# **MODULE 10: NDFs FOR TIMBER PRODUCING TREE SPECIES**

1. **What is in this module?**

The present Module builds upon the guidance outlined in Modules 1 to 2 and provides complementary guidance on key principles of sustainable forest management (SFT) for Parties to consider when undertaking NDFs for timber-producing tree species.

Approximately 750 tree species are included in the Appendices of CITES, for which timber is the main specimen destined for international trade. Specimens of other listed tree species are used for pharmaceutical production, incense, perfumes, or other products (see Module 11 [NDFs for Plants]). Some of the timber-producing tree species are rare in the wild and traded internationally in small quantities for specific high value end uses; others are more abundant and traded in significant quantities of relevance to national economies. Management of timber production for international trade varies considerably from minimal to highly sophisticated depending on history of forest management and current scientific, technical and financial resources. In accordance with Articles III and IV of the Convention, export permits for specimens of species included in Appendices I and II shall be granted only when a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of the species (a determination known as a 'non-detriment finding' or NDF; see also Module 1). Hence, like for all species listed in CITES Appendices I and II, a requirement for the international trade in high value timber species listed under CITES is the development of Non-Detriment Findings (NDFs).

Considerable experience has been gained by Parties in making NDFs for high value timber species and guidelines, as reflected in the CITES website, including as the NDF database, and other initiatives on [CITES and forests](https://cites.org/eng/topics/flora/cites-and-forests#:~:text=CITES%20regulates%20the%20international%20trade,through%20its%20species%2Dspecific%20focus.), such as such as the [CITES Tree Species Programme](https://cites-tsp.org/sites/default/files/project_files/2023-09/ACNP_Prunus.africana_12septembre2023.pdf) (CTSP). Throughout this Module, some of these are highlighted as illustrative examples of the interpretation of sustainable forest management principles in the context of NDFs for timber-producing tree species.

Challenges remain relating to information gaps, for example, on tree species distribution and population structure, abundance and ecology; identification of species and products; alignment with management systems already in place; management gaps; and recent data on local and international trade and amounts exported illegally. Where CITES listed timber-producing tree species are harvested in areas with clearly defined forest management systems in place, formulation of NDFs may be relatively straightforward but without a clear management framework NDF formulation remains more challenging.

The present Module is to be read jointly with the overarching Modules 1 to 2, and is structured as follows:

* Section 2 discusses the general forest management principles for timber species that are of particular relevance to NDF development for high-value timber producing tree species, with further information included in the Annexes to this document.
* Section 3 provides additional considerations in formulating NDFs for timber-producing tree species
* Section 4 provides supporting information sources for formulating NDFs for timber-producing tree species.
* Section 5 lists the references cited through this module.

Additionally, in the Annexes to this Module, the users will find:

* Annex X: Glossary of key terms and definitions for the development of NDFs for timber-producing tree species
* Annex X: Index of case studies, boxes and tables covered in this Module
* Annex X: Historical background on NDFs for timber-producing tree species in the context of CITES
1. **Forest management principles relevant to NDFs for timber producing tree species**
	1. **Prelude to this section**

[To include a bit more context as to why forest management principles were used as the backbone for this particular module. Prioritize introducing SFM as an overarching principle, and ensure this is properly justified]

One major source consulted for the following section is [Chapter 3](https://www.fao.org/3/w8212e/w8212e07.htm) of the Guidelines for the management of tropical forests (FAO, 1998). [pending to include a summary of this publication, as it is a prominent reference for this Module. See for example the text added on the 9 steps below]

In reading this section, it is recommended as well to use as an additional overarching reference the third edition of the CITES non-detriment findings for timber (Wolf *et al.*, 2018). The 9-step guidance (Wolf et al., 2018) provides a framework for determining whether a detailed NDF is needed, evaluating conservation concern and biological risk in the context of harvest and trade, and evaluating the impacts of trade and the efficacy of the management measures in place to mitigate concerns. Worksheets in an MS Excel spreadsheet are available to assist with the determination of an NDF based on low/medium or high risk factors. Version 4.0 is being developed incorporating further feedback from experts and from participants in training workshops. It is also planned to incorporate results from this process, including from the international expert workshop scheduled for December 2023 in Nairobi. The guidance has been updated with the latest decisions at CoP19. New features include an online training course that can be found on a dedicated 9-Step website [<https://www.9steps-cites-ndf.org/>]. The worksheets that accompany the guidance have been further developed into an online decision tree [https://decisiontree.9steps-cites-ndf.org/cites-non-detriment-findings-for-timber/new/], which provides an online 9 step NDF format.

* 1. **Forest Management Plan (FMP)**

AForest Management Plan (FMP) is defined by FAO as:*A document that translates forest policies into a coordinated programme for a forest management unit and for regulating production, environmental and social activities for a set period of time through the use of prescriptions specifying targets, action and control arrangements.*

A forest management plan defines the planned forestry activities (e.g., inventory, yield calculation, harvesting, silviculture, protection and monitoring), specifying objectives, actions and control arrangements in a forest area.

A forest management plan should state long-term management objectives and set out specific prescriptions and measures – in relation to protection, inventory, yield determination, harvesting, silviculture, monitoring and other forest operations – for achieving those objectives.

The planning process in forest management units (FMUs) begins with an assessment of the forest resource including a forest inventory and often also environmental and social impact assessments; analysis of market and economic conditions; and assessment of the social, environmental, legal and other aspects. Continuous improvement through accumulating learning is an integral part of SFM, and forest management plans need to be reviewed regularly and revised accordingly as conditions change. Outcomes and impacts are evaluated and used in adaptive management. In forest concessions, a review is recommended in FAO guidance every 5–10 years over the course of the concession period.

Detailed management planning for an FMU should involve three plans of differing duration and strategic importance: 1. The strategic or long-term management plan, covering 20–40 (or more) years and reviewable every 5–10 years; 2. The tactical management plan, a medium-term expression of the strategic management plan (e.g. covering successive 5–10 year periods), for example setting out the areas in which harvesting will take place during the period; and 3. The operational plan through which the tactical management plan is programmed, implemented and monitored annually. The operational plan indicates the practical measures to be taken in the coming year, such as the types and scheduling of silvicultural measures and harvesting by compartment or stand, the opening up of skidding tracks, the construction of firebreaks, and other activities. The operational plan is also used for monitoring purposes.

Yield regulation is a central concept in SFM, particularly in natural tropical forests. Yield regulation is the practice of calculating and controlling the quantities of forest products (e.g., standing volume of commercial timber) removed from a forest each year to ensure that the rate of removal does not exceed the rate of replacement. A sustainable yield implies that products removed from the forest are replaced by growth, with or without management interventions. In commercial forests where the major product is wood, calculating and implementing sustainable wood yields requires information on stocking levels and replacement rates (i.e., inventory and growth and yield data).

**Case Study 1: Forest Management Plans, Quotas and NDFs in Belize**

In Belize, tools to carry out NDFs for CITES listed timber species include a Sustainable Forest Management Plan, Annual Plan of Operation and General Yield Model to determine sustainability. These are peer reviewed with recommendation for export of not, made to the CITES SA. Recently a Management Plan Framework has been developed to guide Sustainable Forest Management Plans for Forest Reserves that comprise about 18% of the National Protected Area System. The focus has been on sustainable harvesting of economically valuable timber species but the ultimate goal is the protection of biodiversity and ecosystem services. Sustainable Forest Management Plans are prepared and submitted to the Forest Department every 5 years within the context of 40 year Long Term Licences and Annual Plan of Operations (APO). The APOs guide annual reduced impact logging and are based on the General Yield Model.

Each Sustainable Forest Management Plan should include inventory information to assess the structure and composition of the forest with the sampling intensity at least 0.2% of the Forest Reserve. There should be an inventory of all trees (over 25cm DBH) with further details for commercial timbers.

Plans for management of timber production should refer to the Code of Practice for Reduced Impact Logging and the General Yield Model. Information is required to justify the approach to harvesting of commercial species, (size and quantities) with calculation of cutting cycle and annual allowable cut, division of the forest into annual harvesting units and a schedule of timber production. Harvesting operations are based on minimum environmental standards specified in the legislation, licence and Code of Practice e.g., crown cover, maximum number of trees felled per hectare, restrictions against harvesting on slopes and watershed areas, minimum DBH for tree felling, a list of species to be protected, cutting techniques to optimize natural regeneration.

Monitoring of forest cover is required through, for example, pre- and post-harvest inventory. In addition, the use of remote-sensing tools including satellite imagery, fly-overs and drones should be explored. Use of standardised methodologies accepted by academia and the Forest Dept. is required. References must be provided. Monitoring of water supply and certain wildlife is also required.

Belize sets annual export quotas for *Swietenia macrophylla*, *Cedrela odorata* and *Dalbergia* spp. In accordance with the guidelines provided by CITES and in adherence to national Forestry laws, the national export quota is set according to the following basic steps:

A. A long-term forest license is approved for a given private land or forest reserve.

B. A Management Plan is developed by the license holder and reviewed by the Forest Department and forest experts including the Scientific Authority. The Management Plan is approved.

C. An Annual Plan of Operation for a given cutting block is prepared as per the established guidelines and framework and presented to the Forest Department for review and approval.

D. In a given cutting block in a sustainable logging concession, a full count and measurement of all standing trees is performed. The group of trees is taken as a single, independent population and a sustainable harvest yield is determined using scientific methods.

E. The previous step is repeated for all individual logging concessions in which a licensee proposes to harvest CITES listed species, and a national sustainable harvest yield is determined by summation.

F. The CITES SA then validates the proposed sustainable harvest yields and verifies the estimated volume of lumber to be produced – which forms the export quota.

G. Once validated, the CITES Management Authority confirms an export quota to each individual logging concession, which can then begin to cut and export the lumber.

H. Only licensees with approved export quotas can export CITES listed species, but only from areas to which the export quota applies. However, the licensee can sell such timber to third parties, who may then export the material under the export quota for the designated area from which the timber was cut.

I. The Forest Department undergoes a legal acquisition finding process, as per the Convention and its Resolutions to ensure that the timber is sourced from legal sources. The sale or transfer of timber from one buyer to the other must adhere to this process to verify quota integrity.

 J. The Forest Department has established the volume of timber in log, flitch or sawn lumber form which may be exported based on conversion factors since the estimated standing export volume cannot be the same as the volume of sawn lumber.

Belize Forest Department, 2020

* 1. **Forest Inventory** **Protocols**

Forest inventory is the systematic collection of data on the forestry resources within a given area. It allows assessment of the current status of tree species for analysis and planning, constituting the basis for sustainable forest management. Identification of trees to species level is a critical component of forest inventory.

Diameter at breast height (DBH) is a straightforward measurement of individual trees and is used in almost every forest inventory. DBH class distribution can be used to provide a rough estimate of relative age structure when no growth data are available. It can also be used together with tree basal area distributions to determine minimum felling diameter (MD) Sokpon & Biaou, 2002.

Inventory data provides essential baseline information for setting quotas and making NDFs for a species. Ideally for NDFs, forest inventories should be examined at three levels: national, forest concession, and annual cutting plot (Betti in litt.).

National forest inventories may provide national stock levels for high value timber species including those listed on CITES. National forest inventories have been conducted in many countries with low sampling rates (about 1/1000).  This can help to have a broad idea on the distribution of the species in the country. National forest inventories are expensive requiring some level of ground-truthing. In making NDFs, the focus for relatively widespread species is generally better directed at discrete FMUs where the species in question is already known to exist, usually with exploitation already occurring (Steve Johnson, in litt.).

Concession level inventory: Forest management inventories, at sampling rates depending on the size of the forest (for example forests with surface area less than 5,000.0 ha are typically sampled at 5-7%). For low density species, sampling sufficient plots (or plotless methods points) to obtain a stable variance is more appropriate. This level of inventory will help to take crucial management decisions based on densities, diameter structures, reconstitution or recovery rate. At this level decisions can be made on whether to allow harvest.

Annual cutting plot inventory: systematic (sampling rate of 100%) inventory of the exploitable resource (individuals selected based on the management constraints defined as above.

As noted above, forest inventories are carried out by different agencies and they use different techniques. Commercial logging companies are required to carry out inventories in many countries. In Central Africa, most commercial logging companies have followed an inventory protocol (Réjou-Méchain et al., 2011). In 2009, 88% of these companies were involved in developing or implementing a management plan mandated by new forest laws and regulations designed to promote SFM in Central African Republic (CAR), Republic of Congo, Democratic Republic of Congo, Cameroon and Gabon. The first step in developing such plans was to conduct a systematic inventory to (i) locate timber resources, (ii) calculate management parameters such as rotation length, minimum felling diameters, harvestable volume, etc. and, (iii) identify areas that are ecologically vulnerable or unique in terms of biological diversity and/or patrimonial value. The forest inventory data covered about 22 million ha, representative of 46% of Central Africa’s production forests. The systematic sampling design consisted of continuous 25 m wide transects, separated on each side by 2–3 km, and subdivided into rectangular 0.5-ha plots of 25 m by 200 m. A total of 803 transects were inventoried during four field campaigns. In the overall dataset the transect length ranged from 221 m to 32.3 km, with a mean length of 6.3 km. Trees throughout the 0.5-ha plot with a diameter at breast height (DBH) ≥30 cm were recorded while those between 10 and 30 cm DBH were recorded only on a 0.125 ha area (i.e. the first 50 m of the plot). The centre of each plot was located using a global positioning system (GPS). A total of 28,229 plots were established across the four concessions. Tree identification was based on both commercial and local names where available. To minimize possible discrepancies between scientific names and local or commercial names, local botanical experts were provided with training and a correspondence list between local and scientific names prior to the inventory.

The Inventory of a concession typically required a workforce of 30–50 people permanently in the field for 18–24 months. Data quality was checked by a systematic re-sampling procedure conducted by experienced field botanists. This re-sampling procedure took place within one month of the commercial inventory and without any information about the identity or abundance of the inventoried species.

**Case Study 2: NDF Formulation for *Swietenia macrophylla* in Mexico**

In Mexico, the management of CITES timber species at the national level operates within the framework of the General Law of Sustainable Forestry Development. The process for formulating NDFs for *Swietenia macrophylla* is linked to the framework for sustainable forest management. The process has been developed since 2008, with the CITES SA working with forestry authorities from the outset. The State of Quintana Roo is the main area for export of mahogany wood. The State authorities request Technical Opinions (TOs) from the CITES SA on the Forest Management Programs (PMF) or Unified Technical Documents (DTU) prior to harvesting authorizations. In general, a TO can be considered a pre-NDF and is based on analysing information available in management plans and programs, technical studies and annual reports, on the property or place of origin, the methods of obtaining, analysis and results of the population sampling/monitoring in the field, the management measures of the species and its habitat, and the methods and estimation of the rate of exploitation. Management plans for timber species last for a specified period of time and NDF requirements can be modified when the management plan is revised.

Negative or partial NDFs are issued when the forest referrals come from properties whose PMF does not have a TO and/or when there is a lack of information to formulate the NDF. The steps necessary to develop technical considerations for a mahogany NDF or TO are set out in the Manual of Procedures with support sources included that contain reference values, literature or guides that can be used to determine if the data, methods and management of the species are adequate and therefore the estimates are reliable.

An analysis of the information required for NDF formulation for mahogany, indicating the relationship with national and international legislation has been undertaken. This includes elements such as: basic information of the species and the property, method of sampling, field data and calculation memory, volume of use and management of the species, including recommendations for information delivery. This was shared with CITES PC24 as PC Inf. 3. which provides a checklist of information requirements.

Source: CONABIO (2018) & CONABIO (2021)

**Case Study 3: Inventory for *Pterocarpus erinaceus* in Burkina Faso, Niger and Togoas a basis for NDFs**

Forest inventories have been undertaken for *P. erinaceus* populations in Burkina Faso, Niger and Togo (Segla et al 2016). Sampling was based on two methods, the band transect method and the random method. The transect method was chosen as appropriate in areas with low density of the species in Sudanian and Sahelian zone vegetation in Burkina Faso and Niger, whereas the random method was adopted for the Guinean and Sudanian zones in Togo with a relatively high density of species.

For the transect method, two perpendicular transects with widths of 200 m each were used, use of north–south and east– west transects taking account the heterogeneity of the plant formations. Sufficient inventories of *P. erinaceus* individuals to estimate the density could subsequently be made. In each observation band an azimuth method was carried out using a GPS. Gradually moving along the transects, all *P. erinaceus* individuals were observed and diameters at breast height (DBHs) ≥ 10 cm were measured.

The random method was based on 1000 m2 (40 m × 25 m) sampling units at regular intervals of 200 m, randomly defined in populations dominated by *P. erinaceus*. A total of 60 plots were studied in Togo (20 in Abdoulaye wildlife reserve, 25 in Oti-Keran National Park and 15 in Togodo wildlife reserve).

In all cases the DBH ≥ 10 cm measurements were performed using a tree caliper for large diameters or a tape measure for medium and small stems. Measurements of total and merchantable heights were made using a graduated pole (for trees lower than 5 m) or a Relascope of Bitterlich (for trees higher than 5 m).

Forest characteristics were assessed by calculating the average diameter, the total average height and the average merchantable height of the species. An analysis of variance was performed to compare the dendrometric parameters (diameter and height) according to the climate zones. A general linear model was applied using R software (https://cran.rproject.org/bin/windows/base/) and Minitab 16 (http://en.softonic. com/s/free-download-minitab-16).

The average density (average number of standing individuals estimated per ha), the basal area (the sum of the cross sections of all *P. erinaceus* individuals per m2 /ha) and Lorey's mean height (average height of individuals weighted by their basal area) of individuals in each climate zone were calculated.

To determine the size class distribution, Minitab 16 software (http://en.softonic.com/s/free-downloadminitab-16) was also used to estimate the parameters of the Weibull distribution from diameter and height data. To ensure adequate adjustment of the observed Weibull distribution, SAS software (SAS Inc., 1999) was used for an adjustment test based on a log-linear analysis.

The minimum felling diameter (MD) and the rotation cycle for *P. erinaceus* is based on the formula of Durrieu de Madron and Forni (1997) which calculates the recovery rate (the ratio between the stock of harvestable trees at the beginning of the forestry operation and the predicted remaining stock after one felling cycle) and adapted to the distribution per diameter class of the species basal area by Sokpon and Biaou (2002) and Sokpon et al.(2006). This rotation calculation method is based on the principle that the duration of rotation is related to the passage of trees with a diameter lower than the MD to the group of exploitable tree diameter (plant diameter higher than the MD). The rotation cycle, therefore, takes into account the growth rate and the diametric structure of the species.

To determine the rotation cycle, the restoration percentage of the original exploitable basal area for the species needs to be calculated, the restoration percentage is based on the exploitation losses, the diameter growth and the natural mortality of individuals. The MD is determined iteratively by testing the various diameter classes, including the classes 25 cm, 35 cm, 45 cm and 55 cm. When the restoration percentage is low (below 50%) the MD increases and a new restoration percentage is calculated until an MD favouring restoration of the species (N50%) is obtained. The restoration percentage is calculated based on the transition time, or rotation, which is the time required to move all individuals in one diameter class to a diameter higher than the MDE. The restoration percentage does not indicate the actual restoration, but gives a renewed idea of the restoration of populations of a species. The formulae used to determine the transition time and the restoration percentage are from Durrieu de Madron and Forni (1997).

In Togo an NDF has been developed for *P. erinaceus* for the period 2022-2023. Comprehensive data collection took place as a basis for the NDF. “Principles for Non-Detriment Findings (NDF) for Trees” methodology developed in Cancun in 2008 were followed considering five points: biology and distribution area of the species; information on the population; management measures and harvesting regime; control and follow-up; conservation and precautionary principle. Workshops were held to review the information and draft NDF. Based on species density per hectare, population structure, MD and recovery rate, the study set the operating quota at 80% of the potential to be exploited within a defined area. In order to ensure a rapid recovery of degraded stands of *P. erinaceus*, 20% of the standing resource in the form of seed trees is preserved. The exploitation of the species in protected areas and in ecologically sensitive areas is forbidden. At the same time there is a national moratorium on the cutting, marketing, import or re-export of *P. erinaceus* timber for a period of 10 years (2016-2026) in order to limit overexploitation and allow natural stands to be able to regenerate.

Source: Segla et al. 2016 and Laboratoire de Recherche Forestiere, 2022.

* 1. **Size class distribution of trees**

Based on forest inventory, this gives the number and/or volume of trees of a species in each size class (often divided into units of 10 cm diameter) per area. Diameter at breast height (DBH) is generally measured as an indicator of size. Measurement is usually at 1.3m. Diameter distribution models play an important role in forest inventories, growth prediction, and management. The Weibull probability density function is widely used in forestry. Plotting the number of stems against equal diameter classes as a frequency histogram results in a reversed J-shaped curve indicating a healthy population structure.

* 1. **Regeneration (or recovery capacity)**

The regeneration (or recovery) capacity of a harvested population is the ability of the remaining trees to rebuild the population or to re-populate areas where individuals or sub-populations have been removed (Wolf *et al,* 2018). The recovery rate is the percentage recovery rate of harvestable trees after one cutting cycle **OR** the ratio between the stock of harvestable trees at the beginning of the forestry operation and the predicted remaining stock after one felling cycle.

The formula of Durrieu de Madron et al (1997) is one method to calculate the recovery rate.

The EU Scientific Review Group uses measures of regeneration capacity for NDFs of CITES tree species imports noting that the ability of a forest to regenerate and recover can be calculated using various Recovery Index formula such as Durrieu de Madron 1997. Furthermore it can be calculated within FMUs by reference to various parameters such as population demography, natural mortality, proximity to mature forest stands, distance to seed sources, climate, growth rates, duration of logging cycle and logging damages. Further important parameters for assessing the recovery capacity of harvested tree populations include the diameters of seed producing trees and planned harvest rate. The regeneration capacity of a species within the forest is a key indicator for its sustainability, including ensuring that timber species are maintained throughout their range at a level consistent with their role in the ecosystem.

* 1. **Minimum Felling Diameter (MD)**

The Minimum Felling Diameter (MD) or Minimum Diameter of Exploitation (MED) is the diameter below which trees of a species should not be cut. In some countries this is specified in legislation. In some national laws there are MDs for timber species in general and sometimes there are specific ones for certain (protected) species. One method for estimating the MD is based on the observation of the diameter corresponding to the peak of the useful population basal area.

**Case Study 4: Information collection & NDF recommendations for *Cedrela* spp. in Colombia**

In Colombia there are four species of *Cedrela: C. fissilis*, *C. montana*, *C. nebulosa* and *C. odorata* distributed in diﬀerent ecosystems at altitudes from 0 to almost 3000 m above sea level. Many of the forest habitats are undergoing transformation. To support the development of NDFs for these species, information collection and review has been carried out following the 9-step guidance for timbers.

Information on distribution of *Cedrela* spp. used data from Global Biodiversity Information Facility- GBIF(<https://www.gbif.org/>) together with data from Colombia Biodiversity Information System -SIB (https://sibcolombia.net/), the National Herbarium, University herbaria and theTropicos database (https://www.tropicos.org/home). Complementary data on *Cedrela odorata* was included from the Instituto Amazónico de Investigaciones Científicas-SINCHI.

Information on the threat status of *Cedrela* spp. nationally and globally was based on the IUCN Red List (https://www.iucnredlist.org/es/), the red book of threatened timber plants in Colombia (Cárdenas & Salinas 2007) and resolution 1912 of 2017 of the Ministry of Environment and Sustainable Development (MADS) by which the list of threatened wild species found in the national territory is established.

Information on spatial distribution and population density of *Cedrela* spp. was collected from documents available online and from SINCHI. For population size structure, information was collected on the diameter and height of individuals of the species by department. Information on diametric growth of *Cedrela* spp. was based on Cárdenas et al. (2015) for the Colombian Amazon and information on growth and mortality was obtained from a 25ha permanent plot in Amacayacu- Amazonas established by SINCHI, the National University of Colombia, Sede Medellin and National Parks.

The population density of *Cedrela* spp. (number of individuals/ha) varies depending on the species and the area of distribution. In the review, population density could only be established for *C. odorata* and varies between 0.051 and 4.8 individuals with DBH > 10 cm per ha, similar to population density in Bolivian forests. Information to determine the density population of the species including individuals < 10 cm DBH is uncommon and further research is needed to integrate the information into NDF development for C. *odorata* populations. Furthermore, information is needed in the departments of Antioquia, Choco, Nariño and Santander where harvesting is thought to be greater but volumes were not available. Generally, there is insuﬃcient information to establish the size structure of the populations of *Cedrela* spp. In the case of *C. montana*, for example, an approximation of the population structure could only be made for the department of Cundinamarca. The average diameter for isolated trees is 30.6 cm, for primary forest it is 45.23 cm and for fragmented forest it is approximately 38 cm. The species shows good regeneration but for the seedlings to reach the adequate DBH for use it will require a long period of time. Likewise, the number of individuals with harvestable diameters (>40 cm) was few and their harvesting can aﬀect the reproduction of the species mainly due to the elimination of seed trees.

Minimum felling diameters have only been established for *C. odorata*. In Amazonia a MD of 80 cm was proposed (Castaño et al., 2007), while in the department of Chocó a MCD of 45 cm was established (Cárdenas et al., 2015). However, Regulations specify that in the Chocó harvesting of threatened species including *C. odorata* is included, must guarantee the permanence of at least 30% of each diameter class and the harvestable diameter will be at least 50 cm.

**Case Study 4 (continued): Information collection & NDF recommendations for *Cedrela* spp. in Colombia**

Information was requested from 16 Regional Autonomous Corporations where *Cedrela* spp. are harvested relating to administrative arrangements, forest management plans and harvesting plans for *Cedrela* spp. between 2018 and 2020. Several responded, with for example, the Corporación Autónoma Regional de Santander (CAS), providing the characterization, methodology, deﬁnition of forest management administrative units, guidelines for updating the Forest Management Plan of its jurisdiction and a database with information on harvesting permits granted between 2018 and 2019 (also in the database provided by the MADS).

Harvesting information between 2013-2020 including species, product type and quantity was obtained from a database maintained by MADS of harvesting permits issued at national level. A database of transport permits granted for these species recorded by volume also maintained by MADS was also utilized. MADS also provided data on registered plantations of *Cedrela* species shared by the Colombian Agricultural Institute - ICA.

The Colombian Ministry of Environment (MADS) has issued logging permits for a total of 29,357.85 m3 of *Cedrela* spp timber. The years 2018 and 2019 were the years with the highest logging volumes during the period under review. Logging permits for timber in natural forest were mainly for the departments of Nariño (36%), Santander (30%) Antioquia (14%) and Boyacá. The main places where those products were commercialized were Valle del Cauca (26%), Bogotá (15%) and Santander (8%).

Exports for the period 2018-2020 were sourced from CITES (htps://cites.org/) together with a review of secondary information provided by the MADS. There have been some exports of *Cedrela* timber to Spain (from natural forests) and also to Cuba (from plantation stock) and some discrepancies in the quantities recorded.

Utilisation of timber products in Colombia is mainly for household consumption (61%), followed by Logs (27%) and sawnwood (6%). (MADS 2022).

From the information review, relevant aspects were identiﬁed for conducting the NDF for Cedrela spp. together with knowledge gaps. It was observed that there are issues in species identification which hinders knowledge of populations and control of wood exploitation. Data on population dynamics (growth, reproduction, mortality and recruitment ), is scarce – as has also been noted in Bolivia. The lack of knowledge on usable stocks of *Cedrela* spp. together with high levels of illegality make it difficult to establish utilization and export quotas. More information may exist that has not been made available for this study. Additional information on the distribution of *Cedrela* spp. needs to be sourced from national forest inventory and research initiatives.

Source: Vasquez Valderrama, M. (2021)

A supplementary study of *C. odorata* in Amazonas, Chocó and inter-andean valleys has been undertaken confirming the need for an NDF for the species (Gutierrez, E. et al. undated)

* 1. **Rotation cycle**

The rotation cycle (cutting, felling or logging) is the period between felling within a given area. To determine the rotation cycle, the restoration percentage of the original exploitable basal area for the species needs to be calculated, the restoration percentage being based on the exploitation damages, the diameter growth and the mortality of population individuals.

* 1. **Annual Allowable Cut (AAC)**

The Annual Allowable Cut (AAC) is the quantity of the species, that may be harvested from a forest management unit, annually. The AAC is calculated on the basis of the management objectives, the standing stock and growth rates of commercially valuable tree species, and the area of forest under management. The AAC is a practical measure of the sustainable yield in a given period and can be used to monitor forest production and set limits for forest use. For some purposes the AAC is aggregated for all commercial species, but in NDF development the AAC is necessary at species level.

Growth and yield predictions require high-quality data on tree growth, which are best obtained through the careful design and remeasurement, over time, of permanent sample plots. Where there is little or no information on the growth rates of desirable tree species (e.g., where forest management is being introduced for the first time), the AAC should be based on classical empirical procedures most relevant to the FMU in question (see, for example, pages 158–159 in FAO, 1998) until adequate location-specific information is accumulated. The classical empirical procedures for AAC are:

· A combination of area and the felling cycle.
· A combination of area, volume and the felling cycle.
· A combination of volume and forest increment.
· A consideration of volume only.

Two methods of calculating AAC for NDFs are given in Wolf et al 2018.

Once the AAC has been reached, within the forest block or compartment no more harvesting should be carried out until the next felling cycle (as specified in the forest management plan). Records of production levels of wood and non-wood products should be maintained for each harvested compartment or block and reconciled against predicted yields to ensure that the AAC is not being exceeded. This information is also essential for predicting future growth and yield and for the accurate revision of yield levels, and it helps provide management continuity over time.

**Case Study 5: Forest management and NDF development for *Pericopsis elata* in Cameroon**

In Cameroon, *Pericopsis elata* is mainly found in the southeast of the country, notably in the departments of Boumba and Ngoko, Haut-Nyong and Kadey. In 2004 MINEF estimated the area of distribution as 4 071 857 ha, representing around 19% of the national forest estate. More recently the CITES SA has estimated a larger area of distribution.

There are four different categories of forest management within the country: forest concessions (Forest Management Units) managed by the private sector; communal forests – managed by municipalities; community forests, and standing timber sales.

The period of management for a FMU is 15 years, and is renewable once. With a maximum area of 200,000 ha, the FMU is divided into Annual Cutting Areas. A management plan is required by the Ministry of Forests & Fauna (MINFOF). Annual operating plans are required for each area to be harvested. The required elements of the management plan are specified in Arrêté 0222/A /MINEF/25 May 2021.

*Pericopsis elata* is categorised as a special species and is subject to management requirements which link to the NDF. The CITES MA allocates the volumes of *Pericopsis elata* to be exploited, monitoring and controlling the entire exploitation chain. The National Forestry Development Support Agency (ANAFOR) is the CITES SA responsible for issuing the NDF based on scientific studies.

Annual harvest quotas are set for *Pericopsis elata* in each management area. The harvest quota is adjusted each year based on the profile of the annual exploitation "block" and the exploitation/harvest history in the previous annual blocks of the same FMU.

The total annual harvest potential for *Pericopsis elata* is 75,715.08 m3 based on exploitation inventories of all valid sites.The national harvest quota allocated is 37,653.23 m3 representing49.73% of the harvest potential. It is considered precautionary and appropriate for sustainability of the species. The harvest quota equates to 14,989.72 m3 of processed timber - for export by 18 companies.

Source: Fouda Ndjodo et al, 2023

* 1. **Silviculture**

Natural-forest silviculture is defined by FAO [reference year pending] as “the practice of controlling the establishment, growth, composition, health and quality of natural forests to meet diverse needs and values”. Silvicultural practice consists of the interventions applied to forests to maintain or enhance their utility for specific purposes, notably for the production of wood. Silviculture in natural forests also implies the conservation of the genetic variety of selected timber species to ensure the perpetuity of the resource. Silviculturaltechniques include canopy alterations to induce natural regeneration, the harvesting of mature trees, planting, and thinning to improve timber quality and stand growth.

Assisted natural regeneration is designed to promote natural regeneration of timber species in a forest, stimulating their growth and maintaining their health. The goal is usually the production of good quality timber while maintaining the basic ecological processes. Silvicultural methods applied in assisted natural regeneration include selection of mother trees, selective felling, group felling, successive opening-up of the canopy, soil treatment, protective measures for single trees, tending, thinning and pruning.

In relation to canopy opening, three kinds of species can be distinguished: shade-intolerant species (so-called pioneer species), which need large canopy gaps to develop; long-living shade-intolerant species (so-called nomad species, gap opportunists or gregarious species), which regenerate in small gaps; and shade-tolerant species or forest climax species.

Enrichment planting is defined involves increasing the population density of valuable timber species in degraded forests. Enrichment of natural forests after logging may be appropriate in areas where natural regeneration is insufficient. Nursery-grown seedlings or transplants from the wild (=wildlings) are planted in felling gaps, log landings, or along cleared lines through degraded forest. Seedlings need to be planted under appropriate conditions especially with regards to light availability, and tended until they are large enough to grow as established plants. This process often requires annual removals of lianas and cutting back of encroaching vegetation

* 1. **Harvest techniques**

Reduced impact logging is a sustainable timber harvesting and management approach that aims to minimize ecological disturbance. It involves selective logging as well as practices such as directional tree felling, stream buffer zones, setting aside areas for habitat protection (such as areas around springs) constructing roads, trails and landings to minimum widths, and methods to extract timber with minimal damage. However, for light demanding species open gaps of RIL activities might not be sufficient to regenerate. Therefore another, adequate management would be desirable.

* 1. **Conversion of standing tree volume to timber specimens or products**

Taken directly from Wolf et al. When trees are harvested a significant amount of “standing volume” may be lost due to not finding the tree which was inventoried, imperfections in the tree and in forming the products to be traded, damages while felling the tree and lost trees in the forest. This simple diagram on the basis of [PC17 Doc. 16.1.3](https://cites.org/sites/default/files/eng/com/pc/17/E-PC17-16-01-03.pdf) illustrates this for conversion of standing trees to exportable sawn wood. The conversion will depend on a lot of individual factors. For mahogany PC17 Doc. 16.1.3 found that the conversion of standing timber to sawnwood was 38% and for export grade only 20% (not considering losses due to lost trunks or damaged trees in the process of felling, to name only two of the possible options). It is preferable to use specific figures for the species and site. For more information see FAO, ITTO and United Nations (2020) <https://www.fao.org/3/ca7952en/CA7952EN.pdf>

Maplesden, F. and Pearson, H. (2021) Forest products conversion factors: Tropical logs and sawnwood. ITTO

* 1. **Establishment of sustainable harvest and export quotas**

Harvesting of CITES listed timber-producing tree species for the purposes of commercial trade takes place within the forest management context set out in the national forest policy and legislation of the range state concerned. This may provide an additional layer of complexity in CITES management but also the potential for increased management data for NDF formulation for timber species as compared with most other CITES listed species. For this reason, the High Value Timber NDF Working Group has considered forest management in some detail. National forest policy sets out the framework for managing forest areas for different uses and the framework for timber production. Forest policy is applied through the formulation of a Forest Management Plan (FMP) defined by FAO as:*“A document that translates forest policies into a coordinated programme for a forest management unit and for regulating production, environmental and social activities for a set period of time through the use of prescriptions specifying targets, action and control arrangements”.* A Forest Management Unit is defined by FAO as:*“An area of forest for which an approved Forest Management Plan is in operation, or any subdivision of it, such as a block*(*a specified locality*)*or a felling series.”*

Forest management plans are designed to enable sustainability at both species and ecosystem level and are considered by Parties in formulating NDFs for high value timbers (see for example Case Study 5 regarding management of *Pericopsis elata* in Cameroon).

In Belize, the CITES SA has requested interested persons or Parties to present forest management plans through the Forest Department to enable the SA to determine whether trade in timber species from these forests will be detrimental to the survival of the species in the wild (see Case Study 5).

Traditional forest management was based on sustainable yield management for specific timbers with inventories primarily aimed at assessing timber availability. Over the past 30 years, forests have increasingly been recognised as complex ecosystems with different elements (including people) interacting and with management needs accordingly. Sustainable forest management (SFM) is defined by Resolution A/Res/62/98 of the United Nations General Assembly as a “dynamic and evolving concept, which aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations.”

The need for forests managed for timber production to play a role in increasing SFM and contributing to the Sustainable Development Goals is internationally recognised. Around 70% of all tropical forests are public forest concession regimes. Voluntary guidelines have been developed to guide SFM in such concessions (FAO & EFI, 2018). They build on the ITTO Voluntary Principles and Guidelines for the Sustainable Management of Natural Tropical Forests and other relevant guidance. These guidelines have relevance and give context to the development of NDFs for CITES timber species as shown in Table 2.

**Table 2. Concession management and NDF development for timber-producing tree species**

| **Key steps in concession management** | **Purpose & value for SFM** | **Relevance to NDF development** |
| --- | --- | --- |
| 1. Mark boundary | Clear and permanent on-the-ground definition of the concession boundary is a vital and practical first step to forest management. | Essential to define area for which a NDF is applied. |
| 2. Map concession area | Mapping should include the physical features of the entire concession area.  | Helps define the distribution and amount of timber that can be sustainably harvested. |
| 3. Transparent tenure and access rights | An important condition for sustainable forestry is maintaining the integrity of the forest estate by protecting the area from incursion and conversion | Factor in reducing illegality & the risk of land conversion, which is a prerequisite to come to a positive NDF. |
| 4. Inventory forest and environment | Forest inventory must be completed before full-scale harvesting is approved. Environmental inventory allows for the protection and management of the entire area and its resources.  | Essential for species for which NDF is required. |
| 5. Develop forest management plan | Forest management plans detail the silvicultural methods and procedures for implementing Reduced Impact Logging (RIL). | Important for sustainability of species and maintenance of its role in the ecosystem. Management plan can be considered a major source for making an NDF. The better the forest management plan, the easier it will be to formulate an NDF. |
| 6. Plan transport infrastructure | The transport plan includes road specifications on roadbed, rivers, rails and the level and frequency of maintenance and repair. A proper transport plan can reduce costs and improve conservation efforts. | Relevant for maintenance of the role of the species in the ecosystem. Persisting infrastructure improves access and by this increases the risk of illegal logging activities but improves the likeliness that proposed silvicultural measures planned over years and post-harvest monitoring takes place.  |
| 7. Develop forest use plan | Where the concession is tied to wood processing facilities, a forest utilization plan is required. It is based on the forest inventory and will determine the size and design of processing plants.  | Important in relation to wood conversion and to likelihood of fraud.  |
| 8. Create social and community development plan | The plan should document commitments on the part of the concession holder to community and social development. It is also linked to the forest utilization plan. | Not directly applicable but important to ensure livelihood benefits, noting need for socioeconomic and ethnobiological studies to support definition of access rights and rules. |
| 9. Develop initial annual operating area plan | The initial operating area plan should include a logging plan layout on the ground and marking of trees. After these are completed and approved by the forest administration, harvesting can begin. | Harvesting plan essential for NDF formulation. |
| 10. Annual harvesting and post-harvest silviculture | Concession holder develops annually operating area plans that, when approved, allow annual harvesting of areas. Concession holder also conducts required post-harvest silviculture | Actual harvested volume on an annual basis is essential for NDF-formulation. Checking of silvicultural activities can give an idea of whether the plan is being implemented. |

Central to SFM is the principle that only as much wood/timber should be felled as can grow back through natural regeneration and recruitment from remaining trees or through planned reforestation within the same time period (e.g., a cutting cycle). With regard to harvested tree species, this principle requires several population biological preconditions, including sufficient population densities and healthy age structures that, in combination with other parameters such as natural reproduction, dispersal and annual increments, enable local tree populations to regenerate after harvest.

Inventory information is critical for SFM and for the development of forest management plans. Furthermore, forest inventory data provides essential baseline information for setting quotas and making NDFs for a species. More information on forest inventories is given in Annex 2 and Case Study 6 outlines inventory methodology and application for *Pterocarpus erinaceus*. There remains a need for further consideration of appropriate sampling methods to ensure robust NDFs for different species of high value timbers.

Different silvicultural methods have been developed to promote the use of individual timber species, to sustain existing forests or to create new forest stands (see Annex 2). The methods are generally incorporated into Forest Management Plans. Silvicultural knowledge exists for some CITES-listed timber species such as *Khaya* spp., *Gonystylus bancanus*, *Pericopsis elata* and *Swietenia macrophylla* but scarcely exists for most others, such as different species of *Dalbergia* spp. and *Diospyros* spp. ([Doc. PC.10.8.1](https://cites.org/sites/default/files/eng/com/pc/10/PC10-8-1.pdf)). Where silvicultural measures do exist and are applied, monitoring is necessary on their effectiveness for the recovery of the harvested species.

As noted by Canetti *et al*. (2021), the complexity of tropical forest structure requires flexible and adaptable systems for management, in which decisions about logging intensity, cutting cycle, and minimum felling diameters should be based on the characteristics of each species in each compartment. This applies to NDF development.

In addition, NDFs may be required for timber sourced by small-scale forest users operating outside the regulatory system (usually managed as commercial concessions), who as noted by FAO may play important roles in developing countries by generating local employment in the small-scale harvesting and processing of wood products. Nevertheless, timber from CITES-listed species from areas outside the formal regulatory system, still require the same types of information, for example, on the species population and its structure, and scrutiny, in NDF formulation.

**Case Study 6: Information collection & NDF formulation for *Dalbergia* & *Diospyros* in Madagascar**

A workshop to evaluate scientific knowledge and identify priority research required for the issuing of an NDF was organized by TRAFFIC on 22-23 September 2014 in Antananarivo, in cooperation with the CITES Scientific and Management Authorities of Madagascar. The workshop was attended by government representatives from forestry, finance and police departments together with World Bank, EU, WWF, TRAFFIC, MBG, WCS, CI, MNP, the National Group of Forest Operators of Madagascar (GNEFM) and individuals from teaching and research institutions. The main objective was to allow stakeholders involved in the conservation and management of Madagascar’s resources to evaluate available information and to identify priority research required for *Dalbergia* and *Diospyros* species to guide the NDF process. The workshop used the IUCN NDF Guidelines, compiled by Rosser and Haywood (2002).

The workshop concluded that there was insufficient biological and ecological data available on precious timbers of Madagascar for the issuing of a NDF for the export of tree species. Gaps in essential information included species abundance, regeneration and population trends, particularly since data were only available from a few sites, thus making it difficult to extrapolate reliably. Few forest inventories existed for the species and these were hard to access. Accurate information on standing stocks, quantities felled and logging locations was not available. In addition experts were not able to estimate the regeneration capacity of key species hindering the development of sustainable action plans.

A comprehensive review of available information on *Dalbergia* and *Diospyros* of Madagascar was carried out by TRAFFIC to inform the NDF workshop and subsequently to prepare an overall assessment of the situation. Detailed recommendations were presented on research needs together with recommendations on management of forestry operations and controls on the trade in the species. Various of the recommendations have subsequently been carried out enabling Madagascar to make progress in identification of the main commercially valuable species in the genera; and in the development of NDFs for these species including implementation of appropriate monitoring mechanisms.

Source: Ratsimbazafy et al 2016.

# **Additional considerations in formulating NDFs for timber-producing tree species**

The NDF Working Group for High Value timbers agreed that the action plan set out in PC17 Doc. 16.1.2. remains relevant and the 9-step guidance for timber NDFs (Wolf et al. 2018) is comprehensive, straightforward to follow and already in wide use.

The present Module is primarily applicable to timber harvesting in natural forests, whether dense high forest or open deciduous woodlands, where the timber is given Source Code W. It is also applicable to timber obtained through assisted production with Source Code Y (see Module 10 on Perennial Plants). This refers to a plant, or parts orderivatives thereof, that does not meet the definition of artificial propagation and therefore does not qualify for source code A. However, it is not a wild plant because it was propagated or planted in an environment with some human intervention in its cultivation or production; therefore, it does not qualify for source code W either. Managed natural forests all involve human intervention to some degree. Silvicultural techniques commonly employed in forests to enhance natural regeneration of timber species and promote forest enrichment are noted in Annex 2.

The NDF will be applicable to timber derived from the species and it is important to consider the conversion from individual trees to units of timber in considering sustainability. The product type and quantity are important considerations. For individual species, a reference framework is required to indicate the volume of wood exploitable and traded in relation to standing timber. This is particularly important and maybe challenging for species whose timber is only partially used, for example, the heartwood of *Dalbergia* spp.

For the majority of timber species (except for species that resprout from the base) any harvesting of trees will reduce the number of individuals of the species. The aim should be to limit the harvest to a level which does not result in a population decline in the species over time. In case decline in population size is happening, it should not approach the level that would move a species into an IUCN category of threat if it is currently categorised as Least Concern or Near Threatened (see Box 3 for consideration of IUCN Threat Status). When conservation status information is not available or up-to-date the presumption should be that the species is at high risk, meaning, that the level of precaution given to the further NDF process is high.

Maintaining sustainability of the species depends on both intrinsic factors such as overall population size, population age structure, growth rate of the species and reproduction biology and on extrinsic factors such as harvesting levels, forest management, threats and conservation measures, such as protection in well managed protected areas, in place. Resolution Conf. 16.7 (Rev CoP 17) highlights that *the data requirements for a determination that trade is not detrimental to the survival of the species should be* ***proportionate to the vulnerability of the species*** *concerned*.

Making an NDF involves consideration of all available information. This is based on discussion within the High Value Timber NDF Working Group and from a review of documents primarily, CONABIO 2018 which sets out information requirements for mahogany NDFs. Some of the information required for NDFs is available from standard online sources (see Annex 4) and other data will be specific to the species at a national or forest unit level. The SA of a country should maintain or have access to information on all CITES-listed species within the country. Making NDFs for newly listed timber species will require initial data collection for review. This can be time-consuming and could focus on areas of known exploitation. An incremental approach to data collection for NDFs (as proposed in FFI (2006); Scientific Authority of Belgium (2014) may be necessary with incremental refinements to the NDF process over time. As noted above, once the SA has made an initial determination on what levels of export of a national population of a species will be non-detrimental, and/or whether planned harvest and export from specific FMUs is sustainable, these determinations guide further NDFs for the species.

Forest inventory data provides essential baseline information for setting quotas and making NDFs for a species. Ideally for NDFs, forest inventories should be examined at three levels: national, forest concession, and annual cutting plot (Betti in litt.). National forest inventories may provide national stocking levels for high value timber species including those listed on CITES, supporting the development of species management parameters. They provide national distribution data for the species; and, if conducted at periodic intervals, for example every 10 years, enable monitoring of population trends.

National forest inventories have been conducted in many countries generally with low sampling rates. Forest inventory at the national level may not always by appropriate for NDF formulation, however. In Indonesia, for example, management for the purpose of the national forest inventory is carried out by different authorities in each land category (degraded land, production forest and conservation area) and different protocols may be required (Yulita Kusumadewi in litt.).

In making NDFs, the focus for relatively widespread species is generally better directed at discrete FMUs where the species in question is already known to exist, usually with exploitation already occurring (Steve Johnson, in litt.)

At the concession level, forest management inventories provide key information crucial to guide management decisions based on densities, diameter structures and recovery rate. At this level it can be decided if the species can be harvested or not. Sampling rates depend on the size of the forest (for example forests with surface area less than 5,000.0 ha are typically sampled at 5-7%) and may vary according to the density of the particular species. For low density species, sampling sufficient plots (or plotless method points) to obtain a stable variance is more appropriate. Within the annual cutting plot systematic or full inventory (sampling rate of 100%) of the exploitable resource (individuals selected based on the management constraints) is required.

To the extent possible NDF development should be considered at FMU level based on key components of species inventory; management plan; monitoring and tracking.

A forest management plan can be considered as key to NDF development. A management plan for the FMU that demonstrates a sustainable approach to harvesting, based on an adequate inventory of the resource and appropriate monitoring of harvesting impacts provides an assurance of individual species sustainability. The more robust the data are, the better the forest management plan will be, and the easier it will be to formulate an NDF.

Logging intensity for high value timber species is a key consideration in management plans in formulating NDFs. As well as determining the quantity of timber to be harvested through the Annual Allowable Cut (AAC), the minimum number and density of large reproductive trees that must be left for natural regeneration of the harvested species should be formulated (see Annex 2). Other factors are the areas to be retained between felling sites and skid trails for species regeneration, and harvesting techniques that minimise damage to vegetation, soil and water. This will help to ensure that the role of the species in its ecosystem is maintained (see Box A).

Where there is no clearly defined FMU, some other form of area definition will be required for formulating an NDF, such as the area within an administrative land boundary. Inventory of the timber species within the area will still be necessary together with management to ensure that only an appropriate amount of the resource will be harvested within the given area.

The minimum requirement for making a non-detriment finding for specimens sourced from regular, continued or substantial timber operations should be evidence that the timber has been harvested in accordance with an agreed management plan based on pre-harvest forest inventory. Management should be designed to ensure sustainability of harvest at a management unit level and minimize ecological disruption.

Where a forest management unit has been certified by an independent forest certification body this helps to demonstrate that a management plan is in place consistent with national regulations and the stricter requirements of the certification body (see Annex 3).

It is important to have some kind of tracking system in place to ensure that the wood covered by the NDF actually comes from the area where the NDF was applied. This is important when the NDFs (and the harvest quotas defined in them) are carried out in specific sub-national management areas and when there are other parts of the country where the species grows but are not covered by the NDF. Tracking systems are also an integral part of carrying out the legal acquisition findings also required for export of products from Appendix II listed species(Steve Johnson in litt.).The tracking system may vary among countries. In the case of Indonesia, for example, tracking is through an online system for tracking documents (Yulita Kusumawediin litt.) Bar-coding is becoming a common practice for timber tracking and it is now fairly common to use DNA analysis for some of the rare species, especially when trees are suspected of being illegally harvested.

There are no generally agreed thresholds for determining sustainable levels of timber in relation to developing an NDF but NDFs should be based on quantitative considerations and also take into account the rigour and validity of the forest management provisions. Considering the best available information, a positive, negative or conditional NDF may be formulated. A rationale should be provided for the NDF decision and for the quantity of timber permitted for export.

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| --- |
| **BOX A: Role of tree species in forest ecosystems**Module 1 on Principles of NDFs covers definitions of ecological role and function and considers them to be different.It has been noted that silvicultural activities lead in general to a simplification of initial primary or secondary forest stands in respect to their species composition and structure. A certain loss of biodiversity in comparison with primary forests therefore tends to be unavoidable in managed forests. (Doc. PC.10.8.1) In general, tree species play a major functional role in the world’s ecosystems (and in particular, forests), while also supporting many other plants, animals and fungi. As the dominant component of forest ecosystems, trees make a significant contribution to regulatory processes at the scale of the entire Earth system, such as climate regulation (via carbon uptake), soil formation and stabilisation, as well as cycling of nutrients and water. The functional roles of individual tree species vary. Despite the uncertainties expressed in the scientific literature, there is general consensus that (i) the functional characteristics of species strongly influence ecosystem properties, (ii) the effects of species loss can differ among ecosystem properties and ecosystem types and (iii) some ecosystem properties are relatively insensitive to species loss because ecosystems may have multiple species that carry out similar functional roles. This implies that some tree species that are rare or occur at low densities may contribute relatively little to ecosystem properties. However, evidence is accumulating that rare tree species can often make important contributions to ecosystem function. Each individual tree is a member of multiple ecological networks, composed of the species with which the tree interacts through ecological processes including competition,mutualism and predation. If a tree species islost from a particular ecological community, those species linked with the tree through these ecological networks could also be extirpated ultimately leading to an extinction cascade. Such cascades are often characterised by thresholds, leading to the rapid collapse of whole networks can ultimately result in the collapse of an entire ecosystem. Risks of extinction cascades are highest when autotrophs such as trees are removed from an ecological community and when the species richness of such a functional group is reduced. As a tree species declines in abundance, many ecological interactions with other species may be lost before the tree species itself disappears, indicating that ecosystem function and services may decline at a faster rate than species extinctions. Source: Rivers *et al.*, 2022 The roles of individual timber tree species within the ecosystem where they occur vary and may include shelter; provision of food – pollen, fruit, leaves; soil stabilisation and fertility enhancement through nitrogen fixation. *Dalbergia* species, for example, have an important role in fixing soil nitrogen, improving soil quality through the presence of nodules and mycorrhiza in their root systems. In Madagascar the fruits supply food for some species of lemurs including *Lepilemur ruficaudatus* and *Propithecus verreuxi*. In Southern Africa, *Pterocarpus angolensis* provides food for baboons, monkeys and yellow-footed Squirrels (*Paraxerus cepapi*) which eat theflowers and seed pods. The flowers also attract bees. Kudu and elephant browse theleaves.  Larvae of the butterfly, Emperor or Bush Charaxes: (*Charaxériodeesnériodeesnes*) also feed on the leaves [Pterocarpus angolensis | Tree SA](https://treesa.org/pterocarpus-angolensis/) |

**Case Study 7: NDFs for *Dalbergia* spp. in Vietnam**

A process to develop NDFs for two native species, *Dalbergia cochinchinensis* and *Dalbergia oliveri*, was undertaken based on data collection and review workshops following methodology provided Rosser & Haywood, 2002. The guidance includes two steps of review. After the initial review relating to harvest of the species, it was found that there are negative opinions. Therefore, the assessors carried out a thorough review to see if the international trade could be detrimental to the survival of *D. cochinchinensis* and *D. oliveri*. The second review looked at parameters on biology, distribution, population size, population trend, main threats and management, harvest management, capacity for monitoring the harvest, benefits of harvest, and strict protection. These parameters were divided into seven categories of biological characteristics; national status; harvest management; control of harvest; monitoring of harvest; incentives and benefits from harvest and protection from harvest. 26 indicators were developed corresponding to multiple-choice questions. Data and information were collected to fill in these indicators. In each question, there are five answers ranked in order from 1 to 5. Score 1 reflected the lowest risk, whilst score 5 represents the highest risk. These values were then formed up a radar plot to indicate the level of each indicator to help understand an overview of NDF for *D. cochinchinensis* and *D. oliveri*. As the populations of both species are small and fragmented, facing major threats of illegal logging and trade and habitat loss, and no management plans are in place, the CITES Vietnam Scientific Authorities have seen that the harvest for export of *D. cochinchinensis* and *D. oliveri* timbers will be detrimental to the current vulnerable populations. Thus, the NDFs are negative and annual zero export quotas are being applied for 2022-2027.

Source: Center for Nature Conservation and Development (2021)

**Case Study 8: Potential for NDF development for timbers of Mozambique**

In Mozambique, the Forest and Wildlife Policy and Strategy and the Forest and Wildlife Law (LFFB) - Law No 10/1999 divides forests into ‘conservation’, ‘productive’, and ‘multiple use’. An exploitation licence is required to fell trees, with associated fees, except in cases of personal consumption. There are two main types of licence: simple licence and forest concession agreement. The legislation allows for enforcement by forest and wildlife inspectors and community agents. Concession authorisations are at three levels: up to 20,000 hectares (ha) authorised by the provincial governor, 20,000 to 100,000ha by the Minister for Agriculture, and over 100,000ha by the Council of Ministers. Concession holders are required to carry out sustainable exploitation of forest resources in accordance with the approved management plan,harvest and process the timber and guarantee inspection of the concession, in accordance with the legal provisions.

Two timber species recently listed in CITES Appendix II, *Afzelia quanzensis* and *Pterocarpus angolensis* are of great significance in Mozambique as together with *Millettia stuhlmannii* they account for 78% of the country’s total timber production.The current available commercial volume for *Afzelia quanzensis* in Mozambique is about 2,514,000 m3. The regulation size for harvesting is a DBH ≥ 50 cm. The estimated available volume of *Pterocarpus angolensis* in Mozambique is about 5,620,000 m3 and the regulation DBH for harvesting is ≥40 cm. Studies of the growth rate of *P. angolensis* indicate that it takes 29 years for a tree to reach a DBH of 10 cm, and around 100 years to reach a DBH of 30 cm–40 cm; but ages up to 300 years are possible and growth rates vary depending on environmental factors at specific sites.

Another timber species of Mozambique already listed on CITES Appendix II is *Dalbergia melanoxylon*. Mozambique is currently the major exporter of timber of this species as recorded in CITES Wildlife TradeView. A quota was developed for exploitation of this species in Mozambique laid out in Ministerial Decision (1 April 2016) by province from 10t to 400t. It is not known whether NDFs have been formulated for the species which is currently categorised as Near Threatened by IUCN as it almost qualifies for Vulnerable under Criterion A (population decline due to levels of exploitation in Mozambique and Tanzania).

Macqueen, D (ed.) (2018) China in Mozambique’s forests: a review of issues and progress for livelihoods and sustainability. Research report. IIED, London.

*Mate, R., Johansson, T.& Sitoe, A.(2014) Biomass Equations for Tropical Forest Tree Species in Mozambique. Forests 2014, 5, 535-556; doi:10.3390/f5030535*

# **Supporting information sources for formulating NDFs for timber-producing tree species** [to be further completed at the 2023 NDF workshop]

This list is based, and updated from, on Wolf et al (2018) and PC26 Inf. 3 Non-Detriment Findings – Useful sources for plant and timber NDFs submitted by the United Kingdom of Great Britain and Northern Ireland on behalf of the Royal Botanic Gardens, Kew (RBG Kew).

**Overarching references for this module**

* Guidelines for forest management planning (FAO, 1998), available at: <https://www.fao.org/3/w8212e/w8212e07.htm#3%20guidelines%20for%20forest%20management%20planning>
* CITES non-detriment findings for timber: A nine-step process to support CITES Scientific Authorities making science-based non-detriment findings (NDFs) for timber/tree species listed in CITES Appendix II (Wolf et al., 2018). Available at: <https://static1.squarespace.com/static/5f31306336006c736780d6b3/t/5f315b05bbfe257d13a70a93/1597070118275/timber-9steps.pdf>

**Scientific names and specimen identification**

Scientific names

* The [CITES Checklist of CITES species](https://checklist.cites.org/#/en) database
* [Resolution Conf. 12.11 (Rev. CoP19)](https://cites.org/sites/default/files/documents/COP/19/resolution/E-Res-12-11-R19.pdf) on *Standard nomenclature*
* Plants of the World Online <http://apps.kew.org/wcsp/home.do>
* International Plant Names Index (IPNI) <https://www.ipni.org>
* Tropicos (<https://www.tropicos.org/home>)
* [The World Flora Online](http://www.worldfloraonline.org/)
* Plant Resources of Tropical Africa (PROTA)
* African Plant Database

Identification of timber-producing tree species

* [CITES repository on Timber Identification Resources and Tools](https://cites.org/eng/timber/timber-ID-repository)
* Inside Wood <https://insidewood.lib.ncsu.edu>

**Conservation status**

* IUCN Red List of Threatened Species <https://www.iucnredlist.org/>
* BGCI GlobalTree Portal <https://www.bgci.org/resources/bgci-databases/globaltree-portal/>.– provides information on tree distribution to country level, national and global conservation status, and, for some species, conservation action in place
* GeoCat - Geospatial Conservation Assessment Tool https://geocat.kew.org
* Protected Planet Species biological data and information
* The Botanical Information and Ecology Network (BIEN) database
* Global Biodiversity Information Facility (GBIF)
* iNaturalist

**Trade information**

* [**CITES Trade Database**](https://trade.cites.org/)[**https://trade.cites.org/**](https://trade.cites.org/)
* **Guide to using the** [**CITES Trade Database**](https://trade.cites.org/cites_trade_guidelines/en-CITES_Trade_Database_Guide.pdf) **(CITES, 2022)**
* **CITES** [**Review of Significant Trade Management System**](http://sigtrade.unep-wcmc.org/)
* [**ITTO Annual Review Statistics Database**](http://www.itto.int/annual_review_output/)

**Illegal trade**

* **Chatham House,** [**Illegal logging portal**](https://forestgovernance.chathamhouse.org/) **(including seized material)** **Chatham House,**
* **USFWS LEMIS databases (for illegal trade) and** [**EU TWIX**](https://www.eu-twix.org/) **(restricted access)**
* Arbor Harbor <https://woodid.info>
* Forest Plot Network <https://forestplots.net>
* Panjiva Supply Chain Intelligence <https://panjiva.net>
* Wildlife Trade Portal<https://www.wildlifetradeportal.org>

**Forest Management and certification**

* [**Sustainable forest management | FAO | Food and Agriculture Organization of the United Nations**](https://www.fao.org/sustainable-forests-management/en/)
* [**https://www.rainforest-alliance.org/**](https://www.rainforest-alliance.org/)

**Conversion factors – see examples in the following**

* [United States Department of Agriculture, CITES I-II-III Timber Species Manual](https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/cites.pdf) - covers conversion cubic feet to meters etc, veneer conversion, volume of a log, but not roundwood equivalents.
* [Volumetric Conversion of Standing Trees to Exportable Mahogany Sawn Wood](https://www.cites.org/sites/default/files/eng/com/pc/17/E-PC17-16-01-03.pdf) (PC17 Doc 16.1.3)
* FAO, ITTO and United Nations. 2020. [Forest product conversion factors](https://www.fao.org/3/ca7952en/CA7952EN.pdf). Rome. https://doi.org/10.4060/ca7952en

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## **Annex X: Glossary of key terms and definitions introduced in this Module [to be expanded and completed at NDF workshop]**

* Diameter at breast height (DBH) […]
* Forest Management Plan (FMP): []
* Forest Management Unit […]
* Minimum Felling Diameter (MD) […]
* Rotation cycle […]
* Sustainable Forest Management (SFM): […]
* The Annual Allowable Cut (AAC) […]
* […etcetera]

## **Annex X: Index of tables, boxes and case studies covered in this Module**

## **Annex X: Historical background on formulation of NDFs for timber-producing tree species in the context of CITES**

Detailed guidance for making CITES NDFs was first provided by Rosser & Haywood 2002. A specific focus on the development of NDFs for high value timber species dates back to the listing of mahogany (*Swietenia macrophylla*) on Appendix II of CITES in 2002.

NDFs were addressed at the second Mahogany Working Group (MWG) meeting held in Brazil in 2003, where a paper suggested that: “Recognizing that the information currently available is incomplete and scattered and that policies for sustainable forest management are not yet fully in place, procedures for NDF development for mahogany should be developed and refined in an incremental way as approaches are tested, sustainable forest management more generally is developed and information is built up”. Three components were suggested as a basis for developing NDFs for mahogany:

a) A national or regional-level stock assessment as a basis for determining overall quantities for export, for example through an annual export quota;

b) A requirement for management plans for forest management units from which mahogany is harvested for export: management plans should demonstrate provisions for sustainable management of the forest unit and mahogany stocks as a prerequisite for determining that export will be non-detrimental;

c) Monitoring of mahogany harvesting in the forest management units and timber exports against the overall export quota.

The second MWG meeting agreed that the forest management unit (FMU) is the most appropriate for making an NDF for mahogany, and recommended that only wood originating under management plans, with specific components for mahogany management, should be accepted for export under Appendix II (Fauna & Flora International 2006).

The International Tropical Timber Organization (ITTO) organized a workshop in Peru in 2004, to encourage and inform practical action for the formulation of NDFs for mahogany, focusing on the three largest mahogany producers: Bolivia, Brazil and Peru.

Mexico, as Chairman of the MWG, organized an International Workshop on “Non-Detriment Findings on Bigleaf Mahogany” held in Cancun in April 2007 (PC17 Doc. 16.1.2.). The action plan developed at that workshop was adopted at CoP14 in 2007 (Decision 14.145). The action plan states the following: all range States of the bigleaf mahogany should: facilitate the making of non-detriment findings by: i) preparing, adopting and implementing, as a priority, forest management plans at a national and/or local levels that include specific requirements for the bigleaf mahogany; and ii) developing and conducting forest inventories that enable specific identification and data analysis of the bigleaf mahogany, as well as programmes to monitor the distribution, population size and conservation status of the bigleaf mahogany, and incorporating the three basic requirements for non-detriment findings highlighted in document MWG2 Doc. 7, paragraphs 44 a) to c) – as above.

The action plan set out in PC17 Doc. 16.1.2. remains relevant as it provides an NDF template based on modern forestry mensurational practices, lays out a logical flow relevant to the management of tree populations, requires that the CITES-listed species be considered as a part of a forest management plan, and can be readily followed by Parties with limited capacity. An effective management plan (for sustainable forest management) considers not only population-level effects but also other CITES requirements, such as age-class structure, function in the ecosystem, and landscape level aspects including distribution of the species and context within the country as highlighted for example in Case Study 6 (Ian Thompson in litt.).

Case studies for NDF development for high value timber species including for *Gonystylus bancanus*, *Guaiacum sanctum*, *Paubrasilia echinata*, *Pericopsis elata* and *Swietenia macrophylla* were produced for the International Expert Workshop on CITES NDFs held in Cancun in 2008. At this meeting the Trees Working Group produced a document “Principles for Non-Detriment Findings (NDF) for Trees.” Five essential elements were outlined as follows:

Element 1: Species distribution area (range) at relevant scales

Objective: Characterize the species’ distribution at different spatial and jurisdictional scales so that production and conservation areas can be identified.

Element 2: Population parameters as indicators of sustainable management

Objective: Characterize species population status (standing stocks & dynamics) to provide standards for evaluating harvest impacts.

Element 3: Management systems & harvest rates

Objective: With sufficient knowledge of distribution and population parameters, determine whether management systems are appropriate to species populations subject to harvest AND whether harvest levels are sustainable.

Element 4: Monitoring & verifying harvests

Objective: Determine whether adequate monitoring & verification systems are in place to ensure the sustainability of harvest and to reduce illegal activities & illegal trade.

Element 5: Conservation & the precautionary principle

Objective: Determine whether safeguards are in place to ensure that representative natural populations and phenotypic & genetic diversity represented in harvested populations are conserved.

Building on the outcomes of the International Expert Workshop on CITES Non-Detriment Findings held in Cancun in 2008; the development and publication of a guidance document on CITES NDFs for perennial plants (Leaman & Oldfield, 2014) and extensive further consultation, the “CITES Non-detriment Findings for Timber Version 1.0” was developed by Bundesamt für Naturschutz, Federal Agency for Nature Conservation (BfN). This “9 step” guidance document, has subsequently been revised with version 2.0 produced in 2017 and version 3.0 published in 2018 (Wolf et al. 2018).

The 9-step guidance for timber NDFs has been widely tested, used for training purposes and adapted for national use by Parties. The UK SA, for example, uses a modified 9-step process in making NDFs for imported timber. In Mexico, the guidance has been used as a basis in the evaluation process for the development of NDFs for all timber species, but current practices have moved beyond the process outlined in the guide (UNEP-WCMC, 2019).In Colombia, information collection for NDF development for *Cedrela* spp. has followed the 9-step guidance (see Case Study 7). The 9-step guidance for timber NDFs is comprehensive, straightforward to follow and is recommended for consideration by all Parties exporting CITES timber species.

Assisting range states to formulate NDFs for specific timber species (and trees yielding other traded products) has been a core component of the ITTO-CITES Programme for Implementing CITES Listings of Tropical Timber Species and the CITES Tree Species Programme (CTSP). The NDF reports produced under these are listed in Table 1.

**Table X. NDF reports thus far produced under the ITTO-CITES Program and the CITES Tree Species Programme**

|  |  |
| --- | --- |
| **Species** | **Country** |
| **ITTO-CITES Program** |
| *Aquilaria malaccensis* | Malaysia, Indonesia |
| *Cedrela odorata* | Guyana |
| *Cedrela odorata* | Peru |
| *Dalbergia retusa* and *D. stevensonii* | Guatemala |
| *Gonystylus* spp. | Indonesia |
| *Gonystylus* spp. | Malaysia |
| *Pericopsis elata* | Cameroon |
| *Pericopsis elata* | Congo, Rep. |
| *Pericopsis elata* | Democratic Republic of Congo |
| *Prunus africana* | Cameroon |
| *Prunus africana* | Democratic Republic of Congo |
| *Swietenia macrophylla* | Bolivia |
| *Swietenia macrophylla* | Brazil |
| *Swietenia macrophylla* | Ecuador |
| *Swietenia macrophylla* | Peru |
| **CITES Tree Species Programme** |
| *Dalbergia cochinchinensis* and *Dalbergia oliveri* | Cambodia (Choam Ksant District) |
| *Dalbergia cochinchinensis* and *Dalbergia oliveri* | Vietnam |
| *Dalbergia latifolia* | Indonesia (Java and West Nusa Tenggara) |
| *Dalbergia latifolia* | Indonesia (Java and West Nusa Tenggara) |
| *Dalbergia retusa* | El Salvador |
| *Dalbergia retusa* | Guatemala |
| *Dalbergia retusa* | Nicaragua |
| *Guaiacum officinale*  | Cuba |
| *Guaiacum sanctum* | Cuba |
| *Guibourtia* spp. | Democratic Republic of Congo |
| *Pericopsis elata* | Côte d’Ivoire |
| *Pericopsis elata* | Democratic Republic of the Congo |
| *Pterocarpus erinaceus* | Benin |
| *Pterocarpus erinaceus* | Togo |
| *Pterocarpus erinaceus* | Côte d’Ivoire (2 out of 5 inventoried regions)  |

Despite over 20 years of experience in the formulation of NDFs for high value timber species, some deficiencies in their development remain and further guidance has been requested by Parties. Lack of information on the status of wild populations has been noted as a hindrance to NDF formulation, for example, for *Afzelia* and *Guibourtia* by Groves & Rutherford, 2023, and remains one of the issues relating to *Dalbergia* and *Diospyros* in Madagascar (see Case Study 3).

Formulation of NDFs can be particularly challenging for newly listed species owing to a lack of available data and lack of experience with making NDFs for timber. This is illustrated, for example, by recent concerns about the legality and sustainability of trade in African rosewood (*Pterocarpus erinaceus*)*,* currently listed in Appendix II with annotation #17. These concerns led to the expedited application of compliance processes under the Convention (Article XIII and the Review of Significant Trade) for all range States of *Pterocarpus erinaceus*, some of which are currently undergoing a trade suspension recommendation until, inter alia, the Parties concerned make scientifically based NDF for trade in the species in ther countries to the satisfaction of the Secretariat and the Chair of the Plants Committee.

The latest report by the CITES Secretariat regarding the ongoing the compliance recommendations and updates on their implementation for both these compliance processes, is available in document [SC77 Doc. 33.2.2](https://cites.org/sites/default/files/documents/E-SC77-33-02-03.pdf).

As shown by Case Study 6, progress has now been made in NDF development for *P. erinaceus* based on inventory work carried out by three range States of the species (Burkina Faso, Niger and Togo).