The community indicated that an agreement had been signed with OOPC although a copy of the agreement was not readily available at the time of the assessment. They indicated some of the conditions of the agreement included employment opportunities, rehabilitation of a school, provision of electricity and a police post. Other issues raised were that the school rehabilitation was not completed and that the police post had been built in another community. They indicated that there was an increased in emigration from the area as the acquisition of the land by OOPC had reduced available land to farm for locals.

The issue of ongoing logging was also discussed with the community members. The community mentioned that some locals are actively engaged in the illegal logging activities in the undeveloped, forested areas of the proposed land with the excuse that the land had been taken from them and was not yet being used by OOPC. They admitted that most people in the community (about 90%) did not fully understand the need to conserve HCV areas as only a few were included in HCV training by OOPC. They suggested that OOPC should engage some community members as security to safeguard the concession, especially conservation areas.

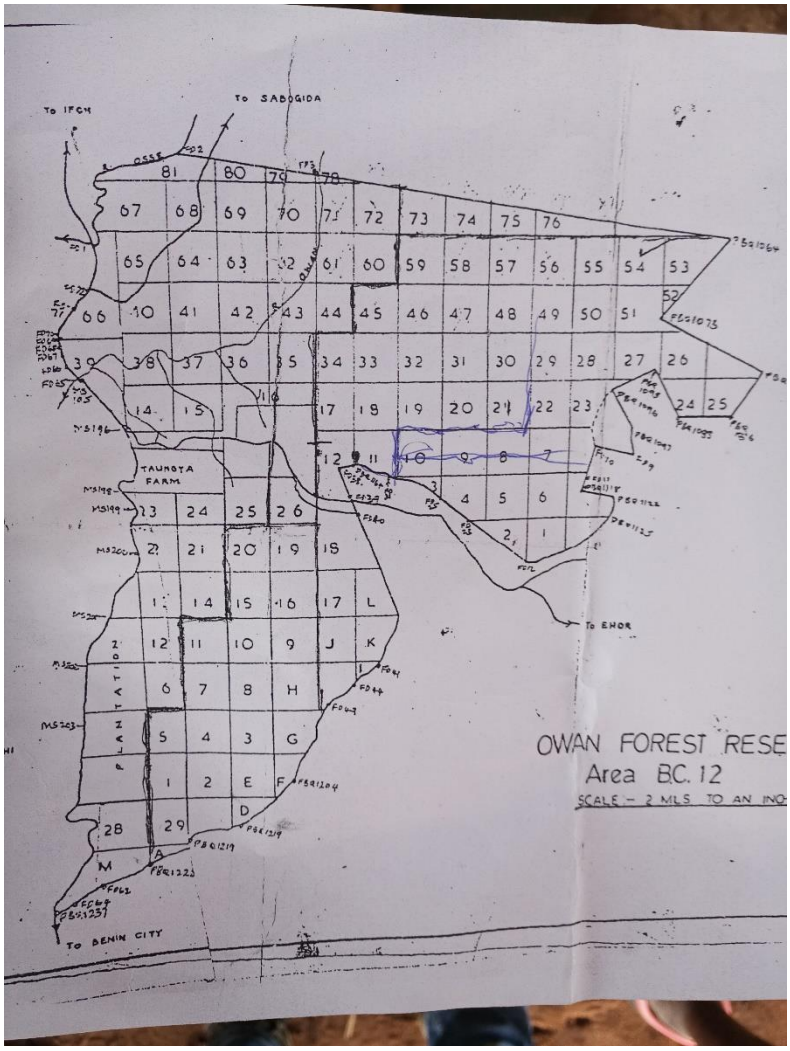

Figure 14 Map shared by Oke community member of Owan forest reserve and where his opinion of OOPC's boundary (in blue ink)

Ekpan community

The Ekpan community also indicated that they had signed an FPIC agreement with OOPC although the agreement was not at hand at the time of the community engagement. They indicated that OOPC had already supported the community with the provision of a borehole, road maintenance, construction of a copper's lodge, town hall and market. They indicated however that the coppers lodge

required maintenance as it was not in good condition. They also admitted that some community members were engaged in logging within the concession, although they said they believed they had legal permits to do so. They also indicated that OOPC had provided a notice board as a means of sharing information and sensitizing the community.

The community added that OOPC should not seek to acquire any more land from the Ekpan community since they had limited land remaining for their own farming and subsistence.

Umokpe community

The Umokpe community indicated that they had a shrine within the extension II area, although this was not indicated during the HCV assessment in 2015. They added that this was discussed with some management representatives of OOPC during a meeting in the community after the HCV assessment, but later found that the area had been planted without being given the opportunity to transfer it.

They indicated that the Umokpe community signed an FPIC agreement with OOPC, but the original copy sent for the Enogie's signature, and they had not yet received a copy afterwards. The community members named some of the agreed projects including renovation of palace, relocation of market, annual road maintenance. They however complained about inadequate employment opportunities from OOPC to members of the community. They added that the concession boundaries were clearly demarcated with no evidence of encroachment by OOPC.

10.2 Pictures of community consultations

Figure 16 Meeting with the Oke community

Figure 15 Meeting with Umokpe community

Figure 17 Notice board provided for Ekpan community by OOPC

Figure 18 Meeting with the Oke community

11 Annex 2: Land cover and forest inventory supplemental information

11.1 Classification accuracy table

Land cover classes	HDF	LDF	MDF	OL	OPP	SCR	YRF	Total	User accuracy
HDF	35		10			2	3	50	70.0%

LDF	3	39	1			2	5	50	78.0%
MDF	4	2	40				4	50	80.0%
OL				50				50	100.0%
OPP		1			49			50	98.0%
SCR				1		46	3	50	92.0%
YRF	9	3	6			2	30	50	60.0%
Total	51	45	57	51	49	52	45	350	
Producer accuracy	68.6%	86.7%	70.2%	98.0%	100.0%	88.5%	66.7%		82.6%

11.2 Plots table details

Plot_Code	Latitude	Longitude	Altitude	Land use
1	6.73163	5.89969	83	Medium density forest
2	6.73519	5.90340	125	Low density forest
3	6.73612	5.89981	106	Medium density forest
4	6.73461	5.89666	88	Medium density forest
5	6.73323	5.89501	78	Medium density forest
6	6.73582	5.89536	102	High density forest
7	6.74501	5.90482	162	Young regenerating forest
8	6.74932	5.90348	135	High density forest
9	6.75103	5.90339	171	Open land
10	6.74128	5.89640	116	Medium density forest
12	6.74174	5.89222	111	Medium density forest
13	6.73938	5.89899	115	Medium density forest
14	6.75504	5.90610	159	Medium density forest
15	6.75733	5.90265	174	Young regenerating forest
16	6.75833	5.90305	170	Young regenerating forest
17	6.75754	5.90525	170	Low density forest
18	6.75946	5.90101	153	Young regenerating forest
19	6.75889	5.89948	179	Scrub
20	6.75614	5.90342	183	Scrub
21	6.75491	5.90398	183	Scrub
22	6.75644	5.89205	122	Scrub
23	6.75323	5.89500	134	Low density forest
24	6.75593	5.89356	136	Scrub
28	6.72947	5.90317	105	Scrub
29	6.75128	5.89412	158	Open land
31	6.75642	5.89819	187	Scrub

32	6.73887	5.89403	98	Low density forest
33	6.75188	5.89916	164	Open land
34	6.75444	5.90142	172	Medium density forest
35	6.75269	5.90169	146	Medium density forest
36	6.73205	5.90334	115	Young regenerating forest
37	6.73266	5.90125	92	High density forest
38	6.73356	5.89972	111	Scrub
39	6.73328	5.90270	110	Medium density forest
40	6.72996	5.90201	113	Young regenerating forest
41	6.72973	5.90069	95	Scrub
42	6.73712	5.90440	127	Low density forest
43	6.73102	5.90299	119	Young regenerating forest
45	6.73485	5.89740	90	High density forest
46	6.73509	5.89839	97	Medium density forest
47	6.73524	5.89984	103	Medium density forest
48	6.73473	5.90115	120	Scrub
49	6.73633	5.89327	79	Medium density forest
50	6.73747	5.89448	76	Medium density forest
51	6.73490	5.89352	94	Scrub
52	6.74093	5.89820	90	High density forest
53	6.75822	5.89817	178	Scrub
54	6.75729	5.89714	181	Open land
55	6.75812	5.89613	158	Scrub
56	6.75667	5.89523	147	Scrub
57	6.75618	5.89465	139	Young regenerating forest
58	6.76123	5.90043	138	Low density forest
59	6.75820	5.90042	167	Open land
60	6.75666	5.90049	155	Low density forest
61	6.75785	5.90185	156	Young regenerating forest
62	6.75539	5.89954	190	Scrub
63	6.75311	5.89327	132	Medium density forest
64	6.75501	5.89234	128	Scrub
65	6.74860	5.89678	127	Medium density forest
66	6.75193	5.89477	153	Low density forest
67	6.75125	5.89719	154	Scrub
70	6.74474	5.89340	99	Medium density forest
71	6.74099	5.89258	106	Medium density forest
72	6.74271	5.89327	114	Low density forest
73	6.74244	5.89628	113	Medium density forest

74	6.73985	5.89170	96	Low density forest
75	6.74061	5.89189	103	Medium density forest
76	6.73868	5.89210	89	High density forest
77	6.73824	5.89106	84	High density forest
78	6.74401	5.89620	93	Medium density forest
79	6.73996	5.89583	94	High density forest
80	6.74641	5.89999	127	Medium density forest
81	6.74482	5.90120	106	Medium density forest
82	6.73804	5.90133	112	Medium density forest
83	6.73919	5.90355	120	Low density forest
84	6.74068	5.90523	126	Low density forest
85	6.74010	5.90163	115	Medium density forest
86	6.74896	5.90654	143	Young regenerating forest
87	6.75018	5.90638	148	Medium density forest
88	6.75150	5.90605	150	Low density forest
89	6.75175	5.90685	156	Medium density forest
90	6.75604	5.90694	161	Medium density forest
91	6.74757	5.90431	139	Open land
92	6.74506	5.90317	140	Scrub
93	6.75241	5.90316	165	Open land
94	6.75378	5.89944	175	Open land
95	6.74984	5.89828	132	Low density forest
96	6.73769	5.89804	116	Low density forest
97	6.75754	5.90525	170	Low density forest
98	6.75697	5.89621	168	Scrub
99	6.75727	5.89328	125	Scrub
100	6.74256	5.90419	147	Young regenerating forest
101	6.75327	5.89723	140	High density forest
102	6.75064	5.90181	157	Scrub
103	6.74528	5.89484	136	Low density forest
104	6.74293	5.89453	134	Scrub
105	6.74820	5.90155	131	Low density forest
106	6.74134	5.89953	102	High density forest
107	6.75250	5.90419	179	Open land
108	6.75043	5.90268	164	Scrub

11.3 Species list

Species	Family	IUCN Status	National Threat Status
Afzelia africana	Fabaceae	Vulnerable	Endanger
Albizia ferruginea	Fabaceae	Vulnerable	Endanger
Albizia zygia	Fabaceae	Not assessed	Not assessed
Alchornea cordifolia	Euphorbiaceae	Not assessed	Not assessed
Alchornea laxiflora	Euphorbiaceae	Not assessed	Not assessed
Allanblackia floribunda	Clusiaceae	Vulnerable	Endanger
Allophylus africanus	Sapindaceae	Not assessed	Not assessed
Alstonia boonei	Apocynaceae	Not assessed	Not assessed
Anthocleista nobilis	Gentianaceae	Least concern	Not assessed
Anthocleista vogelii	Gentianaceae	Not assessed	Not assessed
Antiaris toxicaria	Moraceae	Not assessed	Not assessed
Baphia nitida	Fabaceae	Least concern	Not assessed
Blighia sapida	Sapindaceae	Not assessed	Not assessed
Blighia unijugata	Sapindaceae	Not assessed	Not assessed
Bosquea angolensis	Moraceae	Not assessed	Not assessed
Bridelia ferruginea	Phyllanthaceae	Not assessed	Not assessed
Bridelia micrantha	Phyllanthaceae	Not assessed	Not assessed
Ceiba pentandra	Malvaceae	Least concern	Not assessed
Celtis brownii	Cannabaceae	Not assessed	Not assessed
Celtis mildbraedii	Cannabaceae	Least concern	Not assessed
Celtis zenkeri	Cannabaceae	Least concern	Not assessed
Chrysophyllum albidum	Sapotaceae	Not assessed	Not assessed
Cleistopholis patens	Annonaceae	Not assessed	Not assessed
Cola millenii	Malvaceae	Not assessed	Not assessed
Deinbollia pinnata	Sapindaceae	Not assessed	Not assessed
Desplatsia subericarpa	Malvaceae	Least concern	Not assessed
Dialium guineense	Fabaceae	Not assessed	Not assessed
Diospyros dendo	Ebenaceae	Not assessed	Not assessed
Diospyros monbuttensis	Ebenaceae	Not assessed	Not assessed
Diospyros suaveolens	Ebenaceae	Not assessed	Not assessed
Entandrophragma utile	Meliaceae	Vulnerable	Endanger
Entandrophragma cylindricum	Meliaceae	Not assessed	Endanger
Ficus capensis	Moraceae	Not assessed	Not assessed
Ficus exasperata	Moraceae	Not assessed	Not assessed
Ficus mucuso	Moraceae	Not assessed	Not assessed
Funtumia elastica	Apocynaceae	Not assessed	Not assessed
Garcinia mannii	Clusiaceae	Not assessed	Endanger

Gmelina arborea	Lamiaceae	Not assessed	Not assessed
Irvingia grandifolia	Irvingiaceae	Least concern	Not assessed
Lannea welwitschii	Anacardiaceae	Not assessed	Not assessed
Lecaniodiscus cupanioides	Sapindaceae	Not assessed	Not assessed
Lonchocarpus cyanescens	Fabaceae	Not assessed	Not assessed
Lophira alata	Ochnaceae	Vulnerable	Endanger
Malacantha alnifolia	Sapotaceae	Vulnerable	Not assessed
Manikara obovata	Sapotaceae	Not assessed	Not assessed
Margaritaria discoidea	Phyllanthaceae	Not assessed	Not assessed
Massularia acuminata	Rubiaceae	Not assessed	Endanger
Milletia thonningii	Fabaceae	Not assessed	Not assessed
Monodora myristica	Annonaceae	Not assessed	Rare
Monodora tenuifolia	Annonaceae	Not assessed	Not assessed
Morinda lucida	Rubiaceae	Not assessed	Not assessed
Musanga cecropioides	Urticaceae	Least concern	Not assessed
Myrianthus arboreus	Urticaceae	Not assessed	Not assessed
Napoleona vogelii	Lecythidaceae	Not assessed	Not assessed
Nauclea diderrichii	Rubiaceae	Vulnerable	Endanger
Nauclea latifolia	Rubiaceae	Least concern	Not assessed
Nesogordonia papaverifera	Malvaceae	Vulnerable	Endanger
Newbouldia laevis	Bignoniaceae	Not assessed	Not assessed
Parinari excelsa	Chrysobalanaceae	Least concern	Not assessed
Pentaclethra macrophylla	Fabaceae	Not assessed	Not assessed
Piptadeniastrum africanum	Fabaceae	Not assessed	Not assessed
Pterocarpus soyauxii	Fabaceae	Not assessed	Not assessed
Pterygota macrocarpa	Malvaceae	Vulnerable	Endanger
Pycnanthus angolensis	Myristicaceae	Not assessed	Not assessed
Ricinodendron heudelotii	Euphorbiaceae	Not assessed	Not assessed
Rothmannia hispida	Rubiaceae	Not assessed	Not assessed
Senna podocarpa	Fabaceae	Not assessed	Not assessed
Solanum torvum	Solanaceae	Not assessed	Not assessed
Spathodea campanulata	Bignoniaceae	Not assessed	Not assessed
Spondias mombin	Anacardiaceae	Not assessed	Not assessed
Staudtia stipitata	Myristicaceae	Not assessed	Not assessed
Sterculia tragacantha	Malvaceae	Least concern	Not assessed
Strombosia pustulata	Olacaceae	Not assessed	Not assessed
Tabernaemontana pachysiphon	Apocynaceae	Not assessed	Not assessed
Terminalia avicennioides	Combretaceae	Not assessed	Not assessed
Terminalia ivorensis	Combretaceae	Vulnerable	Endanger

Terminalia superba	Combretaceae	Not assessed	Endanger
Trema orientalis	Cannabaceae	Not assessed	Not assessed
Trichilia monadelpha	Meliaceae	Least concern	Not assessed
Uapacca staudtii	Phyllanthaceae	Not assessed	Not assessed
Vernonia amygdalina	Asteraceae	Not assessed	Not assessed
Vitex doniana	Lamiaceae	Not assessed	Not assessed
Voacanga africana	Apocynaceae	Not assessed	Not assessed
Zanthoxylum zanthoxyloides	Rutaceae	Vulnerable	Endanger

12 Annex 3: Patch analysis supplemental information

12.1 Table of forest patches details

Patch Number	Patch area (ha)	Core area (ha)	Priority	Connectivity
590	7792.1	1433.6	High	Connected to HPP
237	51.9	0.1	Low with core	
1630	34.5	0.000003	Low with core	Connected to HPP
2	250.9	44.5	Medium	Connected to MPP
1539	35.8		Low without core	
567	27.3		Low without core	
1285	17.4		Low without core	
485	16.5		Low without core	Connected to HPP
1304	13.0		Low without core	Connected to HPP
262	11.7		Low without core	
1441	10.7		Low without core	Connected to HPP
54	9.6		Low without core	
1101	8.5		Low without core	Connected to HPP
802	8.1		Low without core	
310	7.3		Low without core	
1194	6.2		Low without core	
1833	5.9		Low without core	Connected to HPP
513	5.3		Low without core	
1737	5.3		Low without core	Connected to HPP

1977	4.9		Low without core	Connected to HPP
1119	4.6		Low without core	
1184	4.4		Low without core	
1934	4.2		Low without core	Connected to HPP
76	3.9		Low without core	
614	3.6		Low without core	Connected to HPP
2049	3.6		Low without core	Connected to HPP
1027	3.0		Low without core	Connected to HPP
2131	3.0		Low without core	Connected to HPP
449	2.9		Low without core	
921	2.9		Low without core	
135	2.9		Low without core	
651	2.9		Low without core	Connected to HPP
1641	2.8		Low without core	Connected to HPP
585	2.8		Low without core	
854	2.7		Low without core	
840	2.7		Low without core	Connected to HPP
1558	2.6		Low without core	Connected to HPP
139	2.6		Low without core	
347	2.6		Low without core	
920	2.6		Low without core	
677	2.5		Low without core	Connected to HPP
531	2.5		Low without core	
14	2.4		Low without core	
771	2.4		Low without core	
785	2.4		Low without core	
1236	2.4		Low without core	
325	2.4		Low without core	Connected to MPP

1278	2.4		Low without core	
1133	2.3		Low without core	
1889	2.3		Low without core	
504	2.3		Low without core	
1984	2.2		Low without core	Connected to HPP
200	2.2		Low without core	
2150	2.2		Low without core	Connected to HPP
1704	2.1		Low without core	Connected to HPP
792	2.1		Low without core	
190	2.1		Low without core	
1989	2.1		Low without core	Connected to HPP
269	2.1		Low without core	
46	2.1		Low without core	
600	2.0		Low without core	
420	2.0		Low without core	

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