MODULE 10: NDFs FOR TREE SPECIES

Contents

1. What is in this module?

The present module builds upon the generic guidance outlined in **modules 1** to **2** and provides complementary guidance on key principles of sustainable forest management (SFM) for Parties to consider when undertaking NDFs for tree species traded as timber or wood products. This module provides an overview of the linkages with module 2 on general NDF making. In general, the Simplified Assessment stage in NDF formulation suggested in module 2 is not suitable for tree species traded as timber or wood products.

Approximately 750 tree species are included in the Appendices of CITES, many of which are in trade as timber and other wood products (hereafter, referred to as 'CITES-listed tree species' or 'tree species'). Specimens of other listed tree species are used for pharmaceutical production, incense, perfumes, or other products (see **module 11** on NDFs for Perennial Plants). Some CITES-listed tree species are rare in the wild and traded internationally in small quantities for specific high value end uses; others may be more abundant or have a broader distribution and may be traded in large volumes. International trade in tree species plays an important role in national economies around the world. Management of timber and other wood products for international trade varies considerably from minimal to highly sophisticated depending on history of forest management and current scientific, technical, and financial resources. As with all species included in CITES Appendix I or II, export permits for specimens of CITES-listed tree species 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, in accordance with Articles III and IV of the Convention (a determination known as a 'non-detriment finding' or NDF; see also **module 1**).

Considerable information has been developed by Parties to guide the implementation of CITES for tree species, including Res. Conf. 10.13 (Rev. CoP18) on *Implementation of the Convention for tree species*. In relation to making NDFs for tree species, information that is made available on the CITES website includes the CITES NDF database, the CITES and forests page, as well as the CITES Tree Species Programme (CTSP). Throughout this module, some of these resources are highlighted as illustrative examples of the interpretation of sustainable forest management (SFM) principles in the context of NDFs for tree species.

Challenges remain in NDF development for CITES-listed tree species. These relate to information gaps on biology, for example, on tree species distribution and population structure, abundance, and ecology; information gaps on local and international trade and levels of illegality; identification of species and products; alignment with management systems already in place; and management gaps. Where CITES-listed tree species are harvested in areas with clearly defined forest management systems in place, formulation of NDFs may be relatively straightforward. However, without a clear management framework NDF formulation remains more challenging.

The present module should be read jointly with the overarching information presented in **modules 1** and **2**. It is structured as follows:

- **Section 2** discusses the general forest management principles that are of particular relevance to NDF development for tree species,

- **Section 3** provides further important considerations in formulating NDFs for tree species,
- **Section 4** lists the references cited throughout this module,
- **Section 5** provides supporting information sources for formulating NDFs for tree species.

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

- **Annex 1**: Useful references and tools for making of NDFs for CITES-listed timber and other wood products species,
- **Annex 2**: Historical background on NDFs for CITES-listed tree species and the development of this module.

2. Forest management principles relevant to NDFs for CITES-listed tree species

2.1. Prelude to this section

CITES-listed tree species may be sourced from a variety of ecosystems that are subject to differing degrees of management. In considering the development of NDFs, it is relevant to consider both the management of the particular species and the broader management of the forest or other ecosystem in which it occurs. Traditionally forest management was generally based on sustainable yield management for specific timber and other wood product species. Over the past 30 years, forests have increasingly been recognised as complex ecosystems with different elements (including people) interacting and with management needs accordingly. Maintaining and increasing forest cover and managing forests sustainably are important international goals. Sustainable forest management (SFM) is described 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*. As noted by ITTO (2015) (**1**), "*in general, SFM involves the application of the best available practices based on current scientific and traditional knowledge that allow multiple objectives and needs to be met without degrading the forest resource"*.

As noted by Canetti *et al.* (2021) (**2**), the complexity of tropical forest structure requires flexible and adaptable systems for management of timber production, in which decisions about logging intensity, cutting cycle, and minimum felling diameters should be based on the characteristics of each species. This applies to NDF development, which is applied for individual species and their products.

This section on forest management principles relevant to NDFs for CITES-listed tree species draws on a variety of sources recognising that there are different definitions of SFM and different approaches to its implementation. It also recognises that sustainable forest management in itself does not ensure sustainable management of CITES-listed tree species. One major source consulted for the following section is the Guidelines for the management of tropical forests by FAO (**3**). These Guidelines are intended to be practical and provide advice on how to plan and manage tropical forests for the sustainable production of wood, while paying increased attention to the sustainability of other goods and services provided by them. The Guidelines are intended for government district forest officers, concession managers and supervisors, managers and planners of privately owned forests, supervisors of logging and wood processing companies and forest supervisors of local communities and of non-governmental organizations having a managerial role with tropical forests. Currently, an online toolbox with modules on different aspects of SFM is maintained by FAO - Background | SFM Toolbox | Food and Agriculture Organization of the United Nations (fao.org)

Another important reference is ITTO Voluntary Principals and Guidelines for Sustainable Forest Management for Natural Forests (**1**). These voluntary guidelines address the policy, legal, governance, institutional, ecological, social and economic issues that need to be taken into account in the planning, implementation and evaluation of SFM in natural tropical forests to ensure the sustainable provision of forest goods and environmental services. The guidelines aim to be simple and practical for use by forest managers, avoiding unnecessary prescriptions.

The need for forests managed for timber and other wood product production to play a role in increasing SFM and contributing to goals such as those of the Global Strategy for Plant Conservation of the Convention on Biological Diversity (CBD) and 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 (**4**). 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-listed tree species as shown in **Table 10A**.

In some cases, NDFs may be required for timber and other wood products sourced by small-scale forest users operating outside the regulatory system (often 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 and other wood products from CITES-listed tree species from areas outside the formal regulatory system, still requires the same types of information, for example, on the species population and its structure, and scrutiny, in NDF formulation.

Harvesting of CITES-listed 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 provides the potential for increased management data for NDF formulation for tree species, as compared with most other CITES-listed species. National forest policy sets out the framework for managing forest areas for different uses and the framework for timber and other wood product production.

When formulating or interpreting an NDF it is important to understand *who* the CITES Authorities are in the country in question; which agencies have authorities that inform the export of CITES specimens and the legality of trade; and the underlying national regulations including definitions of terms in a national context. For example, countries designate land in different ways in relation to timber and other wood product harvesting. In Cameroon, the forest area is divided into non-permanent forest estate, including community forest and private forest, and permanent forest estate. The permanent forest estate includes forest reserves, logging concessions, protected areas and council forests.

2.2. Forest Management Plan (FMP)

Forest policy is generally 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* (**5**).

Forest management plans can vary from simple to very complex documents (**6**). For commercial timber and other wood product production, it is generally accepted that a forest management plan should state long-term management objectives and set out specific prescriptions and measures, in relation to protection, inventory, yield calculation, harvesting, silviculture, monitoring and other forestry operations, for achieving the objectives. The forest management unit (FMU) to which the plan is applied may be a forest concession or another form of designated land use. The planning process begins with an assessment of the forest resource including a forest inventory (see **section 2.3** 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 (see **module 1** for guidance on adaptive management in the context of NDFs). In forest concessions, FAO guidance recommends a review every 5–10 years over the course of the concession period.

Detailed management planning for an FMU may 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 (may not be required in small FMUs), 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, including the types and scheduling of silvicultural measures and harvesting by compartment or stand. The operational plan is also used for monitoring purposes.

Yield regulation is a central concept in SFM - and within the FMP - 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 and other wood products) removed from a forest each year to ensure that the rate of removal does not exceed the rate of replacement. It should be noted that generally this concept aims to ensure the economic sustainability of forest production rather than sustainability of an individual species, which is an essential consideration for NDF development. 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).

2.3. Forest Inventory

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 SFM. It should be noted that forest inventories can be resource intensive, both in terms of the cost and time related to the number of people required to undertake the inventory, and the location of the forest in question (7). Forest inventories may be carried out by different agencies using different techniques. Commercial logging companies are required to carry out inventories in many countries (see **module 14 case study 8.3**). A module on forest inventory is included in the online SFM Toolbox maintained by FAO and a comprehensive standard reference on forest inventory techniques is provided by Rondeux, 2021 (7).

Inventory data for individual species provides essential baseline information for setting quotas and making NDFs for a CITES-listed tree species. Ideally, for NDFs, forest inventories should be examined at three levels: national, FMU, and, where appropriate, annual cutting plot.

- National forest inventories may provide national stock levels for tree 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 establish a broad idea on the distribution of the species in the country. If conducted at periodic intervals, for example every 10 years, national inventories enable monitoring of species population trends. 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.
- FMU 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 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 and recovery capacity. At this level, decisions can be made on whether to allow harvest.
- Annual cutting plot inventory: At this level, systematic (sampling rate of <100%) or full (sampling rate of 100%) inventory of the exploitable resource (individuals selected based on the management constraints) is required and may vary according to the density of the particular species and the resources available to undertake the inventory. If a systematic approach is adopted, modelling can be used to ascertain the potential exploitable resource across the full inventory.

Important measurement of individual trees used in almost every forest inventory is Diameter at Breast Height (DBH). 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 (MFD) Sokpon & Biaou, 2002 (8).

2.4. Class distribution of tree species populations

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. DBH is generally measured as an indicator of size. According to standard practice, 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.

2.5. Regeneration of tree species populations

At a forest level, natural regeneration reflects natural succession through ecological processes. Existing trees and other species reproduce and develop into a natural community based on site conditions. Following natural disturbances and stresses, forests regenerate through appropriate recruitment and growth of an assemblage of native species.

At a tree species level, regeneration is the process of population renewal through reproduction and growth of trees to maturity. Tree regeneration is a key process for long-term forest dynamics, determining changes in species composition and shaping ecological succession. Poor natural regeneration in rare and threatened tree species may be one of the key factors in their decline. Changes in population size and structure, for example as a result of increasing isolation of individuals, may lead to decline in pollination and seed production. Loss of pollinators can also be a critical issue. Frequently the reasons for the lack of natural regeneration of tree species are poorly understood.

In forests managed for timber and other wood products production, interventions are designed to ensure recovery and maintenance of the harvested species. 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.

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 (**10**). The regeneration and recovery capacity is the percentage rate of reconstitution 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. 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 including anticipated climate change, 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 tree species are maintained throughout their range at a level consistent with their role in the ecosystem.

The formula of Durrieu de Madron et al. (1997) (**10**) is one method to calculate the regeneration and recovery capacity. It may not be the ideal method for all locations and requires a significant amount of information or level of confidence that may not generally be available. It is important to understand the strengths and weaknesses of various methods used in these forestry calculations and choose appropriate ones for specific NDF formulations.

2.6. Minimum Felling Diameter (MFD)

The Minimum Felling Diameter (MFD) or Minimum Diameter of Exploitation (MED) is the diameter below which trees of a species should not be cut. It is determined to ensure that sufficient trees reach maturity to enable regeneration through seed production. In some countries, the MD is specified in legislation. In some national laws there are MFDs for tree 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.

2.7. Rotation cycle

The rotation cycle (cutting, felling or logging) is the period between felling within a given area. To ensure sustainability the length of time between felling needs to be sufficient for regeneration of species and the maintenance of ecological functions of the forest. 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, including anticipated incremental mortality as a result of climate change,

2.8. 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 the tree species of interest (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 (**3**)) until adequate species-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 (**9**).

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.

2.9. Silviculture

Natural-forest silviculture is defined by FAO (**11**) 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 tree species to ensure the perpetuity of the resource. Silvicultural techniques 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 tree species in a forest, stimulating their growth and maintaining their health. The goal is usually the production of good quality timber or other wood products 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 involves increasing the population density of valuable tree 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.

Different silvicultural methods have been developed to promote the use of individual tree species, to sustain existing forests or to create new forest stands. The methods are generally incorporated into Forest Management

Plans. Silvicultural knowledge exists for some CITES-listed tree 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). Where silvicultural measures do exist and are applied, monitoring is necessary on their effectiveness for the recovery of the harvested species.

2.10. Harvest techniques

Reduced impact logging (RIL) is a sustainable harvesting and management approach for timber and other wood product species that aims to minimise ecological disturbance. Important objectives include minimizing damage to target species (including regeneration), improving timber and other wood products use and the recovery of the forest and minimising damage to wildlife. RIL 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 and other wood products with minimal damage.

2.11. Conversion of standing tree volume to timber specimens or wood products

Appropriate management of CITES exports of timber and other wood product producing species should preferably be based on the use of adequate conversion factors allowing for the calculation of the round wood equivalent volume of specimens to be exported (See CITES example for mahogany). When trees are harvested, a significant amount of "standing volume" of timber may be lost due to not finding the tree which was inventoried, imperfections in the tree, damage whilst felling the tree and in transforming the tree trunk to products to be traded. Conversion of standing trees to exportable sawn timber of mahogany is outlined in PC17 Doc. 16.1.3. 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 and local studies for the species and site. For individual species, a reference framework is required to indicate the volume of wood exploitable and traded in relation to standing timber.

For more information on forest product conversion factors see Maplesdon & Pearson (2021) (**12**) and FAO et al. (2020) (13).

3. Formulating NDFs for CITES-listed tree species

3.1. Source and type of timber and other wood products

The present module is primarily applicable to timber and other wood products harvesting in natural forests, whether dense high forest or open deciduous woodlands, where the timber and other wood products is given source Code W. It is also applicable to timber and other wood products obtained through assisted production with source Code Y (see **module 11** on Perennial Plants). Source code Y refers to a plant, or parts or derivatives 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. It should be noted that managed natural forests all involve human intervention to some degree with silvicultural techniques commonly employed in forests to enhance natural regeneration of tree species.

The NDF will be applicable to timber and other wood products derived from the species and it is important to consider the conversion from individual trees to units of timber and other wood products in considering sustainability. The product type and quantity are important considerations.

3.2. Linking NDFs to SFM components

Based on SFM principles and practices discussed in **section 2** above, 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.

Examples of the use of forest management plans in formulating NDFs for timber and other wood products are given in **module 14 case study 8.1** and **8.5**.

The formulation of an NDF for a CITES-listed tree species requires as a minimum:

- Inventory data for the species
- Management of the area from where the species is harvested for export: demonstrating provisions for sustainable management as a prerequisite for determining that export will be non-detrimental
- Monitoring of species harvesting and timber and other wood product exports

Building on these minimum requirements, and taking as a framework the steps in SFM for a forest concession, **Table 10A** shows how the elements involved in forest management can potentially be linked to the requirements of an NDF for a CITES-listed tree species.

Table 10A. Forest concession management and NDF development for tree species

Key steps in forest 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 an 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 and other wood product 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 are considerations in NDF development.
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	Important in relation to wood conversion and to likelihood of fraud.

Key steps in forest concession management	Purpose & value for SFM	Relevance to NDF development
	inventory and will determine the size and design of processing plants.	
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.	See **Module 3** on incorporation of local and traditional knowledge and participatory species monitoring
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.

Logging intensity for high value tree species is a key consideration in management plans in formulating NDFs. As well as determining the quantity of timber and other wood products 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. 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. These and other related factors will help to ensure that the role of the species in its ecosystem is maintained (see **Box A** and the Definitions, explanations and guidelines provided in Res. Conf. 9.24 ([Rev. CoP17)] Annex 5).

Where a FMU 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 **module 12**). It is important to note that not all certification schemes or bodies operate in the same way or to the same standards. Parties should therefore undertake their own due diligence to ensure the certification scheme or body is suitable and of an appropriate standard for the species and location in question.

3.3. Harvest sustainability

As noted by Newton (2008) (**14**) sustainable forestry management does not guarantee sustainable use of a tree species and sustainable use in itself is rarely a proven method in tree species conservation. Maintaining sustainability of the tree 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.

For the majority of tree species (except for species that resprout from the base) any harvesting of trees for timber and other wood products will reduce the number of individuals of the species. The aim should be to limit the harvest to a level that 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 a category of threat if it is currently categorised as Least Concern or Near Threatened. When conservation status information is not available or up-to-date, the presumption should be that the species is at risk, meaning, that the level of precaution given to the further NDF process is high.

3.4. Information requirements

It is essential that all available information be utilized in developing an NDF for a CITES-listed tree species. CONABIO (2018) (**15**), for example, sets out information requirements for mahogany NDFs.

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.*

Some of the information required for NDFs is available from standard online sources (see **Annex 1**) and other data will be specific to the species at a national or forest unit level. The Scientific Authority of a country should maintain or have access to information on all CITES-listed species within the country. Making NDFs for newly listed tree 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) (**16**); Scientific Authority of Belgium (2014) (**17**) may be necessary with incremental refinements to the NDF process over time.

3.5. Undertaking the NDF

Module 2 sets out the factors that should be considered in evaluating both risk and impact in the formulation of NDFs. The 9-step guidance for timber NDFs (**9**) has been shown to be fully compatible with the requirements of **module 2** should Parties wish to follow this approach. The 9-step guidance (**9**) 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. It is considered to be comprehensive, straightforward to follow and is already in wide use. Worksheets in an MS Excel spreadsheet are available to assist with the determination of an NDF based on low/medium or high risk factors. New features include an online training course that can be found on a dedicated 9-Step website. The worksheets that accompany the guidance have been further developed into an online decision tree, which provides an online 9-step NDF format.

The factors that are important for consideration in formulation of NDFs for tree species are shown in **Table 10B**. This table links the requirements set out in **module 2** for evaluating the risk to the species and the impact of harvesting for trade with elements considered specifically for CITES-listed tree species included in this module. It also shows the appropriate steps in the 9-step approach for timber.

Table 10B. Factors in evaluation of risk and impact for development of an NDF showing links to the current module on tree species, **module 2** guidance on general NDF making, and the 9-Step Guidance for Timbers.

Factor	Module 2		Module 10	9-Step for Timbers (9)
	Risk	Impact		
Species biology & life history	Yes		Population size and structure, growth rate/annual increment	Steps 6 & 7
Habitat specificity & vulnerability				Step 5
Species range (historical & current)	Yes		Inventory	Step 5 Geographic distribution
Resilience of species populations			Adaptability of tree species to a range of stresses with ongoing regeneration	Step 5
Population structure, status and trends	Yes	Yes	Inventory – DBH, age class distribution	Step 5 Population size/size structure
Management Measures		Yes	Forest Management Plan	Step 8 Management measures
Conservation status	Yes		IUCN Red List & national	Step 4
Threats	Yes		IUCN Red List & national	Step 4
Harvest overview	Yes	Yes	AAC, permit information	Step 6 Impacts of harvesting

Trade Trends	Yes	Yes	Permit information, trade data	Step 7 Trade impacts

3.6. Traceability

It is important to have some kind of traceability 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 occurs but are not covered by the NDF. Tracking systems are also an integral part of carrying out the legal acquisition findings required for export of products from Appendix II listed species. The traceability of timber and other wood products continues to be challenging, particularly for front-line personnel responsible for identifying specimens at the border. Technological advances in anatomical, genetic and chemical techniques already underpin many Party's capabilities for tracing timber and other wood products specimens in international trade, however more research is needed to improve traceability in relation to determining the geographical origin of timber and other wood product specimens (**18**).

Box A: Role of tree species in forest ecosystems

Module 1 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 across various ecosystems, 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 is lost 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 and 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: (**19**)

The roles of individual timber and other wood product producing 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 the flowers and seed pods. The flowers also attract bees. Kudu and elephant browse the leaves. Larvae of the butterfly, Emperor or Bush Charaxes also feed on the leaves *Pterocarpus angolensis* | Tree SA

4. References

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Annex 1: Supporting information sources for formulating NDFs for tree species

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
- CTSP, available at: https://cites-tsp.org/
- Principles for NDF for trees (Cancun 2008)
- ITTO-CITES Programme

Scientific names and specimen identification

Scientific names

- The CITES Checklist of CITES species database
- Resolution Conf. 12.11 (Rev. CoP19) 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
- Plant Resources of Tropical Africa (PROTA) https://www.prota.org/
- African Plant Database https://africanplantdatabase.ch/

Identification of tree species

- CITES repository on Timber Identification Resources and Tools
- 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
- The Botanical Information and Ecology Network (BIEN) database https://bien.nceas.ucsb.edu/bien/

- Global Biodiversity Information Facility (GBIF) https://www.gbif.org/
- iNaturalist https://www.inaturalist.org/

Trade information

- CITES Trade Database https://trade.cites.org/
- Guide to using the CITES Trade Database (CITES, 2022)
- CITES Review of Significant Trade Management System
- ITTO Annual Review Statistics Database

Illegal trade

- Chatham House, Illegal logging portal (including seized material) Chatham House,
- USFWS LEMIS databases (for illegal trade) and EU TWIX (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.atibt.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 - 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 (PC17 Doc 16.1.3)
- FAO, ITTO and United Nations. 2020. Forest product conversion factors. Rome. https://doi.org/10.4060/ca7952en

Taxa-specific resources for tree species

Rosewood-tree species

- Cowell C., Williams E., Bullough L.-A., Grey J., Klitgaard B., Govaerts R., Andriambololonera S., Cervantes A., Crameri S., Lima, H.C., Lachenaud O., Li S.-J., Linares J.L., Phillipson P., Rakotonirina N., Wilding N., van der Burgt X., Vatanparast M., Barker A., Barstow M., Beentje H., and Plummer J. 2022. CITES *Dalbergia* Checklist. Commissioned by the CITES Secretariat. Royal Botanic Gardens, Kew, Surrey. Accessible in English, French and Spanish at: https://www.kew.org/science/our-science/science-services/UK-CITES/cites-resources

- CITES Secretariat. 2024. Study on the conservation and trade of CITES-listed rosewood tree species [Leguminosae (Fabaceae)].

Annex 2: Historical background on formulation of NDFs for 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 tree 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.

Case studies for NDF development for tree 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 (see **Module 14**). 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 United Kingdom of Great Britain and Northern Ireland Scientific Authority, 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 tree 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 **module 14 case study 8.7**). The 9-step guidance for timber NDFs is comprehensive, straightforward to follow and is recommended for consideration by all Parties exporting CITES tree species.

Assisting range states to formulate NDFs for specific tree 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 10C**.

Table 10C. 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
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	
Bulnesia sarmientoi	Argentina
Dalbergia cochinchinensis and *Dalbergia oliveri*	Cambodia (Choam Ksant District)

Species	**Country**
Dalbergia cochinchinensis and *Dalbergia oliveri*	Viet Nam
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
Prunus africana	Burundi
Prunus africana	Cameroon
Pterocarpus erinaceus	Benin
Pterocarpus erinaceus	Togo
Pterocarpus erinaceus	Côte d'Ivoire (2 out of 5 inventoried regions)
Pterocarpus erinaceus	Nigeria