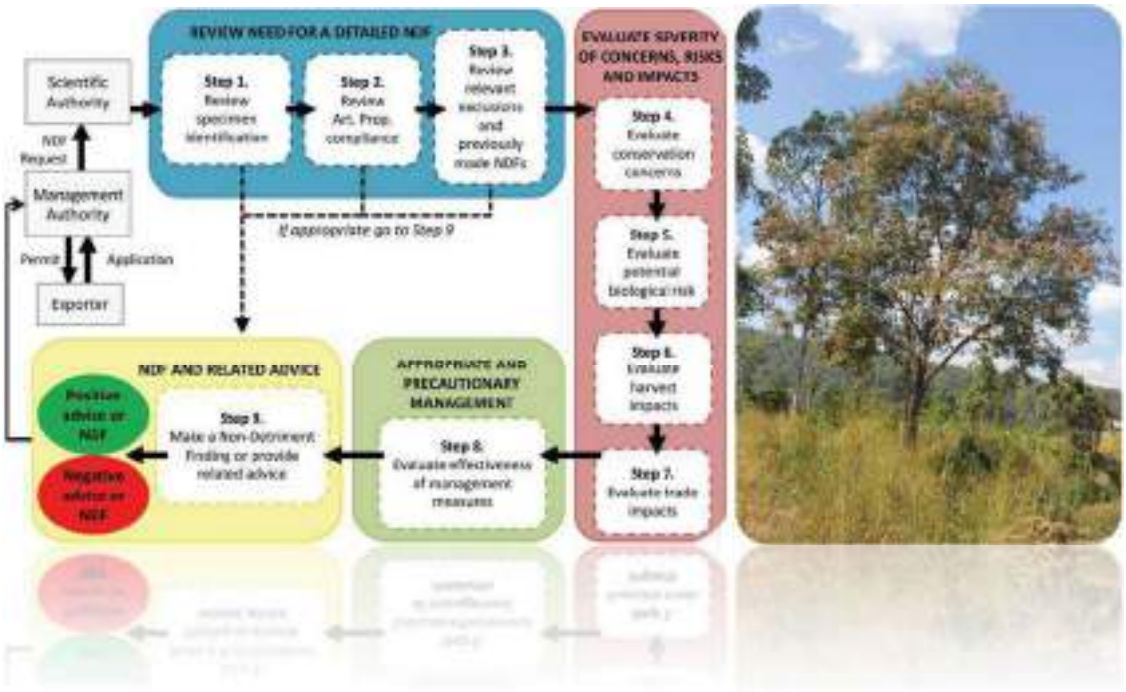
CITES Non-detriment Findings Report on *Dalbergia cochinchinensis and Dalbergia oliveri* in the Choam Ksant District, Preah Vihear Province

Integrating the Development of Guidelines and Incentives for Piloting the Establishment of Small-scale Private *Dalbergia* Plantations with the Determination of a Non-detriment Findings Report in Preah Vihear Province, Cambodia



Forestry Administration

September 2021

CITES Non-detriment Findings Report
on *Dalbergia cochinchinensis and Dalbergia oliveri*
in the Choam Ksant District, Preah Vihear Province

Programme: CITES Tree Species Programme
Web Page: https://cites-tsp.org/

Financial Support: The European Union and CITES Tree Species Programme

Implementing Agency: Forestry Administration of the Ministry of Agriculture, Forestry and Fisheries (MAFF)

Cambodia Project Team and Contributors to the Report:
Dennis J. Cengel, Pang Phanit, Neab Keng, Vann Vean, Phoung Sophea, Kong Kongkea, Buor Vuthy, Sin Chandara, As Brosden, Nuon Sithun, and Ouch Sineth

Editors: Dennis J. Cengel and Chheang Dany

Cover: On the left, the nine-step process incorporated into the CITES guidelines for preparing a scientific-based NDF for timber species. Source: Daniel Wolf, 2018.
On the right, *Dalbergia cochinchinensis* fruiting, at the Choam Ksant District, Preah Vihear Province.

Citation: Say Sinly, Chheang Dany, Hort Sothea, Pang Phanit, Lim Sopheap and Kim Sobon (2021). CITES Non-detriment Findings Report on *Dalbergia cochinchinensis and Dalbergia oliveri* in the Choam Ksant District, Preah Vihear Province

#40 Preah Norodom Blvd.
Phnom Penh, Cambodia
Tel: (855-23) 214 651
Website: https://fa.maff.gov.kh/

Acknowledgements

The Cambodia Project Team expresses its appreciation to everyone involved in conducting surveys and compiling the CITES Non-Detrimental Findings Report on *D. cochinchinensis* and *D. oliveri* in the Choam Ksant District, Preah Vihear Province.

The production of this report was funded through the project on "Integrating the Development of Guidelines and Incentives for Piloting the Establishment of Small-scale Private *Dalbergia* Plantations with the Determination of a Non-detriment Findings Report in Preah Vihear Province, Cambodia." Financial support for this report was also received from the European Union. We acknowledge, as well, the support and encouragement that has been provided to us by Dr. Milena Sosa Schmidt, CITES Tree Species Programme Coordinator, Dr. Haruko Okusu Chief, Outreach and Projects Unit, CITES Secretariat and Mr. Thang Hooi Chiew, CITES Tree Species Programme Regional Coordinator for Asia.

This report would not have been possible without the support and encouragement of the Forestry Administration in Phnom Penh, especially H.E. Dr. Keo Omaliss, Delegate of the Royal Government of Cambodia, Director General of Forestry Administration, as well as other senior officials of the Forestry Administration. It is also incumbent to recognize the Governor of Preah Vihear Province, as well as the provincial military and police commanders, and other relevant authorities for their assistance and cooperation, including the many local people who assisted the project team in organizing and implementing field activities during the course of this phase of the project.

We also recognize the active participation of local Forestry Administration officers of the Preah Vihear Forestry Administration Cantonment; Choam Ksant Forestry Administration Division; and the Forestry Administration Triage, especially Mr. Nuon Sokhom and Mr. Kim Chethavy.

The collective efforts of the Cambodia Project Team in preparing the supportive assessment report on *"the Conservation Status, Management Practices, and Harvest Monitoring of Dalbergia cochinchinensis and Dalbergia oliveri in Choam Ksant District, Preah Vihear Province,"* including those of Dr. Chheang Dany, Dr. Dennis J. Cengel, Mr. Hort Sothea, Ms. Lim Sopheap, Mr. Kim Sobon, Mr. Pang Phanit, Mr. Neab Keng, Mr. Vann Vean, Mr. Phoung Sophea, Mr. Kong Kongkea, Mr. Buor Vuthy, Mr. Sin Chandara, Mr. As Brosden, Mr. Nuon Sithun, and Ms. Ouch Sineth are also recognized.

We express our appreciation, too, to all of the other specialists who took their time to advise, review, and comment on the various aspects that were associated with producing this report.

Executive Summary

Cambodia has been a member of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1997. The Ministry of Agriculture, Forestry and Fisheries has been assigned the role as Cambodia's CITES Management Authority and the Forestry Administration has been designated Cambodia's CITES Technical Scientific Authority. The species that are covered under CITES are listed in one of its three Appendices according to the degree of protection required.

The member countries of CITES are obliged to comply with the CITES regulations, especially controlling the distribution of species that are included in the CITES Appendices with regard to both exports and imports from and to the member country. Appendix I contains a list of species that are most endangered and threatened with extinction, while Appendix II includes species not necessarily threatened with extinction, but for which trade must be controlled in order to avoid utilization incompatible with their survival.

One of the purposes of this assessment is to increase the understanding of the resources and processes required to prepare NDF reports that adhere to the compulsory nine-step process supporting CITES Scientific Authorities in their efforts to establish science-based determinations.

Since 2014, the Royal Government of Cambodia has, through Regulation No. 601, suspended its exports of every forest product and forest by-product derived from luxury grade timber species until such time that it would have been otherwise informed through superseding legislation that would have been developed to increase sustainable forest resource management and use in the country.

In the event that the current measure is replaced by superseding legislation and there is a request to export a specimen of *Dalbergia* that originated in natural forests, the process of developing an NDF shall be conducted in accordance with the representative assessment of the 26 parameters and 7 factors that was conducted in this study. There are also provisions to conduct a virtual assessment if there is a request to export specimens from one or both of these *Dalbergia* species that are sourced through artificial propagation in plantations even though an NDF would not be specifically required. In such a case, legal acquisition would still prevail, however, so that if the current measures are not replaced, any specimen of either of these *Dalbergia* species sourced through artificial propagation would not be allowed to be exported as virtually assessed.

This pilot study on the CITES Non-Detriment Findings Report for *Dalbergia cochinchinensis* and *Dalbergia oliveri* reflects the conservation status and management in the Choam Ksant District, Preah Vihear Province. The assessment systematically followed the IUCN Checklist of NDFs. Nevertheless, some factors and parameters' ordinal conditions were modified to some extent to conform to the conditions in Cambodia. Most of the short descriptions of each parameter related to species characteristics that were used in the scoring system in the assessment followed the factors of sustainability in the guidelines on Non-detriment findings for timber, medicinal plants and agarwood (CoP15 Doc. 16.3) and the Indonesian Guidelines for Non-Detriment Findings Assessment of Ramin *Gonystylus* spp. The factors affecting management of the harvesting regime consisted of biological characteristics; current status of the species; harvest management; harvest regime; harvest monitoring; logging impact to environment and ecological condition; and conservation and protection.

There were 26 parameters under the 7 factors, each of which was assessed a score ranging from 1, the lowest score, to 5, the highest score. Once each of these parameters had been assessed, an NDF radar plot was constructed for each of the *Dalbergia* species.

The information and data that were employed in the assessment were extracted from a supporting taxonomy review report and systematic survey report in combination with several literature reviews. The results indicated that the clear-cutting harvesting regime that is used in economic land concessions and social land concessions where timber harvesting is regarded to be legal and accounts for more than 30,700 ha, or 8.1%, of the land area in the district seems to have some detrimental effects on the *Dalbergia* species in that the post-harvest and collecting environment cannot readily be restored naturally to its previous condition.

Despite the Prime Minister's Order No. 02 that instituted measures, as well as imposed controls on the harvesting, transporting, collecting, storing, and exporting of *D. cochinchinesis* throughout the country, the illegal selective logging, as well as unregulated burning, of forests in the district have had significant impacts on the target *Dalbergia* species associated with their high commercial value. These, too, have impeded the natural regrowth ability of *D. cochinchinensis*, in particular, and reduced its survival rate.

The lack of effectiveness of some of the measures of management seems to correspond with the decline in reported cases of illegal forest offenses even though intensive law enforcement and patrolling is conducted across the district's forestlands, although the results of the inventories revealed the already low population densities of *D. cochinchinensis* and *D. oliveri.* These declining populations were caused to a considerable extent by (1) illegal selective logging during the transition of the forestland management system in combination with a lack of transparency associated with the control and monitoring the trade of the target species; and (2) a limited number of Protected Area rangers and foresters available to conduct patrolling more extensively.

Irrespective of the shortcomings leading to the high impact severity and low population densities of the target species in natural habitats, the distribution of tree seedlings of these species could conceivably recover their genetic conservation through artificial propagation. This means that management measures should have, at a minimum, the appropriate level of rigor required to reduce the severity of identified concerns, risks, and impacts should be implemented assiduously. It is, therefore, recommended that the genetic conservation of the two *Dalbergia* species should be further concentrated through restoration, planting, and the maintenance of natural populations.

The scoring conducted in the assessment of Non-Detriment Findings for *D. cochinchinensis* and *D. oliveri* revealed the severity of the state of most of the parameters incorporated under the factors affecting management of the harvesting regime. The principal difference in the scoring was that *D. cochinchinensis* exhibited states of greater severity because of its attenuated dispersal distribution, smaller population density, and greater instances of illegal selective logging gleaned from numbers of forest offensive cases than did *D. oliver,* even though the regenerative capacity of *D. oliveri* exhibited considerable vulnerability, as well.

The management measures associated with the distribution of tree seedlings that contribute to the recovery of both of the populations of the *Dalbergia* species have been useful. At the national level, 1.2-1.4 million seedlings were reported to be produced annually with an estimated 60-70% of those sold and subsequently planted by private households, landowners, monks, and at pagodas, petrol stations, and restaurants. It is recommended that the genetic conservation of these species should now be further concentrated through restoration, planting, and the maintenance of natural populations.

While Article VII of the CITES Convention includes provisions for the exceptions of specimens produced as the result of artificial propagation, it is concluded on the basis of the results of this report that the current policy of the Cambodian CITES Management Authority in which the Royal Government of Cambodia (RGC) has suspended the exports of all products extracted from luxury grade timber species, including *Dalbergia,* irrespective of whether the specimens have been artificially propagated or derived from natural forests, should continue unimpeded.

Table of Contents

List of Tables

List of Figures

Acronyms

asl	Above sea level
CAI	Current Annual Increment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CF	Community Forestry
CPA	Community Protected Area
CTSP	Cambodian Tree Seed Program
COP	Conference of the Parties
DBH/dbh	Diameter at Breast Height
DFW	Department of Forestry and Wildlife
DFSC	Danida Forest Seed Centre
EN	Endangered
EIA	Environmental Impact Assessment
ELC	Economic Land Concession
IUCN	The International Union for the Conservation of Nature
FA	Forestry Administration
FEIA	Full Environmental Impact Assessment
IEIA	Initial Environmental Impact Assessment
ITTO	International Tropical Timber Organization
KPWS	Kulen Prumtep Wildlife Sanctuary
MAFF	Ministry of Agriculture, Forestry and Fisheries
MB	Military Brigade
MoE	Ministry of Environment
NDF	Non-detriment Findings
NDVI	Normalized Difference Vegetation Index
PFE	Permanent Forest Estate
PFR	Permanent Forest Reserve
PVPF	Preah Vihear Protected Forest
PVA	Preah Vihear Authority
PRWS	Preah Rokar Wildlife Sanctuary
PVTPL	Preah Vihear Temple Protected Landscape
RIL	Reduced Impact Logging
SLC	Social Land Concession
UNEP-WCMC	The UN Environment World Conservation Monitoring Centre
VU	Vulnerable

1. Introduction

1.1 Preamble

Cambodia's natural forests, which have been declining during past decades, have been under the management of the state and, until recent years, there has been limited recognition and encouragement associated with the establishment of private forest plantations. The emphasis of this assessment of Non-Detriment Findings for *Dalbergia cochinchinensis* and *Dalbergia oliveri* is in response to instances of illegal logging of these and other related species that have been occurring throughout Southeast Asia, which accentuates the relevance of the study to both the CITES Tree Species Programme and the listing of endangered tree species in the CITES Appendix II.

The illegal logging and trafficking of *D. cochinchinensis* and *D. oliveri* associated with Cambodia has transboundary connections that often culminate in markets in China. These connections have been especially reflected in the volume of Vietnam's imports of logs and sawnwood from Cambodia that have been destined for the Chinese markets (Phuc et al., 2016). There are no official statistics that are differentiated by species available to determine the extent of the illegal logging and smuggling of *D. cochinchinensis* and *D. oliveri* occurring in Cambodia and the information that is accessible, moreover, is often fragmented and not very well documented.

To respond to the declines of *D. cochinchinensis* and *D. oliveri* populations, the project entitled "Integrating the Development of Guidelines and Incentives for Piloting the Establishment of Small-scale Private *Dalbergia* Plantations with the Determination of a Non-detriment Findings Report in Preah Vihear Province, Cambodia" was implemented. It emphasizes the preparation of a non-detrimental findings (NDF) report on *D. cochinchinensis* and *D. oliveri* in the Choam Ksant management district of Preah Vihear Province and promoting the establishment of small-scale private plantations of *D. cochinchinensis.* This approach is considered to be the one that will make the most effective contributions to genetic resource conservation and sustainable management practices associated with the *Dalbergia* populations in Cambodia.

Selected as the pilot study area on the basis of the extent of the distribution of *D. cochinchinensis* and *D. oliveri* that occurs in Cambodia is the Choam Ksant District in Preah Vihear Province which is located in the northern part of the country. This is one of the areas where the two primary species of *Dalbergia* that are native to Cambodia are 'precious wood' that is highly valued in international trade for a range of their inherent qualities.

In adhering to the CITES Guidelines on Non-detriment Findings (NDF) for timber, this study supports the country's Scientific Authority in its task to gather, evaluate, and document relevant information in which data quality is "proportionate to the vulnerability of the species concerned" (Resolution Conf. 16.7 [Rev. CoP17] Non-detriment Findings). That guidance contributes, too, to the identification of information gaps and management deficits for further improvement of the sustainable management of the target *Dalbergia* species.

The ultimate task of the Scientific Authority is to posit a positive or negative NDF or related decision and to advise the Management Authority whether to allow the proposed export of specimens of the target species based on the outcome of this assessment report.

1.2 Scope and Limitations

Since the documentation on approved permits for timber resources legally collected in the Choam Ksant District are restricted to domestic uses, some wide-ranging considerations were not able to be considered in this assessment. These included quotas for harvest and export and the impacts of harvests and trade on the national populations of the native *Dalbergia* species.

In this assessment, target species refers to *D. cochinchinensis* and *D. oliveri,* as well as in some cases to *Pterocarpus pedatus* and *Afzelia xylocarpa* (Kurz). These species may be defined as a group of important luxury timber species that are considered to be the main targets of illegal selective logging in the district.

2. CITES and NDF Guidelines

2.1 Understanding CITES

Cambodia has been a member of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 4 July 1997[1]. The Ministry of Agriculture, Forestry and Fisheries has been assigned the role as Cambodia's CITES Management Authority and the Forestry Administration has been designated Cambodia's CITES Technical Scientific Authority. The species that are covered under CITES are listed in one of the three CITES Appendices according to the extent of protection that they require.

The member countries of CITES are obliged to comply with CITES regulations, such as controlling the distribution of species that are included in the CITES Appendices with regard to both exports and imports from and to the member country. This provides a two-way system for controlling the traffic of the wild plant and animal export and import trade in both the exporting and importing countries.

CITES system control is executed by using the CITES' standard licensing system that is published by the CITES Management Authority, which is responsible for inspecting goods moving in and out of the country on the basis of the documents and specimens registered in the CITES Appendices I, II and III. Specific plant and animal species that are covered in CITES are registered in the list included in the Appendices of the CITES Convention.

Appendix I contains a list of species that are most endangered and threated with extinction that are or may be affected by trade. Trading, including exports, imports, re-exports or introductions from the sea, of these species must be determined according to strict criteria so that trade will not increase these species' threat of extinction. The trading of the species in Appendix I is only allowed for certain purposes, such as research or if the species is able to be regenerated to the second generation (F2).

Appendix II includes species not necessarily threatened with extinction, but for whom trade must be controlled in order to avoid utilization incompatible with their survival[2]. The requirements for obtaining an export license are summarized in the following Articles of the CITES Convention:

> ***CITES Article IV, paragraph 2***
> The export of any specimen of a species included in Appendix II shall require the prior grant and presentation of an export permit. An export permit shall only be granted when the following conditions have been met:
>
> ***Article IV, paragraph 2.a)***
> A Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species.
>
> ***Article IV, paragraph 3***
> A Scientific Authority in each Party shall monitor both the export permits granted by that State for specimens of species included in Appendix II and the actual exports of such specimens. Whenever a Scientific Authority determines that the export of specimens of any such species should be limited in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs and well above the level at which that species might become eligible for inclusion in Appendix I, the Scientific Authority shall advise the appropriate Management Authority of suitable measures to be taken to limit the grant of export permits for specimens of that species.

Source: CITES Convention.

[1] CITES. Cambodia. Retrieved on 19 September 2020 from: https://cites.org/eng/cms/index.php/component/cp/country/KH
[2] CITES. How CITES works. Retrieved on 19 September 2020 from: https://www.cites.org/eng/disc/how.php

2.2 NDF Guidelines

The assessments supporting the preparation of an NDF report for both of Cambodia's *Dalbergia* species were primarily determined using applications of the following procedures:

- The nine-step process incorporated into the CITES Guidelines for preparing a scientific-based NDF for timber species (Daniel Wolf, 2018);
- Non-detriment findings for timber, medicinal plants and agarwood (CITES, 2010);
- Guidance for CITES Scientific Authorities: Checklist to assist in making non-detrimental findings for Appendix II exports (Rosser and Haywood, 2002); and
- Indonesian Guidelines for non-detrimental finding assessment for *Ramin gonystylus* spp., (2010).

There were 7 factors composed of 26 parameters that were assessed to produce a visual scoring radar plot to facilitate the determination of the NDF.

2.3 Exemption

According to the procedures stipulated in the CITES Guidelines for preparing a scientific-based NDF for timber species, if a national regulation bans the exporting of any forest product or forest by-product derived from the concerned species that is listed in Appendix II, whether it is in a form derived through artificial propagation or produced in its natural habitat, an NDF shall not be required. Rather, it is suggested that a negative NDF advice be accorded to the CITES Management Authority. There is a relevant regulation in Cambodia that bans the export of those wood products derived from luxury timber species, which include both of the country's *Dalberga* species. Notwithstanding the presence of that regulation, the assessment of the NDF that was conducted in this study aimed to undertake a representative pilot case study in Choam Ksant District that would include these processes that are referred to in the 'Guidelines for CITES Scientific Authorities: Checklist to assist in making non-detrimental findings for Appendix II exports (Rosser and Haywood, 2002).'

3. Biological Data

3.1 Scientific Information

3.1.1 *Dalbergia cochinchinensis*

Scientific name:	*Dalbergia cochinchinensis*
Class:	Magnoliopsida
Order:	Fabales
Family:	*Fabaceae* (Leguminosae)
Subfamily:	*Papilionoideae* (*D. cochinchinensis*)
Genus:	*Dalbergia*
Common names:	Rosewood, Siamese Rosewood, Thailand Rosewood, Vietnamese Rosewood, Burma rosewood, Cam Lai
Khmer Name	Kranhaoung
Cambodian Commercial grade: Luxury	
CITES Appendix:	II
IUCN Red List:	Vulnerable (VU)

Scientific synonym: *Dalbergia cambodiana* is a synonym for *D. cochinchinensis* (IUCN, 2008[3]). Following CITES CoP16 in 2013, *D. cochinchinensis* was listed in Appendix II (CITES, 2014 (COP16[4])) and *D. cambodiana* was separated from *D. cochinchinensis* since both species were recognized as accepted names according to The Plant List.

[3] IUCN Red List. *Dalbergia cochinchinensis*, Siamese rosewood. IUCN 2008: T32625A9719096.

[4] Cites. Notification to the Parties: Trade in Siamese rosewood (*Dalbergia cochinchinensis*) from Thailand. Dated 4/7/2014.

3.1.1 *Dalbergia oliveri*

Scientific name: *Dalbergia bariensis*
Class: Magnoliopsida
Order: Fabales
Family: *Fabaceae* (Leguminosae)
Genus: *Dalbergia*
Common names: Rosewood, Siamese Rosewood, Thailand Rosewood, Vietnamese Rosewood, Burma rosewood, Cam Lai
Khmer Name Neang Nuon
Cambodian Commercial grade: Luxury
CITES Appendix: II (2 January 2017[5])
IUCN Red List: Endangered (EN)

Scientific synonyms: Lock and Heald (1994) considered *D. laccifera* and *D. prazeri* to be synonyms for *D. oliveri*, while *D. bariensis*, *D. dongnaiensis, D. duperreana*, and *D. mammosa* were considered to be separate species. Chính *et al*. (1996) and the IUCN Red list (Nghia, 1998) also recognized *D. bariensis, D. mammosa*, and *D. oliveri* as separate species. In contrast to these decisions, Van Sam *et al*. (2004) considered *D. bariensis, D. dongnaiensis, D. duperreana*, and *D. mammosa* to be synonyms for *D. oliveri.* As the result of more reliable identification by means of DNA barcoding in 2015, Hartving confirmed *D. oliveri* to be well supported as monophyletic (n = 8) in a study that included two specimens from Cambodia, in which the name *D. bariensis* was used. He strongly suggested that the name *D. oliveri* be used consistently across its distribution range, as recommended by Niyomdham *et al*. (1997).

3.2 Forest Habitats in the Study Area

Forests in the study area of the Choam Ksant District are representative of seven forest cover types. The majority of forestland is deciduous forest which constitutes 54.2% of the total area of the district, followed by evergreen forest which makes up 14.5% of the area, semi-evergreen forest which makes up 11.8% of the area, and bamboo and regrowth which make up 1.3% and 0.1%, respectively, of the total area of the district (Table 1; Figure 1).

Table 1. Cover types in the Choam Ksant District.

Cover type	***Area (ha)***	***Area (%)***
Deciduous Forest	204,449	54.2
Evergreen Forest	54,589	14.5
Semi-Evergreen Forest	44,294	11.8
Bamboo	4,929	1.3
Forest Regrowth	337	0.1
Rubber plantations	189	0.1
Non-forest land	68,154	18.1

Source: Forestry Administration Forest Cover 2014.

[5] CITES. Checklist of CITES Species: *Dalbergia oliveri retreived from:* https://checklist.cites.org/#/en/search/cites_appendices%5B%5D=II&output_layout=alphabetical&level_of_listing=0&show_synonyms=1&show_author=1&show_english=1&show_spanish=1&show_french=1&scientific_name=Dalbergia+oliveri&page=1&per_page=20

The deciduous forests are located in the lowland areas that extend throughout most of the Choam Ksant forest landscape which is flooded during the rainy season, while the mixed deciduous forests, semi-evergreen forests, and evergreen forests are situated in the southeast, southwest, and northern parts of the district, respectively, along the Dang Rek mountain range that forms part of the international boundary between Cambodia and Thailand and in the northeast and eastern parts of Choamksan District, Preah Vihear Province, as well as along streams.

The deciduous forest dominates the lowland plains of the Choam Ksant forest landscape. Its trees are relatively short, in general, compared to those in semi-evergreen forests and evergreen forests and in their natural state rarely attain DBH's > 1 m. The predominant tree species in the deciduous forest have large leaves that form a characteristic feature of that forest type. There is considerable variation within deciduous forests, nevertheless. The Choam Ksant forest landscape is particularly noteworthy for its extensive areas of savannah-like deciduous forest in which the population density of trees is very sparse. Other variations that are rather extensive throughout the forest landscape include relatively dense deciduous forests dominated by Dipterocarp tree species.

There is also considerable variation in the understory of deciduous forests. Savannah areas characteristically have sparse, relatively short patchy cover. The deciduous forests on riparian terraces, in contrast, often have dense tall grass that attains heights of up to 2 m. Small deciduous bamboo patches (*Arundinaria* spp.) provide the ground cover in some areas, as well.

The deciduous forests are adapted to fire and their understories usually burn every year. The majority of those fires generally occur in the early dry season as the result of anthropogenic activities. Despite the frequency of fire, the deciduous forest community appears to be well adapted to its occurrence, presumably because the frequency of fire has been high over a considerable period of geologic time.

The evergreen forests and the semi-evergreen forests in the Choam Ksant District have been modified by logging, which has resulted in the near-complete removal of their upper canopies that has apparently resulted in major alterations in their forest structure and composition. Retrospective assessments of the original character of those forests are, thus, rather difficult. The more obvious, generally relatively mature, evergreen and semi-evergreen forest tracts are typically dense formations growing in rich soil with often thick and tangled understories.

The semi-evergreen forests cover relatively large areas and exhibit the greatest variation in structure and composition. This is at least, in part, since the definition of evergreen forest has yet to be agreed and in current discussions it includes forests that were previously classified as mixed deciduous forests. The semi-evergreen forests vary from apparently evergreen-dominated stands often with an understory that, in patches, could be considered typical of pure evergreen forests with a more open understory, but often also have a high density of saplings that forms a dense lower canopy.

The more classical semi-evergreen forests grade into and occur in patches in forest areas that are heavily dominated by deciduous forests. To what extent this feature is a result of selective logging for the commercially more valuable evergreen tree species is unclear. Their canopy covers are also variable and their understories are often relatively sparse and frequently burned. In areas that are less frequently burned, patchy bamboo stands dominate.

Observations from flora inventories that were conducted in this study indicated that forest fires occur even in mixed deciduous forests and evergreen forests and semi-evergreen forests. These fires may burn out the seedlings of *D. cochinchinensis and D. oliveri*, although additional research is required to confirm the observation.

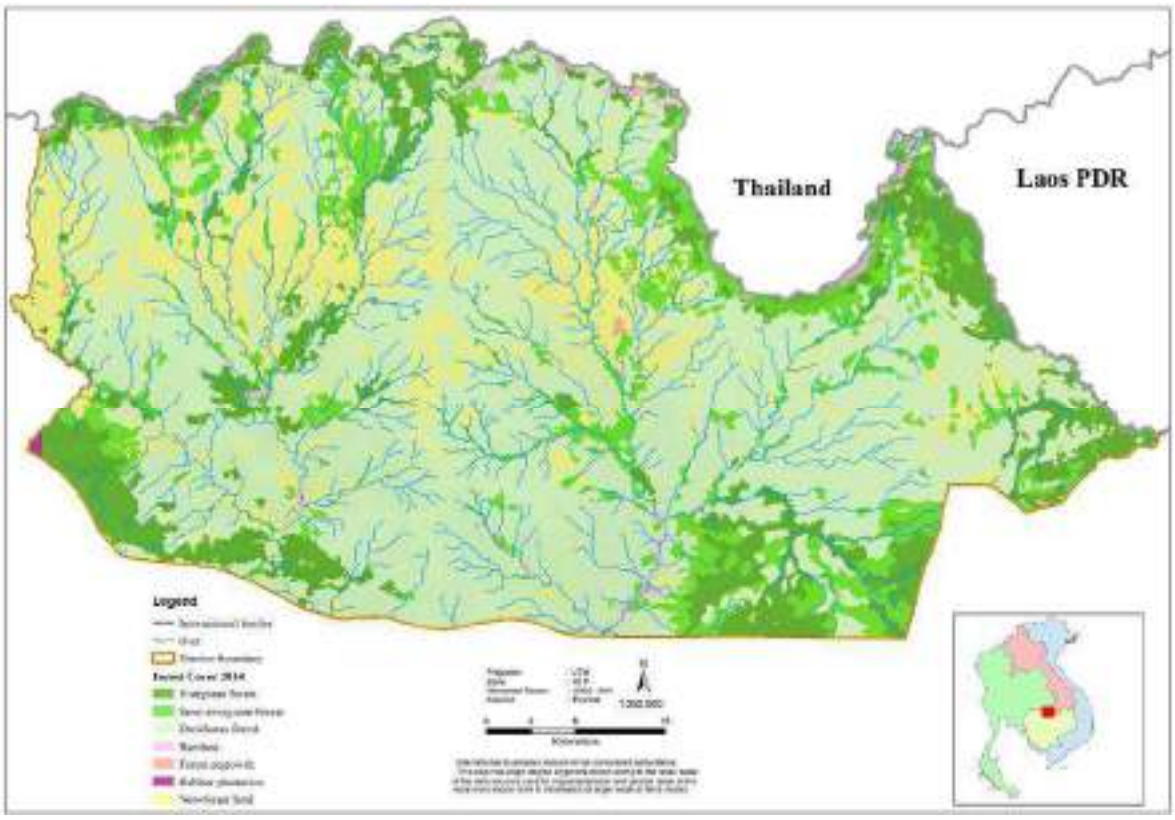


Figure 1. Forest cover of the Choam Ksant District in 2014.

3.3 Biology

3.3.1 *Dalbergia cochinchinensis*

Dalbergia cochinchinensis is a large tree that grows up to 30 m tall and reaches 60-120 cm in diameter. The tree's bark is light yellow and its canopy is ramified. Its leaflets are oval and alternate and its inflorescence is axillary with white flowers (Tan Dung, 1996). This species can be identified by its pinnate leaves which generally have 7 – 9 leaflets, the uppermost of which are the largest (CTSP, 2004). It produces flowers in May and June with its fruits ripening in November through January (DFSC, 2000) (Figure 3). Its pod is long and tapering consisting of 1 or 2 seeds where one kg composed of about 35,000 seeds. The maturity of the seeds is recognizable when the pod becomes dark brown. The fruits are often collected as soon as the color turns from green to yellow in order to avoid impending damage from insects. Its pods may be collected by cutting or shaking the branches so that the pods will fall on the ground. Covering the ground with canvas around the base of the tree can assist in the collection of the seeds (Joker, 2000). Once the pods have been collected, they are dried in direct sunlight for about two days. Seeds may then be extracted from the pods using a seed thresher, although care is required to avoid damage to the seeds. The seeds may also be extracted from the dried pods manually. Once they are clean, the seeds should be dried in the sun for one day before sowing or storage. The dried seeds may be stored in a sealed container (e.g., a plastic bag) under room conditions for about five years (CTSP, 2003).

D. cochinchinensis is shade-tolerant when young, but this characteristic gradually declines with age. The species in its natural setting has a slow growth rate and natural regeneration is often poor, although it does regenerate well through coppicing (Figure 2). The diameter growth of the heartwood of 20-year-old trees reaches, on average, only about 3 cm. The species is pollinated by insects, but often produces a self-pollinated crop, which results in limited genetic variation observed within natural populations. There is a rather low percentage of young seedlings that attain

maturity (CITES, 2013). The wood of *D. cochinchinensis* is heavy, hard, and durable with a density of 0.98 – 1.06 g/cm^3 (Richter et al., 2014).

Figure 2. Planted trees of *Dalbergia cochinchinensis* regrown from cut stumps.

Figure 3. *Dalbergia cochichinensis* fruiting in December.

3.3.2 *Dalbergia oliveri*

Dalbergia oliveri grows up to 30 m in height and 90 cm in diameter (Tan Dung, 1996). Its bark is gray and its branches are stout and slightly pubescent. Its leaves are pinnately compound having

13 to 17 leaflets, although occasionally there are 9-11 or 19-21 leaflets which are arranged alternately. Its inflorescence which is corymbose-paniculate, axillary, or nearly terminal is 10-20 cm long and 7.5-15 cm wide. The inner part of its flower is white and its fruit is flat, 6-7 cm long and 1.7 cm wide, consisting of a single seed, although sometimes the pod may have 2 or 3 seeds (CTSP, 2001) (Figure 4).

The tree initiates flowering in Cambodia during May to July and the fruit becomes ripe from November to January. The seed is orthodox and can be stored in cool dry places for several years. It is brown with an oval shape that is 10 mm long and 6 mm wide. There are about 6,100 seeds per kilogram. The young pods of the species are green, but they will turn a dark brown when ripening. The fruits must be collected immediately when they start to mature to protect them from impending damage from insects. The best season for seed collection is during December and January when collectors cover the ground around the base of a mother tree with canvas prior to shaking the tree's branches to allow the seeds to drop. The cutting of small branches provides another, simpler, method of collecting the seeds. The seed pods are dried under sunlight for 2-3 days before the seeds are extracted by threshing. Damaged seeds are separated by removing those that sink when placed in water from those seeds that are undamaged which float. The undamaged seeds are dried under sunlight for one day prior to storing them in a cold room at 10° C (CTSP 2003).

Individual trees of this species often produce many seeds, but natural regeneration is often poor due to low germination rates and/or disadvantageous weather and site conditions. This species' trees generally grow slowly in both natural and man-made forests (CTSP, 2001). The color of the sapwood is distinct from that of the heartwood and its wood is heavy and hard with a density of 0.90 - 0.98 g/cm^3 (Richter *et al*., 2014).

Figure 4. A: Seeds of *Dalbergia oliveri*; B: Ripened fruits of *Dalbergia oliveri* (Photo: Norn Narong et al. (2014)); C: Trees of *Dalbergia oliveri* in the yard of the Neak Bous Temple in the study area.

3.4 Distribution and Ecological Habitats

3.4.1 *Dalbergia cochinchinensis*

A. Distribution of *Dalbergia cochichinensis*

Dalbergia cochinchinensis is widely distributed in Cambodia, including in the provinces of Kampong Thom, Kampung Speu, Preah Vihear, Ratanakiri, Pursat, Siem Reap, Kratie, Koh Kong, Stung Treng, and Modulkiri (Sareth K., 2002). Its population size is uncertain, but it is thought to have dramatically declined with mature individuals considered to be 'very rare' outside of strictly protected areas (UNEP-WCMC, 2018).

B. Habitats of *Dalbergia cochichinensis*

Dalbergia cochinchinensis thrives in mixed deciduous forest and sometimes in seasonal evergreen and riparian forests, occasionally in pure stands. It can be found at altitudes of up to 2000 m above sea level (asl), but it is primarily concentrated at 400-500 m asl. The species grows well under full-sun conditions and prefers fertile and deep sandy clay or calcareous soils along streams. It requires uniform rainfall that ranges from 1200-1650 mm per year, but it is also drought tolerant (Joker, 2000).

3.4.2 *Dalbergia oliveri*

A. Distribution of *Dalbergia oliveri*

Dalbergia oliveri occurs in Cambodia, Laos, Thailand, and Vietnam (Dy Phon, 2000). In Cambodia, the species is sparsely found in Kratie, Preah Vihear, Kampong Thom, Ratanakiri, Stung Treng, Pursat and Siem Reap provinces (Sareth K., 2002).

B. Habitats of *Dalbergia oliveri*

Dalbergia oliveri occurs individually or in groups of 5-10 trees in evergreen or semi-evergreen forests dominated by *Lagerstroemia* and Dipterocarp species (Figure 5). The presence of the species ranges below 900 m and it is normally found near streams and in foothills. The tree is able to grow under shade when young, but it has to be exposed to more sunlight when mature (CTSP, 2001).

Figure 5. Regrowth of *Dalbergia oliveri* from its mother stump cut illegally in semi-evergreen forest.

3.5 Status and Trends

While the sizes of the populations of *D. cochinchinensis and D. oliveri* in Cambodia are unknown and there are no systematic population estimates that exist, both of these populations are considered to be 'severely depleted.' Mature trees of both species are reported to be 'very rare' even in protected areas and the two species were regarded to be "critically endangered" in a 2012 report by Cambodia's Forestry Administration (UNEP-WCMC, 2018).

3.5.1 *Dalbergia cochinchinensis*

A. National Trend

The largest remaining population of *D. cochichinensis* was reported to be a seed source in Siem Reap Province. That population was considered to be fairly well protected, although some trees were reported to have been felled with the remainder having dbh's of 20-25 cm. The second largest population was reported to be in Leap Kuy Community Forest in Kampong Speu Province. It consists of 200 trees found in a natural forest that extends over 107 ha. Other known populations of *D. cochinchinensis* exist in Damrey Chak Thlork Community Forest in Kampung Speu Province that cover 15,000 ha, O Soam Community Forest in Kampong Thom Province that consists of 50-100 trees of 10-15 cm dbh, and Tbeng Lech Community Forest in Siem Reap Province that consists of about 10 trees, although the largest tree was illegally cut in 2017 (UNEP-WCMC, 2018).

There are some population estimates that are also available from studies that have been conducted on a local scale. The results of a study conducted under the Cambodia Tree Seed Project in 2003 which recorded the number of *D. cochinchinensis* trees for seed sources in the Cambodian natural forests reported that the average number of trees per hectare was only 1.34 in natural forests in Sre Nauy commune in the Siem Reap Province. In a related survey conducted in 2007 in the lowland forests of Stung Treng Province, it was revealed that illegal logging had led to the local extinction of the species. Similarly, there have been five botanical surveys, each of 14 days duration, that have been conducted in Samkos in the Central and Eastern Cardamom Mountains since 2015 and during that period there has been only a single *D. cochinchinensis* individual, a root sucker that had survived felling and the removal of the root of the mother tree has been reported. Rangers commented that all of the *D. cochinchinensis* trees "had been felled for the rosewood trade" in the Southern Cardamom Mountains, as well. Scientists contacted by the Environmental Investigation Agency involved in field and genetic studies of the species in 2016 had also noted that the number of *D. cochinchinensis* trees in the country was "dramatically decreasing" and that "field guides in Cambodia reported in 2015 that many of the populations sampled from 2010-2012 no longer exist due to deforestation and logging."

B. Study Area

The population density of *D. cochinchinensis* in the Choam Ksant District was estimated in this study on the basis of its presence in different levels of interrelated subplots and plots. In establishing these estimates, seedlings of *D. cochinchinensis* were regarded as plants with a height < 1 m and a DBH < 5 cm, while saplings were defined as plants with a height > 1 m and a DBH < 5 cm. Since *D. cochinchinensis* was recorded most often in mixed deciduous forests, as well as in dry deciduous forests, population estimates and estimates of wood volume were determined from trees observed in those forest types, in which it was indicated that it is strictly distributed in certain locations and not commonly found (Forestry Administration, 2021a).

The average population density of *D. cochinchinensis* estimated in the study was 113.1± 64.5 plants/ha and, of those 113.1 plants/ha, 87.2 plants/ha, on average, were seedlings and 23.3 plants/ha, on average, were saplings (Table 2). There were only 2.6 plants/ha with diameters > 5 cm. The average wood volume of *D. cochinchinensis* was also very low (0.139 m^3/ha), which is

indicative of the need for more effective restoration efforts if the species is to continue to survive in its natural forest habitat in Cambodia (Table 3).

Table 2. Population density of *D. cochinchinensis* in natural forest habitats.

	DBH < 5 cm		*Density (trees/ha), DBH ≥ 5 cm*								
	Seedlings/ha	Saplings/ha	5-10 cm	10-15 cm	15-20 cm	20-30 cm	30-40 cm	40-50 cm	> 50 cm	**Sub Total**	**Grand Total**
Average	**87.209**	**23.256**	2.326	0.155	0.155	-	-	-	-	**2.636**	**113.10**
S.E.	*±49.754*	*±12.118*	*±2.326*	*±0.155*	*±0.155*	-	-	-	-	*±2.636*	*±64.51*

Table 3. Volume of *D. cochinchinensis* in natural forest habitats.

	Volume (m^3/ha)							
	5-10 cm	10-15 cm	15-20 cm	20-30 cm	30-40 cm	40-50 cm	> 50 cm	**Total**
Average	0.104	0.016	0.019	-	-	-	-	**0.139**
S.E.	*±0.104*	*±0.016*	*±0.019*	-	-	-	-	*±0.139*

The small numbers of large trees recorded during the systematic inventory of both *Dalbergia* species in the Choam Ksant District were primarily attributable to the illegal logging occurring over much of the Past fifteen years, notwithstanding the relatively high numbers of seedlings that were also recorded. Field observations conducted during spot checks of the distribution of both of the species revealed, moreover, that large trees with diameters of 15-30 cm were only observed in the Preah Vihear Temple World Heritage Forest and at the gates of community houses close to the border with Thailand. It appears that villagers in these areas maintain large trees in their home gardens because they recognize the extraordinary value of the wood of these two species and want to conserve the trees for their children and their posterity. That act of conservation will provide significant seed sources of local *D. cochinchinensis*, as well.

3.5.2 *Dalbergia oliveri*

A. National Trend

Dalbergia oliveri has been reported to be found in the northeastern provinces of Kratie, Ratanakiri, and Stung Treng; in the northern provinces of Preah Vihear and Siem Reap; in the western province of Pursat; and in the central province of Kampong Thom. Its populations in the country are considered to consist of very few mature or large individual trees and are characterized as "seriously threatened" on the basis of the species' potential uses and the IUCN's conservation criteria, as well as risk of extinction if no effective conservation measures are more effectively implemented and enforced. It has, as a result, been selected as a priority tree species for gene conservation in Cambodia, as well as under the Asia Pacific Forest Genetic Resources Program which encourages the conservation and management of forest genetic resources throughout the region.

Seeds of *D. oliveri* can be obtained from a number of identified seed sources in natural forests, such as in the Pal Hal commune in the Tbeng Meanchey District in the Preah Vihear Province or in the Prognel commune in the Phnom Kravanh District in the Pursat Province. The remnant forest surrounding Boeung Yak Loam in the Rattanakiri Province is also the habitat of a number of mature trees of *D. oliveri* where seed collection is possible (UNEP-WCMC, 2014).

B. Study Area

Similar to the methodology that was used with *D. cochinchinensis*, the population density of *D. oliveri* was estimated on the basis of its presence in different levels of interrelated subplots and plots. Since *D. oliveri* was recorded most often in deciduous forests, mixed deciduous forests, and semi-evergreen forests, population estimates and estimates of wood volume were determined from

trees in these two forest habitat types (deciduous and semi-evergreen) which indicated that it has a limited distribution and scattered and is not commonly found (Forestry Administration, 2021b).

The overall average population density of *D. oliveri* was 234.5 ± 191.5 plants/ha and, from the 234.5 plants/ha, 145.4 plants/ha, on average, were seedlings and 88.4 plants/ha, on average, were saplings. There were only 0.8 plants/ha with diameter > 5 cm (Table 4).

Table 4. Population density of *D. oliveri* in natural forest habitats.

Forest Type	*Seedlings/ha*	*Saplings/ha*	*5-10 cm*	*10-15 cm*	*15-20 cm*	*20-30 cm*	*30-40 cm*	*40-50 cm*	*> 50 cm*	***Sub Total***	**Grand Total**
Average in DF	198.41	95.24	-	0.21	0.21	0.42	-	-	-	**0.85**	**294.50**
S.E.	*198.41*	*59.16*	-	*0.21*	*0.21*	*0.30*	-	-	-	0.72	**258.29**
Average in SF	-	69.57	-	-	-	0.58	-	-	-	0.58	**70.14**
S.E.	-	*0.14*	-	-	-	*0.58*	-	-	-	0.58	**0.72**
Overall Average	**145.35**	**88.37**	**-**	**0.16**	**0.16**	**0.47**	**-**	**-**	**-**	**0.78**	**234.50**
S.E.	**145.35**	**45.55**	**-**	**0.16**	**0.16**	**0.27**	**-**	**-**	**-**	**0.58**	**191.48**

The average population density of *D. oliveri* in deciduous forests was 294.5 ± 258.3 plants/ha and, from the 294.5 plants/ha, 198.4 plants/ha, on average, were seedlings and 95.2 plants/ha, on average, were saplings. There were only 0.8 plants/ha with diameter > 5 cm.

The average population density of *D. oliveri* in semi-evergreen forests was 70.1 ± 0.7 plants/ha and, from the 70.1 plants/ha, 69.6 plants/ha, on average, were saplings. There were no seedlings and only 0.6 plants/ha with diameter > 5 cm.

Table 5. Volume of *D. oliveri* in natural forest habitats.

	Volume (m^3/ha)							
Forest Type	5-10 cm	10-15 cm	15-20 cm	20-30 cm	30-40 cm	40-50 cm	> 50 cm	**Total**
Average in DF	-	0.150	0.031	0.127	-	-	-	**0.308**
S.E.	-	*0.150*	*0.031*	*0.090*	-	-	-	*0.271*
Average in SF	-	-	-	0.197	-	-	-	**0.197**
S.E.	-	-	-	*0.197*	-	-	-	**0.197**
Overall Average	**-**	**0.015**	**0.022**	**0.146**	**-**	**-**	**-**	**0.183**
S.E.	-	*0.015*	*0.022*	*0.084*	-	-	-	**0.121**

The average wood volume of *D. oliveri* in its natural forest habitats was low in both deciduous forests (0.308 m^3/ha) and in semi-evergreen forests (0.197 m^3/ha) (Table 5).

It is understood that one of the most critical consequences of the heavy logging and harvesting of both of the *Dalbegia* species has been the dramatic decline in the populations of both of these species. The populations remaining in the natural forests in the study area are primary composed of seedlings and saplings. There were neither mature trees nor mother trees that were observed when the systematic forest inventory was conducted for both of these species. Unregulated logging, combined with forest degradation and the loss of habitat, has been severely threatening the existence of both of these species throughout the project area. The genetic conservation of these species will continue to depend on efforts to conserve the species through forest restoration and planting activities and effective measures to maintain their populations in forest habitats (Forestry Administration, 2021a).

3.6 Population Structure and Dynamics

The population density and structure of both *D. cochinchinensis* and *D. oliveri* reflect the current status, the change detection from inventories over different periods, of the species and occurrence of plants recorded from preliminary spot checks, observations of planted trees, and systematic surveys that were conducted in the study area. Collectively, there were no more than 30 trees of *D. cochinchinensis* per diameter class and no more than 25 trees of *D. oliveri* per diameter class that were recorded.

The negative exponential relationship between population density and diameter distribution exhibited by *D. cochinchinensis* that was developed in the inventory assessment approximates a standard reverse J-shaped curve, which represents underlying structural conditions conducive to the reproductive sustainability of the species occurring in natural forest habitats (Figure 6). The maximum DBH that was recorded for *D. cochinchinensis* in natural habitats was only 20 cm, however, which, together with the very low average wood volume of *D. cochinchinensis* (0.139 m^3 /ha), underscores the requirement for more effective conservation efforts.

In a similar manner, the negative exponential relationship between population density and diameter distribution exhibited by *D. oliveri* that was developed in the inventory assessment also approximates a standard reverse J-shaped curve (Figure 7). Despite the presence of the relationship, the sustainability of the species seems to be very much threatened by the small number of large DBH trees - less than one per hectare - that were observed during field observations in natural forest habitats. These observations provide compelling evidence that the harvesting of the species should be strictly prohibited while every effort is made to protect the remaining mother trees.

The field observations from the inventory assessment that were conducted during the study indicate that the distributions of the DBH classes of both the *Dalbergia* species were unlikely to allow for sufficient recruitment and regeneration to replace trees that had been removed as the result of illegal harvesting. There is a very small number of mature trees with diameters > 20 cm that were recorded and the fruiting patterns of these trees remaining under natural conditions often culminate in sporadic reproduction.

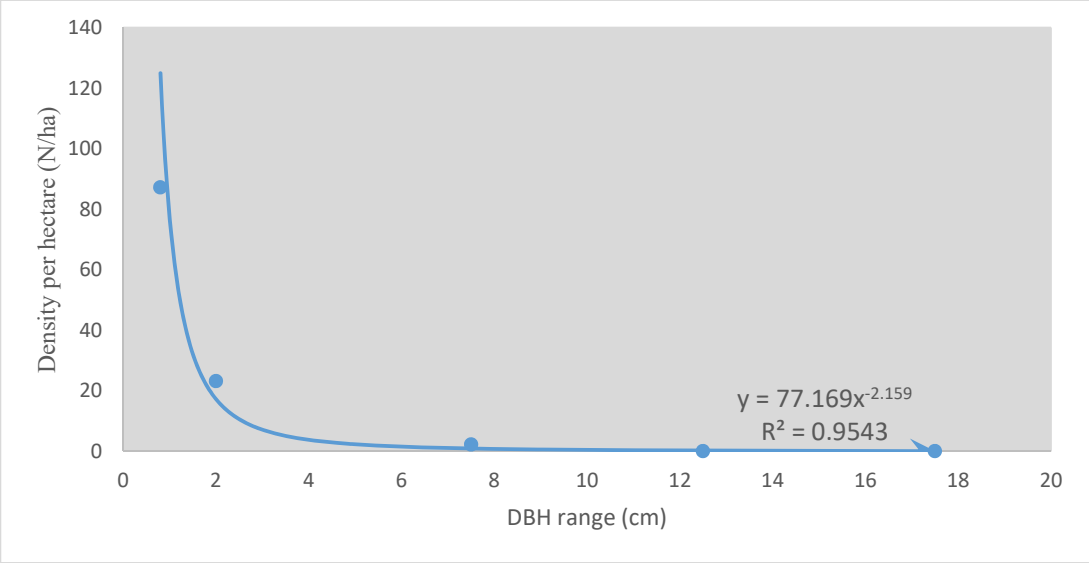


Figure 6. The population density and diameter distribution represented in the reverse J-shaped curve for *D. cochichinensis.*

The seedlings of both the species are threatened seasonally by human-induced fire, although the mortality rates of these seedlings as the result of fire are currently unknown. It is probable that instances of deforestation, habitat fragmentation, and illegal logging will continue to pose substantial threats to the species since the fertile soils in semi-evergreen forests, as well as in areas close to riverbanks, are favorable to the production of agricultural crops by local communities, which tend to impede the natural recruitment and regeneration of both the species. The deforestation and forest clearance associated with agriculture production, as well as settlements and other infrastructure development, were observed throughout the project area and if these trends continue unabated, the inevitable result will be further losses of habitat for both species. It is as a result of these and other related factors that a negative Non-detriment Findings Report associated with the harvesting of these two species would be rendered. This action would engender a recommendation by the Scientific Authority to the CITES Management Authority to reject exports of these species' specimens as the result of their precipitously declining populations in the natural habitats. Indeed, if countervailing measures are not undertaken to maintain and restore remaining and lost habitat, the populations of both of these species will continue to decline.

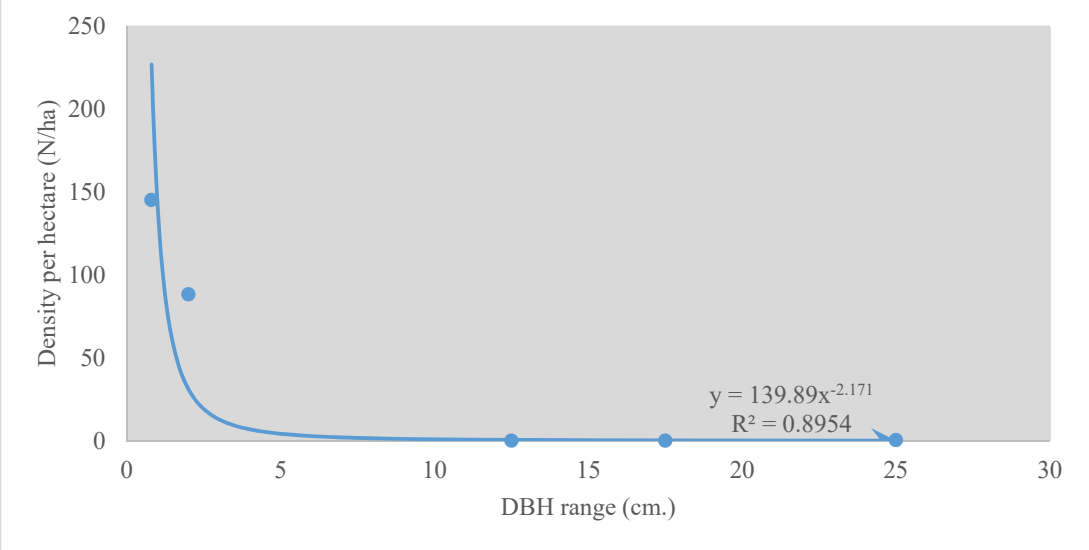


Figure 7. The population density and diameter distribution represented in the reverse J-shaped curve for *D. oliveri.*

4. Biological Risks and Major Threats

4.1 Habitat Specificity

The distribution of *D. cochinchinensis* may, thus, more probably occur over a suitable habitat range that extends along streams, gentle slopes with well-drained soils at elevations > 70 m asl, with an average elevation of 107 m, and mixed deciduous or dry deciduous forests. The map provided in Figure 8 demonstrates that occurrences of *D. cochinchinensis* were, indeed, primarily reported in the forest landscape along the trans-boundary area between Cambodia and Thailand with some distribution in the eastern and western parts of the Choam Ksant District, as well. It appears that this species grows in habitats with high site requirements and that its habitat preference seems to be in mature, climax forests. Likewise, it appears that *Dalbergia oliveri* has relatively low adaptability, grows in certain successional types, and prefers mature, climax forests.

4.2 Biological Risks and Vulnerability

Threats and ecological constraints can affect the reproduction, resilience capacities, and natural growth of *D. cochinchinensis,* which can result in either mortality or increased vulnerability. These threats include human-induced activities as illegal selective logging, forest burning, and clearing forestland for agriculture, while some of the more representative ecological constraints include the limited ecological ranges of both the *Dalbergia* species in the study area.

There were 45 plots, accounting for 52% of the total number of plots, that had been selectively logged with only the stumps, trunks, and embedded roots of several large-diameter, high-value commercial timber species that included *Pterocarpus pedatus,* Pierre, *Afzelia xylocarpa* (Kurz), *Xylia dolabriformis* Benth. and *Sindora cochinchinensi,* Baill remaining. The plots where *D. cochinchinensis* exists were reported to have been selectively logged, as well. It is inarguable that even the remaining roots embedded in the ground of *D. cochinchinensis* may be collected by the local people because of their commercial value, even though they are aware that it is highly restricted by law, which increases the severity of the vulnerability of the species in natural habitats. Such a situation occurs throughout almost the entire study area, except on the mountain range along the trans-boundary area where the critical danger of landmines deters access to the area by local people and is prohibited by the military. Each of these disturbances impedes the natural regrowth ability of *D. cochinchinensis* in the habitats distinguished in the study and reduces its survival rate.

Forest fires occur throughout the district during the dry season and at least 60% of the 86 flora plots that were established in the study area were reported to have been completely burned as the result of the long droughts that are experienced every year during the dry season and the spread of the fires over extensive areas of mixed and dry deciduous forest. There was another 30% of the plots that were recorded to be partly burned, particularly those that were located in mixed deciduous forest. Understory plants, which include *D. cochinchinensis,* are, as a result, prone to burning every year, which would have a deleterious effect on the survival rate of *D. cochinchinensis* seedlings and coppices.

The surge of new settlements has increased the threat of the rate of forestland conversion in the district, as well. According to a report of the Forestry Administration (FA)-International Tropical Timber Organization (ITTO) project in the Preah Vihear Protected Forest, forests will be affected by future land use demands from agriculture associated with changes occurring in habitats and biodiversity (FA, 2016b). Forest fragmentation in the Choam Ksant District occurs after a large area of contiguous forest has been subdivided into smaller forest patches by roads, agricultural practices, urbanization, and other developments. That was apparent with the harvesting of the target species since the harvesters of these species did not only clear forestland for agriculture or residential purposes, but also entered the forests near their homes searching for high-value commercial timber species.

It is now recognized that genetic traits also pose a threat to survival of the target species by introducing a biological risk that can affect the reproductive rates of the species throughout the district. The systematic survey conducted in 2020 revealed that small amounts of seeds might have been collected in natural habitats, but a majority of the seeds were believed to have been imported from Thailand. It was recorded that trees grown from the seeds sourced from Thailand that were about 10 years old were reported to have yet to flower, while those sourced from the seeds of native trees seem to mature at around 5-6 years old.

While it is recognized that *D. cochinchinensis* flowers during May-June and its fruits ripen from November until January (CTSP, 2003), it is not clear at what age and of what dbh size an individual tree of *D. cochinchinensis* starts to flower. Some individual trees may become mature at an early age with a small dbh, while others may mature much later or during a period when its dbh has

become relatively large. Since it was not until the germination of seedlings from seeds of *D. cochinchinensis* or its natural regrowth from stumps embedded in the ground that individual trees were observed and recorded in this study, there is still much that remains to be learned about seed dispersal and pollination during the reproductive cycle of *D. cochinchinensis*. There were a few local villagers who said that they used to collect seeds of *D. cochinchinensis* from mother trees with a dbh > 25 cm for germination and planting, however, rather than collecting them from stumps since they thought these would not survive.

In this study, the reproductive pattern of *D. cochinchinensis* was categorized by dbh class. Early maturity was defined as the period when an individual tree with dbh < 15 cm starts to flower; medium maturity as the period when an individual tree with a dbh ranging from 15-30 cm starts to flower; and late maturity as the period when an individual tree with a dbh > 30 cm starts to flower. One of the monks in Bos Sbov pagoda reported that there were a few trees of *D. cochinchinensis* with a dbh of 15 cm that had started to flower a few years ago and that its seeds could be collected annually, which suggests its early maturity and fruiting. Some local villagers reported that their planted tree species of *D. cochinchinensis* with diameters ranging from 13-15 cm had also started to flower 3 years previously (at 5 years old) and that this was most probably due to the fact that they had collected seedlings of the species regrown naturally from stumps and roots embedded in the ground to plant. It may therefore be inferred that the flowering of *D. cochinchinensis* could occur in early maturity every year in natural forests in the study area. It would appear that the regenerative capacity of seedlings regrown from stumps of *D. cochinchinensis* may be relatively fast, while the efficiency of seed dispersal may be relatively low as a result of the difficulties associated with natural barriers, especially the effects of natural ranges and the reproductive patterns of seed dispersal.

Similar to the assessment conducted for *D. cochinchinensis,* the threats and biological risks of *D. oliveri* refer to all of the disturbances and biological vulnerabilities that have the ability to affect the reproduction, resilience capacities, and natural growth of *D. oliveri,* which can result in either mortality or increased vulnerability.

There were at least 60% of the 86 flora plots that were established in the study area that were reported to have been completely burned during the dry season when drought-related fires spread over extensive areas of mixed and dry deciduous forests (Figure 10). Understory plants, which include *D. oliveri,* are, as a result, prone to burning every year, which would have a deleterious effect on the successful germination of *D. oliveri* seedlings and saplings from the stump.

The unregulated selective logging conducted by local villagers has become a severe challenge affecting the sustainability of this species, as well, and even its stumps, trunks, and embedded roots were reported to be collected because of their commercial value.

The risk associated with the biological reproductive characteristics of *D. oliveri* is also becoming a serious threat. The officers of the Preah Vihear Authority reported that they collected the seeds from mother trees of this species growing naturally within the Preah Vihear temple complex on top of Dang Rek Mountain during the period from May to July 2018, but that since that time none of those trees has flowered or fruited. Nor have any members of the survey teams confirmed having seen those trees flowering, which suggests that this species may not flower and fruit every year. This observation is supported by related reports of local villagers that *D. oliveri* generally flowers and fruits every couple of years after its initial period of flowering. This reproductive pattern of *D. oliveri* may be especially influenced by its genetic characteristics growing in these habitat types. The result is that the seeds of *D. oliveri* are year-by-year becoming less available for collection which threatens the species' genetic resources. It would seem that the regenerative capacity of *D.*

oliveri may be relatively slow and irregular in the same manner that its seed dispersal efficiency may also be relatively low as the result of natural barriers associated with its reproductive pattern.

5. Management Measures

5.1 Management History

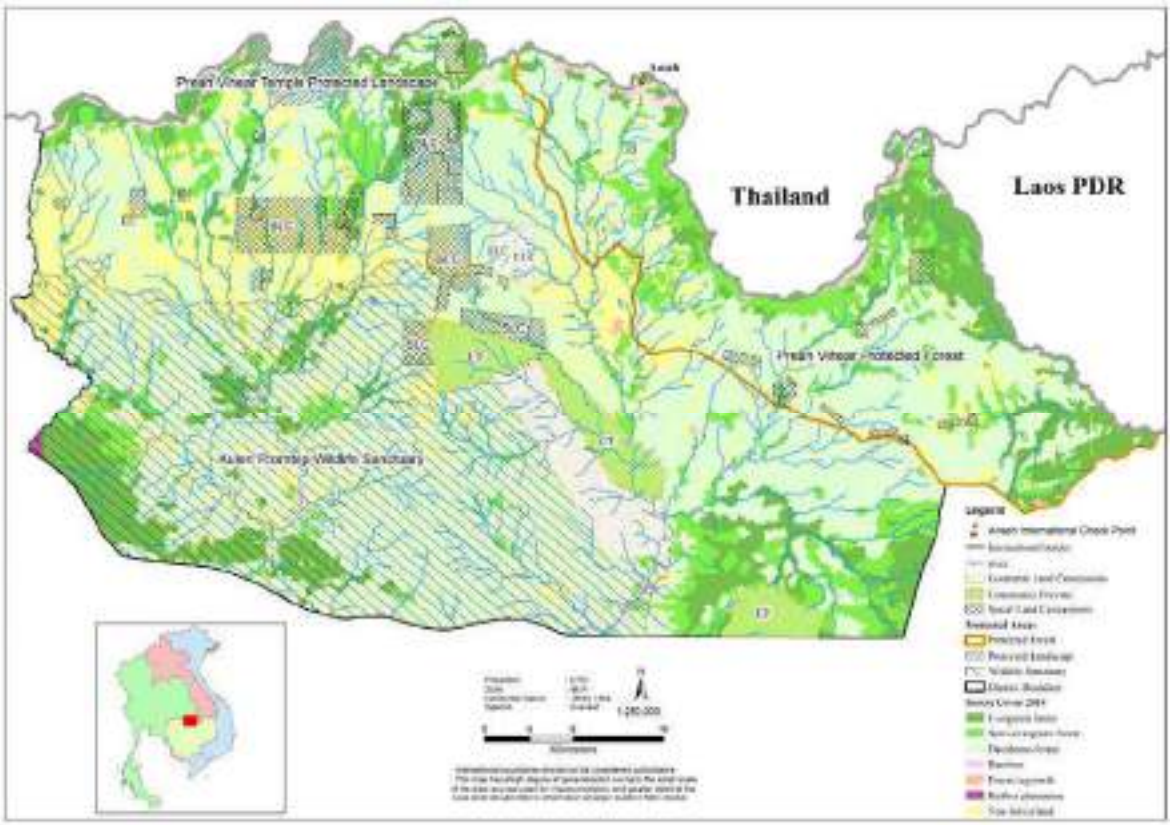
5.1.1 Forest Management System

The Choam Ksant District extends across 103 km in the northeastern part of the Preah Vihear Province. It is situated in the Dang Rek Mountain range along the trans-boundary area between Cambodia, Laos, and Thailand. It has an elevation that ranges between 46 and 802 m above sea level (asl) with slopes ranging between 0 and 132%.

The Royal Government of Cambodia (RGC) granted the eastern part of the Preah Vihear Province as a forest concession to the BLP Import Export Company of Thailand in 1991, but the concession was cancelled seven years later as a result of the company's inability to comply with management procedures stipulated in the Concession Agreement.

Meanwhile, the Royal Decree on the Establishment of Protected Areas in Cambodia had been promulgated in 1993 to protect ecologically and culturally important areas and soon thereafter the Kulen Promtep Wildlife Sanctuary and the Preah Vihear Protected Landscape, both of which cover parts of the Choam Ksant District, were established (Figure 8).

Figure 8. Map illustrating land uses in the Preah Vihear Province prior to 2016.



The RGC also issued Sub-decree No. 76 in 2002 to establish the Preah Vihear Protected Forest for Plant and Wildlife Genetic Resources Conservation (PVPF) under the jurisdiction of the Forestry Administration in the Ministry of Agriculture, Forestry and Fisheries (MAFF). The Forestry Administration, in cooperation with the Wildlife Conservation Society, was responsible for the

management of the area for several years through the Landscape Management in the Northern Plains of Cambodia project.

In more recent years, the Forestry Administration, in cooperation with the International Tropical Timber Organization, as well as Thailand and Laos, implemented the seminal project for the Management of the Emerald Triangle Protected Forests Complex to Promote Cooperation for Transboundary Biodiversity Conservation between Thailand, Cambodia and Laos (Forestry Administration, 2016a).

5.1.2 Authorized Harvesting Areas

The land area of the Choam Ksant District consists of 376,941 ha under three jurisdictional management systems. Those include Production Forests which are under the jurisdiction of the Forestry Administration, the Preah Vihear Temple Protected Landscape which is under the jurisdiction of the Preah Vihear Authority, and Protected Areas which are under the jurisdiction of the Ministry of Environment. Each of these systems emphasizes distinguishable land use priorities.

The social land concessions (SLCs) that belong to military families and that are scattered throughout the district (Fig. 8) cover 19,505 ha. Since 2011, the military infantry Brigade No. 9 has established 42 SLCs for its military families and brigade offices. The brigade has assumed responsibility for land management in all of the blocks of the SLCs in which timber has been collected or harvested and that former forest area is no longer under the management of the Forestry Administration.

There are three economic land concessions (ELCs) that are authorized to develop investment projects on forestland in the Choam Ksant District. The cumulative land area of these three concessions, the first of which initiated its investment project in 2013, is 11,203 ha. The overall area of concessions, inclusive of the SLCs and ELCs in which timber harvesting is legal is approximately 30,707 ha, accounting for 8.1% of the district's total land area.

5.1.3 Trends in Harvesting and Trade

During the period from 2013 to 2019, the volume of wood of the luxury timber species group, which includes the target species, that was harvested from forest concessions was reported to be 913 m^3 (Table 6). That wood was measured at sawmills prior to issuing the legal permits for the processed forest products and by-products to be transported out of the district. The annual fluctuations in the volumes suggest that harvesting plans were implemented in a rather irregular manner. Consistent with the conventional practice of measuring the sawnwood at sawmills, a conversion ratio of 1 m^3 of logs is equal to 0.6 m^3 of sawnwood or 0.5 m^3 of processed wood for export was used.

The amount of the wood that was harvested accounted for about 40% of the volume of the wood of the standing roundwood that was inventoried prior to harvesting. This difference resulted as approximately 30% of the total wood volume was damaged and was categorized as fuelwood, while another 30% was considered to be small trees with dbh between 5 and 30 cm that were categorized as poles.

Table 6. Sawnlog volume reported as legally harvested in the Choam Ksant District, 2013-2019.

Wood volume (m^3)								
Wood Classes	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Luxury Grade	172.77	436.98	109.76	80.28	59.10	47.80	6.54	913.2265
Grade 1	991.49	516.80	2,053.08	2,384.27	1,867.49	222.35	254.19	8,289.666
Grade 2	1,731.07	1,886.02	5,731.57	8,986.56	2,846.02	391.21	276.80	21,849.251
Grade 3	9.00	34.65	239.80	1,924.43	13.59	-	15.11	2,236.588
Non-Graded	10.34	-	-	-	59.71	-	-	70.049
Total	**2,914.67**	**2,874.45**	**8,134.21**	**13,375.55**	**4,845.92**	**661.35**	**552.65**	**33,358.78**

Source: Choam Ksant Forestry Administration Division.

There are some small-scale household wood processors as well as several outlets that sell wood furniture in the district and most of them have bought the wood in the form of logs or roundwood from local villagers who have illegally logged forestland in the Choam Ksant District. The target timber species are of high-value and have been used in the processing of various forest products and by-products. This is indicative of the multiple uses of those species that are traded and that are in high demand in the markets. Figure 9 provides one of many of the examples of small-scale household outlets that sell processed forest products and by-products.

The local transportation of processed forest products and by-products for domestic use is regarded as legal under the Forestry Law and the transporting of those products and by-products from the district to Phnom Penh and domestic city centers in other provinces has become a common avenue for trade.

The realization that the local transportation of processed forest products and by-products for domestic uses is regarded as a legal activity actually appears to contradict approved processes and procedures. That is, establishing a sawmill or a wood processing facility requires requesting a permit although the harvesting of timber outside of the concession areas is illegal. When those products are brought to household outlets from illegal wood processors, they could readily be transported outside of the district without a permit or further certification of the sources from which the wood originated. Those procedures are not transparent and are relatively ineffective for monitoring the illegal timber trade, which suggests that harvest control measures are not always implemented in accordance with existing rules and regulations.

Figure 9. Small-scale household outlets in Choam Ksant district that sell wood furniture made from the target timber species.

The surge of new settlements in the district has prompted the conversion of forestland, moreover, has increased the harvesting of the target species since those who harvest these species do not only clear forestland for agriculture or residential purposes, but also enter forests near their homes searching for high-value commercial timber species.

It was reported that after 2016 the volume of the trade of processed forest products and by-products originating in the concessions seemed to substantially decrease in combination with declines in the target timber species as well as other timber species, reflecting the increasingly limited availability of wood resources.

Despite the unavailability of data related to market demand, it was reported that a very large volume of processed forest products and by-products have been transported out of the district. The results of the systematic survey that was conducted in 2020 suggest that the small numbers of large trees that were recorded during the inventory of both *Dalbergia* species in the Choam Ksant District were primarily attributable to the illegal logging that was occurring throughout much of the past several years.

5.1.4 Master Plan or Management Plan

In economic land concessions, a master plan comprised of a series of annual management plans that are part of a long-term investment project is required on the signing of the Concession Agreement (RGC, 2005). The annual harvesting of timber in an ELC is defined by the area of forestland within which a permit for harvesting timber has been requested by a concessionaire. There is no quota established for the volume of timber to be harvested since it is the area requested for harvesting that is subject to verification through an annual management plan that determines the size of forestland to be cleared and planted with crops.

In social land concessions, an annual work plan for harvesting timber is required that should subsequently be followed up by a request for clearing the forestland in the SLC. The management plan, or annual work plan, does not mitigate, however, the impacts associated with harvesting timber by clearing the land. The primary objective of the master plan and the annual plans is for a social land concession to maximize economic returns. While there may be both a master plan and annual plans, implementation does not seem to consistently follow either of those plans.

5.1.5 Illegal Harvesting and Trade

Since wood production in the district has been reserved for domestic uses, there are no data that are related to legal wood exported to other countries. The district could, nevertheless, be considered to be one of the principal crossings through which timber has been illegally transported to other areas throughout the country or even exported to Vietnam.

During the period between 2013 and 2019, the total wood volume associated with the illegal logging of *D. cochinchinensis* and *D. oliveri* was 31 m^3 and 27 m^3, respectively, as reported by the Choam Ksant Forestry Administration Division (Table 7). Notwithstanding these volumes, local villagers claimed that the actual wood volume associated with the illegal logging of both the *Dalbergia* species that escaped detection by law enforcement was much larger than that which was officially reported. The documentation of the extent of illegal logging activities in the Protected Areas in the district also appears to have been underestimated.

Table 7. Wood volume of *D. cochinchinensis* and *D. oliveri* reported as illegally harvested and/or traded in the Choam Ksant District, 2013-2019.

Wood volume (m^3)								
D. Cochinchinensis	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Sawn wood	6.193	1.356	0.202	0	0	0	0	7.751
Hard wood (log)	2.494	1.761	6.207	2.796	9.229	0.604	0	23.091
Sub total	***8.687***	***3.117***	***6.409***	***2.796***	***9.229***	***0.604***	***0***	***30.842***
D. Oliveri	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Sawn wood	2.36	24.956	0	0	0	0		27.316
Hard wood (log)	0	0	0	0	0	0		0
Sub total	***2.36***	***24.956***	***0***	***0***	***0***	***0***	***0***	***27.316***
Total	**11.047**	**28.073**	**6.409**	**2.796**	**9.229**	**0.604**	**0**	**58.158**

Source: Choam Ksant Forestry Administration Division.

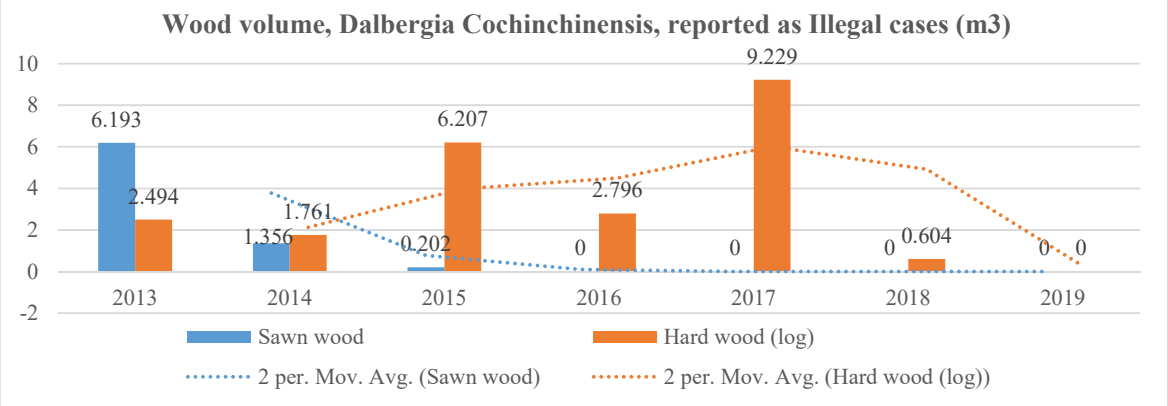


Figure 10. Number of reported cases involving the illegal trading of *D. cochinchinensis* in the Choam Ksant District.

Figure 10 illustrates the downward trend in the illegal logging and trading of *Dalbergia cochinchinensis* which fell from 8.687 m^3 in 2013 to less than 1 m^3 in 2018.

There were no commercial plantations of either *D. cochinchinensis* or *D. oliveri* that had been established in the district during that period and a ban on the cutting and trading of *D. cochinchinensis* had been imposed by means of the Prime Minister's Order No. 2. Nevertheless, it was recognized that there was a considerable amount of illegal cutting, transporting, and trading of *D. cochinchinensis* and, to a lesser extent, *D. oliveri* that was occurring in many parts of the forests throughout the district with some of the wood even crossing the borders into Thailand and Laos.

Figure 11. Confiscation of illegally transported *D. cochinchinensis* (left) and luxury tree species in the area of the Teuk Kraham commune, Cham Ksant District (right).

5.2 Harvest Monitoring

5.2.1 Harvest Regime

There are several recognizable similarities in management between forest concessions and economic and social land concessions in that in each of these concession types there are no specified target species, the legal and technical requirements and procedures - including zoning and operational plans - are comparable, and an Environmental Impact Assessment (EIA) report must be prepared (RGC, 1999). There are understandably significant differences, as well, especially with regard to the required incorporation of logging cycles, minimum cutting diameters, and annual allowable cuts in forest concession harvesting operations.

Unlike in forest concessions, the timber harvesting systems used in ELCs and SLCs involve clear cutting and there is no reason to define a logging cycle or annual allowable cut since the principal objective in these types of concessions is to convert forestland into intensive agricultural or residential land. The riparian forests along the main streams defined on an approved map in an economic or social land Concession Agreement, however, must be protected as agreed between the government, through its representative ministry, and the concessionaire.

In this context, the authorized ELC or SLC concessionaires would only be allowed to harvest timber on forestlands that had been approved for development projects as stipulated in the Concession Agreements and in individual contracts between the concession companies and the respective government agencies. The companies would be expected to clear the forestland, divide it into sub-zones within the approved development area in ELCs, and collect the timber and pay the taxes on the timber, either through a tax on standing trees or on the basis of the volume of processed wood determined through the forest inventory guidelines specified by the Forestry Administration on behalf of the government. The harvesting regime in either of these two types of concessions is not determined by means of a market-driven quota, but rather on the basis of the annual sub-zone area that is to be harvested.

5.2.2 Methods of Monitoring Harvests

Once approval has been received from the government for the requested area to be designated as an ELC or SLC, it is recommended that a feasibility study and an initial environmental impact assessment (IEIA[6]) be conducted concurrently. In implementing these pre-investment requirements, the evaluation of the effects on the social environment and the area's natural resources is used to determine the extent of the possible impacts of the investment. These might include overlapping areas with local villagers' lands or damages that might potentially trigger the depletion of biodiversity resources. If mitigation measures are able to be introduced to avoid the potential degradation resulting from the project's implementation, the evaluation of the investment would proceed to the next step. If the impacts would not be able to be mitigated, however, the projected investment in that area might fail to be approved, in which case another area would have to be chosen for undertaking the proposed investment.

At the time that an ELC or SLC has been authorized to commence implementation, the process of demarcating the project area and registering the land is initiated to avoid land conflicts with local villagers and a full environmental impact assessment (FEIA[6]) that employs a more detailed methodology incorporating a forest inventory is required. The total area of sampling plots commonly applied in that forest inventory is about 1% relative to the total project forestland area. The assessment of forest resources during this stage of the process is directed to providing baseline information about the forest resources in the project area. The FEIA should be employed for

[6] **Full Environmental Impact Assessment (FEIA):** Detailed study on physical environmental resources, biological environments, and socioeconomic resources that is based, in general, on primary data available within and around the project area to determine, predict, and analyze potential and combined environmental and social impacts caused by project activities in order to develop measures to minimize negative impacts and maximize positive impacts and to analyze environmental damage and economic gains of a development project.

harvest monitoring and control, but, in practice, that is somewhat difficult to accomplish since the forestland is assessed with limited accuracy.

While an annual allowable cut is not applied in an ELC or SLC, the effects of the zoning, or division, of the concession land in an ELC into smaller sub-zones, or blocks, for harvesting timber are comparable with those undertaken in a forest concession. This division allows the concession landholder to harvest timber by clear cutting the forestland in each sub-zone according to a mutually-approved schedule referenced in the master plan. The request for permission to conduct the annual clear cutting must be submitted to the Ministry of Agriculture, Forestry and Fisheries after the forest inventory has been completed and its report has been mutually approved and released. A representative ELC with 5,000 ha of forestland in its project area might, thus, be conveniently subdivided into 5 sub-zones, or blocks, of 1,000 ha each. If the ELC owner were to commence its timber harvesting in sub-zone 1, the approval request to the MAFF would have to be submitted relatively early in the process and a comprehensive forest inventory, which according to regulations is compulsory, would have to be undertaken prior to harvesting the timber or clearing the forestland.

Each sub-zone of forestland that is allowed to be cleared annually is commonly about 1,000 ha. The concession companies must apply to MAFF to clear the sub-zones every year until all of the sub-zones have been cleared and planted with other crops or trees as stipulated and agreed in the Concession Agreement. There is usually no limitation on the volume of timber removed, but the forest inventory must be completed prior to the clearing of the sub-zones. The total area of sampling plots is at least 10% of the ELC's project forestland. This level of sampling intensity is always used for estimating flora species and wood volume with relatively high accuracy and in the monitoring and control of the timber harvest. The practice ensures that timber is not collected outside of the allowed forestland approved for harvesting.

Unlike operations in an ELC, the forestland in an SLC is not subdivided into sub-zones and the forest inventory is conducted only once with stratified samples that represent the entire forestland of all of the SLCs in the Choam Ksant District. In 2010, the establishment of each of the current social land concessions in the district was requested by the military during the violent clashes that were occurring along the border with Thailand for which a resolution was sought and which was ultimately achieved.

The timber harvested from the forestland of an ELC or SLC is stored at a sawmill or forest products and by-products processing facility near the forestland that has received a permit for processing the wood prior to transporting the resultant products to the market for which a permit for transporting wood (License Permission: LP) is required. Sometimes, another company (a third party) through its successful participation in a competitive bidding process would be selected to conduct the timber harvesting and wood processing operations.

According to the Forestry Law, activities related to the permanent forest estate and forest products and by-products shall require permits to (1) set annual harvesting quotas for forest products and by-products; (2) set transport quotas for forest products and by-products; (3) transport forest products and by-products without quotas; (4) establish through a Prakas a forest industry, sawmill, or other forest products and by-products processing facility; (5) establish a stock place to sell and distribute forest products and by-products; (6) establish all types of kilns that use forest products and by-products as raw materials; and (7) establish other permits for other activities.

The Forestry Administration is the only authority that is allowed to certify the logs or volume of timber removed within SLC and ELC development areas. This allows timber harvests to be monitored and controlled through the annual reports, or logbooks, of the local Forestry Administration Division. While monitoring is commonly conducted by measuring the actual wood collected on-site at a sawmill, these measurements are not regularly cross-referenced with the data originating from the forest inventories or with regard to verified population estimates of the concerned species in the district.

There are several sources that are expected to provide the required timber to the supply chain that extends from harvested and cleared forest areas through timber processors, distributors, and exporters (Figure 12). Those sources include ELCs, harvesting coupes, hydropower projects, and community forests, each of which is regulated under either the Ministry of Agriculture, Forestry and Fisheries or the Ministry of Environment and there is understandably some variation in the control of the harvesting that occurs under each of these sources. Every log that is produced has to be registered in a log list (Log Book A) that is verified by the local Forestry Administration staff. Log Book A is used in obtaining a License Permit issued by the Forestry Administration headquarters after appropriate royalties and fees have been paid. A PC-1 permit provides approval for transporting logs from the forest to the mill. The resulting processed timber products require a PC-2 permit for domestic sales, while a PC-IMEX permit is required to transport material originating from imports or is used to approve products for export. The License Permit and the PC-1 permit are not used for logs produced from planted trees (GFS-FA-EU, 2014). While Figure 14 does not specifically incorporate SLCs as one of the sources of logs, it does illustrate the flow of timber through which several different required permits are available for monitoring the timber supply chain. Nevertheless, the species of timber is not recorded in the permits. The target species are instead recorded as luxury grade timber species which reduces the specificity and hinders the effectiveness of the monitoring process.

Figure 12. Timber supply chain in Cambodia.

Source: GFS-FA-EU, 2014.

5.2.3 Confidence in Harvest Monitoring

The permanent plots of the national forest inventory would have been used under idealized conditions to extrapolate the growth of tree species in natural habitats as a part of the process of monitoring timber harvests in the ELCs and SLCs. Since neither the data nor detailed records of wood volumes of specific species were available from the inventory, however, a comparative evaluation was conducted to investigate whether the wood volume of those species categorized as luxury grade was exceeding that of the volume of harvested wood recorded in harvest permits. The assessment was based on detecting changes of forestland in the concessions compared to previous forest inventories.

Detected Changes of Forestland in Concessions

Since reliable information on quotas or areas to be harvested from the concessions every year in either their master plans or annual management plans was not available, forest cover changes between 2014 and 2020 were used to estimate the harvested areas. These changes were used to extrapolate from the data associated with reported harvested areas in the concessions by comparing them with those obtained from the forest inventory implemented during the systematic survey that was conducted in 2020.

Considering the unavailability of forest inventory data related to Environmental Impact Assessments (EIA), some extrapolation of existing data, especially those that were collected during the systematic survey which was conducted in 2020 and the assessments of national forest cover that were implemented in 2014 and 2020 were used to estimate the harvest levels.

During the period from 2014 to 2020, it appears that at least 3,107 ha of the forestlands of ELCs and SLCs in the Choam Ksant District were cleared. The regrowth forest that was primarily situated in deciduous forests in ELCs revealed that 316.7 ha had also been cleared during that period, although the area was restored as the result of natural regrowth (Table 8). During those six years, as a result, approximately 3,424 ha of timber were harvested in the clearing of forestlands in ELCs and SLCs.

Table 8. Forest cover changes between 2014 and 2020 in ELCs and SLCs in the Choam Ksant District.

Forest Cover	*2014 (ha)*	*2020 (ha)*	*changes (ha)*
Bamboo	281.1	281.0	0.1
Deciduous Forest	18,062.0	15,358.0	2,703.9
Evergreen Forest	1,283.9	1,000.6	283.3
Semi-Evergreen Forest	2,764.8	2,328.0	436.8
Regrowth Forest		316.7	(316.7)
Total forestland	**22,391.7**	**19,284.4**	**3,107.3**
Non-Forestland	8,131.2	11,238.5	(3,107.3)

During timber harvesting that occurred during 2014 to 2020 in those concessions, there was no targeting of the species that were to be harvested since every tree species was removed with the exception of *D. cochinchinensis*, the logging of which had previously been banned under the Prime Minister's Order 02.

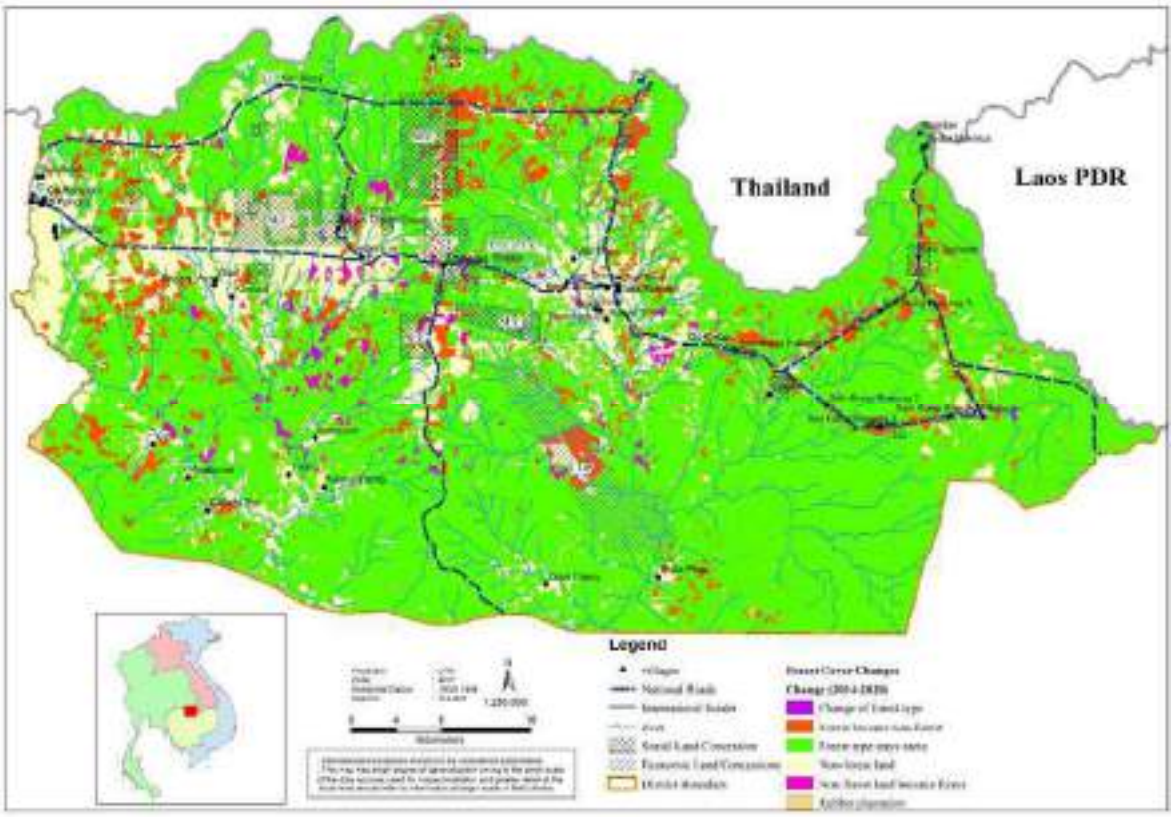


Figure 13. Map illustrating forest cover changes (2014-2020) in the Choam Ksant District.

The map provided in Figure 13 indicates that there were several detected changes in the extent of forestland that was converted into non-forestland throughout the Choam Ksant District between 2014 and 2020, especially along the main road and in areas where forest roads were accessible outside of the concession areas. There were also changes in forest types where patches of forestland were exposed to regular disturbances, especially as the result of selective logging and forest clearing, that destroyed the structure of some forest canopies and led to changes in the classifications of forest types during the assessment of forest cover changes.

Comparative Assessment of Target Species

There was a comparative assessment conducted to compare population densities and wood volumes of the target species group derived from the concessions' harvested areas over a period of six years from 2014 to 2020 using periodic data associated with the forest inventories.

The series of forest inventories conducted by the Forestry Administration-ITTO project, Royal University of Agriculture students, ELC-CDP, and the systematic survey that was conducted in 2020 were employed to compare the average tree population density and wood volume in semi-evergreen forests and deciduous forests between 2014-2016 and 2020 (Table 9).

Table 9. Forest Inventories conducted between 2014 and 2020 used to detect changes in population density and wood volume of target species.

Designed sampling & period	FA-ITTO[7]	Phoung Sopea[8]	Heng Soriya[9]	Chea Kearath[10]	ELC-CDP[11]	Average (2014-2016)	Systematic Survey[12]
Main purpose	Carbon Stock	Carbon Stock	Carbon Stock	Carbon Stock	ESIA		*Dalbergia* species
Period	2014-2015	2015	2015	2016	2015		2020
# plots sampled	89	33	12	20	36		86
Sampled plot shape	Rectangle	Rectangle	Circle	Circle	Rectangle		Rectangle
Sampled plot area (m^2)	1500	1500	314	314	1500		1500
Sampling method	Randomly	Randomly	Randomly	Randomly	Randomly		Systematic
Locations of sampled plots	PVPF*	PVPF*	PVPF*	PVPF*	ELC-CDP		Choam Ksant**
Results							
Semi-evergreen forest (SF)							
Density (trees/ha)	2,839	1,900	335	305	658	**1,207.4**	189.87
Wood volume (m^3/ha)	217.18	NA	NA	52.15	59.91	**109.75**	55.19
Target species group in SF							
Luxury Grade (trees/ha)	NA	117	NA	0	40.5	**52.5**	11.6
Luxury Grade (m^3/ha)	NA	6.02	NA	0	3.69	**3.24**	1.84
Deciduous forest (DF)							
Density (trees/ha)	764	764	225	279.6	434	**493.32**	165
Wood volume (m^3/ha)	169.92	NA	NA	19.4	48.29	**79.20**	32.199
Target species group in DF							
Luxury Grade (trees/ha)	NA	13	NA	12.7	26.7	**17.5**	16.4
Luxury Grade (m^3/ha)	NA	2.41	NA	0.49	2.97	**1.96**	0.81

Note: * PVPF = Preah Vihear Protected Forest (Chheb Wildlife Sanctuary); ** throughout Choam Ksant forestland

The population densities and wood volumes in both semi-evergreen and deciduous forests in 2014-2016 were relatively high compared to those recorded in 2020. The average population density in 2014-2016 in semi-evergreen forests was 1,207 trees/ha with a volume of 110 m^3/ha, while the systematic survey conducted in 2020 recorded only 190 trees/ha with a volume of 55 m^3/ha. These results were indicative of declines of about 6.4 times in population density and 2.0 times in wood volume.

In deciduous forests, the average population density was initially 493 trees/ha with a wood volume of 79 m^3/ha, while in the systematic survey conducted in 2020 there were only 165 trees/ha with a wood volume of 32 m^3/ha, reflecting declines of about 3.0 times in population density and 2.5 times in wood volume.

[7] FA (2016b). Integrating Forest Biodiversity Resource Management and Sustainable Community Livelihood Development in the Preah Vihear Protected Forest: Preliminary Assessment of Carbone Stocks. The forest inventories were conducted between 2014-2015.
[8] Phoung Sophea (2015). Estimation of Aboveground Wood Biomass in Preah Vihear Protected Forest, Chhaep District, Preah Vihear Province.
[9] Heng Soiya (2015) .Estimation of Above Ground Biomass through Evaluation of Stand Structure in Preah Vihear Protected Forest, Choam Khsan District, Preah Vihear Province.
[10] Chea Kearath (2016). Forest Inventory Implementation for Biomass Estimation and Understory Species Study in The Preah Vihear Protected Forest, Choam Ksant District, Preah Vihear Province
[11] ELC-CDP (2015). Personal contact for sharing inventory data in January 2021.
[12] Systematic survey of *Dalbergia Cochinchinensis and Dalbergia Oliveri* For Piloting Assessment on Sustainable Genetic Conservation, conducted in 2020.

The declines in population density and wood volume of the target species in both semi-evergreen and deciduous forests paralleled those of other species and corresponded to interview results obtained from the local Forestry Administration officers and other relevant authorities that illegal selective logging and forestland encroachment occurred relatively extensively throughout the Choam Ksant District during the transition of the Protected Forest to a Protected Area[13] initiated in 2016. These results are consistent with the perception that the reported harvest volumes and volumes of illegally logged target species were considerably less than the actual occurrences during the period from 2014 to 2016.

The estimation of timber resources collected from the concessions over the period from 2014-2020 was used to compare the reported scale of timber harvesting with the detection of changes in forestlands to assess the severity of the impacts associated with illegal harvesting and trading of timber.

Since the forest inventories in 2014-2016 were conducted in less-disturbed forests and the systematic inventory that was conducted in 2020 revealed extensive disturbances throughout the district, the average wood volume in 2014-2016 was considered to be the maximum average wood volume and that in 2020 to be the minimum average wood volume. Under these assumptions, the total wood volume removed from the semi-evergreen forests in the concessions was estimated to have ranged between 24,106.99 m^3 and 47,938.8 m^3 and the total wood volume removed from the deciduous forests was estimated to have ranged between 87,065.58 m^3 and 214,148.88 m^3 (Table 10). The total wood volume of the target species group, which consists of 8 luxury timber species, was estimated to have ranged between 803.71m^3 and 1,415 m^3 in the semi-evergreen forests and between 2,190.16m^3 and 5,299.64 m^3 in the deciduous forests.

Table 10. Estimation of timber resources collected in concessions.

Forest types and target species group	Total converted forestland 2014-2020 (ha)	Estimates based on average wood volume (2014-2016)		Estimates based on average wood volume (Systematic Survey conducted in 2020)		Difference in average wood volume (m^3)
		Average wood volume (m^3/ha)	Total (m^3)	Average wood volume (m^3/ha)	Total (m^3)	
Semi-evergreen forest (SF)	436.8	109.75	47,938.80	55.19	24,106.99	23,831.81
Target species group in SF		3.24	1,415.23	1.84	803.71	611.52
Deciduous forest (DF)	2,703.9	79.2	214,148.88	32.20	87,065.58	127,083.30
Target species group in DF		1.96	5,299.64	0.81	2,190.16	3,109.49
Total volume (target species group)			**6,714.88**		**2,993.87**	

The total wood volume of the target species that was collected from the concessions during the period from 2014-2020 was between 2,993.87 m^3 and 6,714.88 m^3.

The rather high variability suggests that the harvesting, including illegal harvesting, of timber must have been occurring throughout the forests in the Choam Ksant District, rather just in the concessions. While the wood volume of the species categorized as luxury timber was not exceeding that of the harvested amount recorded in permits during those years, the confidence in the monitoring the harvesting must to be considered low since there were no data available from

[13] Protected Forests were formerly under the jurisdiction of the Forestry Administration (Ministry of Agriculture, Forestry and Fisheries), under a system in which forestland use planning and/or partition were subject to the articles of the Forestry Law (2002), while Protected Areas are under the jurisdiction of the Ministry of Environment (MoE), under a system in which forestland zoning is subject to the articles of the Law on Protected Areas under which each Protected Area is subdivided into 4 zones, namely, a Core zone, Conservation zone, Sustainable Use zone, and Community zone.

either the national forest inventories or from records of wood volume associated with specific target species in permits.

5.2.4 Mortality Rate and Maturity

The mortality rate of *D. cochinchinensis* and *D. oliveri* in natural forest habitats is still not completely known, although several threats and ecological restraints are commonly considered to be the underlying causes of severe impacts on these species' survival. The size class at maturity of the target species was recorded for quite a few *D. cochinchinensis* trees, but the information on *D. oliveri* was not available in the study area in the Choam Ksant District.

While illegal selective logging, as well as the natural and unregulated burning of forests in the district, are commonly recognized as having major detrimental impacts on the survival of both the *Dalbergia* species, it is now understood that genetic traits also pose a threat to their survival by introducing a biological risk that can affect the reproductive rates of the target species throughout the district. The systematic survey conducted in 2020 revealed considerable information about the maturity of some of these species. Some local villagers reported that their planted tree species of *D. cochinchinensis* with diameters ranging from 13-15 cm had started to flower 3 years previously, at 5 years old, and that this was most probably due to the fact that they had collected seedlings of the species regrown naturally from stumps and roots embedded in the ground to plant. It may be inferred as a result of the discussions with the villagers that the flowering of *D. cochinchinensis* occurs in early stages of maturity every year in natural forests in the study area.

The observations on the maturity of *D. oliveri* are supported by reports from the local villagers that *D. oliveri* generally only flowers and fruits every few years after initial flowering. This reproductive pattern may be especially influenced by its genetic characteristics growing in those habitat types. The result is that the seeds of *D. oliveri* are year-by-year becoming less-and-less available for collection, which threatens the species' genetic resources.

5.2.5 Legal Framework

A. Forestry Law (2002)

- Article 30 of the Forestry Law implies that it is prohibited to process forest products and by-products or establish and operate a forest industry, including a sawmill or a forest products and by-products' processing facility, as well as all types of kilns in the domains of Permanent Forest Reserves.
- Article 76 of the Forestry Law stipulates that forest offenses are criminal offenses, which are specially defined in that law. The Forestry Administration officials, who are qualified as judicial police officials, have jurisdiction to investigate forest offenses and file such cases and documents to the court. Every level of the Forestry Administration shall have the duty to investigate, control and suppress forest offenses within their assigned territory. The operation of Forestry Administration officials qualified as judicial police officials shall be implemented consistent with the Law on Criminal Procedures.
- Articles 96, 97, 98 and 99 of the Forestry Law are related to the punishing and penalizing of forest offenders who violate a provision of the Forestry Law according to the degree of forest offense.

B. Protected Area Law (2008)

- Article 11 of the Protected Area Law stipulates that each Protected Area shall be divided into four management zones, including a Core zone, Conservation zone, Sustainable use zone, and Community zone. That management system does not apply to the Apsara Authority, Preah Vihear Authority, or other designated authorities or management area(s) to which the Royal Government has specifically allocated those tasks.

- Articles 41, 42, and 43 of the Protected Area Law indicate that all of the activities harmful to natural resources in the Projected Areas are prohibited.
- Chapter IX, inclusive of Articles 45-52 of the Protected Area Law, is related to the implementation of law enforcement and procedures for resolving offenses.
- Chapter X, inclusive of Articles 53-64 of the Protected Area Law, concerns natural resource offenses and penalties.

C. Other Relevant Legislations

- Regulation No. 601, dated 24 April 2014, issued by the Council of Ministers of the Royal Government of Cambodia, suspended the exporting of all forest products and forest by-products derived from luxury grade timber species until it would be informed by means of a more recent regulation with the aim of improving sustainable forest resource management and use.
- Sub-Decree 53, dated 29 May 2006, issued by the Royal Government of Cambodia, is concerned with the Trading of Endangered Flora and Fauna species listed in CITES Appendices. Every species listed in CTES Appendix I is highly restricted with regard to cross-border trading, with the exception of some instances that are prescribed in the CITES Convention, while those listed in Appendix II are also under similar restrictions.
- The Prime Minister's Order 02, dated 22 February 2013, initiated measures and controls on the cutting, transporting, collecting, storing, and exporting of *Dalbergia cochinchinesis* throughout the country.
- The Ministry of Agriculture, Forestry and Fisheries issued Prakas 89 on Prohibited Forest Products and Non-timber Forest Products for harvesting from Reserved Permanent Forests in Cambodia in 2005. That announcement also regulates minimum felling limits based on the diameter at breast height (DBH) of *Dalbergia cochinchinensis* and *Dalbergia oliveri*, which are categorized as luxury species with the minimum DBH for the allowable cut established as 0.45 m.

5.3 New Forestland Management System

5.3.1 Reformed Forestland Zoning and Management

The management of forestland in the Choam Ksant District has been under the jurisdiction of three primary institutions since 2016. Those institutions include the Ministry of Agriculture, Forestry, and Fisheries, the Ministry of Environment (MoE), and the Preah Vihear Authority (PVA). There are currently 105,746 ha of land under the jurisdiction of the Forestry Administration; 4,042 ha of land under the jurisdiction of the Preah Vihear Authority; and 267,153 ha of land managed as Protected Areas (Figure 14) (Table 11).

The harvesting of timber in any area outside of the ELCs and SLCs is not currently allowed for commercial purposes, except for the harvesting associated with traditional uses of the local communities, unless permission is provided from the Royal Government of Cambodia in connection with some legal arrangements.

In such a legal context, only the harvesting of *D. oliveri* from source areas that are under the management of the Forestry Administration as economic land concessions or social land concessions have been considered to be legal sources of harvesting since these entities have received their legal rights through sub-decrees granting permission for the uses of forestland. Local communities, as well as community forestry members, also have rights either for traditional uses, through which they are allowed to collect Non-Timber Forest Products (NTFPs) for their domestic use or for commercial purposes.

Figure 14. Map of current distinguished land uses and forest management systems in the Choam Ksant District.

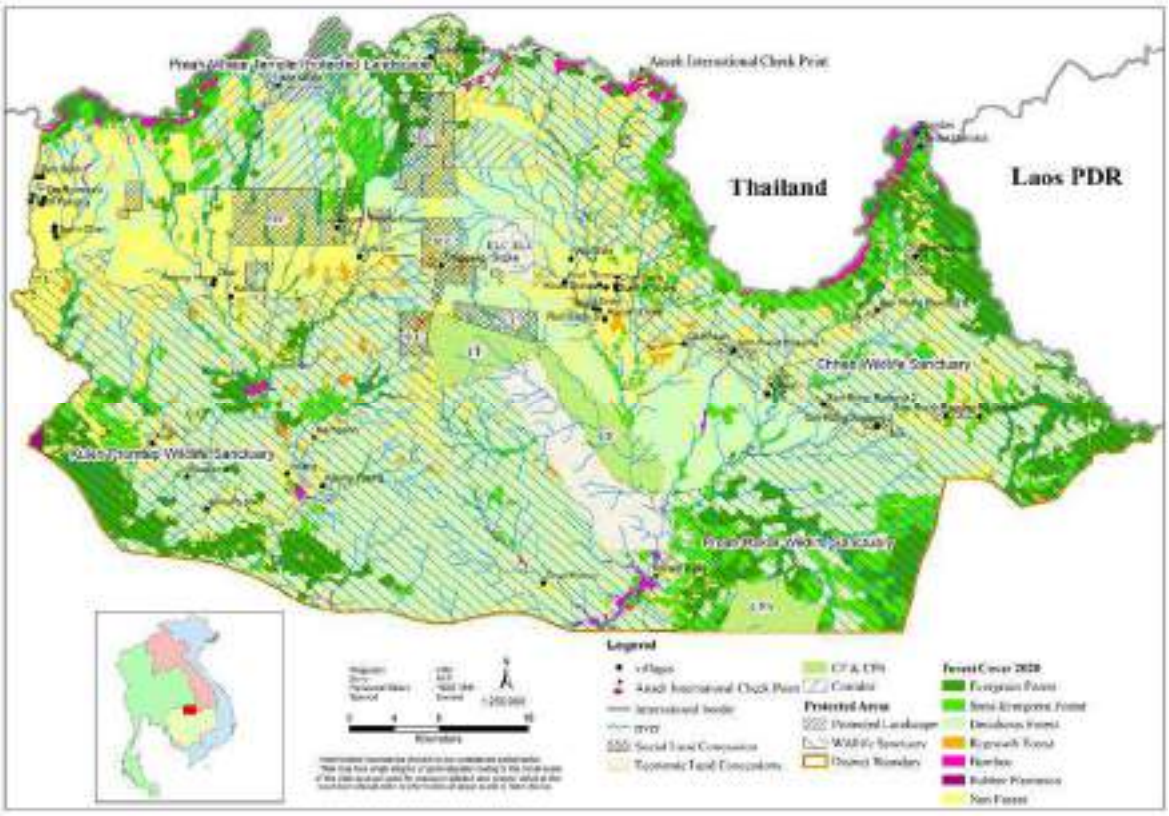


Table 11. Land uses and forestland management under respective authorities in the Choam Ksant District.

Land Uses and Forestland Jurisdiction Management	Area (ha)	%	Strategic Functions	Remarks
Forestry Administration (MAFF)	***105,746***	***28.1%***		
Community Forestry (CF)	8,349	2.2%	Conservation and traditional uses based on community forest management plans	The minimum DBH for the allowable cut is applied
Economic Land Concessions (ELCs)	11,203	3.0%	Economic development	Forestland conversion; clear cutting; EIA report (forest inventory); the Prime Minister's Order is still applied
Social Land Concessions (SLC)	19,505	5.2%	Socio-economic development	
The remaining forestland (Non-Protected Area forestland)	66,690	17.7%	Protection, reservation, production; traditional uses	The minimum DBH for the allowable cut is applied; restrictions with law enforcement
Preah Vihear Authority (PVA)	***4,042***	***1.1%***		
Preah Vihear Temple Protected Landscape	4,042	1.1%	Conservation, forest restoration, and traditional uses (Zone III)	Restrictions with law enforcement
Protect Areas (MoE)	***267,153***	***70.9%***		
Chheb Wildlife Sanctuary	81,403	21.6%	Conservation, forest restoration, and traditional uses (Community zone)	Restrictions with law enforcement; compromise for community zone
Kulen Promtep Wildlife Sanctuary	118,530	31.4%		

Land Uses and Forestland Jurisdiction Management	Area (ha)	%	Strategic Functions	Remarks
Preah Rokar Wildlife Sanctuary (plus CPA)	37,692	10.0%		
Corridor	29,528	7.8%		
Total	**376,941**	**100%**		

Forestland use planning in the Choam Ksant District is premised on the Forestry Law and the Protected Area Law. According to the Protected Area Law, each Protected Area shall be divided into the four following management zones:

- **Core zone**: management area(s) of high conservation values containing threatened and critically endangered species and fragile ecosystems. Access to the Core zone is prohibited except to Nature Conservation and Protection Administration officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of the preservation and protection of biological resources and the natural environment, and national security and defense personnel.
- **Conservation zone**: management area(s) of high conservation values containing natural resources, ecosystems, watershed areas, and natural landscape located adjacent to the Core zone. Access to the Conservation zone is allowed only with the prior consent of the Nature Conservation and Protection Administration with the exception of national security and the defense sector. Small-scale community uses of NTFPs to support local ethnic minorities' livelihoods may be allowed under strict control provided that they do not have serious adverse impacts on the biodiversity within the zone.
- **Sustainable Use zone**: management area(s) of high economic values for national economic development and the management and conservation of Protected Areas that contributes to local communities and indigenous ethnic minorities' livelihood improvement. Subsequent to consulting with relevant ministries and institutions, local authorities, and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in response to requests from the Ministry of Environment.
- **Community zone**: management area(s) for socio-economic development of the local communities and indigenous ethnic minorities that may contain existing residential lands, paddy fields or field gardens or swidden (Chamkar).

In spite of the restricted areas established in Protected Areas, the interviews that were conducted divulged that local authorities recognized the illegal logging of the target species not only in Protected Areas, but also in those areas originating in Thailand and Laos. The logs were transported, in some cases, across the Choam Ksant District to Phnom Penh or were illegally transported to other provincial towns, supporting the supposition of the intensity of the illegal logging that was occurring in several Conservation and Protected Areas during the years from 2016 to 2019.

5.3.2 Law Enforcement

There are more than 50 rangers conducting regular patrolling duties daily in the Protected Areas in the Choam Ksant District and at least 5 sub-camp sites are strategically situated on different forest access roads. The enforcement is highly restrictive in the Core and Conservation zones and most of the illegally logged wood is destroyed immediately when discovered while rangers are patrolling. The illegal loggers are arrested and dispatched to prison. In a similar manner, the Forestry Administration foresters conduct their patrolling and confiscation operations in several

locations and bring illegal trafficking cases to the provincial court. It is nevertheless recognized that there are many perpetrators of illegal logging that escape apprehension because of the limited number of foresters in the district.

In recognition of the loss of some of its biodiversity and land conflicts in the country, the Royal Government of Cambodia, in mid-2020, commenced implementation of a campaign to increase private and state land registration on long-term, temporarily-occupied forestland used by local villagers. The measure, which is still in the initial stage of data collection, is ultimately expected to reduce land conflicts, forestland encroachment, and forest offenses throughout the country.

5.3.3 Species Restoration

No enrichment planting has been applied in the Protected Areas by the Ministry of Environment nor on forestland by the Forestry Administration, but some forest restoration has been accomplished in forest plantations or by planting trees on public land. There is a considerable number of *D. cochinchinensis* trees that have been planted on public land along fences, in open yards to provide shade, and in gardens of schools, pagodas, local military offices, and commune offices (Figure 15). There are about seven hundred trees planted along the road to Preah Vihear Temple by the local Forestry Administration units and some of these were reported to have regrown naturally and are now protected by the Preah Vihear Authority. The Forestry Administration Division and sub-governmental district authorities have also provided opportunities for the local people to participate in planting trees during the annual Arbor Day ceremonies which contribute to genetic conservation, especially of the target species.

Figure 15. Plantation of *Dalbergia cochinchinensis* established to restore forest cover and conserve this species in an area of the Preah Vihear Temple Protected Landscape.

5.3.4 Promotion of Establishment of Forest Plantations

Since 2013, there have been just under 84,000 seedlings of *D. cochinchinensis* that have been distributed to local villagers, monks, and public institutions to plant on their land or that have been planted as forest plantations in the district (Table 12; Figure 16). While there are no available data on the number of seedlings of *D. oliveri* that were distributed from 2013 to 2020, it was reported that a smaller number of less than 3,000 seedlings of the species were planted in the district.

Under the CITES Tree Species Programme, a total of 50,000 seedlings was distributed to at least 650 local people, including monks, police, military units, and other public institutions, in 24 villages of 7 communes in the district (Figure 16).

Table 12. Distribution of tree seedlings of *D. cochinchinensis* in the Choam Ksant District.

Institutions/Projects	2013	2014	2015	2016	2017	2018	2019	2020	Total
FA Division	2,900	1,600							4,500
FA-ITTO Project			7,700	3,720					11,420
Preah Vihear Authority					3,000	5,000	5,000	5,000	18,000
CITES Tree Species Programme								50,000	50,000
	2,900	**1,600**	**7,700**	**3,720**	**3,000**	**5,000**	**5,000**	**55,000**	**83,920**

Source: Choam Ksant Forestry Administration Division; Forestry Administration (2016c); CITES Tree Species Programme (2021).

The survival rate of the 84,000 seedlings of *D. cochinchinensis* that were distributed and planted was not able to be determined, but it was observed that there were only about 2,000-5,000 seedlings, or about 7-17%, of 28,920 trees that were planted and observed prior to 2020 that survived. That is not a good survival rate in either plantations or natural habitats, especially since the causes of those dead seedlings were reported to be attributed to human-induced factors that included carelessness and the planting of the seedlings under unsuitable conditions.

Figure 16. The distribution of tree seedlings of *Dalbergia cochinchinensis* to monks and local communities by the project team of the CITES Tree Species Programme.

5.3.5 Private Forest Plantation Certification

Small- and medium-scale investment in forest plantations was initially promoted at the national level through incentives provided in public-private partnerships. The purpose of the Declaration on Private Forest Rules that was promulgated in 2017 was to provide legal support for private forest registration and to encourage private sector involvement, especially on legal private land. The Guidelines for Private Forest Registration further elaborated the procedures and legal requirements as well as benefits that would be associated with investments to facilitate the establishment and development of forest plantations on private land.

To complement the implementation of the Private Forest Rules and to promote the registration of private forest plantations, several practical procedures, which included the use of efficient application and verification and evaluation forms, registration certificates, and logbooks were developed to facilitate and inform individuals, local communities, legal entities and the private sector on how and where to register their private forest plantations.

A survey of the tree nurseries in Cambodia that was conducted in 2013-2014 confirmed that *D. cochinchinensis* was the most abundant native species planted in the nurseries (Theilade *in litt.* to UNEP-WCMC, 2018). It was revealed in the survey that there were 1.2-1.4 million seedlings produced annually and an estimated 60%-70% of those seedlings were sold and were subsequently planted by private households, landowners, monks, and at pagodas, petrol stations and restaurants.

The principal beneficiaries of the initiatives include local communities, small- and medium-scale farmers, landowners, private sector companies, forest resource and land use management practitioners, and planners involved in planting trees in plantations.

5.3.6 Effectiveness of Management Measures

The lack of effectiveness of some of the measures of management seems to correspond with the decline in reported cases of illegal forest offenses even though intensive law enforcement and patrolling is conducted across the district's forestlands, although results of the inventories revealed the already low population densities of *D. cochinchinensis* and *D. oliveri.* These declining populations were caused to a considerable extent by (1) illegal selective logging during the transition of the forestland management system in combination with a lack of transparency associated with the control and monitoring of the trade of the target species; and (2) a limited number of Protected Area rangers and foresters available to conduct patrolling more extensively. While regulations exist, they are not fully implemented. Moreover, there is a lack of good forest governance associated with the distribution of power and authority in a transparent and democratic manner which weakens reporting procedures, law enforcement, and general institutional performance.

Despite the shortcomings leading to the high impact severity and low population densities of the target species in the natural habitats, the distribution of tree seedlings of these species could conceivably recover their genetic conservation through artificial propagation. This means that management measures should have, at a minimum, the appropriate level of rigor required to reduce the severity of the identified concerns, risks and impacts should be implemented assiduously. It is recommended that the genetic conservation of the two *Dalbergia* species should be further concentrated through restoration, planting, and the maintenance of natural populations.

6. Non-detriment Findings

One of the purposes of this assessment is to increase the understanding of the resources and processes required to prepare NDF reports that adhere to the nine-step process supporting CITES Scientific Authorities in their efforts to establish science-based determinations (Figure 17).

Since 2014, the Royal Government of Cambodia has, through Regulation No. 601, suspended its exports of every forest product and forest by-product derived from luxury grade timber species until such time that it would have been otherwise informed through superseding legislation that would have been developed to increase sustainable forest resource management and use in the country.

In the event that the current measure is replaced by superseding legislation and there is a request to export a specimen of *Dalbergia* that originated in natural forests, the process of developing an NDF shall be conducted in accordance with the representative assessment of the 26 parameters and 7 factors that was conducted in this study as in Annex 1. There are also provisions to conduct a virtual assessment if there is a request to export specimens from one or both of these *Dalbergia* species that are sourced through artificial propagation in plantations even though an NDF would not be specifically required. In such a case, legal acquisition would still prevail, however, so that if the current measure is not replaced, any specimen of either of these *Dalbergia* species sourced through artificial propagation would not be allowed to be exported as virtually assessed as in Annex 2.

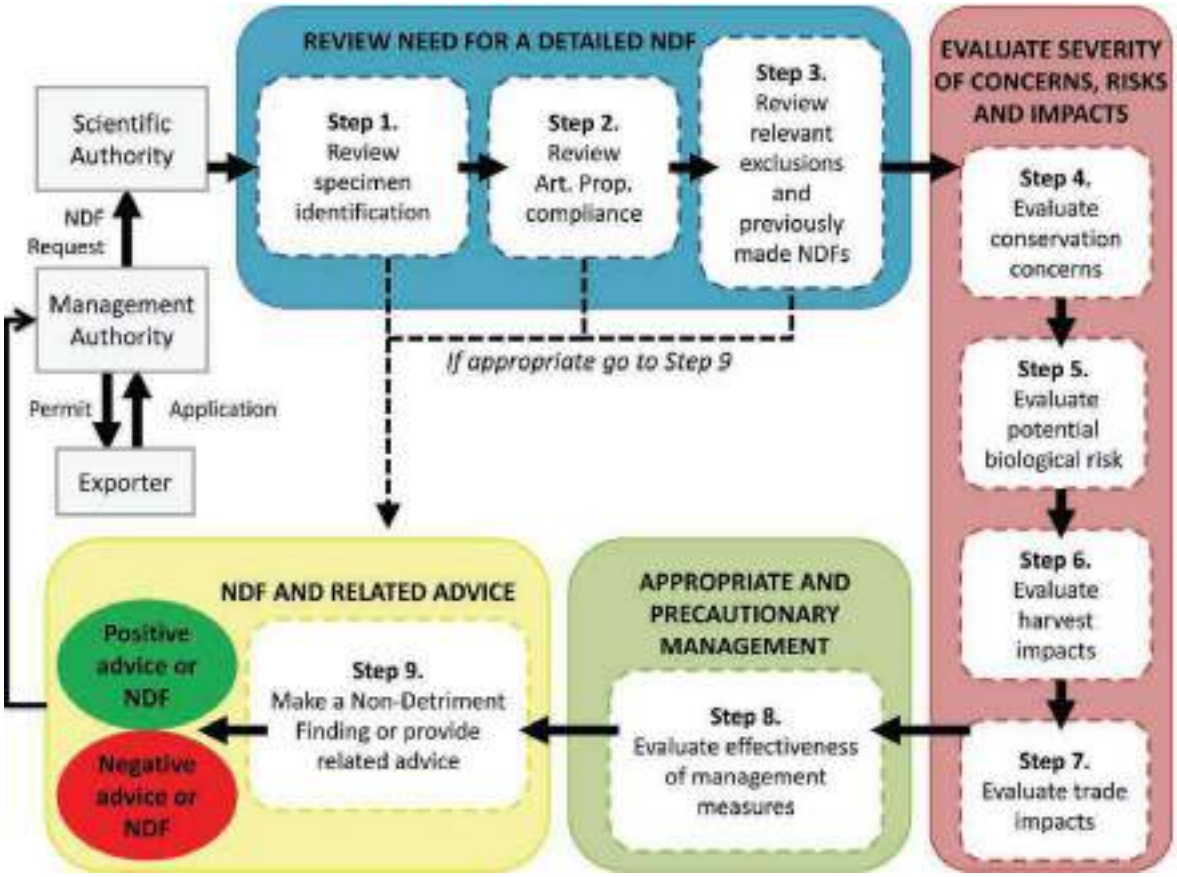


Figure 17. The nine-step process incorporated into the CITES guidelines for preparing a scientific-based NDF for timber species.
Source: Daniel Wolf, 2018.

6.1 Assessments of the Resilience of the Species

The assessments of the target *Dalbergia* species's resilience adhere to the guidance suggested in CITES document – "CoP-15 Doc. 16.3: Non-Detriment Findings for Timber, Medicinal Plants and Agarwood". Referring to the information of biological and harvest characteristics, both *Dalbergia* species are considered lower resilience with respect to collection. Both *D. cochinchinensis* and *D. oliveri* are long-lived life form and generally found in specific natural forest habitats with high site requirements (edaphic, temperature, and elevation). For national abundance, the species are known scattered with decreasing in population trend that threatens are in high risks due to their high-value commercial wood and increasing demands in the local and international markets. The species reproduction are unpredictable since *D. cochinchinensis* has no specific pollinators while either does that of D. oliveri with sporadic fruiting between years. The regeneration of *D. cochinchinensis* is relatively fast from seeds or stump, while regeneration of *D. oliveri* is slow and irregular with seeds or stumps. For dispersal factor, the seeds of both *Dalbergia* species are undispersed due to natural barriers (i.e., natural ranges, seed dispersers, water barriers, and predation).

Regarding the harvest characteristics, the harvest practices legally originated from land concessions are commonly from clear-cutting, so there is no cycle rotation of harvest, which leads to indiscriminate collection of other species (all species are collected) nor selective collection of one age-class. As wood demand increases, the species are in multiple uses while the plant grows slowly with low mean annual increment (MAI) yielding in tiny amount of wood for collection. In

the meantime, since the scale of trade were very high with increasing fast demand in the past many years, the harvest from legal sources are getting lower and lower.

6.2 Assessments (Required NDFs)

The assessments of the target *Dalbergia* species systematically followed the IUCN Checklist of NDFs (Rosser and Heywood, 2002). Nevertheless, some factors and parameters' ordinal conditions were modified to some extent to conform to conditions in Cambodia. Most of the short descriptions of each parameter related to species characteristics that were used in the scoring system followed the Indonesian Guidelines for Non-Detriment Findings Assessment of Ramin *Gonystylus* spp. (2010). The factors affecting management of the harvesting regime consisted of biological characteristics; current status of the species; harvest management; harvest regime; harvest monitoring; logging impact on the environment and ecological condition; and conservation and protection (Table 13).

There were 26 parameters under the 7 factors, each of which was assessed a score ranging from 1, which was the lowest score, to 5, which was the highest score (Table 13). The lower the score, the greater the severity of impacts associated with each of the parameters. The assessment results and scores for *D. cochinchinensis* and *D. oliveri* associated with each of those parameters are summarized below, with the scores provided in bold face type, as well as detailed in Annex 1.

A.1 Biological Characteristics

- Adaptability: *D. cochinchinensis* grows only in certain habitats with high site requirements (edaphic, temperature, and elevation) **(2)**, while *D. oliveri* has relatively low adaptability and grows in specific habitats and succession types **(3)**;
- Regeneration capacity: regeneration of *D. cochinchinensis* is relatively fast from seeds or stump **(3)**, while regeneration of *D. oliveri* is slow and irregular with seeds or stumps **(2)**;
- Dispersal efficiency: the seeds of both *Dalbergia* species are undispersed due to natural barriers (i.e., natural ranges, seed dispersers, water barriers, predation) **(2)**;
- Habitat: both *D. cochinchinensis* and *D. oliveri* prefer climax forests (undisturbed mature forests) to over logged-over areas or other types **(2)**.

A.2 Status in Choam Ksant District

- Distribution in district: *D. cochinchinensis* is strictly distributed in certain locations **(2)**, while *D. oliveri* is limitedly distributed, scattered in all places **(3)**;
- District abundance: both *Dalbergia* species are not commonly found **(3)**;
- District population trend: the populations of both *Dalbergia* species are reduced and still decreasing **(2)**;
- Quality of information: the information from inventories of both *Dalbergia* species is limited to only certain locations, good quality **(4)**;
- Major threats: the status of both *Dalbergia* species is under serious threat, but populations and habitats could be eventually restored within the long term period **(3)**.

A.3 Harvest Management

- Illegal harvest or trade: *D. cochinchinensis* is considered to have serious illegal harvests and illegal trade **(2)**, while *D. oliveri* is considered to have moderate illegal harvests and illegal trade **(3)**;

- Management history: harvest control of both *Dalbergia* species is not implemented in accordance with the existing rules and regulations **(3)**;
- Management plan or Master Plan: documents for management plans for both *Dalbergia* species are available, but less implemented **(3)**;
- Aim of harvest regime in management planning: the aim seems to be to maximize economic yields of both *Dalbergia* species **(3)**;
- Quotas or area to be harvested annually: there is no market-driven quota(s), arbitrary quota(s), or no quotas for exporting both *Dalbergia* species **(1)**.

A.4 Harvest Control

- Harvesting in Authorized Concessions: harvesting in authorized concessions is considered to be moderate for both *Dalbergia* species in which a large portion of the harvest is conducted in the designated areas **(4)**;
- Harvesting in Conservation and Protected Areas: *D. cochinchinensis* is considered to have a high intensity of illegal logging in conservation and protected areas **(2),** while *D. oliveri* is considered to have moderate illegal logging at several conservation and protected areas **(3)**;
- Harvesting in Production Forests (Outside of Protected Areas and Authorized Concessions): the harvesting of both *Dalbergia* species outside of Protected Areas and authorized concessions is considered to be of high intensity and out of control) **(2)**;
- Confidence in harvest management: confidence is uncertain (logging monitoring plan available for both species, but uncertain that the plan is properly implemented) **(2)**.

A.5 Harvest Monitoring

- Methods used to monitor the harvest: the harvest monitoring of both *Dalbergia* species is through on-site monitoring (sawmill) **(2)**;
- Confidence in harvest monitoring: there was no information available **(1)**.

A.6 Logging Impact to Environment and Ecological Condition

- Benefit to environment: harvests of both *Dalbergia* species give negative impact to the environment **(3)**;
- Logging impact to environment damages: harvest system for both *Dalbergia* species causes severe damage to the environment over widespread areas **(3)**;
- Environment recovery: for both *Dalbergia* species, the environment could not recover, even changes to a low-quality environment **(2)**.

A.7 Conservation and Protection

- Protection Percentage: the protection percentage of both *Dalbergia* species is uncertain **(1)**;
- Protection effectiveness: It is uncertain for both *Dalbergia* species since protection of the species is totally ineffective **(2)**;
- Harvest control: the harvest control for both *Dalbergia* species is not effective since regulations exist, but are not fully implemented **(3)**.

Table 13. Parameter scores of *D. cochinchinensis* and *D. oliveri.*

No.	Factors	Parameters	Response (A)	Response (B)
1.1	Biology	Adaptability	2	3
1.2		Regeneration capacity	3	2
1.3		Dispersal efficiency	2	2
1.4		Habitat	2	2
2.1	Status	Distribution	2	3
2.2		District abundance	3	3
2.3		District population trend	2	2
2.4		Quality of information	4	4
2.5		Major threats	3	3
3.1	Management	Illegal harvest or trade	2	3
3.2		Management history	3	3
3.3		Management plan	3	3
3.4		Aim of harvest in management plan	3	3
3.5		Quotas or area to be harvested annually	1	1
4.1	Control	Harvest in authorized concessions	4	4
4.2		Harvest in conservation and Protected Areas	2	3
4.3		Harvest in Production Forests	2	2
4.4		Confidence in harvest management	2	2
5.1	Monitoring	Methods to monitor the harvest	2	2
5.2		Confidence in harvest monitoring	1	1
6.1	Logging Impact	Benefit to environment	3	3
6.2		Logging impact to environment damages	3	3
6.3		Environment recovery	2	2
7.1	Protection	Protection Percentage	1	1
7.2		Protection effectiveness	2	2
7.3		Harvest control	3	3

Note: A refers to *D. cochinchinensis* and B refers to *D. oliveri.*

The scores of *D. cochinchinensis* and *D. oliveri* generally ranged from 1 to 3, highlighting the relatively severity of the impacts on both the species associated with biological characteristics, current status of the species, harvest management, the harvest regime, harvest monitoring, logging impact on the environment and ecological conditions, and conservation and protection in the Choam Ksant District. The principal difference in the scoring between the two species was that *D. cochinchinensis* exhibited states of greater severity because of its attenuated dispersal distribution, smaller population density, and greater instances of illegal selective logging gleaned from the numbers of cases of forest offenses than did *D. oliveri,* even though the regenerative capacity of *D. oliveri* exhibited considerable vulnerability, as well. On the basis of the assessment, it is recommended that the Scientific Authority issue a negative Non-detriment Findings Report to the CITES Management Authority in Cambodia to ensure that any requests for exporting specimens of these species should be rejected because of their declining populations in natural habitats.

6.3 Visual Scoring System (Radar Plots)

Once each of the 26 parameters contained under the 7 factors had been assessed and scored, an NDF radar plot was constructed for each of the *Dalbergia* species (Figures 18 and 19). The interpretation of the polygons in the figures is as follows:

a. The highest scores (4 or 5) produce a wide polygon, while the lowest scores produce a narrow polygon;

b. The wide polygon indicates that the harvesting of the species meets NDF requirements and is sustainable, while a narrow polygon indicates that the harvesting of the species is not sustainable and may even have detrimental impacts on the species' populations.

Figure 18 depicts the relatively small polygons that were formed in the radar plot constructed for *D. cochinchinensis*. There were 24 of the 26 assessed parameters that received a score of less than 4 as the result of the severe impacts associated with those parameters on *D. cochinchinensis* in natural habitats. Of the 24 critical parameters, 9 were associated with the species' biology, status, management, harvest, and logging impact that received a score of 3, which reflected the moderately threatened status of *D. cochinchinensis* affected by the impacts of those parameters. The impacts of the other 15 critical parameters were primarily those associated with biology and harvesting monitoring, received a score of either 2 (12) or 1 (3) and have the most critical impacts on *D. cochinchinensis.* These parameters include management, especially the absence of quotas for annual harvests; monitoring, especially the lack of confidence in harvest monitoring, for which there was no information; and protection, especially the protection percentage, or portion of *D. cochinchinensis* retained, which was uncertain. Overall, the impacts of 9 of the assessed parameters were considered to be less critical, while those of the remaining 15 critical parameters were considered to be moderately to very critical. The resulting recommendation would, therefore, be for a negative NDF finding for *D. cochinchinensis*.

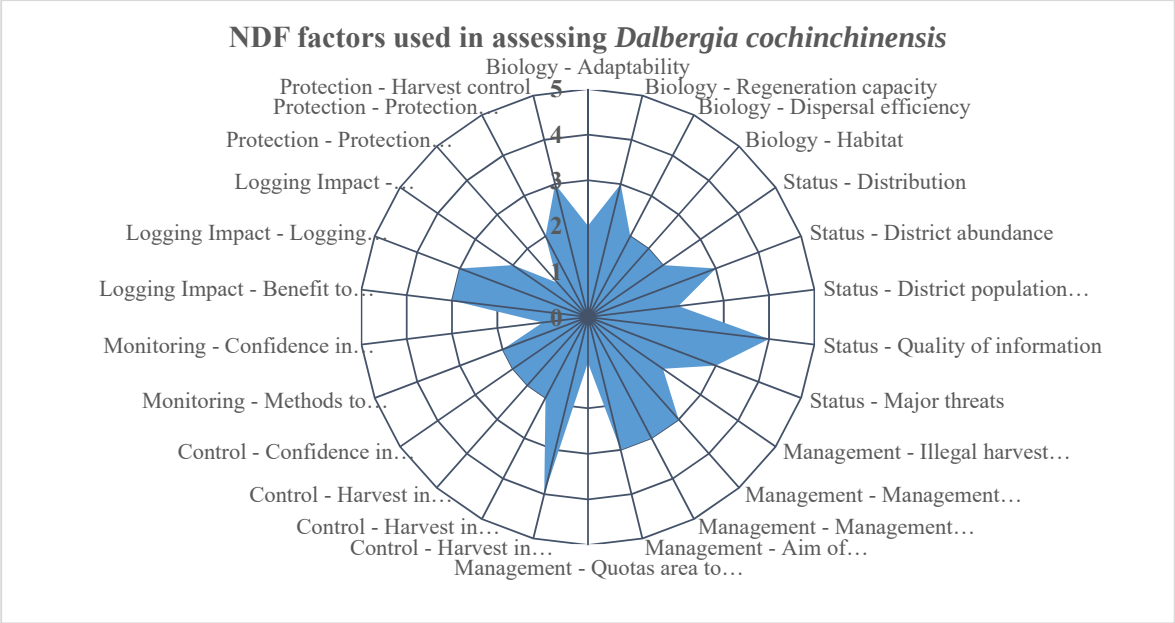


Figure 18. The NDF radar plot for *D. cochinchinensis.*

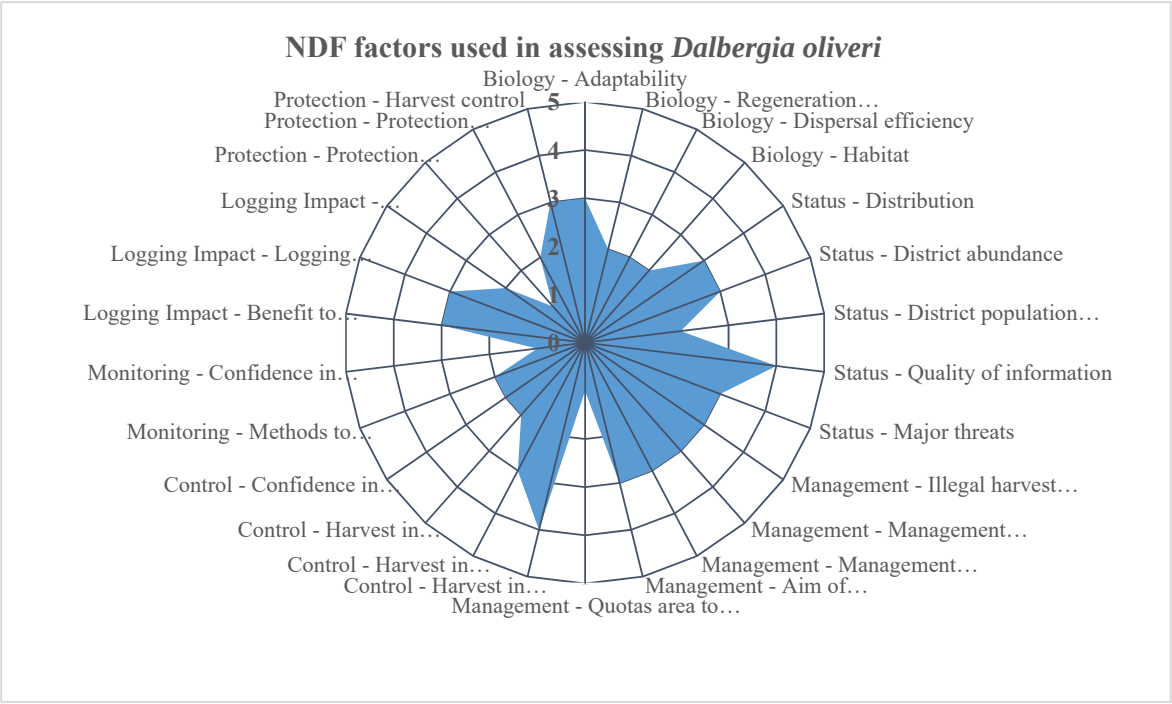


Figure 19. The NDF radar plot for *D. oliveri*

The scoring conducted in the assessment of the NDF associated with *D. oliveri* paralleled that of *D. cochinchinensis* with respect to the severity of the state of most of the parameters impacting of the species in natural habitats. The principal difference in the scoring was that *D. cochinchinensis* exhibited states of greater severity because of its attenuated dispersal distribution, smaller population density, and greater instances of illegal selective logging gleaned from numbers of forest offenses cases than did *D. oliveri,* even though the regenerative capacity of *D. oliveri* exhibited considerable vulnerability, as well (Figure 19). The resulting recommendation would, therefore, be for a comparable negative NDF finding for *D. oliveri*.

6.4 Virtual Assessment (NDF not required for specimen export)

In practice, an NDF is not required to export *Dalbergia* specimens sourced through artificial propagation in plantations. Article VII of the CITES Convention includes provisions for the exceptions of exports of specimens produced as the result of artificial propagation. In such a case, legal acquisition would still prevail, however, so that if the current measure (Regulation No. 601) is not replaced, any specimen of either of the *Dalbergia* species sourced through artificial propagation would not be allowed to be exported as virtually assessed in Annex 2.

In adhering to the nine-step process to support CITES Scientific Authorities to make science-based NDF determinations, it is noted that:

Step 1 (Review specimen identification): The response is that "*The Scientific Authority is confident that the scientific names are: (1) Dalbergia cochinchinensis, which has the synonymous name of Dalbergia cambodiana that is listed in CITES Appendix II and classified as Vulnerable (VU) in the IUCN Red List; and (2) Dalbergia bariensis, which has the synonymous name of Dalbergia oliveri that is listed in CITES Appendix II and classified as Endangered (EN) in the IUCN Red List."* This provides the response to key question 1.1 and refers to Guidance for Step 1.

Step 2 (Review compliance with requirements of artificial propagation): The response is supposed to be "*yes*" to key question 2.1 "*Is the permit application for artificially propagated specimens?*", so go to the subsequent key question "*Is the export of artificially propagated specimens of this species permitted by national or relevant sub-national legislation?*" The response is "*No, it is not allowed*" based on the existing regulation and/or measure (Regulation No. 601). "*The Royal Government of Cambodia has suspended its exporting of all forest products and forest by-products derived from luxury grade timber species until it is informed via a new regulation. This aims to improve sustainable forest resource management and usages*." This provides the response to key question 2.2, and allowed us to go to step 9.

Step 9 (Non-Detriment Finding and Related Advice): The response to key question 9.2 from the outcome of Step 2 is "*The export of artificially propagated specimens of this species is not permitted by national or relevant sub-national legislation"*. This negative decision denies export permits, which are supported by this Guidance.

In such a case, a strong recommendation to the CITES Management Authority is that the permit for the exporting of any products derived from these species should not be issued as referred to in the regulation provided in the above worksheet in which the RGC has been suspending all exports of any products extracted from luxury grade timber species (includes both of the Dalbergia species), including the specimen from either artificially propagated or natural forests.

However, a new thorough decision shall be made accordingly if such a restricted measure is lifted and a regulation is renewed allowing exporting specimens of these Dalbergia species that are artificially propagated and fully meet the criteria of CITES' "propagation" definition. The advice regarding a permit of products related to this matter that is requested to be exported may appear with positive NDFs.

7. Conclusions

The case study on non-detriment findings associated with *D. cochinchinensis* and *D. oliveri* was conducted to assess the impacts of harvesting on their survival in natural habitats in the Choam Ksant District. In the district, the population density of seed-producing trees is very low and there have been no enrichment planting restoration activities on lands administered by either the Forestry Administration or the Ministry of Environment. The maximum average DBH that was recorded for *D. cochinchinensis* and *D. oliveri* in natural habitats was around 20 cm, with average population densities of seed trees of only 0.155 trees/ha in semi-evergreen forests for *D. cochinchinensis* and 0.42 trees/ha in deciduous forests and 0.58 trees/ha in semi-evergreen forests for *D. oliveri*. The results underscore the realization that the distances between reproducing individuals are higher than the moving distances of pollinators and dispersal vectors.

The results of the study also indicated that the clear-cutting harvesting regime used in economic land concessions and social land concessions where timber harvesting is regarded to be legal and accounts for more than 30,700 ha, or 8.1%, of the land area in the district seems to have some detrimental effects on the *Dalbergia* species in that the post-harvest and collecting environment cannot readily be restored naturally to its previous condition.

Despite the Prime Minister's Order No. 02 that instituted measures, as well as imposed controls on the harvesting, transporting, collecting, storing, and exporting of *D. cochinchinesis* throughout the country, the illegal selective logging, as well as unregulated burning, of forests in the district have had significant impacts on the target *Dalbergia* species associated with their high commercial value. These, too, have impeded the natural regrowth ability of *D. cochinchinensis*, in particular, and reduced its survival rate.

The assessments of the target *Dalbergia* species considered their resilience lower with respect to collection in reference to the information of biological and harvest characteristics of both *Dalbergia* species.

The scoring conducted in the assessment of the Non-Detriment Findings associated with *D. cochinchinensis* and *D. oliveri* revealed the severity of the state of most of the parameters incorporated under the factors affecting management of the harvesting regime. These factors consisted of biological characteristics; current status of the species; harvest management; harvest regime; harvest monitoring; logging impact on the environment and ecological condition; and conservation and protection. The principal difference in the scoring was that *D. cochinchinensis* exhibited states of greater severity because of its attenuated dispersal distribution, smaller population density, and greater instances of illegal selective logging gleaned from numbers of forest offensive cases than did *D. oliver,* even though the regenerative capacity of *D. oliveri* exhibited considerable vulnerability, as well.

The management measures associated with the distribution of tree seedlings that contribute to the recovery of both the populations of the *Dalbergia* species have been useful. It is recommended that the genetic conservation of those species should now be further concentrated through restoration, planting, and the maintenance of natural populations.

While Article VII of the CITES Convention includes provisions for the exceptions of specimens produced as the result of artificial propagation, it is concluded on the basis of the results of this report that the current policy of the CITES Management Authority in which the RGC has suspended the exports of all products extracted from the luxury grade timber species, including *Dalbergia,* irrespective of whether the specimens have been artificially propagated or derived from natural forests, should continue unimpeded.

References

Chea Kearath (2016).Forest Inventory Implementation for Biomass Estimation and Understory Species Study in The Preah Vihear Protected Forest, Choam Ksant Diatrict, Preah Vihear Province.

Chính, N. N., Chung, C. T., Can, V. V, Dung, N. X., Dung, V. V, Dao, N. K., Hop, T., Oanh, T.T., Quynh, N. B. & Thin, N. N. (1996). Vietnam forest trees. Hanoi, Viet Nam: Agricultural Publishing House.

CITES Tree Species Programme (CTSP) (2021). Updated Project Progress Report through Additional No-cost Project Extension "Integrating the Development of Guidelines and Incentives for Piloting the Establishment of Small-scale Private *Dalbergia* Plantations with the Determination of a Non-detriment Findings Report in Preah Vihear Province in Cambodia.

CITES, (2020). Cambodia. Retrieved on 19 September 2020. From: https://cites.org/eng/cms/index.php/component/cp/country/KH

CITES, (2020). Checklist of CITES Species: *Dalbergia oliveri. From: https://checklist.cites.org/#/en/search/cites_appendices%5B%5D=II&output_layout=alphabetical&level_of_listing=0&show_synonyms=1&show_author=1&show_english=1&show_spanish=1&show_french=1&scientific_name=Dalbergia+oliveri&page=1&per_page=20*

CITES, (2020). How CITES works. Retrieved on 19 September 2020. From: https://www.cites.org/eng/disc/how.php

CITES (2013). Consideration of Proposals For Amendment of Appendixes I and II, Sixteen Meeting of the Conference of the Parties, Bangkok (Thailand), 3-14 March 2013

CITES (2014). CITES. NOTIFICATION TO THE PARTIES: Trade in Siamese rosewood (*Dalbergia cochinchinensis*) from Thailand. Dated 4/7/2014. Geneva.

CITES (2010). Non-detriment findings for timber, medicinal plants and agarwood. Fifteenth meeting of the Conference of the Parties (CoP Doc. 16.3.). Doha (Qatar).

CTSP, (2004). Cambodian tree species, Monopraphs. Cambodia Tree Seed Project. Forestry Administration, Phnom Penh, Cambodia.

CTSP, (2003). *Dalbergia cochinchinensis* Pierre. Species Leaflet, Cambodia Tree Seed Project.

CTSP, (2003). Forest Gene Conservation Strategy Part A: Conservation of Forest Genetic Resources, Cambodia Tree Seed Project (CTSP), Phnom Penh.

CTSP, Cambodia Tree Seed Project, (2001). Some Endangered Species of Cambodia, unpublished report.

Daniel Wolf et al., 2018. CITES Non-Detrimental Findings for Timber: A nine-step process to support CITES Scientific Authority making science-based non-detrimental findings (NDFs) for timber/tree species listed in CITES Appendix II (version 3.0).

DFSC, (2000). Seed Leaflet No.26, Dalbergia cochinchinensis Pierre. Danida Forest Seed Centre.

Dy Phon, P., (2000). Dictionary of Plants Used in Cambodia. Olympic Publish House, Phom Penh.

EIA 2016. Red Alert: How fraudulent Siamese rosewood exports from Laos and Cambodia are undermining CITES protection. EIA, London, UK. 6 pp.

Forestry Administration. (2021a). Systematic Survey Report of *Dalbergia cochinchinensis* and *Dalbergia oliveri* for a Piloting Assessment of Sustainable Genetic Conservation in Choam Ksant District, Preah Vihear Province.

Forestry Administration. (2021b). A review of the taxonomy, biology, ecology, and the status, trend, and population structure, of *D. cochinchinensis* and *D. oliveri* in Choam Ksant District, Preah Vihear Province, Cambodia.

Forestry Administration. (2016a). The Management Plan 2016-2019 of the Protected Forest for Plant and Wildlife Genetic Resources Conservation.

Forestry Administration. (2016b). FA-ITTO Project's Technical Report: Integrating Forest Biodiversity Resource Management and Sustainable Community Livelihood Development in the Preah Vihear Protected Forest.

Forestry Administration. (2016c). FA-ITTO Project's completion Report: "Management of the Emerald Triangle Protected Forests Complex to Promote Cooperation for Trans-boundary Biodiversity Conservation between Thailand, Cambodia and Laos (Phase III)".

Forestry Research and Development Agency (Indonesia), (2010). Guideline for non-detrimental finding assessment for Ramin Gonystylus spp. Bogor.

Global Forest Service, the Forestry Administration of Cambodia and the EU FLEGT Facility, 2014. Technical Working Group on Forestry Reform. Understanding timber flows and control in Cambodia in the context of FLEGT.

Hartvig et al. (2015). Hartvig I, Czako M, Kjær ED, Nielsen LR, Theilade I. The use of DNA barcoding in identification and conservation of rosewood (*Dalbergia* spp.) PLOS ONE. 2015;10:e0138231. doi: 10.1371/journal.pone.0138231.

Heng Soiya (2015). Estimation of Above Ground Biomass through Evaluation of Stand Structure in Preah Vihear Protected Forest, Choam Khsan District, Preah Vihear Province.

IUCN Red List. Dalbergia cochinchinensis, Siamese Rosewood. IUCN 2008: T32625A9719096.

IUCN (2020). IUCN welcomes Cambodia as a State Member. From: https://www.iucn.org/news/membership/202004/iucn-welcomes-cambodia-a-state-member

Joker, D., (2000). *Dalbergia cochinchinensis* Pierre. SEED LEAFLET No. 7. Danida Forest Seed Centre.

Lock, J.M. and Heald, J. 1994. *Legumes of Indo-China*. The Royal Botanic Gardens, Kew.

Nghia, N.H. 1998. *Dalbergia oliveri. The IUCN Red List of Threatened Species 1998*: e.T32306A9693932. From: http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T32306A9693932.en

Niyomdham C, Hô PH, Dy Phon P, Vidal JE, editors. Leguminoseae-Papilionoideae Dalbergieae. Paris: Muséum National d'Histoire Naturelle; 1997.

Norn Narong and Kim Sobon (2014). Review of biological and silvicultural characteristics of timber trees planted in Cambodia.

Phoung Sophea (2015). Estimation of Aboveground Wood Biomass in Preah Vihear Protected Forest, Chhaep District, Preah Vihear Province.

Phuc, X., Quyen, N.T., Hanh, H. V., Huy, T.L. and Cam, C.T. (2016). Vietnam's Imports of Cambodian Logs and Sawnwood from Natural Forests: 2013-2015. Forest Trends, Washington D. C. 20 pp.

Rosser, A.R. and Haywood, M.J. (Compilers). (2002). *Guidance For CITES Scientific Authorities: Checklist to assist in making non-detriment findings for Appendix II exports*. IUCN, Gland, Switzerland and Cambridge, UK. xi + 146pp.

Sam, H. V., Nanthavong, K., and KeBler, P.J.A., (2004). Trees of Laos and Vietnam: a field guide to 100 economically or ecologicaly important species. *Journal of Plant Taxonomy and Plant Geography* 49: 318-320.

Sam, H. V., Nanthavong, K., and KeBler, P.J.A., (2004). Trees of Laos and Vietnam: a field guide to 100 economically or ecologicaly important species. *Journal of Plant Taxonomy and Plant Geography* 49**:** 322-323.

Sareth, K. (2002). Distribution of Selected Tree Species for Gene Conservation in Cambodia.

Tan Dung, V., (1996). Vietnam Forest Trees. Forest Inventory and Planning Institute. Agricultural Publishing House, Hanoi.

Theilade, I. 2018. Ida Theilade *in litt.* to UNEP-WCMC, 24 April 2018.

UNEP-WCMC. (2014). Non-CITES Timber Species from South-East Asia (Leguminosiae) potentially warranting further protection. UNEP-WCMC, Cambridge.

UNEP-WCMC. (2018). Report on species/country combinations selected for review by the Plants Committee following CoP17. UNEP-WCMC, Cambridge.

Law and regulations:

Forestry Law (2002)

Law on Protected Area (2008)

RGC, (1999). Sub-Decree 72 on Environmental Impact Assessment Process.

RGC, (2005). Sub-Decree 146 on Economic Land Concession.

RGC, (2006). Sub-Decree 53 on Trading of Endangered Flora and Fauna species listed in CITES's Appendix.

RGC, (2013). Premier's Order 02, dated 22 February 2013, on Controls and Crackdown on Cutting, Trafficking, Collecting, Storing, and Exporting *Dalbergia cochinchinesis* in the Country.

RGC, (2014). A regulation No. 601, dated 24 April 2014, issued by the Council of Minister of the Royal Government of Cambodia suspended its exporting of all forest products and forest by-products derived from luxury grade timber species until it is informed via a new regulation. This aims to improve sustainable forest resource management and usages.

MAFF, (2005). A Promulgation on Prohibited Forest Products and Non-timber Forest Products for harvesting from Reserved Permanent Forests in Cambodia.

Websites:

IUCN Red List. *Dalbergia Cochinchinensis* (Siamese Rosewood). Retrieved on 04 May 2020. From: https://www.iucnredlist.org/search?query=Dalbergia%20cochinchinensis&searchType=species

Annex 1 - Guidelines for factors affecting management of the harvesting regime.

The NDF study on *D. cochinchinensis* and *D. oliveri* systematically followed the IUCN Checklist of NDFs (Rosser and Heywood, 2002). Most of the short descriptions of each parameter related to species characteristics that were used in the scoring system followed the Indonesian Guidelines for Non-Detrimental Finding Assessment of Ramin *Gonystylus* spp. (2010). Each parameter has a score from 1 (the lowest) to 5 (the highest).

Factor	Species Characteristics and status under study	Score	A	B
1. Biological Characteristics				
1.1 Adaptability: How is the adaptability of the species under study to the variety of habitats?	Easy to grow and adapt to all types of habitats and all types of forest succession	5		
	Easy to grow and adapt to some types of habitats and several types of forest succession	4		
	Relatively low adaptability, grows in certain habitats and certain succession types	3		*
	Grows only in certain habitat with high site requirements (edaphic, temperature, and elevation)	2	√	
	No information available related to adaptability	1		
1.2 Regeneration capacity: How is the regeneration capacity of the species?	Regeneration could be through vegetative propagation, fast	5		
	Regeneration could be through vegetative propagation, relatively slow	4		
	Regeneration relatively fast, with seed/stump	3	√	
	Regeneration slow, irregular, with seeds or stumps	2		*
	No information available on this aspect	1		
1.3 Dispersal efficiency: How efficient is the species' dispersal mechanism?	Very efficient: seed dispersed to distant area	5		
	Efficient: seeds dispersed to surrounding fruiting trees	4		
	Moderate: seeds dispersed under the fruiting tree	3		
	Bad: seeds undispersed due to natural barriers (i.e. ecological range, seed dispersers, water barrier, predation)	2	√	*
	Uncertain	1		
1.4 Habitat: What is the habitat preference of the species?	Shrub or disturbed open	5		
	Secondary forests	4		
	Logged-over area	3		
	Climax forest	2	√	*
	No information available	1		
2. Status in Choam Ksant District**				

Factor	Species Characteristics and status under study	Score	A	B
2.1 Distribution in district: How is the species distributed in the district?	Widely distributed, evenly to all places	5		
	Widely distributed, scattered to all places	4		
	Limitedly distributed and scattered	3		*
	Strictly distributed in certain locations	2	√	
	No information available	1		
2.2 District abundance: What is the abundance in the district?	Abundance in its habitat	5		
	Commonly found	4		
	Not commonly found	3	√	*
	Rare, hardly found	2		
	Uncertain	1		
2.3 District population trend: What is the recent district population trend?	Increasing	5		
	Stable	4		
	Reduced, but stable	3		
	Reduced and still decreasing	2	√	*
	Uncertain	1		
2.4 Quality of information: What type of information is available to describe abundance and trend in the district population?	Information on abundance and trends of population based on quantitative, recently updated	5		
	Information limited to only certain location, good quality	4	√	*
	Quantitative data, outdated	3		
	Anecdotal information	2		
	None	1		
2.5 Major threats: What major threat is the species facing (underline following: overuse/habitat loss and alteration/invasive species/other: and how severe is it?	No existing threat to this species	5		
	Limited threat in certain areas, populations and habitats could be restored	4		
	Serious threat, but populations and habitats could be eventually restored within the long term period	3	√	*
	Serious threat, populations and habitats could not be restored	2		
	Uncertain	1		
3. Harvest Management				
	No illegal harvests and illegal trade	5		
	Limited cases of illegal harvests and illegal trade	4		

Factor	Species Characteristics and status under study	Score	A	B
3.1 Illegal harvest or trade: How significant is the district problem of illegal or unmanaged harvest or trade?	Moderate illegal harvests and illegal trade	3		*
	Serious illegal harvests and illegal trade	2	√	
	Uncertain	1		
3.2 Management history: What is the history of harvest?	Harvest control is in accordance with the existing rules and regulation	5		
	Harvest control executed, but still insufficient in accordance with the existing rules and regulation	4		
	Harvest control is not implemented in accordance with the existing rules and regulations	3	√	*
	Harvest is on and off	2		
	Uncertain	1		
3.3 Management plan or Master Plan: Is there a management plan related to the harvest of the species?	Document for management plan is available and implemented accordingly	5		
	Document for management plan available, but not fully implemented	4		
	Document for management plan available, but less implemented	3	√	*
	No approved plan: informal unplanned management	2		
	No information available on this issue	1		
3.4 Aim of harvest regime in management planning: What is harvest aiming to achieve?	Generate conservation benefit	5		
	Population management/control	4		
	Maximize economic yield	3	√	*
	Opportunistic, unselective harvest, or none	2		
	Uncertain	1		
3.5 Quotas or area to be harvested annually: Is the harvest based on a system of quotas?	Ongoing national quota:	5		
	based on biologically derived local quotas	4		
	Ongoing quotas: “cautious” national or local	3		
	Untried quota: recent and based on biologically derived local quotas	2		
	Market-driven quota(s), arbitrary quota(s), or no quotas	1	√	*
4. Harvest Control**				
4.1 Harvesting in Authorized Concessions: What percentage of the legal	High: all harvests are conducted the designated areas	5		
	Moderate: large portion of harvest conducted in the designated areas	4	√	*

Factor	Species Characteristics and status under study	Score	A	B
district harvest occurs in State-controlled Protected Areas?	Low: large portion of harvest are not conducted in the designated areas	3		
	Most of the harvests are conducted outside the designated areas	2		
	Uncertain	1		
4.2 Harvesting in Conservation and Protected Areas: What percentage of the legal district harvest occurs in State-controlled Protected Areas?	None: no logging in protected and conservation areas	5		
	Low: illegal logging in protected and conservation areas, but small scale	4		
	Moderate: illegal logging in several conservation and protected areas	3		*
	High: high intensity of illegal logging in conservation and protected areas	2	√	
	Uncertain	1		
4.3 Harvesting in Production Forests (Outside PA & Authorized Concessions): What percentage of the legal district harvest occurs in areas where there is no strong local control, giving *de facto* or actual open access?	No logging in production forests	5		
	Low: logging in production forests, but small portion area	4		
	Moderate: logging in production forests with larger portion area	3		
	High: logging in production forests of high intensity and out of control	2	√	*
	Uncertain	1		
4.4 Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?	Certain: yes, logging could be conducted properly according to the principle of sustainability	5		
	Certain: Most of logging activity conducted properly	4		
	Uncertain: proper harvest conducted only in small areas (compared to national)	3		
	Uncertain: logging plan available, but uncertain that the plan is properly implemented	2	√	*
	Uncertain	1		
5. Harvest Monitoring				
5.1 Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest?	Direct population estimates	5		
	Verification (based on inventory and actual harvest)	4		
	Quantitative indices (based on inventory)	3		
	On-site monitoring (sawmill)	2	√	*
	No monitoring or uncertain	1		

Factor	Species Characteristics and status under study	Score	A	B
5.2 Confidence in harvest monitoring: Do budgetary and other factors allow effective harvest monitoring?	Highly certain: yes, monitoring could be conducted properly	5		
	Certain: Most of monitoring program could be conducted	4		
	Uncertain: monitoring could be conducted in a limited area only (compared to national)	3		
	Uncertain: logging monitoring plan available, but not fully implemented	2		
	No information available	1	√	*
6. Logging Impact to Environment and Ecological Condition**				
6.1 Benefit to environment: How is the impact of logging compared to the benefit to the environment?	More beneficial not to be harvested because this species provides more to environment	5		
	Neutral: harvest gives no impacts to environment	4		
	Harvests give negative impact to environment	3	√	*
	Harvests give severe impact to environment	2		
	Uncertain	1		
6.2 Logging impact to environment damages: How is the direct impact resulted from logging to the nearby environment (including other activities related to logging activity, such as collecting and storing in log-pond and log-yard)	Harvest not cause damage to environment and ecology	5		
	Harvests cause slight damage to environment and ecology	4		
	Harvests cause severe damage to environment over widespread areas	3	√	*
	Harvests cause severe damage to all ecosystem	2		
	No information available	1		
6.3 Environment recovery: How difficult is the environment recovery if the species is harvesting?	Environment quickly recover after logging	5		
	Environment will recover after logging, but takes longer time	4		
	Environment could recover with serious efforts and human intervention	3		
	Environment could not recover, even change to low quality environment	2	√	*
	Uncertain	1		
7. Conservation and Protection**				
7.1 Protection Percentage: From the natural distribution of species distribution, how big is the portion retained?	>15%	5		
	5-15%	4		
	<5%	3		
	All distribution areas are harvested	2		

Factor	Species Characteristics and status under study	Score	A	B
	Uncertain	1	√	*
7.2 Protection effectiveness: How certain is the effectivity of protection effort?	Highly certain: the species could be protected effectively based on the previously answered percentage	5		
	Certain: large portion of the species could be protected effectively based on the previously answered percentage	4		
	Uncertain: only small portion of the species could be effectively protected according to the previously answered percentage	3		
	Uncertain: protection to the species is totally ineffective	2	√	*
	No information available on the effectivity of protection	1		
7.3 Harvest control: How effective is the existing regulation to control the excessive logging?	Highly effective: the existing regulation is effective to control excessive logging	5		
	Effective: the existing regulation is sufficient to prevent excessive logging	4		
	Not effective: regulation exist, but not fully implemented	3	√	*
	No regulation to control logging	2		
	No information available	1		

Note: Species A (√) represents *D. cochinchinensis*; Species B (*) represents *D. oliveri.*

** The 'factors or parameters' ordinal conditions were modified to some extent to fit the conditions and status in Cambodia.

Annex 2 - The nine-step process to support CITES Scientific Authorities in making science-based NDF determinations (Virtual Assessment).

Step 1: Review specimen identification:

Key questions for step 1	Responses and outcome (Refer to Guidance for Step 1)					Information sources used
1.1 Is the Scientific Authority confident, that the timber or timber product concerned has been correctly identified, and that the right scientific name has been used for the timber?	The Scientific Authority is confident about the species identification or has corrected a simple error or outdated name and taxonomic concerns have been resolved	yes	x	Describe concerns or error(s) resolved below	Go to step 2	- CITES Appendix List; - IUCN Red List; - Van Sam et al. (2004); - Hartving (2015); - Niyomdham et al. (1997).
	The species is not correctly identified and/or concerns cannot be resolved by the Scientific Authority or referral to the MA or an expert	no	x	Describe concerns or unresolved error(s) below	Go to Step 9: Decision 9.1	
	Concerns about clear identification:					
	Yes, the Scientific Authority is confident that the scientific names are: *1. Dalbergia cochinchinensis, which has the synonymous name of Dalbergia cambodiana that is listed in CITES Appendix II and classified as Vulnerable (VU) in the IUCN Red List.* *2. Dalbergia bariensis, which has the synonymous name of Dalbergia oliveri that is listed in CITES Appendix II and classified as Endangered (EN) in the IUCN Red List.*					

Step 2: Review compliance with requirements of artificial propagation:

Key questions for step 2	Responses and outcome (Refer to Guidance for Step 2)					Information sources used
2.1 Is the permit application for artificially propagated specimens?	Supposed to be "yes"	yes	x		Go to Key Question 2.2	NA
		no	x		Go to Step 3	
2.2 Is the export of artificially propagated specimens of this species permitted by national or relevant sub-national legislation?		yes	x	Describe relevant legislation below	Go to Key Question 2.3	A regulation No. 601, dated 24 April 2014, issued by the Council of Minister of the Royal Government of Cambodia
	No, it is not allowed	no	x	Describe relevant legislation below	Go to Step 9: Decision 9.2	
	Describe relevant legislation:					
	The Royal Government of Cambodia has suspended its exporting of all forest products and forest by-products derived from luxury grade timber species until it is informed via a new regulation. This aims to improve sustainable forest resource management and usages.					

Step 9: Non-Detriment Finding and Related Advice

Possible decisions of the NDF process based on this Guidance are listed in this worksheet. Each export permit application should have just one of the following outcomes/decisions. The Worksheet, together with more detailed information in the relevant Worksheets for previous steps, may be useful as a summary report of the NDF results and related advice to the CITES Management Authority.

Outcome of NDF Process	NDF Results and Related Advice
9.2. The outcome of Step 2, Key Question 2.2 is: *Export of artificially propagated specimens of this species is not permitted by national or relevant sub-national legislation*	[x] Negative decision (deny export permit) (supported by this Guidance) **Justification for advice of Scientific Authority:** *[Summary, or refer to Worksheet 2, Key Question 2.2]* *In such a case, a strong recommendation to the CITES Management Authority is that the permit for the exporting of any products derived from these species should not be issued as referred to in the regulation provided in the above worksheet in which the RGC has been suspending all exports of any products extracted from luxury grade timber species, including the specimen from either artificially propagated or natural forests.* *However, a new thorough decision shall be made accordingly if such a restricted measure is lifted and a regulation is renewed allowing exporting specimens of these Dalbergia species that are artificially propagated and fully meet the criteria of CITES' "propagation" definition, an advice regarding a permit of products related to this that is requested to be exported may appear with positive NDFs.*