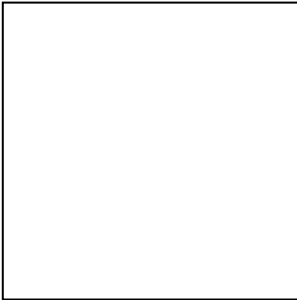


Session 15

[Friday 2nd period 1.5 hours - Hall A]

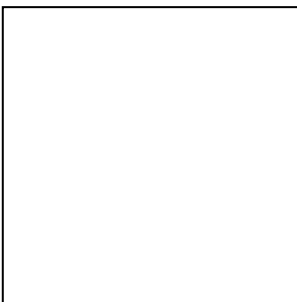
Focus on sandalwood and teak

Speakers



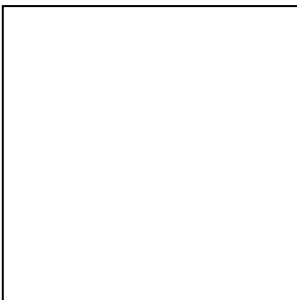
Speaker:
V S Venkatesha Gowda

Topic:
Global Emerging Trends on Sustainable Production of Natural Sandalwood in Ghana



Speaker:
H S Ananthapadmanabha

Topic:
Sustainable Supply of Sandalwood for Industry



Speaker:
Ramesh Chandra Mishra

Topic:
Sandalwood: The Saviour of Ecological Balance and Super Wealth Creator



Speaker:
K Jayaraman

Topic:
TEAKNET – The International R&D Network on Teak

Global Emerging Trends on Sustainable Production of Natural Sandalwood

V S Venkatesha Gowda¹

Abstract

There are sixteen recognized species of sandalwood spread over in the world; broadly they can be grouped as East Indian sandalwood, Australian sandalwood, Hawaiian sandalwood and sandalwood of the Pacific Islands. Many of these are under the threat of extinction due to over exploitation. Some countries are taking steps towards commercial cultivation using modern techniques to save these species. East Indian sandalwood, Santalum album L., is the queen among sandalwood species, yielding superior quality essential oil very much required by perfumery and related industries. Over the past decades, India was producing the largest quantity of sandalwood oil, meeting over 80 percent of world demand. However, due to over exploitation and various other reasons, the quantity of production has declined drastically during recent years.

Many sandalwood based industries have sprung up recently in India as well as abroad due to a worldwide shift in customer preference towards natural products and a demand for legal, ethical sustainable supplies of Natural Sandalwood and essential oil. Sandalwood oil is used for perfumes, fragrances, flavours, cosmetics, panparag and gutka, among other applications. Many countries, such as Australia, Sri Lanka, Thailand, Cambodia, Costa Rica, etc., are involved in the commercial cultivation of East Indian sandalwood to meet global demand.

In the meanwhile, India remains competitive in its attempt to grow more sandalwood both in-situ & ex-situ by inter plantation methods to bring back its lost glory as a emerging economy in the world with vast human resources potential. It is hoped that this initiative will meet both domestic and international market demands. Furthermore, this will increase green cover, reduce global warming, economic empowerment of the grower, alleviate poverty, generate massive rural employment and conserve the ecology and bio-diversity of the country.

¹ Karnataka Soaps and Detergents Limited, Sandal City, P. B. No. 5531, Bangalore - Pune Highway, Bangalore 560 055, India (vsaigowda@yahoo.co.in)

1. INTRODUCTION

Sandalwood is the fragrant heartwood coming from the species of genus *Santalum*, of family Santalaceae. The most notable members of this group are *Santalum album* (Indian Sandalwood) & *Santalum spicatum* (Australian Sandalwood).

Sandalwood has been valued for centuries for its fragrance, wood working potential and various purported medicinal qualities. In India the genus is represented by *Santalum album* and the wood is commercially known as East Indian Sandalwood and the essential oil from it is East Indian Sandalwood oil. East Indian Sandalwood & Sandalwood Oil are amongst the oldest perfumery materials used.

Role of KS&DL on sustainable production of Sandalwood

KS&DL, a State owned Company in India with a nearly 100 year legacy in the production of natural sandalwood oil and sandalwood oil based products working towards promoting the sustainable development of sandalwood for meeting the needs of society, present and future. Accordingly, the company integrated the practice of Sandalwood Tree based farming by joint cultivation on a Share & Prosper basis for reaping the rich benefits, both individually and for the community, by making efforts in converting unproductive waste lands into productive lands. In this endeavor the company is trying to interconnect the needs of the nature, traditional culture of the brand of Mysore Sandal product and contemporary science.

Agro-technology of cultivation of Sandalwood

It is a mistaken belief that sandalwood grown in natural forest conditions alone produce scented heartwood and sandalwood grown in northern region does not. Sandalwood can be grown in a variety of soil with pH ranging from 7 to 8.5, with area temperature ranging from 5° to 50°C. It is not region specific and can adapt to different environmental conditions. The plantation-grown trees with irrigation and fertilization perform exceedingly well compared to natural forest conditions. In natural conditions sandalwood trees takes more than 7 years to produce scented heartwood and its growth is restricted due to climatic factors, soil, vegetation, fire, grazing and human interventions. Under these stress conditions, fully developed tree requires about 30 to 35 years for harvesting. Whereas the plantation grown trees produce heartwood formations in about 3 to 4 years and develop good heartwood ranging in diameter from 15 cm to 25 cm in about 12 to 15 years. Harvesting at this age is much more economical and commercially viable.

The sandalwood oil obtained at this age may range from 3.5 to 4 percent with good percentage of total santalol content. These results are based on the existing plantations of Indian Sandalwood in Australia. Timely Irrigation, fertilization, soil working, pruning or training and inducing stress, providing good host plants are the important criteria for the healthy growth of sandalwood. The sandalwood tree is a partial root parasite, requiring another host tree by its side, through which it draws nutrient for its good growth.

Cultivation Practices

Seeds are available in two seasons, April to May and September to October; both the seeds perform alike with respect to germination. Some seed producing areas have been identified for collection. Fresh fruits collected are depulped and dried seeds are kept for two months due to dormancy before sowing. If the seeds are soaked in 0.05% gibberlic acid for 16 hours prior to sowing, good and uniform germination could be achieved.

Well-developed healthy seedlings of 6 to 8 months old are ideal for planting in the field. Different configuration models can be adapted in the field depends on the sustenance of the grower. If one needs regular income returns from the plantation, interplanting with fruit crops of small canopy can be made. Some of the trees identified for intercrops are, grafted Amla or gooseberry (*Phyllanthus emblika* or *Emblika officinalis*), or grafted Tamarind (*Tamarindus indica*), or grafted Pomegranate (*Punica granatum*).

Planting sandalwood trees is much more economical and the expenditure required for planting and maintenance up to a period of 12 to 15 years for a hectare would be about Rs.10 lakhs, with impressive economic returns. On average about 500 trees can be planted on one hectare and the average yield per tree is about 15 to 20 kg of scented heartwood after 13 years.

Discounting 20 percent towards the causality of trees, the total production of scented heartwood would be approximately 6.75 Metric tonnes. Lucrative returns can be calculated from sandalwood, apart from other benefits from host and other intermediate plants.

Cultivation of Sandalwood - Economic feasibility in Indian Context

I. No.	Particulars	Per Hectare (2.5 Acre)	Quantity / Price
01	Requirement of Sandal Seedlings / Hosts		
	No of Sandal plants required per hectare		500 Nos.
	No of pot hosts required per hectare		500 Nos.
	No of Intermediate hosts plant required		500 Nos
	No of long term hosts plant required		500 Nos
02	Cost of Sandalwood Seedlings / Hosts		
	Cost of production of sandalwood seedling	Rs.12 x 500	Rs. 6,000-00
	Cost of production of seedling primary host	Rs.2 x 500	Rs. 1,000-00
	Cost of production of Intermediate host	Rs.10 x 500	Rs. 5,000-00
	Cost of production of long term host	Rs.10 x 500	Rs. 5,000-00
	Cost of planting, transportation, soil work, pit formation, watering etc.,	Rs.10 x 500	Rs. 5,000-00
	Cost for pit formation, soil work, watering etc.,		Rs. 20,000-00
	Cost of Drip Irrigation		Rs.1,00,000-00
03	Recurring Expenditure till Harvesting		
	Security &Vigilance for 15 years	Rs.36,000/- pa	Rs.5,40,000-00

	Annual Weeding & Soil working for 8 years	Rs. 2,000/- pa	Rs. 16,000-00
	Irrigation for 8 years	Rs. 2,000/-pa	Rs. 16,000-00
	Fertilizer/Manure for 8 years	Rs. 5,000/-pa	Rs. 40,000-00
	Miscs., expenses (Management of Pests & Diseases, Supervision etc.) for 15 years	Rs.25,000/-pa	Rs.3,75,000-00
	Expenditure on Land & other Infrastructure		Rs.10,00,000-00
	Total approximate expenditure (After reckoning the Investment, Inflation @ 5% & Interest @ 12% on Investment)		Rs.48,00,000-00
04	Expected Heartwood yield at the age of 15 yr. after taking 10% as mortalities, thefts etc., at the prevailing rates of Sandalwood of various class in Karnataka	Per Hectare	
	No. of Sandalwood Trees eligible for extraction	450 Nos.	
	Approx. quantity of Heartwood expected per tree	20 kgs. x 450	9000 Kgs.
	Approx. quantity of Sapwood expected per tree	30 kgs x 450	13500 Kgs.
	Average Price of Sandalwood Heartwood class	Rs.3,500 per kg x 9000 Kgs	Rs.3,15,00,000-00
	Cost of Sapwood	Rs.65 per kg x 13500 Kgs	Rs.8,77,500-00
	Estimated profit from Inter crops for 10 years	Rs.12,000/- pa x 10 years	Rs,1,20,000-00
	TOTAL		Rs,3,24,97,500-00
05	NET ESTIMATED PROFIT AFTER RECONING EXPENDITURE OF Rs.48,00,000/-	Per Hectare	Rs.2,76,97,500-00

Distillation and Extraction

Karnataka Soaps and Detergents Ltd are the pioneers in distilling quality sandalwood oil. Distillers follow different methods for obtaining oil from wood. However, steam distillation is a simple and efficient method and the oil extracted from steam distillation is widely accepted in the perfume & medicinal industries. The crude oil floating on the surface of distillate is skimmed off and filtered. Moisture present in the oil is removed by vacuum process. On average, good quality sandalwood yields about 5 to 6 percent of oil upon distillation.

Quality of Sandalwood oil

The quality of Sandalwood oil is assessed on the basis of the total Santalol content by GLC method along with the other physico chemical characteristic viz., optical rotation, refractive index, specific gravity etc., detailed evaluation report of different Sandalwood oil including GCMS are enumerated as per the Annexures for information of the participants the physico

chemical analysis of Indian Sandalwood oil, vis-à-vis other different origin Sandalwood oils is enumerated as follows:-

Sl No	Characteristics	Results			Specifications		
		Sri Lankan	Austro Caledonicum	Australian Spicatum	East African	Australian Spicatum	Indian
1	Specific gravity (270C)	0.9709	0.9730	0.90643	0.9613	0.9400 to 0.9720	0.9635 to 0.9775
2	Refractive Index (200C)	1.5024	1.5052	1.5052	1.5079	1.5003 to 1.5095	1.5000 to 1.5070 (270C)
3	Optical rotation	-160	-40	-40	-450	-10 to -40	-150 to -200
4	Esters	6.66	5.87	2.72	7.61	Max. 5.0%	Max. 7.0%
5	Total alcohols	90.89	87.44	85.08	80.44	Min. 70%	Min. 90%
6	Santalols by GLC	89.39	85.10	69.90	25.48	Min. 53%	--
7	Solubility	Soluble	Soluble	Soluble	Soluble in 4 vols 70% alcohol	Soluble in 5 vols 70% alcohol	Soluble in 5 vols 70% alcohol
8	Colour	Pale yellow viscous liquid.	Yellowish red viscous oily liquid.	Golden yellow oily liquid	Yellow coloured viscous liquid.	Golden yellow oily liquid	Nearly colourless to golden yellow some what viscous oily liquid.
9	Odour		Not comparable to Indian sandalwood oil.	Sandalwood odour with terpinic some what green floral top note.	Very faint, pleasant woody somewhat sweet odour.	Sandalwood odour with terpinic some what green floral top note	Pleasant, sweet, woody & persistent.

The detailed GCMS analysis also enumerated is as follows:-

Sl No	Constituents	Santalum Album-India	Santalum Album-Indonesia	Santalum Spicatum-West Australian	Santalum Yasi - Fiji	Santalum Osyris-East African
1	Furfural	-	-	-	0.01	-
2	Santene	-	0.87	-	0.02	-
	Alpha-Santalene	0.68	1.37	0.88	0.85	0.50
3	Trans-Alpha-Bergamotene	0.12	0.25	0.35	0.35	0.65
4	Epi-Beta Santalene	0.88	1.80	0.63	0.62	0.80
5	Beta – Santalene	1.33	2.78	1.03	1.32	1.36
6	Gamma-Curcumene	0.01	-	0.50	-	-

7	AR-Curcumeme	0.18	-	1.12	0.18	0.31
8	Beta-Farnesene	-	-	-	-	0.88
9	Beta-Bisabolene	-	-	-	0.01	1.42
10	Trans-Nerolidol	0.02	0.03	6.08	0.30	-
11	CIS-Alpha-Santalol	55.15	47.30	13.85	47.39	17.08
12	Trans-Alpha Bergamotol	5.11	6.27	2.33	5.18	8.51
13	Epi-Beta-Santalol	4.49	3.22	1.17	3.96	1.76
14	CIS-Beta-Santalol	18.89	18.78	7.48	23.20	10.41
15	CIS-Nuciferol	1.93	4.14	11.21	4.18	-
16	Trans-Nuciferol	0.48	0.69	3.49	0.92	2.13
17	CIS-Lanceol	1.80	1.80	3.13	1.44	41.22

Indian Sandalwood oil has 90% Santalol content, in respect of Australian Sandalwood oil, which is in the range of 38-39% only. The age of the tree also plays a vital role along with other agro-climatic conditions in the Santalol content in sandalwood oil. Indian Sandalwood oil contains 50 to 60% of alpha santalol & remaining 15 to 25% beta santalol, which plays a vital role in high class perfumes as a base, fixative, modifier and enduring fragrance ingredient.

Colour of heartwood and oil content

The superiority of wood is generally judged based on colour, weight and from the parts of the tree from which it is taken.

2. THE CLASSIFICATION OF INDIAN SANDALWOOD IN THE TRADE:

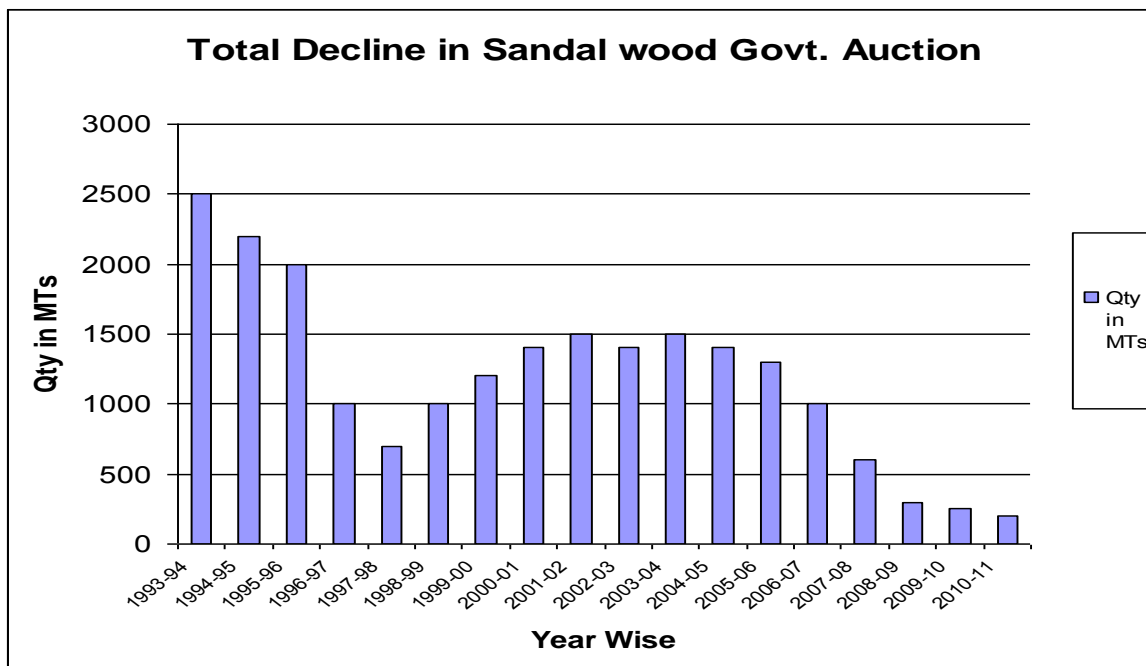
The classification is enumerated in to 18 classes as follows.

1. First class billet. (Vilayat budh)
2. Second class billet (China budh)
3. Third class billet (Panjam)
4. Ghotla (billets of short length)
5. Ghat badla
6. Begardad
7. Roots (First class)
8. Roots(Secondclass)
9. Roots (Third class)
10. Jajpokal (First class)
11. Jajpokal (Second class)
12. Ain bagar
13. Cheria
14. Ain chilta
15. Hatrichilta
16. Milva chilta
17. Basola bukni
18. Saw dust powder

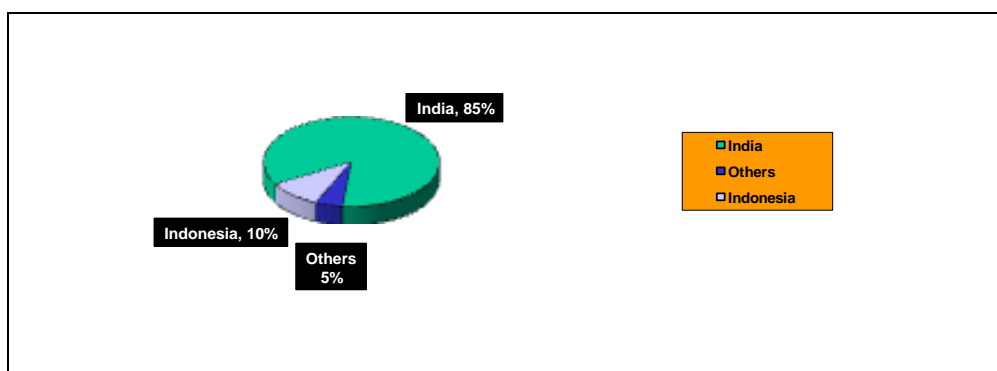
Present scenario Sandalwood production in India;

Due to rampant smuggling, illegal trade of sandalwood and the declining the area of cultivation, the production of sandalwood may reach to 300 - 400 MTs/annum.

The fall in decline of Sandalwood sale in auctions conducted by different state Governments in India.



The Global production Details of Santaum Album & Oil Production



With the Indian Sandalwood supply being limited and expensive, industries dependent on sandalwood are on the look of alternates, such as Western Australian Sandalwood oil, Fiji and New Caledonia Sandalwood and oil, South African Sandalwood oil etc.

Legal aspect of sandalwood

Sandalwood plants are widely distributed in the southern states like, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala, hence sandalwood is defined as a “forest produce”, although the “Indian Forest Act” does not have any special provisions for sandalwood.

Meanwhile, the Indian government categorised Chandana as one of 32 recognised medicinal plant. However, the government of India and the concerned departments have to decide whether these medicinal plants come under the Forest Act & Rules, as medicinal & aromatic plants do not. The legal hassles created by sandalwood trade regulation result from the fact that there is no comprehensive regulation applicable to the entire country. Hence, clandestine trade is flourishing and the sandalwood population declining, verging on extinction and sandalwood is now classified as one of the endangered plant species in India.

Realizing the sharp decline in the sandalwood population in their states and having accepted that they cannot be the custodians of sandalwood any more, the Karnataka and Tamil Nadu Forest Departments amended the Sandalwood Act in 2001 and 2002 respectively and made the grower himself a owner of the sandalwood as per the Amended Act. Further, Govt. of Karnataka already made amendments on the sale of Sandalwood through Forest Dept. & Govt. Departments to eliminate the clandestine trade and to encourage farmers to take cultivation of Sandalwood on commercial scale during the recent years.

Uses of Sandalwood Oil

Some of the major industries depending on sandalwood oil:

- Attar industry
- Perfumery
- Soaps and toiletries
- Chewing scented tobacco
- Pan Masala
- Pharmaceutical applications

The production of Attars has occurred in India for centuries, it is a blend of sandalwood oil and flower oil, such as rose petal, jasmine, kewda etc. The quality of attar depends on the concentration of flower effervescence with in sandalwood oil. Numerous types of attar products are made in India and it forms an important constituent for the manufacture of incense sticks and Scented tobacco, Pan Masala, Zarada, Gutka etc.

The word Sandal is derived from Chandana (Sanskrit). The Wood & Oil has been used as one of the main materials in Indian medicine for centuries. It is said that sandalwood finds its use in human life, particularly Indian culture and civilizations from “Cradle to Cremation”.

3. PHARMACEUTICAL USE

Sandalwood oil was used traditionally to treat skin disease, acne, dysentery, gonorrhoea & number of other ailments. In traditional Chinese medicine, sandalwood oil is considered as an excellent sedating agent.

The characteristic strong, woody, pleasant odour & medicinal properties are mainly due to α & β – Santalols. Indian Sandalwood oil contains the highest amounts of α & β - Santalol compared to any other sandalwood oil produced in the world. The α -Santalol posses anti bacterial properties & β -Santalol possesses sedative properties, whereas synthetic sandalwood boosters do not contain these active ingredients.

Today sandalwood essential oil is considered in aromatherapy to be effective in treating dry skin, general skin irritation & acne besides acting as a mood enhancer. It is effective in the treatment of bronchitis, dry persistent coughs, laryngitis as well as sore throats. It may also help in to relive diarrhea, nausea & some cases of cystitis, fever, dermatitis, arthritis, hyperacidity, insomnia, stress, anxiety etc.; the paste of wood or infusion is a good dressing for eruptive skin disease.

Furthermore, it is used as a tonic for hyper active mind and is considered to be an anti-depressant, as it can help to relive heat, agitated emotional states and relief people from stress & worry. It can also be used as a sedative, astringent, disinfectant to genitourinary tract, diuretic & stimulant. It is also a diaphoretic & aphrodisiac.

4. PERFUMERY USAGE

Sandalwood Oil is a natural fixative for all the top class perfumes. As regards the perfume, Cosmetics & Soap Industries, East Indian Sandalwood Oil is one of the most important natural fixative ingredients. No composition of the heavy or oriental class of perfume is complete without an ample dose of this oil. Its sweet, powerful & long lasting odour makes it an excellent natural fixative in the scenting of soaps and it blends very well with all kinds of perfume composition.

It is pertinent to note that, Indian Sandalwood Oil usage has declined substantially by the European perfumery houses in view of the non-availability of sustainable and ethical supplies of quality sandalwood oil. Hence, it would be prudent to review the commercial cultivation of sandalwood on a large scale in view of the huge demand in the domestic as well as global market. This would conserve the sandalwood species and to restore our heritage, since the sandalwood tree is on the verge of extinction and classified as one of the endangered plant species.

Future of Sandalwood in the World:

The production of sandalwood was picking up the momentum by the year 2011 onwards, since the major plantation company in Australia, M/s TFS Ltd., had planted about 5000 hectares of the Indian Sandalwood by scientific methods. They expect harvesting by the year 2011 in first installment. Furthermore, they are also planning about 2000 hectares in the Kemberly region of Western Australia. There is a high demand for Indian Sandalwood because of its unique fragrance quality, its use in medicines, cosmetics, beauty aids & paradigmatic shift of the consumers towards the natural products.

Additionally, since 2003, Karnataka farmers have also been showing active interest in cultivating sandalwood on a commercial scale in view of the liberalization of the sandalwood trade and amendment of the Forest Act & Rule and granting of ownership to the private patta land owners.

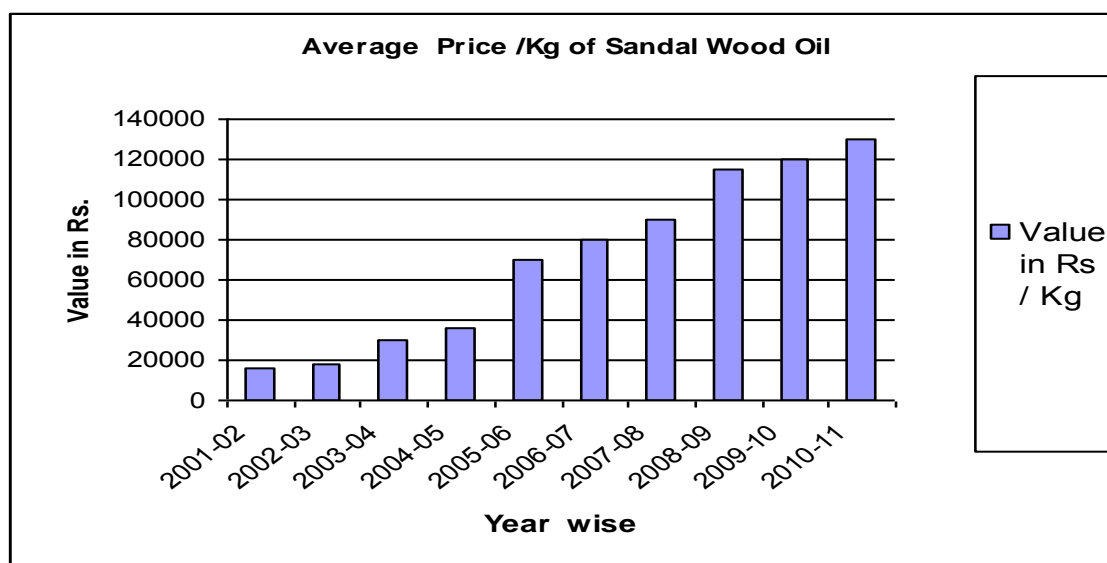
In India, the National Medicinal Plant Board & National Horticultural Mission are assisting sandalwood cultivation and inter-planting with other medicinal plants through their State Agencies. There has been a healthy response from the private land owners for commercial

cultivation and the harvesting of commercially planted sandalwood in India is expected by the year 2015 onwards, particularly in Karnataka. Furthermore, many farmers and entrepreneurs are setting up plantations of Indian Sandalwood in the states of Gujarat, A.P., M.P, Maharashtra, Rajasthan & Assam on a large commercial scale of some 5000 hectares.

Assistance from the commercial banks & other financial institutions for the farmers & entrepreneurs in India is yet to pick up the momentum. Hence there is urgent need of intervention of the Indian government, particularly from the NABARD and even for Foreign Direct Investment (FDI). However, countries like Australia are encouraging companies who are entering into the plantation crops by extending huge rebates from income tax in the context of investment made towards the maintenance of eco balance. Moreover, several countries such as China, Australia, Thailand, Costarica, Cambodia are Srilanka are also venturing into Santalam Album plantation because of its fragrance characteristics and economic feasibility coupled with the huge demand for natural products worldwide

Price trend

The price of Indian Sandalwood of good heartwood class at present is over Rs.6500 per kilogram and that of oil is over Rs.1,23,000 per kg, from the legal & ethical sources. The price at the international market is about 15 to 20 % higher than the domestic market. Though there is ban on the export of bigger logs of wood from India, these nevertheless reach the world market. The annual increase of price is going at a premium of more than 30 percent.



The exhausted powder is used in incense stick to Dhoop manufacture and resin is also extracted from it for which is being used as fixative in woody kind of fragrances.

International Conference on the Art and
Joy of Wood

19-22 October 2011

Presentation on
GLOBAL EMERGING TRENDS ON
SUSTAINABLE PRODUCTION OF
NATURAL SANDALWOOD

From the House of *Mysore Sandal*
(KS&DL)

WELCOME

TO

PRESENTATION ON GLOBAL EMERGING TRENDS ON SUSTAINABLE PRODUCTION OF
NATURAL SANDALWOOD - 21.10.2011

By

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KARNATAKA SOAPS & DETERGENTS LIMITED, BANGALORE-INDIA

INTRODUCTION:

- Sandalwood is the fragrant heartwood of some of the species of genus Santalum of family Santalaceae.
- The most notable members of this group are Santalum album, Indian Sandalwood & Santalum spicatum, (Australian Sandalwood).
- Sandalwood has been valued for centuries for its fragrance, wood working and various purported medicinal qualities

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- KS&DL a State owned Company in India having the legacy of over 95 years in the production of natural Sandalwood oil and Sandalwood oil based products.
- KS&DL working for accelerating sustainable development of Sandalwood requirements aims at meeting the needs of society present and future.

Agro-technology of cultivation of Sandalwood

- Sandalwood tree is partial root parasite, requires another host tree by its side, through which it draws nutrient for its good growth.
- Sandalwood can be grown in variety of soil with pH ranging from 7 to 8.5, with area temperature ranging from 5° to 50°C. It is not region specific and can adapt to different environmental conditions.

- In natural conditions Sandalwood tree takes more than 7 years to produce scented heartwood and its growth is restricted due to climatic factors, soil, vegetation, fire, grazing and human interventions.

- Under these stress conditions fully developed tree requires about 30 to 35 years for harvesting.
- Where as the plantation grown trees produce heartwood formation in about 3 to 4 years and develop good heartwood in about 12 to 15 years.
- Harvesting at this age is much more economical and commercially viable.

Cultivation Practices

- Seeds are available in two seasons, April May and September to October; both the seeds perform alike with respect to germination.
- Well-developed healthy seedling of 6 to 8 months old is ideal for planting in the field

- Some of the plants identified for intercrops are, grafted Amla or gooseberry (*Phyllanthus emblika* or *Emblika officinalis*), or grafted Tamarind (*Tamarindus indica*), or grafted Pomegranate (*Punica granatum*).

Quality of Sandalwood oil:

- The quality of Sandalwood oil is assessed on the basis of the total Santalol content by GLC method along with the other physico chemical characteristic viz., optical rotation, refractive index, specific gravity etc.,

- The Indian Sandal wood oil has 90% Santalol content, in respect of Australian Sandalwood oil is in the range of 38-39% only.
- The age of the tree also play vital role along with other Agro climatic condition.

Colour of heartwood and oil content ;

- The superiority of wood is generally judged based on colour, weight and from the portions of the tree from which it is taken.

THE CLASSIFICATION OF INDIAN SANDALWOOD IN THE TRADE:

The classification is enumerated in to 18 classes;

1. First class billet. (Vilayat budh)
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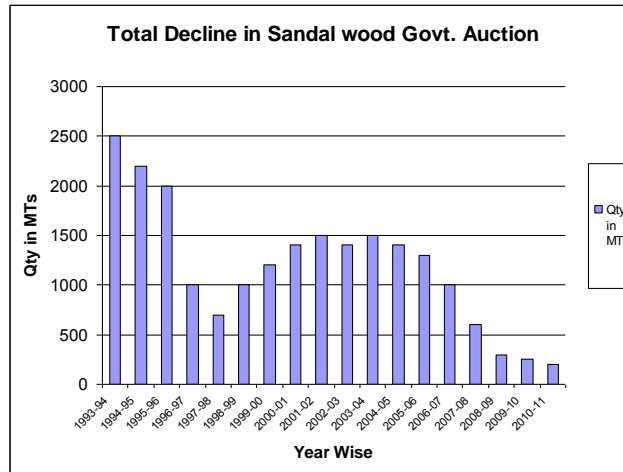
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Present scenario of Sandalwood production in India;

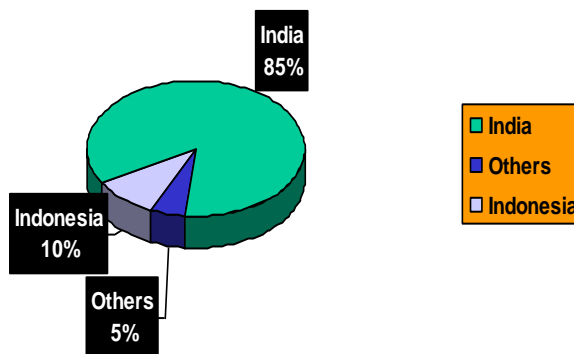
- Due to rampant smuggling on illegal trade of Sandalwood and declining the area of cultivation of Sandalwood the production of Sandalwood may reach to 300 - 400 MTs/annum.

- **There is a decline of Sandalwood sale in auctions conducted by different state Governments in India in the recent years.**

Decline of Sandalwood sale



The Global production Details of Santalum Album & Oil Production



- In view of the Indian sandalwood supply is being limited and expensive, industries dependent on Sandalwood are on the look of alternates, such as Western Australian sandalwood oil, Fiji and New Caledonia sandalwood and oil, South African sandalwood oil etc.

Legal aspect of sandalwood

- Sandalwood plants are widely distributed in the southern states like, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala, hence, defined sandalwood as a “forest produce”, where as “Indian Forest Act” does not have any special provisions for sandalwood.

- The legal hassles faced by the Sandalwood trade regulation is that there is no comprehensive regulation applicable to the entire country.
- The clandestine trade is flourishing and Sandalwood population declining which is in the verge of extinction and Sandalwood is classified as one of the endangered plant specie in India.

- Karnataka and Tamil Nadu forest departments have amended the Sandalwood Act in 2001 and 2002 respectively and made grower himself as a owner of the Sandalwood as per the Amended Act.

- Govt. of Karnataka already made amendment on the sale of Sandalwood through Forest Dept. & Govt. Departments to eliminate the clandestine trade and to encourage farmers to take cultivation of Sandalwood on commercial scale during the recent years.

Uses of Sandalwood Oil:

- The word Sandal is derived from Chandana (Sanskrit). It is said Sandalwood finds its use in human life particularly Indian culture and civilizations from **Cradle to Cremation.**

- Some of the major industries depending on sandalwood oil:
 - Attar industry
 - Perfumery
 - Soaps and toiletries
 - Chewing scented tobacco
 - Pan Masala
 - Pharmaceutical applications

PHARMACEUTICAL USE OF SANDAL

- Sandalwood oil was used traditionally to treat skin disease, Aroma therapy, acne, stress, anxiety, bronchitis, dysentery, gonorrhoea & number of other ailments.

PERFUMERY USAGE:

- Sandalwood Oil is a natural fixative for all the top class perfumes. As regards the perfume, Cosmetics & Soap Industries, East Indian Sandalwood Oil is one of the most important natural fixative ingredients because of its sweet, powerful & long lasting aroma.

Future of Sandalwood in the World:

- There is a good demand for Indian Sandalwood because of its unique fragrance quality, its use in medicines, cosmetics, beauty aids & paradigmatic shift of the consumers towards the natural products.

Sandalwood cultivation in Karnataka

- In addition to the above since 2003 Karnataka farmers are also showing active interest in cultivating the Sandalwood on commercial scale in view of the liberalization of the Sandalwood trade and amendment of the Forest Act & Rule and granting of ownership to the private patta land owners.

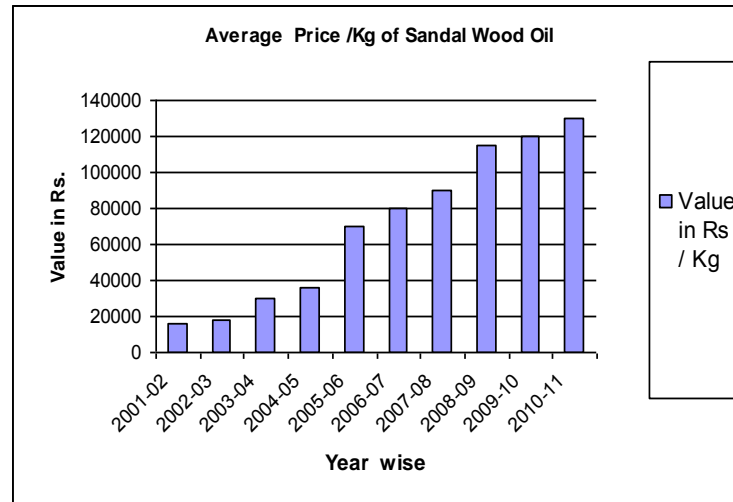
- Under 'Grow More Sandal' programme, KS&DL has entered into an Buy-back MoU with over 250 farmers/growers of the State & equal number of farmers have enquired for Commercial cultivation of Sandalwood on 'Share & Prosper' basis and it spreads over 5000 acres of land.

NMPB ASSISTANCE

- In India, National Medicinal Plant Board & National Horticultural Mission are assisting through their State Agencies for cultivation of Sandalwood along with the other medicinal plants as one of the haustorial plant with Sandalwood.

- Further, several countries in worldwide viz., China, Australia, Thailand, Costarica, Cambodia & Srilanka are also venturing into Santalum album plantation because of its fragrance characteristics and Economic feasibility coupled with huge demand for natural products worldwide

Price trend



Scope of Cultivation of Sandalwood

- The Scope for cultivation of Sandalwood is very much encouraging.
- There is a wide gap between demand & supply.
- Govt. of India encouraging by extending the subsidy through National Medicinal Plant Board and National Horticultural Mission for the growers of Sandalwood along with other houstarial plants.

- This would definitely generate Green cover, reduce Eco impact, conservation of nature, Santalum album specie from the verge of extinction.
- This would also facilitate the poverty alleviation, rural employment and economic empowerment of the growers

Saplings when 1 Month Old



Saplings when 2 Months Old



Saplings when 3 Months Old



Saplings when 4 Months Old



Progress of the tree girth



• **Cultivation of Sandalwood - Economic Feasibility in Indian Context**

• No.of Sandal Plants per (Hectare)	:	500 Nos
• No.of Primary Host Plants	:	500 Nos
• No.of Intermediate Host Plants	:	500 Nos
• No.of Long term Host Plants	:	500 Nos
• Cost of Sandalwood Seedlings Rs.12 x 500	:	Rs.6000-00
• Cost of Primary Hosts(Rs.2/- each)	:	Rs.1000-00
• Cost of Intermediate Host(Rs.10/-)	:	Rs.5000-00
• Cost of long term Hosts(Rs.10/-)	:	Rs.5000-00
• Cost of Transportation, Pit formation	:	
• Planting, watering etc.,	:	Rs.20000-00
• Cost of Drip Irrigation	:	Rs.100000-00

Recurring Expenditure for 15 years

• Security & Vigilance @ Rs.36000 per yr.	:	Rs.540000
• Weeding & Soil work expenses(8 yrs)	:	Rs.16000
• Irrigation facilities for 8 years	:	Rs.16000
• Fertilizers/Manure etc., for 8 years	:	Rs.40000
• Management of Pests & diseases Supervision etc., for 15 years	:	Rs.375000
• Land & other infrastructure	:	<u>Rs.1000000</u>

TOTAL EXPENDITURE (AFTER RECONING
THE INVESTMENT, INFLATION 5% &
INTEREST AT 12% ON INVESTMENT : Rs.48,00,000/-

Expected yield of Heartwood after 15 years

- No. of Sandalwood trees eligible for extraction after taking 10% as mortalities theft etc., : 450 Nos.
- Qty. of Heartwood expected (20kg per tree) : 9000 kgs
- Qty. of Sapwood (30kg per tree) : 13500 Kgs
- Average cost of Heartwood per kg : Rs.3500/-
- Cost of sapwood per kg : Rs.65/-
- Approx. cost of 9000kg of Heartwood : Rs.31500000/-
- Approx. cost of 13500kg of sapwood : Rs.877500/-
- Estimated profit from inter crops : Rs.120000/-
- Total : Rs.32497500/-
- NET ESTIMATED PROFIT AFTER RECONING EXPENDITURE OF Rs.48,00,000/- : **Rs.2,76,97,500/-**



Vision of KS&DL

- Our Vision is to produce the best quality Sandalwood & Sandalwood Oil 'from Soil to oil' from the legal & ethical sources on sustainable basis through commercial cultivation of natural Sandalwood.

- Our Vision is to produce the best quality natural Sandalwood oil based Soaps, Cosmetics, Beauty aids, Wellness products, Health & Hygienic products along with Oral care / Dental care products through continuous innovation and excellence to meet the global standards for improvement in quality of life and making our planet more sustainable

Mission of KS&DL

- KS&DL Research centre constant endeavor is continuously working on upgrading the products quality formulation of all the products viz., Soaps, Detergents, Cosmetics, Beauty aids, Wellness products, Health & Hygienic products and Oral care products, Agarbathi, Dhoop including newer products with the heightened regulatory measures to meet the highest International quality standards viz., FDA & REACH guidelines.

- The major thrust of R&D is committed for developing the natural essential oil based products using the natural Sandalwood oil as base to achieve the new paradigm of competitiveness, for natural based products to maximum customer satisfaction, to meet the customer requirements & expectations.

- Our Mission would be to get the best value for money paid by our customer. The products are conceived with the concept of aromatherapy, to gain the visibility of the supply chain in the shelf and creating a business for the future by meeting ISO: 9001-2008 & ISO:14001-2004 guidelines and making KS&DL a world class FMCG PSU.

- I hope with this presentation, the participants would definitely benefit for venturing into the cultivation of Sandalwood as one of the potential commercial crop in the present as well as in future to meet the growing demands for the Sandalwood



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Sustainable Supply of Global Sandalwood for Industry

H S Ananthapadmanabha² and V S Venkatesha Gowda³

Abstract

There are 16 recognised species of sandalwood in the world; broadly they can be grouped as East Indian sandalwood, Australian sandalwood, Hawaiian sandalwood and sandalwood of the Pacific Islands. Many of these are under the threat of extinction due to over exploitation. Some countries are taking steps to cultivate using modern techniques to save these species. East Indian sandalwood, Santalum album L., is the queen among the species yielding supreme quality essential oil much required by the perfume and allied industries. India was producing large quantity of sandalwood oil, meeting over 80 percent of world demand over the past decades, but due over exploitation and various other reasons the quantity of production has come down drastically.

Many sandalwood based industries have come up recently in India as well as abroad on its proven importance and sustainable supply of wood and essential oil. Based on the importance of natural sandalwood oil, many countries like, Australia, Sri Lanka, Thailand, Cambodia, Costa Rica, Pacific Islands etc. are trying to grow different species of sandalwood to meet global demand; India is not lagging behind in its attempt to grow more sandalwood to bring back the past glory and very soon it may meet demand of both the domestic and international market.

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1. INTRODUCTION

The sandalwood and sandalwood oil industry is one of the oldest in the world of perfumes. It has long been traded for its fragrant wood and essential oil. Since this oil can blend well with most natural essential oils, it is in more demand in perfumery industries. Synthetic substitutes have been produced as early as 1960, but are in no way identical to that of the natural material to replace it in the perfumery industry.

New sandalwood based industries evolved after 1990 using more and more natural sandalwood oil, due to this there was over exploitation of this species around the world, consequently the production is on the decline. The essential oil and allied industries can absorb more than 15,000 tonnes of sandalwood annually.

There is no concise literature available in the market containing information on all species of sandalwood, regarding respect of distribution, availability and its economic importance, which would be of interest to foresters and scientists to improve the species for economic potential and to the traders for their marketing innovations.

The genus 'Santalum' grows naturally throughout the Pacific and Eastern Indian Ocean regions. Sandalwood trees are evergreen ranging in size from tall shrubs to large trees. They grow in a variety of climates ranging from Australian desert to sub-tropical New Caledonia and at elevations from sea level to 5000 meters. It is distributed in the peninsular India, parts of Malaysia, Australia, New Zealand and Polynesia extending to the Hawaiian Archipelago and Juan Fernandez Islands. The species belongs to this genus are usually partial root parasitic plants, equipped with special structures on its root that penetrate the roots of host plants to obtain nutrients.

Some of the species furnish fragrant heartwood, known as sandalwood, yielding different kinds of sandalwood oil.

Sandalwood is the fragrant heartwood of some species of genus *Santalum* (Santalaceae). All sandalwood oil or fragrant wood traded in international market comes from species in the genus *Santalum* (Family Santalaceae). The genera contain 16 recognised species, and more than 12 varieties, distributed throughout the world. Out of them only five species, produce commercially exploitable scented heartwood (*S.album*, *S.yasi*, *S.spicatum*, *S.austrocaledonicum* and *S.lanceolatum*). These are important species for their fragrant scented heartwood and for essential oil. Other species of *Santalum* also produce fragrant heartwood and oil; however their contribution to essential oil industry is limited. The sandalwood wood is also an excellent material for carving and to make curious handicrafts.

All species occur in natural forest in different habitats. Most of the species are over exploited and are under threat as endangered species. The demand for the scented heartwood and natural sandalwood oil is increasing and the supply is on the decline. Because of inconsistent supply, the price is fluctuating and has gone up very steeply, making it difficult to obtain for various industries. The only alternate left is to produce sandalwood commercially with high input and management technique to make a short-term rotation crop.

There are more than 56 species and varieties of 'Santalum' mentioned in the literature, based on the morphological characters.

Different species (Var) of Santalum occurring in the world

1. *Santalum acuminata*
2. *Santalum album*
3. *Santalum austrocaledonicum*
4. *Santalum cognatum*
5. *Santalum cunninghamii*
6. *Santalum cygnorum*
7. *Santalum diversifolium*
8. *Santalum freycinetianum*
9. *Santalum homei*
10. *Santalum involutum*
11. *Santalum latifolium*
12. *Santalum longifolium*
13. *Santalum marchionense*
14. *Santalum mida*
15. *Santalum murrayanum*
16. *Santalum obtusifolium*
17. *Santalum papuanum*
18. *Santalum preissii*
19. *Santalum raiateense*
20. *Santalum venosum*
21. *Santalum cuneatum*
22. *Santalum fernandezianum*
23. *Santalum insulare*
24. *Santalum littorale*
25. *Santalum megacarpum*
26. *Santalum oblongatum*
27. *Santalum pelgeri*
28. *Santalum spicatum*
29. *Santalum acuminatum*
30. *Santalum angustifolium*
31. *Santalum boninense*
32. *Santalum crassifolium*
33. *Santalum ellipticum*
34. *Santalum haleakalae*
35. *Santalum hornei*
36. *Santalum lanaiense*
37. *Santalum leptocladum*
38. *Santalum macgregorii*
39. *Santalum margaretae*
40. *Santalum mitchellii*
41. *Santalum myrtifolium*
42. *Santalum ovatum*
43. *Santalum persicarium*
44. *Santalum preissianum*
45. *Santalum salicifolium*
46. *Santalum yasi*
47. *Santalum affine*
48. *Santalum capense*
49. *Santalum densiflorum*
50. *Santalum hendersonense*
51. *Santalum lanceolatum*
52. *Santalum majus*
53. *Santalum multiflorum*
54. *Santalum paniculatum*
55. *Santalum pyrularium*
56. *Santalum obstfolium*

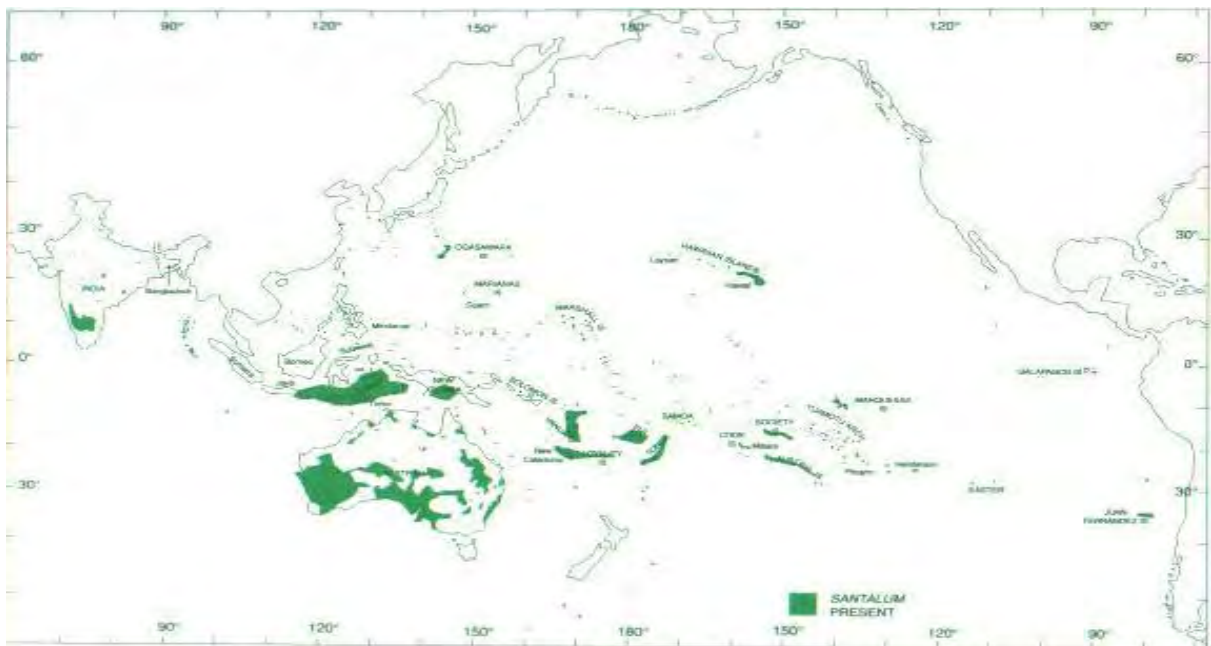
However, currently only 16 recognised species have been identified in ‘Santalum’ and their geographical occurrences in the world are as follows;

Species and varieties

Geographical occurrence

- | | |
|---|--|
| <ul style="list-style-type: none"> • <i>S.album</i> L • <i>S.austrocaledonicum</i> Viell • <i>S.boninense</i> (Nakai) Tuyama • <i>S.lanceolatum</i> R.Br. • <i>S.macgregorii</i> F.Muell • <i>S. Obtusifolium</i> R.Br. • <i>S.yasi</i>. Seem • <i>S.freycinetianum</i> Gaudich • <i>S.haleakale</i>. Hillebr • <i>S.ellipticum</i> Gaudich. • <i>S.paniculatum</i> Hook&AM. • <i>S. fernaandezianum</i> F.Phil. • <i>S.insulare</i> Bertero • <i>S.acuminatum</i> (R.Br. A.D.C. • <i>S.murrayanum</i> (T.Mitch) C.A.Gardner • <i>S.spicatum</i> (R.Br.) A.D.C. | <ul style="list-style-type: none"> • Australia, Indonesia, India • New Caledonia, Vanuatu • Bonin Islands • Australia • Papua New Guinea • Australia • Fiji, Tonga • Hawaii Islands (O’ahu.Moloka’I) • Hawaiian Islands (Maul) • Hawaiian Island • Hawaii Islands • Jaun Fernandez Island • Society Islands (Tahiti) • Australia • Australia • Australia |
|---|--|

Map of Santalum distribution in the world.



2. EAST INDIAN SANDALWOOD

The genus represented by *Santalum album* Linn., produces rich scented heartwood and oil. Its wood is known commercially as “East Indian Sandalwood” and the distilled essential oil from it as “East Indian Sandalwood Oil”. Sandalwood oil is one of the oldest perfumery materials and is economically important. Both the wood and oil are used in incense, jaw-sticks, perfumes and soaps and in medicine and are of great commercial importance. Sandalwood is one of the finest woods for carving, since it is closely grained with fewer knots. It is used for making idols, boxes and other curios of exquisite beauty. Wood and oil of *S.yasi* is almost similar to that of *S.album*.

Production and marketing

The Indian average production of wood during 1965 to 1975 was about 4500 tonnes, and most of it was used for oil production. The natural forest resource of sandalwood has been over exploited, there by the elite population source have disappeared from the forest. Due to change in the forest policy, “that the dead and the dried sandalwood trees to be removed from the forest”, chances of natural regeneration occurring in the forest is increased, however, it is not enough to meet the growing demand.

The annual harvest drastically on the decline from 2004-2005 to only 1000 tonnes and then during 2010 it has reached the bottom level of merely 500 tonnes.

Similar trend on the decrease of sandalwood production has occurred in Indonesia, however their contribution of wood and ail to the international market is less than 10 percent. During 2010 there is ban on cutting of sandalwood from the natural forest to effect regeneration.

Sri Lankan contribution to the sandalwood industry is too small, but efforts are on the cultivation of sandalwood by private participation.

Australia has realized the importance of Indian sandalwood and is making commercial progress. They will be world leader of the sandalwood industry in the near future.

Many corporate bodies and farmers in India have come forward to grow sandalwood as a commercial crop, with the hope that this movement may reduce the gap between the demand and supply.

3. AUSTRALIAN SANDALWOOD

Sandalwood is an integral part of the history and ecology of Australia. There are six species of *Santalum* grown naturally, *Santalum spicatum*, *S album*, *S.lanceolatum*, *S.murrayanum*, *S.accuminatum* and *S.obtusifolium*. Out of six species only three species, *S.spicatum*, *S.album*, and *S.lanceolatum* yield commercially important scented heartwood and oil.

S.spicatum, popularly known as West Australian sandalwood is also one of the important species producing scented heartwood and oil. Wood has been exported to different countries since 1844. The oil has a different chemical composition and has better medicinal properties. The oil is used in perfumery, incense sticks, soaps and toiletries and aromatherapy. The wood

is also used in carving. Recently it has become an alternate source of essential oil for sandalwood based industries.

Wood production is on the decline, and adequate conservative methods to limit the annual harvest are being taken by the government. Since 2000 large plantation activities are being taken up by corporate bodies to meet the growing demand...

S.lanceolatum is the second major type of sandalwood native to Australia; the heartwood contains fewer odours and yields comparatively less oil; the oil mixes well with other sandalwood oil. The scented oil is used in perfumery industry.

S. acumminatum is also a native species of Australia and the trees are cultivated for fruits rather than oil. The timber is hard, usually used for furniture making and is not scented.

S.murrayanum is a small shrub or a small tree growing to 4 meters with spreading branches. The wood is not perfumed and bark is more or less smooth. The tree has no commercial value.

S. obtusifolium. Is a small shrub growing up to 2.6 m., the wood is not perfumed and has no commercial value.

4. PACIFIC ISLAND SANDALWOOD

S. austrocaledonicum, is an important species growing in New Caledonia and Vanuatu islands, scented heartwood is used for making beautiful handicraft items and the oil produced from heartwood is highly scented and are sold as New Caledonian oil or New Caledonian sandalwood oil. The oil is highly priced and very much sought after in the perfume industries.

The species has been over exploited commercially, and annual harvest exceeds 100 tonnes.. Sandalwood contributes substantial forest revenue to the island. Attempts are being made to conserve the species in different pacific islands..

S. yasi grows in Fiji and in Tonga islands, its scented heartwood yield high quality sandalwood oil. Fijians and Tonganians scent coconut oil during marriage ceremonies, in which the bride and bridegroom are dusted with powdered heartwood.

The fruit and flowers are similar to that of *S.album*, but the leaves are oblong. The heartwood is yellow and highly scented. It has been reported that native Fijian species *S.yasi* is able to naturally hybridise with *S.album*. The seeds collected from *S.yasi* trees in mixed plantation with *S.album* gave 20% hybrid seeds. Hybrid sandalwood seedlings showed growth rate almost twice to that of *S.yasi*, achieving over 2.5 m height in two years.

Sandalwood oil is similar to that *S. album* and the oil yield is about 7 percent. Sandalwood has been over exploited. Annually about 100 tonnes of wood are exported to different countries.

5. HAWAIIAN SANDALWOOD

Four species of sandalwood are found distributed on the Island. They are small shrubs or trees typically 5 to 10 m or larger at maturity. All species exhibit considerable morphological variations and numerous traditional varieties are recognized. Wood is traditionally used in the Pacific islands for carvings, cultural uses and is burnt as insect repellent.

All species are attractive, especially when in flower and suitable for home gardens.

1. *Santalum ellipticum*
2. *Santlum freycinetianum*
3. *Santalum haleakalae*
4. *Santalum paniculatum*

Sandalwood has strong history and is particularly culturally attached to different religions. The product derived from it has been in use for several centuries. Other species of *Santalum* are only of academic interest since their production and contribution to the essential oil industry is limited; however, they are the important species of the region contributing to the cultural heritage and use, but due to over exploitation of the species, many have disappeared or in the endangered list.

Santalum macgregori, called Papua New Guinea sandalwood, is another species producing scented heartwood and oil used in perfumery.

Several non-*Santalum* species (e.g. *Osyris tenuifolia*, *O. laceolata* from East Africa and *Amyris balsamifera* L. from West Indies) are also used as sources of “Sandalwood” type. The less fragrant wood and the distilled oil are different when compared to true sandalwood.

Different *Santalum* species occurring in different parts of the world have some characteristic features of their own and are culturally attached to the region. Some of the species of *Santalum* which yield scented heartwood and essential oil can be used to make a gene bank to improve the species commercially. Studies are required to utilize the adaptive nature of *Santalum* species to different habitats.

Some of the wood properties and charectertics of sandalwood oil are very interesting.

6. WOOD PROPERTIES AND CHARACTERISTICS

S.album	S.spicatum	S.lanceolatum	S.accuminatum	S.astrodonicum	S.yasi	S.ellipticum	S.freycinatanum	s.macgregori	S.insulare
HW is heavy and durable, offers pleasant strong scent, yellow or brown in appearance. on distillation yield 4 to 6% oil	HW is dark brown, less strongly scented. wood on distillation yield 2 to 2.5% oil	HW is brown slightly scented. Wood on distillation yield 2% oil	HW is not scented	Hw is light brown, hard highly scented. Wood on distillation yield 2 to 3% oil.	HW is yellowish brown, hard oily, strong scented. Wood on distillation yield 4 to 7% oil	It is called Ilahi sandalwood. HW is fragrant. Wood on distillation yield 1% oil or less.	Wood is called frecinet sandalwood. wood is slightly scented and the distilled oil is called Tahiti sandalwood oil. Oil yield is about 2%	HW is light brown, less perfumed. Oil yield is about 3.5%. the quality of oil is low.	HW is less scented. Ethanol concentration from wood gives fragrance.

Sandalwood

Fragrance Of The World
(Sustainable Supply)

H.S. Ananthpadmanabha

Santalum album

- **Distribution :**

- ◆ India
- ◆ Sri Lanka
- ◆ Indonesia
- ◆ Fiji
- ◆ Australia
- ◆ China
- ◆ Pacific Islands

Australian Sandal Wood

- ◆ **S. spicatum**
- ◆ **S. lanceolatum**
- ◆ **S. accuminatum**
- ◆ **S. obtusifolium**
- ◆ **S. murrayanum**

Sandalwood in Pacific Islands

- ◆ **S. austrocaledonicum**
- ◆ **S. yasi**
- ◆ **S. macgregori**
- ◆ **S. insulare**
- ◆ **S. bominense**
- ◆ **S. Fernandezianum**

Hawaiian Sandalwood

- ◆ *S. elipticum*
- ◆ *S. freycinetium*
- ◆ *S. haleakalae*
- ◆ *S. paniculatum*

All Santalum sps are root parasites



Sandalwood Flower



Nursery bed



Seedlings Transferred To Poly Pots



Sandalwood Nursery



Sandalwood Nursery



Planting In The Field



Planting Instrument



Sandalwood Plantation in Australia



Sandalwood Plantation in Australia



Sandalwood Plantation in Karnataka



Sandalwood Plantation in Sri Lanka



Sandalwood Plantation in Sri Lanka



Sandalwood Plantation in Sri Lanka



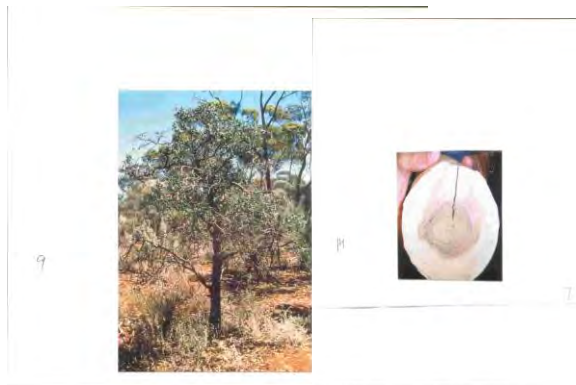
Growth Sandal Wood Tree



Attar Preparation



S.spicatum



FLOWERING



- S.yasi is predominantly out-crossing
- Hybridizes freely with S.album
- Self-pollinates to some extent



Segregating plants in nursery

NATURAL REGENERATION

- Alternative method of regenerating sandal
- Need an effective management system
- Thousands sprout only a few will persist
- Fittest & those that secured host survive



TREE IMPROVEMENT

- Santalum yasi
- Santalum album
- S.yasi x S.album F1 Hybrid

Seed trees



Wood core drilling



S. YASI X S. ALBUM F1 HYBRID

- Hybrids have potential to combine desirable characteristics of both parents
- S.yasi x S.album F1 hybrid is more vigorous, faster-growing, and more adaptable, and produces oil faster than the parents
- F1 hybrid is produced when the 2 parents are grown close to each other



S.yasi

S.album





MASS PRODUCTION OF CUTTINGS

- Juvenile cuttings of young seedlings of can be rooted but not mature trees
- Past trials affected by watering problems and lack of staff
- One MSC student currently doing thesis on shoot production and root cuttings

Sandalwood Activities in Papua New Guinea



Introduction

Since new interest was rekindled in 1996, the work in sandalwood has been somewhat slow, especially in awareness and educating resource owners in sandalwood growing areas in the Central, Gulf and more recently in the Western Provinces of Papua New Guinea.

Despite the slow progress, it is however, pleasing to report that some measure of success have been achieved in the attempt to promote and develop sandalwood in the country as a low volume high value species.

Sandalwood Activities in Papua New Guinea



Current Work

● **Seed Collection**

- First collection was made in 1997 and distributed for trials in Australia, FRI and Kuriva in the Central Province..
- Second seed collection was done by NTSC and FPCD in August, 2001
- Third seed and germplasm collection was done by FRI and CSIRO September, 2001
- In October, 2002, PNG was fortunate to attend the Regional Workshop on Sandalwood Research, Development and Extension in Noumea, New Caledonea.
- Fourth seed and germplasm collection was again carried by FRI and CSIRO in 2004 when materials collected in 2001 failed.

Sandalwood Activities in Papua New Guinea



Nursery Trials

- Pot host trials began at FRI in 1997.
- Work on various germination techniques also began in 1997 with the pot host trials
- Extensive work on germination technique and various germination medium done at FRI this year and internally reported in October, 2005.



Sandalwood Activities in Papua New Guinea



Ex-situ Conservation

- Three attempts have been made so far at ex-situ conservation as already mentioned above. Of the three trials, only the Markham Bridge trial is promising while the other two failed due to fire and poorly drained site.
- The Leron site got burnt and the LBG site is still growing but poorly.

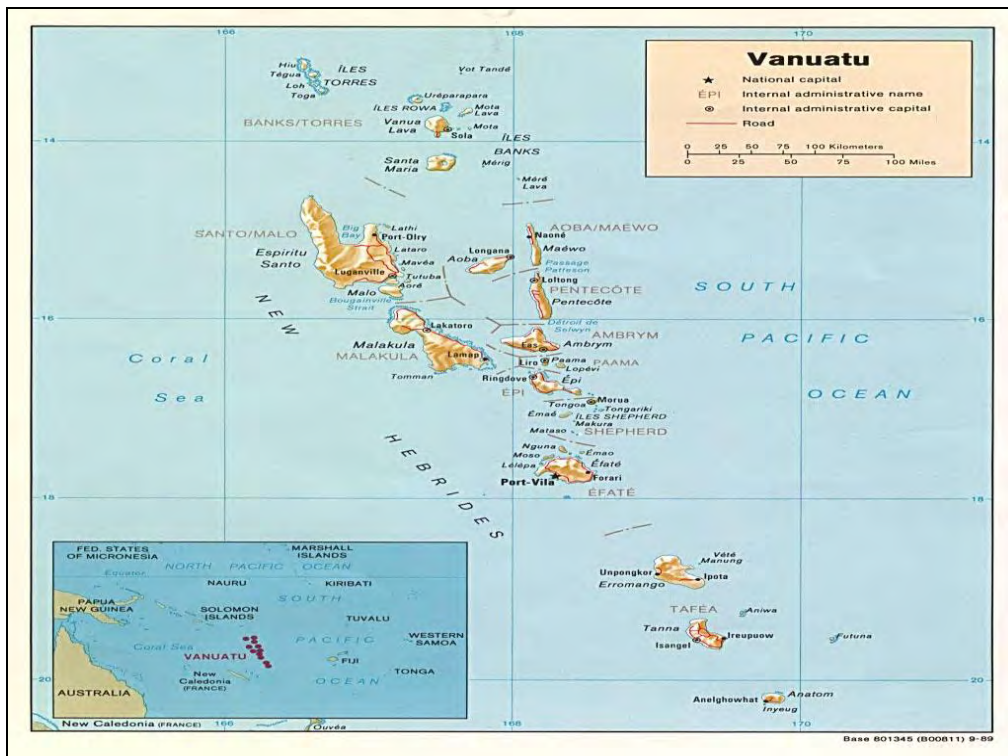


Sandalwood Activities in Papua New Guinea



Seed Storage

- Sandalwood seed storage and germination tests are still being carried out. So far all seed stored for more than six months have either shown very low germination or none at all.
- Some desiccation work is also being done in the hope of hastening germination by reducing the seed moisture.



Trade and Industry cont..

- The Forest Policy allows for an Annual harvest of 70 ton heartwood.
- Currently 80 ton heartwood was shared between the 2 existing buys
- In yr 2000, 73 ton of Sandalwood worth Vt31,727,850 while the value of logs was Vt32,974,910 for 39,860 cubic meters

Harvesting & Transporting Sandalwood logs to Vila



Sandalwood Seedling Ready to be Transported to Local Farmers



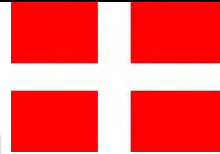
Sandalwood Seedlings in the Nursery



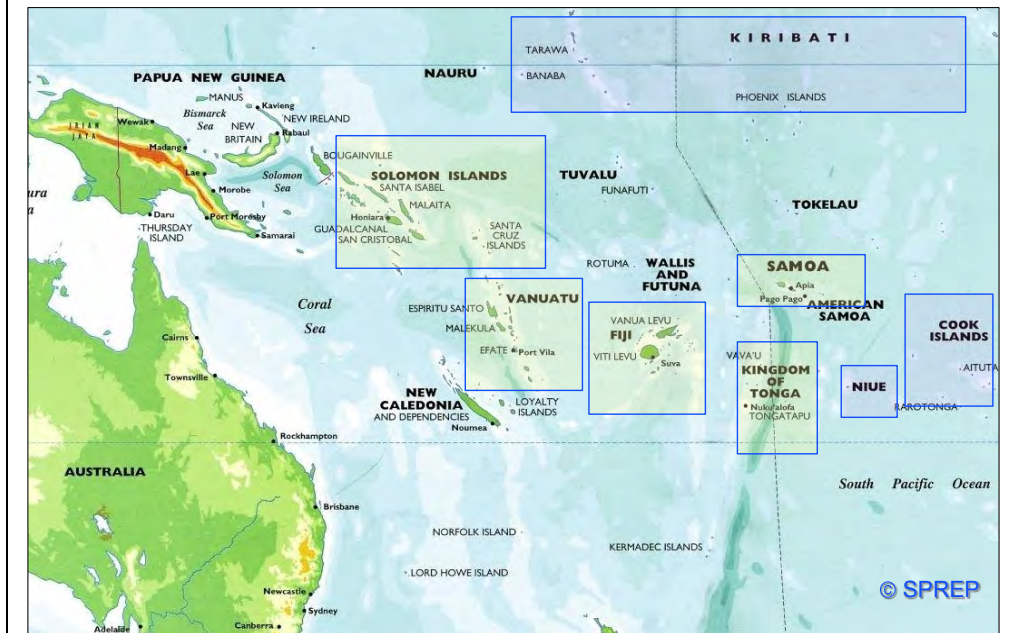
Farmers Sandalwood Plot



Sandalwood work in Tonga



PACIFIC ISLAND NATIONS PARTNERS



Tonga



Heartwood – S.yasi





Methodology

• Tree

- Leaf length & width
- Fruit diameter
- Trunk diameter
- Tree height
- Depth of heartwood
- Colour of heartwood & bark blaze
- Est. bud, flower & fruit number

- Heartwood core sample
- Dried leaf sample
- Herbarium specimen



Oil & Heartwood



Variation In Heartwood





Thank You

Sandalwood: The Saviour of Ecological Balance and Super Wealth Creator

Ramesh Chandra Mishra⁴

Abstract

Nearly 25 species of the genus Santalum L. commonly known as sandalwood are awaiting their turn to transform the ecological balance of nature after suffering serious setback and gross depletion due to indiscriminate hacking in the past. The wild existence of the leading species Santalum album L. has suffered to the highest level. Natural as well as artificial regeneration could conceivably rejuvenate their existence and thus provide an extremely valuable natural resource that could be harvested on a sustainable basis

Planned plantations of these species, individually or in various combinations, is capable of fulfilling almost all the luxuries of the futuristic progressive civilization, mainly through their fragrant and beautiful wood and its products. Considering their semi parasitic nature, additional advantages can also accrue through the intercropping of more than 300 host plants. The flow of food, fodder, fuel, fibre, fruits, flowers and fragrance is likely to provide additional sources of income. Collectively they can form a basis for lucrative and exploitative trade in future.

Although the initial establishment of plantations is challenging, once established, sandalwood trees withstand all the vagaries of nature due to their tough, hardy and tenacious nature. Moreover, they possess good regeneration potential and an ability to colonise new and suitable sites. The species can be planted practically anywhere with the help of available modern technologies.

The present paper enumerates, describes and pinpoints the suitable facets of modern planting, maintenance and protective techniques suitable for various circumstances. The existing research gaps which need the immediate attention of the scientists have also been pinpointed.

The production and utilization of woods of this type is perhaps the need of the day.

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SANDALWOOD

THE SAVIOUR
OF ECOLOGICAL BALANCE
AND SUPER WEALTH CREATOR

Ramesh Chandra Mishra

- ▣ Ex Head Division of Extension
Indian Lac Research Institute,
Namkum, Ranchi, (I.C.A.R.)
- ▣ Chairman,
Friends of Santalum Society of India,
Lucknow.

SUPREMO

SANDALWOOD

WOOD IS GOOD

but

SANDALWOOD

is

WONDER WOOD

the

SUPER WOOD

SANDALWOOD TREE

- ▣
- ▣ NOBLE TREE
- ▣ and
- ▣ DIVINE TREE
- ▣ VIRTUALLY
- ▣ a
- ▣ SAINT

SCENTED WOODY PLANTS

- ▣
 - ▣
 - ▣
 - ▣
 - ▣ Kati Na Santi Mahishu Mahiruhah
 - ▣ Surabhipusprasalphalalyah
 - ▣ Surbhiyanti Na Koapi Cha
 - ▣ Bhuruahaniti Yashoasti Param Tav Chandan
- :
- ▣ So many trees bearing fragrant flowers and juicy fruits exist on the Earth, but none of them O Sandal can compete with your greatness

GUARANTEED SURVIVAL

Anye vriksha apekshyante,
Poshkaanshan sada bahoon
chandanastu bina sarvan
Vardhate asaar bhumishu

Other trees grow on comparatively fertile soil with sufficient nutrients, but the sandal wood grows everywhere even on waste lands.

ETERNAL FRAGRANCE

**Rogagrasta vinashyanti ,
Paryantelan vinashayan .
Anyevrikshashchandanastu,
Rugnoapyanyan sugandhyet.**

While other diseased trees perish and continue to contaminate , Diseased sandalwood tree, however, continues to spread fragrance even after death

FAMILY SANTALACEAE

- ▣ A major group of Angiosperms
- ▣ 2525 species
- ▣ 577 accepted plant names
- ▣ 39 genera including SANTALUM

GENUS: SANTALUM L.

- ▣ 25 species
- ▣ 15 species produce highly aromatic wood
- ▣ *Santalum album* L. leads them all
- ▣ Mostly root hemi-parasitic
- ▣ Few are stem parasites as well
- ▣ Some bear nutritious edible fruits
- ▣ Seeds contain nutritious endosperm
- ▣ Seeds also contain useful oil

SANTALUM: DISTRIBUTION

- ▣ Ranging from **India** through **Malaysia** to the **pacific Islands** as far as **Hawaii** and the **Juan Fernandez islands** off the coast of **South Africa**
- ▣ *S. album* is the only species found on the Asian mainland
- ▣ Only *S. album* is found in Indian subcontinent
- ▣ Endemic species : Australia=5, Hawaii =4 ;
S. fernandezianum of Juan Fernandez (Chile)=
Is on the verge of extinction

S. album RETROSPECT

- 1792 - RULER'S GREED IMPRISONED THE HERITAGE
Tipu Sultan of Karnataka declared Royal Tree
- 1978-79 TRADE POLICY WORSENERD THE SITUATION
Indonesia banned export: → Supply void →
→ India stepped in to fill → Prices spiraled →
→ Mindless wild harvesting → Smuggling.
- 1996 ROAD TO HELL WAS PAVED
Export quotas → Auction system →
→ Oil exporters compelled → Closure of Factories
- 2000 GOOD SENSE PREVAILED BUT HALF HEARTED
Legal restrictions remodeled half heartedly

ECOLOGICAL PERSPECTIVE

MALADIES

- ▣ Dwindling primary forest cover
- ▣ Wild harvesting of forest products
- ▣ Modern Agriculture
- ▣ Increasing urbanization
- ▣ Industrialization
- ▣ Greenhouse effect
- ▣ Global warming

REMEDIES

- ▣ Planting trees near habitations
- ▣ Scientific exploitation of forest products
- ▣ Mixed horticultural plantation on wasteland

CARBON SEQUESTRATION

Single mature tree

Absorbs 48 lbs Co₂/y

Stores 13 lbs C /y

Releases O₂ for two



Single American

Generates 2.3 tons CO₂/y

If plants one tree each

Will offset 5% H.A.E.

An Indian is of course not so expensive



GLOBAL WARMING

- ▣ Global Temperature will Rise by 5.8 °C by 2100

CONSEQUENCES:

- ▣ Maximum Human Survival is Likely for 7500 Years

REMEDIES:

- ▣ Tree Planting is Cheapest Means
- ▣ Sandalwoods are Ideal
- ▣ Cost Effective and Efficient
- ▣ Due to Multiplier Effect

PROBABLE PLANTING SITES

- ▣ Urban and Rural Households
- ▣ Wasteland
- ▣ Degraded Forests
- ▣ Vacant Government land
- ▣ Government and Private Institutions
- ▣ Sanctuaries and Megaparks
- ▣ Betel Vine and Other Vine Yards as Props
- ▣ Other Suitable Places

NATURAL REGENERATION

- ▣ Existing Sandalwood groves and spots all over the country may be surveyed and preserved as seed production and processing cum nurseries
- ▣ Fencing subsidies may be granted and purchase guaranteed
- ▣ The sites may be augmented with other Santalum species for natural breeding
- ▣ Abandoned Govt. farms may also be developed similarly for future

RESEARCH NEEDS

- ▣ Germination
- ▣ Rigorous host plant screening
- ▣ Seed technology , processing ,priming etc.
- ▣ Nutritional studies
- ▣ Mycorrhiza
- ▣ Developing host- independence
- ▣ Induction of heartwood and oil formation
- ▣ Seed oil studies and utilisation
- ▣ Non destructive sampling /Bark and other correlations for harvesting decisions

Organizational Proposals

- ▣ International Santalum Research Institute
- ▣ Sandalwood Promotion Council
- ▣ National Sandalwood Research Institute
- ▣ Sandalwood Research and Development Centers
- ▣ Seed Production -cum-Processing Centers

LAWS

No Forest Laws

For the Land Owner

Growing Sandalwood Tree(s)

Anywhere

POETIC VERSES

POETRY

Darde- sar ke vaste
Chandan lagana hai mufeed
Iska ghisna aur lagana
Darde -sar Eh bhi to hai_

Atishaya ragad kare jo koi
Anal prakat chandan se hoi

MEANING

Sandalwood is ideal for the treatment of headache but making a paste of it (wet grinding) is not a less headache

Even sandalwood will generate fire , if somebody rubs it excessively

PRAYER OF GODESS SARASWATI

Shvetakshasutrahasta Cha
Shveta Chandan Charchita!
Shevata Veenadhara Shubhra
Shvetalankar Bhu Shita
Shvetapadmasana Devi
Shvetapushpapi Shobhita
Shvetambardhara Nitya
Shvetagandhnulepana

-
Padmapuranam

- O Goddess, sitting on a white seat- decorated with white flowers on a white sheet fully smeared with white fragrance, you sit in lotus pose, wearing a white thread on the wrist which is drenched with white chandan : you hold a white veena (musical instrument) you are decorated with white jewellery

□ - Padmapurana

TEAKNET – The International R&D network on Teak

K Jayaraman⁵ and M P Sreelakshmy⁶

Abstract

TEAKNET, established in 1995, is an international network of institutions and individuals interested in teak. Its members are mostly growers, traders and researchers as well as policy makers and others who have a profound interest in teak. TEAKNET was established to address the issues of the global teak sector. The goal of TEAKNET is to transform the global teak sector from its current suboptimal state to that of a dynamic entity for the benefit of all stakeholders of the sector. Its mode of operation is through collective discussions and persistent follow up actions. Issues are identified through periodical workshops and meetings of the stakeholders. The most basic activity of TEAKNET is information exchange which is achieved through its website www.teaknet.org and the TEAKNET Bulletin. The members have certain additional privileges with respect to access to information supplied by the organization.

By linking the various institutions across the world, the network really acts like a virtual research and development organization for the species. Teak is one of the best high quality timber species of the world. Teak is successfully grown in many tropical countries. The species holds high promise for meeting the hardwood requirement of the globe which is expected to be on the rise. Its cultivation needs to be extended to more regions, productivity levels need to be enhanced through the use of improved planting material and better cultural practices in order to meet the growing hardwood crisis. Unlike many food crops, demand for teak is highly elastic and thus depends to a great extent on efficient marketing mechanisms. But for that, the many features that make teak attractive are the hardy and adaptive nature of the species, the high level of returns and the superior quality of wood. Apart from networking, TEAKNET also undertakes much promotional activities on teak and its products.

This presentation makes a broad sketch of the current activities of TEAKNET and provides a futuristic outlay for its functioning. The perspectives are built taking into consideration the global situation with respect to forestry in general and the hardwood sector in particular.

Keywords: Teak, R & D Network, Teaknet, Information exchange

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1. INTRODUCTION

Teak (*Tectona grandis* L.f.) is a versatile timber known for its quality, durability and strength. It is used largely in furniture industry and construction of buildings, ship and boat making, for veneer and as poles. Teak is an undisputed leader of high value tropical timbers. It is always referred to as standard timber for comparative evaluation of quality and utilization potential of other tropical hardwoods. Teak is being grown in plantations in more than 36 tropical countries across the globe although its natural occurrence is limited to India, Laos, Myanmar and Thailand.

TEAKNET is an organization established to promote teak and was operating from Myanmar with the support of FAO of the United Nations. The headquarters was shifted to India in 2008. Presently, Kerala Forest Research Institute hosts the TEAKNET Secretariat by providing logistic support and infrastructure facilities. TEAKNET is governed by an international Steering Committee consisting of representatives from FAO, ITTO, Forest & Landscape, KFRI and other organizations around the world. The primary function of TEAKNET is to address the issues related to the global teak sector. The players of the sector are growers, traders, industrialists, researchers and policy makers. Issues are identified through organizing workshops and meetings of the stakeholders and solutions sought through discussions.

2. CURRENT ACTIVITIES

The most basic activity of TEAKNET is information exchange which is achieved through its website www.teaknet.org. The website provides a plethora of information related to teak by way of reference to publications, directories of researchers, traders and growers, information on events related to teak at an international level and information on technological developments. TEAKNET has a newsletter called TEAKNET Bulletin and also runs a global teak information center at its Secretariat.

Since its inception in 1995, TEAKNET has been holding a series of workshops, meetings and conferences on several topics related to teak. The proceedings/reports of these conferences are widely circulated which are expected to spur actions from the concerned. The latest of the series have been the international conference on 'Production and Marketing of Teakwood: Future Scenarios' conducted in June 2009 and the international training workshop on 'Innovations in the Management of Planted Teak Forests' held in August-September 2011 at Peechi, India.

3. FUTURE ACTIVITIES FOR TEAKNET

The global scenario with respect to teak has been undergoing changes over the past several years. Over time, there has been a shift in the ownership of forests to the private sector, with smallholders becoming major producers of teakwood. This has led to planting of teak in nontraditional areas. Teakwood being in short supply, we should expect a continued spurt in demand and consequent price increases. Competition from alternative products may also increase but their use is generally being discouraged on account of environmental problems. Demand for certified timber and the need for certification of teak plantations are emerging as

strong cases. Issues related to climate change and trends toward conservation efforts are more and more apparent.

The future perspectives are to be built on the gaps in the current scenario. As regards teak, poor productivity and poor marketing have been identified as blocks in the progress on the sector.

Presented below are a number of means by which transformation can be accomplished in the global teak sector, along with the impact these activities can bring about.

Activity	Impact on the sector
Continuance of secretarial activity	Information exchange
Database on teak resources	Better perspectives through outlook studies
International network of sample plots in the Asia-Pacific Region	Optimal management of plantations
Market intelligence on teak prices and availability of timber	Efficient marketing
Training programmes on cultivation and management of teak	Capacity building
Meetings of traders, growers and researchers	Better plans and policies
Research support on specific themes	Productivity enhancement
International consultancy assignments	Problem solving
Developmental activities on teak resources	Expansion of area

TEAKNET intends to generate funds for these activities through its membership fees and donor contributions. A glimpse of the services that can be offered by TEAKNET can be obtained from the following list.

- (i) Members are entitled to have access to all the information available with the Secretariat. Such information may include not only scientific information but also that of interest to traders like availability and price of teakwood, plantations or products from teakwood.
- (ii) Invitations to periodical national or international meetings of the members wherein expert discussions are held on latest developments in cultivation, trading, processing or policies.
- (iii) Members will have the privilege to present and discuss common issues of their interest and suggest action plans leading to the solutions. TEAKNET could arrange to send resolutions from such meetings to the concerned on behalf of the members.
- (iv) As part of a long term strategy, TEAKNET plans to provide research support, training or consultancy services for any topical issues concerned with teak. TEAKNET would make deliberate attempts to generate funds for such purposes by approaching donor agencies across the globe.
- (v) Exchange of materials is yet another service that is thought of but will be subject to all the international regulations involved.

The activities of TEAKNET have mostly been confined to Asia-Pacific so far. Of late, the network is being extended to Africa and Latin America. The measurable output from these activities will be reflected in higher plantation productivity, higher production, quality products, better marketing and affordable prices for the products. If this happens during the ensuing years and continues so further, the purpose of TEAKNET will be fulfilled.



TEAKNET - International R & D network on teak

Teak

Teak (*Tectona grandis* L.f.) is a versatile timber known for its quality, durability and strength.

It is used largely in furniture industry and construction of buildings, ship and boat making, for veneer and as poles.

Teak is an undisputed leader of high value tropical timbers. It is always referred to as standard timber for comparative evaluation of quality and utilization potential of other tropical hardwoods.

Teak is being grown in plantations in more than 36 tropical countries across the globe although its natural occurrence is limited to India, Laos, Myanmar and Thailand.

TEAKNET is an organization that was established in 1995 to promote cultivation and trade of teak



TEAKNET

What is TEAKNET?

TEAKNET is an international network of institutions and individuals interested in teak.

Its members are mostly growers, traders and researchers apart from policy makers and others who have a stake in teak.

TEAKNET is governed by an international Steering Committee consisting of representatives of FAO, ITTO, DANIDA and other organizations around the world.

TEAKNET was established in 1995 and was operating from Myanmar. The HQ was shifted to India in 2008.

KFRI hosts the TEAKNET secretariat by providing logistic support and infrastructure facilities.



TEAKNET

What does TEAKNET do?

Primary function :

TEAKNET addresses issues related to the global teak sector.

The stakeholders /players of the global teak sector are

Growers,
Traders,
Industrialists,
Researchers,
Policy makers

Mode of operation : Issues are identified through organizing workshops and meetings of the stakeholders and solutions sought through discussions.



TEAKNET

Activities of TEAKNET

Information sharing is the most fundamental activity of TEAKNET

(1) Provides information on teak through its website www.teaknet.org

The website contains directories of growers, traders and researchers,
Information on events related to teak at an international level,
Information on publications and developments in technology.

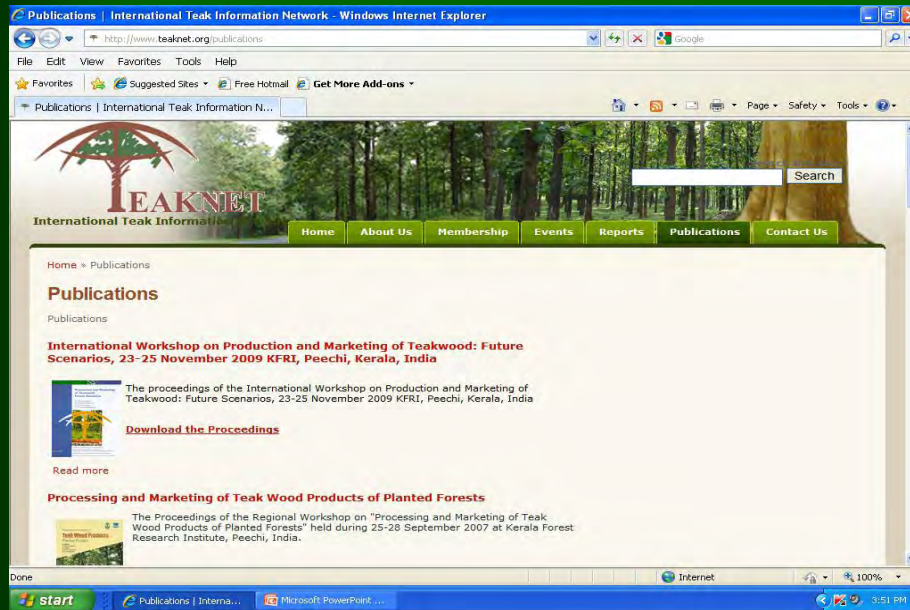
Directories of growers, traders and researchers

The screenshot shows the TEAKNET website in Internet Explorer. The browser address bar displays 'http://www.teaknet.org'. The website header includes the TEAKNET logo and a navigation menu with links for Home, About Us, Membership, Events, Reports, Publications, and Contact Us. The main content area is titled 'TEAKNET - Online Teak Resources and News'. It features a search bar, a 'Latest News Letter' section with a thumbnail of a newsletter, and three main directory sections: 'Researchers Directory', 'Teak Traders', and 'Teak Traders' (repeated). The 'Researchers Directory' section includes a search icon and text promoting scientific interactions. The 'Teak Traders' section includes a search icon and text promoting domestic and international processing and trade. The 'Teak Traders' section also includes a search icon and text promoting domestic and international processing and trade. The footer of the browser window shows the Windows taskbar with the start button and several open applications.

Information on events related to teak at an international level

The screenshot shows the TEAKNET website in Internet Explorer, specifically the 'Events' page. The browser address bar displays 'http://www.teaknet.org/events'. The website header includes the TEAKNET logo and a navigation menu with links for Home, About Us, Membership, Events, Reports, Publications, and Contact Us. The main content area is titled 'Events' and features a search bar. The 'Upcoming events' section lists three international events: 'International Forestry Conference "Planted Teak Forests – a Globally Emerging Forest Resource", Guanacaste, Costa Rica, 2-6 May 2011', 'A willingness to work together with other teak producers in Latin America to enhance progress and development of the high-grade hardwood sector', and 'XXIII IUFRO World Congress, Seoul, Republic of Korea, 23-28 August 2010'. The 'Latest News Letter' section includes a thumbnail of a newsletter and a link to 'Volume 4 Issue 1.pdf'. The footer of the browser window shows the Windows taskbar with the start button and several open applications.

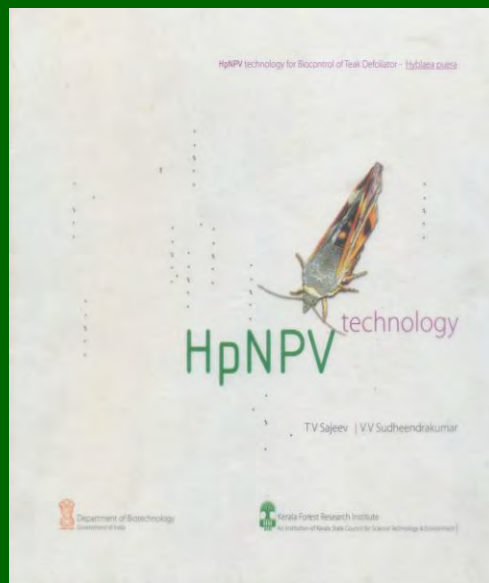
Information on publications and developments in technology



The screenshot shows a web browser window displaying the TEAKNET website. The page title is "Publications | International Teak Information Network - Windows Internet Explorer". The URL is "http://www.teaknet.org/publications". The website features a navigation menu with links for Home, About Us, Membership, Events, Reports, Publications, and Contact Us. The main content area is titled "Publications" and lists two publications:

- International Workshop on Production and Marketing of Teakwood: Future Scenarios, 23-25 November 2009 KFRI, Peechi, Kerala, India**
The proceedings of the International Workshop on Production and Marketing of Teakwood: Future Scenarios, 23-25 November 2009 KFRI, Peechi, Kerala, India.
[Download the Proceedings](#)
Read more
- Processing and Marketing of Teak Wood Products of Planted Forests**
The Proceedings of the Regional Workshop on "Processing and Marketing of Teak Wood Products of Planted Forests" held during 25-28 September 2007 at Kerala Forest Research Institute, Peechi, India.

Information on publications and developments in technology



Information on publications and developments in technology

Teak Planner

Teak Planner functionally is a growth simulator for teak plantations. Its scope of application is the range of growing conditions that is available in Kerala. This programme can be used to identify the optimum thinning schedule and rotation age for even-aged teak stands under a range of site quality and management levels. The optimum thinning schedule is that which maximizes the net present value of cash flows, out of a variety of possible thinning schedules in a plantation. It also enables the user to make an investment plan by providing information on net present value (NPV), internal rate of return (IRR), benefit cost ratio (BCR) and payback period (PPB) for a range of management options. The software is also an effective tool for financial valuation of the growing stock for commercial purposes.

The input data at the first level consists of interest rate that is to be used for discounting purposes, site quality class and weeding intensity. The system can then generate mean diameter at 5th year which is the starting point of simulation assuming an initial planting intensity of 2500 trees per ha. In case, the user wants to optimize purchase cost of a plantation or maximize the returns from a purchased plantation, the corresponding input values can be entered and can proceed further. With the input data that is supplied, the programme identifies the optimum thinning schedule for the stand under consideration and displays the number of trees to be retained at 5 yearly intervals with information on several associated stand features like mean diameter of trees, volume of standing crop, accumulated yield from thinning and mean annual increment in total volume (MAI).



It also displays the NPV, IRR and BCR. The optimum rotation age can then be taken as the age at which NPV reaches its maximum. This programme thus fills in the need for a self-contained user-friendly software for finding out optimum thinning schedule and associated stand features for any given stand.

One additional feature is that the user is supplied with the option of making the financial projections either under 'constant' levels of teak timber price, input cost and management interventions or under 'varying' rates. This option provides the user a whole scenario of possible projections and every time the simulator identifies the best thinning schedule to be followed to maximize the returns.

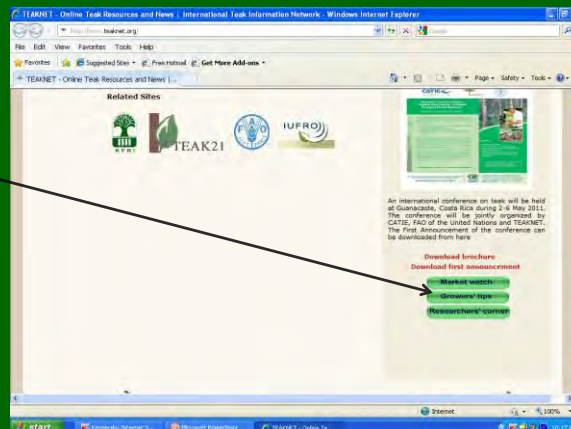
The simulator has been built using Visual Basic software. The equations used for projecting the different stand features were developed using long-term data gathered from permanent sample plots laid out in teak plantations in Kerala. Whole stand models based on Richards function with biologically meaningful parameters formed the basis of diameter and volume growth functions.

Kerala Forest Research Institute,
An Institution of Kerala State Council for
Science, Technology and Environment,
Peechi - 680 653, Kerala, India

Contact person : Dr. K. Jayaraman, KFRI,
Peechi 680 653, Thrissur, Kerala, India

Information for Researchers, Growers and traders

- Market watch
- Growers' tips
- Researchers' corner



Market watch

The screenshot shows the 'Market Watch' page of the International Teak Information Network (TEAKNET). The page features a navigation menu with links for Home, About Us, Membership, Events, Reports, Publications, and Contact Us. The main content area is titled 'Market Watch' and includes several news items:

- Tender/ Auction sale of Teak timber in Kerala Forest Department, Malayattoor Division to be held on 18 January 2011 at 10.00 am.** For more details: [Download Teak auction details on 08-01-2011](#)
- Auction sale of teak poles in Kerala Forest Department, Thenmala Division hold on 8th December 2010.** For more details visit www.keralaforest.org

On the right side, there is a 'Latest News Letter' section with a thumbnail of a newsletter cover and a link to 'Volume 4 Issue 1.pdf Newsletter Archive'. Below this, there are links for 'TZ2010909', 'BIBLIO', and 'MY ACCOUNT'. The browser window shows the URL 'http://www.teaknet.org/market-watch' and the Windows Internet Explorer interface.

Growers' tips

The screenshot shows the 'Informations for Teak Growers' page of the International Teak Information Network (TEAKNET). The page features a navigation menu with links for Home, About Us, Membership, Events, Reports, Publications, and Contact Us. The main content area is titled 'Informations for Teak Growers' and includes several sections:

- Teak Information Bulletin**: Download Teak Information Bulletin
- FAQ**: Question from Roderic Evers, Managing Director, Future Forests Fiji. Fiji is well known for its sandalwood. I have some questions which perhaps one of the researchers at KFRRI can answer:
 1. Is there any research available on intercropping teak with sandalwood?
 2. Could teak be a host to sandalwood?
 3. Is sandalwood shade tolerant?
 4. Will sandalwood compete with teak for nutrients in the soils?Answer from Dr. R.C. Pandalai, Silviculturist, KFRRI: Intercropping of teak with sandal has not been experimented till date. However there are reports that pot culture experiments showed good growth of sandal in association with teak as a host with good

On the right side, there is a 'Latest News Letter' section with a thumbnail of a newsletter cover and a link to 'Volume 4 Issue 1.pdf Newsletter Archive'. Below this, there are links for 'TZ2010909', 'BIBLIO', and 'MY ACCOUNT'. The browser window shows the URL 'http://www.teaknet.org/growers-tips' and the Windows Internet Explorer interface.

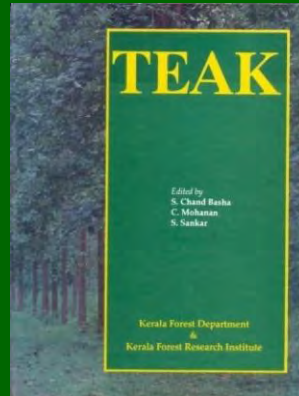
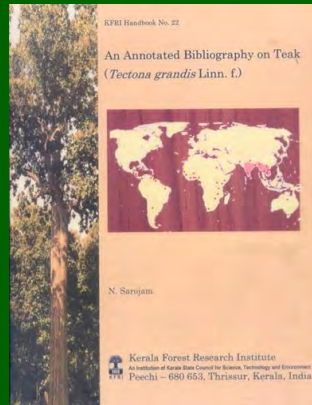


TEAKNET

Activities of TEAKNET

(3) Runs a global teak information center at its Secretariat

TEAKNET Secretariat has a collection of literature on teak consisting of research papers and other materials. Members are entitled to call for any information available with TEAKNET.



TEAKNET

Additional Activities of TEAKNET

(4) Conducts regional/International conferences on themes related to teak

The last international workshop was held in November 2009 at KFRI, Peechi. Proceedings available in the TEAKNET website.

(5) Arranges training programmes on cultivation and management of teak.

An international training programme on 'Innovations in the management of planted teak forests' was held during 31 August – 3 September 2011 at KFRI, Peechi with support from FAO, Bangkok.

(6) Undertakes studies related to teak at international level.

Efforts to develop an international database on teak are underway.

What future holds for TEAKNET?

**Objective : To bring about transformations on the global teak sector.
Question : What kind of transformation and under what context?**

The current context of forests and forestry as regards teak

1. Shift in the ownership to the private sector, small holders becoming major producers of teakwood.
2. We should expect a continued spurt in demand and consequent price increases.
3. Competition from alternative products may also increase.
4. Demand for certified timber and the issue of certification of teak plantations.
5. Climate change issues and trends toward conservation efforts.

The gaps in the current scenario

1. Poor productivity
2. Poor marketing


What future holds for TEAKNET?


Transformations on the global teak sector

Activity	Impact on the sector
Continuance of secretarial activity	Information exchange
Database on teak resources	Outlook studies
Market intelligence on teak prices and availability of timber	Efficient marketing
Training programmes on cultivation and management of teak	Capacity building
Meetings of traders, growers and researchers	Better plans and policies
Research support on specific themes	Productivity enhancement
International consultancy assignments	Problem solving

Funding sources for TEAKNET

Annual Membership Fee -	Annual	Lifetime
	Amount (USD)	
Individual	25	250
Institutional/Organization	250	4000
Donor contributions		
	Amount (USD)	
DANIDA	10000	
FAO	18000	





TEAKNET
(International Teak Information Network)

Application for Membership/Renewal of Membership

Name _____

Institution/Organization/Company _____

Designation _____

Mailing Address _____

Tel. _____ Fax _____ E-Mail _____

Professional Category: Researcher Trader Grower Others (Specify) _____

In case of individuals, please provide the following details:

Passport Number _____ Date of issue _____ Place of issue _____

Issuing Authority _____

In case of Institutions, please provide the following details:

Public Sector/ Private Sector _____

Registration details of the organization _____

TEAKNET Membership Number if already a member _____

Date: _____ Signature _____

Type of membership sought (Tick the one applicable):

	Annual fee from the date of enrollment (USD)							
<input type="checkbox"/> Individual	<table border="1" style="font-size: small;"> <tr> <th>Less Forfeiture</th> <th>Developed</th> </tr> <tr> <td style="text-align: center;">25</td> <td style="text-align: center;">100</td> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center;">1000</td> </tr> </table>	Less Forfeiture	Developed	25	100	250	1000	
Less Forfeiture	Developed							
25	100							
250	1000							
<input type="checkbox"/> Institutional/Organization								

The payment of fee may be made either through demand draft or money transfer.

Enclosed my bank draft for USD _____
(The Demand Draft may be drawn in favour of Director, Vattai Forest Research Institute payable at Thrissur, India and sent to the address given below)

OR

Transferred USD _____ to Account No. 328920140019296 of the Director, KFRRI at Sikkhen Arcade Branch of the Union Bank of India with Swift Code UBININ33CH

Please retain this form in original to the Coordinator, TEAKNET, KFRRI along with CD or money transfer receipts.
In the case of individuals, a copy of the passport photograph will be needed.

Dr. K. Jayaraman,
TEAKNET Coordinator,
Kerala Forest Research Institute, Pechi 686 653, Thrissur District,
Kerala State, India
Email: coordinator@teaknet.org



Services offered to TEAKNET Members

Members are entitled to have access to all the information available with the Secretariat.

Such information may include not only scientific information but also that of interest to traders like availability and price of teakwood, plantations or products from teakwood.

Invitations to periodical national or international meetings of the members wherein expert discussions are held on latest developments in cultivation, trading, processing or policies.

Members will have the privilege to present and discuss common issues of their interest and suggest action plans leading to the solutions. TEAKNET could arrange to send resolutions from such meetings to the concerned on behalf of the members.

As part of a long term strategy, TEAKNET plans to provide research support, training or consultancy services for any topical issues concerned with teak. TEAKNET would make deliberate attempts to generate funds for such purposes by approaching donor agencies across the globe.

Exchange of materials is yet another service that is thought of but will be subject to all the international regulations involved.



Impact on the global teak sector

Goal :

To transform the global teak sector from its current suboptimal state to that of a dynamic entity for the benefit of all stakeholders.

Sector development Indicators :

Higher productivity,
Higher production,
Better marketing, resulting in better flow of timber across the regions,
Affordable prices for the products,
Better quality products

Short term target :

If this happens during the next 5 years and continues so further, the purpose of TEAKNET will be served.