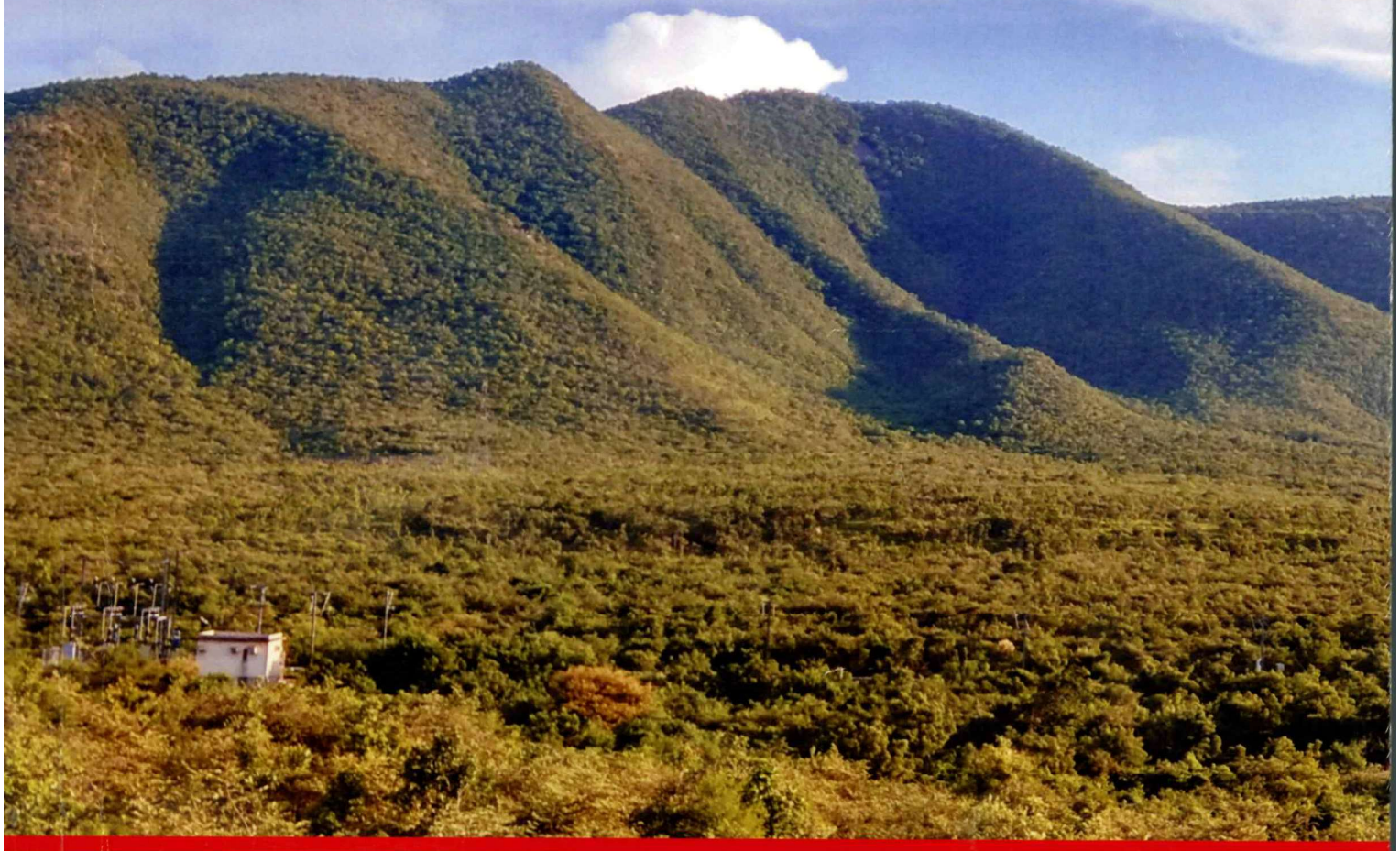
NON-DETRIMENT FINDINGS REPORT ON THE RED SANDERS TREE (*Pterocarpus santalinus* L.f.)



Botanical Survey of India (Deccan Regional Centre)
Ministry of Environment, Forest & Climate Change
Hyderabad
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NON-DETRIMENT FINDINGS REPORT ON THE RED SANDERS TREE (*Pterocarpus santalinus* L.f.)

Background

In its review of the recommendations [ref. SC62 Doc.27.2 (Rev.1)] to suspend trade made more than two years ago the 62nd meeting of the Standing Committee of CITES at Geneva, 23-27 July 2012, agreed to withdraw its earlier recommendation to Parties to suspend trade in (*P. santalinus* L.f) from India once the Secretariat receives the completed Non-Detriment Findings (NDF) study being undertaken the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore, India, one of the designated Scientific Authorities for CITES in India, in compliance with the long-term recommendations formulated by the Plants Committee at its 17th meeting (PC17, Geneva, April 2008) and as endorsed at the 61st meeting (Geneva, August 2011) of the Committee. The recommendations (reproduced verbatim) were:

"If exports of wild origin are to continue:

> a) *[India should] carry out a preliminary inventory of standing stock, establish estimates of sustainable off-take and establish a scientific monitoring system of the harvested and unharvested populations;*
>
> *b) [India should] establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take; and*
>
> *c) the Management Authority [should] report to the Secretariat the result of its actions to implement the provisions of Article IV, and how the Scientific Authority currently determines that levels of export are not detrimental to the populations concerned."*

The present report is the result of a study commissioned by the Ministry of Environment, Forests & Climate Change (MoEFCC), Government of India, to make fresh NDF study for the Red Sanders Tree, which is listed in Appendix II of CITES. Owing to the high international demand for the red sanders wood and the consequent illicit trade that became rampant in recent years, the Government of Andhra Pradesh approached the MoEF&CC, Government of India, in the year 2011 to permit it to harvest the mature trees on a sustainable

basis and also initiate steps for exclusion of *Pterocarpus santalinus* L. from Appendix II of CITES. Subsequently, the MoEFCC charged the Institute of Forest Genetics and Tree Breeding (IFGTB), under the Indian Council of Forestry and Education (ICFRE), to carry out an NDF study in 2011. The IFGTB submitted a negative NDF report the subsequent year denying harvest of natural populations of red sanders, which in effect meant denial of export quota as per CITES and calling for total stoppage of illegal felling and smuggling. The Management Authority of India submitted to the CITES Secretariat on 30 April 2012 a report from the comprising recommendations of the Management Authority and a copy of NDF study undertaken by the IFGTB, Coimbatore, India. Subsequently, Cites Secretariat through the MoEFCC, Government of India, accorded a one-time permission for sale of the confiscated Red Sanders wood, with the proviso that the Government of Andhra Pradesh should conduct a fresh inventory of wild and cultivated populations for sustainable management by the year 2016. The Andhra Pradesh Forest Department initiated a stratified area inventory of the growing stock in red sanders rich forest areas in 2014. However, in the context of the present NDF study an independent field assessment was warranted to ensure an unbiased result.

The state government has sought to delist the red sanders tree from CITES Appendix II on the grounds that red sanders has good regeneration capacity and it has put adequate control measures in place to curb smuggling. The regeneration when compounded by the slow growth of the tree in no way seems to compensate for the high level of illegal off-take from the wild. Therefore, there is no denying the fact that the red sanders tree is the most exploited tree species in India; its rampant smuggling as often reported in the media and as evidenced by the crime reports and/or illegal trade information as well as the increasing stocks of confiscated wood, warranting its sale. The illegal felling/trade fetches huge returns in terms of financial gain, with high quality red sanders wood costing as much as Rs. 40,00,000/- INR per MT (equivalent to roughly 58040 US Dollars) in the open international use market. The cost is said to be doubled during illicit trade. The gap between demand and supply, without adequate supplementation by way of extraction from cultivated areas, is feared to be the prime cause for the wanton illicit extraction from the wild for smuggling abroad. The natural habitat of the species is also threatened by many anthropogenic factors leading to certain

decline in the populations. The commercial exploitation of this tree since decades without any commensurate replenishment in the wild has remained the prime threat to the species leading to its continued depletion (Ahmedullah & Nayar, 1984). With no discernible mitigation of concerns whatsoever, the threat perception for the species remains the same today.

Considering the above, there is a primary need for BSI to conclude whether any proposed trade in red sanders would represent a risk and prove detrimental for the survival of wild populations of red sanders and impact the ecology of its natural habitat.

THE NDF METHODOLOGY/STEPS

The NDF methodology was first outlined by the IUCN (Rosier & Haywood, 2002), following which it was further deliberated upon at the Cancun NDF Workshop in the year 2008 for application to various taxonomic groups resulting in the NDF Guidance prepared by Austria (Rose, 2014), and NDF Guidance for Perennial Plants (Wolf et al., 2016).

The present report is developed along the lines proposed by Leaman & Oldfield (2014) and improved version by Wolf et al. (2016) for perennial plants and Wolf et al. (2018) specifically for timber species. The nine-step NDF process (Figure 1) follows the following pathway: 1. Review specimen identification, → 2. Review compliance with artificially propagated requirements, → 3. review relevant exclusions and previously made NDFs, → 4. evaluate conservation concerns, → 5. evaluate intrinsic biological risk, → 6. evaluate harvest impacts, →7. evaluate trade impacts, → 8. evaluate effectiveness of management measures, → 9. make a non-detriment finding or provide related advice. The sequential steps are depicted/outlined below:

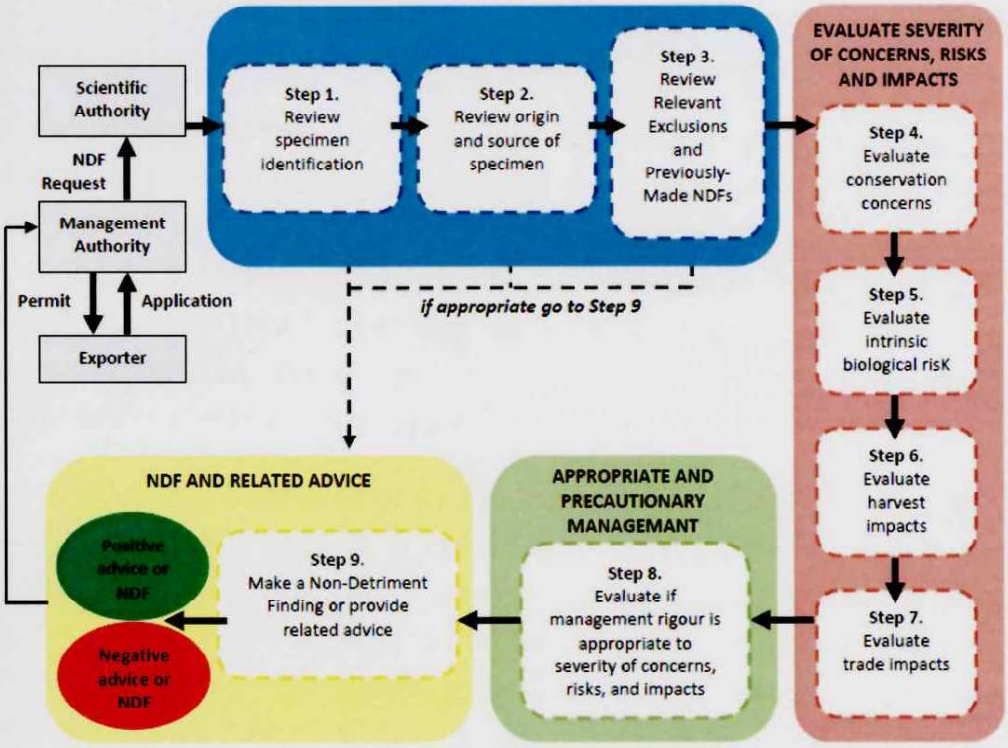


Figure 1. Nine-step NDF process (*Source*: Leaman & Oldfield, 2014)

Study of wild populations: Towards a quantitative field evaluation for the wild populations of Red Sanders tree sample plots of 0.1 ha were established randomly in the five districts (Kadapa, Chittoor, Nellore, Kurnool, Prakasam) of Andhra Pradesh where the natural populations occur; about 616 sample plots (within 228 forest beats) within the forest areas known to be bearing Red Sanders were randomly covered during the study.

Study of cultivated living stock: The areas known to have cultivations of Red Sanders within the country were surveyed to assess the living stock in the States of Tamil Nadu, Andhra Pradesh, Karnataka, and Kerala. Plantations developed by Government agencies (State Forest Departments/research units) and wood farmers on their private lands were surveyed and random sampling of girth was done to derive the average gbh of the cultivated trees.

STEP 1. REVIEW OF SPECIMEN IDENTIFICATION

1.1. Has the plant/specimen been correctly identified, and, is the scientific name used compliant with the appropriate CITES Standard?

Taxonomically, *Pterocarpus santalinus* L.f., commonly known as the red sanders tree, is a distinct tree species with crocodile skin bark, 3-foliolate leaves (rarely 4-5),broadly ovate or nearly orbicular, flowers axillary in simple or sparingly branched racemes, and pod with 0.8 cm long stipe concavely curved between the stipe and style. It is included in the subfamily Papilionoideae, which is one of the six monophyletic subfamilies now recognised under the family Leguminosae.

The genus *Pterocarpus* Jacq. is pantropical with about 35-40 species (Klitgaard & Lavin, 2005) in the world. Rojo (1972) in his revisionary work included only 20 species under genus; it is presumed that he merged/lumped many 'good' species under synonymy. Rojo (1972) includes all Asian species of *Pterocarpus* under two forms of *Pterocarpus indicus* Willd., i.e., forma *indicus* and forma *echinatus*, with binomials for the Asian *Pterocarpus* taxa placed under synonymy of each. This is in total disagreement with the work of Prain (1900) who recognised only five species in Asia. Oddly, Chauhan & Vijendra Rao (2003) mention that the genus has 60 species globally; this estimate appears to be on a very high side. Many species of *Pterocarpus* across its natural range are exploited either for timber or medicine. There are 5 species of *Pterocarpus*, especially with winged fruits, that are found in south and southeast Asia. The genus is represented in India by the following 5 species: *Pterocarpus dalbergioides* DC., *P. indicus* Willd., *P. macrocarpus* Kurz, *P. marsupium* Roxb. subsp. *marsupium*, *P. marsupium* subsp. *acuminatus* (Prain) Thoth., *P. santalinus* L.f.

The trade name of the species *Pterocarpus santalinus* L.f. is Red Sanders

The known vernacular names of *Pterocarpus santalinus* are:

In Indian languages:

Agarugandha, Arka, Chandana, Harichandana, Kshudrachandana, Kuchandana. Kushikam, Patranga, Tilaparni, Rakthachandan (Sanskrit); *Lalchandan, Raktha Chandan* (Hindi); *Agarugandhamu, Chandanum,*

Raktagandhamu, Yerrachachandanam, Rakthachandanam (Telugu); *Atti, Kusanddanam, Pidagattam, Salliyam, Sandanavengai, Sandauam, Sensandakkattai, Sensandanam, Sivappuchandanam, Semmaram-* (Tamil); *Patrangam, Tilaparnni, Chenchandanam* (Malayalam); *Ratanjan* (Marathi); *Ratanjali* (Gujarati); *Lalchandan, Rakthachandan* (Bengali); *Agaru, Honne, Kempugandha, Patranga, Raktashandana* (Kannada)

In foreign languages:

Red Sanders, Red Sandal wood, Almug, Red sadal wood, Red Sanders, Red Sandas, Red Sanders wood, Ruby wood, Sandalwood, Saunders wood (English); *Nasani, Sandaku* (Burmese); *Zitan* (Chinese); *Rod Sandelved, Sandeltrae* (Danish); *Rood Sandelhout, Sandelboom* (Dutch); *Santal Rouge* (French); *Caliaturholz, Rotes Sandelholz, Rothes Sandelholz, Rothes Santelholz* (German); *Lal Chandan, Ragat Chandan, Rukhto Chandan, Undum* (Hawaiian); *Kayu merah* (Indonesian); *Sandalo Rosso* (Italian); *Cendana Janggi* (Malay); *Sandalo Vermelho* (Portuguese); *Sandalo Rojo* (Spanish); *Naga Narra* (Taglog); *Rakta Candan* (Nepalese)

Names in systems of medicine: *Rakta Chandan* (Ayurveda); *Sandal surkh* (Unani)

The taxonomic status of *Pterocarpus* species can be checked online at the following websites: The Plant List (http//:www.theplantlist.org), IPNI (http//: www.ipni.org), ILDIS (http//:ildis.org), TROPICOS (http//:www.tropicos.org)

The specimens of *Pterocarpus santalinus* L.f. examined during this study in the major Indian herbaria are at *Annexure* - I.

It is confirmed that the scientific name used (*Pterocarpus santalinus* L.f.) is compliant with the appropriate CITES Standard.

STEP 2: REVIEW COMPLIANCE WITH ARTIFICIALLY PROPAGATED REQUIREMENTS

2.1. Is the permit application for artificially propagated specimens?

The MA has asked the SA to assess the Red Sanders tree in an all inclusive manner as an umbrella study. Therefore, the assessment of wild as well as cultivated populations was done as part of this NDF study.

The answer for allowing export of wild sourced plants would be 'no', while the answer to whether export of cultivated/artificially propagated specimens may be allowed is 'yes'.

2.2. Is export of Art. Prop. specimens of this species permitted?

Yes.

2.3. Do specimens clearly meet all the requirements for Art. Prop.?

Yes. This step in the NDF process involves evaluation of the specimen (Red Sanders) sourced from artificially propagated stock. If specimens identified for export are declared as artificially propagated the Scientific Authority should ensure that they conform to the requirements laid down in the CITES Resolutions. According to the guidelines, if an applicant for export permit provides information to conclude that the specimens clearly meet all CITES requirements for artificially propagated an NDF may not be necessary and a simple positive decision may be made to approve export.

According to CITES the core definition of the term 'artificially propagated' "*shall be interpreted to refer to plant specimens: a) grown under controlled conditions; and b) grown from seeds, cuttings, divisions, callus tissues or other plant tissues, spores or other propagules that either are exempt from the provisions of the Convention or have been derived from cultivated parental stock. It further determines that plants grown from cuttings or divisions are considered to be artificially propagated only if the traded specimens do not contain any material collected from the wild*" [Resolution Conf. 11.11 (Rev.

COP17)]. Further it is clarified that *"timber, other parts and derivatives of trees from monospecific tree plantations should be considered as artificially propagated"*. [Resolution Conf. 10.13 (Rev. COP15)]

In context of the definition of 'artificially propagated' the CITES Resolution Conf. 11.11 (Rev. COP 17) with regard to the regulation of trade in plants (reproduced verbatim) *"determines that plants grown from cuttings or divisions are considered 'artificially propagated' only if the traded specimens do not contain any material collected from the wild. However, it* ***recommends that an exception may be granted and specimens deemed to be 'artificially propagated' if grown from wild-collected seeds*** subject to the condition, among others, that *"the relevant Management Authority of that range State has determined that the collection of seeds or spores was legal and consistent with relevant national laws for the protection and conservation of the species; .... and the relevant Scientific Authority of that range State has determined that a) collection of the seeds or spores was not detrimental to the survival of the species in the wild; and b). allowing trade in such specimens has a positive effect on the conservation of wild populations".*

Improvement of Art. Prop. specimens: Some aspects of scientific interventions for improvement of artificial propagation of Red Sanders are reviewed.

Advancing regeneration: Assisted natural regeneration has been one of the restoration strategies, with studies undertaken to see the effects of specific treatments on seedling recruitment and establishment through control of vegetation/grass (Aide & Cavelier, 1994) and reducing competition (Bouffard et al., 2007) and litter control (Marrero-Gomez et al., 2000). Removal of competing/invasive species and clearing canopy is also known to be useful in encouraging regeneration. Kukrety et al. (2012) evaluated the impacts of silvicultural treatments for improving establishment of advancing regeneration in Red Sanders. Such studies have implications in restoration of wild populations of Red sanders in degraded or threatened habitats.

Micropropagation: While conventional propagation of Red Sanders through vegetative means has not been very successful in terms of large scale production for forestry purposes, tissue culture is viewed as a promising technique for mass multiplication. Work on tissue culture of red sanders began in the early 1980s and attempts to improve shoot sprouting using seedling explants continue (Patri et al., 1988; Sita et al., 1992; Anuradha & Pulliaiah, 1999; Arockiasamy et al., 2000). The advances in biotechnology applications for micro-propagation of Red Sanders have been recently reviewed (Teixeira da Silva et al., 2018). The survival , which in effect translates into successful rooting, of *in vitro* raised plants with proper hardening/acclimatisation and successful transfer to field conditions is the anticipated aim of any protocol development exercise. The red sanders has been subject of many biotechnological studies: Prakash et al. (2006) used mature nodal explants from elite quality Red Sanders tree for *in vitro* multiplication; with combinations of serial transfer technique and incorporating antioxidant into the culture medium they were able to minimise the medium browning and improve explant survival during shoot sprouting leading to successful establishment (c. 70%) of micropropagated plantlets. Leaf segments from 1-2 year old plants were also used as source of *ex vitro* explants (Ashrafee et al., 2014). Key advances, including *in vitro* conditions for tissue culture studies, in the biotechnology studies of Red Sanders tree have been reviewed recently by Teixeira da Silva et al. (2018). The future prospects for tissue culture based biotechnology in Red Sanders look promising, with many useful protocols for direct shoot regeneration from a variety of explants /through callus induction. As most explants are derived from seeds/seedlings that are not appropriate for clonal propagation development of clonal method from elite germplasm is warranted (Teixeira da Silva et al., 2018). As in the case of most tropical trees the challenge that remains is to reduce the rate of mortality of the micropropagated plants. Studies to address this issue need to be encouraged.

Considering the above, it is clear that there is an imperative need to develop science-based tree breeding/improvement programmes to help promote Red Sanders plantations in conducive areas with high confidence level and totally prevent harvest/extraction from the wild populations. This, along with strict protection of wild populations, could prove to be the most viable and practical option for the conservation of this threatened species.

STEP 3. REVIEW OF RELEVANT EXCLUSIONS AND PREVIOUSLY MADE NDFS

3.1. Are the specimens covered by CITES Appendix II?

Yes. The Red Sanders tree (*Pterocarpus santalinus* L.f.) is listed in **CITES Appendix II, with Annotation #7** which determines that no commodities other than logs, wood chips, powder and extracts are controlled under CITES. All other commodities are excluded from CITES control. In this context reference may be made to Article 1 of the Convention which indicates in which cases commodities or products can be exempt from CITES controls. Subparagraph (b) of Article I of the Convention means the following:

- *"Any individual animal or plant, whether alive or dead, is regulated.*
- *For plant and animal species in Appendix I all parts or derivatives are always regulated and cannot be exempted.*
- *For plant species in Appendices II and III it is possible to exempt certain commodities and products from the CITES listing. These parts and derivatives have to be specified in an Annotation to the listing in the CITES Appendices. These Annotations are marked with "#", followed by a number.*
- *Regulated are only those parts or derivatives which are readily recognizable (cf. Res. Conf. 9.6 Rev. CoP16)".*

Therefore, for the purpose of clarification it may be mentioned that an Annotation is a note attached to certain species in the Appendices to indicate which parts or derivatives fall under the CITES listing (Uwe, 2018).

3.2. Is the harvest of wild export of wild harvested specimens of this species permitted?

No. In context of the Red Sanders tree (*Pterocarpus santalinus*), the threatened endemic species that is in high demand in the international market for its high quality timber and source of dyes as well as medicine, incense industry, crafted artefacts and many other uses. As the international trade, mostly illicit in nature, involves hundreds of tonnes of wood, chips and powder annually. Legal export is sourced mostly from seized/confiscated stocks and is often limited to

value-added products or sometimes as extracts, viz., oleoresin. CITES implementation in the species is apparently very less/insignificant, and limited only to seized/confiscated wood. In the current listing "exclusion of the powder in accordance with **annotation #7** would mean that a significant proportion of trade in red sanders powder be outside the CITES control" [COP Prop. 27, The Hague (Netherlands), June 2007]. It was agreed subsequently (PC 15) that trade in powder and extract should be covered by CITES controls. Further, it was also agreed that finished products (musical instruments, furniture, etc.) should be exempt from the control of CITES. Therefore, Red Sanders was annotated with the revised annotation (Annotation #7rev.), wherein logs, wood chips, powder and extracts are designated.

3.3. Has a science-based NDF been made for this species that is still valid and sufficient to evaluate the current application?

Yes. However, while reviewing the earlier NDF report (Hegde et al., 2012) it was found that although the findings in terms of girth class classification were almost similar, the report did not cover the cultivated stock of Red Sanders. Therefore, the present NDF study was extended to assess the cultivated stock also.

A comparison of the present NDF studies of BSI(DRC) with studies of IFGTB (Hegde at al., 2012) is made hereunder (Table 1).

Table 1. Comparison of Red Sanders surveys of BSI and IFGTB

S. No.	Name of the Forest Division	Ranges with RS		Beats with RS		No. of Sampling Plots	
		BSI_DRC	IFGTB	BSI_DRC	IFGTB	BSI_DRC	IFGTB
1	Chittoor East	4	7	23	25	144	5
2	Giddalur	2	2	9	6	27	19
3	Kadapa	5	5	37	33	109	107
4	Nandyal	1	1	4	6	14	22
5	Nellore	4	4	28	17	82	27
6	Proddatur	4	4	20	26	70	79
7	Rajampet	4	4	28	32	91	62
8	WLM Tirupati	3	3	24	26	79	84
	Total	27	30	173	171	616	405

Field work: A comparison of field studies undertaken by IFGTB in 2012 (Table 1) as part of the earlier NDF study and the present study undertaken by Botanical Survey of India (Deccan Regional Centre) [BSI(DRC)] shows that there is much similarity in the survey patterns carried out by both studies in terms of Forest Divisions within which the Red Sanders occurs. The FDs covered by both teams included, Chittoor East, Giddalur, Kadapa, Nandyal, Nellore, Proddatur, Rajampet and WLM Tirupati. Overall, the Red Sanders ranges covered by both IFGTB and BSI(DRC) are comparable, with IFGTB finding Red Sanders in 30 ranges and BSI(DRC) finding Red Sanders in 27 ranges only; in three ranges, viz., Chittoor, Karvetinagar, Bhakarapet (Pileru) of Chittoor East Division the Red Sanders was not found by the BSI teams during the present study. Similarly, IFGTB had covered 171 forest beats containing Red Sanders while BSI(DRC) has covered 173 beats. IFGTB had sampled 405 plots while BSI(DRC) has sampled 616 plots, out of which 344 plots only were found to be bearing Red Sanders, across whole natural range of Red Sanders in this study.

In the earlier NDF study (Hegde et al., 2012) the harvestable girth class (> 70 cm) was found to be 7.8 percent. Even if one allows a margin of error owing to difference in the approach adopted by the two NDF studies/difference in the sampling plots it clear that the harvestable girth class in the wild populations have been reduced drastically over the last six years. It is pertinent to mention that in the previous NDF study a very high percentage (15.7 percent) of harvestable trees at Nandyal Division was recorded, while in the present study the Red Sanders trees above 70 cm girth were not found at all in any of the plots sampled. Therefore, excluding the Nandyal populations in the previous NDF study (Hegde et al., 2012), the percentage of harvestable trees would work out to be only 3.9 percent.

Broad findings of NDF by BSI(DRC): As seen in the above section the NDF field study of BSI(DRC) across the entire natural range of Red Sanders in Andhra Pradesh shows Red Sanders populations on an average (8 divisions) are more in the lower girth class range (<30 cm girth: >50%), (31-40 cm girth: 22.38%), (41-50 cm girth: 14.33%), (51-60 cm girth:7.31%), (61-70 cm girth:3.02%), which shows that a total of 97.79 % of Red sanders trees are in the lower girth

class, i.e., non harvestable, whereas higher girth class trees (71-80 cm girth: 1.24%), (81-90 cm girth:0.34%) (>90 cm girth:0.61%), totalling a mere 2.19%. This confirms that a very small percentage of the standing Red Sanders in its natural range is harvestable. The slow progression from 30 cm girth class to 70 cm girth class, spanning almost 50-60 years (Hegde et al., 2012), is an issue that has to be taken into consideration in future management plans. It must further be considered that it takes 10-12 years for growth of Red sanders from one girth class to the next girth class. What is most worrying is that the Red Sanders trees in the higher girth class are widely scattered throughout its natural range or even absent in some areas which were earlier known to harbour Red Sanders.

Considering that the Red sanders tree is extremely slow growing saplings would take almost 80-100 years to reach the harvestable size (>70 cm girth). Even these 'harvestable' natural standing stock are extremely threatened; debarking by smugglers to test the heartwood formation makes the trees vulnerable to infestations. It was observed that lack of management of coppicing trees renders the multi-stems unproductive as good quality heartwood formation in such trees/multi-stems is suspect.

BSI(DRC) teams also found that the species (both in lower girth and higher girth classes) is highly threatened by illegal felling, annual fires and cattle grazing, etc. which are adversely affecting the population structure/dynamics and population biology.

3.4. Review of Red Sanders plantations in India

As per the State Forest Department records and secondary data in public domain a total of ca. 14214.418 ha of area is under Red Sanders cultivation in India (Map 1).

During the present study, selected plantation sites were randomly visited. Preference was given to plantations that were established before 1980, (i.e., with 35/40 years or older planted trees) to ensure that harvestable stock could be evaluated in context of the present situation. The year 1980 was considered as the cut-off year for all practical purposes; it is accepted that the pre-1980 plantations would be able to yield some quantum of RS wood with gbh class of

70-80 cm or above. The post-1980 plantations would not reach the desired girth class, except perhaps in moist forest areas such as in Kerala, where the heartwood formation would not be of the desired grain quality.

The break-up of plantations in all Indian states as per the available State Forest Records and information gleaned from secondary sources is given in Table 2.

Table 2. State-wise breakup of plantations as per forest department records

State	*Govt. plantations as per forest department records in ha*	*Approx. number of mature individuals*	*Private plantations in ha*	*Approx. number of mature individuals*	*Total plantations (Govt. & Private) in ha*	*Total plants in Govt. & Private plantations*
Andhra Pradesh	6839.428	7591765	1175.686	196706	8015.114	7788471
Karnataka	413.2	27800	0	0	413.2	27800
Odisha	1.3	105	0	0	1.3	105
Tamil Nadu	6953.17	590229	14.6687	12004	6967.83	602233
Telangana	0	0	15.842	5543	15.842	5543
West Bengal	5.32	2211	0	0	5.32	2211
Gujarat	0	0	0.08	40	0.08	40
Kerala	2	1000	0	0	2	1000
Total	14214.418 ha	8213110 trees	1206.2767 ha	214293 trees	15420.686 ha	8427403 trees

Source: State Forest Department Records and public domain information

Table 3. State-wise breakup of plantations (pre-1980 & post-1980) surveyed by BSI (DRC)

State	Surveyed area in ha	Approx. number of mature individuals	Avg.height (m)	Avg. girth (m)	Area in ha (Post-1980)	Post 1980 trees	Area in ha (Pre-1980)	Pre 1980 trees	Avg. harvestable height (m)	Avg. harvestable girth (m)	Harvestable area in ha %
Andhra Pradesh	1899.85	418061	9.38	0.6048	1058.99	330498	840.86	87563	11.33	0.81	44.25
Karnataka	413.2	27800	5.5	0.516	30.2	11800	383	16000	5.25	0.525	92.69
Odisha	1.3	105	6	0.55	1.3	105	0	0	0	0	0
Tamil Nadu	3703.49	399219	8.81	0.8298	1230.58	117217	2472.91	282002	0.8795	66.83	66.77
Telangana	15.842	5543	5.9	0.421	15.842	5543	0	0	0	0	0
West Bengal	5.32	2211	8.75	0.8257	1.9	1867	3.42	344	1.175	0.092	64.28
Gujarat	0.08	40	12	0.9	0	0	0.08	40	0.9	0.0021	100
Kerala	2	1000	18.29	0.8957	2	1000	0	0	0	0	0
Total	6041.082	853979	9	0.6864	2340.812	468030	3700.27	385949	9.98	0.8579	61.25

Based on the information culled from the State Forest Departments and secondary sources, the NDF project team randomly sampled the plantations as part of the field assessment. The areas surveyed by the team are reflected in the map. The state-wise break-up of old plantations (pre-1980) and new plantations (post-1980) are shown in Table 3.

3.5. Cultivated stock assessment of RS in Andhra Pradesh

A review of the records of the State Forest Department of Andhra Pradesh revealed that out of a total of 8015.114 ha area under Red Sanders cultivation, Government plantations cover an area of 6839.428 ha while private plantations cover an area of ca. 1175.686 ha. The Government plantations are said to have 75,91,765 individual trees of all girth classes. The private plantations are said to have 1,96,706 individual trees of Red Sanders, as per the records.

As per the Forest Department records the State has about an area of about 1871.498 ha under Red Sanders cultivation that is old/harvestable; i.e., about 20.05 percent of the total area under RS cultivation. The remaining area, i.e., 5468.11 ha (79.94 percent) of the total area under cultivation comprises new plantations, from which no immediate harvesting of wood can be contemplated.

As per the APFD records the Red Sanders cultivations in the different Forest Divisions of Andhra Pradesh are as under (Table 4).

Table 4. Red Sanders cultivation in the forest divisions of Andhra Pradesh

Name of the Forest Division	*Pre 1980 plantation area in ha*	*Post 1980 plantation area in ha*	*Total plantation area in ha*
Anantapuram	0	15.5	15.5
Chittoor East	669	1422	2091
Chittoor West	0	191.61	191.61
Giddalur	0	100	100
Guntur	0	20	20
Kadapa	0	989	989
Nandhyal	0	50	50
Nellore	0	1430	1430
Proddatur	0	505	505
Rajampet	701.68	585	1286.68
Tirupati WLM	0	160	160
Vizianagaram	0.818	0	0.818
	1371.498	5468.11	6839.608

Source: APFD RC.No.867/2014/Prod.2, dated 31.10.2018

3.5.1. Review of cultivated stock of Red Sanders in Andhra Pradesh:

During the present NDF study the project team covered an area of 840 ha of old plantations, i.e., 61.24 percent of the area under RS cultivation (pre-1980). The total RS cultivated area covered by the BSI team is 1899.85 ha, including both Government and private plantations.

The Division-wise assessment is as under:

Chittoor West

In this Division the Red Sanders plantations covering 132.19 ha with 1,46,934 individual RS trees were reportedly developed during the period 1961-1988 (Ref. APFD: RC No. 867/2014/Prod. 2, dated 30 October 2018). Oddly enough, none of these 'plantations' were traceable during the present NDF study. As per official records the new plantations (post-1980) cover an area of c. 191.61 ha. One good plantation in the Chittoor West Range was found at Keenatampally Beat, near Koyyur village; this was established in 1988-89 and covers 15 ha with about 15,000 trees of average girth of 45 cm and average height of 5 m.

In context of private plantations the one at Rishi Valley School, Thettu, Madanapalle Range, with Red Sanders planted sporadically in an area covering 70 ha; this plantation is fairly good with ca. 700 trees falling in the girth class of 70-80 cm gbh and average height being 7.5 m.

Kadapa

In the Kadapa Division the so-called 'plantations' of Red sanders officially cover 989 ha out of which 500 ha are reportedly for the purpose of forest 'gap filling' exercise carried out during 1998-99; these are doubtful 'plantations' as they have actually become subsumed in the Reserve Forests and Sri Lankamaleshwara Wild Life Sanctuary and cannot be distinguished as plantations. On field assessment it was difficult to identify/distinguish the cultivated Red sanders from the natural/wild ones; no records of monitoring exist to evaluate if these so-called 'gap filling' exercises yielded any substantial results. The remaining 489 ha plantations have been raised from 2010-11 onwards only.

Chittoor East

In this Division the Red Sanders plantations covering 2091 ha have been developed by the Forest Department; these are well-established in almost all areas except in KN Agaram Block, Karvetinagar Range (established in 1965 over an area of 14 ha) and Surendera Nagar (established in 1979 in 4 ha area) where the success rate is around 40 percent. Out of the 2091 ha 669 ha only are pre-1980 plantations, i.e., have harvestable trees; the average girth (gbh) of the trees in this Division is c.70 cm, which means that these cultivated stocks would become harvestable soon and a harvest cycle can be planned on a selective basis. The remaining 1422 ha of plantations are of post-1980 period.

The plantations of Red Sanders by private farmers are mostly by way of peripheral plantations along the fences of agricultural fields; exceptions are found at two places, i.e., Nagari and TP Palem, where the Red Sanders are grown by way of monoculture plantations.

Red Sanders plantations reportedly established during 1956-1988 supposedly at Vampally (97 ha), Inagaluru (16 ha) and Pallem (7 ha) in Sri Kalahasthi Range and a few in Chittoor Range were not traceable during this study.

Tirupathi WLM

The peculiarity of the Red Sanders plantations, which are reportedly established by the TTD, are by way of 'avenue plantations' along the roads within as well as outside the entire campus areas of all the educational institutions run by the TTD. Clearly, these were not planted specifically for extraction purposes. As these are not formal 'plantations' as such there are no specific management measures in place as a result of which the trees are vulnerable due to road expansion plans. The natural regeneration in these trees is also, as expected, very poor with grazing pressure in the area making the situation worse.

As per the official records the plantations reportedly raised by the State Forest Department (Ref. APFD: RC No. 867/2014/Prod. 2, dated 30 October 2018) during the period 1953-1989, covering c. 207 ha with 2,29,770 individual Red Sanders trees, are also not traceable.

The Forest Department has raised some new plantations of Red Sanders and its associates in an area of 160 ha from the year 1990 onwards.

The private plantation near Narasingapuram, covering ca. 17.40 ha with 4113 individual trees, is fairly good; this plantation is at some risk as a road widening and flyover bridge construction plan is being envisaged by the local administration. It was reported that approximately 1300 Red Sanders trees, whose gbh is around 70 cm, are earmarked for felling.

Proddatur

This Division has Red Sanders plantations covering c. 560 ha area. About 55 ha area of these plantations are fairly old plantations raised during the period 1961 -1974. However, except for an area of 1 ha which contained about 30 individual trees, these were not traceable. The remaining 505 ha of RS plantations are new, having been raised from the year 2011 onwards.

Giddalur

The Red Sanders plantations in this Division cover an area of ca. 100 ha; these are very recent plantations raised since 2016 onwards and one would have to wait for 4-5 decades for the expected yield of heartwood.

Rajampet

The Red Sanders plantations in this Forest Division are Government plantations covering about 1286.68 ha area, of which 701.68 ha are old plantations located in Reserve Forest; these plantations are mostly located at Salivendula RF, Seshachalam RF and Redwood Park at Kodur. During the field assessment it was found that the trees fall in the girth class of 70 -80 cm gbh. The remaining area of 585 ha are post-1980 plantations.

Guntur

This Forest Division has Red Sanders plantations, covering c. 20 ha, that are relatively young having been raised during 2014-2015, and are, therefore, of not much significance in the present context.

Eluru

The Red Sanders plantations in this Division, covering c. 5 ha area, are all raised by private wood farmers. On assessment it was found that these plantations have about 807 individual trees, with an average gbh of 75 cm and clear bole of about 3 -4 m, therefore, harvestable.

Nandyal

The Red Sanders plantations in this Division are very recent ones, not meriting a detailed field assessment.

Nellore

The Red Sanders plantations in this Division, covering an area of 1430 ha, were established by the Forest Department only during this decade, therefore, these plantations would have tree girth under the non-harvestable class. However, there are a few exceptions. The Red Sanders plantation in 4 ha area planted during 1997-98 under the VSS scheme at Yathalur Beat, Chinanapet village, Venkatagiri Range, where the tree growth is very good with gbh above 50 cm. The plantation at Koturpally, Rapur Range, established in 1991-92, is also good, comprising Red Sanders trees of 5 m height and 40 cm gbh. Other good plantations are also at Ramkur Beat established during 1992-93 with average height of 5.5 m and 62 cm gbh.

Of the private plantations, there is a plantations in Rapur with average height of 6 m and 60 cm gbh; these have been planted on the periphery of mango orchards.

Vizianagaram

The Red Sanders plantations raised by Forest department cover about 0.818 ha while the private plantations cover about 4 ha. On field assessment of the plantations it was found that the cultivated trees in this particular Division are often the tallest; the average height of the trees is 12 m with c. 100 cm gbh. However, as these plantations are in moist climatic conditions the heartwood formation is expected to be rather less and of poor quality.

Srikakulam

There are no Red Sanders plantations established by the State Forest Department, whereas the few known plantations by private farmers/wood growers are all less than 10 years old. The average height of these cultivated Red Sanders trees is c. 7 m with 40 cm gbh. Therefore, no RS wood yield can be anticipated in the immediate future.

3.5.2. Review of cultivated stock of Red Sanders in Tamil Nadu

The total area under Red Sanders plantation is 6967.74 ha as per the SFD records and secondary information; this includes 6953.17 ha of Government owned plantations and 14.66 ha of private ownership. The distribution of Red Sanders plantations in various forest divisions/circles is given in Table 5.

Table 5. Plantations with approximate/estimated number of trees in Tamil Nadu

Name of the circle/forest division	*Area in ha*	*Number of trees available/ survived*
Afforestration Division Tiruvannamalai	524.5	14694
Chennai Circle	1737.42	422225
Dharmapuri Circle (Dharmapuri, Harur, Hosur divisions)	2600.05	33659
Social Forestry Division Vellore	890.7	3289
Tiruvannamalai Division	164.4	27876
Vellore Division, Vellore	1036.01	88486
Private lands (in Coimbatore, Erode, Salem Districts)	14.6687	12004
Total	6967.7487	602233
Surveyed by BSI		
Total plantations (including old & new)	3703.49	399219
Pre -1980 plantations	2472.91	282002
Post - 1980 plantations	1230.58	117217

Source: TNFD letter. No. E2/15433/2011, dated 06.03.2012

During the present survey/assessment for the NDF study the study team surveyed a total of 3703.49 ha (including old/new). Out of this total area

surveyed, the new plantations (post-1980) comprise 1230.58 ha, i.e., 33.22 %. The old (pre-1980) plantations covered during this study is ca. 2472.91 ha, i.e., 66.77 % of the known Red Sanders plantation area; the oldest plantation is at Thaniyar Nursery, Periamalai Beat, Polur RF, Tiruvannamalai Division, with few individuals, but with maximum gbh (200 cm). It was observed that a majority of the plantations are well established, with the height of Red Sanders trees ranging from 4-15 m and 30-200 cm gbh.

In general, it was observed that in 11 divisions and 10 districts the Red Sanders plantations that were raised by the Forest Department are having good trees from which heartwood could be extracted. On the other hand the private plantations in Tamil Nadu, which were mostly established in recent years, are not having Red Sanders of good size, i.e., harvestable trees.

Apparently, some of the Red Sanders trees planted in Government lands adjoining Reserve Forest area earlier during 1920-70 have dispersed their seed to the deeper forest areas where they have become established/ naturalized.

The regeneration aspect in a few Red Sanders plantations that were planted in conducive areas adjacent to reserved forests area is good, indicating that the plantations would be sustainable in the future. Vallimalai RF (Santavasal Range, Tiruvannamalai Division), Vanganur RF (SVG Puram Beat, Tiruvallur Division), Peranamallur Section/Beat (Arani Range), Athubambadi Beat, Polur SF (Tiruvannamalai Division) are excellent examples of regeneration in plantation areas.

In context of wood quality it was observed that the colour of the heart wood in plantation- raised trees is rather paler compared to the wild trees; similarly, the texture of the bark is also perceptibly different compared to the trees growing in wild/natural conditions. The sapwood content in cultivated tress also appears to be more when compared to the wild trees.

3.5.3. Review of cultivated stock of Red Sanders in Kerala

It was observed that plantations of Red Sanders trees cover a little over ca. 2 ha only. These plantations are under the management of the Research Wing, Kerala State Forest Department.

3.5.4. Review of cultivated stock of Red Sanders in Karnataka

There are as many as 6 plantations in the State. The cultivated stock of Red Sanders in Karnataka are mostly under the management of State Forest Department; this includes 2 plantations in Mandya Forest Division and rest under Bengaluru Research Division. All these plantations have been covered during this survey.

On assessment it was found that about 80% individuals are multi-stemmed in Yeswanthpur A & B Blocks, Kolar Research Range, Nallal A2 beat, Hosakote Research Range, Bengaluru Research Division of Karnataka Forest Department. Much of this is owing to natural coppicing that occurs in absence of management measure such as pruning of unwanted stems to allow single boles to grow vigorously in a healthy manner.

The regeneration of plantations, established around 1965 at Hulikere Lower Beat, Mandya Forest Range, is very indeed good; the red gravelly soils in the area conducive to the growth of Red Sanders; regeneration in these plantation areas is excellent.

The quality of Red Sanders heartwood in Hulikere is also good compared to other research and forest ranges in Karnataka.

However, leaf gall disease has been found in the Hulikere Forest; there is need to address the issue scientifically. Invasive species are also a threat to the cultivated stock. Invasive species such as *Chromolaena odorata* (Syn. *Eupatorium odoratum*), *Lantana camara* and *Gliricidia sepium* are replacing the original grass species that were uprooted by way of maintenance measure/management practice. (eg., K Shettihalli Beat/RF, Sriranagapatnam Forest Range, Mandya Forest Division), with the result that regeneration has also been significantly reduced in such areas.

3.5.5. Review of cultivated stock of Red Sanders in West Bengal

The Red Sanders plantations in West Bengal cover about 5.32 ha area. About 29 individuals of Red Sanders trees were initially introduced in the Arabari Forest Range of Midnapore district during 1950's; the average height of the trees is now 12 m with about 150 cm gbh (the max gbh is 230 cm in 18 m high originally planted trees; the gbh of new/regenerated trees is 57 cm and height is 6 m). Overall, the regeneration is also excellent. About 367 trees were planted recently in the year 2000 in the adjoining areas in same Range; their maximum girth is 60.cm and 7 m tall at present.

The sandy loamy soil and climatic conditions in the area support the seed recruitment and establishment of seedlings in this area.

About 10 individuals were introduced long back (around 1950) in the *ex-situ* conservation area of Amlachati Vesaj Udyan, State Silviculture South Division, Jhagram District of West Bengal. The average height of these trees is 10 m and the average girth (gbh) is ca. 120 cm, with max. 170 cm.

However, the heartwood quality is very poor, proving that the Red Sanders has to be only grown in ecologically conducive areas for good heartwood yield.

3.5.6. Review of cultivated stock of Red Sanders in Telangana

The area under Red Sanders cultivation in the State of Telangana is c. 15.842 ha. These are recent plantations being only 5-13 years old, raised by farmers in private lands. The girth (gbh) of these trees is less than 40 cm and, therefore, not harvestable.

3.6. Fixing quota for export of cultivated red sanders wood

3.6.1. Red Sanders wood from confiscated/seized stock

While export of Red Sanders wood in any form (raw, processed/unprocessed) sourced from the wild is prohibited for export under the CITES regulatory regime as well as the EXIM policy of Government of India, a onetime relaxation had been granted to the Governments of Andhra Pradesh, Tamil Nadu, Maharashtra and Karnataka for allowing export of Red Sanders wood sourced from the seized/confiscated stock. The one-time relaxation for export (Year 2012) for the four states are: Andhra Pradesh-8498.095 MT, Tamil Nadu - 1200 MT, Maharashtra - 299.732 MT, Karnataka - 186.588.

The national quota allowed by the CITES Secretariat to India for Red Sanders specimens from source "I" is at Table 6.

Table 6. National quota allowed by CITES Secretariat

S. No.	Year	Source "I" (quantity in MT)
1	2012-13	11,806*
2	2013-14	11,507
3	2014-15	9,090.09
4	2015-16	9,090.09
5	2016-17	9,090.09

* one-time quota granted for India

The details of the Red Sanders wood sold and the revenue realised from the one-time quota with respect to Andhra Pradesh are in the Table 7.

Table 7. Details of the quantity of Red Sanders wood sold and revenue realized by APFD from the quota of 8498 MTs

S. No.	Year of sale	Quantity (in MTs)	Total Revenue realized (in INR) (crores)
1	2005-06	233.619	2.870
2	2008-09	1998.591	46.210
Before bifurcation of State	Sub-total	2232.210	49.080
1.	2014-15 (Phase –I)	2174.148	609.609
2.	2015-16 (Phase-II to V)	840.234	178.060
3.	2016-17 (Phase-VI)	843.207	238.780
4.	2017-18 (Phase-VII to IX)	992.412	204.970
5.	2018-19 (Phase-X and XI)	639.512	251.820
After bifurcation of State	Sub-total	5489.513	1483.239
	Grand total	7721.723	1532.319

Source: APFD

During 2018-2019 the state of Andhra Pradesh has generated a revenue of 251.82 crores from the sale of 639.512 MT (Phase X & XI) Red Sanders wood and the remaining quantity available out of the permitted quota (8498 MT for Andhra Pradesh) is 776.277 MT (RC.No. 867/2014/Prod.2, dated 30th October 2018).

The date for export of Red Sanders by Andhra Pradesh had been extended up to 31st December 2017 vide Notification No. 24/2015-2020, dated 29th August 2016. Subsequently the time for finalising the modalities and complete the process of export was extended further up to 30th April 2019 vide Notification No. 08/2015-2020, dated 23rd May 2017.

As per Notification No. 40/2015-2020, dated 3rd October 2018, issued by the Directorate General of Foreign Trade (DGFT) the time up to 30th April 2019 for 'finalizing the modalities and complete the process of export of the respective allocated quantities of Red Sanders' wood has been granted to the Governments of Maharashtra and Tamil Nadu.

As per the latest Notification of DGFT (No. 56/2015-2020, dated 18th February 2019, the Government of India has amended the export policy of Red Sanders wood under **Chapter 44 of the ITC (HS), 2018, Schedule -2 (Export Policy),** to include Red Sanders wood obtained from private land (including Pattaland) (Sl. No. 188A) and specified value added products of Red Sanders wood and other handicrafts made from the Red Sanders wood procured from legal sources (Sl. No. 189). Thus, the export of the Red Sanders wood exclusively sourced from cultivated origin from private land (including Pattaland) has now been notified to allow 'restricted' export (subject to certain policy conditions/ documentation) of Red Sanders wood in the log form, roots and value added products to facilitate export. This comes as a great relief to the Red Sanders wood farmers who have been pressuring the Government for this kind of relaxation/amendment of the export policy. The present notification addresses most of their grievances to a large extent.

The issue of quota from the confiscated/seized source needs to be determined based on the quantity of RSW with the State Forest Departments. As per information available the quantum RSW from confiscated/seized source is at Table 8.

Table 8. Confiscated Red Sanders Stock details in various states

State Name	*Quantity in MT*
Manipur	3.044
Maharashtra	1115.04
Karnataka	257.73
Telangana	1123.972
Tamil Nadu	987
JNCH, Mumbai	1189.956
Andhra Pradesh*	7888.981
	12565.723

* This excludes the remaining quantity of Red Sanders wood (776.277 MT) after completing the export/sale based on the previous one-time quota/permission.

The existing stocks of seized/confiscated Red Sanders, which are to the tune of 12565.723 MT, are lying with State Forest Departments. This is over and above the quantum of 11,806 MT of Red Sanders seized wood for which a one-time permission was granted by the CITES Secretariat earlier. A decision on the disposal of the existing seized stock (12565.723 MT) needs to be taken by the Management Authority of CITES in India, i.e., the Ministry of Environment, Forests and Climate Change (MoEFCC).

3.6.2. Existing export quota from cultivated stock

The present yearly export quota from cultivated stock of 310 MT as per the quota permission of CITES Secretariat (Table 9) is being divided between the state Andhra Pradesh (250 MT) and Tamil Nadu (60 MT).

Table 9. Yearly quota permitted for export of Red Sanders wood

S. No.	*Year*	*Source "A" (quantity in MT)*
1	2012-13	310
2	2013-14	310
3	2014-15	310
4	2015-16	310
5	2016-17	310

Source: CITES national export website

3.6.3. Proposed quota for Red Sanders from cultivated source

As seen from the tree volume of cultivated stock in all the states having cultivations of Red Sanders (Table 10) the state of Tamil Nadu has the maximum cultivated stock (45065 MT), followed by Andhra Pradesh (14367 MT), Karnataka (511 MT), West Bengal (125 MT). The states of Gujarat, Kerala Telangana and Odisha have negligible cultivated stock.

Table 10. Tree volume of cultivated stock as per the present NDF study

State	Surveyed area in ha	Approx. number of mature trees	Avg. height (m)	Avg. girth (m)	Area in ha (Post-1980)	Post 1980 trees	Area in ha (Pre-1980)	Pre 1980 trees	Avg. harvest table Height (m)	Avg. harvest stable girth (cm)	Harvest stable area in ha %	Results after Hoppus formula	volume in CU M	Tree volume in MT
Andhra Pradesh	1899.85	418061	9.38	0.6048	1058.99	330498	840.86	87563	11.33	81	44.25	0.464601	40681.84094	14366.66
Karnataka	413.2	27800	5.5	0.516	30.2	11800	383	16000	5.25	52.5	92.69	0.090439	1447.03125	511.0143
Odisha	1.3	105	6	0.55	1.3	105	0	0	0	0	0	0	0	0
Tamil Nadu	3703.49	399219	8.81	0.8298	1230.58	117217	2472.91	282002	9.36	87.95	66.77	0.452509	127608.5407	45064.53
Telangana	15.842	5543	5.9	0.421	15.842	5543	0	0	0	0	0	0	0	0
West Bengal	5.32	2211	8.75	0.8257	1.9	1867	3.42	344	12	117.5	64.28	1.035469	356.20125	125.7913
Gujarat	0.08	40	12	0.9	0	0	0.08	40	12	90	100	0.6075	24.3	8.581464
Kerala	2	1000	18.29	0.8957	2	1000	0	0	0	0	0	0	0	0
Total	6041.082	853979	9	0.6864	2340.812	468030	3700.27	385949	9.98	0.8579	61.25		170117.9141	60076.57

Based on the cultivated stock assessment made by the present NDF study (Table 10) the suggested yearly quota from the cultivated source is computed as under:

Tamil Nadu standing Red Sanders crop: 45,000 MT

Extraction potential: 45,000 / 50 = 900 MT per annum

Andhra Pradesh standing RS crop: 14,000 MT

Extraction potential: 14,000 / 50 = 280 MT per annum

Karnataka standing RS crop: 511 MT

Extraction potential: 511 / 50 = 10 MT per annum

Extraction potential for all 3 states : 1190 MT per annum

The potential for extraction of Red Sanders in these states is roughly calculated based on the cultivated tree volume and on the premise that the red sanders trees move from one girth class to another in about ten years at an average in optimum growth conditions that are specific to Red Sanders. Therefore, to attain the harvestable girth class of > 70 cm the standing trees of girth class 60-70 cm would take ten years. This would be the girth class for ready replenishment of stocks for next harvest/off-take. It is observed that most of plantations in Andhra Pradesh are relatively recent, i.e., from 2010/12 onwards; a few old ones in the forest fringe areas, i.e., Rajampet Division (Salivendula RF, Seshchalam RF, Railway Kodur), Chittoor East Range (Shasis hills, Nefti Nagar, Deer Park, Karaveti Nagar), Nellore Division (Chinanapet, near Yathalur, Kavali range), Vizianagaram Division (Phool Bagh) are at a fairly mature/established stage where they can yield harvestable wood. The oldest plantation in Tamil Nadu are at Thaniyar Nursery. Therefore, the above mentioned quota for all the three states (Tamil Nadu, Andhra Pradesh, Karnataka) has been computed and prescribed to ensure sustainability/ availability of the Red Sanders plantations for the next fifty years.

A recent study of heartwood proportion analysis across all age classes of plantations showed that red sanders wood of moderate amount of heartwood could be harvested in 40-50 years rotation age (Suresh et al., 2017). It has been observed that the growth of Red Sanders, including girth volume, is more in wet/moist climatic conditions that prevail in West Bengal and Kerala (Babu, 1992).

3.6.4. Justification for including Government plantations in export quota

A total area of 15,420 ha is under Red Sanders cultivation. This includes 14,214 ha (92.2 %) of Government lands and 1206 ha (7.8 %) of private lands (including pattalands). It is seen that most of the harvestable trees are in Government lands (Table 10) and, therefore, there is now a strong justification for allowing sustainable harvest from Government plantations raised by the State Forest Departments, particularly the Andhra Pradesh Forest Department (6813 ha) and Tamil Nadu Forest Department (6953 ha), which have a fairly good quantity of harvestable Red Sanders wood (> 70 cm girth). Sourcing Red Sanders wood from both government and private plantations for export would be advisable. As per the field study/random sampling carried out as part of the NDF study, it is observed that Tamil Nadu has 64.28 percent harvestable area of Red Sanders tree under cultivation, while Andhra Pradesh has 44.25 percent area of Red sanders harvestable size. **Therefore, it is practical to also allow sustainable harvest of cultivated trees of Red Sanders from Government lands, including forests, to help reduce pressure on the wild populations. A good harvest management plan, with considerations of rotation age, for cultivated Red Sanders in Government lands, including forests, needs to be developed.**

Periodic assessments of cultivated stock may be made to ascertain the quota over the years. A sustainable harvest regime needs to be planned for the next two decades based on the present data and the data that would be collected through any fresh assessment in the future.

Implicit in the above assessment of available/existing stocks of Red Sanders from the cultivated source (Source "A") there is a need for fixing of a regular annual quota for export for Source "A" material.

A recommendation for the above is derived from the present NDF study to ensure a "regulated" export based on a sustainable harvest regime of cultivated stocks, and make sure that standing cultivated stocks do not get exhausted too soon and adversely impact the wild stock/populations by way of illegal extraction from the wild.

STEP 4: REVIEW OF CONSERVATION CONCERNS

4.1. Considering the conservation status assessments what is the indicated severity of conservation concern?

Severity of conservation concern: High

Review of earlier status assessments

The Red Sanders tree, *Pterocarpus santalinus*, an endemic tree with narrow distribution range in Pallakonda-Seshachalam-Veligonda-Nallamala hills, was feared to be on the verge of depletion way back in 1984 (Ahmedullah & Nayar, 1984) owing to continuous exploitation of the wood from the wild for illegal trade. Subsequently, it was enumerated as a 'Threatened' plant in the BSI publication *Endemic Plants of the Indian Region* (Ahmedullah & Nayar, 1987).

More than a decade later, the Red Sanders tree was assessed as **Endangered (EN)** in the IUCN Red List in 1998 as it was highly threatened primarily by rampant illegal extraction compounded by other threat factors such as livestock grazing and repeated forest fires, leading to a gradual decline of the wild populations. However, much to the dismay of the scientific community, it was re-assessed as Near Threatened (NT) in 2018, without resorting to a wider consultative process. The assessment rationale reads, "The species is globally assessed as **Near Threatened** as it almost qualifies for the **Vulnerable B1ab(iii, v)**". This self-contradictory statement reflects an ambiguity that makes the assessment suspect. While such assessments are made, the benefit of doubt, if any, should go in favour of the species which is clearly subject to severe threats. The logic for down-listing the species, in a scenario when all the threat factors are continuing to be operated and illegal felling/trade continuing rampantly, with the wild populations continuously declining, was incomprehensible, particularly when it was conceded that the "the species has been subject to historical population decline due to over extraction of trees for timber". The 2018 Red List Assessment also acknowledges that "currently, the species suffers from low fruit set and hence poor regeneration. Therefore, in the future, the population of the species may decline further and it is also predicted to suffer from genetic erosion and inbreeding depression due to relatively remaining small population(s)".

In context of the natural distribution of *Pterocarpus santalinus*, the 2018 IUCN Red List assessment also mentions that Red sanders is 'native' to Tamil Nadu and Karnataka and depicts the same in the annexed distribution map. The populations presently found in Tamil Nadu and Karnataka are purely cultivated ones. Some plantations in Tamil Nadu (Chengalpatu, N. Arcot) were established in the 1960's and later became naturalized. Similarly, the populations in Karnataka (Mandya) are cultivated plants that became naturalized.

Further, the argument of the 2018 'global assessment' rests on the criteria of AOO/EOO which apparently take into consideration the cultivated areas of Red Sanders in the neighboring states such as Tamil Nadu and Karnataka as well, thereby, effectively increasing the area of occupancy (AOO) and extent of occurrence (EOO). This is not acceptable as a bulk of the cultivated stock is in a juvenile stage of development which cannot be deemed as full-fledged mature populations. It may be noted that wild populations are endemically confined to the state of Andhra Pradesh only. The EOO as per the present study is 19655.921 km^2 and AOO is 1068 km^2 which have been depicted in the conservation assessment tool, GeoCAT (Figure 2).

Figure 2. AOO and EOO of Red Sanders depicted in GeoCAT software

All the above warrants a review of the 2018 IUCN Red List assessment of *Pterocarpus santalinus*.

4.2. Conservation concerns

The concern about the manner in which *Pterocarpus santalinus* was down-listed from 'Endangered' category to the 'Near Threatened' category, despite clear evidence to the contrary, is compelling. Therefore, there is an urgent to

challenge this assessment and call for a re-assessment, based on the fact that it is a narrow endemic, with discontinuities in occupancy/habitat, and has increasing fragmentation of populations/rapidly shrinking habitats and subject to severe threats, including rampant illicit felling/smuggling, livestock grazing, repeated forest fires, invasive species and other anthropogenic factors.

4.3. Present threat assessment

Severity of threat perception: High

A threat assessment was done as part of the current NDF study in Kadapa-Chittoor-Nellore-Prakasam-Kurnool districts of Andhra Pradesh. The specific threats observed during the field tours in all the forest divisions of Andhra Pradesh that naturally bear Red Sanders tree are as under:

Kadapa Forest Division

Threats

- Old cut stumps of Red Sanders were observed in Ippenta, Maddimadugu East beats of Kadapa Range, Kadikota, Korthimadugu, Guvvalacheruvu beats of Rayachoti range; Nadimaplly, Ontimitta, Madhavaram, Pathur, Chintharajupalli, Dasarladoddi, Nandalur beats of Ontimitta range; and Bonagundi Cheruvu beat of Vempalli Range. These indicate rampant illegal felling of the species in the areas.
- Forest fires are very common along all beats.
- Livestock grazing was observed in Maddimadugu West of Kadapa Range.

General observations

- Red Sanders leaves are used as fodder in Guvvalacheruvu East Beat of Rayachoti Range.

Chittoor East Forest Division

Threats

- Illegal felling was observed in S.K. Madugu, P. Gollapalli, Chellur beats in Satyavedu Range, Aadavaram in Sri Kalakasthi Range.
- Populations of Red Sanders were earlier known/recorded in Ganugapenta and Mangalampet beats of Pileru (Bhakarapet) Range, but

at present only some remnant old cut stumps are seen, indicating that the tree species has been subjected to illicit felling with the entire populations having become depleted now.

- Evidence of forest fires were found in almost all the forest beats, indicating that forest fires are frequent in this Division.
- Grazing by cattle was found to be very common in Nendrangunta, Yerpedu beats of Tirupathi range as well as the entire Pileru range.
- Invasive weeds are very common all the beats of Pileru Range and Melanchur beat of Sri Kalakasthi range.

Giddalur Forest Division

Threats

- Old cut stumps were seen in Ambavaram beat of Kanigiri Range, pointing heavy illicit felling in the area.
- Livestock grazing was found to be very common in Ambavaram Beat of Kanigiri Range.
- The seedlings of Red Sanders were observed to be eaten by caterpillars in Ambavaram Beat of Kanigiri Range.
- Quarrying for granite (locally known as blue metal) was observed in Vedullacheruvu Beat of Kanigiri Range. This illegal activity is indirectly impacting/degrading the natural Red Sanders forests.

General observations

- During the lean summer months the young foliage of Red Sanders tree was collected by local communities for use as fodder.

Nellore Division

Threats

- Fresh felling of Red Sanders trees was observed in Udayagiri Range.
- Old cut stumps were observed in Rajupalem Beat of Rapur Range, Atmakur Beat of Venkatagiri Range, indicating heavy illicit felling of Red Sanders.
- Livestock grazing was observed at Koturpalli Beat of Rapur Range.
- Forest fires, believed to be lit by locals, were found quite frequently.

Tirupathi WLM Division

Threats

- Illegal felling was found to be very common in Papanasanam, Gundampeta, Kangimadugu, Balapally West of Balapally Range; and Bhakarapet and Talakona South in Chamala Range.
- The NDF project team members saw smugglers operating in Krishnapuram beat of Tirupathi range. Fresh felling of Red Sanders was observed in Karakambadi, Mamandur South, while three-year old stumps of felled Red Sanders trees were observed in TN Palem Central and Papavinasanam Beats of Tirupathi Range.
- Introduction of *Acacia auriculiformis* and *Pinus* trees around the Alipiri and Papavinasanam beats of Tirupathi Range, carrying populations of Red Sanders, are posing a threat to the native species.
- The invasive weed, *Waltheria indica,* is found to be common in the entire Tirupathi Range.
- High pilgrim pressure was evident in the entire Tirumala forest area which harbours many temples inside the forests; the anthropogenic pressure is degrading the forest areas.
- Livestock grazing was seen frequent in Desettipalli Beat of Balapally Range and Nagapatla West of Chamala Range.

General observations

- It was reported that most of the smugglers come in the attire of pilgrims and later enter the forests areas for illicit felling/smuggling of Red Sanders.

Proddatur Division

Threats

- Cutting of *Chloroxylon swietenia* (Ceylon Satinwood) along with Red Sanders was observed in Thaduku Beat of Porumamilla Range.
- Old cut stumps of Red Sanders were noticed in Jyothi Beat of Porumamilla Range, indicating that illicit felling was carried out in the area.

- Fresh forest fires was observed in Mallepalle, Siddavaram, Tekurupeta, Balayyapalli, Jyothi beats.

General observations

- Most of the seized artefacts crafted from Red Sanders wood are from Porumamilla Range, indicating that some local communities subsist on illicit felling/trade of wood.
- It was observed that oxen and bullock carts are often used for transporting the illegally felled Red Sanders trees in Byanapalli Beat of Proddathur Range.
- Young leaves of Red Sanders were being used as fodder by the local village inhabitants.

Rajampet Division

Threats

- Illegal feeling was observed in Rollamadugu, Armanipenta, Vathalur, Annasagar and Annasamudram beats of Rajampet Range; Konduru Beat of Chitvel Range; and K.V. Bhavi South, N.G. Penta beats of Koduru Range.
- In the entire Rajampet Fores Division, particularly Vanarajpalli of Sanipaya Range, Rollamadugu, and Armanipenta of Rajampeta Range, it was reported that smugglers check the quality of the wood prior to identifying trees for felling. This was clearly evident on the bark of the Red Sanders tree. The open debarked/damaged tree trunks are susceptible to pathological infections.
- Invasive weeds are found to be very common in Salivendula Beat of Chitvel Range.

The present threat assessment surveys show that the species is subjected to very high levels of threat, with factors such as illegal felling, repeated annual fires, livestock grazing and invasive weeds adversely affecting population dynamics. Some secondary threats include pathological/pest infestations, damage due to debarking, anthropogenic/pilgrim pressure, etc.

Some village communities in Andhra Pradesh (particularly in Proddatur Range) and Tamil Nadu (Jawadi and Malyali tribes who inhabit the twin mountains of the same name that are at a distance of about 110 km from Seshachalam hills) are dependent on the Red Sanders wood and sandal wood for subsistence/ livelihood means; the Jawadi Malyalis form part of the communities who are traditional wood cutters and hunters and thrive on smuggling of Red Sanders wood. (Sensitisation programmes conducted by the Forest Department has apparently not yielded any substantial results.)

In terms of the primary basic threat factors, the same conclusion was drawn by the earlier NDF study (Hegde et al., 2012) conducted for the Red Sanders tree by another Scientific Authority (IFGTB) designated by the CITES Management Authority for India.

The rapidly increasing level of illegal trade reflected in the increasing stocks of seized/confiscated Red Sanders wood is indicative of the fact that the protection measures in place, although well structured, are inadequate in face of the rampant smuggling activities.

The present threat assessment done as part of this NDF study strengthens the argument for keeping the species in the Endangered (EN) category owing to the following major risk factors: (i) being a tree species with very long gestation period the species is at greater risk, (ii) endemic nature or narrow geographic range at global level, (iii) niche specificity in terms of climate, physiographic and edaphic factors (Red Sanders tree has exclusive preference for areas with quartzite and shale), and (iv) severity of threat being very high.

Therefore, there is no denying the fact that the Red Sanders is indeed an endangered species, with high severity of threat, and the conservation concerns are very much valid in the present day context.

STEP 5: EVALUATION OF INTRINSIC BIOLOGICAL RISK

What is the severity of potential biological risk?

Risk Severity : High

5.1. Geographic distribution

The species, *Pterocarpus santalinus* L.f., is endemic to the Eastern Ghats region of Andhra Pradesh where it forms part of the dry deciduous forest tracts at elevations ranging from 200 m to 900 m, with well-drained loamy lateritic soils and 800-1200 mm rainfall (Ahmedullah & Nayar, 1984). The species is confined to a narrow range (Kadapa-Nellore-Chittoor) of the Eastern Ghats.

Geographic distribution: The species, *Pterocarpus santalinus* L.f., is endemic to the Eastern Ghats region of Andhra Pradesh where it forms part of the dry deciduous forest tracts at elevations ranging from 200 m to 900 m, with well-drained loamy lateritic soils and 800 - 1200 mm rainfall (Ahmedullah & Nayar, 1984). The species occurs naturally in the Seshachalam-Veligonda hill ranges and Palakonda-Lankamala-Nallamala hill ranges in the Kadapa, Chittoor, Nellore, Kurnool and Prakasam districts of Andhra Pradesh. It has also been recorded in North Arcot and Chengalpet districts of Tamil Nadu. It is also under cultivation in Tamil Nadu, Andhra Pradesh, Karnataka, Kerala, Odisha, Maharashtra and West Bengal; the plantations are raised by Government agencies (mostly the Forest Departments) and farmers in private lands.

There are records of its introduction in Sri Lanka (Rudd ,1991); Arunakumara et al., 2011), Philippines (Pardo de Tavera, 2008) and Taiwan (Huang & Ohashi, 1977).

The other species of the same genus occurring in India are: *Pterocarpus dalbergioides* DC., *P. indicus* Willd., *P. macrocarpus* Kurz, *P. marsupium* Roxb., *P. marsupium* subsp. *acuminatus* (Prain) Thoth.

5.2. National/sub-national population size and distribution

The species is spread across 19655.921 km^2 of its area of natural distribution/occurrence, being mostly concentrated (in an order of density) in the Kadapa, Rajampet and Proddatur Forest Divisions of Andhra Pradesh,

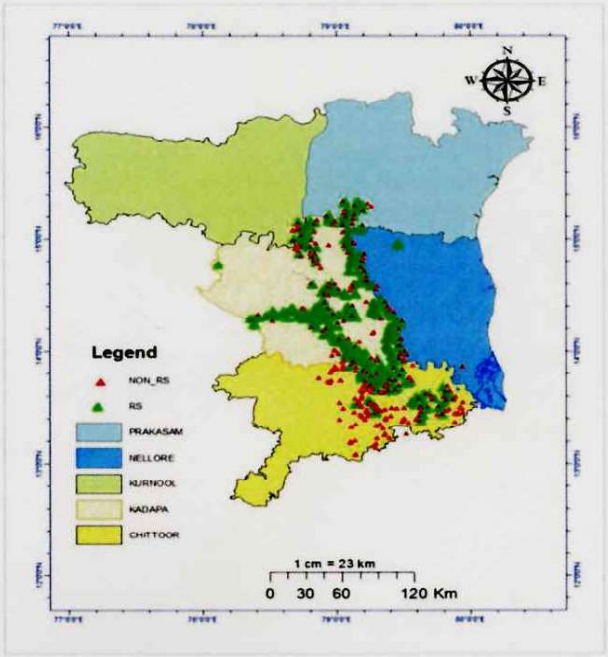
followed by Tirupati, Chittoor East, Nellore with sporadic distribution in Giddalur and Nandyal.

5.3. Size structure of national/sub-national populations

A field study was taken as part of the present NDF, the results of which are given below in terms of population structure/density and frequency.

Abundance: Quantitative assessment for Red Sanders was done by establishing 0.1 ha sample plots randomly in all the five districts (Kadapa, Chittoor, Nellore, Kurnool, Prakasam) of Andhra Pradesh comprising its natural range. As many as 616 sample plots (within 228 beats) within these Red Sanders forest areas were randomly covered during the study. The phyto-sociological parameters such as Relative Density (rD), Relative Dominance (rD) and Importance Value Index (IVI) were calculated following Cottom & Curtis (1956).

The major forest divisions studied (Kadapa FD, Nandyal FD, Chittoor East FD, Giddalur FD, Nellore FD, Tirupati WLMD, Proddatur FD, Rajampet FD) are reflected in Map 2.

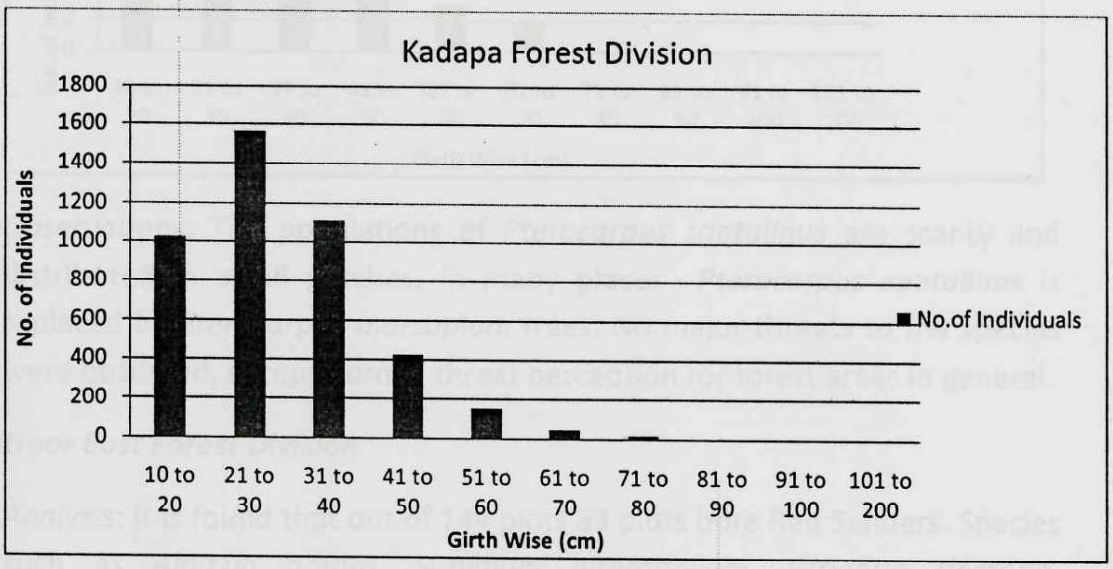


Map 2. Sampling points in the five districts of Andhra Pradesh

The resultant analytical findings/observations with respect to the individual major forest divisions studied are discussed below in brief.

Kadapa Forest Division

Analysis: Out of the 109 plots surveyed it was found that 87 plots had Red Sanders. The Red Sanders tree is the most dominant tree species in this Division, followed by *Croton scabiosus* and *Anogeissus latifolia*. It is observed that more than 94% of the Red Sanders trees are below 50 cm gbh and less than 1 % (0.7%) are above 70 cm gbh. Guvvalacheruvu West beat has some patches of pure stands of Red Sanders.

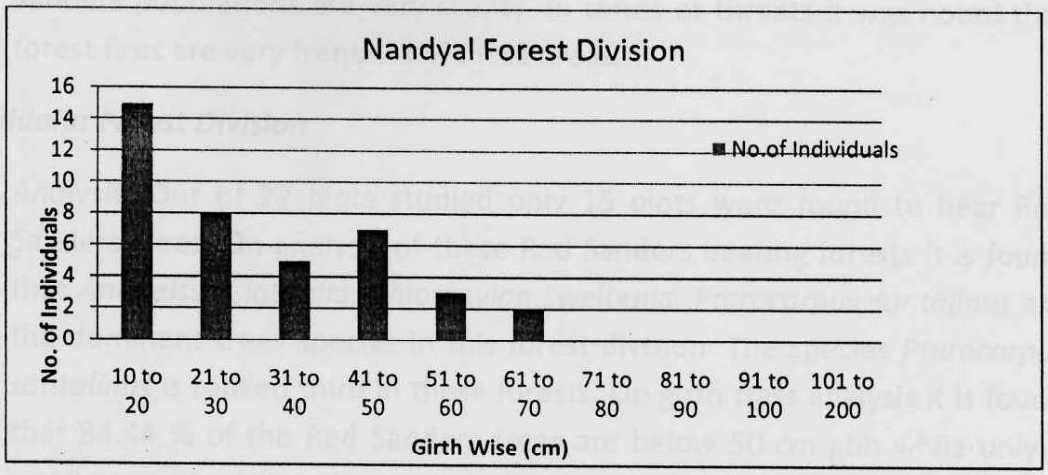


General observations: It is observed that regeneration of Red Sanders in hill slope areas and plateau are very high as compared to the plain areas. Coppicing (multistem individuals) is more in Kadapa Division as compared to other forest divisions. In terms of local utilisation by the local people the leaves of Red Sanders are used as fodder in Guvvalacheruvu East Beat. On threat assessment it was found that Gadikota, Chinntharajupalli, Dasarladoddi, Nandalur are the highly threatened areas.

Nandyal Forest Division

Analysis: Out of the 14 plots surveyed 5 plots had Red Sanders as part of their composition. The forest areas in this Division are dominated by *Anogeissus latifolia, Tectona grandis, Terminalia tomentosa, Chloroxylon*

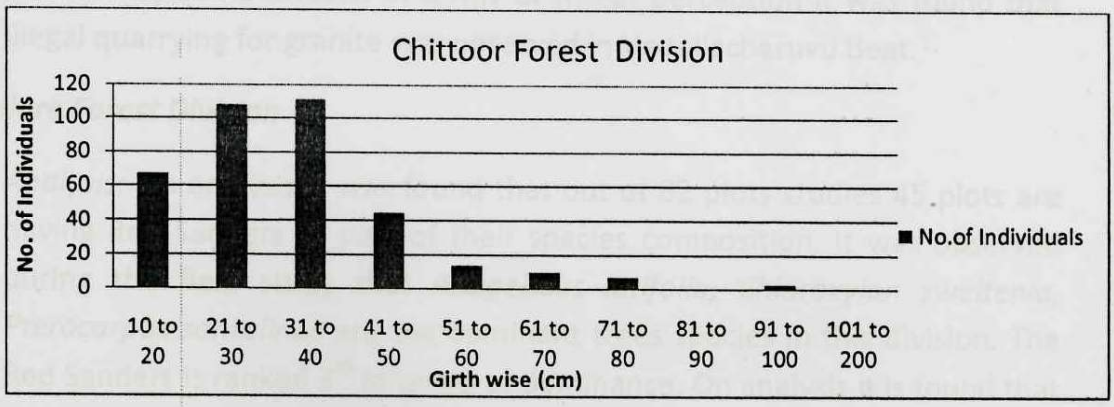
sweitenia. The *Red* Sanders tree (*Pterocarpus santalinus*) is ranked in 10th position based on the IVI. It is interesting to note that 87% of the Red Sanders trees are below 50 cm gbh and no trees of this species are found to be above 70 cm gbh.



Observations: The populations of *Pterocarpus santalinus* are scanty and distributed in small patches. In many places *Pterocarpus santalinus* is replaced by *Pterocarpus marsupium* trees. No major threats to the species were observed, except normal threat perception for forest areas in general.

Chittoor East Forest Division

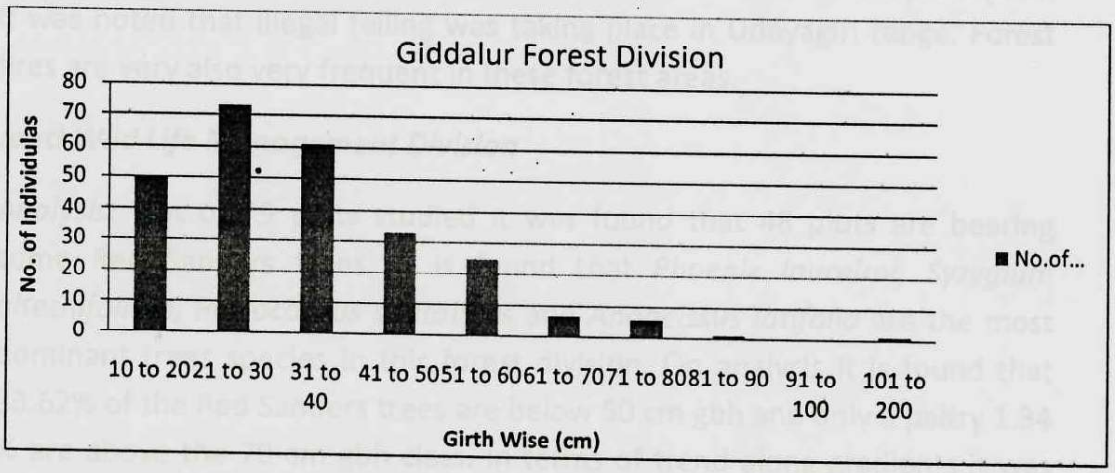
Analysis: It is found that out of 144 plots 33 plots bore Red Sanders. Species such as *Albizzia amara, Syzygium alternifolium, Wrightia tinctoria, Chloroxylon sweitenia* are the dominant based on the IVI. Red Sanders tree is ranked in 5th position in the forests of Chittoor East Division. It was found that about 90.7 % of the Red Sanders trees are below 50 cm gbh class and only 2.72 % of the trees are found to be above 70 cm gbh class.



General observations: Maximum forest areas are scrub jungles and Red Sanders are reported mostly from Srikalakasthi range. It was found that out of 144 sample plots studied only 33 plots in these forest areas were having Red Sanders as part of their species composition. Therefore, the Red Sanders populations are very scanty. In terms of threats it was noted that forest fires are very frequent in these areas.

Giddalur Forest Division

Analysis: Out of 27 plots studied only 15 plots were found to bear Red Sanders trees. On analysis of these Red Sanders bearing forests it is found that *Anogeissus latifolia, Chloroxylon sweitenia, Pterocarpus santalinus* are the dominant trees species in this forest division. The species *Pterocarpus santalinus* is ranked third in these forests. On girth class analysis it is found that 84.44 % of the Red Sanders trees are below 50 cm gbh while only a small percentage (3.1 %) are above 70 cm gbh class.

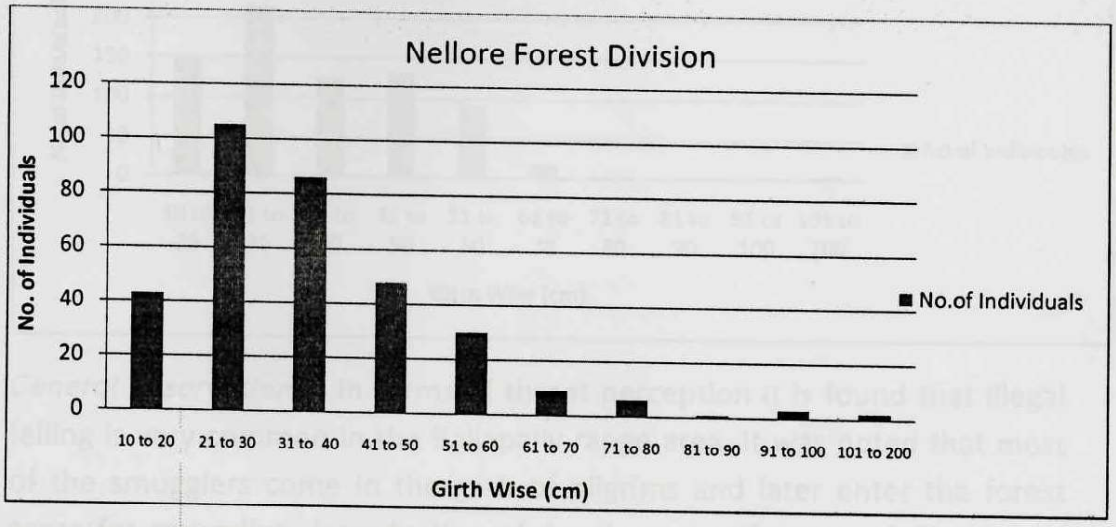


General observations: It was noted that seedlings of Red Sanders are affected by some insects. In terms of threat perception it was found that illegal quarrying for granite was observed in Vedullacheruvu Beat.

Nellore Forest Division

Analysis: On analysis it was found that out of 82 plots studies 45 plots are having Red Sanders as part of their species composition. It was observed during the field study that *Anogeissus latifolia, Chloroxylon sweitenia, Pterocarpus santalinus* are the dominant trees species in this division. The Red Sanders is ranked 3rd in terms of dominance. On analysis it is found that

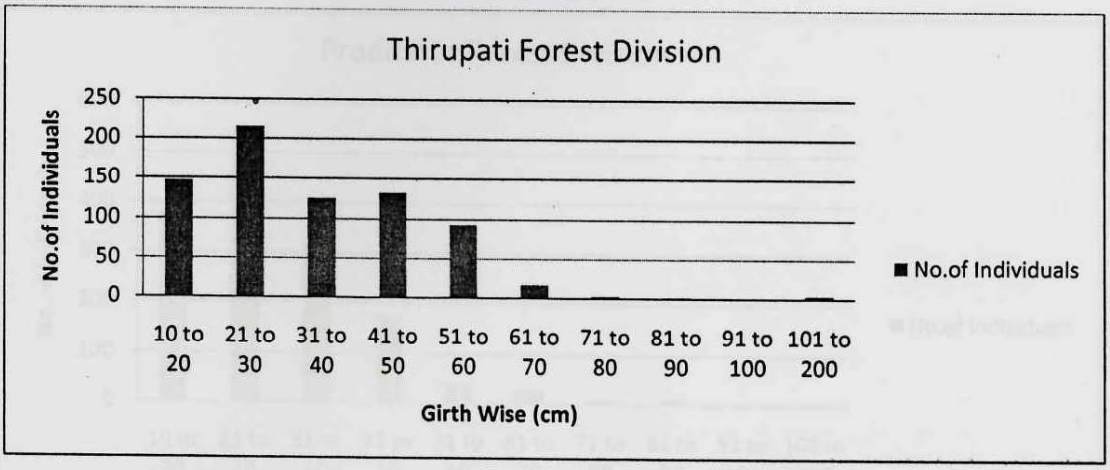
84.68% of Red Sanders trees are below 50 cm gbh class whereas only 3.6 % are above 70 cm gbh class.



General observations: Generally Red Sanders populations are more on slopes than plain and plateaus in this Division. In terms of threat perception it was noted that illegal felling was taking place in Udayagiri range. Forest fires are very also very frequent in these forest areas.

Tirupati Wild Life Management Division

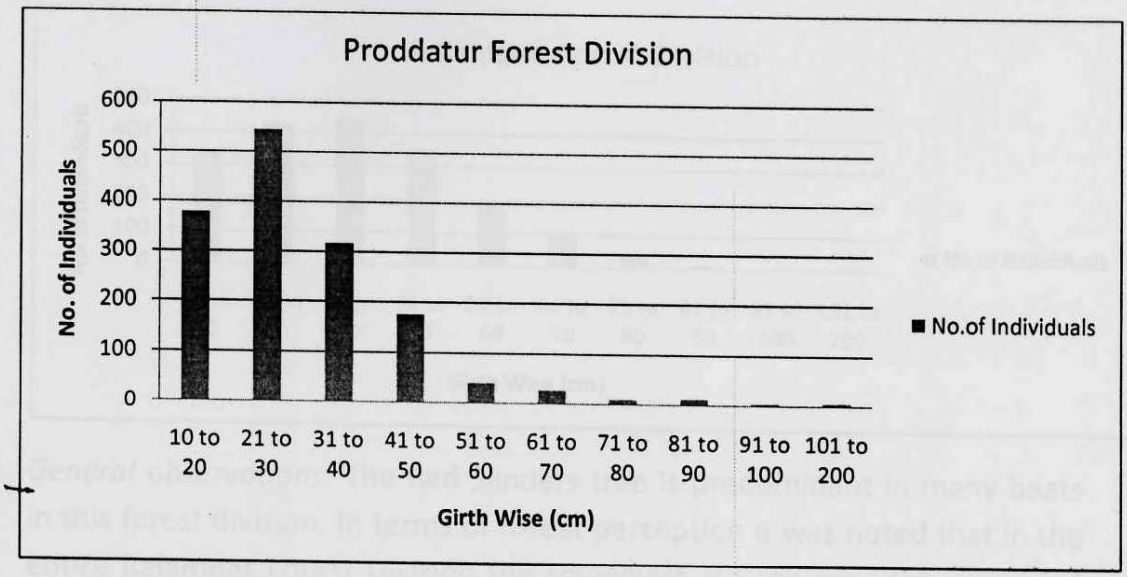
Analysis: Out of 79 plots studied it was found that 48 plots are bearing some Red Sanders trees. It is found that *Phoenix loureiroi, Syzygium alternifolium, Pterocarpus santalinus* and *Anogeissus latifolia* are the most dominant trees species in this forest division. On analysis it is found that 83.62% of the Red Sanders trees are below 50 cm gbh and only a paltry 1.34 % are above the 70 cm gbh class. In terms of trend along gradients it was found that the population of Red Sanders is gradually increasing from 300-600 m and gradually decreasing after 650 m altitude. No populations of Red Sanders were recorded above 1000m elevation.



General observations: In terms of threat perception it is found that illegal felling is very common in the Ballapally range area. It was noted that most of the smugglers come in the garb of pilgrims and later enter the forest areas for smuggling. Introduction of *Acacia auriculiformis* and *Pinus* trees around the Tirumala hills are posing threat to the native species. The entire Tirumala area, with many temples located in the forest areas, is subject to various anthropogenic pressures.

Proddatur Forest Division

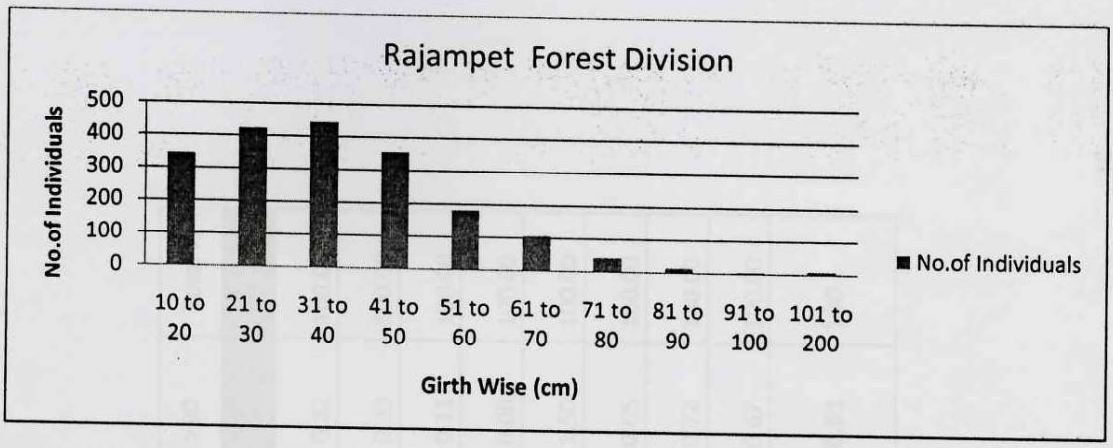
Analysis: Out of 70 plots surveyed during this study only 41 plots were found to have Red Sanders trees. *Anogeissus latifolia, Pterocarpus santalinus, Chloroxylon sweitenia,* are the dominant trees species based on the IVI values, showing that Red Sanders is ranked second in terms of dominance. On analysis it is found that 93% of the Red Sanders trees are below 50 cm gbh and only 2.22 % fall in the > 70 cm gbh class.



General observations: It was noted that a good amount of artefacts carved from of Red Sanders wood were seized from this forest division. It was also observed that oxen and bullock carts are used for transporting the illegally felled Red Sanders trees in Boyanapalli Beat. In terms of local utilisation it was noted that leaves of Red Sanders are used as fodder by the local communities.

Rajampet Forest Division

Analysis: Out of 91 plots surveyed during the present study 70 plots were found to be Red Sanders bearing. It is found that *Pterocarpus santalinus, Acacia chundra, Anogeissus latifolia and Grewia daemia* are the dominant trees species based on the IVI values. The Red Sanders tree found to be most dominant being ranked first. On girth class analysis it was found that 81.16% of Red Sanders trees are below 50 cm gbh and only 3.83 % are in the >70 cm gbh class.



General observations: The Red Sanders tree is predominant in many beats in this forest division. In terms of threat perception it was noted that in the entire Rajampet Forest Division the smugglers are checking the quality of the wood by removing the bark; this debarking makes the tree susceptible to infections, posing a threat to the populations.

Girth class distribution

Analysis of the girth class distribution for the Red Sanders populations studies showed that out of the total 616 sample plots 344 plots were Red Sanders bearing forest plots. It was generally seen that more than 72% of individuals are under 40 cm gbh class. The harvestable girth class (of > 70 cm) of Red Sanders trees were just about 2.19 percent, of which only 0.61 percent were of > 90 cm girth. The younger individuals are more in the Proddatur Forest Division (ca. 81 percent) and less in Rajampet Forest Division (c. 65%). The higher girth class trees were found to be more in Rajampeta (3.83%), Nellore (3.6%) and Giddalur (3.08%) and less in Kadapa (0.7%). The >70 cm girth class trees were totally absent in the Nandhyal Forest Division. The summary of the girth class distribution in the eight Forest Divisions bearing Red Sanders are depicted in Table 11 and Figure 3.

Table 11. Summary of girth class distribution of Red Sanders

Division	Total Plots	RS Plots	<30	31-40	41-50	51-60	61-70	71-80	81-90	>90	Total %
Chittoor East	144	33	47.81	30.60	12.30	3.83	2.73	1.91	0.00	0.82	100.00
Giddalur	27	15	47.86	23.74	12.84	9.73	2.72	2.33	0.39	0.39	100.00
Kadapa	109	87	59.28	25.61	9.73	3.53	1.15	0.48	0.11	0.11	100.00
Nandyal	14	5	57.50	12.50	17.50	7.50	5.00	0.00	0.00	0.00	100.00
Nellore	82	45	44.44	25.83	14.41	9.01	2.70	1.80	0.30	1.50	100.00
Proddatur	70	41	60.54	20.81	11.65	2.81	1.96	0.72	0.85	0.65	100.00
Rajampet	91	70	39.80	22.93	18.43	9.47	5.54	2.28	0.83	0.72	100.00
WLM Tirupati	79	48	48.72	17.05	17.85	12.62	2.42	0.40	0.27	0.67	100.00
Total	**616**	**344**	**50.74**	**22.38**	**14.33**	**7.31**	**3.02**	**1.24**	**0.34**	**0.61**	**100**

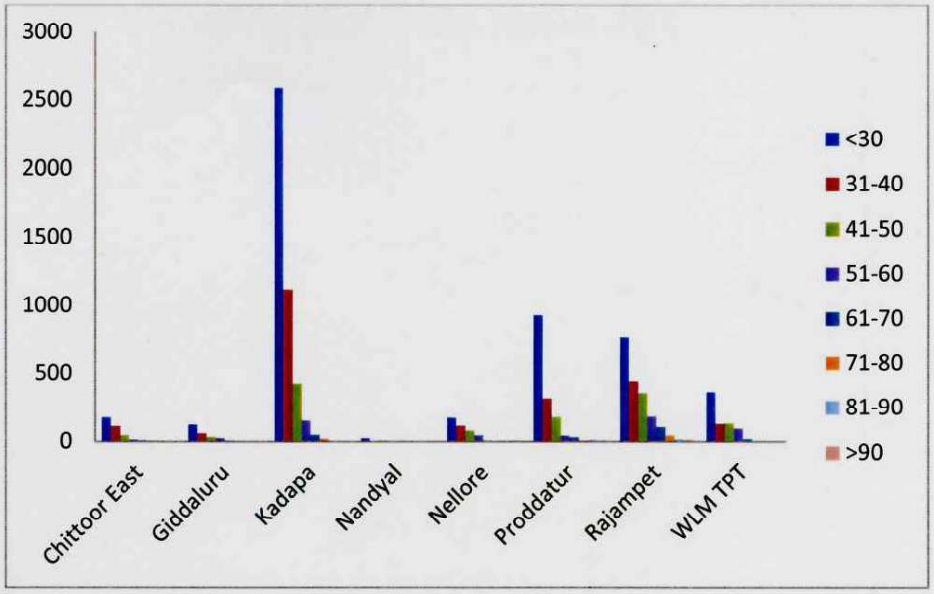


Figure 3. Girth class distribution of Red Sanders in the eight forest divisions of Andhra Pradesh

Stratum wise distribution

As part of this NDF study field survey was conducted in 30 forest ranges covering 228 beats in the five forest divisions of Andhra Pradesh. Out of these Red Sanders populations were recorded only in 27 ranges and 173 forest beats.

The stratum wise analysis of the present study reveals that populations of Red Sanders are more in the plateau areas (48%) followed by the slope areas (43%). Although in general Red Sanders are predominantly found in the slopes, the obvious reason for the marginally out of true distribution derived in this study is that the sampled plots were mostly laid in the plateau areas (Kadapa and Rajampet areas). The distribution of Red Sanders is mostly governed by elevation; it grows best in optimum elevation range of 300-600 m. In Tirupati hills, for example, the plateau areas did not harbour many trees of Red sanders as the areas are at elevations above 700 m. The distribution of Red Sanders was found to be very low in the in plains, sometimes even negligible. The sample points laid in the plains of Giddalur, Kadapa and Nandyal showed total absence of Red Sanders trees. The summary of stratum-wise distribution of Red Sanders tree is shown in Table 12.

Table 12. Summary of stratum wise distribution of Red Sanders

S. No.	Name of the Forest Division	Total No. of Ranges			Total No. of Beats			No. of Sampling Plots			Stratum wise RS Population (%)			
		Total	Non RS	RS	Total	Non RS	RS	Total	Non RS	RS	Plain	Slope	Plateau	Total
1	Chittoor East	7	3	4	65	42	23	144	111	33	2.22	40.63	57.14	100
2	Giddalur	2	0	2	9	0	9	27	12	15	0.00	45.81	54.19	100
3	Kadapa	5	0	5	38	1	37	109	22	87	12.26	43.94	43.80	100
4	Nandyal	1	0	1	6	2	4	14	9	5	0.00	41.67	58.33	100
5	Nellore	4	0	4	28	0	28	82	37	45	0.00	50.99	49.01	100
6	Proddatur	4	0	4	22	2	20	70	29	41	2.41	59.94	37.34	100
7	Rajampet	4	0	4	32	4	28	91	21	70	24.81	33.19	42.00	100
8	WLM Tirupati	3	0	3	28	4	24	79	31	48	14.80	36.90	48.30	100
		30	3	27	228	55	173	616	272	344	7.06	43.76	48.76	100

NOTE: It may be noted that the Andhra Pradesh Forest Department (APFD) has completed the quantitative study by establishing the 0.1 ha in three strata viz., Hills (above 30° slope above or below 300m elevation), Plain area (below 30° slope and below 300m elevation) and Plateau area (below 30° slope and above 300m elevation) randomly in red sanders bearing forest divisions (APFD, 2015). As the NDF study required an independent study the present study was done with a fresh field study. Owing to this reason the present BSI study has not taken the APFD enumeration details/inventory into consideration as it was planned to be an independent one with primary data for the purpose of developing an unbiased NDF for Red Sanders.

5.4. Habitat specificity and vulnerability

Risk severity: High

Habitat specificity: The Red Sanders is known to effectively utilise the microhabitats on the dry hill slopes (Raju & Nagaraju, 1999). The Red Sanders tree is almost niche-specific in terms of the geology of the area in which it prefers to grow; it is found in areas with quartzite and shale, indicating a geo-botanical response to these stratigraphic/geological formations along the Kadapa-Nellore-Chittoor range of the Eastern Ghats. A study has found that almost 80 per cent of naturally growing Red Sanders occurs in rocky outcrops comprising quartzite with the remaining in areas having shale (Raju & Nagaraju, 1999). Of the various rock formations investigated, areas with quartzites, which contain high levels of potassium, were found more suitable for Red Sanders of good quality. In another interesting study (Raju & Raju, 2000) it was seen that the heartwood of *Pterocarpus santalinus* accumulated larger quantities of uranium and thorium in comparison to *Pterocarpus dalbergioides* and *Pterocarpus marsupium*.

Vulnerability: Owing to the fact that the Red Sanders has been subject to historical illegal felling/extraction from the wild for illicit trade, which continues to this day, the wild populations are continuously declining rapidly. The species is also vulnerable to various other factors, including ecological/biological factors.

Vulnerability to disturbance regime: Selective felling of *Pterocarpus santalinus* is the direct result of its high demand in international market. Selective felling/over-exploitation of single species alters its regeneration potential and in effect its population structure in entirety (Bharali et al., 2013). A study on the tree diversity structure of a dry deciduous area in Sri Lankamalla sanctuary located in southern eastern Ghats (Mastan et al., 2016) revealed that the population structure of *Pterocarpus santalinus* has high abundance of individuals in the lower girth class owing to its regeneration potential, adaptation to local conditions and also to due selective logging of the higher girth class trees.

To specifically evaluate the impacts of a disturbance regime on the population structure of Red Sanders a study was undertaken by Ankalaiah et al. (2017); the study assessed the impacts of logging and other threats on this endemic tree species. The study assessed the impacts on three selected sites (Guvvalacheruvu, Vangimalla and Gadala) in the Kadapa hill ranges taking into account the life forms of Red Sanders under development (seedlings, saplings, regenerating trees and fully mature trees) with reference to various disturbance regimes with selective logging as the primary threat. The results showed variations in the distribution of gbh class and population structure of Red Sanders; trees and seedlings were observed to be the major life forms. Sapling distribution showed high variation as major thinning apparently occurred in the progression from seedling stage to fully established maturity stages. Among the three study sites, the moderately disturbed site showed high density of individuals of all life forms and basal area value. In the relatively less disturbed site all the three life forms, except for regenerating trees, scored a second place, while in the highly disturbed site regenerating trees scored a second position and all other life forms had lesser number of individuals. The gbh class-wide distribution in the highly disturbed site showed reverse 'J' shaped curve with maximum individuals occurring in the lower girth classes of 10-30 cm (52%) and 31-50 cm (42%). Significantly, in the study of Ankalaiah et al. (2017) the highly disturbed study site lacked large girth class trees, i.e., reproductively fit mature individuals, while, surprisingly, high percentage of cut stems and non-reverse 'J' shape population occurred in less disturbed site. The study indicated that selective logging is the major factor that influenced

the variation of population structure, stem density and basal area. The study concluded that selective felling of Red Sanders can be a major factor for abnormal size-class distribution and total lack of mature trees is owing to past and present indiscriminate and rampant illicit felling of the tree species.

Biological vulnerability: The pollination ecology is also said to be vulnerable to the hot/arid climatic conditions that prevails in the region. The Red Sanders tree is known to suffer from low fruit (ca. 6 percent) set and hence poor regeneration. The natural fruit set occurs as a result of pollinator activity in the moonlit nights; the severely hot winds prevent the pollinators, rock bee (*Apis dorsata*) and carpenter bee (*Apis xylo-copa*), from visiting the flowers/forage for nectar during daytime only. The blooming phenology and pollination mechanism in Red Sanders has been dealt with in detail by Rao et al. (2001) and Rao & Raju (2002). In conditions when the pollinators are scarce self-compatibility through geitonogamy remains the only option for seed production; this is a biological strategy to produce seeds in adverse conditions of resource scarcity including pollinators. However, cross-pollination mainly occurs showing that facultative xenogamous breeding system prevails in Red Sanders.

Compared to the high flower production, with the phenomena of intermittent mass blooming, the natural fruit production/set is very low, owing to the large scale abortions, with xenogamous fruits developing to maturity and autogamous and geitonogamous fruits dropping off. This suggests that the species has not evolved any strategy to increase fruit set through geitonogamy (Rao et al., 2001). The factors for low fruit set could mainly be the limiting climatic factors during seeding and progressive purging of poor seeds from self pollination, less probability of out-crossing, due to limitations of population size and availability of pollinator. Lower fruit production due to selective abortions may be attributed to limitation of resources (Bawa & Webb, 1984). Therefore, in the future, the population of the species may decline further and it is also predicted to suffer from genetic erosion, and inbreeding depression due to relatively small remaining populations (Arunakumara et al., 2011). Clearly, population size is critical for the survival of the species.

Vulnerability to repeated forest fires: The Red Sanders seedlings are adversely effected by the repeated forest fires in the early developmental stages, despite

their characteristic die-back quality. The repeated forest fires also have a continuous scorching effect throughout the tree's life (Hole, 1913), posing a potential and constant threat. Interestingly, seed germination, seedling height and root collar diameter were notably encouraged by fire (Kukrety et al., 2013); but this is applicable only when seedlings are subjected to forest fire on one or two instances only. In tropical dry forests survival of seedlings is said to be influenced by various abiotic/anthropogenic factors and a majority of the plant populations show greater reduction in the seedling stage (Khurana & Singh, 2001). Therefore, the Red Sanders is also prone to exhibit a higher degree of thinning during the seedling to maturity phases owing to factors such as repeated forest fires to which its natural area is very susceptible.

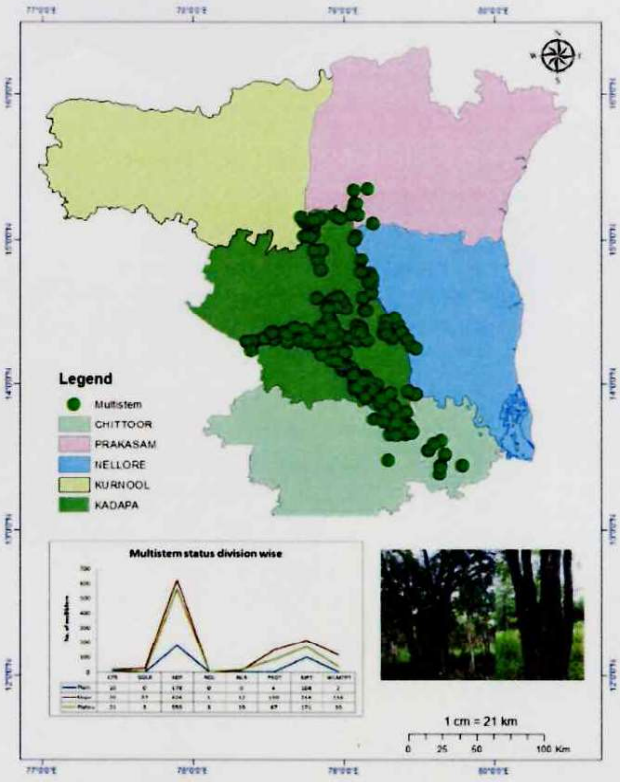
5.5 Resilience of tree species

The Red Sanders tree has survived rampant exploitation since the sixteenth century owing to its regeneration potential and immense capacity for coppicing. It would not, therefore, not be wrong to say that this resilience has helped the species survive so far despite sustained exploitation over the decades.

Regeneration: Under conducive edaphic conditions the natural regeneration in Red Sanders tree is fairly good; with good loose soil containing adequate moisture seeds sprout well provided they are safeguarded from intensive browsing pressure and recurring fires. Characteristically, a die-back feature is observed till the roots of seedlings develop a thick enough root to be able to sprout a vigorous shoot capable of withstanding drought conditions. Seedlings attain a height of about 10-15 cm with a long tap root system by the end of the first season (Luna, 2005). The regeneration potential of the species has helped the species survive and re-establish fresh populations.

Coppicing: In the present study coppicing was found to be intense Kadapa, Rajampet, Proddatur and WLM Tirupati (in the same order) indicating prevalence of continuous illegal felling practices in these areas (Map 3). In context of stratum-wise analysis it is found that maximum coppicing is in the

slope areas followed by plateau, with minimum in the plains, indicating greater resilience in slope areas.



Map 3. Areas with coppicing in Red Sanders bearing forests

During the random sampling done in the field work for the NDF study it was observed that the Red Sanders forests areas were dotted with small to large areas having coppices/multi-stems indicating past as well as present Illicit felling of Red Sanders trees. These gap areas were mostly without mature individuals, a reflection of the fact that Red Sanders trees were being systematically lopped off in the forest areas, particularly in the Kadapa-Rajampet-Tirupati-Proddatur-Nellore ranges. Fresh felling was observed mostly in Tirupati and Udayagiri range of Nellore District indicating that smugglers were presently targeting the species in these areas. It was also seen that the selection for felling was based on age/girth class and the trees were selectively and randomly felled leaving a mix of mature and young trees in certain forest areas. The specific areas where first-hand observations were made in the eight forest divisions of Andhra Pradesh are given below:

Kadapa Division: Vampalli Range (Bonagundicheruvu) Kadapa Range (Rasoolpalli, Ippapenta, Guvvalacheruvu East), Vontimitta Range (Nandalur, Dasarladoddi, Chintarajupalli, Mantapampalli, Patur).

Giddalur Division: Singasanipalli, Ambavaram

Nandyal Division: Utla and Peddavangli

Rajampet Division: Rajampet Range (Annasagar, Annasamudram, Aramanipenta, Rollamadugu, Thummalabailu, Vattalur), Sanipaya Range (Jandrapenta), Kodur Range (K.V. Bhavi North and South), Chitvel Range (Chukkavaripally, Kondur).

Proddatur Division: Proddatur Range (Boyanapalle), Badvel Range (Gangireddipally), Porumamilla Range (Jyothi and Thaduku).

Nellore Division: Udayagiri Range (Gudigunta), Atmakur Range (Venkatapuram), Rapur Range (Koturpalle, Rajupalem).

Chittoor East Division: Puttur Range (Vadamalpet), Srikalahasti Range (Katur and Ramapuram), Satyavedu Range (S K Madugu), Tirupati Range (Chellur).

Tirupati Division: Balapalli Range (Sailendrakona, Papanasanam, Mogilipenta, Kangimadugu, Balapalli West, Papavinasanam), Chamala Range (Talakona South, Nagapatla West), Tirupati Range (Krishnapuram, Karakambadi, Mamandur South, TN Palem).

Without any doubt, it can be said that the characteristic regeneration potential and coppicing capacity of the Red Sanders have contributed immensely to the resilience of the species and helped it survive so far despite wanton exploitation over the years.

STEP 6: EVALUATE IMPACTS OF WILD HARVEST

6.1. Impact of harvest on target populations

Severity of wild harvest: High

It has been mentioned in the earlier step that illegal felling is the single major threat to which the Red Sanders is subjected, and this certainly has adverse impact on the wild populations of the species. It must be acknowledged that illicit selective logging of Red Sanders is the direct result of its high demand in international market. The selective logging/harvest of Red Sanders can be seen across its entire natural range in the State of Andhra Pradesh its regeneration potential and in effect its population structure. A recent study (Ankalaiah et al., 2017) assessed the impacts of harvest on Red Sanders on some selected sites in the natural range of the species in context of selective logging along with other threat factors. The significant finding was that the highly disturbed areas lacked large girth class trees, i.e., reproductively fit mature individuals, while, surprisingly, high percentage of cut stems and non-reverse 'J' shape population occurred in less disturbed site. This indicated that selective logging is the major factor that influenced the variation of population structure, stem density and basal area. It was concluded that selective felling of Red Sanders can be a major factor for abnormal size-class distribution and total lack of mature trees is owing to indiscriminate and rampant illicit felling of the tree species.

Girth class analysis made through the present study indicates that the impact of illicit harvest of Red Sanders is of medium to high severity across the natural range of the species (Ref. Step 5).

The exploitation of Red Sanders by smugglers is inordinately high, impacting natural populations. Although the seedling recruitment/establishment and regeneration is fairly good, the rate of depletion of natural populations of Red Sanders is a cause for concern.

6.2. Impact of harvest on national population

Severity of wild harvest: High

The species is endemic to the Seshachalam-Veligonda hill ranges and Palakonda-Lankamala-Nallamala hill ranges of the Eastern Ghats of Andhra Pradesh and as the wild populations are confined to this narrow range, the national populations are subject to considerable risk if the overexploitation (illicit harvest from the wild) continues in its natural range. It would only be a matter of time for the natural/national populations to become depleted, if protection measures are not properly implemented and the illicit trade fully controlled.

Cultivated source: The single best option for reducing the pressure on the wild populations is to go in for large-scale cultivation programmes. The State Governments of Andhra Pradesh, Tamil Nadu, Telangana and Karnataka are doing a yeoman service in this direction by encouraging farmers to cultivate Red Sanders in their private lands.

From a commercial standpoint planting Red Sanders may not be very viable in terms of quick returns/gains. In cultivated stocks the slow growth of Red Sanders or the long gestation period leads to long rotation period slowing the economic returns for wood farmers.

6.3. Impact of harvest on other similar species

Severity of wild harvest on similar species: Low

The only other species of *Pterocarpus* in the peninsular India is *P. marsupium*, commercially known as 'Beejasal' in trade, which is exploited for its use in medicine and timber and as source of 'Kino gum', a resinous exudate. However, the timber is not as much sought after as Red Sanders. *P. marsupium* is found in the dry deciduous mixed forests of India south of the Himalayas, being more abundant in the states of Gujarat, Madhya Pradesh, Chhatisgarh, Bihar and Odisha. Therefore, the impact of harvest of *P. santalinus* does not have any direct bearing on the other species, *P. marsupium,* which has its own trade value/importance in international market. The other species of the genus in India are *P. dalbergioides* (endemic to Andaman-Nicobar islands), *P. indicus* and *P. macrocarpus*, all of which are of use as timber and in medicine, but their demand is exclusive from that of *P. santalinus.*

STEP 7: EVALUATE IMPACTS OF TRADE

What is the impact of legal and illegal trade on the national populations of the species concerned?

Background: The Red Sanders is said to be in trade since the sixteenth century; it was initially being exported to the European countries as a source of natural dye, which subsequently diminished as the artificial dyes made their way into the market stream. The Dutch traders were also known to have exported huge quantities of wood. Export of Red Sanders to Europe continued in the seventeenth century primarily for dye, although there was some demand for wood as well. Exports averaged about 3000 tonnes annually around 1880; the primary demand was by the United Kingdom. Export of Red Sanders as a textile dye effectively diminished with the advent of synthetic/artificial dyes. The value of Red Sanders wood began to shoot up again in the international market when the Japanese approached the Forest Department of Andhra Pradesh for wood. The history of utilisation/trade of Red Sanders wood has been recorded in detail (Reddy, 1972). As per records (Gamble, 1902) during the five years ending in 1882-83 about 12,782 tonnes of Red Sanders was exported to UK, 1116 tonnes to France and 1687 tonnes to other Indian and Sri Lankan ports. During 1882-1901 Red Sanders wood was extracted by contractors without any restrictions as to the localities from it was to be procured. As per earlier records the Andhra Pradesh Forest Department (APFD) has sold about 1400 MTs of Red Sanders; the sale was effected at the rate of Rs. 1,20,000 per MT (APFD 2005). Subsequently, 2002 MT of Red Sanders wood was auctioned in 2008; the bid rate was Rs. 2.5 to Rs 7 lakhs per MT (GoAP, 2009) different grades of wood, averaging Rs. 4 lakhs per MT. Over the years the value of traded Red Sanders wood increased to US $ 150,000 per Cubic Metre (Wenbin & Xiufang, 2013) and at present it is said to be worth around Rs. 40 lakhs (ca. US $ 58040) per tonne.

At present the legal trade is mostly from seized/confiscated source which is sold by e-auction mostly through the State Forest Departments of Andhra Pradesh, Karnataka, and Tamil Nadu. The State Forest Departments are the authorised agencies for effecting sale/export of from seized/confiscated source.

The details of trade as per the CITES Trade Database are given at Table 13 and depicted in Figure 4.

Table 13. Trade of Red Sanders from 2010-2017

Year	2010	2011	2012	2013	2014	2015	2016	2017
Exports in MT	69.1	32.3	5.4	5.4	752.2	288.4	727.2	15859.9

Source: CITES Trade Database

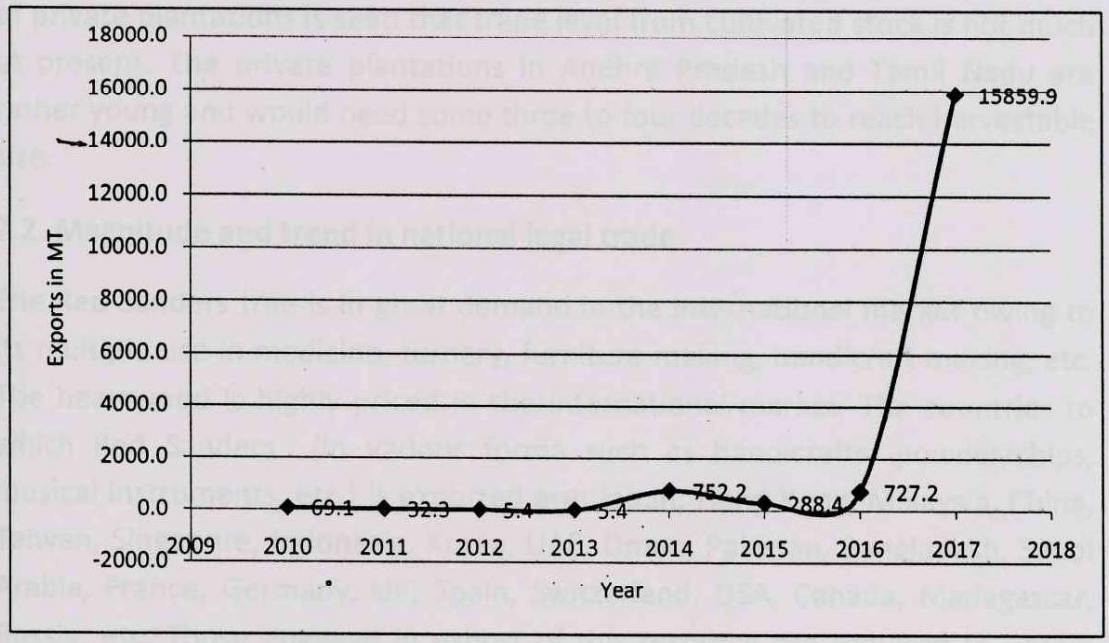


Figure 4. Trade in Red Sanders based on CITES Trade Database

The steep rise in the sale of Red sanders is owing to the one-time permit/ national quota accorded by the CITES Secretariat during 2014-2015 for sale of 9,090.09 MT of seized/confiscated wood; the revenue accrued by the state of Andhra Pradesh from the sale of Red Sanders wood from its quota of 8498 MTs during the current period (2018-2019) is Rs. 251.82 crores (APFD, 2019). The yearly quota permitted for India from Source A from the year 2012 onwards is 310 MT. The quantum of trade include Red Sanders logs/timber, chips, powder, extracts, sawn wood and carvings (artifacts); the source is mostly from 'unknown origin'/' India', which would apparently be seized specimens. The quantum of pre-convention specimens amount to about 5,900 MT.

No quantitative studies on the impacts of the legal/illegal trade on the natural populations are available. However, the previous NDF as well as the present study point out that the illegal felling is at the cost of natural populations.

7.1. Trade level in relation to harvest area production

The trade level from wild populations; particularly for girth classes above 40-50 cm is quite high. However, detailed information is not available owing to poor documentation process and lack of proper monitoring mechanism. In context of private plantations is seen that trade level from cultivated stock is not much at present. The private plantations in Andhra Pradesh and Tamil Nadu are rather young and would need some three to four decades to reach harvestable size.

7.2. Magnitude and trend in national legal trade

The Red Sanders tree is in great demand in the international market owing to its multiple use in medicine, turnery, furniture making, handicraft making, etc. The heartwood is highly priced in the international market. The countries to which Red Sanders (in various forma such as handicrafts, powder/chips, musical instruments, etc.) is exported are: Japan, Hong Kong, Malaysia, China, Taiwan, Singapore, Indonesia, Korea, UAE, Oman, Pakistan, Bangladesh, Saudi Arabia, France, Germany, UK, Spain, Switzerland, USA, Canada, Madagascar, Russia, etc. Those engaged in export of this resource are required to obtain export license, for which a certificate of origin, with details of quantity and date of procurement, from the office of the PCCF of State from which the Red Sanders has been sourced. Stock verification is done by an official from the office of the PCCF. The trade data on Red Sanders from the year 2010 to 2017 is indicative of the high level of trade of this species.

7.3. Magnitude of illegal trade

Magnitude of illegal trade: High

It is clear that legal trade is much very limited as compared to the illicit trade that is rampant in context to Red Sanders. The numerous seizures of Red Sanders wood from various states (through which the logs are transited) in India as well as other countries bears testimony to the fact that illegal felling

from the is wanton and trade unabated. The details of seizures of Red Sanders from 2002 onwards are given below (Table 14).

Table 14. Details of criminal cases booked in relation to Red Sanders (2002 to 2018)

Year	*No. of cases recorded*	*Red Sanders wood seized (in MT)*	*Number of vehicles seized*	*No. of persons arrested*
2002-03	183	187.72	42	39
2003-04	481	719.09	122	320
2004-05	269	323.93	118	310
2005-06	458	623.99	199	319
2006-07	728	1028.89	393	378
2007-08	890	1438.84	304	819
2008-09	668	797.66	223	433
2009-10	880	922.07	384	630
2010-11	1373	1250.21	772	1391
2011-12	1346	1437.18	985	2658
2012-13	1488	1389.58	1002	3139
2013-14	2038	188.21	1366	4243
2014-15	1353	886.59	971	3831
2015-16	752	353.48	474	2586
2016-17	630	309	486	2384
2017-18	373	155.018	312	1973
Total:	14132	13734	8553	25387

Source: APFD

The high demand of Red Sanders in international market is the main cause of illegal felling and smuggling. As can be seen overexploitation of Red Sanders tree from the wild over decades without any commensurate replenishment in the wild has remained the major threat to the species leading to its continued depletion (Ahmedullah & Nayar, 1984). Despite many protection measures being put in place by the State Forest Departments there is no containment of the rampant smuggling/illicit trade whatsoever, due to which the threat perception for the species is much more now than it was earlier.

In the recent years illegal felling and smuggling of Red Sanders has increased many folds and the off take is being illegally exported to many countries threatening the survival of the natural populations in the wild.

It is apparent that illegal felling/smuggling/trade continues unabated as evidenced by the news reports in the media with singular regularity.

Owing to the exorbitant rate the demand for Red Sanders in international market has made a quantum leap which has given rise to heavy illegal felling in the natural forests. The illegal activities relating to Red Sanders in Chittoor were documented in context to the protection measures (Bhagyaraj, 2017).

The magnitude of illegal trade mostly remains unrecorded as documentation is possible only after seizures take place and are recorded through the administrative procedures/process of the concerned state. It is expected that only about 30 percent of illegal trade is recorded through seizures.

Review of confiscated/seized stock

Confiscated stocks of Red Sanders are in custody of the state forest departments of Andhra Pradesh, Manipur, Maharashtra, Karnataka, Telangana and Tamil Nadu. Some stocks are also in the custody of customs house (JNCH, Mumbai). The quantum of stock in these states as per their communications to BSI is given below (Table 15).

Table 15. Confiscated Red Sanders Stock details in various states

State Name	*Quantity in MTs*
Manipur	3.044
Maharashtra	1115.04
Karnataka	257.73
Telangana	1123.972
Tamil Nadu	987
JNCH, Mumbai	1189.956
Andhra Pradesh	7888.981
Total	12565.723

It is generally seen that seized wood has all classes of logs, although only the ones above 70 cm girth class are sought in the international market. The seized logs are of 50-90 cm girth. However, the local woodcutters also indiscriminately cut the trees, apparently for domestic use as small timber for minor construction and/or agricultural implements/tools. However, the demand for the Red Sanders wood in the local market is believed to be very low.

The illegal trade could also affect the international market value/potential of Red Sanders wood cultivated by farmers, for whom it is of high subsistence value. The slow growth of the tree, which takes about 18-22 years to start developing the heartwood and takes about 70-80 years to give the heartwood (>70 cm girth) of desired quality, leads to very long rotation period, and therefore, does not lend itself to quick market returns for the farmers. The illegal trade thus only adds to their woes. It is expected that permission for export of Red Sanders from cultivated source would considerably reduce the illicit felling from the wild and thereby help in the containment of illegal trade.

STEP 8: EVALUATE APPROPRIATE RIGOUR OF EXISTING MANAGEMENT/ PROTECTION MEASURES

8.1. What management/protection measures are in place for the target species?

Review of legislations

National level: The two main legislations regulating/governing the harvest of forest produce, including medicinal plants, at national level are the Indian Forest Act, 1927, and the Wildlife (Protection) Act, 1927, (amended in 1991, 2002). The former Act strengthens the laws in context to forest produce, including NTFPs and medicinal plants, and empowers states through the forest department to regulate the harvest/transit of forest produce from reserved forest, protected areas and forests adjoining villages. Most of the Indian states and Union Territories (UTs) have 'Negative Lists' of species that are banned from harvest from forest areas. While the Indian Forest Act, 1927, is by and large adopted by most Indian states and UTs, a few states have their own Acts in place; these are broadly based on the Indian Forest Act itself. Further, the states frame their own set of Rules under the said Act to preserve/protect their forest resources.

At national level the Red Sanders tree was included in India's Negative List of Exports under the EXIM policy in March 1996, theoretically banning virtually all export of wild harvested specimens. The 1997-2002 and 2002-2007 listing annotated that "value added products" of the wood such as extracts, dyes and musical instruments could be exported, if the wood was procured from legal sources. As per the amendment of the Schedule 2 Appendix 2 of *ITC(HC) Classifications of Export and items* 1997-2002 "export of plants, plant portions and their derivatives and extracts obtained from the wild is prohibited"; the Negative List of 29 plant species also includes *Pterocarpus santalinus* (ref. Notification No. 2(RE-98)/1997-2002, dated 13th April 1998, issued by the Ministry of Commerce, Government of India).

State level: The state of Andhra Pradesh has enacted the *A.P. Forest Act, 1967,* for protection of forest trees (including those specified in Schedule I (Prohibited Trees) and Schedule II (Reserved Trees). The Red Sanders tree (*Pterocarpus santalinus*) is included in Schedule II (Reserved Trees). For all practical purposes the *A.P. Forest Act, 1967,* serves as the umbrella legislation

for all matters pertaining to the forests of the state; under this Act there are 16 Rules that address various issues.

Rule 8(iii) of *The AP Forest Offences (Compounding and Prosecution) Rules, 1969*, empowers the Forest Range Officer (FRO) to take action in case of offences involving fast moving motor vehicles carrying Sandal wood, Red Sanders wood or teak or any other high value timber.

The *AP Forest Act* was amended in 2016 to ensure that almost all forest offences are made cognizable and non-bailable, with the police officers also having concurrent powers and investigate the forest offences.

The state of Andhra Pradesh has taken a lead in having two special Rules specifically for a single tree species that had been categorized until recently as "Endangered" following IUCN criteria. The two Rules are: *The AP Sandalwood and Red Sanders Wood Transit Rules (1969)* and *The AP Red Sanders Wood Possession Rules (1989)*, which have been framed in accordance with the enabling provisions of the umbrella legislation, *The AP Forest Act, 1967*. This is indeed a unique and commendable legislative measure for protecting a single tree species, namely, the Red Sanders.

Review of the specific legislations, i.e., The AP Sandalwood and Red Sanders Wood Transit Rules (1969) and The AP Red Sanders Wood Possession Rules (1989), as well as The AP Forest Offences (Compounding & Prosecution) Rules,1969, Section 8(iii), show that there are no specific enforcement or empowerment issues. The Red Sanders Wood Task Force (RSWTF), located at Tirupati, which is headed by the Inspector General of Police, looks into the enforcement issues in important Red Sanders areas.

According to *The AP Preservation of Private Forest Rules (1978)*, the Red Sanders tree is listed in Schedule II (Reserved Trees); the felling, sale or transport of the species require specific permission from the Divisional Forest Officer (DFO). *The AP Sandalwood and Red Sanders Transit Rules, 1969*, also require that import/export and cartage of wood, chips or powder need special permit with details of source, quantity and destination, and the items also need to be marked/sealed. *The AP Red Sanders Possession Rules, 1989*, state that a license would be required for possession of Red sanders wood in excess of 20 kg, with maintenance of records of manufacture/trade of products being mandatory. Even under the said license the possession of Red Sanders is

capped; no licensee can possess more than 1 Mt/1000 kg at any one time. Domestic use is excluded from the purview of this Rule.

The above two are, therefore, examples of ideal legislation, that have proven effective to some extent.

Smugglers of Red Sanders trees are being booked under *The Preventive Detention Act, 1950*, and laws.

The following further initiatives have been taken for amending *The A.P. Forest Act, 1967*:

- The A.P. Forest Act was amended by Gazette Notification, dated 19th May 2016.
- It came into effect by Gazette Notification, dated, 25th May 2016
- All the forest offences are made cognizable and non-bailable.
- The Red Sanders, Sandalwood and Schedule Trees are given special status of protection.
- The punishments have been enhanced.
- The term of imprisonment may be from 5 years to 10 years.
- Fine may be from Rs. 3.00 lakhs to Rs. 10.00 lakhs
- The illegally acquired property from Sandalwood or Red Sanders or 'Schedule Trees' are liable for forfeiture.
- Special courts may be constituted by the Government for the trial of forest offences.

It is clear that on the legislation front the state of Andhra Pradesh has made good headway, with proper Acts and Rules in place insofar as Red Sanders is concerned. However, it must be appreciated that legislation itself is not enough to stop illegal felling or smuggling of Red Sanders. Enforcement of legislation comes into play only when the forest offences are booked, with good conviction rate; the Acts/Rules in themselves are not enough to serve as a deterrent to illegal activities, probably owing to lack of awareness among the perpetrators of forest crimes or due to scant respect for the preventive legislations out of criminal arrogance.

Tamil Nadu

As in the case of AP, the state of Tamil Nadu also has enacted *The T.N. Red Sanders Wood Transit Rules, 1968*. Under the said Rules import/export and

cartage of Red Sanders wood specifically requires a permit reflecting the details of source, quantity and destination. Further, no person can have in his possession or transport timber logs, chips, powder, without a special permit issued by the DFO. However, the Rules would not apply to Red Sanders wood up to 5 kg being moved for personal use by a bonafide owner or his authorised representative from trees grown on his own lands on the condition that the said person shall obtain/carry a certificate from the Village 'Munsif' to the effect that the Red Sanders wood is sourced from the owners 'pattaland', and that the quantity of wood cut does not exceed 5 kg on one single occasion. For possession/transport of Red Sanders exceeding 5 kg the owner is required to obtain a certificate from the DFO deployed by the State in the area over which he/she has jurisdiction. Felling of Red Sanders is banned in the state of Tamil Nadu, with restrictions imposed/permit requirements for cutting of Red Sanders from hilly lands/private lands.

Karnataka

No specific legislation by way of an Act/Rules have been enacted/framed specifically for Red Sanders by the Government of Karnataka. However, as in the case of other forest produce, the Red Sanders is also subject to permit requirements for sale/transport. The permit requirements also apply for sale of Red Sanders products through tender/auction process at specified depots or through license for sale at pre-approved rates.

Review of protection measures

Andhra Pradesh

Fire lines: To protect the Red Sanders from forest fires 'fire lines' have been cleared in almost all Forest Divisions. The aftermath of fires have been observed to be damaging in fire-prone areas such as Jyoti Beat, Proddatur Division; these areas did have had fire lines, but they were apparently not effective in stopping massive forest fires, which continue to impact Red Sanders populations. Therefore, how effective these lines are for containment of forest fires cannot really be gauged.

Trenches: Trenches are often dug in forest fringes to discourage encroachment of forest land and, to a lesser extent, smuggling.

The following protection measures have been adopted by the Andhra Pradesh Forest Department (APFD) to protect Red Sanders from illegal felling/ smuggling.

Base Camps: Deployed for patrolling and perambulating Red Sanders forests and to gather information about the movement of Smugglers in the interior areas of Forests. They are positioned at strategic locations (Table 16). In each Base camp local villagers are employed as protection watchers. At present, base camps are operating at 193 places in AP. Out of 193 Base Camps, 86 are in Red Sander bearing areas.

Table 16. Division-wise details of base camps established

Name of Circle	*Total Base Camps in Circle*	*Base Camps situated in RS bearing areas*	
		Name of Division	*No. of Base Camps*
Anantapur	14	0	0
Guntur	14	Giddalur	5
		Nellore	9
Kurnool	36	Nandyal	7
		Proddatur	12
		Kadapa	17
Rajahmundry	31	0	0
Visakhapatnam	21	0	0
WLM Circle, Tirupati	36	Chittoor East	6
		Rajampet WL	16
		WL Tirupati	14
FDPT Srisailam	41	0	0
Grand Total:	193		86

Source: APFD

Strike Forces: Strike forces are meant for regular patrolling and interception in fringe areas and outside forests. Each strike force is provided with a vehicle and a driver and five protection watchers. At present, 52 Strike Forces have been deployed for patrolling in vulnerable areas (Table 17). Out of 52 Strike Forces, 30 Strike Forces are located in Red Sander bearing areas.

Table 17. Location of Strike Force in Red Sanders areas

Name of Circle	*Total Strike Force in Circle*	*Strike Force situated in RS bearing areas*	
		Name of Division	*No. of Strike Force*
Anantapur	2	0	0
Guntur	6	Giddalur	2
		Nellore	3
Kurnool	11	Nandyal	1
		Proddatur	3
		Kadapa	6
Rajahmundry	8	0	0
Visakhapatnam	6	0	0
WLM Circle, Tirupati	15	Chittoor East	4
		Rajampet WL	4
		WL Tirupati	7
FDPT Srisailam	4	0	0
Grand Total:	52		30

Source: APFD

Check Posts: They are located at crucial points on Roads leading to Chennai, Bangalore, Hyderabad, Nellore and other vulnerable routes (Table 18). At present, 113 check posts have been established in vulnerable locations by placing ex-servicemen/tribal watchers. Out of 113 Check posts, 50 check posts are in Red Sander bearing divisions.

Table 18. Location of check posts in Red Sanders areas

Name of Circle	*Total Check Posts in circle*	*Check Posts situated in RS bearing areas*	
		Name of Division	*No. of Check Posts*
Anantapur	9	0	
Guntur	18	Giddalur	5
		Nellore	13
Kurnool	13	Nandyal	2
		Proddatur	5
		Kadapa	6
Rajahmundry	34	0	0
Visakhapatnam	15	0	0
WLM Circle, Tirupati	19	Chittoor East	8
		Rajampet WL	8
		WLM Tirupati	3
FDPT Srisailam	5	0	
Grand Total:	113		50

Source: APFD

Boat party: One boat party has also been deployed to patrol and comb forest areas in Somasila back waters covering 4 Divisions i.e., Rajampet, Kadapa, Proddatur, Nellore.

E-Surveillance (iVIS): Web-enabled CCTV cameras (infrared cameras) have been fixed at certain vulnerable locations for e-surveillance and monitoring of Red Sanders areas, by way of a pilot project.

At present there are about 19 CCTV cameras installed in Red Sander areas for protection and monitoring in Tirupati (WL), Rajampet (WL) and Chittoor East divisions of WLM Circle, Tirupati. (The project was initiated during the year 2015-2016 and is being implemented through iVIS Pvt Ltd.) The details of location where CCTV cameras installed and monitored by iVIS Pvt Ltd are in Table 19.

Table 19. Location of CCTV cameras installed

S. No.	*Name of Division*	*Name of Range*	*Location*
1	Tirupati (WL)	SVNP, Balapalli	Boring Road
2	Tirupati (WL)	SVNP, Balapalli	Jyothi Colony
3	Tirupati (WL)	SVNP, Balapalli	Ramapuram Gate
4	Tirupati (WL)	SVNP, Balapalli	Vegetikona
5	Tirupati (WL)	SVNP, Balapalli	Darga Road
6	Tirupati (WL)	SVNP, Tirupati	Malati Lane
7	Tirupati (WL)	SVNP, Tirupati	Thadkal Railway Track
8	Tirupati (WL)	SVNP, Tirupati	Theendra Gunta
9	Tirupati (WL)	SVNP, Tirupati	Watch Tower-1 back side of Sarovar
10	Tirupati (WL)	SVNP, Tirupati	Watch tower-2 at T.N.Palem
11	Tirupati (WL)	SVNP, Tirupati	Back side of DFO office Vigilance
12	Tirupati (WL)	SVNP, Tirupati	Signal point
13	Tirupati (WL)	SVNP, Tirupati	Anjaneyapuram checkpost
14	Rajampet (WL)	Koduru	Gurrappagarikunta – M.Bhavi beat
15	Rajampet (WL)	Koduru	Jandagutta- K.V. Bhavi beat
16	Rajampet (WL)	Sanipaya	Dona Road opp- Jandrapenta beat
17	Rajampet (WL)	Sanipaya	Pump House- Jandrapenta beat
18	Rajampet (WL)	Sanipaya	Kavalaipalli watch tower – T. Sundupalli
19	Chittoor East	Tirupati	CWC Godown, Renigunta

Source: APFD

The e-surveillance promises to be effective with greater area coverage. There is clearly a need to replicate the project in other Red Sanders areas.

Publicity Measures: Various publicity measures such as wall writings, publicity boards and publicity vans with audio visual facilities are being used to sensitize villagers in the fringe areas.

Dog Squads: Two dog squads, one at Tirupati and another one at Kadapa, are maintained in RS bearing areas. Both the dog squads, which are under the control of Tirupati Urban Superintendent of Police and Kadapa Superintendent of Police, are maintained by the Task Force. With collaboration of the Police Department these dogs have been trained in detecting Red Sanders wood. These trained dogs are being used effectively to detect illegally stored Red Sanders wood. There is need for more dog squads to be deployed in main Red Sanders transit routes/zones.

Red Sanders Anti-Smuggling Task Force (RSASTF)

In G.O.Ms.No.217, Finance (HR.I) Department, dated, 25th November 2014, the Government has issued orders for formation of Red Sanders Anti-Smuggling Task Force (RSASTF) and sanctioned 463 Posts in Police and Forest Department to control Red Sanders smuggling (Table 20).

Table 20. Staff strength of RSASTF

Institution	*Sanctioned*	*Filled*	*Vacant*
RSASTF, Tirupati	463	247	216

Source: APFD

There is an urgent need to fill up the vacant post to make the Task Force more effective in curbing the smuggling activities.

Impact of protection measures:

The establishment of base camps, Strike Force, Check Posts, E-surveillance and boat parties resulted in booking of considerable number of Red Sanders criminal cases during the last five years from 2014-15 till date (Table 21).

Table 21. Criminal cases booked with reference to Red Sanders

Year	*No. of cases*	*RS wood seized (in tons)*	*No. of vehicles seized*	*No. of persons arrested.*
(1)	*(2)*	*(3)*	*(4)*	*(5)*
2014-15	1385	918.49	994	3952
2015-16	753	355.658	480	2587
2016-17	911	487.632	705	3344
2017-18	890	363.879	685	2776
2018-19	500	178.08	321	943

Source: APFD

The above-mentioned protection measures are apparently having a considerable impact by way of reduction of smuggling activities, particularly during the last two years (FYs: 2017-18 & 2018-19). However, data on convictions is wanting; in fact, it is said to be fairly low. The rate of convictions will actually determine the success of these measures.

8.1. Do existing management measures adequately mitigate harvest impacts and trade impacts for the populations/sub-populations?

No. The management measures/practices by the Andhra Pradesh State Forest Department (APFD) that were commonly observed during the field assessment for this NDF study were establishment of base camps in Red Sanders areas, mobile patrolling, combing operations, trenches along the boundaries and preparing fire lines prior to summer season. While the management practices of the APFD are laudable, it must be recognized that the forest area to be covered is quite vast and the man force/infrastructure is inadequate. There is an urgent need to strengthen these.

If the positive trend continues and the measures are further strengthened, there is yet some hope for the better protection of Red Sanders forests. With better infrastructure in terms of staffing requirements and facilities such as arms and vehicles for better enforcement, there is scope for improvement of the situation and, perhaps in years to come there would be a possibility of legal/regulated harvesting from the wild (outside PA areas) through a proper harvest management plan, with requisite precautionary measures built in to make sure that viable populations, both in terms of number and size, remain constant/stable. However, such as situation is not likely to come at least in the in the next five decades, given the fact the growth progression from one girth class to another in Red Sanders is about ten years. In such a scenario, there would be a need for a science-based/quantitative monitoring mechanism to make sure that regulated harvest from the wild does not lead to the reduction of Red Sanders populations to levels that might directly or indirectly threaten the populations and prove detrimental to their survival. This would certainly not be possible until effective control of illegal trade and smuggling is achieved, and a proper monitoring mechanism for the standing wild populations is in place.

8.1.1. The way forward for enforcement:

However, given the scenario at present where the harvestable girth size plants are at the lowest, with only 2.19 per cent, any further fragmentation/ reduction in its populations would lead to a situation where the species, *Pterocarpus santalinus*, may have to be shifted to Appendix I of CITES (vide CITES Conf. 9.24 (Rev. CoP 17, Johannesburg, South Africa, 2016). Therefore, there is an urgent need to facilitate better enforcement to avoid Red Sanders from becoming eligible for inclusion in Appendix I in the future.

In context to enforcement for plants the CITES recommends [Resolution Conf. 11.11 (Rev. Cop 17)] that Parties to the Convention ensure that "*(i) enforcement officers are adequately informed of CITES requirements, procedures governing inspection and clearance of CITES plant specimens, and the procedures necessary for the detection of illegal trade; (ii) enforcement agencies obtain access to materials and expertise enabling identification of plant specimens in trade, including whether the specimens are of wild or artificially propagated origin; (iii) enforcing agencies utilise annual reports, plant health documents, nursery catalogues and other sources of information to detect possible illegal trade; (iv) enforcing agencies maintain close liaison with the Management Authority and Scientific Authorities for the purpose of setting and implementing enforcement priorities; and (v) material in trade is carefully checked in order to improve enforcement and in particular that plants declared to have been artificially propagated are checked both on import and on export.*" Therefore, there is need for the State Forest Departments to adopt this recommendation to ensure better enforcement and monitoring.

STEP 9: MAKE NDF AND PROVIDE RELATED ADVICE

I. NON DETRIMENT FINDING OF RED SANDERS TREE

From Step 1

9.1. Specimens identification is not clear and/or scientific name is not complaint.

The specimen identification is clear in this case and most specimens being exported legally are under the same name. The Red Sanders wood is characteristic and there are no records of it being exported (logs, chips) under a different name.

From Step 2

9.2. Export of artificially propagated specimens of this species is not permitted by national law or relevant sub-national legislation.

Export of artificially propagated specimens of this species is permitted by national law or relevant sub-national legislation subject to certain requirements and documentation (DGFT Notification No. 56/2015-2020, dated 18 February 2019).

9.3. Specimens covered by the export permit application clearly meet all requirements for artificially propagated according to Res. Conf. 11.11 (Rev. COP 15).

The present standing stock of cultivated Red sanders have been developed through seeds sourced from the wild. However, the Scientific Authority is convinced that the seed collection being done for this is not detrimental to the wild populations. This is in accordance with the exemption granted (CITES Resolution Conf. 11.11 (Rev. COP 17) with regard to the regulation of trade in specimens deemed to be 'artificially propagated' if grown from wild-collected seeds.

As the cultivated specimens of *Pterocarpus santalinus* are permitted under the national legislations/Rules, subject to certain conditions, a **positive advice** is proposed for export of specimens from cultivated sources (Source A) in this NDF report.

From Step 3

9.4. The specimen is not covered by CITES Appendix II.

The specimen is listed under Appendix II of CITES (Ref Step 3) and also protected by national and sub-national legislations.

9.5. Export of wild harvested specimens of this species is not permitted by national or relevant sub-national legislation or regulation.

The wild harvested specimens are protected by national level as well as state-level regulations/rules and export of Red Sanders is not permitted (See Step 8 for details).

Accordingly, this NDF proposes a **negative advice** for harvest from wild/natural populations (Source W) for the time being.

9.6. Evidences used for a previous NDF is still valid and sufficient to evaluate the current permit application.

The results of the previous NDF (Hegde et al., 2012) are still valid and, therefore, in accordance to the findings of the earlier NDF as well as the present NDF, export of Red Sanders harvested from the wild may be not be allowed for the present. From the two NDF studies it is evident that the harvestable girth class in the wild populations have been reduced drastically over the last six years.

From Steps 4 - 8

9.7. Do existing management measures adequately mitigate harvest and trade impacts?

No. The management and protection measure are fairly good and innovative, but for want of sufficient infrastructure, they are presently not rigorous or effective enough to mitigate the impacts of harvest and trade.

Therefore, this NDF proposes a **negative advice** for harvest from wild/natural populations (Source W) for the time being.

II. RELATED ADVICE:

1. In view of the negative NDF, harvesting of Red Sanders (*Pterocarpus santalinus*) from the wild/natural areas needs to be discouraged. The decision on 'sustainable harvest' from the wild may be taken only after detailed ecological studies are undertaken to make sure that the harvestable populations are sufficiently stabilised and population dynamics of Red Sanders will allow regulated off-take from the wild. This is imperative for the future security of the species.

2. The quota from cultivated stock is proposed to be revised as per the extraction potential of the States (Tamil Nadu, Andhra Pradesh, Karnataka) having cultivated stock in private/government land. The proposed national quota may be fixed at 1190 MT per annum. The State Forest Working Plan Guidelines in the states with Red Sanders plantations in Government lands, including forest areas, need to include specific management plans/harvest plans with approved rotation periods for sustainable harvest of Red Sanders wood from plantations in forest areas. It may be mandated that at least 10 percent of the plantation trees be left unharvested to allow seed production for future use in keeping with CITES Resol. Conf. 11.11 (Rev. COP 17).

3. Export of Red Sanders wood in log form and roots or value added products such as (including chips, powder, extracts, dyes, musical instruments or parts thereof, furniture or parts thereof, toys, dolls, and other handicrafts made from Red Sanders wood procured legally from (i) cultivated stock (in private/Government lands, including forests) or (ii) from seized/confiscated material auctioned by the authorised Government agencies, may be permitted, subject to fulfilment of laid down policy conditions/necessary documentation.

4. As the monitoring mechanism for populations of Red Sanders is inadequate there is need for developing a mechanism wherein populations/stocks are properly monitored it is suggested that
    a. the e-auctioning of confiscated RS wood be done through one nodal agency in the country to facilitate and regulate the

sale/export by way of a single-window portal; as the State of Andhra Pradesh is a major custodian of the wild stock the APFD may be considered the nodal agency. All states with seized/confiscated stock could send the same to APFD for disposal through e-auction. The proceeds of the sale could be on basis of a 60:40 ratio for Andhra Pradesh and other states, with the cost of cartage to be borne by the APFD;

b. similarly, for sale/export of Red Sanders from cultivated stock the wood farmers/private agencies from all states/agencies may be done through the APFD.

5. As per the CITES/DGFT guidelines 30 percent of the proceeds of the Red Sanders sale is mandated to be ploughed back for the express purpose of protection, management and regeneration/recovery of the species. (Thus, if the revenue accrued by the Government is Rs. 100/- by way of sale/export, 30 percent will be utilised for management, protection and regeneration/recovery of populations). This condition must be strictly followed by the APFD, Government of Andhra Pradesh, for conservation and protection of Red Sanders.

6. The single greatest threat to Red Sanders populations being illicit felling/smuggling, there is an urgent need for stringent enforcement of all relevant rules/legislations to curb smuggling at any cost and ensure the survival of this species in the wild. A separate Multi-Disciplinary Expert Committee, comprising enforcement/forest officers, techno-legal experts, representatives of CITES Scientific Authorities, as well as representatives of environmental NGOs and forest/rural communities may be set up to go into the modalities of proper enforcement [as per CITES Resolution Conf. 11.11 (Rev. COP 17)] to ensure future survival of the species. It is imperative that local forest/rural communities should also be given a responsible role in enforcement.

7. Acknowledging that capacity building is imperative for effective enforcement, the CITES Management Authority of India needs to ensure that requisite infrastructure, in terms of human resources and high-tech

equipment, is built in the State Forest Departments with augmentation of necessary budgetary allocation for this purpose.

8. Red Sanders tree management guidelines based on scientific principles and practices should be made available to wood farmers for helping them get a better quality yield in lesser period. These guidelines should address issues such as management of pathological infestations, arboricultural practices, germplasm selection, tree improvement, etc. The National Biodiversity Authority (NBA), with its envisaged research programmes on Red Sanders tree, would be an ideal agency to formulate these guidelines.

9. There is an urgent need encourage farmers to source plantation material (seeds/seedlings) from the plantations, i.e., cultivated parental stock, so that they can be considered to be 'artificially propagated' as per the CITES definition, and discourage collection of plantation material from the wild. As CITES determines that plants grown from cuttings or divisions are considered to be 'artificially propagated' only if the traded specimens do not contain any material collected from the wild, the concerned state Governments/Forest Departments need to ensure that all future plantations are established through seed/plantation material sourced/derived from cultivated parental stock.

10. There is need for encouraging greater dialogue amongst CITES Management Authority, Custom Departments, State Forest Departments, and State Police Departments with regard to export controls and CITES implementation for the species.

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Annexure - I

Specimens examined as part of the NDF studies on Red Sanders (*Pterocarpus santalinus* L.f.) tree in India

Andhra Pradesh

Andhra Pradesh, Eastern Ghats, Chittoor district, Papavinasanam, 13°43'10.8''N, 79°20'48.4'', 726 m.a.s.l., 10.01.2016, *J. Swamy & S. Nagaraju* 007501 (BSID); Andhra Pradesh, Eastern Ghats, Nellore district, Penchalakona, 14°20'12.6''N, 79°24'37.2'', 171 m.a.s.l., 13.07.2016, *J.Swamy & S. Nagaraju* 007878 (BSID); Andhra Pradesh, Eastern Ghats, Nellore district, Stambalakona, 14°05'22.7''N, 79°28'16.1'', 284 m.a.s.l., 15.07.2016, *J.Swamy & S. Nagaraju* 007878 (BSID); Andhra Pradesh, Eastern Ghats, Nellore district, Eswarakona, Rapur, 178 m.a.s.l., 12.07.2016, *J.Swamy & S. Nagaraju* 008149 (BSID); Andhra Pradesh, Eastern Ghats, Nellore district, on the way to Rapur from Chitvel, Near Palamadugu, 14°11'39.7''N, 79°26'44.4'', 253m.a.s.l., 12.07.2016, *J.Swamy & S. Nagaraju* 008156 (BSID); Andhra Pradesh, Eastern Ghats, Nellore district, Penchalakona, 14°20'12.6''N, 79°24'37.2'', 171 m.a.s.l., 13.07.2016, *J.Swamy & S. Nagaraju* 008160 (BSID); Andhra Pradesh, Chittoor district, on the way to Thumburutheertham, 13°44'079.8''N, 79°21'72.7'', 329 m.a.s.l., 08.01.2016, *J. Swamy* 7300 (BSID); Andhra Pradesh, Chittor, Tirumala, 810 m.a.s.l., 13.09.2008, *M.V.S & B. Ravi Prasad* Rao 31083 (BSID); Kadapa, Idupulapaya RF, 413 m.a.s.l., 27.09.2010, *K. Raja Kullayiswami & B. Sada Sivaiah* 40313 (BSID); Nellore, Nelapattu, 12.08.1999, *P. Venu* 111237 (BSID); Nellore district, Durgam, 29.10.1998, *P. Venu* 110139 (BSID); Flora of Seshachalam Biosphere Reserve, Chittoor District, Srivaripaadalu, Thirumala FB, N 13⁰40'45.9", E79⁰19'58.2", 1081m.a.s.l., 17.06.2012, *P. V. Prasanna & M. Sankara Rao* 002849 (BSID); Flora of Seshachalam Biosphere Reserve, Chittoor District, SVU campus on the way to Vedapatasala, , 30.05.2013, *P. V. Prasanna & M. Sankara Rao* 003201 (BSID); Flora of Seshachalam Biosphere Reserve, Inuparallagutta, N 14⁰20' 13.4", E78⁰46'48.8", 234 m.a.s.l., 31.07.201, *P. V. Prasanna & M. Sankara Rao* 003315 (BSID); Flora of Seshachalam

Biosphere Reserve, Rollamadugu- cross -SR palem, N 14057.192', E79021.149', 320 m.a.s.l., 11.03.2016, *S. Nagaraju* 006979 (BSID).

Andhra Pradesh, Penchalakona, 400 m, 18.07.1986, *A. S. Rao* ASR6397 (Barcode No. MH00216392; Acc. No. 148902) MH; Andhra Pradesh, Vijayawada, 06.08.1983, *P. Venkanna* 5652 (Barcode No. MH00216393; Acc. No. 140884) MH; Andhra Pradesh, Cuddapah district, Jhana Konda, 1000 ft, August 1989, *J. S. Gamble* 21217 (Barcode No. MH00216394) MH; Andhra Pradesh, Guvvala chervu ghat, 1000 ft, July 1884, J. S. Gamble 15023 (Barcode No. MH00216395; Acc. No. 17187) MH; Andhra Pradesh, Cuddapah district, 1885, *J. S. Gamble* (Barcode No. MH00216396; Acc. No. 17183) MH; Andhra Pradesh, Cuddapah district, *J. S. Gamble* (Barcode No. MH00216397; Acc. No. 17189) MH; Andhra Pradesh, Balapalli, 250 m, 20.07.1962, *J. L. Ellis* 14294 (Barcode No. MH00216398; Acc. No. 28388) MH; Andhra Pradesh, Kodur, July 1834, J. S. Gamble 15005 (Barcode No. MH00216399; Acc. No. 17188) MH; Andhra Pradesh, Chittoor district, Chittoor, 20.12.1918, J. S. Gamble 15755 (Barcode No. MH00216400; Acc. No. 17195) MH; Andhra Pradesh, Chittoor district, Mamandur, 28.02.1914, *J. S. Gamble* 10145 (Barcode No. MH00216401) MH; Andhra Pradesh, Chittoor district, Chittoor, 20.12.1918, *J. S. Gamble* 15755 (Barcode No. MH00216402; Acc. No. 17197) MH; Andhra Pradesh, Chittoor district, Akasaganga, 30.12.1975, *G. V. Subba Rao* 46881 (Barcode No. MH00216403; Acc. No. 91317) MH; Andhra Pradesh, Chittoor district, Panapakam Forest rest house compound,375 m, 15.06.1969, *G. V. Subba Rao* 31884 (Barcode No. MH00216404; Acc. No. 61419) MH; Andhra Pradesh, Chittoor district, Way to Tirumala hills, 1050 m, 17.08.1989, *D. Rangacharuyulu* 2352 (Barcode No. MH00216405; Acc. No. 147919) MH; Andhra Pradesh, Chittoor district, Talakona R. F, 26.06.1987, *E. Vajravelu* 82232 (Barcode No. MH00216406; Acc. No. 145243) MH; Andhra Pradesh, Chittoor district, Mamandur, 28.02.1914, *J. S. Gamble* 10145 (Barcode No. MH00216408; Acc. No. 17194) MH; Andhra Pradesh, Chittoor Reserved Forest, 06.10.1938, K. C. Jacob 431 (Barcode No. MH00216409; Acc. No. 83937) MH; Andhra Pradesh, Chittoor district, Panapakam Forest rest house compound, 375 m, 15.06.1969, *G. V. Subba Rao* 31884

(Barcode No. MH00216410; Acc. No. 61418) MH; Andhra Pradesh, Chittoor district, Akasaganga, 30.12.1975, *G. V. Subba Rao* 46881 (Barcode No. MH00216411; Acc. No. 91316) MH; Andhra Pradesh, Chittoor district, Mamandur, 900 m, 21.04.1986, *D. Rangacharuyulu* 539 (Barcode No. MH00216412; Acc. No. 148145) MH.

Andhra Pradesh, Chittoor district, Tirupati hills, 13.08.1998, *N. Venkata Subramanian* (Acc. No. 20807) FRC; Andhra Pradesh, Paparasiri, Thumipalli Hills, 13.08.1998, *N. Venkata Subramanian* (Acc. No. 20829) FRC; Andhra Pradesh, Pularani pakkam, 10.08.1998, *N. Venkata Subramanian* (Acc. No. 20831) FRC; Andhra Pradesh, Kodur, 17.11.1965, *K. N. Subramanian* 2458 (Acc. No. 2309) FRC; Andhra Pradesh, Chittoor district, 1400 f.t, 01.02.1918, *C. E. C Fischer* 4256 (Acc. No. 3934) FRC; Andhra Pradesh, Cuddapaha district, 1987, *J. S. Gamble* (Acc. No. 3935) FRC.

Andhra Pradesh, Chittoor District, 1400 ft, 01.02.1918, *C. E. C. Fischer* 4256 (Acc. No. 131878) CAL; Chittoor District, 1400 ft, 01.02.1918, *C. E. C. Fischer* 4256 (Acc. No. 131879) CAL; Andhra Pradesh, Nellore district, Mullemkonda hills, Block B, Veligonda Reserve, 26.07.1914, *M. S. Ramaswami* 1255 (Acc. No. 131896) CAL; Andhra Pradesh, Nellore, 20.05.1900 2386 (Acc. No. 131887) CAL; Andhra Pradesh, Nellore, 20.05.1900 2386 (Acc. No. 131885) CAL; Cuddapah, 24.07.1899, 238 (Acc. No. 131890) CAL; Cuddapah, Rollamadugu, 1600 ft, February 1883, *J. S. Gamble* 11148 (Acc. No. 131888) CAL; Chittoor, Mamandur, 900m, 21.04.1986, *D. Rangacharyulu* 539 (Barcode No. CAL 0000003301) CAL; Chittoor, Talakona RF, 900m, 26.06.1987, *E. Vajravelu* 82232 CAL; Prakasam district, Konapalli R. F, 24.05.1985, *R. K. Mohan* 936 CAL.

Andhra Pradesh, Chittoor, 21.12.1899, 14927 (Acc. No.131892) CAL; Andhra Pradesh, December,1981 (Acc. No. 131894) CAL; Andhra Pradesh, Nellore, 20.05.1900 2386 (Acc. No. 131886) CAL; Andhra Pradesh, Nellore, 20.05.1900, 2386 (Acc. No. 131881) CAL; Andhra Pradesh, Nellore, 20.05.1900, 2386 (Acc. No. 131886) CAL; Andhra Pradesh,

Nellore, 20.05.1900, 2386 (Acc. No. 131884) CAL; Andhra Pradesh, Nellore, 20.05.1900, 2386 (Acc. No. 131887) CAL; Cuddapah, 24.07.1899, 238 (Acc. No. 131889) CAL.

Tamil Nadu

Tamil Nadu, Chengalpot district, Kambakkam hills, 06.05.1913, *D. Rangacharuyulu* (Barcode No. MH00216413; Acc. No. 17196) MH; Tamil Nadu, North Arcot district, Mordana R. F, 25.10.1986, *M. B. Viswanath* 1215 (Barcode No. MH00216414; Acc. No. 153247) MH; Tamil Nadu, 30.01.1904, 74 (Barcode No. MH00216415; Acc. No. 86897) MH.

Tamil Nadu, Vellore district, Amoor, 11.08.1998, *N. Venkata Subramanian* (Acc. No. 20809) FRC; Tamil Nadu, Madras, Mylapore, 12.08.1998, N. *Venkata Subramanian* (Acc. No. 20808) FRC; Tamil Nadu, Madras, Mylapore, 12.08.1998, *N. Venkata Subramanian* (Acc. No. 20828) FRC; Tamil Nadu, Gudiyatham, Veerapalli Reserve, Bharatha rani, 14.08.1998, *N. Venkata Subramanian* (Acc. No. 20830) FRC.

Tamil Nadu, Denkaikotta, Dharmapuri, Ayyur, Ayyur R. F, Foothills, 1050 m, 08.09.1978, *K. N. Matthew & Venugopal* 17144 CAL; Tamil Nadu, South Arcot, Tindivanam, 29.01.1901, *District Forest Officer* 2427 (Acc. No. 13891) CAL; Tamil Nadu, South Arcot, Tindivanam, 29.01.1901, 2427 (Acc. No. 13891) CAL.

West Bengal

West Bengal, Kolkata, Howrah, Indian Botanic Garden, A. K. Narsear, 22.05.1968 CAL.

Misc.

T. Kistnaswamy Nadiu, July, 1884 CAL; Mr.Lane, 01.09.1900 (Acc. No. 131875) CAL; Mr.Lane, 01.09.1900 (Acc. No. 131876) CAL.