

Report of a carbon stock assessment of Presco Ologbo Extension Concessions

Extension Plots 1, 2 and 3

15th March 2015



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 report is the output of a carbon stock (CS) assessment of Ologbo Extension II concessions that was commissioned by Presco Plc of Nigeria. The report details the background to the assessment area, the methodology for the assessment, analysis, findings and conclusions of a carbon stock assessment of a proposed new oil palm plantations establishment that is expected to start at the end of March 2015. The assessment area consists of three plots with a total land area of 4,268 ha located in the former Ologbo Forest Reserve (OFR) in the Edo State of Nigeria. The assessment was carried out during December 2014 and February 2015 by a team of experts from Proforest.

The objective of this assessment is to estimate the total carbon stock (above and below ground carbon stock) of the three plots and to enable Presco meet the Roundtable on Sustainable Palm Oil (RSPO) requirements on new oil palm plantation development. Criterion 7.8 of the RSPO standards requires that carbon stock of a proposed development area and major potential sources of emissions that may result directly from the development shall be identified and estimated. Given that conversion of natural vegetation to oil palm plantations can be a major source of emissions, RSPO members intended to establish new plantations are expected to estimate carbon stock of the proposed area prior to land conversion. This assessment was to fulfil this requirement.

In estimating the carbon stock of the area, 3,068 ha out of the total land area of 4,268 ha was inventoried. This is because, about 1,200 ha of one of the plots (Plot 1) is contained in a marshy area that had already been designated for conservation purposes and will be excluded from conversion activities.

For this assessment, carbon stock was estimated in the three Presco Ologbo concession extension plots 1, 2 and 3 in 32 1-ha belt transects that were randomly laid in the three plots. All trees with diameter at breast height (dbh) ≥ 10 cm were identified and their diameter and height measured or estimated. The vegetation of the area was highly degraded, with a mosaic of current and old plantations, abandoned farms and fallow lands. Tree found in the concession were predominantly *Gmelina arborea* saplings with very low density due to harvesting for poles and fuelwood. Tree density was 71.5 individuals per ha. Consequently, carbon stocks were very low, averaging 3.47 t/ha (range from 0.73 – 7.50 t/ha). Total carbon stock was estimate to be 9,520 tons, 1,647 tons and 1,614 tons for plots 1, 2 and 3 respectively.

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SUMMARY

1 Introduction and background

1.1 Introduction

Presco Plc, a subsidiary of the SIAT Group of companies intends to expand its oil palm plantations in the former Ologbo Forest Reserve (OFR) in the Edo State of Nigeria. The company has therefore acquired an additional 4,268 ha of land consisting of three plots in the former Ologbo Forest Reserve as extensions to its existing oil palm plantations. This report is an output of above ground carbon stock assessment of the newly acquired plots. The study was commissioned by Presco in fulfilment of the carbon stock estimation requirements as contained in the Roundtable on Sustainable Palm Oil (RSPO) production certification standards.

Assessment areas	
Plot	Area (ha)
Plot 1	2,460
Plot 2	346
Plot 3	1,462
Total	4,268

1.2 About SIAT and Presco

SIAT is an agro-industrial group of companies specialised in upstream plantation development and downstream processing operations. SIAT’s operations in the agriculture sector in Africa focus on oil palm and rubber plantation development with increasing interests in cattle ranching. The company currently has four oil palm operations in three countries including GOPDC in Ghana, SIAT in Gabon and Presco and SIAT Nigeria both located in Nigeria. SIAT is a member of the RSPO and hence is committed to working towards RSPO certification for all of its oil palm plantation development.

Presco Plc., one of the subsidiaries of SIAT, is a public listed liability company established on 24th September 1991 under the Nigerian Laws. The company is headquartered at Obaretin Estate in the Edo State of Nigeria. Presco operates three estates: Obaretin estate in Edo State with a total area of 5,631 ha, Cowan estate in Delta State with a total plantation area of 2,558 ha and the Ologbo Estate in Edo State. The Cowan and Obaretin Estates were existing plantations that the company inherited whiles the Ologbo plantations were established by Presco in a former forest reserve land. Presco has been operating in the Ologbo Forest Reserve since 2007 when it begun its first oil palm plantation after the State Government de-reserved about 7,300 ha of the badly degraded parts of the forest which had previously undergone state sanctioned Taungya system of farming.

Presco acquired this 4,268 ha (hereafter called Ologbo Extension II concession) from the State Government in three parcels measuring 2,460 ha, 346 ha and 1,462 ha as further extension to Presco’s Ologbo Estate. As a member of RSPO, Presco intends to ensure the development of the newly acquired concession meets the RSPO New Planting Procedure (NPP) including requirements on estimation of carbon stock as contained in Indicator 7.8.1 and thus requested Proforest to undertake carbon stock assessment of the two plots prior to land conversion.

1.3 RSPO requirements on carbon

The RSPO principles and criteria contain a set of mandatory requirements for new oil palm plantations that are expected to be certified under the RSPO sustainability certification. These requirements are contained in Principle 7 of the

RSPO principles and criteria (P&C), and requirements on carbon stock estimation in Criterion 7.8, which states that “New plantation developments are designed to minimise net greenhouse gas emissions”. Indicator 7.8.1 specifically states that “The carbon stock of the proposed development area and major potential sources of emissions that may result directly from the development shall be identified and estimated”. Subsequently, as a RSPO member, SIAT and for that matter Presco is required to comply with indicator 7.8.1 by estimating the carbon stock of the proposed area for oil palm development prior to any conversion and new plantings.

2 Assessment process and methods

In order to ensure efficient use of resources, the carbon stock assessment was carried out at the same time with the HCV assessment of the concessions. The process was led by an HCV Resource Network Provisionally Licensed Assessor working with other discipline experts including GIS, Botanist, Ecologist, Mammologist etc.

2.1 Assessors and their credentials

In conducting this carbon stock assessment for Presco Ologbo proposed concession, Proforest has drawn on its internal capacity from the organisations secretariat in Oxford, the regional office in Accra, Ghana and local consultants in Nigeria. The team involved in this assessment are highly competent in the field of natural resources management, botany, forest survey and data processing.

Table 1: List of the assessors along with their location and qualification.

Name	Organisation/company	Role in the assessment
Abraham Baffoe	Proforest	Ecology/landuse planning/ Assessment team leader
Isaac Abban-Mensah	Proforest	Team member
Eli Dziwornu Agbitor	Proforest	Team member
Mike Senior	Proforest	Team member
David Kenfack	CTFS-SIGEO	Carbon stock estimation
Joseph Ugbe	Edo State, Nigeria	Botanists/Flora survey
Akomaye Ashikem	Edo State, Nigeria	Botanists/Flora survey
Samuel Akpan	Edo State, Nigeria	Field technician

The team members had collective expertise in Botany, Agriculture, Forestry, and Environmental Science. Together, they possess several years of experience working on plant identification, tree measurement techniques, forest survey,

carbon stock assessment, vegetation dynamic study, big data treatment and processing, ArcGIS and remote sensing. Below are brief summaries of the team member's experience:

Dr David Kenfack

Current position: CTFS-SIGEO Africa Programme Coordinator, July 2012 to Date

Qualifications: PhD Ecology, Evolution and Systematics. University of Missouri, Saint Louis

Expertise:

Forest ecology, Systematics, Molecular Biology, Botanical Inventories and Forest Dynamics.

Abraham Baffoe

Current position: Associate Director, Proforest, UK since January 2010.

Qualifications: MSc, Forestry and Environmental Economics. Louisiana State University, Baton Rouge, USA. 2008-2009: Certification, Implications for Sustainable Forest Management and Timber Export Trade from Ghana (funded by the ITTO).

Postgraduate Certificate. Natural Resources Management Economics. Wageningen University and Agricultural Centre, Netherlands, 2001

BSc Hons. Forestry. Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. 1996.

Expertise:

Forest ecology, biodiversity conservation, social forestry and hydrology: Extensive experience and knowledge on forest ecology, species identification and forest hydrology. Several years of experience in forest biodiversity assessment and monitoring including practical experience in managing watershed projects. Decades of experience working with local populations on sustainable management and use of community natural resources.

HCV: Have worked with HCVs since 2001. This has included leading tens of HCV assessments for forestry and agricultural commodity production companies in many countries Africa including Ghana, Liberia, Gabon, Nigeria, Zambia, Ethiopia and Ethiopia. Have also provided several HCV trainings since 2005 and a facilitator and co-author of the Ghana National Interpretation of the HCV Toolkit in 2006.

Sustainable agriculture and forestry: Over 18 years' experience with the environmental and social sustainability issues of which 13 years has been with the oil palm sector. Have extensive experience with the RSPO, having led several baseline assessments of oil palm operations against the RSPO standards and having been part of RSPO National Interpretations for Ghana.

Fieldwork: Over a decade of experience of fieldwork with the tropical rainforests of West Africa, having worked as the Afforestation Manager of a leading timber company in Ghana from 1996 and as the WWF West Africa Forest Programme Manager.

Isaac Abban-Mensah

Current Position: Senior Project Manager, Proforest since 2010

Qualification: MSc Agricultural Development, University of Copenhagen, 2009

MSc Environmental Forestry, Bangor University, Wales, 2008

BSc Renewable Natural Resource Management, KNUST, 2006

Expertise and HCV: Isaac has a background in sustainable agricultural development and socio-economics of tropical forestry. He has diverse work and research experience in natural resource governance, commodity certification, smallholder development and High Conservation Values within forestry and agricultural landscapes. Isaac is a Senior Project Manager at Proforest, where he works directly with commodity producers to meet international sustainability standards. Isaac has conducted several HCV assessments in Africa, South East Asia and elsewhere for several different commodities including oil palm, rubber, coffee and forestry products. He has led HCV assessments in line with the RSPO's New Plantings Procedure, as well as HCV assessments for existing plantations. Isaac has run several HCV training courses, ranging from advanced HCV training and mentoring for practitioners to introductory HCV training courses in different countries and ecological zones. He has also facilitated the development of HCV national interpretations and the development of guidance for smallholders.

Current Position: Senior Project Manager, Proforest Ghana since January 2013.

Qualification: MSc. Environmental Resources Management, October 2011, College of Engineering, Kwame Nkrumah University of Science & Technology (K.N.U.S.T), Kumasi, Ghana

BSc. Natural Resources Management, July 2003, Institute of Renewable Natural Resources, K.N.U.S.T

Expertise: Social forestry, community development, forest management and biodiversity conservation.

HCV: Involved in HCV since 2006. Consultant in Ghana's National interpretation of the global HCVF toolkit. Has experience in undertaking (including providing management and monitoring recommendations) and evaluating (within the context of forest management certification) HCV assessments in Ghana, Liberia, Cameroon and Nigeria.

Sustainable agriculture and forestry: Many years of involvement in the implementation and monitoring of social and environmental aspects of sustainable palm oil and forestry production. Carried out numerous (over 20) FSC forest management assessments (since 2006) and several RSPO baseline assessments (since 2013) in Ghana, Liberia and Nigeria.

Fieldwork: Nearly a decade working leading and supporting the implementation of several biodiversity conservation projects (at Friends of the Earth, Care and Christian Aid) with a focus on social aspects and community involvement. Extensive experience in providing practical support to timber companies in Ghana to address social gaps in their efforts to achieve FSC certification.

Eli Dziwornu Agbitor

Current position: Project Manager, Proforest, Ghana. January 2014 to date.

Qualifications: MSc. Environmental Forestry. Bangor University, UK. 2006-2007.

BSc. Natural Resources Management. Kwame Nkrumah University of Science and Technology, Ghana. 2001-2005.

Expertise: Forest ecology and biodiversity conservation

Extensive experience in assessment of forest regeneration, implementing and assessing forest rehabilitation, and ecosystem services management. Over 7 years practical experience in assessing and promoting sustainable forest resources management and biodiversity conservation in forest and agricultural landscapes, using participatory approaches. Previous experiences with the Forest Services Division (Ghana), Ministry of Lands and Natural Resources (Ghana), CATIE (Costa Rica), The Woodland Trust (UK), GTZ, ITTO, UNDP and FSC. Recent experiences include HCV assessments in oil palm landscapes.

Mike Senior

Current position:

Project Manager at Proforest, UK since 2014.

Qualifications:

PhD in tropical forest ecology. University of York, Department of Biology, UK. 2010-2014: Assessing diversity and ecosystem functioning in fragmented tropical landscapes (funded by NERC and Proforest).

BA (Oxon) Hons. Biological Sciences. University of Oxford, UK. 2009.

Expertise:

Conservation biology and landscape ecology: Knowledgeable applied and theoretical conservation ecologist. Experience in biodiversity monitoring, species and landscape conservation, inc. habitat fragments and corridors. Excellent knowledge of species and ecosystem services responses to land use change.

HCV: Co-edited the Common Guidance for the Management and Monitoring of HCVs, contributed content to the Common Guidance for HCV identification. Experience of national level HCV identification and analysis in contexts of Brazil and Finland.

Sustainable agriculture and forestry: Strong understanding and experience of environmental and social sustainability issues in the oil palm sector (especially relating to the RSPO and the HCV approach).

Fieldwork: Extensive experience of fieldwork in rain forest, swamp forest and oil palm plantations in Malaysia, Indonesia, Belize and Ecuador, including 4-6 month periods in the field. Experienced in mammal, avifauna and insect survey methods.

Experimental design: Experience of experimental design for tropical ecology, biodiversity inventory and biodiversity conservation research.

Remote-sensing techniques: Experienced ArcMap user.

2.2 Methodology and procedure used

2.2.1 Desk-based literature review

A desk review of documents including paper and cadastral maps provided by Presco was carried out prior to the field assessment. This also include freely available online satellite imageries that the assessment team accessed. The objective of the desk review was to identify the key landscape level concerns that are relevant for the assessment area and to also have a better understanding of the geophysical characteristics of the landscape.

2.2.2 Planimetrics and land cover classification

Presco provided maps of the concessions. In planning for the assessment, a combination of satellite images of the landscape of which the concessions form part was used. This included publicly available Google Earth imagery which were used in the initial planning for the assessment. Satellite imageries were thereafter used to aid the assessment of the study area and to determine the land cover classes in the area. The figure 1 below presents the key outputs of the land cover classification. The satellite imageries were studied closely in order for the team to get a clearer picture of the nature of the vegetation cover, and to help inform sampling design.

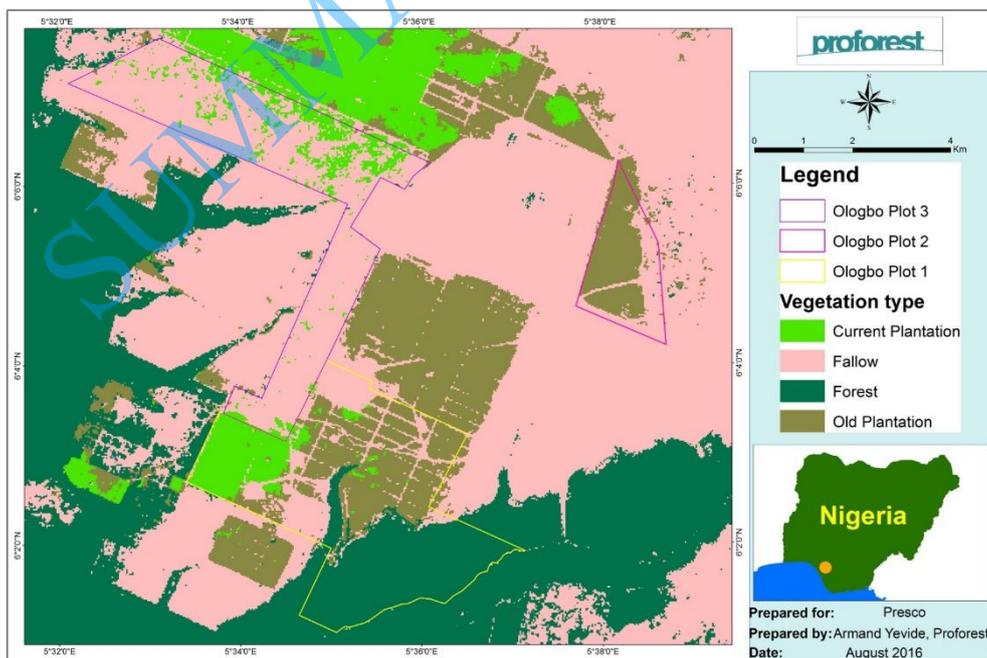


Figure 1: Land cover classification for Ologbo extensions.

NB: The land cover classification was based on a 30 metres resolution satellite image acquired from the EarthExplorer webpage of the United States Geological Survey (USGS) (<http://earthexplorer.usgs.gov/>) for the year 2015.

2.2.3 Sampling and experimental design

Prior to carrying out the botanical survey and carbon stock estimation, the team conducted groundtruthing which was aimed at verifying the accuracy of the land cover classification within the concession area. An approximately 0.75% sampling rate was used to determine the sample size for the estimation of the total carbon stock for the Ologbo extension II. As the proposed concession is divided into three plots, 12, 4 and 16 sampling plots were used for Plot 1, Plot 2 and Plot 3 respectively. Each plot was a rectangle of 1 ha (length 500 m and width 20 m) which was subdivided into 25 quadrats of 20x20 m (400 m²) each. Data collected from the plots included the name of the species, diameter at breast height and observation on the individual tree (whether it was diseased, fruiting, etc). Only live trees and lianas with trunk diameter at breast height (dbh) ≥10 cm were measured, using a diameter tape. In addition to the dbh measurements, the height of each individual tree was estimated visually. Each quadrat within the plot was assigned to a vegetation type. The number of quadrats in each vegetation type was used to estimate its area within the entire proposed concession.



Figure 2: Assessment team laying transect

2.2.4 Data analysis

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:

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

Where **AGB** is aboveground dry biomass (in kg); ρ is wood density (in g/cm³) **D** is diameter at breast height (in cm) and **H** is the height (in m).

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 54 species recorded in the inventory of Plot 1 and Plot 2, wood density was available for 31 (57%). For the remaining species not reported in these databases, we used the mean wood density of the matching genus (13 species) or matching family (10 species). For Plot 3, of the 42 species recorded in the inventory, wood density was available for 26 (62%). For the remaining species not reported in these databases, we used the mean wood density of the matching genus (9 species) or matching family (7 species).

A 30 m resolution satellite imagery retrieved from the USGS's EarthExplorer webpage (<http://earthexplorer.usgs.gov/>) was used to stratify the landscape of the proposed concession into 4 classes: forest, old plantation, current plantation and fallow. The maximum likelihood algorithm was used to perform the land stratification.

Microsoft Excel, QGIS version 2.14.3 and ArcGIS version 10.2 were the three main programmes used to process the data collected.



Figure 3: Grazing field in plot 1



2.3 Team responsible for the mitigation plan

For sustainability and in order to assure that the new planting activities don't affect the structure and functioning of the landscape where the proposed concession is distributed, a team of three persons was selected to draw a mitigation plan and assure its implementation on the ground (Table 2). Below is the list of the members of the team and their position in the company.

Table 2: List of the team responsible for the mitigation plan. (Presco to complete)

Name	Office location	Position
Benedicta Okholo	Edo State, Nigeria	HSE
Paul Yinka Hameed	Edo State, Nigeria	Sociologist
Martin Oosthuizen	Edo State, Nigeria	COO

3 Carbon stock assessment and summary

3.1 Description of the assessment area

This carbon stock assessment report covers three small concessions with a combined area of about 4,268 ha of the former Ologbo forest reserve located in Edo State, Nigeria (Figure 2). Edo State is in South-central of Nigeria, bordered on the west by Ondo State, southeast by Delta State and northeast by Kogi State. The concessions are within the former Ologbo Forest Reserve in Ikpoba-Okha Local Government Area of the Edo State of Nigeria. They are located south-south-west of Benin City (the capital of the Edo State), and to the west of the Benin-Sapele Highway. The three plots combined cover a total gross area of 4,268 ha. Plot 1 is 2,460 ha while Plot 2 is 346 ha and Plot 3 is 1,462 ha. Plot 1 and Plot 3 are located at south-east of the former Ologbo forest reserve while Plot 2 is located at north-east. The three plots are separated by young oil palm plantation that was established in 2013 by Presco. The current vegetation cover on Plot 1 is a combination of the following:

- Pockets of bush fallows on abandoned farm land
- Unmanaged teak and *Gmelina arborea* saplings originally established as plantations by the now-defunct Piedmont Plywood Nigeria Limited, and by the Pockets of active farms and abandoned farmlands
- A relatively less degraded vegetation in a swampy area in the south which has been set aside and is being managed as a Conservation Area. This is part of a larger area of swamp set aside for conservation along the southern and western borders of the reserve.
- Young regenerating natural vegetation dominated by pioneer species
- Grazing fields being used illegally by nomadic herdsman as cattle ranches, camps and grazing.

Figure 4: Abandoned cattle herders camp



Figure 5: Assessment laying transect in abandoned farmland areas of plot 1



Figure 6: Abandoned and burnt plantain farm in plot 1

Plot 1 shares boundaries with Ossiomo Industrial Park which is currently into large-scale cassava cultivation, as well as the Oredo Oil Field’s processing facility. The communities nearest to Plot 1 are the Ologbo communities. The Ossiomo River runs along the southern and south-eastern boundaries of Plot 1 beyond the conservation area in the swamp.

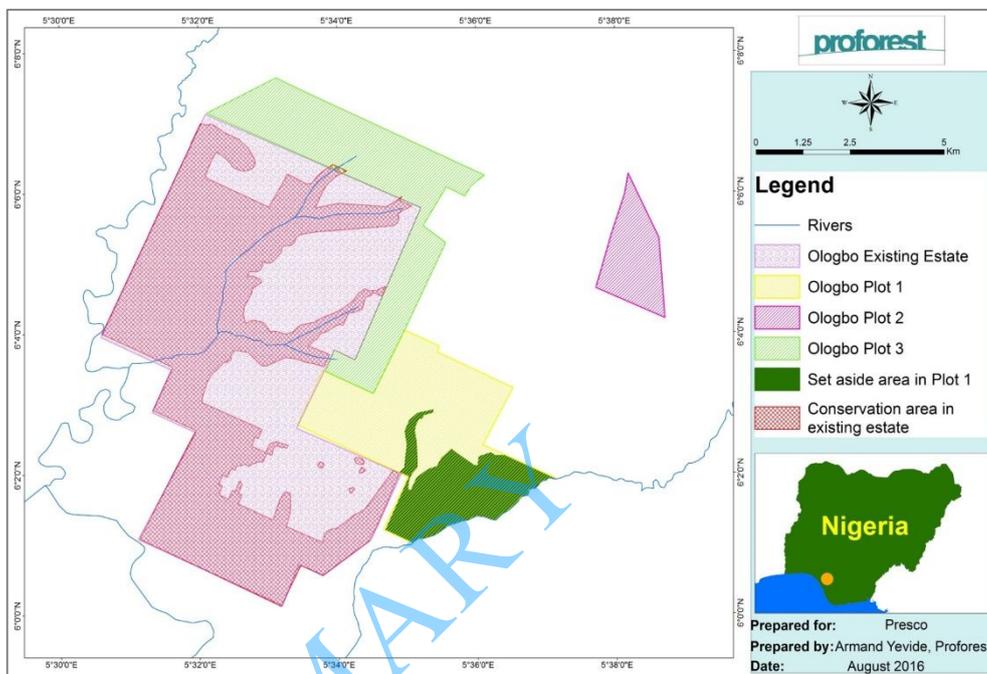


Figure 7: Location of the proposed Ologbo extension II.



Figure 8: Bamboo stand in Plot 2

Plot 2 is located north-east of the Ologbo Forest reserve. It covers a total of 346 ha (Figure 2). The area is heavily degraded and bare of vegetation in most places, occasional interspersed by pockets of bamboo groves. There are planted teak and *Gmelina arborea* stands in parts of the area, and a strip of regenerating scrub vegetation along portions of the western boundary of the plot. As in Plot 1, there are areas being used by nomadic herdsmen as cattle ranches, camps and grazing. Oil pipelines run across the south-eastern corner of the plot. Obayantor is the community nearest to Plot 2.

The plot 2 falls within northern edge: 6°6'0"N, E edge: 5°39'0"E, S edge: 6°4'0"N, W edge: 5°37'5"E. As previously stated, the plots are located on the former Ologbo forest reserve which has been de-gazetted. As with most forest reserves in Nigeria and in particular in the Edo State, the State Government began de-gazetting the Ologbo Forest Reserve around 2000 as a result of it becoming virtually completely denuded of tree cover, and all remaining forest cover highly degraded by illegal clearance and government sanctioned ‘taungya’ farming system. Despite being located in a former Ologbo forest reserve, a number of settlements including Ikara, Ologbo, Ogbekpen, Iyanomor and Obayantor are within walking distance from the concession. The large number of settlements and the high population density of the area coupled with its proximity to Benin City, the State capital of Edo might have been the single most important factor accounting for the systematic degradation of the former Ologbo forest reserve.

The concession area was allocated to Presco Plc. in July 2014 by the Ministry of Environment and Public Utilities of Edo State to develop a commercial oil palm plantation.

Despite being located in a former Ologbo forest reserve, a number of settlements including Ikara, Ologbo, Ogbekpen, Iyanomor and Obayantor are within walking distance (<5 km) of the three plots. The majority of these settlements are located to the east (and north) of the concession along the Benin-Sapele road, where population density is highest. The large number of settlements and the high population density of the area might have been the single most important factor accounting for the systematic degradation, and de-gazettement, of the former Ologbo forest reserve.

The landscape around the Ologbo concession Extension II plots is highly varied. It is dominated by the following anthropogenic land uses:

- Small-scale, mixed-crop and subsistence agriculture (including ‘taungya’ farming). The focal crops are cassava, maize, plantain and yam, and occasionally melon and pineapple
- Other oil palm plantations (Presco’s ~3,000 ha Cowan and ~6,000 ha Obaretin estates to the south and east respectively),
- Low-intensity rubber plantations,
- Pockets of bush fallows which have been farmed and abandoned,
- Planted teak and *Gmelina arborea* stands,
- Pockets of bamboo stands,
- Pipelines do cross the Ologbo estate.

3.2 Results of the carbon stock assessment

The vegetation cover of the three plots surveyed within the Presco Ologbo concession is highly degraded, consisting of current plantations with few remnant forest trees; old plantations mostly with *Gmelina arborea* and fallows, some of which are used for grazing.

Within the 32 ha surveyed, a total of 2,287 living trees including 3,060 stems with dbh ≥ 10 cm were censused. These trees belong to 54 species in 44 genera and 22 families. The most abundant species were *Gmelina arborea* (Beechwood) and *Tectona grandis* (Teak), two timber species introduced from Southeast Asia. Total biomass estimated for these trees was 185.55 tons, corresponding to 88.13 tons of carbon (Table 3).

Table 3: Summary of number of trees (N) and stems with dbh ≥ 10 cm and above ground carbon

Area designation	Area sampled (ha)	Stems	N	Carbon (t)
Plot 1	12	2078	1721	55.96
Plot 2	4	318	191	10.89
Plot 3	16	664	375	21.28
Total	32	3060	2287	88.13



Figure 9: Cattle grazing in Plot 2



Figure 10: Field team laying transect in young *Gmelina* coppice stand in Plot 1

Plot 1

Approximately, 50% of the vegetation of Plot 1 consisted of old plantations of *Gmelina arborea* and *Tectona grandis*. These two species were the most abundant and represented 80% of the total individuals. Fallows represented 41% of the area surveyed and were the second largest vegetation cover of Plot 1. Plantations represented only 1% of the area (Table 4).

Table 4: Total carbon stock in trees with dbh ≥ 10 cm in different vegetation types of plots sampled

Plot	Vegetation type	Sampled area				Total area 1 & 2 (ha)	
		Area (ha)	Proportion	Total carbon (t)	Carbon (t/ha)	Total area (ha)	Total carbon (t)
Plot 1	Current plantation	1	0.08	4.55	4.55	205	933.75
	Fallows	5	0.42	14.76	2.95	1025	3026.06
	Old plantations	6	0.50	36.64	6.11	1230	7514.50
	Total for plot 1	12	1.00	55.96	4.66	2460	11471.84
Plot 2	Fallows	2	0.50	4.52	2.25	173	389.83
	Old plantations	2	0.50	6.39	3.19	173	552.43
	Total for plot 2	4	1.00	10.89	2.72	346	942.26
Plot 3	Current plantation	5	0.31	1.80	0.36	456.88	165.16
	Fallows	11	0.69	19.48	1.77	1005.13	1780.44
	Total for plot 3	16	1.00	21.28	1.33	1462	1937.88

Tree density was low in Plot 1 (147 individuals/ha), which translated into low standing stock of Carbon. The 12 ha surveyed in this area had a total standing carbon stock of 55.96 tons and an average of 4.66 tons per hectare (Appendix 1). The major part of the carbon stock in this area, followed by *Alstonia congensis* and *Alchornea cordifolia* (Table 5).

Table 5: List of ten most abundant species in Plot 1 and their contribution to the carbon stock

Species name	BA (m2)	Carbon (t)	N
<i>Gmelina arborea</i> Roxb. ex Sm.	19.02	31.70	1129
<i>Tectona grandis</i> L. f.	5.33	12.40	258
<i>Alstonia congensis</i> Engl.	1.60	1.84	40
<i>Alchornea cordifolia</i> (Schumach. & Thonn.) Müll. Arg.	0.77	0.78	39

<i>Ficus exasperata</i> Vahl	0.59	0.70	29
<i>Ficus asperifolia</i> Miq.	0.52	0.46	21
<i>Margaritaria discoidea</i> (Baill.) G.L. Webster	0.59	1.16	21
<i>Uvariastrum elliotianum</i> (Engl. & Diels) Sprague & Hutch	0.42	0.54	20
<i>Uvariastrum insculptum</i> (Engl. & Diels) Sprague & Hutch.	0.52	0.59	20
<i>Musanga cecropioides</i> R. Br. ex Tedlie	0.59	0.51	15

Plot 2

Plot 2 comprised fallows and old plantations in equal proportions. Tree density was lowest, with only 47 individual trees/ha. Consequently, standing carbon stock for the four hectares surveyed in Plot 2 was also very low, only 10.89 tons (2.72 tons/ha) (Appendix 1). The teak was the most abundant tree species (40%) of the total individuals) and accounted for nearly 50% of the total standing carbon stock, followed by *Albizia congensis* and *Albizia lebbeck* (Table 6).

Table 6: List of ten most abundant species in Plot 2 and their contribution to the carbon stock

Species name	BA (m2)	Carbon (t)	N
<i>Tectona grandis</i> L. f.	2.54	5.23	77
<i>Alstonia congensis</i> Engl.	2.03	2.31	41
<i>Albizia lebbeck</i> (L.) Benth.	0.33	0.67	10
<i>Uvariastrum insculptum</i> (Engl. & Diels) Sprague & Hutch.	0.15	0.14	8
<i>Thevetia neriifolia</i> Juss. ex Steud.	0.16	0.19	6
<i>Ficus exasperata</i> Vahl	0.11	0.11	5
<i>Gmelina arborea</i> Roxb. ex Sm.	0.27	0.46	5
<i>Harungana madagascariensis</i> Lam. ex Poir.	0.06	0.05	5
<i>Anthocleista vogelii</i> Planch.	0.05	0.08	4
<i>Margaritaria discoidea</i> (Baill.) G.L. Webster	0.14	0.22	4

Plot 3

69% of the vegetation of Plot 3 consisted of fallows and only 31% represents current plantations. Tree density was lowest, with only 25 individual trees/ha. Consequently, standing carbon stock surveyed in Plot 3 was low, only 21.28 tons (1.33 tons/ha) (Appendix 1). The most abundant species were *Alstonia congensis* (24%) and *Alchornea cordifolia* (16%). (Table 7)

Table 7: List of ten most abundant species in Plot 3 and their contribution to the carbon stock

Species name	BA (m2)	Carbon (t)	N
<i>Alstonia congensis</i> Engl.	4.31	6.06	64
<i>Alchornea cordifolia</i> (Schumach. & Thonn.) Müll. Arg.	0.98	1.02	43
<i>Uvariastrum elliotianum</i> (Engl. & Diels) Sprague & Hutch	0.87	0.95	36
<i>Musanga cecropioides</i> R. Br. ex Tedlie	1.03	0.81	27

<i>Ficus exasperata</i> Vahl	0.64	0.65	25
<i>Gmelina arborea</i> Roxb. ex Sm.	0.88	1.51	22
<i>Albizia lebbek</i> (L.) Benth.	0.56	1.24	16
<i>Margaritaria discoidea</i> (Baill.) G.L. Webster	0.62	1.31	15
<i>Harungana madagascariensis</i> Lam. ex Poir.	0.24	0.31	14

3.2.1 Total carbon stock distribution across the proposed concessions

The vegetation cover of the proposed concession consisted of fallows, old and current plantations. They were characterised by a low carbon stock as it is shown on the figure below. Due to the low carbon stock obtained for the different vegetation types, no significant carbon areas were identified across the three surveyed plots.

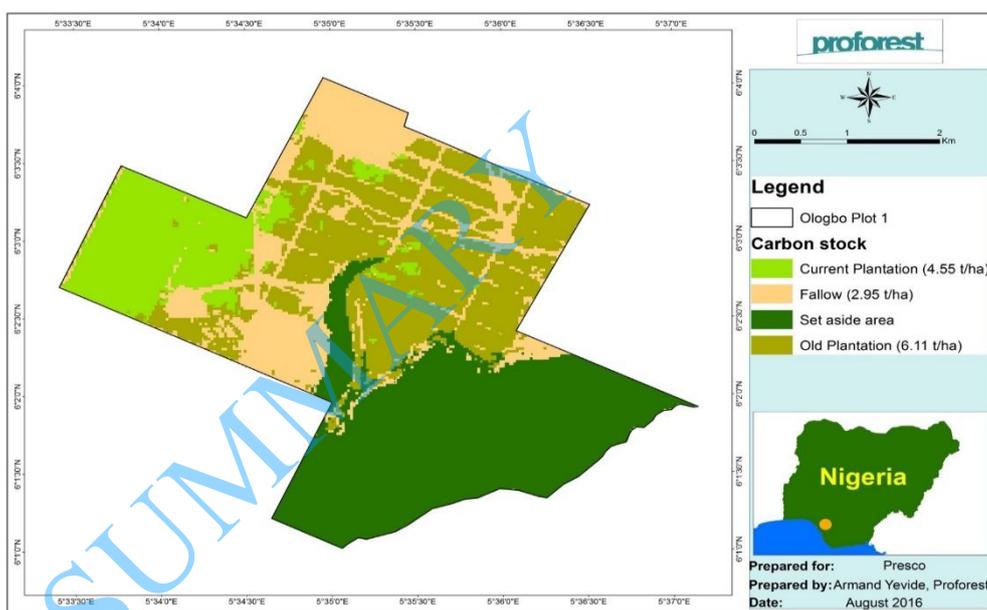


Figure 11: Distribution of carbon stock estimated for Ologbo Plot 1

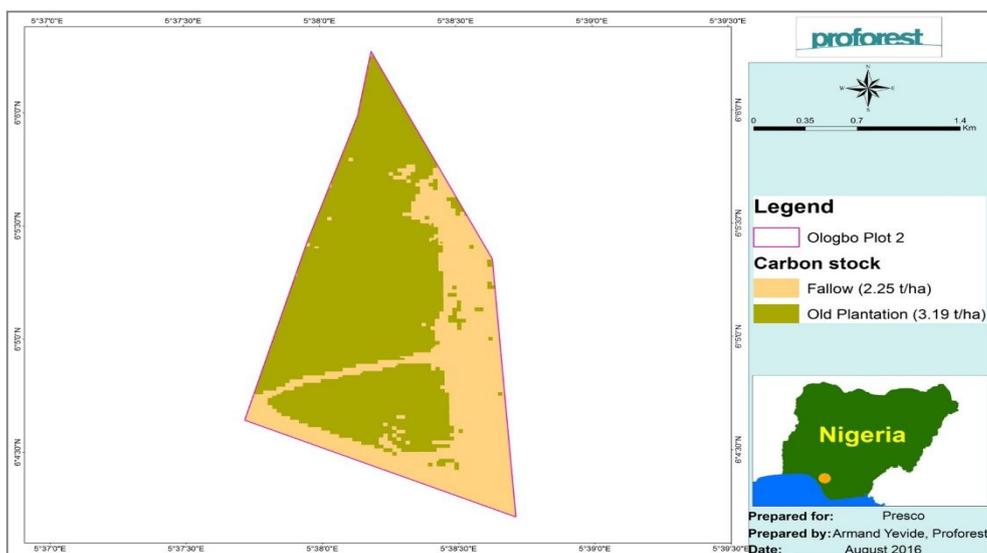


Figure 12: Distribution of carbon stock estimated for Ologbo Plot 2.

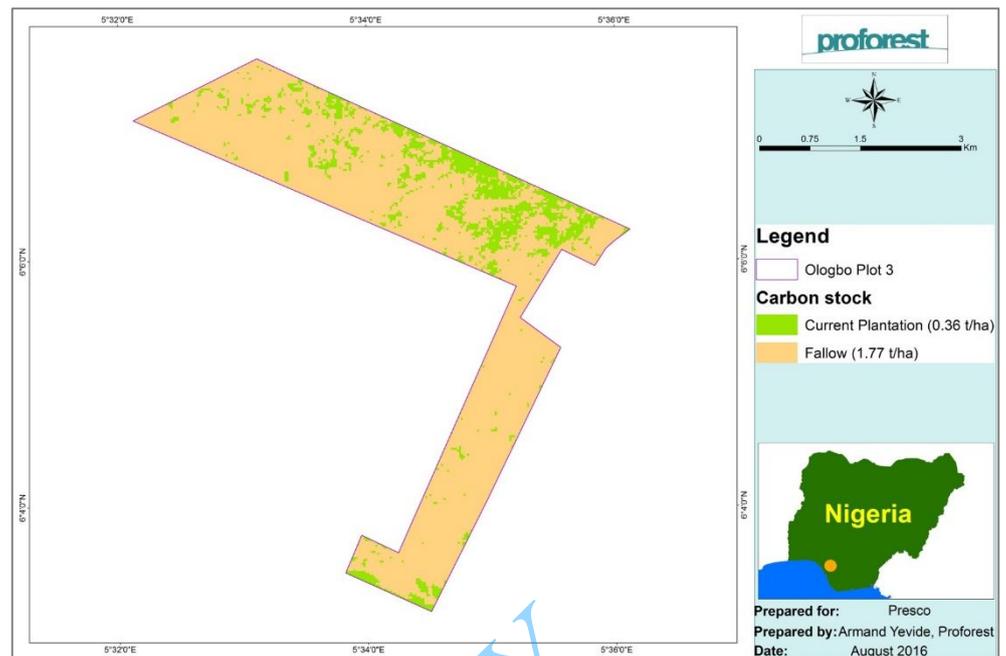


Figure 13: Distribution of carbon stock estimated for Ologbo Plot 3.

3.3 Summary of carbon assessment

The three parcels of land do not contain any primary forest and any significant carbon area. This is also demonstrated by the preponderance of fallow.

Mean carbon stock in the Plot 1, Plot 2 and Plot 3 are 4.66 t/ha, 2.72 t/ha and 1.33 t/ha respectively. The low carbon stock obtained for the plots can be attributed to the predominance of fallow and the low tree density 71.5 individuals/ha.

Total carbon stock was estimate to 9,520 tons, 1,647 tons and 1,614 tons for plots 1, 2 and 3 respectively.

3.4 Location map

The concessions are located in an agricultural landscape dominated by fallow.

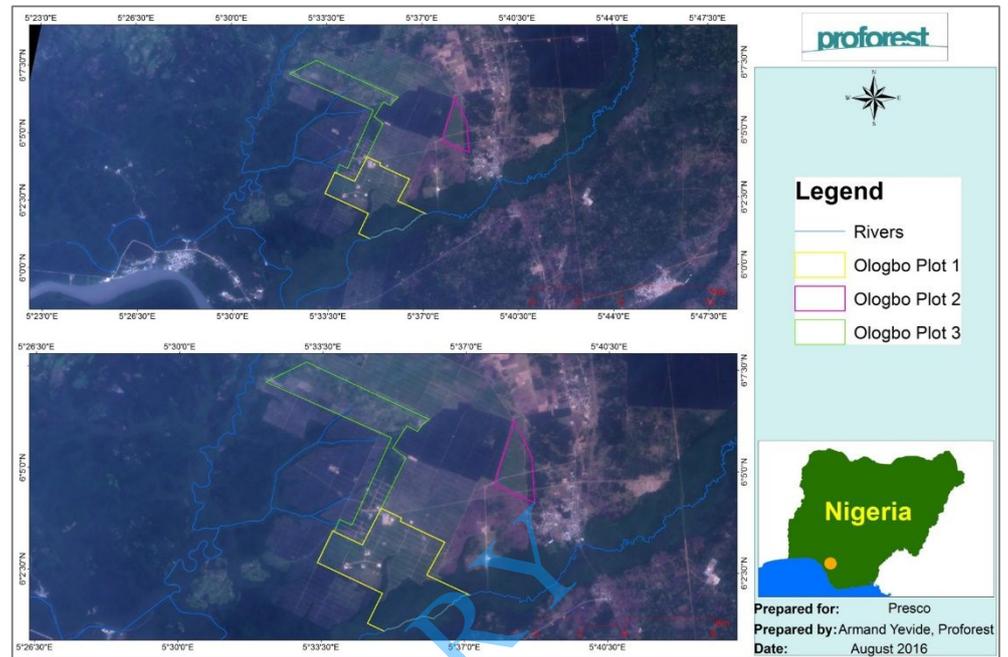


Figure 14: Location maps indicating area of new plantings at landscape level and property level.

SUMMARY

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