Baseline Vegetation and Flora Assessment, Lokutu Concession, Feronia, DRC.

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Prepared by

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(M.Sc., Pri. Sci. Nat)

For

Digby Wells and Associates (International) Limited (Subsidiary of Digby Wells & Associates (Pty) Ltd)

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Appointment of Specialist
Leigh-Ann de Wet (LD Biodiversity Consulting) was commissioned by Digby Wells and Associates (International) Limited (Subsidiary of Digby Wells & Associates (Pty) Ltd) to undertake a vegetation and flora assessment in alignment with High Conservation Value Assessment goals (HCVRN 2014). The scope of work for the vegetation and flora assessment was to review all information available on vegetation and flora of the region, and undertake a brief site visit. Impacts associated with the existing plantation and comments on High Conservation Value are included in this report.

Details of Specialist
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Expertise of the specialist

- M.Sc. in Botany from Rhodes University;
- Registered Professional Natural Scientist with the South African Council for Natural Scientific Professionals (Ecological Science);
- Registered with RSPO as a certified High Conservation Value Assessor (Plants), since 2011; Founded LD Biodiversity Consulting in 2014;
- Ecological Consultant since 2009;
- Conducted, or have been involved in over 100 Ecological Impact Assessments, Baseline surveys, Biodiversity Action Plans and Offset Plans throughout Africa;
- Published four scientific papers, two popular articles and have three scientific papers in preparation;
- Presented 7 international conference presentations, and at two Botanical Society meetings; and
- Lectured methods for specialist assessment for the Rhodes University short course on EIA.

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Scope and Purpose of Report
The scope and purpose of the report is described in Section 1 of this report.

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Executive Summary

The Lokutu area of influence is bounded by the Congo River in the north and the other boundaries are approximately 30kms from the centre of the plantation. Thus, the area of influence to include is defined by ecosystem rather than concession area, which is more appropriate for this study.

The aim of this study is to provide a flora and vegetation baseline with vegetation maps for the Lokutu area of influence, from which a High Conservation Value (HCV) assessment can be completed. A brief site visit was conducted in February 2015, when each vegetation type was visited and categorized, and an inventory complied. This resulted in the description of four different vegetation types and their dominant or indicator species.

The area of influence is in the Guineo-Congolian regional centre of endemism and comprises Tropical Lowland Rainforest, which is widespread in the Congo. Specifically, the Lokutu area of influence is in The World Wide Fund for Nature (WWF) Global 200 Ecoregion in the Tropical and Subtropical Moist Broadleaf Forests Biome, and includes the Western Congolian Swamp Forests, Eastern Congolian Swamp Forests and the Central Congolian Lowland Forests. A report on the Democratic Republic of Congo (DRC) specific HCV vegetation types describes five vegetation types that are likely to occur within the Lokutu study area. These include: Dense deciduous *Brachystegia laurentii* Forest, Swamp Forest, Permanent Swamp Forest and Dense and deciduous *Gilbertiodendron dewevrei* and *Julbernadia seretii* Forests.

From the field survey, natural vegetation was found to occur in much of the area of influence, primarily to the north bordering on the Congo River. This is important, as this forest patch is an extremely large intact Natural Habitat. Some secondary forest exists in the study area where it is disturbed as a result of human use and movement. Forest types include: Dryland Forest (*Pericopsis elata*), Swamp Forest (*Raphia* spp.), Riparian Forest (*Trichilia* spp) and Disturbed Areas, or Modified Habitat (weeds and ruderal species). This forest tends to grow in a pattern, with wet forest restricted to areas too wet for growing palm and dryland forest restricted to unplanted areas. Oil palm plantations occupy much of the study area.

Two International Union of Conservation of Nature (IUCN) listed species were found (*Afzelia africana* and *Pericopsis elata*) with the greatest threat to Afromosia (*Pericopsis elata*) as it is actively logged for export. It is possible that an extensive vegetation and flora assessment will result in large numbers of species and red listed species being recorded from the area of influence. Alien invasive and weedy species are prevalent in disturbed areas with the most common species being Triffid Weed (*Chromolaena odorata*) and Water Hyacinth (*Eichhornia crassipes*).

The preliminary HCV assessment based on flora is presented here: the large forest area is HCV 2, with HCV 4 encompassing much of the area of influence, and HCV 5. Impacts currently associated with the plantation are restricted to secondary impacts related to human use and other on-going impacts. Impacts include loss of Species of Special Concern, Loss of Biodiversity, Fragmentation, and Alien Invasive species. All can be effectively managed to reduce their significance through the development of a monitoring programme and the development of a farming initiative in cooperation with the community. Out growers schemes would also reduce the impact of the plantation to biodiversity by reducing the reliance on natural resources.

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1 Introduction

The Lokutu Concession is located within the Congo Basin, in the DRC and in the Orientale province. The concession is considered as part of the wider landscape as per HCV requirements (Brown *et al.* 2013). As such, protected areas, regional biogeography and other aspects have been taken into account.

Box 1: Spatial Identification

Regional – The region is the area that is most similar in terms of biodiversity, with boundaries defined by geomorphological features. The region into which the concession falls is the Congo Basin.

National – The borders of the DRC define the National area. This is a political boundary and not often useful in terms of biodiversity and habitats.

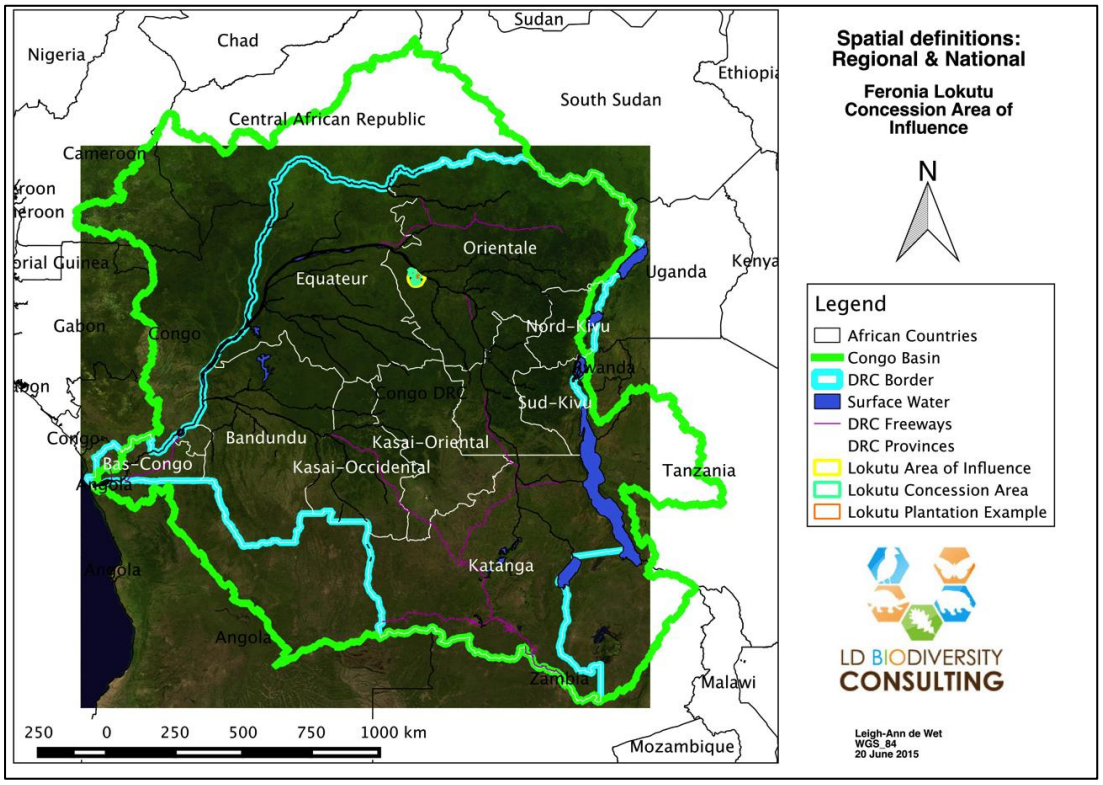
Area of Influence – The study area is an area on a landscape scale defined by the HCV assessor to include the plantations, concession and any other relevant landscape-level attributes. These attributes may include large areas of contiguous forest, for example.

Concession – The concession is the total area for which Feronia holds title deeds. This may include villages, farmlands, and forest areas.

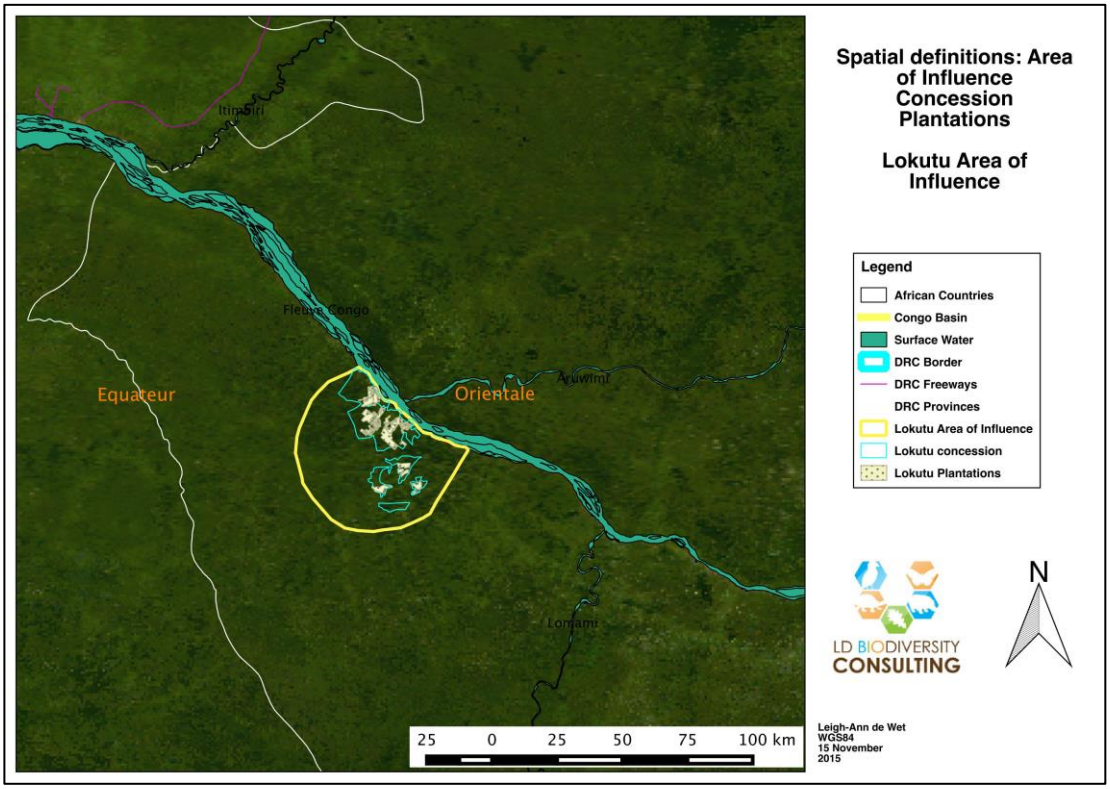
Plantation – The areas in which oil palm is planted. Roads, rivers, forests or villages may border each of these areas.

The area of influence of the project is that area that may be affected by the project, including activities such the development of roads, displacement of resources use by local communities, or areas affected by hydrology. The area of influence in this study was defined as a border around the area of 20kms from the centre of the plantations. The borders were not defined from the centre of the concession and have been identified for the current plantations within the concession. This was done as no additional clearing is planned within the concession boundary extending past the area of influence, rendering this area of the concession as part of the surrounding landscape. Hence there is some disparity between the border of the area of influence and the concession area. For biodiversity assessments, habitat boundaries are most often used to define study areas; in this case no habitat boundaries are present due to the overall homogenous nature of the Lokutu concession and surrounds. One such boundary is formed by the Congo River, and this is preserved as the boundary to the northeast of the site.

The various spatial levels are indicated in Map 1-1 and Map 1-2 and defined in Box 1.



Map 1-1: Spatial definitions: Regional and National



Map 1-2: Spatial definitions: Area of Influence, Concession and Plantation

1.1 Terms of Reference

The Terms of Reference (ToR) include a desktop review, field investigation and report compilation.

Field investigations took place in February 2015 and included:

- Characterisation of vegetation including plant species lists, presence of Species of Special Concern (SSC), alien or invasive species, and areas of sensitivity;
- Determination of the possible presence of any High Conservation Value (HCV) Forests based on the baseline flora and vegetation data.

The report includes:

- Explanation of the methodologies used;
- Results of the study including:
    - Delineation of vegetation habitats on site and a description of the structure and condition of these habitats.
    - Listing of all SSC and their applicable national and international statuses.
- Maps showing significant features of the area of influence;
- A brief HCV Assessment based on the baseline flora and vegetation data; and
- An Impact Assessment (IA) where current impacts associated with the current operations of the plantation are discussed. This includes the impacts on the presence of certain important species as well as the impacts on habitat diversity.

1.2 Assumptions and limitations

Assumptions and limitations; are:

- This study forms the first phase of a detailed assessment and forms the baseline used to determine the HCV status of the study area,
- The preliminary HCV assessment presented here is restricted to the baseline Vegetation and flora data, other aspects are covered in separate reports.

1.3 Expertise of the specialist

Leigh-Ann de Wet, is a flora and fauna specialist with a Bachelor of Science and Honours degree, and a Master of Science degree in Botany (Rhodes University). She is registered as a Professional Natural Scientist, and is an environmental consultant specialising in vegetation assessments, fauna assessments and monitoring plans. She is registered with the Round Table on Sustainable Palm Oil (RSPO) as a High Conservation Value Forest Assessor. Her experience includes ecological impact assessments, baseline vegetation assessments, monitoring plans, biodiversity action plans, and rehabilitation plans in sectors including

renewable energy, mining and palm oil. Leigh-Ann has worked in Mozambique, Malawi, Zambia, Madagascar, Liberia and South Africa.

2 Methodology

2.1 Literature Review and Desktop Study

A desktop study was undertaken, aiming to identify:

- The general vegetation of the region according to WWF, Conservation International and previous reporting on the area;
- Potential species in the area of influence according to literature (previous reporting, available species lists for the country);
- Potential Red Data species and their current status; and
- Current biodiversity and ecosystem status.

2.2 Vegetation analysis

2.2.1 Sample site selection

The vegetation assessment was conducted over 5 days. As such, the most efficient ways of describing the vegetation at a general level were employed. A sampling strategy called stratified random sampling was used.

Stratified random sampling is often used in forestry to ensure the collection of data that best describes the forest. The way in which this is done is that the area to be surveyed is divided up into non-overlapping strata (Czaplewski *et al*. 2004). Here, looking at available satellite imagery for the study site did this. The area was then divided up into clear zones, which corresponded to this imagery. The zones included forest, secondary forest and plantation, for example. Each of these can then be sampled separately to gain an understanding of the composition of these different types. If, in the field, more zones such as different forest types can be seen, then these can be divided up further.

There are several advantages to a stratified random sampling technique (Czaplewski *et al*. 2004). Advantages include:

- It increases the accuracy of population estimates where heterogeneous zones are divided into smaller homogenous zones;
- It allows for the avoidance of estimation bias (for example if secondary and primary forest are lumped together and secondary forest is more accessible, the sample will be biased in favour of secondary forest. Dividing them ensures no bias towards one forest type);
- It allows for the accommodation of different sampling techniques.

2.2.2 Sampling technique

Sampling strategy allowed for the sample plots and transects to be located in each of the different vegetation and forest types present in the study area. For the actual sample technique, a modified Rapid Botanical Survey (RBS) technique was employed. RBS is usually used to study plant communities and describe vegetation (Hawthorne 2012). RBS allows for the elucidation of several aspects of vegetation including:

- Plant distribution, including that of Species of Special Concern (SSC) and invasive species;
- Trends in variation of vegetation including variation following on from environmental variables; and
- Conservation priority of vegetation (Hawthorne 2012).

The RBS survey methodology encompasses and tries to eliminate the issues associated with other methods of vegetation survey including herbarium collections, the Gentry type of survey (measuring certain plants over a measured plot), the releve samples of the Braun Blanquet assessment and the Classic Forestry plots used to measure large trees (Hawthorne 2012).

RBS survey points are unmeasured and plot-less (Hawthorne 2012). They are centred on a point and include the vegetation surrounding that point. Collection occurs from that point and samples of all plants are brought back to the centre until no new plants are collected. Any plants that can be identified in the field are identified there; others are collected and photographed to be identified at a later stage. Thus an idea of the plants present at a particular site, as well as those plants that are dominant and any SSC or invasive species are recorded. Collected plants can also be pressed and added to herbarium collections. (Hawthorne 2012).

For the purposes of this study, where even a standard RBS plot can take up to 5 hours, the methodology was shortened substantially. Each plot or transect was surveyed for the most dominant plant species, as well as SSC and invasive species. Any plant species bearing fruit or flowers was also identified to obtain a more complete list of the vegetation. This allowed for the classification of vegetation on a very general level, but did not allow the full classification of each vegetation type, nor the potential dividing up of the forest types into smaller vegetation types. The result is a broad-scale classification of the vegetation types based on abiotic features and the definitions of secondary and primary forest. This is sufficient for mapping and general vegetation descriptions.

2.2.3 Vegetation mapping

Vegetation was mapped using the information gathered from the sample plots, resultant vegetation communities, and aerial imagery.

2.3 Flora

Through the sample plots, several aspects of the flora were identified; these included the species list, list of Species of Special Concern, and the list of alien and invasive species.

Species list

The species list is compiled mainly from the data gathered from the sample plots and transects. All species occurring in each of the sample plots were identified, either during the site visit or afterwards from photographs. In addition, species seen within the study area, but not occurring within specific sample plots were also recorded. This allowed for the production of a species list representative of the entire study area.

Species of Special Concern

From the overall species list, a list of Species of Special Concern was drawn up. In order to be as comprehensive as possible (considering that so little information is available for the DRC), this list includes plants on each of the following lists:

- International IUCN Red Data list; and the
- CITES list.

An initial list of Species of Special Concern expected to be found within the study area comprises Possible Species of Special Concern (PSSC). If any of these (and any additional species on the above lists) are recorded on site, they are ascribed the status Confirmed Species of Special Concern (CSSC). It is likely that many of the PSSC do occur on site, but were not recorded in this site visit.

According to the IUCN all species are classified in nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (IUCN, 2010). The categories are described in Table 2.1.

Table 2.1: Red Data Categories (IUCN, 2010).

Category		Description
Extinct	(EX)	No known individuals remaining.
Extinct in the Wild	(EW)	Known only to survive in captivity.
Critically Endangered	(CR)	Extremely high risk of extinction in the wild.
Endangered	(EN)	High risk of extinction in the wild
Vulnerable	(VU)	High risk of endangerment in the wild.
Near Threatened	(NT)	Likely to become endangered in the near future.
Least Concern	(LC)	Lowest risk. Does not qualify for a more at risk category. Widespread
Data Deficient	(DD)	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	(NE)	Has not yet been evaluated against the criteria.

The online IUCN data base was referenced in order to identify Red Data Species and their threat status categorizations.

Alien invasive species

Alien invasive species were recorded from each of the sample plots, as well as through opportunistic sightings throughout the study area. Alien invasive species are those that are not indigenous and can create problems by invading areas that should be open to indigenous species. These plants can reduce habitat size and impact on community structure.

3 The Study Area in Context

In this section, various different areas will be discussed. These are defined in Box 3-1 below:

Box 3-1: Biodiversity spatial references

Spatial references for biodiversity include the following:

Region – "The region" is used referring an area comprising the same overall forest type. The "region" in this case is the Tropical and Subtropical Moist Broadleaf Forests of the Congo Basin.

Vegetation type – this usually refers to a specific vegetation type described by a map of the region. Where such a map is lacking, the most recent classification is used. For this study that is the WWF Ecoregions map. Lokutu contains three such "vegetation types": Western Congolian Swamp Forests, Eastern Congolian Swamp Forests and Central Congolian Swamp Forests.

3.1 Vegetation Map of Africa

White developed a vegetation map of Africa that described several regions (White, 1983). He defined five categories of vegetation and 17 different vegetation types. One of the predominant areas defined by White (1983) is the Guineo-Congolean regional centre of endemism. The centre comprises mainly forest, which is defined by White as a continuous stand of trees at least 10 m tall, with interlocking crowns. The centre (Zone 1 on White's map) contains approximately 8,000 species of plants, with about 80% of these endemic to the region of endemism. White notes nine endemic families; 25% of the genera in the region are endemic.

Lokutu is in the Tropical Lowland Rainforest vegetation type described by White (Figure 3-1). Within the Guineo-Congolian Region are areas of cultivation, secondary forest and various other transitional vegetation types. There is also swamp forest. Drier forest types also include cultivated and wooded areas. Although White's classification forms an important basis for the description of the vegetation of the region, it will not be expanded upon further as there are more recent classifications. ..

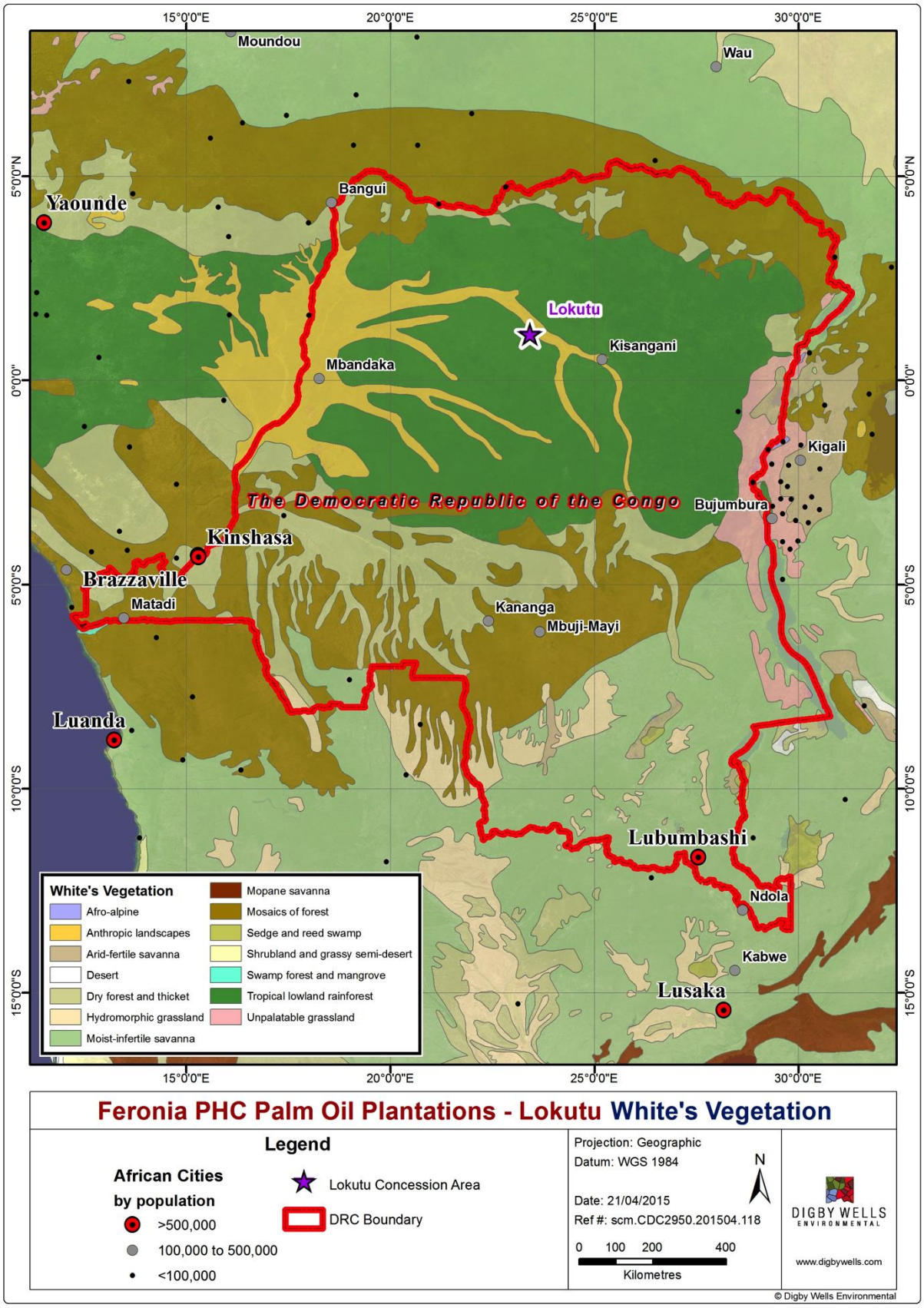


Figure 3-1: Vegetation map of the Lokutu Study Area (White 1983).

3.2 Global 200 Ecoregions

The WWF has mapped 238 regions globally using several features including: high species richness, high numbers of endemic species, unusual higher taxa, unusual ecological or evolutionary phenomena, and the global rarity of habitats (Olson & Dinerstein 2002). These regions include terrestrial, marine and freshwater ecosystems and their conservation would "help conserve the most outstanding and representative habitats for biodiversity on this planet" (Olsen & Dinerstein 2002. pg 199). The study aimed to identify quite large areas that can be globally conserved, representative of all the biomes. Ecoregions are identified on a continent-level scale and are defined as: "a relatively large area of land or water containing a characteristic set of natural communities that share a large majority of their species, ecological dynamics, and environmental conditions" (Olsen & Dinerstein 2002, pg 200). In terms of terrestrial ecoregions, into which the Tropical and Subtropical Moist Broadleaf Forests of the DRC fall, Olsen & Dinerstein did intensive analysis of biodiversity patterns in order to define them. The Congo Basin and surrounding area contain a few of the Global 200 Ecoregions. Conservation status of these Ecoregions is based on landscape level criteria such as habitat loss, fragmentation and future threat. These include the following:

- Congolian Coastal Forests (Critical or Endangered);
- North-eastern Congo Basin Moist Forests (Vulnerable);
- Central Congo Basin Moist Forests (Relatively Stable or Intact); and the
- Western Congo Basin Moist Forests (Vulnerable).

Selection criteria for these Ecoregions are based on data from regional analyses and each area is classified according to whether it is globally outstanding, regionally outstanding, bio-regionally outstanding or locally important. Areas that are globally or regionally outstanding were chosen by Olsen & Dinerstein as potential Ecoregions and were evaluated using a set of criteria including:

- Species richness and endemism;
- High taxonomic uniqueness (endemic families or genera);
- Unique ecological or evolutionary phenomena (for example large intact habitats and large vertebrate assemblages or migrations);
- Global rarity (if the habitat is represented in fewer than eight distinct regions globally);
- Intactness; and
- Representation (where regions are the best representative of the biome where they are not selected for another criterion) (Olsen & Dinerstein 2002).

The Ecoregions of the Congo region have not been well studied, but may well be the most diverse in the Afrotropics (Olsen & Dinerstein 2002).

3.2.1 Tropical and Subtropical Moist Broadleaf Forests

Tropical and subtropical moist broadleaf forests are characterised by high rainfall, low temperature variability and dominance of semi-evergreen and evergreen deciduous trees and usually occur along the equator and between the Tropics of Cancer and Capricorn (WWF 1 2015). Species diversity in this type of forest is exceptionally high with thousands of tree species making up these forests. The forest structure tends to be in five layers: overstory canopy with emergent trees, medium canopy, lower canopy, shrub level and the understory which comprises small plants such as herbs and ferns. The species richness in this ecosystem is the highest in the world, with an estimated 50% of the world's species living in this forest type, both animals and plants. Threats to this ecosystem include clearing for agriculture and commercial logging, and secondary impacts. It is estimated that the extinction rate for these forests is approximately 17,000km^2 per year at the current deforestation rate (WWF 1 2015).

According to the map of the Global 200 Ecoregions, Lokutu is in the Central Congo Basin Moist Forests regions, and is bordered by the Congo River, which is in the Western Congo Basin Moist Forests (Figure 3-2). There are three different regions encompassing the Lokutu study site:

- Western Congolian Swamp Forests (AT0129);
- Eastern Congolian Swamp Forests (AT0110); and
- Central Congolian Lowland Forests (AT0104).

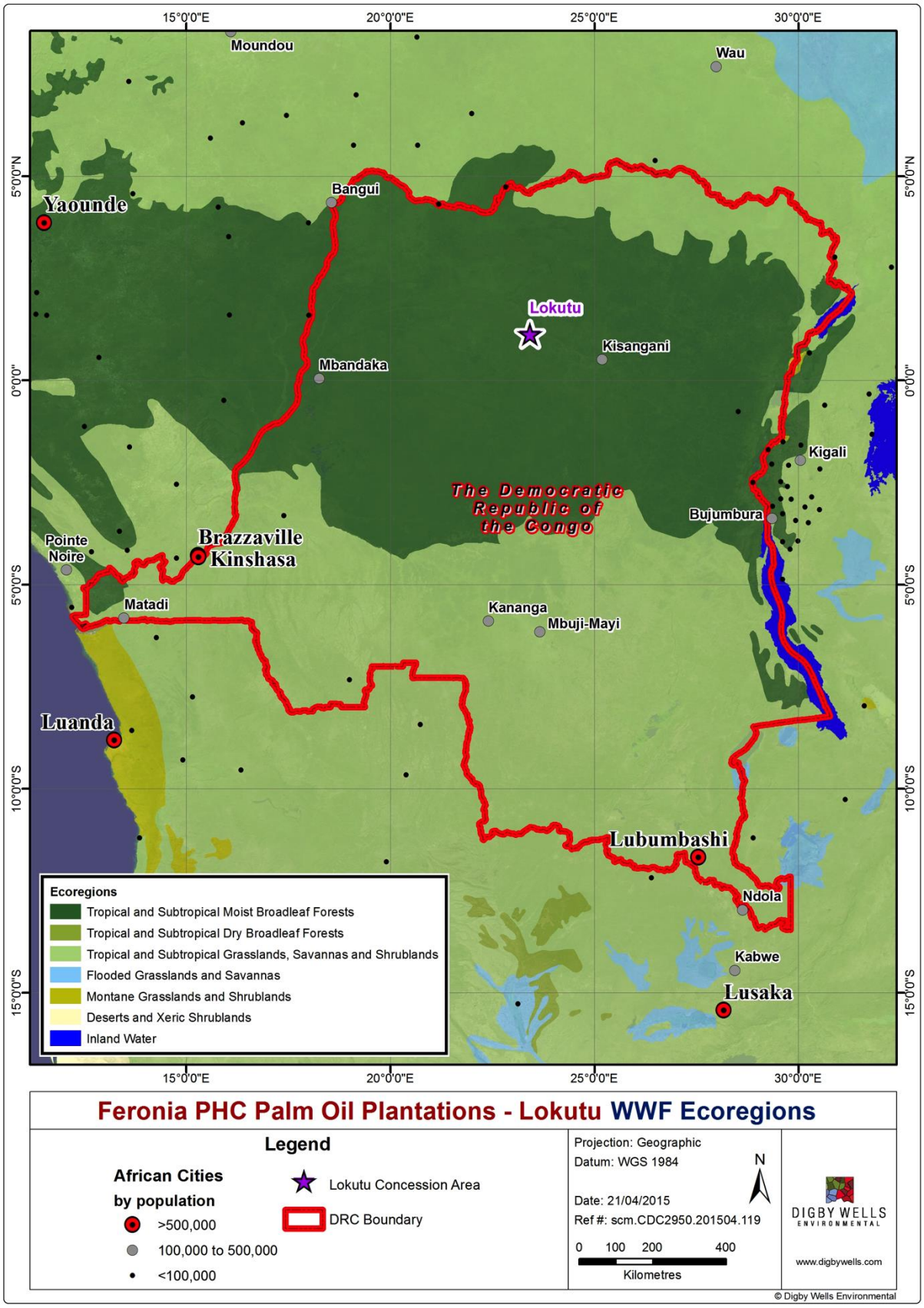


Figure 3-2: Map of the Global200 Ecoregions of the Lokutu study area.

3.2.2 Western Congolian Swamp Forests

Two swamp forest types exist in the region (i.e., the Eastern and Western Congolian Swamp Forests); together they form the world's largest area of swamp forest (Blom 2015a). The Western Congolian Swamp Forest covers an area of 49,700 square miles on the right bank (facing downriver) of the Congo. These swamps are in a sedimentary basin known as the Cuvette Congolaise. This Ecoregion has not been well studied so little is known about species richness and endemicity, it is thus an Ecoregion primarily due to its intactness. This swamp forest forms important habitat for forest elephants (*Loxodonta africana cyclotis*) and the western lowland gorilla (*Gorilla gorilla gorilla*), both of which are under severe pressure due to poaching (Blom 2015a).

The topography comprises flat alluvial plain with an altitude of about 400m, the average annual rainfall is approximately 1,800mm, with average maximum temperatures around 30°C, and minimum temperatures around 22°C with high humidity (Blom 2015a). There are no real seasons due to being on the equator. The forest is flooded during wet periods. The area comprises a mosaic of swamp forest, flooded grasslands, open water and relatively dry forest on higher areas.

Species common to the Ecoregion include *Guibourtia demeusei, Mitragyna* spp., *Symphonia globulifera, Entandophragma palustre, Uapaca heudelotii, Sterculia subviolaceae, Alstonia congensis, Manilkara* spp., *and Garcinia* spp. Flooded areas are characterized by the *Raphia* palm and forests on higher ground are characterised by large numbers of lianas, *Gilbertiodendron dewevrei* and *Daniellia pynaertii*. As in the Eastern Congolian Swamp Forests the arrowroot (*Marantochloa* spp.) and the giant ground orchid *Eulophia porphyroglossa* can be found (Blom 2015a).

3.2.3 Eastern Congolian Swamp Forests

Two swamp forest types occur in the region; Eastern and Western Congolian Swamp Forests; and together form the world's largest area of swamp forest (Blom 2015b). The Eastern Congolian Swamp Forest covers an area of 35,800 square miles on the left bank (facing downriver) of the Congo. The Eastern Congolian Swamp Forest forms on of the Ecoregions due to the fact that it is largely intact, even though endemism and species richness in not outstanding. This is one of the least surveyed areas in the world and may contain many more species than are currently known. It also forms habitat for the forest elephant (*Loxodonta africana cyclotis*) and the bonobo (*Pan paniscus*), both of which are heavily poached, especially along main waterways such as the Congo River (Blom 2015b).

The region is mostly flat, with an elevation of approximately 350 m. The average annual rainfall of over 2,000mm (Blom 2015b). Average maximum temperatures are over 30°C, and mean minimum temperatures about 20°C; humidity is very high. There are no clear seasons.

The vegetation of the region is a mosaic of swamp forest, open water, dryland forest and seasonally inundated forest and savannas. Typical species of the swamp forests include

Guibourtia demeusei, Mitragyna spp.*, Symphonia globulifera, Entandophragma palustre, Uapaca heudelotii, Sterculia subviolaceae, Alstonia congensis, Manilkara* spp., and *Garcinia* spp*.* Permanently inundated forests are characterized by *Raphia* palm. Drier forests tend to have large numbers of climbers and are dominated by *Gilbertiodendron dewevrei* and *Daniellia pynaertii*. The arrowroot (*Marabtochloa* spp.) and the orchid *Eulophia porphyroglossa* occur (Blom 2015b).

3.2.4 Central Congolian Lowland Forests

This Ecoregion occurs to the south and west of the Congo River in the Cuvette Centrale (Blom 2015c). It is an Ecoregion due to its intact nature and the presence of the important bonobo (*Pan paniscus*). The levels of endemicity and species richness are largely unknown as the area is little studied although it is estimated that about 2,000 species of vascular plants occur here, with 10% endemicity. The area is bounded by the Congo River and associated swamp forests in the north, east and west. The forest graduates to savanna-forest mosaic in the south. The Ecoregion covers 160,200 square miles. The topography is largely the same with an elevation of approximately 400m; some hills of up to 800 m are in the southeast. The area receives high rainfall, with a mean average rainfall of 2,000mm. The annual average maximum temperature is around 30°C in the centre and 27°C in the southeast; the annual average minimum is between 18°C and 21°C and humidity is high. There is very little seasonality in the region due to its location in the tropics, (Blom 2015c).

The vegetation of this Ecoregion is quite complex (Blom 2015c). The vegetation ranges from permanently to seasonally inundated swamp forest, to dryland forest on slightly elevated areas that may be evergreen or semi-evergreen. Stands of *Gilbertiodendron dewevrei* dominate evergreen ombrophile forests in the region. Towards the southern part of the Ecoregion the land becomes drier and harbours peripheral semi-evergreen rain forest and, towards the southernmost portion, a mosaic of Lower Guinea rain forest and grasslands occurs. The main forest type is that of semi-deciduous forest comprising the dominant species *Staudtia stipitata, Polyalthia suavaeoleus, Scorodophloeus zenkeri, Annonidium mannii* and *Parinari glaberrimum* (Blom 2015c).

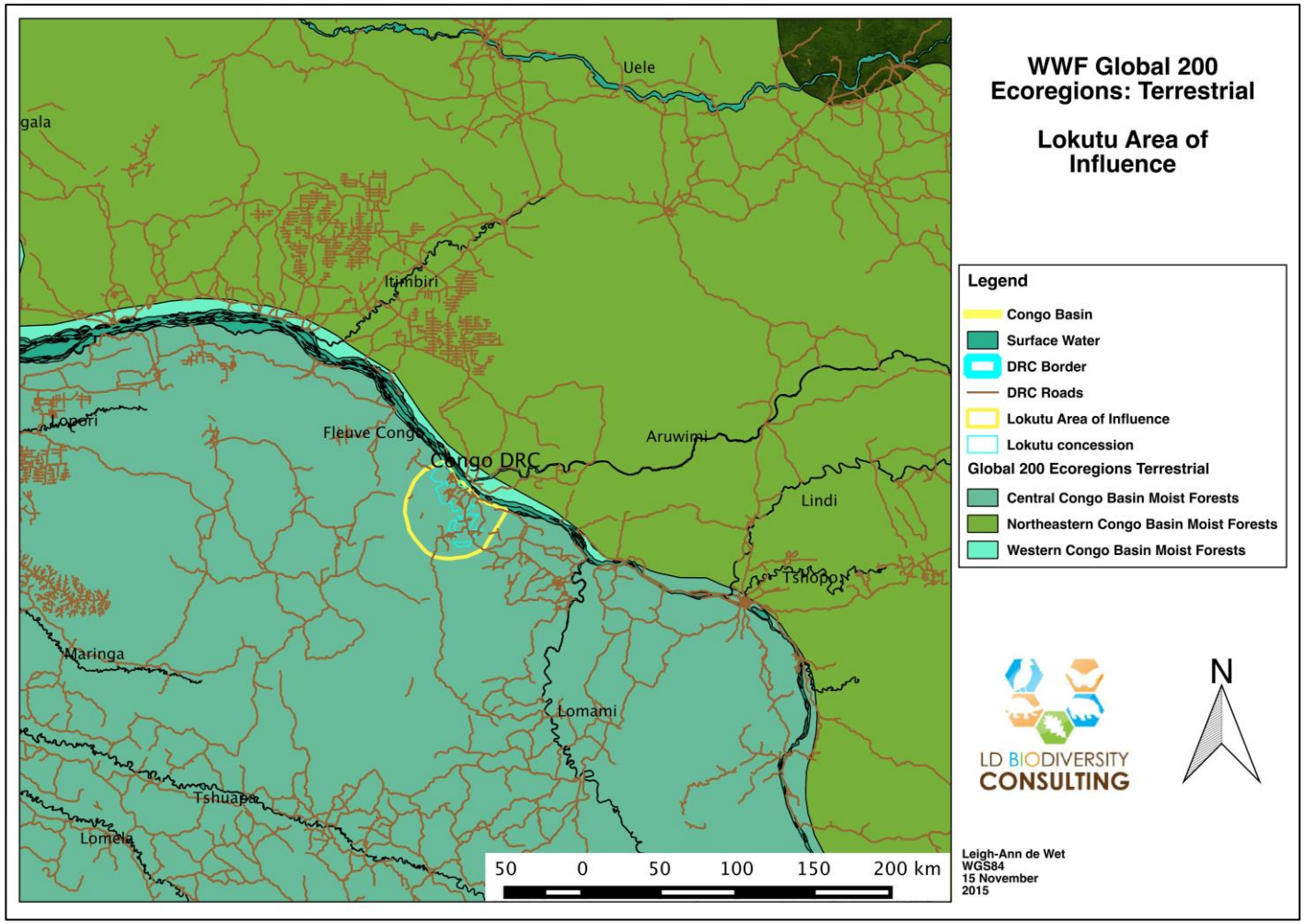


Figure 3-3: WWF vegetation types of the Lokutu study area

3.3 Forêts de Haute Valeur pour la Conservation en RDC

The Proforest Initiative produced (2012), a report for country-specific High Conservation Value (HCV) forest assessments in the DRC (The Proforest Initiative 2012). The report describes several different forest types of the area, although not mapped, four of these are applicable to the study area and are summarised in this section:

- Dense deciduous *Brachystegia laurentii*;
- Swamp forest;
- Permanent swamp forest; and
- Dense and deciduous *Gilbertiodendron dewevrei* and *Julbernadia seretii.*

3.3.1 Dense deciduous *Brachystegia laurentii*

These forests are found exclusively in the crest zone of the north central part of the country (The Proforest Initiative 2012). They are characterised by *Brachystegia laurentii, Julbernadia seretii, Polyalthis suavolens, Staudtia stipitata* and *Annonidium mannii.*

3.3.2 Swamp forests

The swamp forests comprise medium to tall trees on the banks of rivers between crests and plateaus (The Proforest Initiative 2012). Swamp forest areas tend to be one of two types:

- Some are seasonally inundated, and thus are dry for part of the year and heavily waterlogged for other parts of the year. The canopy height is usually 15 to 35 metres.
- Others are permanently inundated, also with medium height canopy. Characteristic species include *Baphia dewevrei, Cleistopholis patens, Diallium corbisieri, Lasiodiscus mannii, Milletia drastica, Scytopetalum piereanum, Baikiaea robynsii, Beilschmedia corbisieri, Symphonia globulifera, Trichilia rubescens, Trichilia lanata, Uapaca guinensis, Cleistanthus inundates, Cleistanthus milbraedii, Coelocaryopan botryoides, Daniellis pynaertii, Dichostemma glaucesccens, Entandophragma palustre, Grewia luisii, Guibourtia demeusei, Hallea stipulosa, Oubanguia africana, Pycnanthus marcakianus, Rothmania sp., Sarkersia laurentii, Lonchocarpus griffonianus, Memecylon sp.,* and *Macaranga saccifera* (The Proforest Initiative 2012).

3.3.3 Permanent swamp forest

These swamp forests occur along large or medium watercourses and in areas with poor drainage. Typical species include *Bridelia sp., Antidesma leptobotryum, Macaranga saccifera, Memecylon sp., Raphia laurentii, Alchornia cordifolia* and *Sarkesia laurentii*.

3.3.4 Dense and deciduous *Gilbertiodendron dewevrei* and *Julbernardia seretii*

Dense and deciduous forests are dominated by *Gilbertiodendron dewevrei* and *Julbernardia seretii*, which form monotypic stands and comprise an average of 50% of the total surface area of these types of forest. The canopy is dense and of a medium height. Other tree species semi-deciduous. The canopy tends to be very tall in waterlogged areas and shorter in dryland forests of this type. Typical species of this forest type include *Drypetes gossweileri, Diogoa zenkeri, Scorodophleus zenkeri, Staudia stipitata* and *Annodium mannii*.

4 Results and Discussion

4.1 Vegetation

At this stage it is important to define some terms associated with vegetation and habitats. The habitats assigned to the vegetation of the area of influence are those described by the IFC. IFC PS6 outlines two different categories of habitat (a third one, Critical Habitat, can be formed from either of the two but is not determined here), which are defined in

Box 4-1. The methodology used for determining the habitats into which the vegetation falls is described in Figure 4-1.

Box 4-1: forest definitions

"*Modified Habitat*

11. Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.

12. This Performance Standard applies to those areas of modified habitat that include significant biodiversity value, as determined by the risks and impacts identification process required in Performance Standard 1. The client should minimize impacts on such biodiversity and implement mitigation measures as appropriate." Reference?

Natural Habitat

13. Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin. And/or where human activity has not essentially modified an area's primary ecological functions and species composition.

14. The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated:

- No other viable alternatives within the region exist for the development of the project on modified habitat;
- Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conservation and degradation; and
- Any conversion or degradation is mitigated according to the mitigation hierarchy.

15. In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible. Appropriate actions include:

- Avoiding impacts on biodiversity through the identification and protection of set-asides;
- Implementing measures to minimize habitat fragmentation, such as biological corridors;
- Restoring habitats during operations and/or after operations; and
- Implementing biodiversity offsets.

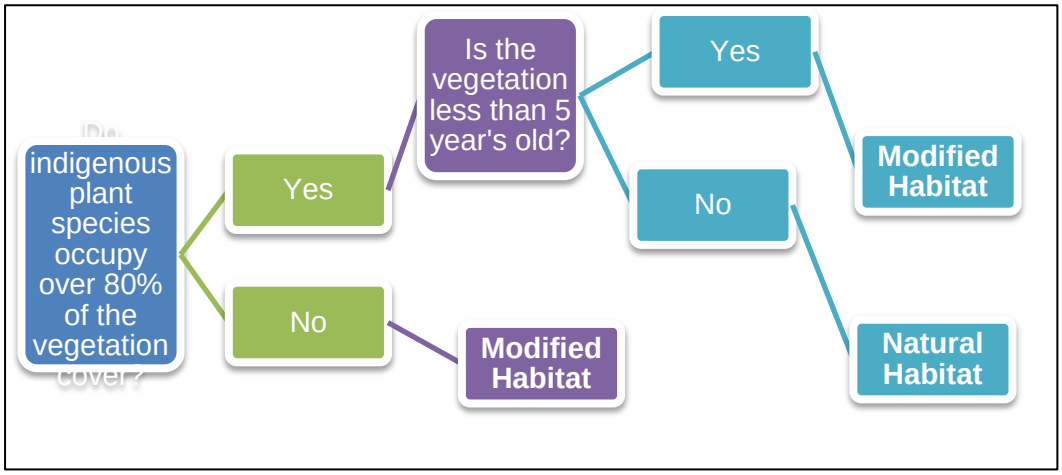


Figure 4-1: Decision tree for determining IFC Habitat type within the Feronia area of influence.

The Lokutu concession area is about 60 000ha, with areas of natural habitat comprising moist forest and large areas of swamp forest along the rivers and watercourses. Limited areas of riparian forest occur along steep riverbanks. Areas of the area of influence are planted with oil Palm (*Elaeis guineensis*); the first of which was planted over 100 years ago. Oil palm is planted largely in dryland areas, with some planted in areas that are seasonally inundated (Figure 4-2). Very few plantations are in areas that are permanently inundated (Figure 4-3).

Figure 4-2: An Oil Palm plantation in a seasonally inundated area

Figure 4-3: An Oil Palm plantation in a permanently inundated area

Most of the Lokutu plantation is on dryland tending towards seasonally inundated areas.

Apart from oil palms, the remainder of the concession is forest which occurs along riverbanks; it forms riparian forest on steep banks and swamp forest on the shallow banks. The areas currently planted with oil palm would have been dryland rainforest; dryland rainforest may exist in the north of the concession where palms have not been planted.

Overall, a clear pattern can be seen in the Lokutu area of influence. The lowest altitude areas have rivers and are dominated by swamp forest, a transitional forest type has developed in areas that are seasonally, rather than permanently, inundated and the altitude increases. At the highest altitudes of the area of influence, dryland rainforest is present. Figure 4-4 shows this change in vegetation according to altitude.

In summary, the vegetation types are indicated by specific species and morphology. Riparian forest occurs on steep riverbanks and tend to be very tall (40 m) and dominated by species such as *Trichilia* spp. Where river banks are shallow, swamps form. The swamps are poorly drained and contain hydrophilic plant species such as the very typical *Raphia* spp. Dryland forests tend to have very tall trees with a mix of forest species including the heavily logged Afromosia (*Pericopsis elata*).

Currently, little dryland forest exists in the Lokutu concession, as this is where the palms have been planted. Figure 4-5 shows a view of the Lokutu plantation and the way in which palm is planted; it can be seen that it is planted in the dry areas and the swamp and riparian

forests have been avoided. Figure 4-6 shows the current average vegetation based on altitudinal variations and the location of the palm plantations. Local communities for cultivation, commonly use areas around swamps that are not planted with palms. The cultivated areas form a band between the rivers and palm plantations in some places in the concession area.

Figure 4-4: Palm is planted in areas that are relatively high, with the swamp and riparian forests left intact.

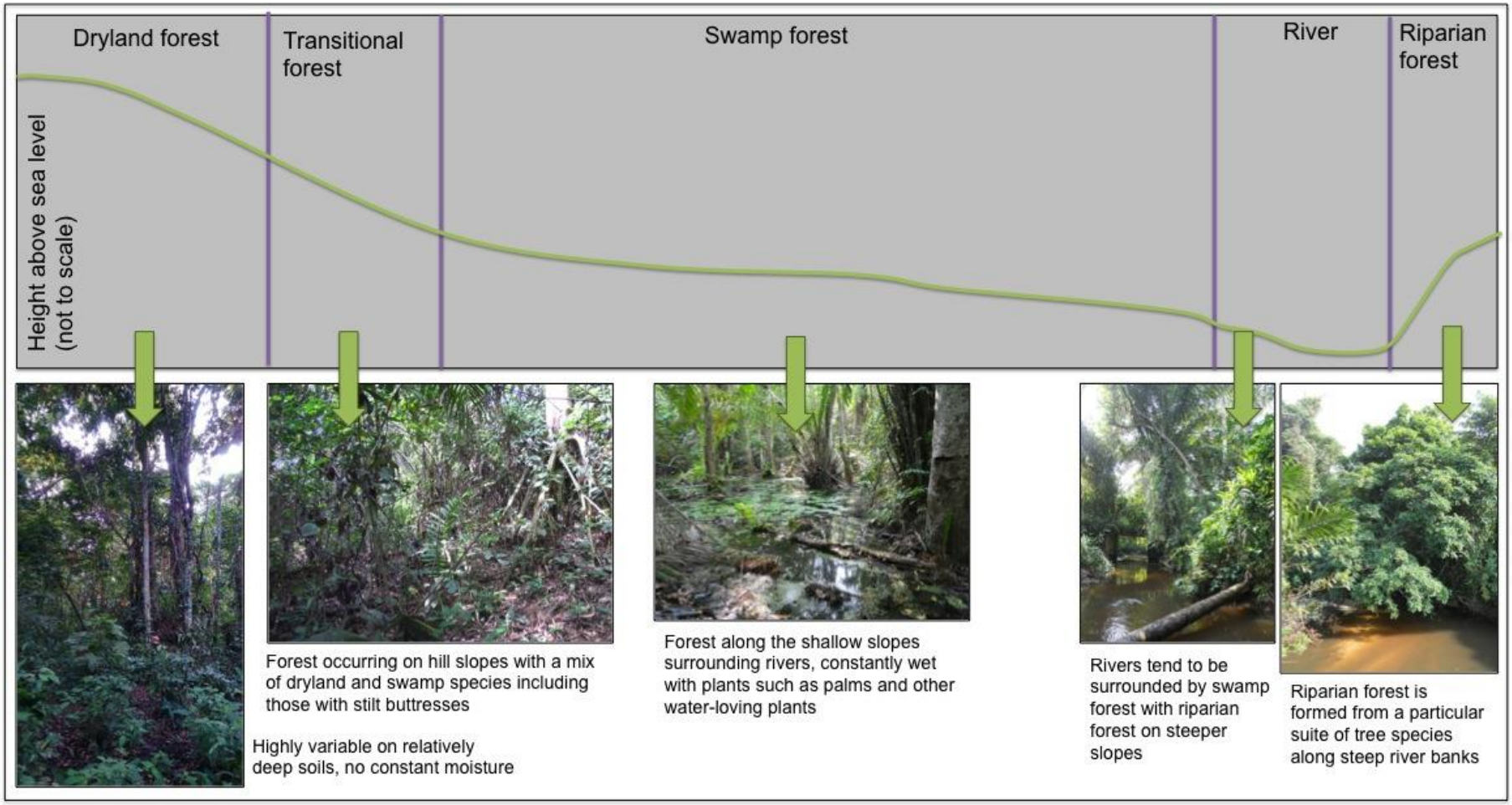


Figure 4-5: Diagram showing vegetation changes along water and altitude gradients

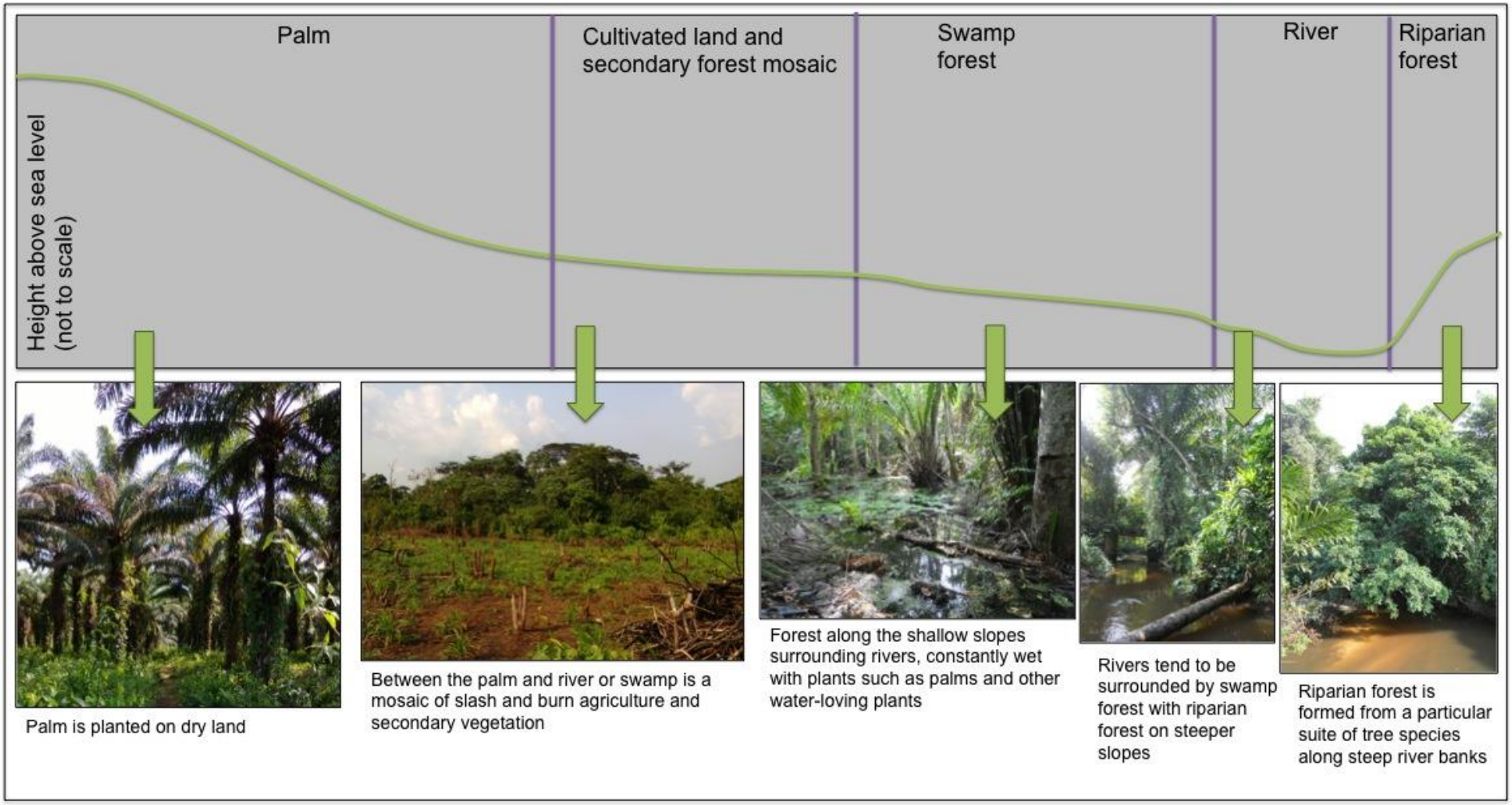


Figure 4-6: The changes in the vegetation in a palm plantation due to water and altitude gradients

The vegetation of the Lokutu study area has been mapped to indicate the distribution of plantations and forests (February 2015). Figure 4-7 shows the vegetation map for the Lokutu area of influence. Indicator species can be used to determine which forest type is present.

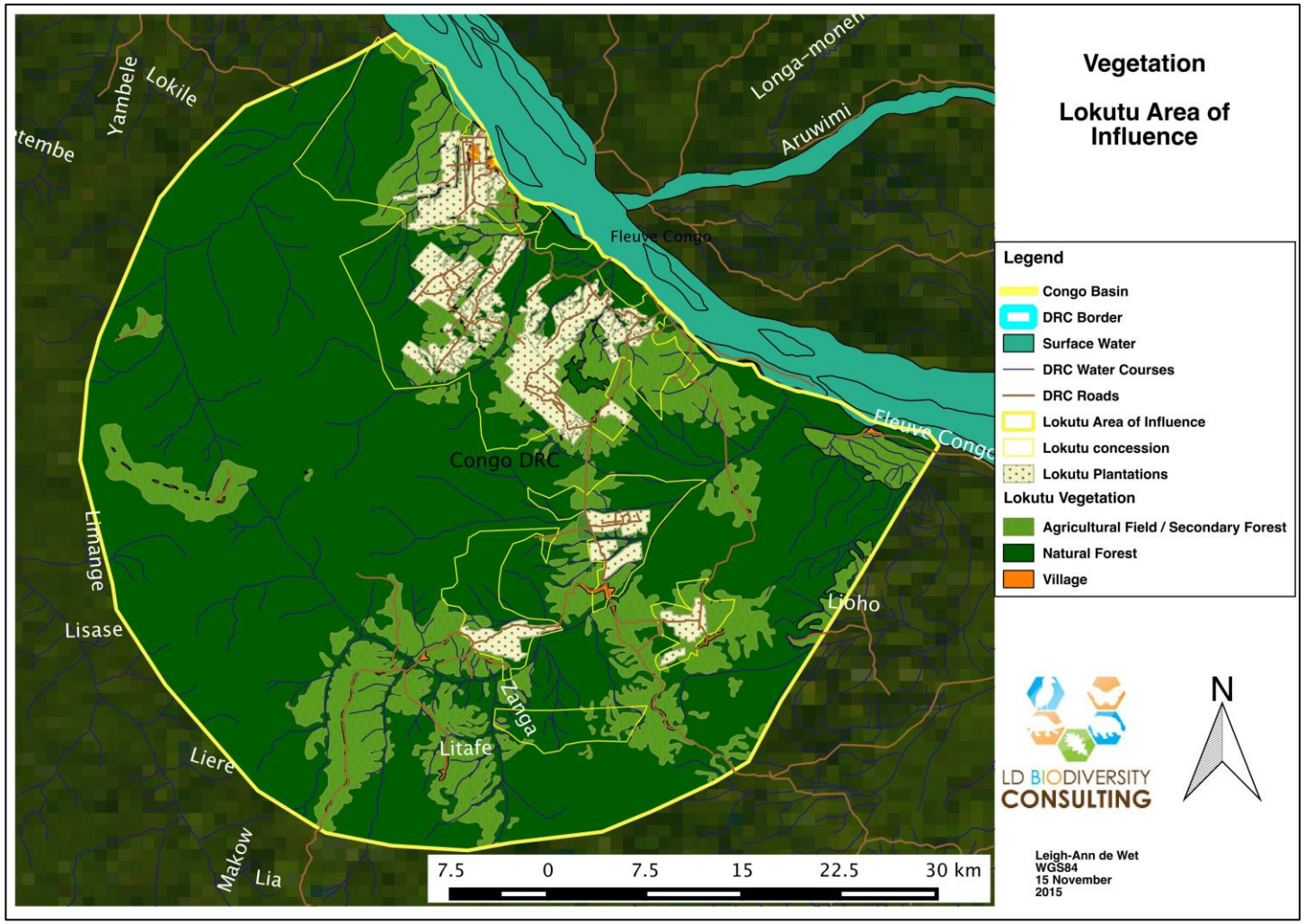


Figure 4-7: Vegetation map of the Lokutu study area

4.1.1 Dryland forest

The main tract of dryland forest is north of the area of influence, where an extensive tract of forest with low disturbance is contiguous with a very large area of relatively undisturbed forest outside the area of influence. Forest with low disturbance is very important, and it can be given a high sensitivity based on its relative intactness and the habitat that it provides in this fragmented landscape. Much of the dryland forest in the remainder of the area of influence is disturbed, or even secondary in nature. Disturbance is mainly due to logging, especially of Afromosia (*Pericopsis elata*) (Figure 4-8).

Figure 4-8: Planks of Afromosia (*Pericopsis elata*) which are logged from the forests of the Lokutu area of influence.

Dryland forest tends to be very tall, with trees reaching heights of 40 to 50 m with some emergent crowns up to 65 m. The vegetation structure is complex, with the upper canopy formed by the emergent trees and the main canopy formed by the bulk of the tree species. There is a medium canopy height formed by smaller trees of approximately 20 m, and a short canopy formed by small trees 10 to 15 m. A shrub layer, which is on average 2 to 3 m and the herbaceous layer, which is on ground level comprising plant species that survive in very low light are also present. It is at this herbaceous layer where ferns, mosses and low, large-leafed monocotyledonous species are found. Figure 4-9 shows dryland forest, and a few species that may be found there.

This forest type is very diverse. An important species found in this forest and often logged from the area is Afromisia (*Pericopsis elata*). Species commonly found in this forest type include: *Afzelia africana, Albizia versicolor, Ceiba pentandra, Parkia bicolor, Pycnanthus*

angolensis and *Xylopia aethiopica*. A full species list for this vegetation type, and for the general area of influence can be found in Appendix 1.

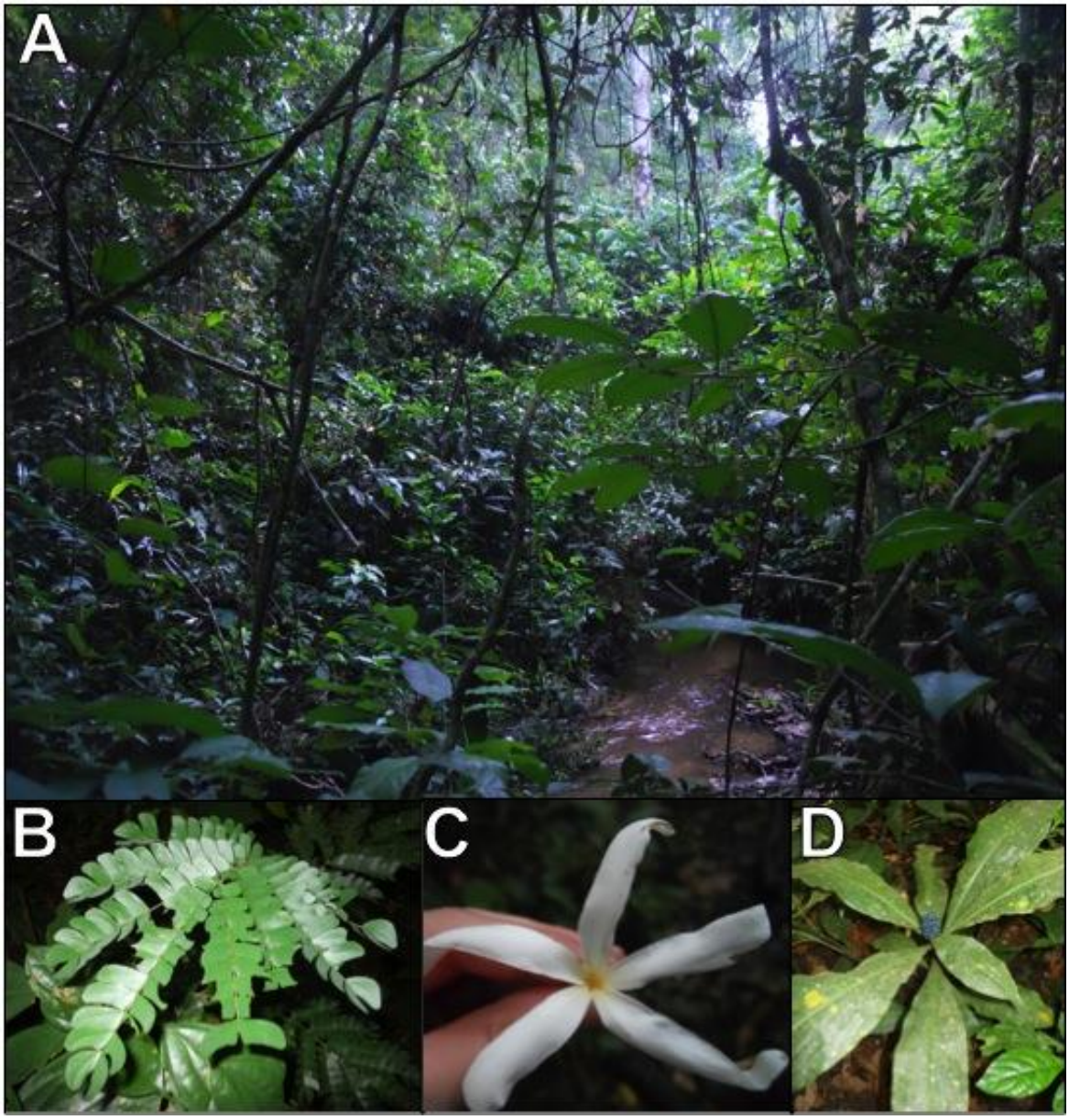


Figure 4-9: A: dryland forest of the Lokutu area of influence. B: *Albizia versicolor*, a common tree species found in the forests of the study area. C: A *Jasminium* species, a commonly found genus in the study area and D: unidentified species.

4.1.2 Riparian forest

Riparian forest occurs throughout the area of influence, mainly along steep banks of the Congo River, its tributaries or streams. Although it may have many of the same species as the surrounding swamp forest, it is distinct in that it has a few typical species and occurs in areas that tend not to be inundated (either seasonally or permanently). This forest type is tall, up to about 40m and occurs as a narrow strip, not usually exceeding 50 meters from the

bank of the rivers. Although it may sometimes occur along the banks of small rivers, it mainly occurs along the banks of the larger rivers of the area of influence.

The forest type is not particularly diverse, but does contain some diagnostic species including the rapid-growing bamboo (*Bambusa vulgaris*). Typical of this vegetation type are two *Trichilia* species: *Trichilia retusa* and *Trichilia welwitschii*, as well as *Uapaca guinensis*. *Entada wahlbergii* and *Anthocleista* spp are also commonly found in the riparian forest of the area of influence. Riparian forest is shown in Figure 4-10 below.

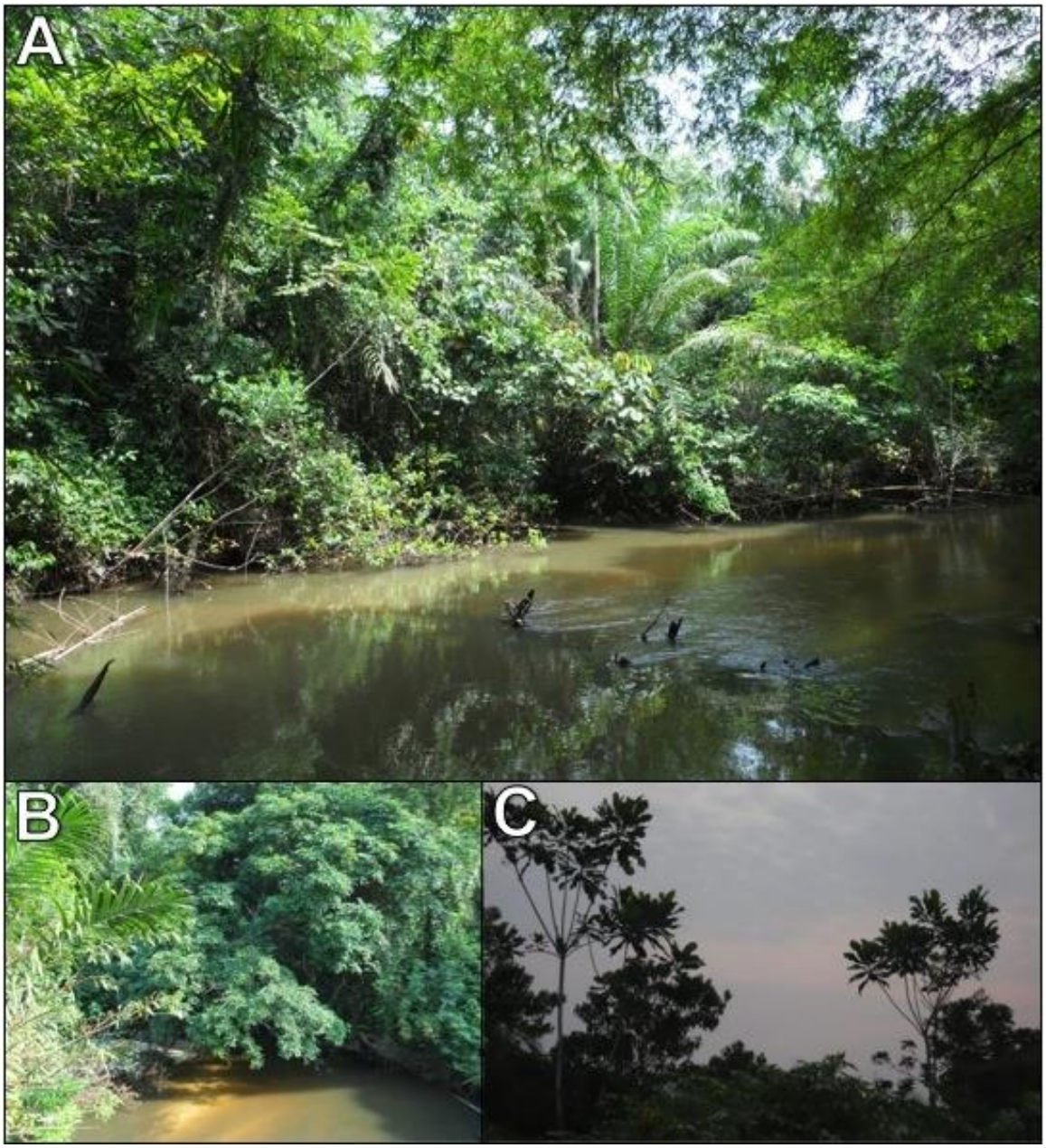


Figure 4-10: A: Typical riparian forest of the area of influence with *Bambusa vulgaris* growing close to the water. Species common to the riparian vegetation of the area of influence include B: *Trichilia retusa* and C: *Anthocleista* sp.

4.1.3 Swamp forest

The swamp forest is typical of the region and occurs in both seasonally and permanently inundated areas. This forest can range from being somewhat short (10 to 20m) to very tall (up to 40m) depending on the level of inundation (where land is seasonally inundated, larger trees tend to grow). Swamps are restricted to the shallow banks of rivers and streams and due to the low-lying nature of the area of influence, are very common. Where they are permanently inundated, the swamp areas are dominated by *Raphia* palm, which is used by the local people to make palm wine. These permanently inundated areas also house some water-loving species such as *Nymphaea* species and the invasive aquatic weed *Eichornia crassipes*.

Overall, typical species in the swamps include the dominant *Raphia* palms, along with trees with stilt buttresses such as *Uapaca* species and relatively small monocotyledonous species. Also found in swamp forests are *Bambusa vulgaris, Anthocleista* sp, *Macaranga* sp and *Musanga* sp. Figure 4-11 shows the swamp forest of the area of influence.

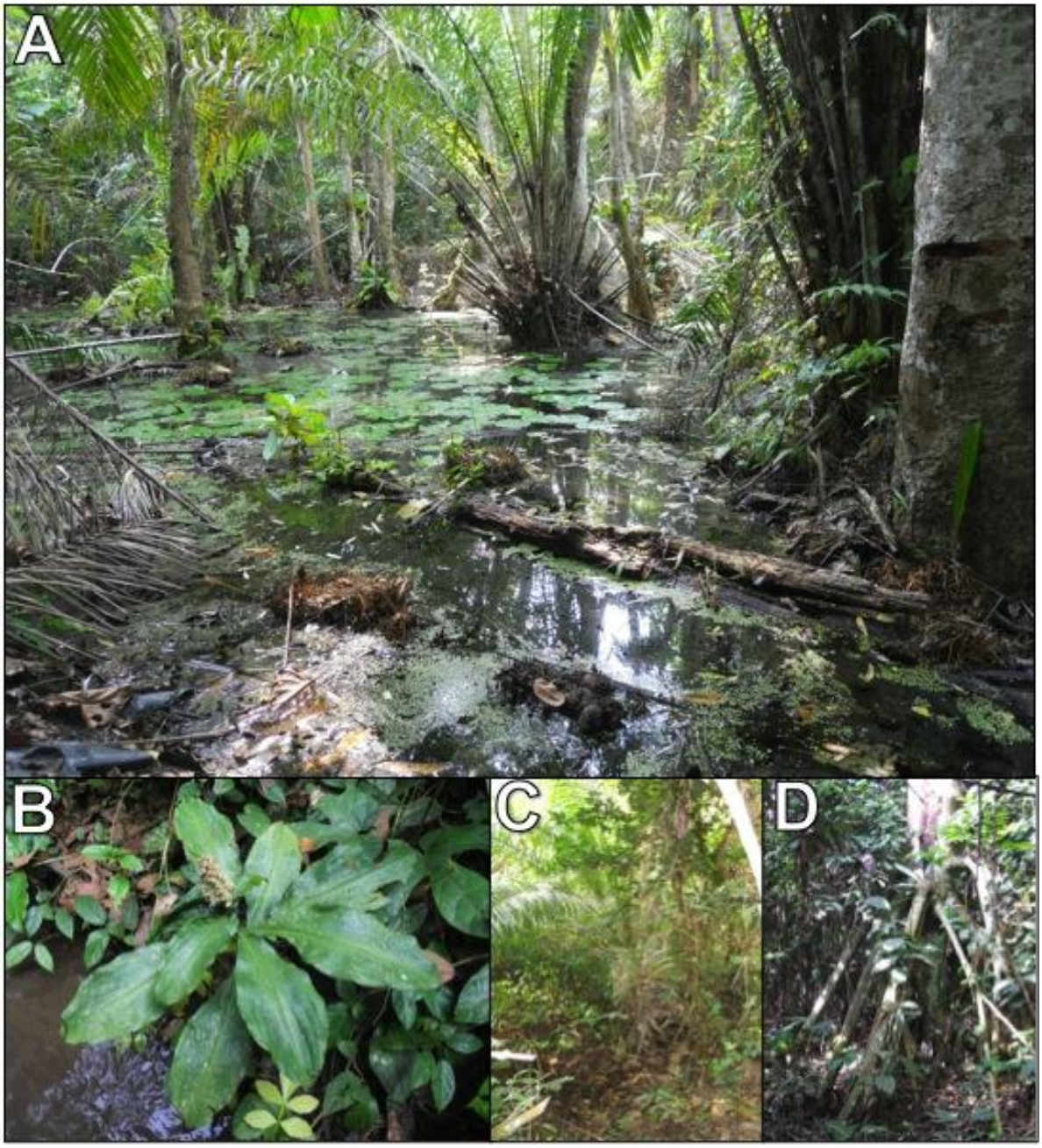


Figure 4-11: A: Swamp forest of the area of influence with dominant *Raphia* palm and the water plant *Nymphaea* sp. Swamp species also include B: a typical understory species unidentified at this stage, C: *Raphia laurentii* and D: *Uapaca* sp. Showing typical stilt roots

4.1.4 Modified Habitat

Disturbed areas, or Modified Habitat are any areas that have been modified by man, including plantations. They no longer contain the indigenous forest of the region. Most of the disturbed areas have been cleared by local people for agriculture, or are currently under plantations. They typically contain weeds and fast-growing ruderal indigenous species that would normally colonise gaps in the forest caused by tree falls.

Common species in disturbed areas include: *Bambusa vulgaris, Canna indica, Ceropegia purpurascens, Chaemaecrista pratensis, Chromolaena oderata, Commelina africana, Costus afer, Macaranga monandra, Macaranga saccifera, Mimosa invisa, Setaria megaphylla, Sida acuta,* the giant ground orchid *Eulophia porphyroglosssa* and the very common *Alchornia cordifolia*. Figure 4-12 shows some of these species.

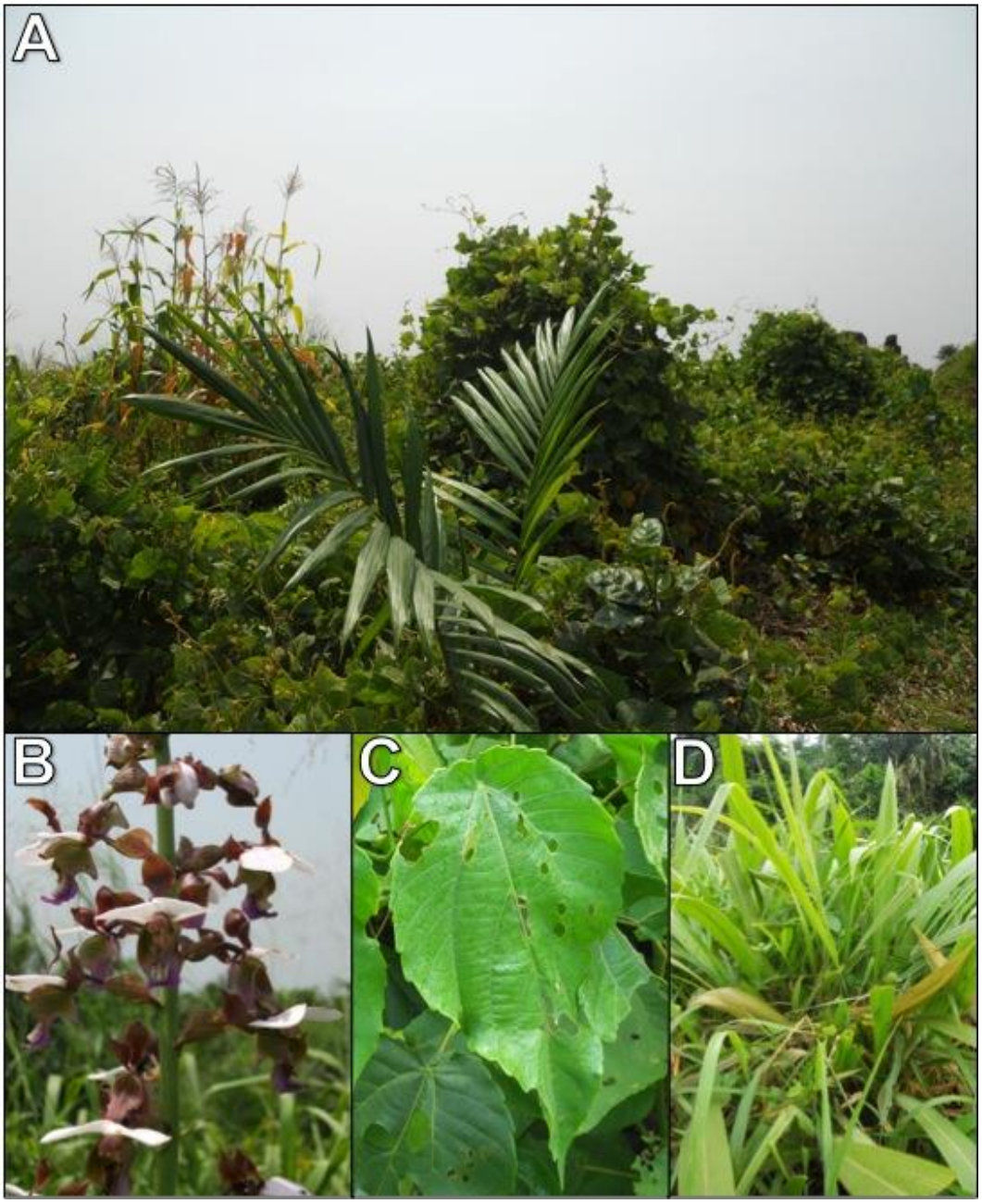


Figure 4-12: A: a typical disturbed area with the new palms growing in the plantation, B: the giant ground orchid *Eulophia porphyroglossa* typical of open areas, C: *Alchornia cordifolia* and D: *Setaria megaphylla*

4.2 Flora

It is possible that new species, and new ranges will be recorded with a more in-depth study. However, for the purposes of this study, a brief inventory was done on plants found flowering or fruiting.

In this study, 87 species were recorded including weeds found in the villages and disturbed areas. The Fabaceae was the most abundant family, with 11 species recorded.), Annonaceae (3 species), Apocynaceae (4 species) and Euphorbiaceae (4 species). A species list is presented in Appendix 1. Although most of these species are those recorded and expected from forest in the region, there are some species that require special mentions. These are the invasive species, or weeds, of the study area, and the SSC recorded from the study area (Sections 4.2.1 and 4.2.2).

4.2.1 Invasive species

There are two different kinds of invasive species:

- Alien invasive species are those species native to other countries that invade and outcompete native flora. These species are problematic and should be actively controlled.
- Indigenous species that have a ruderal growth strategy. They can be problematic as they grow rapidly and often need to be controlled in environments like plantations. These species are not a threat to the primary forest as they play a vital role in its development and natural regeneration (such as when large trees fall within the forest).

Both types of invasive species were recorded during the site visit. Notable alien invasive species that must be actively controlled to prevent the spread into the native forest include Triffid Weed (*Chromolaena odorata*), Canna (*Canna indica*) and Water hyacinth (*Eichhornia crassipes*). Other weeds that may need cutting back as new plantings take place are less problematic for the native flora (e.g., Touch-me-not (*Mimosa* spp), and the very common *Alchornia cordifolia*). Some of the species are ubiquitous weeds that occur worldwide but do not pose a major risk to native flora such species include *Conyza* spp. Some of these species can be seen in Figure 4-13.

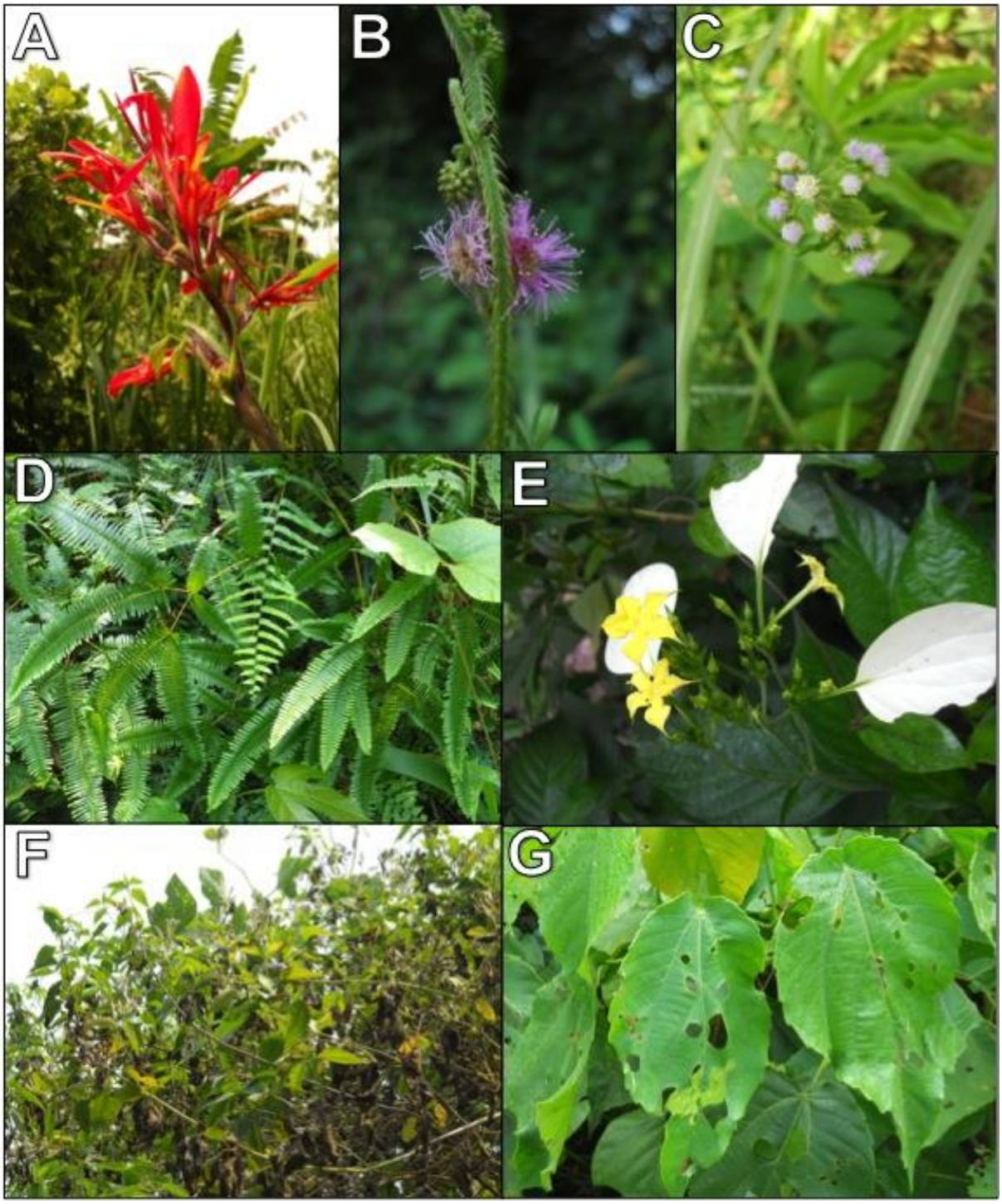


Figure 4-13: Some of the invasive species recorded from the Lokutu area of influence. A: *Canna indica* (alien invasive), B: *Mimosa pigra* (Ubiquitous weed), C: *Conyza sp.* (Ubiquitous weed) D: *Dicranopteris linearis*, E: *Mussaenda chippii*, F: *Chromolaena oderata* (Alien invasive) and G: *Alchornia cordifolia*

4.2.2 Species of special concern

SSC include those species that are on the IUCN red data list, or are endemic to the country or region. Two IUCN listed species were recorded from the study area: Afromisia (*Pericopsis elata*), which is Endangered and *Afzelia africana*, which is Vulnerable. Afromosia is being logged from within the Feronia concession for export by local communities.

5 High Conservation Value

Proforest has developed a method for identifying High Conservation Value (HCV) Forest (Jennings *et al*. 2003). HCV forest assessments are required for voluntary adherence to the Round Table on Sustainable Palm Oil (RSPO) criteria for oil palm plantations. HCV assessment is a useful classification system for forests, based on biodiversity and ecosystem services. There are six HCV categories (Table 5.1).

Table 5.1: HCV Categories according to Jennings *et al*. (2003).

HCV	Description
HCV 1	Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).
HCV 2	Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most, if not all, naturally occurring species exist in natural patterns of distribution and abundance.
HCV 3	Forest areas that are in or contain rare, threatened or endangered ecosystems.
HCV 4	Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).
HCV 5	Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).
HCV 6	Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

These categories have been modified slightly (Brown *et al.* 2013: Table 5.2).

Table 5.2: The six High Conservation Values (Brown *et al*. 2013, pg 5).

HCV	Definition
1: Species diversity	Concentrations of biological diversity including endemic

HCV	Definition
	species, and rare, threatened or endangered 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.
4: Ecosystem services	Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes.
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.
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.

These have been expanded upon for the context of the DRC in a country-specific HCV document (The Proforest Initiative 2012). It is these country-specific HCVs that are used in the HCV assessment document that accompanies this specialist report. The country-specific HCV categories are described in Table 5.3.

Table 5.3: Country-specific HCV categories (The Proforest Initiative 2012).

HCV	DESCRIPTION	
1	**Diversity of species:**	Concentrations of biological diversity – including endemic species, rare species, vulnerable or in danger, world importance, regional and national importance
1.1	Protected zones	

HCV	DESCRIPTION	
1.2	Concentrations of species	Vulnerable species, threatened and endangered
1.3	Concentrations of endemic species	
1.4	Zones of concentrations seasonal species	
2	**Ecosystem and mosaics at a landscape scale:**	vast ecosystems at a landscape scale and mosaics of ecosystems which are important at an international, national or regional level
3	**Ecosystems and habitats:**	ecosystems, habitats or rare refuge zones which might be threatened or endangered
4	**Critical ecosystem services:**	Fundamental Ecosystem Services in critical situations
5	**Community Needs:**	Sites and fundamental resources for the satisfaction of the essential needs of local communities or native peoples identified
6	**Cultural value:**	Sites, resources, habitats and landscapes of cultural, archaeological or historic importance at a national or international level.
6.1	Important cultural, archaeological, historical values	at a national or international level
6.2	Important cultural, ecological, economic or religious/sacred values	for the local or native peoples

Considerations for determining HCV status are the same as those used for IFC habitat, and include field surveys, review of previous work and available information (for the area and country as a whole). Important for the assignation of HCV categories to the study area is the Precautionary Principle.

The Precautionary Principle states: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as

a reason for postponing cost-effective measures to prevent environmental degradation." (Earth Summit in Rio, Principle #15: Rio Declaration, 1992).

The Precautionary Principle, is an important part of such assessments, where scientific certainty is not possible (Cooney, 2004). Best practice encourages integration of conservation, local and scientific knowledge. It is important that the principle is used with caution and not simply to aid conservationist goals, but to take into account all land use options. The principle grew from the tendency for favouring development, and is designed to weigh unknown scientific information about potential impacts against that tendency to favour development. It is stated: "Where there is uncertainty concerning the impacts of an activity, rather than assuming human activities will proceed until and unless there is clear evidence that they are harmful, the precautionary principle supports action to anticipate and avert environmental harm in advance of, or without, a clear demonstration that such action is necessary" (Cooney, 2004).

The Convention on Biological Diversity states: "where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat." (Cooney, 2004). Some definitions of the principle lay the burden of proof on the proponent of the activity (Cooney, 2004). Although both impact assessment and mitigation recommendations can be based on precaution, it is the management that needs to be precautionary.

5.1 HCV 1

HCV	DESCRIPTION	
1	**Diversity of species:**	Concentrations of biological diversity – including endemic species, rare species, vulnerable or in danger, world importance, regional and national importance
1.1	Protected zones	
1.2	Concentrations of species	Vulnerable species, threatened and endangered
1.3	Concentrations of endemic species	
1.4	Zones of concentrations seasonal species	

The HCV 1 categories require concentrations of species, or diversity of species at a regional, national or global scale. Although the study area has Afromosia, there were no other recorded IUCN listed species. This does not make a concentration of important species, or concentrations of endemic or seasonal species. There is a possibility that HCV could occur

within the study area should a full flora assessment with an inventory be done for the site. However, based on the data gathered for this assessment, HCV 1 (in terms of plants) is not present.

1.2 HCV 2

HCV	DESCRIPTION	
2	**Ecosystem and mosaics at a landscape scale:**	vast ecosystems at a landscape scale and mosaics of ecosystems which are important at an international, national or regional level

HCV 2 refers to ecosystems at a landscape scale. A very large area of intact primary forest exists to the north of the site within the study area where it is contiguous with an extremely large area of intact primary forest outside of the study area. There have been (unconfirmed) reports of forest elephants and bonobo chimpanzees in these forests beyond the boundary of the concession by local people, which would indicate its viability as a stronghold of important species. Considering the scale of this ecosystem, HCV 2 occurs in the study area within the large area of forest.

1.3 HCV 3

HCV	DESCRIPTION	
3	**Ecosystems and habitats:**	ecosystems, habitats or rare refuge zones which might be threatened or endangered

HCV 3 refers to particular habitats or refuge zones. As the study area is very homogenous when it comes to hydrology and topography, there are no such habitats and refugia within the study area for vegetation. HCV 3 therefore is not present in the study area.

1.4 HCV 4

HCV	DESCRIPTION	
4	**Critical ecosystem services:**	Fundamental Ecosystem Services in critical situations

HCV 4 refers to Ecosystem Services. These are present and critical within the study area as the forests provide stability reducing erosion; provide a carbon sink, which stabilizes climate and provides provisioning services for the local community (important for HCV 5). Even the palm plantations are important for erosion control and the water system of the area. Forests provide a water provisioning and system service, maintenance of soil structure, flood attenuation, and slope stability. Thus, the whole study area can be described as HCV 4.

2.5 HCV 5

HCV	DESCRIPTION	
5	**Community Needs:**	Sites and fundamental resources for the satisfaction of the essential needs of local communities or native peoples identified

Although not quantitatively assessed for this report, the reliance of the local people on the forests of the study area is clear. The riparian systems are used for fishing, washing and drinking water; the swamp forest is used to produce palm wine, the fermentation of cassava, and growing crops. The forest is used for harvesting of timber and non-timber forest products such as medicines and roofing palm, and hunting (bush meat).

All areas, with the exception of the plantations themselves, are used by the local people. Some of the uses of forest products can be seen in Figure 5-1. Thus all natural vegetation of the area (including disturbed and secondary forest areas) can be categorized unequivocally as HCV 5.

1 HCV 6

HCV	DESCRIPTION	
6	**Cultural value:**	Sites, resources, habitats and landscapes of cultural, archaeological or historic importance at a national or international level.
6.1	Important cultural, archaeological, historical values	at a national or international level
6.2	Important cultural, ecological, economic or religious/sacred values	for the local or native peoples

HCV 6 was not assessed as part of this report.

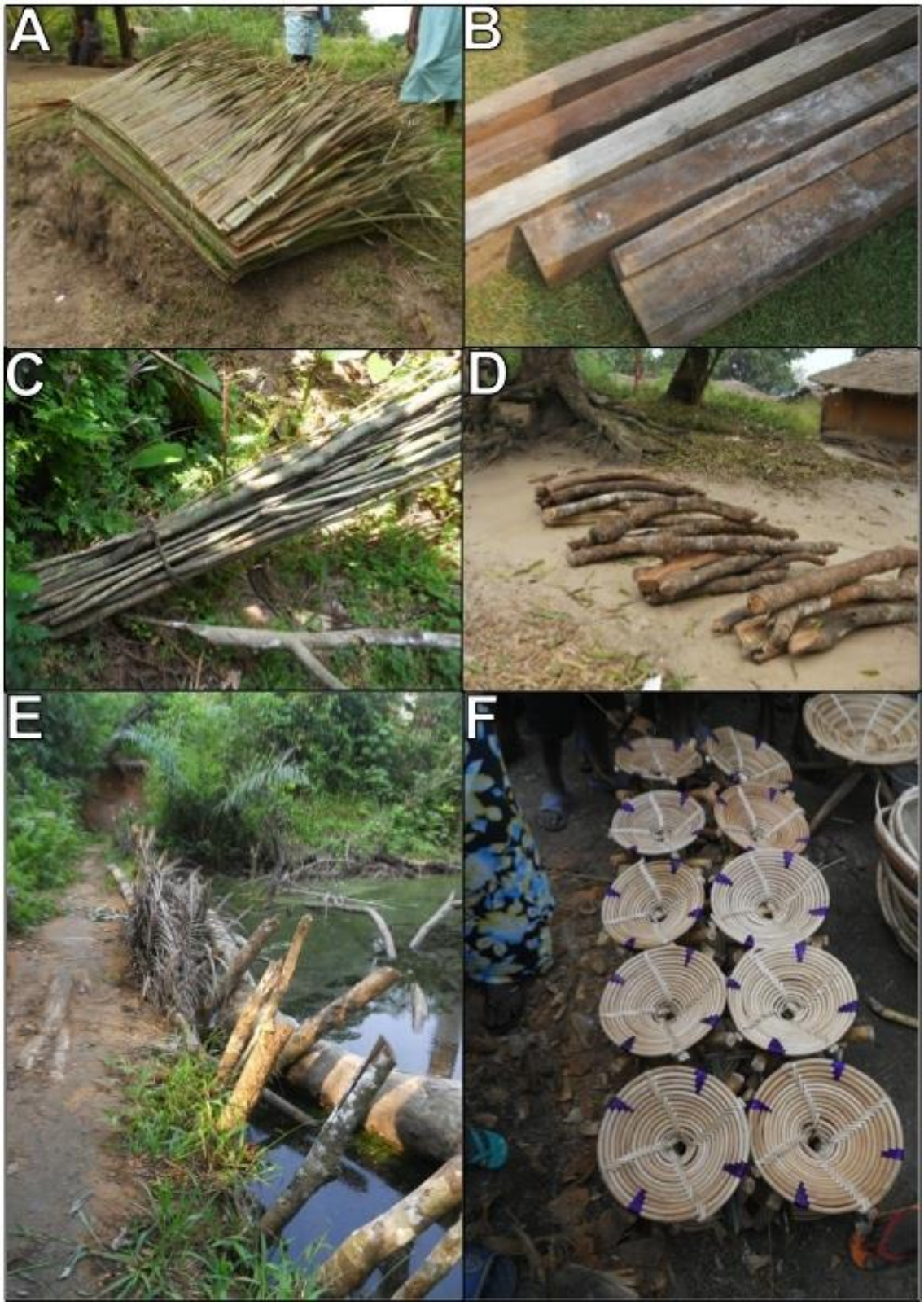


Figure 5-1: Use of forest resources. A: Roofing palm, B: Afromisia timbers, C: Poles for building, D: firewood, E: poles and logs are used to build dams for fishing and washing and F: weaving stools and baskets is a common practice.

6 Impacts

The impacts associated with the Feronia plantation are restricted to the current impacts as the plantation has been in existence for over 100 years. There are thus no construction impacts at this stage of the project. Future expansions may result in a new suite of construction impacts but at this stage impacts are only operational impacts or secondary impacts associated with the local communities. It is important to identify these at this stage, as the impacts currently will result in the development of an effective Biodiversity Management Plan. Here, the potential current impacts are presented in Table 6.1.

The difference between primary and secondary impacts is important to distinguish:

- Primary impacts include those that result directly from the actions of the plantation. These could include loss of forest for the planting of new plantations, or the pollution of water resulting from effluent discharge.
- Secondary impacts are those that occur indirectly as a result of the activities of the plantation. Secondary impacts include
    - the loss of forest as a result of the slash and burn agricultural practices of the people living in the area (some of whom work for Feronia) (Figure 6-1).
    - the loss of forest resources due to population growth
    - the disruption of natural water systems by the building of dams by local fishermen.

Loss of areas of natural forest is not occurring currently as a direct result of the plantation, but is occurring as a secondary impact of the plantation. This is important to manage, as the RSPO does not allow for the clearing of primary forest in a plantation. Other aspects of secondary impacts need to be managed by Feronia with comprehensive community consultation to reduce the pressure on natural resources for building materials, food, medicine, and bush meat. Such management systems, usually pivoting around agriculture project or out-growers schemes, can reduce the impact on the existing natural vegetation.

Figure 6-1: Slash and burn agricultural practices at Lokutu

Table 6.1 Impacts associated with the Feronia Lokutu plantation.

Impact	Comment	Impact rating	Management measure	Impact rating post-management
Loss of Species of Special Concern	Although only two clear SSC were recorded by the specialist in the study area, it is possible that many more are present. The levels of logging of Afromosia in the study area suggest that these are under severe pressure. Using the precautionary principle this impact is rated at high.	High negative	It is recommended that a monitoring plan be put into place for the harvesting of such species to keep a record of how much is being harvested. A plan for the control of their harvesting, or the prohibiting of harvesting from the concession area can then be developed and implemented.	Low negative to positive.
Loss of Natural Forest	This loss is mainly due to the slash and burn practices of the local population (growing crops). At this stage, the loss is relatively slow but will increase with an increasing population (which is increasing at a high natural rate, not from influx).	Moderate negative	Digby Wells recommends that a farming initiative be developed with the community in order to increase yield and reduce the need to clear natural forest.	Low negative
Loss of Swamps	Swamps are the primary vegetation type of the area and are relied upon by the local people for water, fishing, and palm wine production. Swamps are under pressure from the building of dams, by local communities, along the watercourses (to trap fish). This changes the hydrology of the regions and seasonal flooding. This in turn affects the vegetation habitats, resulting in the loss of swamp forest. Although small at this stage continued use of the swamps will result in changes to the vegetation and habitats of the region.	Low negative	Part of the farming initiative should include the education in sustainable fishing techniques and / or the development of aquaculture projects. This would reduce the dependency on the swamps to produce fish and result in fewer dams being built.	Negligible

Impact	Comment	Impact rating	Management measure	Impact rating post-management
Change in soil characteristics	Fertilisers and silt-containing run-off associated with the plantations will change the soil, resulting in a change in vegetation.	Low negative	Silt traps and fertilising and pesticide regimes should be controlled to avoid impacting the natural vegetation.	Negligible
Fragmentation	In such large agricultural developments, fragmentation is a serious issue. In areas where palm cannot be planted (waterlogged swamps and waterways), some form of corridors should be developed and maintained. It is essential that these are retained as corridors and retained in as natural a state as possible. Areas that are required as corridors to maintain habitat connectivity for dryland forest are currently non-existent.	High negative	Corridors need to be developed and maintained. A buffer of 50 m on each side of watercourse should be maintained as natural forest to maintain natural corridors. In addition, areas of natural dryland forest should be maintained as a series of linked corridors. Corridors are essential to maintain ecosystem function, and are required for dispersal of animals and plants.	Moderate negative
Loss of biodiversity	Loss of biodiversity in general is currently occurring due to a variety of activities. It is important that the natural vegetation and habitats are conserved and protected to reduce the loss of species.	Moderate negative	Monitoring plans should be developed and implemented including an inventory of species recorded from the forests. Management measures should include the development and maintenance of corridors, and a farming initiative to reduce the reliance of local communities on the forest (for resources).	Low negative
Alien invasive species	Alien invasive species can outcompete indigenous species to create monotypic stands of plants that are not part of the natural ecosystem. There are several alien species in the area of influence.	Moderate negative	Alien invasive species should be controlled using chemical or mechanical means specific to each species.	Negligible

7 Conclusions and Recommendations

Approximately 10 000 ha of the 60 000ha Lokutu concession area is currently planted with palm. Natural vegetation exists primarily along the watercourses. The vegetation types are Riparian Forest, Swamp Forest and Dryland Forest (Natural Habitat) with disturbed areas (Modified Habitat) comprising the plantations themselves and cleared areas around the villages.

The main issues associated with the Feronia study area are the loss of SSC. This is of particular concern with the timber species Afromosia, which is harvested from the area of influence. In addition, it is possible that several more SSC will be found within the study area should an extensive flora assessment be done; the species list would be expected to reach approximately 1,000 species if a full assessment is done (vegetation sampling in tropical forest usually yields between 800 and 1000 species).

Overall the area of influence suffers from few impacts associated with the Feronia activities though secondary impacts caused by local people are common. Areas of forest are thus under pressure from the actions of communities. However, areas of relatively undisturbed natural forest are still present on site and present an opportunity for conservation of this natural resource.

HCV categories occurring within the area of influence are likely to include HCV 2, HCV 4 and HCV 5. Impacts can be reduced with the adoption of some management measures.

Recommended management measures include a monitoring plan, a farming initiative and out-growers scheme to supplement the local income and reduce the reliance and pressure on forest resources.

Important recommendations include:

- A farming initiative should be set up to increase yields and reduce the dependency of the local communities on slash and burn agriculture; and
- Monitoring of important species should occur, such as Afromosia logged from the forests within the concession area.

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9 APPENDIX 1: SPECIES LIST

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Euphorbiaceae	*Acalypha cupricola*		X			NT
Euphorbiaceae	*Acalypha dikuluwensis*		X			EX
Pteridaceae	*Actiniopteris kornasii*		X			EN
Labiatae	*Aeollanthus saxatilis*		X			NT
Fabaceae	*Aeschynomene elaphroxylon*	X				
Podocarpaceae	*Afrocarpus dawei*		X			NT
Fabaceae	*Afzelia africana*	X	X			VU
Fabaceae	*Afzelia bipindensis*		X			VU
Fabaceae	*Afzelia pachyloba*		X			VU
Legiminosae	*Albizia ferruginea*		X			VU
Fabaceae	*Albizia versicolor*	X				
Fabaceae	*Albizia zygia*	X				
Euphorbiaceae	*Alchornea cordifolia*				X	
Spaindaceae	*Allophylus agbala*		X			VU
Annonaceae	*Alstonia congensis*			X		
Primulaceae	*Anagallis elegantula*		X			NT
Primulaceae	*Anagallis kochii*		X			NT
Commelinaceae	*Aneilema silvaticum*		X			VU
Orchidaceae	*Angraecum pungens*		X			VU
Annonaceae	*Anonidium mannii*			X	X	
Gentianaceae	*Anthocleista procera*	X				
Fabaceae	*Anthonontha nigerica*		X			VU
Fabaceae	*Anthonotha lebrunii*		X			VU
Phyllanthaceae	*Antidesma leptobotryum*				X	
Anacardiaceae	*Antrocaryon micraster*		X			VU
Aponogetonaceae	*Aponogeton bogneri*		X			EN
Moraceae	*Artocarpus heterophyllus*	X				
Acanthaceae	*Asystasia gangetica*	X				
Fabaceae	*Baikiaea robynsii*				X	
Sapotaceae	*Baillonella toxisperma*		X			VU
Theaceae	*Balthasaria schliebenii*		X			LR/nt
Poaceae	*Bambusa vulgaris*	X				
Fabaceae	*Baphia dewevrei*	X			X	
Passifloraceae	*Barteria fistulosa*	X				
Passifloraceae	*Basananthe cupricola*		X			EX
Lauraceae	*Beilschmiedia ambigua*		X			VU
Lauraceae	*Beilschmiedia bracteata*		X			VU
Lauraceae	*Beilschmiedia corbisieri*				X	
Lauraceae	*Beilschmiedia giorgii*		X			VU

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Lauraceae	*Beilschmiedia mayumbensis*		X			VU
Lauraceae	*Beilschmiedia ugandensis*		X			VU
Lauraceae	*Beilschmiedia vermoesenii*		X			VU
Fabaceae	*Berlinia bruneelii*	X				
Hydrocharitaceae	*Blyxa hexandra*		X			DD
Scytopetalaceae	*Brazzeia congoensis*	X				
Scytopetalaceae	*Brazzeia longipedicellata*		X			EN
Scytopetalaceae	*Brazzeia soyauxii*	X				
Euphorbiaceae	*Bridelia sp.*				X	
Cyperaceae	*Bulbostylis fusiformis*		X			CR
Cyperaceae	*Bulbostylis pseudoperennis*		X			VU
Flacourtiaceae	*Caloncoba welwitschii*	X				
Rubiaceae	*Calycosiphonia macrochlamys*		X			VU
Cannaceae	*Canna indica*	X				
Cyperaceae	*Carex runssoroensis*		X			VU
Cyperaceae	*Carpha angustissima*		X			NT
Flacourtiaceae	*Casearia barteri*	X				
Fabaceae	*Cassia didymobotrya*	X				
Rhizophoraceae	*Cassipourea acuminata*		X			EN
Fabaceae	*Cathormion altissimum*	X				
Bombacaceae	*Ceiba pentandra*	X				
Fabaceae	*Centrosema pubescens*	X				
Apocynaceae	*Ceropegia purpurascens*	X				
Fabaceae	*Chamaecrista pratensis*	X				
Acanthaceae	*Chlamydocardia subrhomboidea*		X			EN
Tiliaceae	*Christiana africana*	X				
Asteraceae	*Chromolaena odorata*	X				
Sapotaceae	*Chrysophyllum beguei*	X				
Euphorbiaceae	*Cleistanthus evrardii*		X			VU
Euphorbiaceae	*Cleistanthus inundatus*				X	
Euphorbiaceae	*Cleistanthus milbraedii*				X	
Annonaceae	*Cleistopholis patens*	X			X	
Connaraceae	*Cnestis ferruginea*	X				
Arecceae	*Cocos nucifera*	X				
Myrsinaceae	*Coelocaryon botryoides*				X	
Combretaceae	*Combretum platypetalum*	X				
Commelinaceae	*Commelina africana*	X				
Commelinaceae	*Commelina mwatayamvoana*		X			CR
Commelinaceae	*Commelina zigzag*		X			EN
Boragninaceae	*Cordia mukuensis*		X			VU
Costaceae	*Costus afer*	X				
Fabaceae	*Crotalaria oxyphylloides*		X			EN
Commelinaceae	*Cyanotis cupricola*		X			EN
Cyperaceae	*Cyperus afroalpinus*		X			NT

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Cyperaceae	*Cyperus remotus*		X			DD
Araceae	*Cyrtosperma senegalense*	X				
Burseraceae	*Dacryodes edulis*	X				
Fabaceae	*Dalbergia melanoxylon*		X			LR/nt
Fabaceae	*Daniella pynaertii*			X	X	
Sapindaceae	*Deinbollia longiacuminata*		X			LR/cd
Malvaceae	*Desplatsia dewevrei*	X				
Fabaceae	*Dialium excelsum*		X			EN
Fabaceae	*Diallium corbisieri*				X	
Euphorbiaceae	*Dichostemma glaucescens*				X	
Acanthaceae	*Dicliptera alternans*		X			VU
Gleicheniaceae	*Dicranopteris linearis*	X				
Fabaceae	*Didelotia unifoliolata*		X			LR/nt
Olacaceae	*Diogoa zenkeri*				X	
Ebenaceae	*Diospyros crassiflora*		X			EN
Ebenaceae	*Diospyros pseudomespilus*	X				
Orchidaceae	*Disperis aphylla*		X			VU
Melastomataceae	*Dissotis capitata*	X				
Dracaenaceae	*Dracaena rubroaurantiaca*		X			DD
Droseraceae	*Drosera bequaertii*		X			VU
Droseraceae	*Drosera insolita*		X			CR
Droseraceae	*Drosera katangensis*		X			CR
Euphorbiaceae	*Drypetes gossweileri*				X	
Arecaceae	*Elaeis guineensis*	X				
Myrsinaceae	*Embelia upembensis*		X			VU
Zamiaceae	*Encephalartos ituriensis*		X			NT
Zamiaceae	*Encephalartos laurentianus*		X			NT
Zamiaceae	*Encephalartos marunguensis*		X			VU
Zamiacaea	*Encephalartos schaijesii*		X			VU
Zamiacaea	*Encephalartos schmitzii*		X			VU
Zamiaceae	*Encephalartos septentrionalis*		X			NT
Fabaceae	*Entada wahlbergii*	X				
Meliaceae	*Entandophragma candollei*		X			VU
Meliaceae	*Entandophragma cylindricum*		X			VU
Meliaceae	*Entandophragma palustre*			X	X	
Meliaceae	*Entandophragma utile*		X			VU
Meliaceae	*Entandophragma angolense*		X			VU
Eriocaulaceae	*Eriocaulon stipantepalum*		X			EN
Caesalpiniaceae	*Erythrophleum suaveolens*	X				
Orchidaceae	*Eulophia fernandeziana*		X			EN
Orchidaceae	*Eulophia parilamellata*		X			DD
Orchidaceae	*Eulophia porphyroglossa*			X		
Moraceae	*Ficus mucuso*	X				
Rubiaceae	*Fleroya ledermannii*		X			VU

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Rubiaceae	*Fleroya stipluosa*		X			VU
Clusiaceae	*Garcinia kola*		X			VU
Clusiaceae	*Garcinia spp.*			X		
Lentibulariaceae	*Genlisea angolensis*		X			EN
Rubiaceae	*Geophila repens*	X				
Caesalpiniaceae	*Gilbertiodendron dewevrei*			X		
Gnetaceae	*Gnetum africanum*		X			NT
Fabaceae	*Gossweilerodendron balsamiferum*		X			EN
Malvaceae	*Grewia luisii*				X	
Meliaceae	*Guarea cedrata*		X			VU
Meliaceae	*Guarea mayombensis*		X			VU
Meliaceae	*Guarea thompsonii*		X			VU
Fabaceae	*Guibourtia demeusei*			X	X	
Asteraceae	*Gutenbergia pubescens*		X			CR
Orchidaceae	*Habenaria kornasiana*		X			VU
Rubiaceae	*Hallea stipulosa*				X	
Simaroubaceae	*Hannoa kitombetombe*		X			VU
Connaraceae	*Hemandradenia mannii*		X			LR/nt
Fabaceae	*Humularia anceps*		X			NT
Hypoxidaceae	*Hypoxis malaissei*		X			DD
Irvingiaceae	*Irvingia gabonensis*		X			LR/nt
Annonaceae	*Isolona congolana*		X			LR/nt
Annonaceae	*Isolona dewevrei*		X			VU
Acanthaceae	*Justicia bolomboensis*		X			DD
Meliaceae	*Khaya anthotheca*		X			VU
Meliaceae	*Khaya grandiflora*		X			VU
Rhamnaceae	*Lasiodiscus mannii*				X	
Clusiaceae	*Lebrunia bushaie*		X			VU
Podostemaceae	*Ledermanniella pusilla*		X			EN
Podostemaceae	*Ledermanniella schlechteri*		X			VU
Podostemaceae	*Leiothylax quangensis*		X			EN
Sapindaceae	*Leucaniodiscus cupanioides*	X				
Achariaceae	*Lindackeria dentata*	X				
Fabaceae	*Lonchocarpus griffonianus*				X	
Ochnaceae	*Lophira alata*		X			VU
Asteraceae	*Lopholaena deltombei*		X			VU
Meliaceae	*Lovoa swynnertonii*		X			NT
Meliaceae	*Lovoa trichilioides*		X			VU
Juncaceae	*Luzula johnstonii*		X			DD
Euphorbiaceae	*Macaranga monandra*	X				
Euphorbiaceae	*Macaranga saccifera*	X			X	
Capparaceae	*Maerua elegans*		X			VU
Sapotaceae	*Manilkara spp*			X		
Marantaceae	*Marantochloa spp.*			X		

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Asclepiadaceae	*Marsdenia exellii*		X			EN
Asclepiadaceae	*Marsdenia magniflora*		X			VU
Melastomataceae	*Memecylon bequaertii*		X			VU
Melastomataceae	*Memecylon sp.*				X	
Fabaceae	*Michelsonia microphylla*		X			VU
Compositae	*Mikaniopsis vitalba*		X			VU
Moraceae	*Milicia excelsa*		X			LR/nt
Fabaceae	*Millettia drastica*				X	
Fabaceae	*Millettia griffoniana*	X				
Fabaceae	*Millettia lacus-alberti*		X			VU
Fabaceae	*Millettia laurentii*		X			EN
Fabaceae	*Millettia limbutuensis*		X			VU
Fabaceae	*Millettia stenopetala*		X			DD
Fabaceae	*Mimosa invisa*	X				
Rubiaceae	*Mitragyna spp.*			X		
Cucurbitaceae	*Momordica enneaphylla*		X			VU
Hydrocharitaceae	*Najas welwitschii*		X			DD
Rubiaceae	*Nauclea diderrichii*		X			VU
Fabaceae	*Newtonia devredii*	X				
Nymphaeaceae	*Nymphaea divaricata*		X			DD
Nymphaeaceae	*Nymphaea sulphurea*		X			DD
Menyanthaceae	*Nymphoides tenuissima*		X			NT
Lauraceae	*Ocotea kenyensis*		X			VU
Hydrocharitaceae	*Ottelia verdickii*		X			DD
Lecythidaceae	*Oubanguia Africana*				X	
Chrysobalanaceae	*Parinari glaberrrium*			X		
Fabaceae	*Parkia bicolor*	X				
Rubiaceae	*Pavetta intermedia*		X			VU
Thymelaeaceae	*Peddiea kivuensis*		X			LR/cd
Guttiferae	*Pentadesma lebrunii*		X			VU
Fabaceae	*Pericopsis elata*	X	X			EN
Sapindaceae	*Placodiscus paniculatus*		X			VU
Polypodiaceae	*Platycerium sp.*	X				
Fabaceae	*Platysepalum chevalieri*	X				
Annonaceae	*Polyalthia suaveoleus*			X		
Araliaceae	*Polyscias fulva*	X				
Orchidaceae	*Polystachya brugeana*		X			DD
Sapotaceae	*Pouteria altissima*		X			LR/cd
Sapotaceae	*Pradosia spinosa*		X			NT
Rosaceae	*Prunus africana*		X			VU
Amaranthaceae	*Psilotrichum axilliflorium*		X			VU
Dennstaedtiaceae	*Pteridium aquilinum*	X				
Fabaceae	*Pterocarpus angolensis*		X			LR/nt
Fabaceae	*Pterocarpus soyauxii*	X				

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Sterculiaceae	*Pterygota bequaertii*		X			VU
Myristicaceae	*Pycnanthus angolensis*	X				
Myristicaceae	*Pycnanthus marcalianus*				X	
Areaceae	*Raphia laurentii*				X	
Areceae	*Raphia longiflora*		X			DD
Areceae	*Raphia monbuttorum*	X				
Arecaceae	*Raphia spp.*			X		
Arecaceae	*Raphia sudanica*	X				
Ochnaceae	*Rhabdophyllum arnoldianum*	X				
Bombaceceae	*Rhodognaphalon brevicuspe*		X			VU
Violaceae	*Rinorea oblongifolia*	X				
Lythraceae	*Rotala fontinalis*		X			VU
Lythraceae	*Rotala gerardii*		X			NT
Lythraceae	*Rotala robynsiana*		X			CR
Lythraceae	*Rotala smithii*		X			VU
Rubiaceae	*Rothmania sp.*				X	
Rubiaceae	*Rothmannia whitfieldii*	X				
Poaceae	*Schizachyrium platyphyllum*	X				
Fabaceae	*Scorodophloeus zenkeri*			X	X	
Ascelpiadaceae	*Secamone letouzeana*		X			VU
Ascelpiadaceae	*Secamone racemosa*		X			VU
Poaceae	*Setaria megaphylla*	X				
Malvaceae	*Sida acuta*	X				
Caryophyllaceae	*Silene cobalticola*		X			CR
Zingerberaceae	*Siphonochilus aethiopicus*	X				
Bignoniaceae	*Spathodea campanulata*	X				
Myristicaceae	*Staudia stipitata*			X	X	
Myristicaceae	*Staudtia kamerunensis*	X				
Sterculiaceae	*Sterculia oblonga*	X				
Sterculiaceae	*Sterculia oblonga*	X				
Sterculiaceae	*Sterculia subviolaceae*			X		
Clusiaceae	*Symphonia globulifera*			X	X	
Myrtaceae	*Syzygium malaccense*	X				
Apocynaceae	*Tabernaemontana crassa*	X				
Apocynaceae	*Tabernaemontana sp.*	X				
Fabaceae	*Tetrapleura tetraptera*	X				
Menispermaceae	*Tiliacora lehmbachii*		X			EN
Marantaceae	*Trachyphrynium braunianum*	X				
Ulmaceae	*Trema orientalis*	X				
Meliaceae	*Trichilia lanata*				X	
Meliaceae	*Trichilia retusa*	X				
Meliaceae	*Trichilia rubescens*				X	
Meliaceae	*Trichilia welwitschii*	X				
Menispermaceae	*Triclisia lanceolata*		X			EN

Family	Species	Recorded	IUCN red list	WWF	The Proforest Initiative	IUCN red list staus
Meliaceae	*Turraeanthus africanus*		X			VU
Asclepiadaceae	*Tylophora cameroonica*		X			LR/nt
Euphorbiaceae	*Uapaca guineensis*	X			X	
Euphorbiaceae	*Uapaca heudelotii*			X		
Euphorbiaceae	*Uapaca sp.*	X				
Lentibulariaceae	*Utricularia bracteata*		X			NT
Annonaceae	*Uvariopsis vanderystii*		X			VU
Rutaceae	*Vepris mandangoa*		X			VU
Rutaceae	*Vepris sauveolens*		X			LR/nt
Compositae	*Vernonia duvigneaudii*		X			EN
Compositae	*Vernonia titanophylla*	X				
Sapotaceae	*Vitellaria paradoxa*		X			VU
Lamiaceae	*Vitex doniana*	X				
Apocynaceae	*Voacanga africana*	X				
Campanulaceae	*Wahlenbergia ericoidella*		X			EN
Campanulaceae	*Wahlenbergia malaissei*		X			CR
Rutaceae	*Zanthoxylum heitzii*	X				
Annonaceae	*Xylopia aethiopica*	X				
Annonaceae	*Xylopia hypolampra*	X				
Xyridaceae	*Xyris angustifolia*		X			NT
Xyridaceae	*Xyris bampsii*		X			DD
Xyridaceae	*Xyris densa*		X			DD
Xyridaceae	*Xyris exigua*		X			CR
Xyridaceae	*Xyris gossweileri*		X			DD
Xyridaceae	*Xyris imitatrix*		X			DD
Xyridaceae	*Xyris kibaraensis*		X			VU
Xyridaceae	*Xyris kundelungensis*		X			DD
Xyridaceae	*Xyris kwangolana*		X			DD
Xyridaceae	*Xyris lejolyanus*		X			DD
Xyridaceae	*Xyris popeana*		X			DD
Xyridaceae	*Xyris sanguinea*		X			DD
Rutaceae	*Zanthoxylum tessmannii*	X				