CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Seventy-seventh meeting of the Standing Committee
Geneva (Switzerland), 6–10 November 2023

REPORT ON NON-DETRIMENTAL FINDINGS OF PTEROCARPUS ERINACEUS IN GHANA

1. This document has been submitted by Ghana in relation to agenda item 33.2.*

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11th September, 2023

THE SECRETARY GENERAL
CITES
GENEVA
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Dear Sir/Madam,

SUBMISSION OF NON-DETRIMENTAL FINDINGS FOR PTEROCARPUS ERINACEUS BY GHANA

In March 2022, the CITES Secretariat issued Notification 2022/021, inviting Range States of Pterocarpus erinaceus to either: a) Submit a Non-Detriment Finding (NDF) and Legal Acquisition Finding (LAF) to the Secretariat, or b) Publish a voluntary Zero Export Quota for commercial trade in specimens of the species.

Despite strong and consistent population monitoring programs and other conservation initiatives to protect the species within its range, including a rapid study developed and submitted as an initial NDF for the species in September 2021, Ghana adopted a precautionary approach to species conservation by requesting the Secretariat to publish a Zero Export Quota for Commercial Trade in the Species until a detailed Non-Detrimental Findings (NDF) and Legal Acquisition Finding Report are provided for the species.

Pursuant to this, Ghana has undertaken a comprehensive study and developed an NDF for the species.

We hereby submit Ghana's NDF for consideration by the Plants Committee and approval by the Standing Committee. Ghana is also committed to adopting all the recommendations enumerated in the NDF report, including the establishment of a national annual quota of 23,000 m^3 and 40,000 m^3 for off-reserve and underwater (Volta Lake) operations, respectively, when accepted.

Please acknowledge receipt.

Yours faithfully,

BERNARD ASAMOAH-BOATENG
(EXECUTIVE DIRECTOR)

cc: **The Chairperson, Plant Committee**

The Chief of Science

REPORT ON NON-DETRIMENTAL FINDINGS OF PTERICARPUS ERINACEUS IN GHANA

BY

RESOURCE MANAGEMENT SUPPORT CENTRE

&

FACULTY OF RENEWABLE NATURAL RESOURCES

KWAME NKRUMAH UNIVERSITY OF SCIENCE TECHNOLOGY

AUGUST, 2023

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TABLE OF CONTENT

Lists of Figures

List of Tables

ACRONYMS

CITES	Convention on International Trade in Endangered Species
CSR	Clark Sustainable Resources
EIA	Environmental Impact Assessment
FC	Forestry Commission
FSD	Forest Services Division
GNA	Ghana News Agency
GPS	Global Positioning System
HFZ	High Forest Zone
IWT	Ghana's Inland Water Transport
LV	Lake Volta
MTV	Mean Tree Volume
NASA	National Aeronautics and Space Administration
NDF	Non Detrimental Findings
RMSC	Resource Management Support Centre
TIDD	Timber Industry Development Division
USAID	United States Agency for International development
VRA	Volta River Authority
WABiCC	West Africa Biodiversity and Climate Change

EXECUTIVE SUMMARY

Background

Pterocarpus erinaceus commonly referred to as African Rosewood occurs mainly in the forest savannah transitional zone and parts of the northern savannah woodland of Ghana. The species is currently listed in the Appendix II of CITES. The listing of the species in Appendix II means that (among other issues), any further exploitation, transportation and trade in the species has to meet permitted quotas and must be based on recommendations of valid non-detrimental findings (NDF). In 2017 and 2021, inventories of the species were conducted in areas where the species are commonly found to determine the stocking levels. As an interim measure to ensure sustainable harvesting, felling quotas were recommended for all the political districts where the species were found using the static volumes (m^3) estimated from the survey. Harvesting however, went on without adequate regulation of felling quotas. In recent times, estimates from inventories were characterized by large uncertainties making them largely unreliable from sustainable resource management perspective. In an effort to pursue sustainable management of *Pterocarpus erinaceus*, inventory of the species was carried out in August 2022 with the view of updating the results of the 2021 static inventory to determine the current status of the species. The purpose of the assessment was to conduct a Non-Detrimental Findings (NDF) study on *Ptericarpus erinaceus* to determine whether trade levels were sustainable.

Methodology

The approach used was desk study involving review of existing reports/maps and field measurements using rectangular plots of 40m x 1000m. The plots were randomly laid in rosewood endemic areas in the different political districts. A felling quota system based on a number of assumptions, were used to determine number of stems and volume of trees that could be considered for felling annually at the national and district levels. Given that there is virtually no information locally on the growth dynamics and mortality, as much as possible a precautionary approach was adopted to generate conservative estimates. To regulate harvesting of the species, annual felling quotas were recommended based on three scenarios: 50year, 40years and 30years. The 50-year was adopted for the implementation of annual felling quotas in off reserve in the endowed areas (terrestrial areas). A 16-year felling quota was recommended for the underwater stands in the Volta Lake based on a study conducted in 2007.

Key findings

The study shows that the stocking and stand volume for species in most endowed areas has reduced significantly between 2013 and 2022. The mean stem numbers and volume per km^2 estimates showed a decline. Total stem numbers above the felling limit (of all stems ≥ 20 cm dbh) were estimated to be 5,264,465.85 stems with equivalent standing volume of 2,900,996.00 m^3. Trends in natural regeneration show that the rate of decline reduced from 72% between 2017-2021 to 9% 2021-2022, indicating a positive effect of the implementation of the conservation measures. The felling quota per annum approach per Political District of the endemic zones of Ghana using three

different life spans (felling cycles) of 50, 40 and 30 years gave a volume of 23,207.97 m^3, 29,009.96 m^3 and 38,679.95 m^3 annual felling quota respectively.

Recommendations

The bans on rosewood harvesting, zero quota and other conservation measures have immensely contributed improving regeneration as well as the capacity of the species to adapt to various shocks including wildfires, over harvesting, etc. To further enhance the management of the species in both on and off reserve areas, the following suggestions are made;

a. A conservative national felling quota per annum using a 50-year cycle is proposed as a precautionary measure.

b. To ensure the sustainable exploitation of *Ptericarpus erinaceus* in off reserve areas (terrestrial), a quota system is proposed for adoption and implementation by the Forestry Commission as a means of regulating the harvesting of Rosewood.

c. An indicative national felling quota of **23,207.97 m^3** (terrestrial land outside forest reserves) is proposed. This proposed quota should not be exceeded.

d. For **underwater rosewood** in the Volta Lake, an indicative felling quota of **40,000m^3** per annum has been proposed for a period of 16years. This is consistent with the objectives of the Revised National Transport Policy (2020), the Volta Lake Strategic Plan (2010 – 2014) and the Draft Volta Lake Master Plan 2014.

e. Therefore, the proposed annual aggregate quota for off reserve areas (terrestrial) and under water rosewood harvesting in Ghana to be **63,207.97 m^3.** Barring any changes in policy and other unforeseen circumstances, the proposed harvesting quotas is expected to be implemented for 16years until the underwater stock is depleted. After which, the 23,207.97 m^3 will remain operational based on the fifty (50) year scenario.

f. Additional permanent sample plots should be established in the savannah environment in both on and off reserves to monitor the dynamics of the species and other species of economic importance.

g. Increase the population of *Pterocarpus erinaceus* in off reserve areas through upscale of existing plantation trials in the savanna and transition zone of Ghana where the species predominantly occurs

h. The national quota which is to be implemented by the Forest Services Division, should be monitored by RMSC and endorsed by the representative of CITES in Ghana.

i. The Forestry Commission gradually integrate harvesting of *Ptericarpus erinaceus* into existing wood tracking system for documentation and traceability

j. Increase awareness creation on wildfires in order to reduce the frequency of occurrence and severity in the savanna and transition zones

k. Promote the adoption of more efficient technologies and alternative species for charcoal production. Also, encourage the establishment of woodlots to meet the energy needs of local people

1.0 INTRODUCTION

1.1 Background

The term Rosewood is a name for a wide array of hardwoods native to the tropical areas of Southeast Asia, Africa, Central and South America which comprises of selected species of the genera Dalbergia ('true rosewood') and Pterocarpus (substitute rosewood) (Dumenu and Bandoh, 2016). *Pterocarpus erinaceus* is a deciduous legume tree of African savannas and dry forests famous for producing one of the finest woods in its native region. *Pterocarpus erinaceus* is one of the common species of rosewood exploited in Ghana. The species mainly occurs in the forest savannah transitional zone and parts of the northern savannah woodland ecological zone of Ghana. The species was formerly mainly used for charcoal production by the local people to generate income. It is however, now a threatened species as its demand as timber especially, has been on the increase in the last decade leading to massive exploitation and export in the form of billets to the Asian countries particularly China (Dumenu and Bandoh, 2016).

West Africa's Rosewoods, after their classification as Hongmu (Redwood) suffered overexploitation as exports rose dramatically to meet the demand for Chinese classical furniture, between 2010 and 2016, compared to rosewood exports before 2010 (USAID and WABiCC, 2021). The high unsustainable exploitation levels of the species in the last decade demand that mechanisms are put in place to regulate its exploitation. Led by Senegal, 10 West African countries, the European Union and Chad successfully lobbied for listing of the rosewood *Pterocarpus erinaceus* in Appendix II of CITES in 2017. This means (among other issues), any further exploitation, transportation and trade in the species has to meet permitted quotas and must be based on recommendations of valid non-detrimental findings (NDF) (USAID and WABiCC, 2021).

There is therefore the urgent need to control exploitation levels of the species and bring it to sustainable levels. The new approach, following the 2017 Rosewood inventory, was the adoption of district level felling quotas as a means of regulating harvesting levels. This is a similar approach to the off-reserve annual felling quotas which were developed for all forest districts within the Ghana High Forest Zone (GHFZ) after a national inventory had been conducted. This was an approach to regulate the off-reserve timber resources in 1996 (FC, 1996). The rationale was that felling quotas should be adopted to regulate harvesting levels in all rosewood endemic areas of Ghana until efforts are made to understand better the ecology and population dynamics (increment, mortality and recruitment rates) of the species.

1.2 Submerged tree resources under the Volta Lake

Water bodies have been an amazing mode of transport for carrying people and/or goods within and across regional, national and continental borders. A lot of countries still depend on inland water transport for the transportation of bulk and general cargo across lakes/rivers over long distances (Boadu *et al*., 2021). Similarly, Ghana's Inland Water Transport (IWT) system managed

by Volta Lake transport Company (VLTC) has been in operation for decades. Regardless of the long years of operation, one of the main challenges facing IWT is the removal of underwater stems and stumps of dead trees causing a lot of boat accidents on the lake.

Lake Volta (LV) dominates the territory of the West African state of Ghana. Formed by the construction of the Akosombo Dam over the River Volta between 1961 and 1965, it has an area of 8,482 sq km. The river has divisions of Black Volta, the White Volta, and the Red Volta. In the north-western part of Ghana, the Black Volta forms the frontiers between the Burkina Faso, Ivory Coast and Ghana. In the southern part of Ghana, the Volta River flows through Akwapim-Togoland highlands, and enters the Atlantic Ocean at the Gulf of Guinea at Ada. The reservoir named 'Lake Volta' has a stretch of water from Akosombo in the eastern region to the northern part of Ghana (NASA, 2018).

LV does not only serve as the main source of water to power Ghana's biggest hydroelectric dam; the Akosombo dam, but also provides the main medium through which goods and people are transported from one point to the other on Ghana's inland waters (NASA, 2018). It is Ghana's major navigable river which is sourced from Bobo Dioulasso highlands of Burkina Faso and covers an extensive area thereby making the lake the biggest man-made lake in the world with respect to surface area. It flows through major towns like Yeji, Dambai, Kpando, Kete Krachi, etc. that depend on the use of this water body for their livelihood and business activities.

The Revised National Transport Policy (2020), the Volta Lake Strategic Plan (2010 – 2014) and the Draft Volta Lake Master Plan 2014 recognizes that, one of the safety aspects that need to accompany the development of an integrated transport system on Volta Lake is the continuation of tree stump removal programme prioritizing the main navigational channels.

Approximately two million people live along the shores of the lake, with 80,000 people making a living directly from fishing. The lake contributes 85% of the country's aquaculture production and 16% of the wild fish catch. A total of 3,500km^2 of dense forest area were flooded during the dam's construction. The submerged trees remain standing, and hardwood timber is perfectly preserved. Protruding tree stumps limit the lake's navigability, repeatedly cause fatalities, and limit the scope for recreation and aquaculture (World Bank, 2015).

According to Fitzgerald (2008) and Thrower et al (2007), Ghana has submerged over 14 million cubic meters of rot resistant hardwoods such as Rosewood, Mahogany, Odum and Ebony trees (refer to Annex V for details on volume estimates for submerged rosewood) when they created the Volta Lake. Owing to the lack of oxygen under water, the trees typically do not deteriorate, keeping their outstanding, often old-growth, character and physical properties.

In February 2006, the Government of Ghana and the Volta River Authority (VRA) signed an agreement with Clark Sustainable Resources (CSR) Developments, a Canadian firm

(Ablordeppey, 2009). The said agreement granted a concession to CSR Developments to harvest trees from the submerged forests in the Volta Lake. This is to be done in two Phases, a Preparatory Phase and a Commercial Phase. It is estimated that the Lake is home to timber resources worth 2.8 billion dollars (Ghana News Agency, 2011).

1.3 Progress and challenges with compliance with CITES requirements in Ghana

A recent study conducted on rosewood in 2021 in the various West Africa countries including Ghana highlighted a number of challenges confronting most countries in meeting CITES requirements (USAID and WABiCC, 2021). In Ghana's case, the progress made and challenges being confronted are summarized below:

- A ban has been in place on harvest and export of rosewood since March 2019, only stocks of salvaged and confiscated rosewood auctioned by the government (Forestry Commission) can be exported.
- Government reiterates that key elements of CITES are being followed. A recent report (2020) on Ghana by **EIA** seems to indicate a net-downward trend in rosewood exports to China. This was as result of a ban on the exploitation of the species which led Ghana to take a zero quota and therefore no harvesting, transport and export of the species is permitted
- Independent observers, however, presented a mixed picture of permit issuances not backed by non-detrimental findings (NDFs), as recently as July2019, although at that point, rosewood exports were trending downward.
- Civil society observers believe that increased transparency in CITES compliance will be of benefit to the process, to weed out illegal exports that seem to continue even under enforcement of bans and absence of NDF studies.
- One proposal for the Ghana High Forest Zone by the Resource Management Support Center (RMSC) of the Forest Commission is to institute felling quotas to regulate harvesting levels in all rosewood endemic areas until NDF efforts can generate results of ecology and population dynamics (covering increment, mortality and recruitment rates) of the species.

1.4 Rationale for the study

In 2019, a ban was imposed by the Government of Ghana on the harvesting, transporting and export of Rosewood. The ban is a measure taken by the government to stop illegal harvesting, transporting, processing, trading and exporting of rosewood and control its exploitation. The ban remains in force and the Minister for Lands and Natural Resources has directed the Forestry Commission to cease the issuance of the Convention on international Trade in Endangered Species (CITES) permits for the export of rosewood from Ghana except stocks of salvage and confiscated rosewood from the field auctioned by the Forestry Commission with approval from the Minister of Lands and Natural Resources. The CITES Secretariat issued Notification 2022/021, of 28th

March 2022 inviting range States of Pterocarpus erinaceus to either: a.) Submit a Non-Detriment Finding (NDF) and Legal Acquisition Finding (LAF) to the Secretariat or request the Secretariat to publish a voluntary zero export quota for commercial trade in *Pterocarpus erinaceus*. Ghana, agreed to adopt a precautionary approach to the species conservation by requesting the Secretariat to publish a Voluntary Zero Export Quota for commercial trade in the species until a detailed non-detriment finding (NDF) and legal acquisition finding (LAF) reports are provided for the species. In recent times, there have been calls for the ban to be lifted but this needed to be situated within a risk assessment and risk management context. To provide the basis for such an action, a Non Detriment Findings report needed to be prepared to determine whether exploitation could be sustainable based on available information on the current status and management of species. This report therefore seeks to provide detailed data and information (robust NDF) on Pterocarpus erinaceus and also provide the CITES Secretariat with information required to assess the implementation of Article IV, paragraphs 2(a), 3 and 6(a) of the convention with regard to harvesting and trade of the species.

1.5 Objectives

To conduct a Non-Detrimental Findings (NDF) study on *Ptericarpus erinaceus* to determine whether trade levels were sustainable.

Specific objectives

The specific objectives of the study are:

1. To estimate static volume (m^3) and stocking of Rosewood in the endemic areas of Ghana.
2. To determine sustainable harvesting levels for all the endemic areas (political districts).
3. To assess the effectiveness of implemented conservation measures on the species sustainability

2.0. NON- DETRIMENT FINDING DECISION-MAKING (NDF) PROCESS AND INSTITUTIONS IN GHANA

2.1 Process

The Faculty of Renewable Natural Resources, College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi (KNUST) is the Scientific Authority for CITES in Ghana. Non-Detriment Findings (NDF) are conducted to objectively examine aspects such as species distribution and habitats, population status and trends, harvest techniques, and the volume and effect of trade on target species. The outcome results in either a positive or negative recommendation to Ghana's CITES Management Authority which is the Wildlife Division of the Forestry Commission. To conduct an NDF, the Scientific Authority generally goes through a number of cycles, as shown in Figure 1. It begins with a preliminary examination to determine whether a comprehensive, science based NDF is required for the species and specimens involved. If a science based NDF is required, conservation considerations and potential biological threats must be assessed. These assessments provide the framework of risk in which the harvest, trade, and management should be examined (Figure 1). The method is then followed by a comprehensive examination of harvest impacts and trade impacts relevant to the species in question, as well as an assessment of whether the management mechanisms in place are stringent enough to reduce the concerns, risks, and impacts identified.

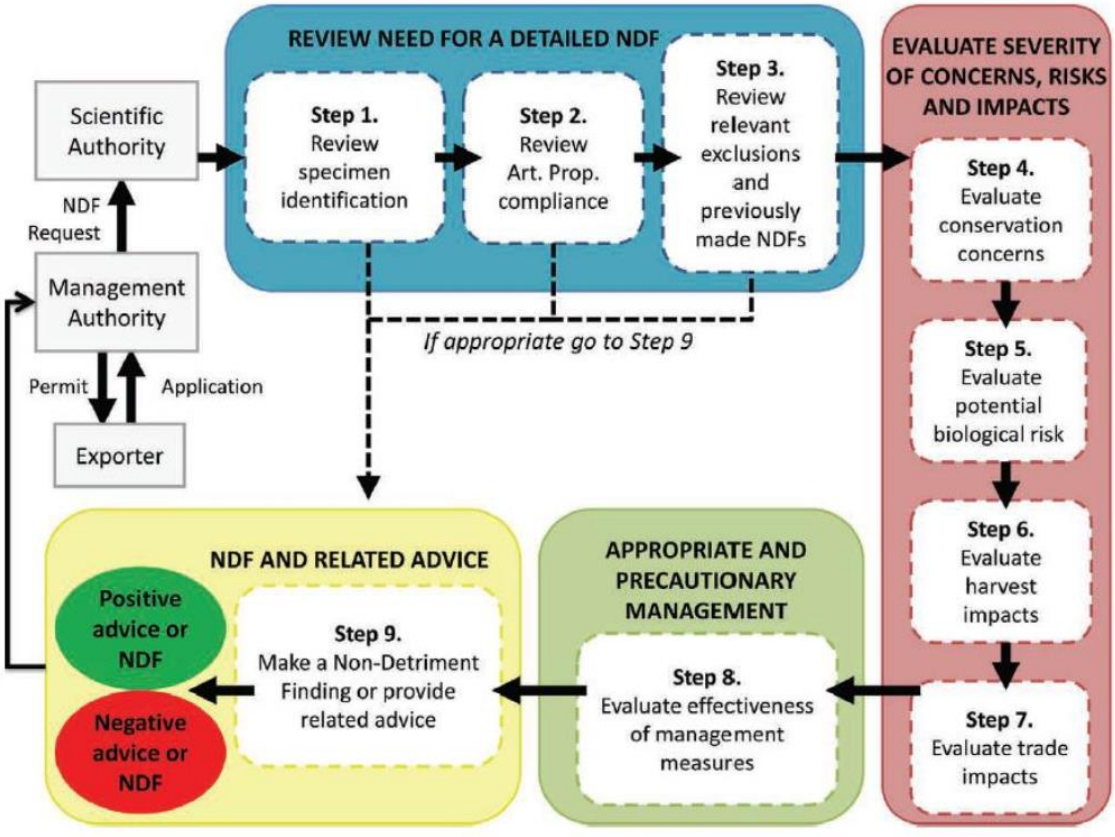

Figure 1 Simplified pathway adopted by the Scientific Authority for making NDF for Timber/Tree species listed in CITES Appendix II Adopted from Wolf et al. 2018)

2.2 Collaborating Institution

The CITES Scientific Authority in Ghana co-ordinates NDF for species that are commercially harvested in Ghana. It coordinates the efforts of various governmental and non-governmental research organizations as well as work with private organizations. The following agencies made contributions to this report on the NDF for *Ptericarpus erinaceus*.

• **Resource Management Support Centre of the Forestry Commission (RMSC)** is the technical and research wing of the Forestry Commission (FC) with responsibility to explore, develop, facilitate and support the implementation and monitoring of effective and affordable forest management systems in Ghana. The Centre as part of its mandate conducts inventories of populations across distribution range of all species in Ghana. The Centre collaborated with the Scientific Authority to perform the NDF for the species.

• **Wildlife Division of the Forestry Commission (WD):** It is responsible for management and conservation of Wildlife Protected Areas and Zoos in Ghana. The WD is the CITES Management Authority in Ghana and responsible issuing CITES permit.

• **Forest Services Division of the Forestry Commission (FSD):** The Forest Services Division is in charge of implementing policies, rules, regulations, and procedures in place to guide the management and utilization of Ghana's forest resources. The awarding of licenses to harvest wood is a key operation of the FSD under Ghana's Legality Assurance System (GhLAS). These rights are divided into four categories: 1. Timber Utilization Contracts, 2. Timber Utilization Permits, 3. Salvage Permits, and 4. Special Permits. Before all trees could be transported, the FSD is the authority to issue (Log Measurement Conveyance Certificate-LMCC) which is the legal document that permits transportation of logs overland.

• **Timber Industry Development Division of Forestry Commission (TIDD)**: TIDD is responsible for establishing guiding price systems for the vetting of contracts of export of wood products. It conducts pre-shipment inspection and examination of wood products and issue permits for the export of timber and wood products. TIDD is also responsible for publishing market intelligence in order to inform industry, government and public regarding pricing, trade and product trends that could impact on the sector, track the movement of logs from forest gates after the issuance of conveyance certificates. While TIDD provides management and technical training for the wood industry and undertake the certification and registration of authorized timber graders and establish levels of certification for such graders, it also monitors the supply of lumber to the local market by recognized millers with the support of the Forest Services Division. Additionally, TIDD advises on approvals to establish new processing mills and register timber processors and traders in timber and wood products and collaborate with international and timber associations on marketing and utilization of wood products as well as coordinate foreign technical assistance aimed at improving efficiency in the industry.

2.3 Monitoring of export levels of species

The monitoring structures for harvesting and trade in timber resources are shown in Figure 2. RMSC monitors the harvesting of trees in Ghana through endorse of yields and periodically undertakes post audits. The FSD monitors volumes harvested and conveyed for processing or export through the issuing Conveyance Certificate (LMCC) systems. Export volumes are monitored by TIDD. The WD issues CITES permits for Timber in trade in endangered species listed in the CITES Appendices. The Custom Division of the Ghana Revenue Authority (GRA) at the Tema and Takoradi ports monitor export containers and documentation for specified tree volumes. Currently, Ghana is implementing a system or systems (Ghana Wood Tracking System) to verify that timber products for shipment have been legally-produced and that only shipments verified as such are exported to the international market. The system for verification includes checks of compliance in order to provide assurance that the timber products destined for export to the international market have been legally produced and that legality licences are not issued in respect of shipments of timber that have not been legally-produced or are of unknown sources.

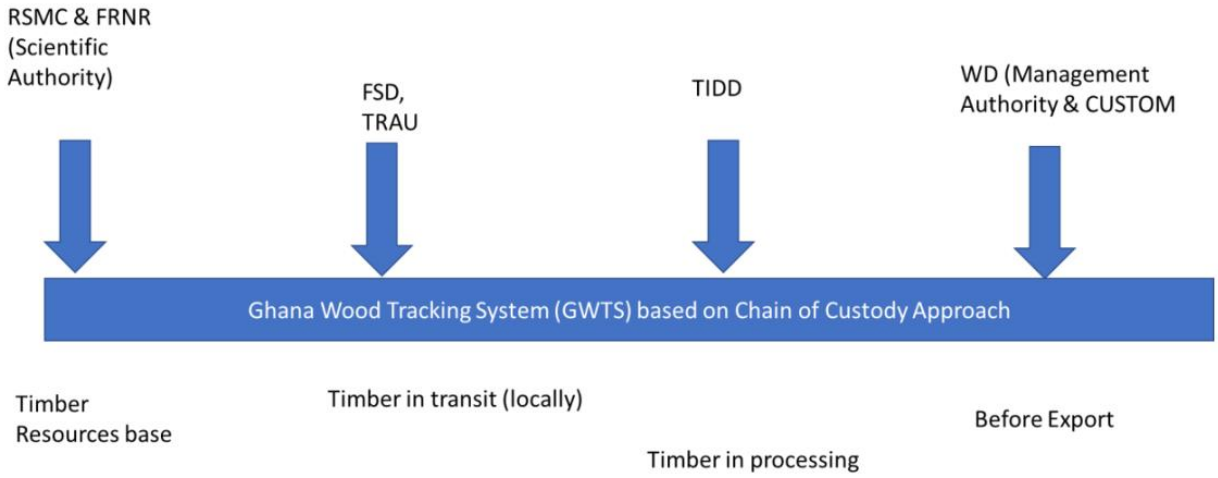

Figure 2 Mechanisms for monitoring population and volumes of *Ptericarpus erinaceus* in Ghana

3.0 ECOLOGY, EXPLOITATION AND TRADE

3.1 Botany and Ecology of *Pterocarpus erinaceus*

Pterocarpus erinaceus is a deciduous legume tree of African savannas and dry forests famous for producing one of the finest woods in its native region (Hutchinson *et al*., 1958). The species belongs to the family Fabaceae. It is a medium-sized, deciduous tree 12-15 m tall, bole often of poor form, strongly fluted and gnarled, with numerous, plank-like buttresses (Hutchinson *et al*., 1958). The bark surface is finely scaly fissured, brown blackish with thin inner bark. The crown +is usually dense and domed with branchlets often lenticel led. Old stems are often hollow. It is commonly found in open forest and wooded savannah. This species together with *Parkia biglobosa* is said to be one of the main components of the remnants of the former dense Sudanian forest. The species occurs in areas with altitudes of 0-600 m, mean annual temperature of 15-32 deg. C, mean annual rainfall of 600-1200 mm (Aubreville, 1950). It grows on shallow soils and growth tends to be stunted on poor soils (Hutchinson *et al*., 1958; Aubreville, 1950). The wood has a fine-grained appearance and once seasoned, maintains shape very well. The tree readily regenerates after cutting, and once established it requires very little attention. *Pterocarpus erinaceus* is a prolific seed producer and is easy to propagate by planting nursery-raised seedlings or rooted cuttings. The fruit, an indehiscent pod, must be cracked open. There are about 3500 unshelled seeds per kg (19,800 per kg if shelled). The recommended seed pretreatment is immersion in water at room temperature for 18–24 hours, or in sulfuric acid for 30–60 minutes and then in tap water for 5–10 minutes (Roussel, 1996). The species produces good quality charcoal and therefore usually extensively exploited for charcoal production.

3.2 Exploitation and Trade

Commercial harvesting and trade in rosewood in Ghana over the years has been restricted to the off-reserve areas. A review of information based on permits issued by the Forestry Commission revealed that the export volumes of the species increased from 77962.5 m^3 in 2017 to 113,253.05 m^3 in 2019 (Figure 3). However, there was a sharp decline in export volumes between 2019 and 2022 due to a temporal ban placed on rosewood harvesting by the Government of Ghana. Moreover, in 2021 a salvage permit issued by the Minister of Lands and Natural Resources under LI 2254, Section 29 to pave way for a developmental project resulted in the harvesting of 716 m^3 of rosewood.

Figure 3 Export volumes based on permits issued by the CITES Management Authority in Ghana, Source, WCMC-UNEP, August 2023

4.0 METHODOLOGY

4.1 Study area description

The species occurs in the Savanna and transitional (Dry Semi-deciduous) zone of Ghana (Figure 3). The Savannah ecosystem is much drier than the southern areas of Ghana, due to its proximity to the Sahel region. The vegetation consists predominantly of grass, sparsely distributed drought-resistant trees including baobabs and acacias. The dry season occurs between December and April whiles the wet season is between July and November with an average annual rainfall of 750mm to 1050 mm. The highest temperatures are reached at the end of the dry season. However, the Harmattan winds from the Sahara blows frequently between December and the beginning of February. The temperatures can vary between 14 °C at night and 40 °C during the day.

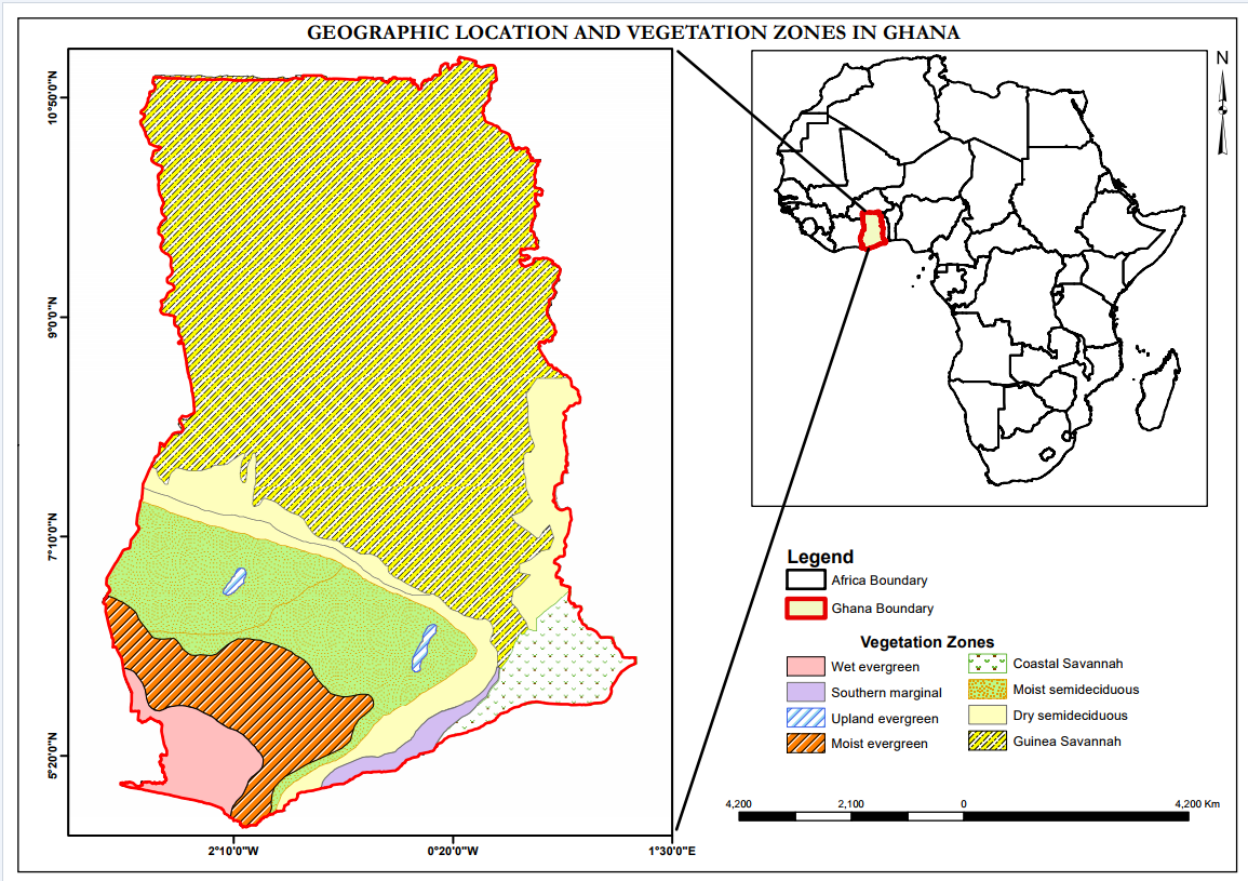

Figure 4 Geographic location and vegetation zones of Ghana

4.2 Selection of sites

A total of twenty-six political districts were selected for the field assessment (Figure 5). The selection of these districts was based on a review of past inventories and interviews with the district forestry staff. These areas were considered to have significant stocks of *Pterocarpus erinaceus*. The selected districts were mapped by the Mapping and GIS Unit, Resource Management Support Centre to guide the field teams in the distribution of sampling plots.

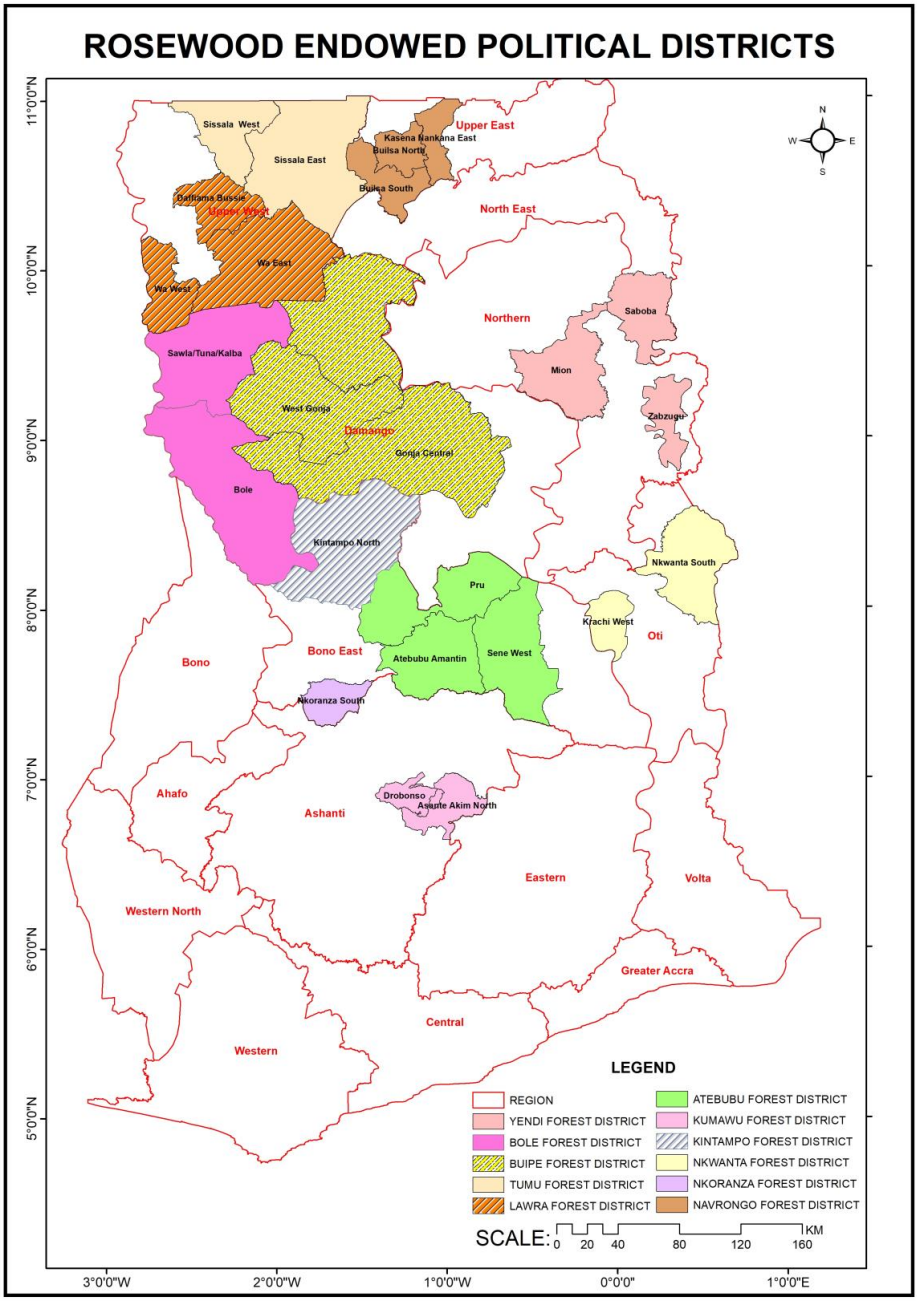

Figure 5 Spatial distribution of rosewood endemic districts

4.3 Desk study

Prior to the field measurement, a review of the methods used for 2013 and 2017 assessment of *Pterocarpus erinaceus* was undertaken to guide the development of sampling procedures for the current study. Subsequently, RMSC liaised with the FSD district offices in the savannah and transitional zones of Ghana to determine where the species occurred in relatively substantial quantities.

4.4 Sampling procedures

Plot size and shape: rectangular plots of size 40 m by 1000 m (i.e., four ha) and sub-divided into 10 quadrats or subplots of 40 m by 100 m were used (Figure 6). These long plots enabled the team to capture data in all the various land use types associated with off reserve areas.

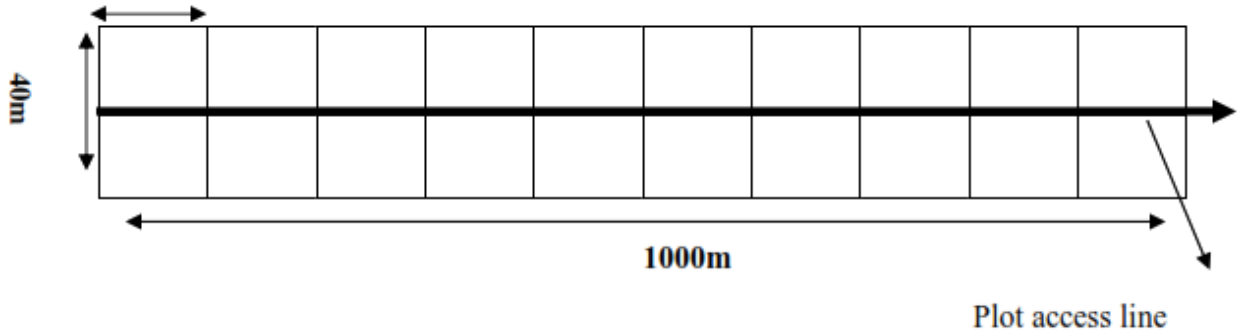

Figure 6 Sample plot layout

Sampling Intensity: Three (3) to five (5) plots depending on the extent of the resource were laid per forest district. In each forest district, the sample plots were distributed across the different political districts in order to capture representative data on species. A forest district is usually made up of a number of political districts.

Plot location and demarcation: Using 1:50,000 topo-sheets of the targeted area, the coordinates of the plots starting points were located. To enhance plot location on the field by the demarcation teams, the starting point of each plot as well as their direction were first identified and constructed on a photocopied topo-Sheet of the site at the office. In each stand, the starting point for each plot was randomly selected.

With the assistance of GPS for direction and machetes for access, these starting points were located on the ground. Similarly, plot directions were also identified using compasses and GPS. Machetes were used for cutting plots access lines. Beacons were placed at each 100 m length along the access line indicating the end of a particular subplot and the beginning of a new subplot (e.g., end of subplot 1, beginning of subplot 2). The demarcation team also determined the major land use type together with terrain condition in each of the 40 by 100 m subplot.

Plot Enumeration: In each plot, all Rosewood trees greater than 10 cm were identified and their diameter at breast height (dbh) measured and recorded. Sapling sampling, where trees between 2 to 9.9 cm diameters were also captured in subplot 1 and 10.

Plate 1 Diameter measurement of rosewood using diameter tape and calipers

4.5 Data entry and analysis

Data captured was keyed into access database and edited to correct errors. Mean stem numbers per ha including their standard errors were generated per Forest District. Mean volume (m^3) per ha including their standard errors for each Forest District were generated using an existing volume equation.

$$\mathbf{V}= 0.0004634(d^{2.201})$$

Where: V= tree volume, d= diameter at breast height

Approach for District Felling Quotas

Extraction per year per Forest/Political District scenarios (Felling Quotas) were generated for discussion and final adoption by FC and other key stakeholders. In proposing the annual felling quota estimates per Political District, the following assumptions were made:

- Only the static estimates of stem numbers/volume (m^3) were used. Thus, the proposal excluded or did not factor in the dynamics (increment, regeneration / recruitment, mortality rates) of the species. This is because information on these parameters were not available.
- In the estimation of net area of vegetation cover for each District Assembly, 60% of the gross area of each Political District was designated as settlement/barelands, forest reserves and national parks. These areas were excluded from the total area of the political district used in the calculation of total stocking (stems and volumes).

- First, static volume/stem estimates per ha were generated for all the political districts and six Rosewood endemic regions namely, Upper East, Upper West, Northern, Volta, Brong Ahafo and Ashanti.
- The size of each Political district (ha) was obtained from the GIS/Mapping Department of RMSC. This was used to estimate total stem numbers and corresponding volume (m^3) of each Political District.
- A retention of 40% of the total stems/volume (m^3) above felling limit (20 cm dbh) per Political District were maintained to cater for conservation, and destructions caused by wildfire, clearance for farming and domestic use.
- 20% of the total stems/volume (m3) above felling limit per Political District was again maintained to cater solely for charcoal production. partly because of the various administrative Rosewood bans at given periods.
- Of the remaining stock (40%) of stems/volume (m^3) above felling limit, three scenarios with an assumed lifespan of 30, 40, and 50 years were used in determining the annual felling quotas.
- **District Quotas:** The annual total of the felling quotas for Political Districts within the Forest District are to be added to generate the Forest District Quota. The felling quotas should be administered by the district offices of the Forest Services Division. This will promote better collaboration between the District Assemblies and Forestry Commission and enhance protection and monitoring of the resources.
- **National Quota:** All the assigned district quotas were summed up to give the national quota, which shall be monitored by RMSC and endorsed by the representative of CITES in Ghana.
- **Scenario:** Three scenarios of 30years, 40years and 50years were used as the felling cycles for the rosewood. Due to inadequate information on mortality rate, recruitment and growth rate of the species, a conservative scenario of 50years was selected out of the three options for the national and district quotas.

5.0 RESULTS

5.1 Diameter class

The stem numbers per km^2 grouped according to diameter classes averaged for all the districts were averaged and generally, the diameter class distribution followed the negative exponential curve typical of natural stands (Figure 7). In most districts, trees recorded were below 40 cm dbh. Large trees greater than or equal to 40cm dbh were recorded in Pru, Sene West, Central Gonja, West Gonja, Biakoye, Wa East, Wa West, Nkwanta South, Saboba and Zabzugu districts (see Annex I for details). Figure 6 shows that about 50% of the trees in the 10-19.9 cm diameter class able to grow to the next diameter class (20-29.9cm dbh) i.e. equal to or above the minimum felling diameter.

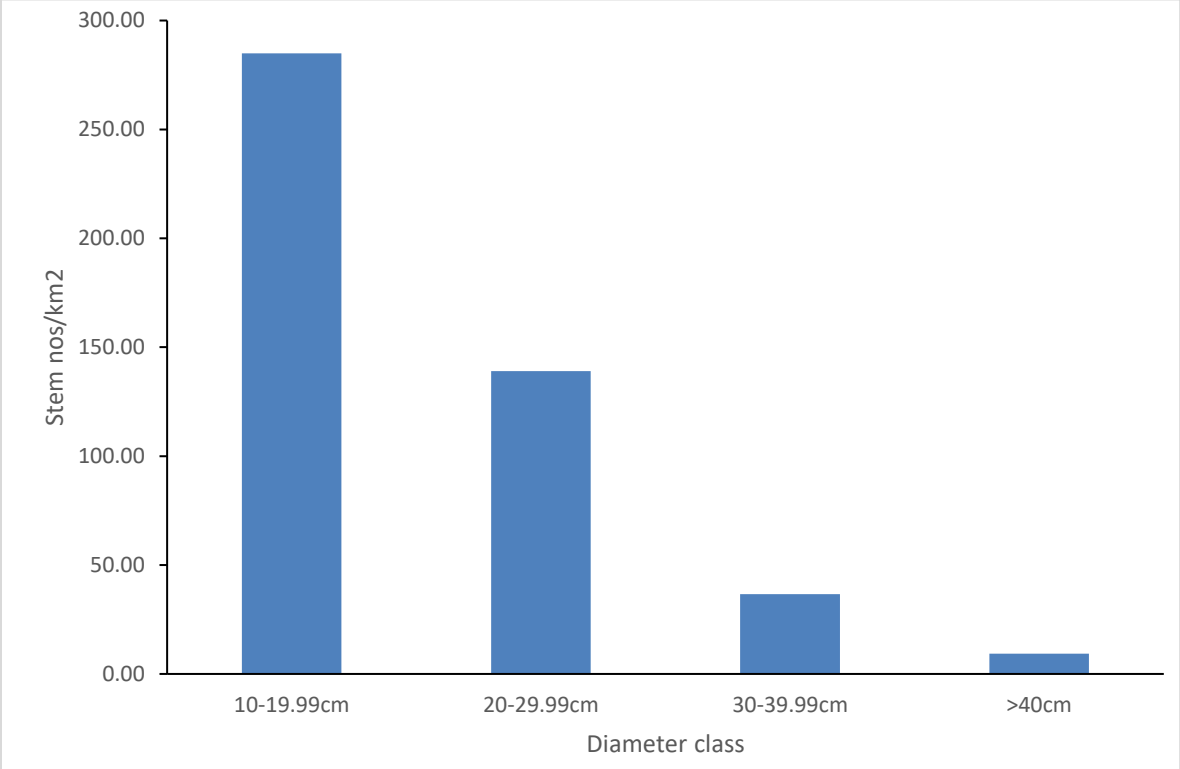

Figure 7 Mean stem number per km2 diameter class distribution for all the political

5.2 Natural regeneration

Advanced regeneration (10-19.9 cm dbh) for the various districts were pooled and averaged to provide an indication of regeneration performance of *Pterocarpus erinaceus*. Regeneration for the species in most political districts was generally good and particularly high in the Kintampo North, Drobonso, Bole, Pru, Nkwanta South and Zabzugu. The performamce of species was poor in Saboba, Navrongo, Builsa South and Kassena Nakana with estimates below 70 stems per km^2 (See Annex I for details). Figure 8 shows a decline in regeneration by 72% between 2017 and 2021.

Between 2021 and 2022 there was reduction of about 9% in natural regeneration. This shows a relatively small reduction in natural regeneration compared to the benchmark value for the year 2017. This improvement in the percentage of natural regeneration reduction could be attributed to the implementation of conservation measures that were prescribed in 2021 NDF report.

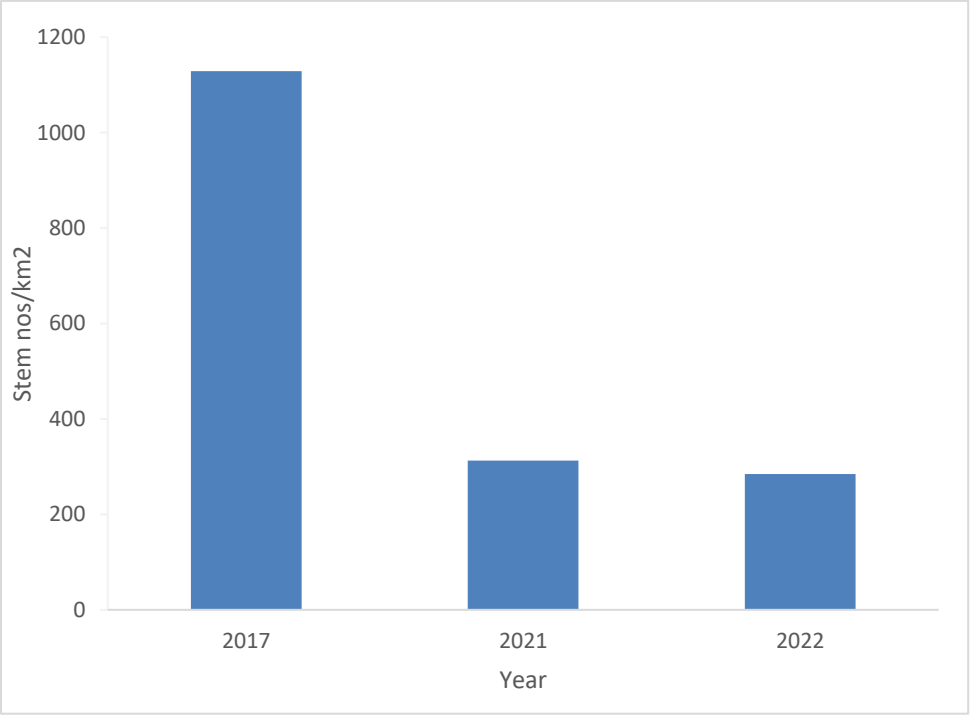

Figure 8 Natural regeneration per km2 across all the districts

5.3 Mean estimates

Mean value per km^2 (100 ha) estimates were generated for stem number and stand volume. Mean stem numbers per km^2 above the felling limit (greater than or equal to 20 cm dbh) and its equivalent mean volume estimates are presented in Table 1. The Northern region recorded the highest mean stem numbers of 211 stems per km^2. The Upper East region recorded the least figure of 154 stems per km^2. Mean volume estimates were rather highest in Volta region with 168 m^3 per km^2 while Ashanti region recorded the lowest average stand volume of 83 m^3 per km^2. Mean stem numbers and volume per km^2 estimates for the various political districts are presented in Annexes I and II. Mean tree volume (MTV) per tree has reduced from $1m^3$ in 2017 to $0.71m^3$ in 2021 and 0.55 m^3 in 2022.

Table 1: Mean stem numbers and mean volume (m3) per 100 ha estimates of rosewood grouped according to regions.

Region	Stems>=Flimit	Sampling error (%)	Vol>=Flimit	Sampling error (%)
ASHANTI	185	1.6	83.5	4.2
BRONG AHAFO	190.2	17.5	107.6	19.3
NORTHERN	211	9.7	151.29	11.4
UPPER EAST	154	21.0	118.4	21.0
UPPER WEST	179.25	21.8	135	17.1
VOLTA	193	4.0	168.67	2.1

5.4 Variation in rosewood stockings

A trend analysis of the mean stem numbers and stand volume estimates for 2017 and 2021 showed a downward trend in stem numbers above the felling limit (≥20cm dbh) in all the rosewood endowed regions (Figures 9 & 10). This information indicates the stocking of rosewood has declined over the years except in the Volta region. The trend pin points to the fact that existing regulatory mechanisms aimed at controlling the exploitation of the species over the years have not been largely effective.

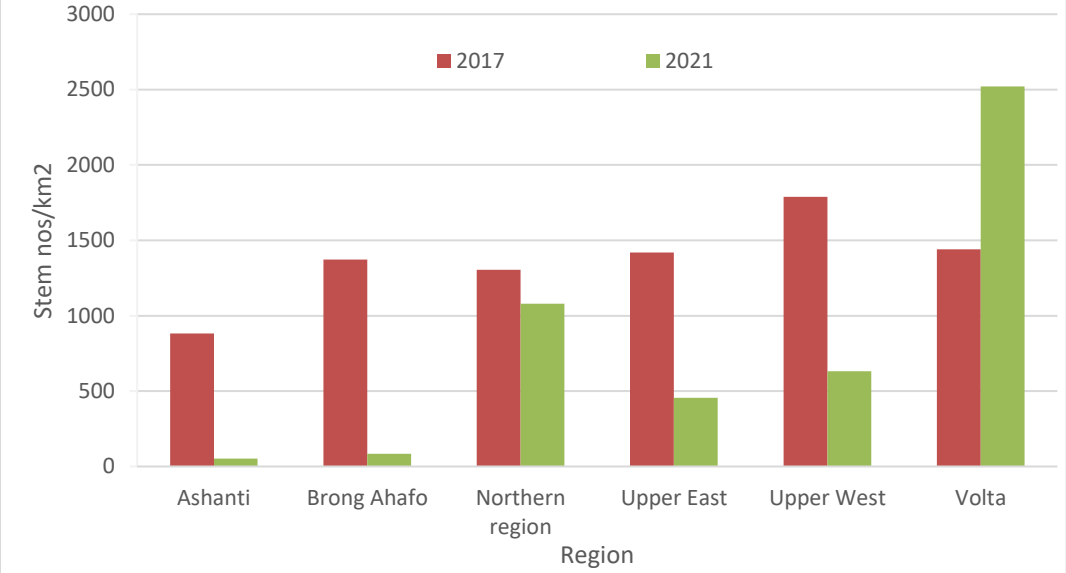

Figure 9 Comparison of stem numbers per km2 of rosewood in 2017 and 2021 for six regions in Ghana

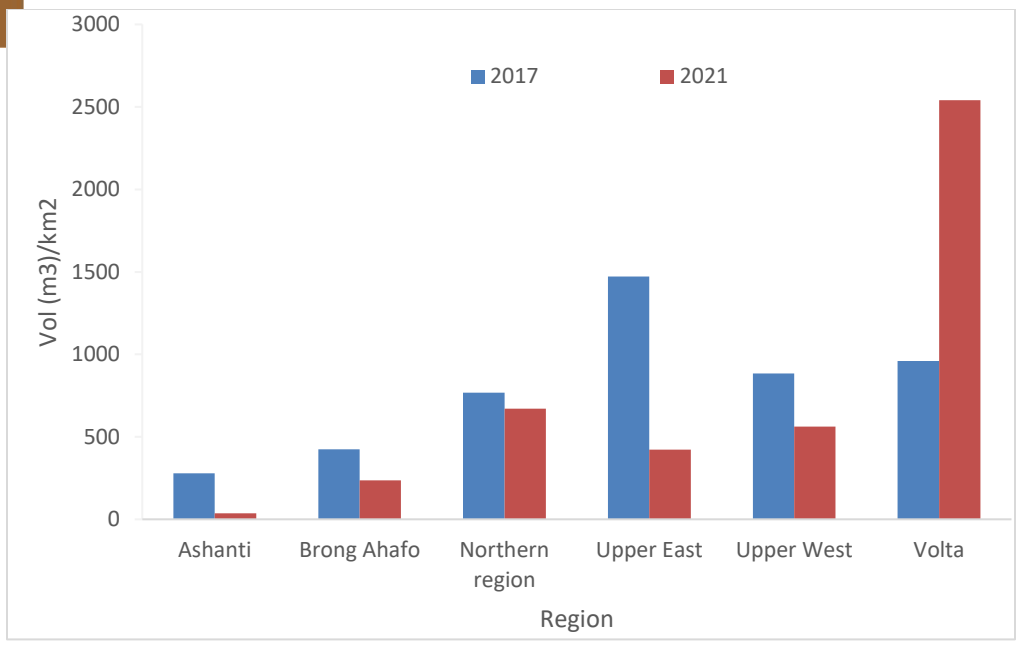

Figure 10 Comparison of volume per km2 of rosewood in 2017 and 2021 for six regions in Ghana

5.5 Total stem and volume estimates

Total standing volume of all stems ≥ 20 cm dbh was estimated to be 2,900,996.00 m^3 with an estimated stem numbers of 5,264,465.85 stems (Annex III). Total stem numbers and stand volume above the felling limit were very high in the East Gonja, West Gonja (584,137.89), Central Gonja (513,003.33), Bole (361,993.59) and Kintampo North (304,477.74) among others (Table 2).

Table 2 Total stems and volume estimates for five endowed political districts

Region	**Political district**	**Total stem ≥ 20cm**	**Total volume (m^3)≥ 20cm**
Northern	East Gonja	589,113.00	324,632.07
Northern	West Gonja	584,137.89	321,890.53
Northern	Central Gonja	513,003.33	282,691.66
Northern	Bole	361,993.59	199,477.40
Brong Ahafo	Kintampo North	304,477.74	167,783.16

5.6 Felling Quota Estimates

5.6.1 National and District Felling Quotas

Felling quotas were estimated for the various political districts based on several considerations. These felling quotas were done with the view to suggest a regulatory mechanism to make of rosewood harvesting in Ghana sustainable. Annual felling quotas estimate based on three scenarios (felling cycles) of 50, 40 and 30 years gave stem numbers of 42,115.73 stems, 52,644.66 stems and 70,192.88 stems for the annual felling quotas respectively. The equivalent in volume is 23,207.97 m^3, 29,009.961m^3 and 38,679.95m^3 for 50, 40 and 30 years respectively (Annex III). The national felling quota was further disaggregated for the twenty-six (26) Political districts that were surveyed. Table 3 shows the ranking of the first five Political districts with the highest felling quota among the three scenarios. The East Gonja District recorded the highest annual felling quota followed by West Gonja, Central Gonja, Bole and Kintampo North in that order. In terms of the proposed annual felling quota for rosewood, these five political districts, out of the total of twenty-six, contribute approximately 45% to both stems and stand volume.

Table 3 First five Political Districts with the highest proposed felling quota per annum

No.	**Political district**	**Scenario 1 (50years)**		**Scenario 2(40years)**		**Scenario 3(30years)**	
		Stem nos.	**Vol (m^3)**	**Stem nos**	**Vol (m^3)**	**Stem nos**	**Vol (m^3)**
1	East Gonja	4,712.90	2,597.06	5,891.13	3,246.32	7,854.84	4,328.43
2	West Gonja	4,673.10	2,575.12	5,841.38	3,218.91	7,788.51	4,291.87
3	Central Gonja	4,104.03	2,261.53	5,130.03	2,826.92	6,840.04	3,769.22
4	Bole	2,895.95	1,595.82	3,619.94	1,994.77	4,826.58	2,659.70
5	Kintampo North	2,435.82	1,342.27	3,044.78	1,677.83	4,059.70	2,237.11

3.6.2 Trends in national felling quotas

National felling quotas proposed over a 50-year felling period have reduced between considerably between 2017 and 2022 (Figure 11). The proposed quotas show a decline of 45% between 2017 from 116,237 m^3 to 52,916 m^3.

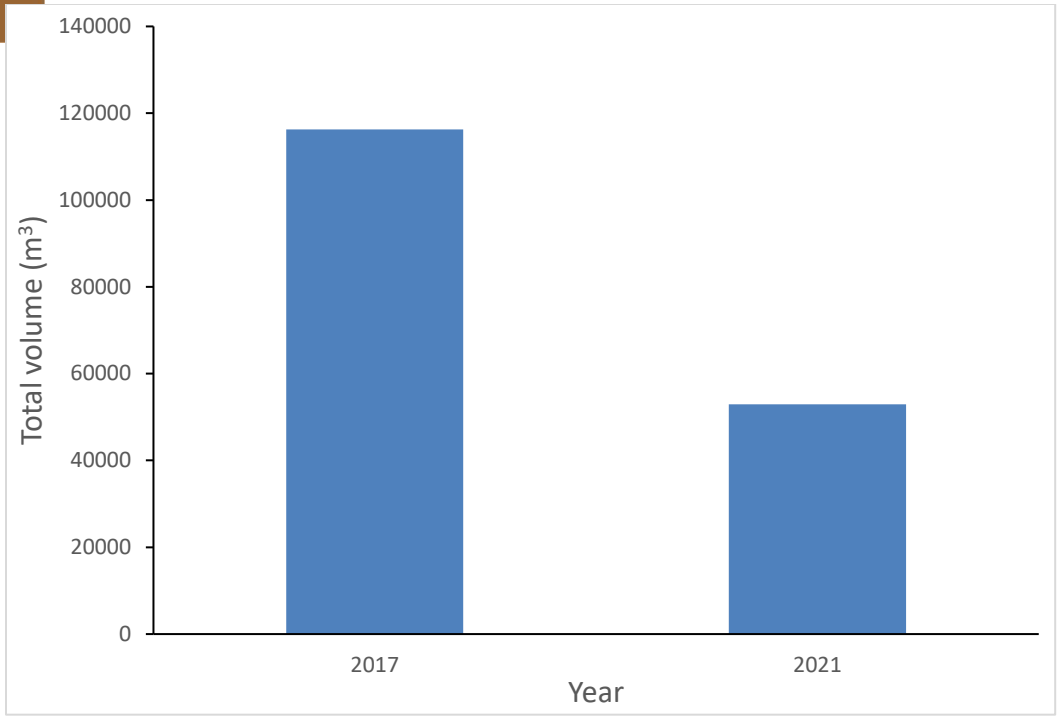

Figure 11 National felling quotas for Rosewood in m3 for 2017 and 2021

5.7 Estimates for rosewood underwater

A study conducted on trees under water within the Volta Basin in 2007 by Volta River Authority (VRA) and the Forestry Commission (FC) revealed that there were large quantities of submerged Ptericarpus erinaceus (rosewood) trees in the lake (Thrower et al., 2007) (see Annex V for details on methodology and volume statistics). The underwater rosewood is distributed within an estimated area of 116,167 ha in the Volta Lake. The total is divided into four Lots according to their locations. Their distribution is either discontinuous (scattered) or wooded (dense). Estimated mean volume across Lots was 5.52 m^3/ha. The total stand volume for all Lots was therefore estimated to be 641,242 m^3 (Table 3). It is estimated that 40,000 m^3 of rosewood will be harvested per annum within the Volta Lake in Ghana. The harvesting of underwater rosewood is expected to be completed within sixteen (16) years barring any eventualities.

Table 4 Projection for Underwater Harvesting of *Pterocarpus erinaceus* (Rosewood) in Volta Lake

Description (Location)	Discontinuous	Wooded	Mean Volume (m^3/ha)	Volume (m^3) Discontinuous	Volume (m^3) Wooded	Total volume (m^3)
Lot 2	2,867	21,882	5.52	15,825.84	120,788.64	136,614.48
Lot 3	6,045	24,657	5.52	33,368.40	136,106.64	169,475.04
Lot 4	9,024	15,498	5.52	49,812.48	85,548.96	135,361.44
Lot 5	7,959	28,235	5.52	43,933.68	155,857.20	199,790.88
Total	**25,895**	**90,272**		**142,940**	**498,301**	**641,242**

5.7 Threats

- Wildfire incidence was observed in almost all sites visited.
- Charcoal production and farming were identified as a major threat to rosewood conservation
- Illegal chainsawing activities

Plate 3: Felled rosewood trees for charcoal production

6.0 DISCUSSION

The study was designed to capture information on stand characteristics in a way that was representative of the range of the species in Ghana. However, it is important to highlight that the field teams could not undertake assessment in most of the riparian areas where a substantial quantity of the existing stands occur could not be accessed during the inventory period due to flooding or inundation of the riverbanks. These areas were excluded during the inventory due to inaccessibility. Harvesting of *Pterocarpus erinaceous* between 2013 and 2017 in the off-reserve areas was initially ad-hoc and poorly regulated. These deficiencies in the implementation of regulatory measures for the harvesting of rosewood have significantly contributed to decline in the species population and volume. Subsequently, steps were taken to address these gaps in implementation to ensure sustainable management of the species. Interim measures included a series of moratorium (ban) on rosewood exploitation in the off-reserve areas in Ghana. Additionally, in recent times other actions including awareness creation, plantation trials, development of electronic App for issuance and tracking of CITES permit, among others are being implemented. Three scenarios for annual quota implementation have been proposed based on fieldwork and ecology of the species – 30years, 40years and 50 years. Among the three scenarios, the 50-year option was selected because it was considered to be conservative. The selection of the 50-year scenario was informed by limited information on the dynamics and ecology of the species coupled with limited information on mortality. The proposed felling quota for the 50-year scenario is 23,207.97 m^3 to be implemented only in off reserve areas. The annual harvesting quota does not include populations of the species that occur in over 80 forest reserves and national parks in Ghana. The forest reserves and national parks serve as gene banks and refugia for a significant population of the species (Annexes for details). For the underwater rosewood trees in the Volta basin, an annual quota of 40,000m^3 is projected for a 16-year period. As earlier indicated in the report, there have been concerns over the accidents caused on the Volta Lake and the danger posed by the submerged trees and recommendations made in Revised National Transport Policy (2020), the Volta Lake Strategic Plan (2010 – 2014) and the Draft Volta Lake Master Plan 2014 made for their removal.

7.0 SPECIES MANAGEMENT AND CONSERVATION MEASURES

Policies and laws: Several laws have been enacted that prescribes procedures, punitive measures and structures to regulate the commercial exploitation of trees in Ghana. Notable among them is the Timber Resources Management Act, 1997 (No. 547 of 1997) and amended in 2002 (Act 617 of 2002) and the Subsidiary Legislation on Timber Resources Management and Legality Licensing Regulation LI 2254 of 2017. The LI 2254 outlines conditions under wood sourced and/or processed in Ghana could be issued with a license for sale within Ghana or for export from Ghana. The implementation of Ghana's Legality Assurance Systems also considers the legal framework that governs the management, enforcement, and trade of the species (FC, 2017). The Parliament of Ghana has passed the Wildlife Resource Management bill into law pending Presidential assent. The law seeks among others to domestic the implementation in Ghana.

Ban on rosewood exploitation: In 2019, a ban was imposed by the Government of Ghana on the harvesting, transporting and export of Rosewood except stocks of salvage and confiscated rosewood auctioned by the Forestry Commission with approval from the Minister of Lands and Natural Resources. The ban is a measure taken by the government to stop illegal harvesting, transporting, processing, trading and exporting of rosewood and control its exploitation. The ban remains in force and the Minister for Lands and Natural Resources has directed the Forestry Commission to cease the issuance of the Convention on international Trade in Endangered Species (CITES) permits for the export of rosewood from Ghana.

Wildfire education: Extensive annual wildfire sensitization and education continue to be undertaken during the dry season in several communities in the savanna and transitional zones. This has been intensified through the implementation of projects (Examples, Shea Landscape Restoration Project, Africa Landscape Restoration Initiative (AFR100) and Ghana Landscape Restoration and Small-Scale Mining Project). These include the establishment and training (Fire management techniques) of fire volunteer squads in selected communities.

Energy efficient technologies for charcoal production: Energy-efficient technologies have been implemented through number of projects in the savanna and transitional zones since 2019 in selected communities. For example, the "Forest Landscape Restoration through a Sustainable Wood Energy Value Chain" has benefitted over 400,000 people and over a million dependents are engaged in charcoal production in the northern and transitional zones of Ghana (Energy Commission, 2006; GSS, 2019). The project supports therefore farmers and charcoal producers in the wood energy value chain to increase efficiency in the charcoal production process aiming at avoiding tree biomass wastage and reduced deforestation.

Quota system: To ensure the sustainable exploitation of the Rosewood trees in Ghana, the Forestry Commission has established quota system to set annual thresholds.

Exclusion of wild populations in protected areas: Presently, rosewood exploitation is restricted to off reserve areas. This excludes wild populations located in Wildlife Parks and forest reserves.

Voluntary Partnership Agreement (VPA): The Government of Ghana as part of the VPA has put in place a robust wood tracking system in collaboration with EU to monitor the exploitation of trees in Ghana. The rationale is to ensure that all harvested trees for trade are sourced legally from a sustainably managed forest. The wood tracking has been in use over the last five years and has been useful in monitoring compliance with existing laws and regulatory mechanisms.

Development of electronic permitting system/App: The Wildlife Division which is the CITES Management Authority of Ghana in collaboration with the ICT directorate of the Forestry Commission are developing a robust software App for the issuance of the CITES permit in Ghana. The electronic permit system is expected to provide interface for the other institutions like Customs, TIDD including importers to verify the authenticity of the permits at various entry and exit points as well as destination countries.

Restoration: The Forestry Commission has initiated rosewood trials across three (3) ecological zones (Northern Savannah and Dry Semi-Deciduous) and outside its native range in the Moist Semi- Deciduous Forest of Ghana. The trails are aimed at studying the growth dynamics and the feasibility of establishing large-scale commercial plantations across the country. The 87.2 ha of Rosewood trials established within the three (3) ecological zones in the previous years in eight (8) forest districts within six (6) regions were maintained. In 2021, an additional area of 57.0 ha was established in eight (8) forest districts (Dormaa, Bibiani, Lawra, Goaso, Bechem, Sunyani, Assin Fosu and Nkawie). The Commission intends to expand the total area of rosewood plantation through a number of programmes and projects.

Plate A two-year old *Ptericarpus erinaceus* (rosewood) stand in the Bosomkese Forest Reserve. Source. RMSC, 2023

8.0 RECOMMENDATIONS

Pterocarpus erinaceus is one of the key remnants species of the former dense Sudanian forest. The species is mainly found in the savanna and dry forest which are considered vulnerable ecosystems. These ecosystems are particularly prone to wildfires and therefore prescriptions in the past for felling of trees in these areas have been very restrictive in order to minimize its impact. The study did not cover rosewood populations in Protected Areas such as forest reserves and national parks where the species is known to occur extensively, but commercial harvesting not permitted (Annex V). Taking into account, the conservation measures initiated so far and other ecological consideration, the following actions are suggested to ensure the sustainable management of *Pterocarpus erinaceus* in Ghana:

i. A conservative national felling quota per annum using 50-year life span scenario should be adopted until they are reviewed as more information particularly on the dynamics of the

species has been fully addressed. Thus, an indicative national felling quota of 23,207.97 m^3 (terrestrial land outside forest reserves) is proposed.

ii. For underwater rosewood in the Volta Lake, an indicative felling quota of 40,000m^3 per annum has been proposed for a period of 16years. This is consistent with the objectives of the Revised National Transport Policy (2020), the Volta Lake Strategic Plan (2010 – 2014) and the Draft Volta Lake Master Plan 2014.

iii. Therefore, the proposed annual aggregate quota for off reserve areas (terrestrial) and under water rosewood harvesting in Ghana to be **63,207.97 m^3.** Barring any changes in policy and other unforeseen circumstances, the proposed harvesting quota is expected to be implemented for 16years until the underwater stock is depleted. After which, the 23,207.97 m^3 will remain operational over the fifty (50) year scenario.

iv. The annual quota should be strictly adhered to through surveillance and a tracking system put in place by the Forestry Commission at the local and national levels. Ensure that exploitation of Rosewood meets the Appendix II requirements of CITES.

v. Additional permanent sample plots should be established in the savannah environment in both on and off reserves to monitor the population dynamics (recruitment, mortality and growth) of the species.

vi. Increase the population of *Pterocarpus erinaceus* through extensive restoration or plantation programmes in the savanna and transition zone.

vii. The felling Political Districts quotas should be administered by the district offices of the Forest Services Division. This will promote better collaboration between the District Assemblies and Forestry Commission and enhance protection and monitoring of the resources.

viii. The national quota which will be implemented by the Forest Services Division, should be monitored by RMSC and endorsed by the representative of CITES in Ghana.

ix. The Forestry Commission gradually integrate harvesting of Ptericarpus erinaceus into existing wood tracking system for documentation and traceability.

x. Increase awareness creation on wildfires in order to reduce the frequency of occurrence and severity in the savanna and transition zones.

xi. Promote the adoption of more efficient technologies and alternative species for charcoal production. Also, encourage the establishment of woodlots to meet the energy needs of local people.

9.0 CONCLUSION

The assessment of the *Pterocarpus erinaceus* is a major initiative that has provided an update report on the status of the species in off reserve areas (terrestrial) as well as those under water trees in the Volta Lake. There is also a considerable stock of dead underwater (submerged) rosewood in the Volta Basin that should be included in the annual felling quotas determined for the terrestrial off-reserve stock. Implementation of the existing Volta Lake master plan which prescribes the removal of underwater trees as the only way to prevent boat accidents will be very critical to saving lives. If the prescribed annual felling quotas are adhered to (50-year cycle for the terrestrial rosewood trees) and implementation of conservation measures are sustained, harvesting of the species will be sustainable. The introduction and fast adaptation of *Ptericarpus erinaceus* outside its native range in the Moist Semi deciduous ecological zone of Ghana, where precipitation is higher gives a positive indication for the development of the species through plantation establishment.

Limitations of the study

Even though illegal harvesting of rosewood has contributed significantly to the placement of the species under Appendix II of CITES, the inadequacies in the dynamics of the species highlighted earlier led to adoption of a **precautionary approach (conservative estimates)** to the determination of annual quotas for the species in off reserve areas. There is also lack of information on the dynamics and general ecology of rosewood and many other tree species in the savannah zone of Ghana. This has been a major limitation in determining allowable cut of many savannah species. When this information has been gathered and analyzed then we will be in a better position to understand increment, mortality and regeneration behavior of the species.

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11.0 ANNEXES

Annex I Mean stem numbers per km^2 grouped according to diameter classes for Rosewood. September, 2022

Region	District Assembly	Forest District	Total area (Km2)	Net area (Km2) - 40%	STEM10	STEM20	STEM30	STEM40	STEM50	STEM60	STEM>60	STEMTOT	FELLSTEM
Ashanti	Asante Akyem North	Kumawu	1126.72	450.7	100.0	250.0	140.0	17.5	0.0	0.0	0.0	507.5	157.5
Ashanti	Drobonso	Kumawu	3867.42	1547.0	265.0	541.3	136.3	16.3	0.0	0.0	0.0	958.8	152.5
Brong Ahafo	Pru	Atebubu	2309.65	923.9	120.0	572.5	240.0	40.0	2.5	0.0	0.0	975.0	282.5
Brong Ahafo	Sene West	Atebubu	4110.13	1644.1	110.0	295.0	105.0	17.5	0.0	0.0	0.0	527.5	122.5
Brong Ahafo	Nkoranza North	Kintampo	1003.86	401.5	344.0	632.0	216.0	36.0	1.0	0.0	0.0	1229.0	253.0
Brong Ahafo	Sene East	Atebubu	4110.13	1644.1	226.7	360.0	155.0	16.7	1.7	0.0	0.0	760.0	173.3
Brong Ahafo	Kintampo North	Kintampo	4832.98	1933.2	157.1	432.9	112.1	8.6	0.0	0.0	0.0	710.7	120.7
Northern	Central Gonja	Buipe	8142.91	3257.2	60.0	246.7	190.0	46.7	6.7	8.3	1.7	560.0	253.3
Northern	West Gonja	Buipe	9272.03	3708.8	76.0	151.0	163.0	26.0	11.0	9.0	6.0	442.0	215.0
Northern	Saboba	Yendi	1819.65	727.9	40.0	40.0	85.0	45.0	15.0	15.0	0.0	240.0	160.0
Northern	Zabzugu	Yendi	2365	946.0	100.0	335.0	208.3	63.3	1.7	1.7	0.0	710.0	275.0
Northern	Bole	Bole	5745.93	2298.4	470.0	597.5	105.0	26.3	2.5	0.0	0.0	1201.3	133.8

Northern	East Gonja	Yendi	9,351	3740.4	100.0	535.0	235.0	22.5	0.0	0.0	0.0	892.5	257.5
Northern	Sawla Tuna Kaba	Bole	4223.21	1689.3	220.0	425.0	165.0	17.5	0.0	0.0	0.0	827.5	182.5
Upper East	Tongo	Bolgatanga	867	346.8	20.0	152.5	142.5	72.5	10.0	0.0	0.0	397.5	225.0
Upper East	Builsa North	Navrongo	816.91	326.8	20.0	60.0	22.5	17.5	5.0	0.0	0.0	125.0	45.0
Upper East	Builsa South	Navrongo	1241.99	496.8	30.0	62.5	80.0	55.0	12.5	0.0	0.0	240.0	147.5
Upper East	Navrongo	Navrongo	1704.6	681.8	320.0	205.0	130.0	80.0	5.0	0.0	0.0	740.0	215.0
Upper East	Kassena Nakana	Navrongo	767	306.8	260.0	60.0	105.0	30.0	5.0	0.0	0.0	460.0	140.0
Upper West	Wa East	Lawra	3633.13	1453.3	100.0	225.0	225.0	18.3	1.7	3.3	0.0	573.3	248.3
Upper West	Wa West	Lawra	1554.42	621.8	153.3	66.7	73.3	15.0	11.7	6.7	1.7	328.3	108.3
Upper West	Sissala East	Tumu	4613.5	1845.4	95.0	151.3	171.3	55.0	17.5	0.0	2.5	492.5	246.3
Upper West	Sissala West	Tumu	1913.35	765.3	120.0	52.5	75.0	32.5	0.0	7.5	0.0	287.5	115.0
Volta	Biakoye	Jasikan	1105.9	442.4	68.0	319.0	134.0	46.0	18.0	5.0	1.0	591.0	204.0
Volta	Nkwanta South	Nkwanta	2134.25	853.7	40.0	307.5	85.0	75.0	15.0	2.5	0.0	525.0	177.5
Volta	Krachi West	Nkwanta	930.28	372.1	70.0	332.5	115.0	57.5	22.5	2.5	0.0	600.0	197.5

Annex II Mean volume estimates per km^2 grouped according to diameter classes for Rosewood. September, 2022

District Assembly	Total area (Km2)	Net area (Km2)- 40%	<9.99cm	10-19.99cm	20-29.99cm	30-39.99cm	40-49.99cm	50-59.99cm	VOL>60cm	VOLTOT	TotF lim Vol
Asante Akyem North	1126.72	450.69	2.78	46.37	70.34	16.45	0.00	0.00	0.00	135.94	86.79
Drobonso	3867.42	1546.97	10.68	91.79	62.50	17.55	0.00	0.00	0.00	182.52	80.05
Pru	2309.65	923.86	6.33	99.70	119.69	40.31	4.07	0.00	0.00	270.10	164.07
Sene West	4110.13	1644.05	4.89	50.77	49.80	17.64	0.00	0.00	0.00	123.09	67.43
Nkoranza North	1003.86	401.54	12.63	102.57	106.66	39.31	1.61	0.00	0.00	262.78	147.58
Sene East	4110.13	1644.05	9.84	63.90	77.93	16.68	2.67	0.00	0.00	171.02	97.29
Kintampo North	4832.98	1933.19	5.47	75.26	54.07	8.13	0.00	0.00	0.00	142.93	62.19
Central Gonja	8142.91	3257.16	1.78	50.48	95.80	48.98	15.55	23.91	7.13	243.62	191.37
West Gonja	9272.03	3708.81	2.64	29.13	85.04	28.37	20.58	25.34	27.30	218.40	186.63
Saboba	1819.65	727.86	2.16	6.31	48.90	50.49	28.73	49.57	0.00	186.16	177.68
Zabzugu	2365	946.00	3.49	67.99	110.75	65.29	3.39	4.72	0.00	255.63	184.15
Bole	5745.93	2298.37	18.59	94.65	50.84	26.54	4.14	0.00	0.00	194.76	81.52
East Gonja	9,351	3740.40	3.14	98.59	116.72	21.88	0.00	0.00	0.00	240.33	138.60
Sawla Tuna Kaba	4223.21	1689.28	7.74	66.48	79.68	18.54	0.00	0.00	0.00	172.43	98.22
Talensi	867	346.80	0.86	31.15	82.98	73.22	15.88	0.00	0.00	204.08	172.08
Builsa North	816.91	326.76	0.78	11.72	9.35	19.10	8.72	0.00	0.00	49.66	37.17
Builsa South	1241.99	496.80	1.49	14.12	40.47	57.85	22.60	0.00	0.00	136.52	120.91
Navrongo	1704.6	681.84	9.69	45.20	68.53	89.91	8.27	0.00	0.00	221.60	166.71
Kassena Nakana	767	306.80	8.33	10.98	57.25	29.85	8.27	0.00	0.00	114.67	95.37
Wa East	3633.13	1453.25	3.57	40.05	108.24	20.02	2.61	8.55	0.00	183.05	139.43
Wa West	1554.42	621.77	3.46	12.52	39.38	15.47	23.15	18.30	6.40	118.68	102.70

Sissala East	4613.5	1845.40	3.62	30.29	89.80	58.45	34.30	0.00	16.43	232.89	198.98
Sissala West	1913.35	765.34	4.55	9.11	42.77	35.59	0.00	20.75	0.00	112.76	99.11
Biakoye	1105.9	442.36	2.65	62.66	72.92	47.06	31.00	14.72	3.87	234.88	169.57
Nkwanta South	2134.25	853.70	1.38	70.63	47.06	79.56	28.51	7.03	0.00	234.16	162.15
Krachi West	930.28	372.11	2.80	77.52	67.46	58.74	40.54	7.36	0.00	254.42	174.10

Annex III Annual felling quotas for three scenarios of 50years, 40years and 30years for Rosewood. September, 2022

Region	District Assembly	Forest District	Total area (Km2)	Net area (Km2)-40%	TOTSTEMS> 20cn dbh	TOTVol> 20cn dbh	60% deducted from stock> 20cm		Scenario 1 (50years)		Scenario 2 (40years)		Scenario 3 (30years)	
							Stem >=FLT	Volume >=FLT	Stem >=FLT	Vol >=FLT	Stem >=FLT	Vol >=FLT	Stem >=FLT	Vol >=FLT
Ashanti	Asante Akyem North	Kumawu	1126.72	450.688	70,983.36	39,115.54	28,393.34	15,646.22	567.87	312.92	709.83	391.16	946.44	521.54
Ashanti	Drobonso	Kumawu	3867.42	1546.968	243,647.46	134,262.49	97,458.98	53,705.00	1,949.18	1,074.10	2,436.47	1,342.62	3,248.63	1,790.17
Brong Ahafo	Pru	Atebubu	2309.65	923.86	145,507.95	80,182.49	58,203.18	32,073.00	1,164.06	641.46	1,455.08	801.82	1,940.11	1,069.10
Brong Ahafo	Sene West	Atebubu	4110.13	1644.052	258,938.19	142,688.48	103,575.28	57,075.39	2,071.51	1,141.51	2,589.38	1,426.88	3,452.51	1,902.51
Brong Ahafo	Nkoranza North	Kintampo	1003.86	401.544	63,243.18	34,850.30	25,297.27	13,940.12	505.95	278.80	632.43	348.50	843.24	464.67
Brong Ahafo	Sene East	Atebubu	4110.13	1644.052	258,938.19	142,688.48	103,575.28	57,075.39	2,071.51	1,141.51	2,589.38	1,426.88	3,452.51	1,902.51
Brong Ahafo	Kintampo North	Kintampo	4832.98	1933.192	304,477.74	167,783.16	121,791.10	67,113.26	2,435.82	1,342.27	3,044.78	1,677.83	4,059.70	2,237.11
Northern	Central Gonja	Buipe	8142.91	3257.164	513,003.33	282,691.66	205,201.33	113,076.67	4,104.03	2,261.53	5,130.03	2,826.92	6,840.04	3,769.22
Northern	West Gonja	Buipe	9272.03	3708.812	584,137.89	321,890.53	233,655.16	128,756.21	4,673.10	2,575.12	5,841.38	3,218.91	7,788.51	4,291.87
Northern	Saboba	Yendi	1819.65	727.86	114,637.95	63,171.51	45,855.18	25,268.60	917.10	505.37	1,146.38	631.72	1,528.51	842.29

Northern	Zabzugu	Yendi	2365	946	148,995.00	82,104.04	59,598.00	32,841.61	1,191.96	656.83	1,489.95	821.04	1,986.60	1,094.72
Northern	Bole	Bole	5745.93	2298.372	361,993.59	199,477.40	144,797.44	79,790.96	2,895.95	1,595.82	3,619.94	1,994.77	4,826.58	2,659.70
Northern	East Gonja	Yendi	9,351	3740.4	589,113.00	324,632.07	235,645.20	129,852.83	4,712.90	2,597.06	5,891.13	3,246.32	7,854.84	4,328.43
Northern	Sawla Tuna Kaba	Bole	4223.21	1689.284	266,062.23	146,614.20	106,424.89	58,645.68	2,128.50	1,172.91	2,660.62	1,466.14	3,547.50	1,954.86
Upper East	Tongo	Bolgatanga	867	346.8	54,621.00	30,099.03	21,848.40	12,039.61	436.97	240.79	546.21	300.99	728.28	401.32
Upper East	Builsa North	Navrongo	816.91	326.764	51,465.33	28,360.09	20,586.13	11,344.04	411.72	226.88	514.65	283.60	686.20	378.13
Upper East	Builsa South	Navrongo	1241.99	496.796	78,245.37	43,117.29	31,298.15	17,246.92	625.96	344.94	782.45	431.17	1,043.27	574.90
Upper East	Navrongo	Navrongo	1704.6	681.84	107,389.80	59,177.40	42,955.92	23,670.96	859.12	473.42	1,073.90	591.77	1,431.86	789.03
Upper East	Kassena Nankana	Navrongo	767	306.8	48,321.00	26,627.40	19,328.40	10,650.96	386.57	213.02	483.21	266.27	644.28	355.03
Upper West	Wa East	Lawra	3633.13	1453.252	228,887.19	126,128.81	91,554.88	50,451.52	1,831.10	1,009.03	2,288.87	1,261.29	3,051.83	1,681.72
Upper West	Wa West	Lawra	1554.42	621.768	97,928.46	53,963.70	39,171.38	21,585.48	783.43	431.71	979.28	539.64	1,305.71	719.52

Upper West	Sissala East	Tumu	4613.5	1845.4	290,650.50	160,163.63	116,260.20	64,065.45	2,325.20	1,281.31	2,906.51	1,601.64	3,875.34	2,135.52
Upper West	Sissala West	Tumu	1913.35	765.34	120,541.05	66,424.42	48,216.42	26,569.77	964.33	531.40	1,205.41	664.24	1,607.21	885.66
Volta	Biakoye	Jasikan	1105.9	442.36	69,671.70	38,392.75	27,868.68	15,357.10	557.37	307.14	696.72	383.93	928.96	511.90
Volta	Nkwanta South	Nkwanta	2134.25	853.7	134,457.75	74,093.25	53,783.10	29,637.30	1,075.66	592.75	1,344.58	740.93	1,792.77	987.91
Volta	Krachi West	Nkwanta	930.28	372.112	58,607.64	32,295.87	23,443.06	12,918.35	468.86	258.37	586.08	322.96	781.44	430.61
Total			**83,562.95**	**33,425.18**	**5,264,465.85**	**2,900,996.00**	**2,105,786.34**	**1,160,398.40**	**42,115.73**	**23,207.97**	**52,644.66**	**29,009.96**	**70,192.88**	**38,679.95**

Assumptions

1. Population dynamics (increment, regeneration / recruitment, mortality rates) are not included in the analysis
2. 60% of the gross area of each District Assembly is designated as settlements, protected areas/forest reserves,
3. Only stems above felling limit (20 cm dbh) were used for the analysis
4. 60% retention of all stems above Felling Limit to cater for destruction such as, wildfire, clearance for farming, charcoal burning, domestic use
5. The 50years scenario was selected among the three scenarios dur inadequate information on growth rate , mortality rate and recruitment of the *Pterocarpus erinaceus*

Annex IV Addendum

Under water rosewood inventory in the Volta Basin in Ghana

Kete Krachi Timber Recovery (KKTR) was granted a permit to salvage under water trees in the Volta Basin by the Minister of Lands and Natural Resources in 2010. These were submerged trees which died about 60years ago during the construction of the Akosombo Hydro electric dam in 1961. A study conducted in 2007 estimated the under water rosewood volume to be 640,855m^3 (Volta Lake Timber Inventory Program – Initial Timber Inventory, September 2007 Population Status, Trade and Sustainable Management of African Rosewood in Ghana- Forestry Commission , September 2021). The underwater rosewood have a different appearance from the terrestrial rosewood in Ghana and therefore make them easy to differentiate. This feature will help in monitoirng to prevent abuse of harvesting permits.

Annex IV Correspondence, methodology and statistics on under water trees in the Volta Basin

KETE KRACHI TIMBER RECOVERY

Mr. John Allotey
Chief Executive, Forestry Commission
Accra

September 30th, 2022

Dear Sir:

KKTR's Exemptions to Export Rosewood, Ghana's Submission to CITES At November's COP 19 in Panama City

I trust this letter finds you well.

I write to follow up on a report that we understand is presently being compiled for presentation to CITES at the above-referenced COP 19, concerning determination of sustainable export volumes for Ghana's rosewood.

As you know, in the course of KKTR's operations we regularly salvage quantities of rosewood from Lake Volta, being submerged trees that died 60+ years ago, so extraction of same has no impact on Ghana's remaining living rosewood stocks. In recognition of this, the Ministry of Lands and Natural Resources in February of 2022 directed that KKTR be granted an exemption from the ban on rosewood export so as to enable us to conduct our commercial operations per our April 2010 salvage concession agreement.

We estimate that Lake Volta contains ~640,000m³ in recoverable rosewood roundlogs (Sources: Population Status, Trade and Sustainable Management of African Rosewood in Ghana - Forestry Commission, September 2021; Volta Lake Timber Inventory Program - Initial Timber Inventory, September 2007), and are eager to assist in the completion of the report to be presented at COP 19 to ensure that it appropriately represents Lake Volta as a source of rosewood that should be exempted from both export restrictions and calculations of any quotas determined for land-based rosewood. As you appreciate, at this juncture in the economic life of our nation, all foreign exchange earnings are crucial, and we stand ready to do our part to realise this neglected national resource.

I trust the above is in order, we are at your disposal to discuss, and thank you in advance for your consideration.

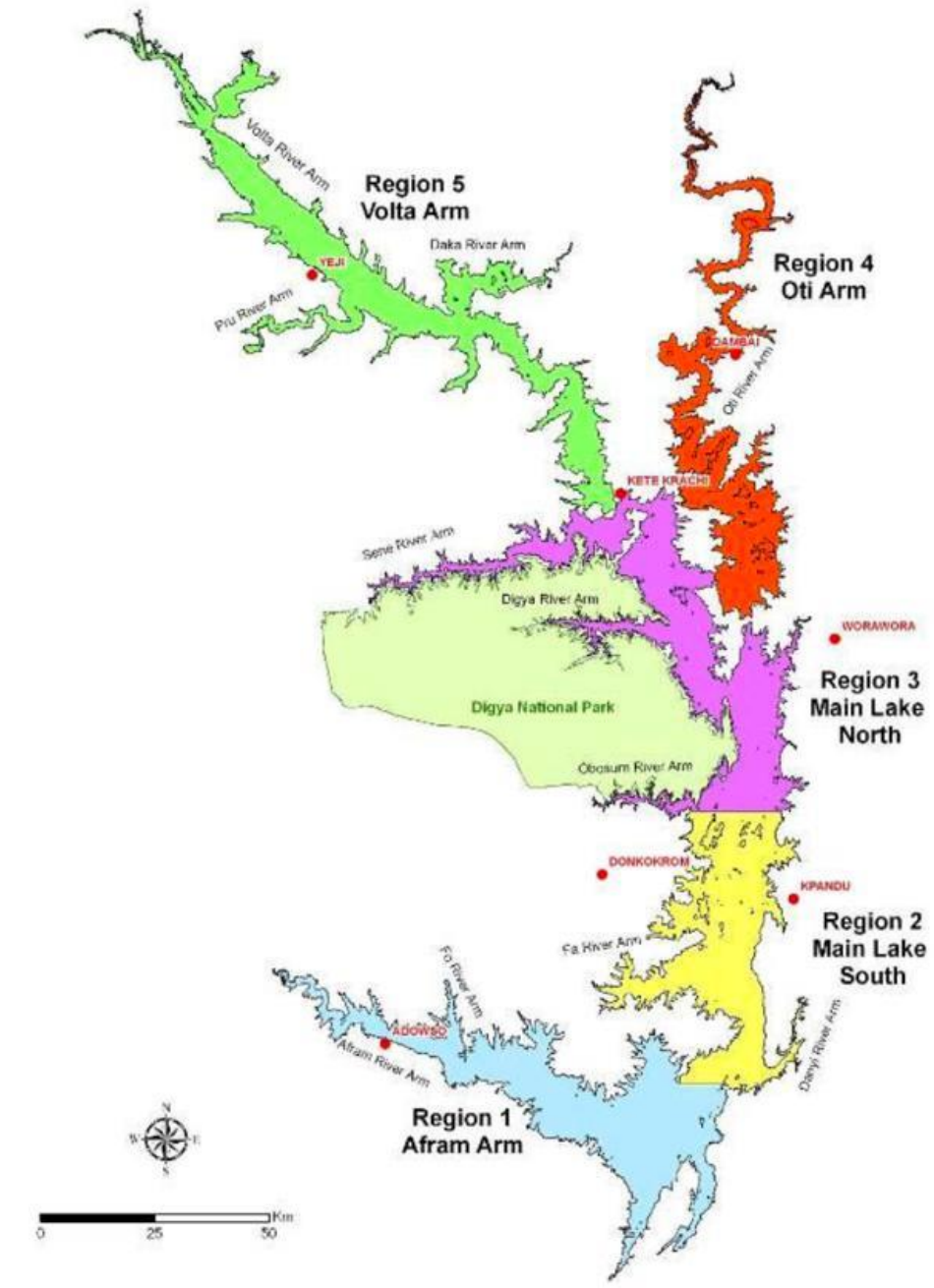
Elkin Pianim
CEO

Copy:

Honourable Samuel A. Jinapor, Ministry Of Lands And Natural Resources
Mr. Yoofi Grant, CEO, Ghana Investment Promotion Center

5 Abafun Crescent, Accra, Ghana. Tel:+233 302 768960-61; Fax:+233 302 768966
Company Number: CS453572014

- The Five Regions of Volta Lake



Source. Thrower et al. 2007

2. Information Sources

2.1 Aerial Photographs & Maps

Aerial Photographs

We acquired 1,750 aerial photographs taken in 1946/47 by the British Royal Air Force (RAF) of the lake area prior to flooding. These are high resolution black and white photos with scales ranging from about 1:25,000 to 1:30,000 (Appendix 1).

Maps

We also acquired the 1:50,000 scale maps made those photos with features updated to 1954. Those maps include geographic features, water features (rivers and creeks), improvements (towns, roads, etc.), contour lines (50 ft intervals), and vegetation mapping symbols (Appendix 2).

Identifying Forested Areas

We identified and mapped the location of closed-canopy forest areas from the photos and maps in Regions 1, 2, 3, and 4 (Appendix 3). Mapping for Region 5 is underway and will be completed near the end of 2007. We used the vegetation symbols on the maps to cross-reference with the location of forested area on the photos to precisely locate and map closed-canopy forest areas. This gives us an accurate location and estimate of size of these areas that are now submerged in the lake.

We did not identify the spatial location of the potentially commercial areas of wooded savanna. That may be done in subsequent phases of mapping and photo interpretation.

Change Before Flooding

We do not believe that any significant changes would have occurred to the forest area identified on these maps and photos in the eight or nine years from the time the maps were published in 1954 to 1962 when flooding of the lake began. Two of the retired forestry experts we interviewed worked in the Afram River area prior to flooding and specifically noted that no commercial timber harvesting was occurring in the area at that time. The area had relatively poor access and commercial timber harvesting in the southern wetter forests (more valuable) had not yet progressed into the northern drier forests (less valuable at that time). They also noted that local villagers would take the occasional tree for local use using pit sawing methods.

Source. Thrower et al. 2007

2.2 *Inventory Data*

Source

The inventory data used in this process were obtained from Dr. William Hawthorne at Oxford University. The data were originally taken under the Ghana National forest inventory completed from 1986 to 1990. Dr. Hawthorne worked in the data collection and analysis on that inventory.

The data were collected in temporary sample plots in Forest Reserves including Afram Headwaters, Afrensu-Brohuma, Awura, Asubima, Chirimfa, Bandai Hills South, Kwamisa, Mankrang, Opro River, and Tain 2. These reserves were selected by Dr. Hawthorne as ones in drier than average, transition areas, and savanna areas from the larger group of Forest Reserves in the dry semi-deciduous (DS) forest type. The intent was to ensure that the summaries, that we use to represent the average of large areas, included these areas and was not biased to better stocked and more classic DS forest types.

Modification to the Data

Most experts consulted noted that the Reserves included in these summaries would have had one and possibly two logging entries prior the data being collected for the National Inventory, and that the area that now flooded would not have had any large scale commercial timber harvesting. This was confirmed by two retired Forestry Commission staff that worked in the area prior to flooding. Consequently, we add a small number of large trees to the data to partially account for those expected differences. These additions were 14 trees per square km (14 trees/100 ha or 0.14 trees/ha) which was about 4.0 m^3/ha (Table 1). We reviewed these additions with some experts and they believe they are reasonable and probably conservative.

Source. Thrower et al. 2007

Volume Reduction for Decay & Defect

We estimated the volume of trees in the inventory data using the equations developed for the Ghana National Forest Inventory (Wong and Blackett 1994). We assigned the mid-point of each 30 cm diameter class to each tree in the class and estimated bole (outside bark) volume using the overall average equation for Zone 1 (defined by Wong and Blackett). Equations are given for specific species groups, but they do not cover all species and thus we used the overall average equation to avoid bias.

We reduced those volumes by 10% to account for bark volume and defect as recommended by Wong and Blackett. We did not make the log-log correction for the back transformation, which reduced the volume by an additional 4%. This was to account for additional internal and some external rot that may have occurred in the trees while submerged. The resulting net volumes are used in these summaries.

Volume Reduction for Silt Accumulation

We did not make any volume reduction for the possibility of silt accumulation on the lake floor (which may require felling trees at some point above the original ground line). Although this is a possibility, we have no information to suggest this is the case. Furthermore, sonar images of the lake floor in Afram Arm suggest that silt accumulation is minimal and should not impact harvesting operations.

2.3 Expert Opinion

Process

We reviewed the inventory data with active and retired operational and research personnel at the Forest Research Institute of Ghana (FORIG) and the Forestry Commission (Ministry of Lands and Forests) in Ghana. The review included the estimates for volume (m^3/ha), species composition (volume by species and species groups), and diameter distributions (numbers of trees/ha by diameter class, species, and species groups). We also spent considerable time with Dr. Hawthorne at Oxford University collating and reviewing these data. The contribution of these experts was essential in developing these estimates and provided frequent *logical checks* of the data, summaries, and assumptions that we made throughout this process.

All experts agreed that the summaries give a reasonable expectation of what to find – on average – in Region 1 and 2 of the lake. Some experts were familiar with Region 3

Source. Thrower et al. 2007

and suggested that the information should be applicable to the closed-canopy forest in that area.

Contributors

The experts directly consulted and who provided major contributions to this process included:

Dr. William Hawthorne, Oxford University
Dr. Joseph Cobbinah, FORIG
Dr. Andrew Oteng-Amoako, FORIG
Dr. Ernest Foli, FORIG
Dr. Joseph Ofori, FORIG
Dr. Victor Agyeman, FORIG
Mr. Edward Obiaw, Forestry Commission
Mr. Kofi Affum Baffoe, Forestry Commission
Mr. Francis Balfour Agurgo, Forestry Commission
Mr. Charles Dei-Amoah, Forestry Commission
Mr. Oppon Sasu, Forestry Commission
Mr. K.K.F. Ghartey, Retired inventory officer, Forestry Commission
Mr. Bimah, Forestry Commission (Ho Forest Regional Manager)
Mr. E.K. Afanyade, Retired Regional Forestry Officer, Forestry Commission
Mr. A.A. Duah, Retired Technical Forestry Officer, Forestry Commission
Dr. E.A. Abeney, Senior Lecturer, KN University of Science and Technology

Others contacted, directly or indirectly, for general or supporting information included:

Dr. Valerie Lemay, Professor of Forestry, University of British Columbia
Dr. Gary Bull, Professor of Forestry, University of British Columbia
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Dr. Geldenhuys, Professor of Forestry, Stellenbosch University, South Africa
Dr. Cris Brack, Professor of Forestry, Australian National University
Dr. R. Hughes, Retired Professor of Tropical Botany and Wetlands of Africa
Dr. Mark Ashton, Professor of Tropical Forest Ecology, Yale University
Dr. Jefferson Hall, Smithsonian Tropical Research Institute
Dr. Michael Swaine, Professor of Tropical Forest Ecology, University of Aberdeen
Dr. A.Y. Omule, Consultant in Tropical Forest Inventory
Dr. Jacob Boateng, Research Scientist, BC Ministry of Forests

Source. Thrower et al. 2007

- Volume by Forest Type and Region

Region	Forest Type	Variant	Area (ha)	Of Region	Of Lake	Volume (m^3)	Of Region	Of Lake
1	DS	Closed Canopy	40,688	31%	7%	3,824,672	85%	27%
	DS	Discontinuous	2,889	2%	0%	135,783	3%	1%
	WS	Wooded	22,174	17%	4%	554,344	12%	4%
	Other	Non Forested	67,417	51%	11%			
	Total		133,168	100%	23%	4,514,799	100%	32%
2	DS	Closed Canopy	17,939	16%	3%	1,686,266	71%	12%
	DS	Discontinuous	2,867	3%	0%	134,749	6%	1%
	WS	Wooded	21,882	20%	4%	547,055	23%	4%
	Other	Non Forested	66,531	61%	11%			
	Total		109,219	100%	18%	2,368,070	100%	17%
3	DS	Closed Canopy	22,983	17%	4%	2,160,402	70%	15%
	DS	Discontinuous	6,045	5%	1%	284,115	9%	2%
	WS	Wooded	25,647	19%	4%	641,174	21%	5%
	Other	Non Forested	77,977	59%	13%			
	Total		132,652	100%	22%	3,085,691	100%	22%
4	DS	Closed Canopy	12,476	15%	2%	1,172,744	59%	8%
	DS	Discontinuous	9,024	11%	2%	424,128	21%	3%
	WS	Wooded	15,498	18%	3%	387,455	20%	3%
	Other	Non Forested	47,121	56%	8%			
	Total		84,119	100%	14%	1,984,327	100%	14%
5	DS	Closed Canopy	10,612	8%	2%	997,536	48%	7%
	DS	Discontinuous	7,959	6%	1%	374,076	18%	3%
	WS	Wooded	28,235	21%	5%	705,869	34%	5%
	Other	Non Forested	85,845	65%	15%			
	Total		132,651	100%	22%	2,077,480	100%	15%
All	DS	Closed Canopy	104,698		18%	9,841,620		70%
	DS	Discontinuous	28,784		5%	1,352,851		10%
	WS	Wooded	113,436		19%	2,835,897		20%
	Other	Non Forested	344,891		58%			
	Total		591,809		100%	14,030,368		100%

Source. Thrower et al. 2007

Annex V Profiles of Forest Reserves and National Parks found within the natural range of *Pterocarpus erinaeus* in Ghana

No.	Name of Reserve	Area/Size (km2)	Latitude	Longitude	Conservation area
1	Tain Tributaries I	30.56	7 25'N	2 14'W	Forest reserve
2	Yaya	51.28	7 27'N	2 08'W	Forest reserve
3	Nsemre	18.1	7 32'N	2 12'W	Forest reserve
4	Sawsaw	62.94	7 36'N	2 10'W	Forest reserve
5	Tain II	509.19	7 35'N	2 30'W	Forest reserve
6	PamuBerekum	189.1	7 25'N	2 56'W	Forest reserve
7	Bosomoa	170.94	7 55'N	1 49'W	Forest reserve
8	Buru	302.3			Forest reserve
9	Klemu Headwaters	10.88	6 46'N	0 31'E	Forest reserve
10	Abutia Hills	8.99			Forest reserve
11	Kpandu Range West	35.5	5 45'N	0 17'E	Forest reserve
12	Togo Plateau	150	7 14'N	0 25 'E	Forest reserve
13	Ho Hills	0.2			Forest reserve
14	Kpando Plantation	0.44			Forest reserve
15	Odome River	16.06	7 19'N	0 29'E	Forest reserve
16	Kabo River	135.97	7 37'N	0 26'E	Forest reserve
17	Apepesu	60.6	7 50'N	0 35'E	Forest reserve
18	Asuokoko River	116.03	7 47'N	0 25'E	Forest reserve
19	Chai River	182.3	8 02'N	0 26'E	Forest reserve
20	Bopona	61.75			Forest reserve
21	Sisili Central	155.09			Forest reserve
22	Gia	21.7			Forest reserve
23	Kanjarga-Fumbisi	12.95			Forest reserve
24	Chasi	72.52			Forest reserve
25	Chiana	43.59			Forest reserve
26	Tankara	4.82			Forest reserve
27	Asebiliki	38.85			Forest reserve
28	Dedoro	3.11			Forest reserve
29	Saboro Gov't	0.28			Forest reserve
30	Kologu-Naga	45.33			Forest reserve
31	Kadembali	23.85			Forest reserve
32	Sisiili North	82.88			Forest reserve
33	Wiaga	9.84			Forest reserve
34	WiagaKandema	67.34			Forest reserve
35	Pogi	26.06			Forest reserve
36	Red Volta West	281.59			Forest reserve
37	Nyokoko Plantation	0.41			Forest reserve
38	Takwindi East	193.21			Forest reserve
39	Takwiddi West	119.14			Forest reserve
40	Bumbuga	4.14			Forest reserve
41	Bumbuga Ex Blk 1	0.41			Forest reserve
42	Morago West	39.76			Forest reserve
43	Basua Bridge (Proposed)	2.18			Forest reserve
44	Red Volta East	217.61			Forest reserve
45	Zamse Hills BLK 1 & 2	10.13			Forest reserve

46	Zamse Plantation	2.28			Forest reserve
47	Upper TamneBlk 1 - 5	17.28			Forest reserve
48	Gambaga East	127.53			Forest reserve
49	Gambaga South West 1	115			Forest reserve
50	Gambaga South West 2	222.22			Forest reserve
51	Morago River	88.06			Forest reserve
52	Nasia Tributaries	314.69			Forest reserve
53	Tamale FuelwoodBlk 1 & 2	2.2			Forest reserve
54	Tamale waterworks	1.41			Forest reserve
55	Sinsangblewini	73.8			Forest reserve
56	Education Plantation	2.6			Forest reserve
57	Biligu	56.7			Forest reserve
58	Daka	2.6			Forest reserve
59	Kulupene	2.2			Forest reserve
60	Karaga	24.5			Forest reserve
61	Bombi	1.48			Forest reserve
62	Damongo Scarp	39.37			Forest reserve
63	Kenikeni	512.98			Forest reserve
64	Nyembong	4.66			Forest reserve
65	Yerada	424.81			Forest reserve
66	Yakombo	1210.95			Forest reserve
67	Kumbo	164.49			Forest reserve
68	Lambo	113.39			Forest reserve
69	Pudo	51.8			Forest reserve
70	Chira	41.44			Forest reserve
71	Tumu	54.39			Forest reserve
72	Mawbia	129.5			Forest reserve
73	Kulpawn Headwaters	155.3			Forest reserve
74	Pulumbugala	39.21			Forest reserve
75	Tapania Tributaries	46.62			Forest reserve
76	Poli	35.61			Forest reserve
77	Kamba	37.56			Forest reserve
78	Lawra Station	1.27			Forest reserve
79	BagwonBawo	64.73			Forest reserve
80	Nandom	1.86			Forest reserve
81	Kulpawn Tributaries	99.95			Forest reserve
82	Ambalaara	99.95			Forest reserve
83	Nuale	51.8			Forest reserve
84	Bambule	204.09			Forest reserve
85	Bomfobri Wildlife Sanctuary	53.1	6 54’-7 01’N	1 08’-1 13’W	Wildlife Protected Area
86	Digya National Park	3,478.30	7 06’-7 44’N	0 06’-0 42’W	Wildlife Protected Area
87	Bui National Park	1,820.60	8 01’-8 50’N	2 12’-2 33’W	Wildlife Protected Area
88	Kogyae Strict Nature Reserve	385.7	7 00’-7 21’N	1 00’-1 13’W	Wildlife Protected Area
89	Shai-Hill Resource Reserve	53	5 85’-5 97’N	0 38’ 9 06’E	Wildlife Protected Area
90	Kalakpa Resource Reserve	320.2	6 18’-6 29’N	0 18’-0 31’E	Wildlife Protected Area
91	Kyabobo National Park	222	8 17’–8 31’N	0 31’–0 44’E	Wildlife Protected Area

92	Mole National Park	4,840.00	9 11'–10 10'N	1 22'-2 13'W	Wildlife Protected Area
93	Gbele Resource Reserve	565.4	10 22'-10 44'N	2 03'–2 12'W	Wildlife Protected Area