

PRESENT STATUS AND DISTRIBUTION PATTERN OF SANDAL WOOD WITH ITS CULTURE AND HERITAGE VALUES ACROSS THE GLOBE

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Abstract: Sandal wood trees are medium sized hemiparasitic in nature falls under the same botanical family of European mistletoe with the notable members like Indian sandal wood (*Santalum album*) and Australian sandal wood (*Santalum spicatum*) which are found in India, Bangladesh, Srilanka, Australia, Indonesia, Hawaii and other Pacific Islands. Indian sandalwood is a threatened species and indigenous to South India and grows in the Western Ghats and a few other mountain ranges like the Kalrayan and Shevaroy Hills (Tamil Nadu, India). Sandalwood from the Mysore region of Karnataka and Marayoor forest in Kerala, Southern India is of high quality.

Keywords: Hemi-parasite, Mistletoe, Threatened species, Economic exploitation, *Padma*

INTRODUCTION

New plantations were created with international aid in Tamil Nadu for economic exploitation.

Producing commercially valuable sandalwood with high levels of fragrance oils, requires *Santalum* trees to be a minimum of fifteen years old (*Santalum album*) at which age they will be harvested in Western Australia - the yield, quality and volume are still to be clearly understood. However it is believed that Australia will be the largest producer of *Santalum album* by 2018, the majority grown around Kununurra, Western Australia. West Australian sandalwood is also grown in plantations in its traditional growing area east of Perth in the Wheatbelt where more than 15,000 hectares can be found in plantations. Currently WA Sandalwood is only wild harvested and can achieve upwards of \$16,000 AUD per tonne which has sparked a growing illegal trade speculated to be worth \$2.5 million AUD in 2012. In Hinduism, sandalwood paste is integral to rituals and ceremonies, to mark religious utensils and to decorate the icons of the deities. Sandalwood is considered to be of the *padma* (lotus) group and attributed to Amitabha Buddha. Sandalwood scent is believed to transform one's desires and maintain a person's alertness while in meditation. Sandalwood is also one of the more popular scents used when offering incense to the Buddha. In sufi tradition sandalwood paste is applied on the sufi's grave by the disciples as a mark of devotion. Sandalwood, along with agarwood, is the most commonly used incense material by the Chinese and Japanese in worship and various ceremonies. Zoroastrians offer sandalwood twigs to the fire keeping priests who offer the sandalwood to the fire which keep the fire burning. Sandalwood is called sukhar in the Zoroastrian community.

Taxonomy and Distribution

Sandal wood trees are medium sized hemiparasitic in nature falls under the same botanical family of European mistletoe with the notable members like Indian sandal wood (*Santalum album*) and Australian sandal wood (*Santalum spicatum*) which are found in India, Bangladesh, Srilanka, Australia, Indonesia, Hawaii and other Pacific Islands.

Indian sandalwood is a threatened species and indigenous to South India and grows in the Western Ghats and a few other mountain ranges like the Kalrayan and Shevaroy Hills (Tamil Nadu, India). Although sandalwood trees in India and Nepal are government-owned and their harvest is controlled, many trees are illegally cut down. Sandalwood oil prices have risen to \$2,000 per kg recently. Sandalwood from the Mysore region of Karnataka (formerly Mysore), and marayoor forest in Kerala (Southern India) is of high quality. New plantations were created with international aid in Tamil Nadu for economic exploitation. In Kununurra in Western Australia, Indian sandalwood (*Santalum album*) is grown on a large scale.

Santalum ellipticum, *S. freycinetianum*, and *S. paniculatum* (the Hawaiian sandalwood) were also used and considered high quality. These three species were exploited between 1790 and 1825 before the supply of trees ran out (a fourth species, *S. haleakalae*, occurs only in subalpine areas and was never exported). Although *S. freycinetianum* and *S. paniculatum* are relatively common today, they have not regained their former abundance or size and *S. ellipticum* remains rare.

Australian sandalwood is used by aroma therapists and perfumers. The concentration differs considerably from other *Santalum* species. In the 1840s, sandalwood was biggest export earner of Western Australia. Oil was distilled for the first time in 1875, and by the turn of the century there was

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intermittent production of Australian sandalwood oil. However in the late 1990s WA Sandalwood oil enjoyed a revival and by 2009 had peaked at more than 20,000kg per year - much of which went to the fragrance industries in Europe. By 2011 WA Sandalwood oil whilst reducing in overall volume had a significant amount of its production heading to the chewing tobacco industry in India, alongside Indian Sandalwood - the chewing tobacco market being the largest market for both oils in 2012.

In India sandalwood is mainly distributed on the Deccan Plateau. The total extent of its distribution is 9034 km², of which 8200 km² is in the states of Karnataka and Tamil Nadu (Fig. 1). In the past, it naturally occurred in peninsular India, but subsequently it has been introduced in other parts too. It generally occurs in the dry deciduous forests of Deccan Plateau at the edge of the Western Ghat Range. A circle with Bangalore city as the center and a radius of 200 km² could be said to be the main zone of natural distribution of sandalwood. The tree



Fig 1. Distribution of sandal (*Santalum album* L.) in India.

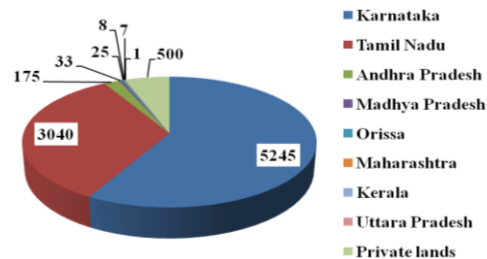


Fig 2. Distribution (area km²) of sandal in India (Source: Rai, S. N. 1990)

Table 1. State wise distribution (area km²) of sandal (*Santalum album* L.) in India.

State	Area (km ²)	State	Area (km ²)
Karnataka	5245	Maharashtra	8
Tamil Nadu	3040	Kerala	7
Andhra Pradesh	175	Uttar Pradesh	< 1
Madhya Pradesh	33	Private lands	500
Orissa	25		

Total Area - 9034 km²

Global status of natural sandalwood resources

Only two native species of *Santalum* are harvested for the aromatic timber in Australia (*S. spicatum* from WA and *S. lanceolatum* from Queensland). Native WA sandalwood occurs at low density over a very large area of the rangeland zone of the State. *S. lanceolatum* has been harvested in WA in the past, but not for the last 40-50 years (Fig 3 & Fig A.). India has been the world's main source of high quality *S. album* for many years, but the supply has shown a steady decline over the last 10-15 years. Indonesia has also been a significant source of *S. album*, from West Timor, Sumba and Flores (Fig B.).

flourishes best between altitudes of 600 and 1050 m, though it may go up to 1350 m and descend as low as 360m. The important sandal tracts lie in places where rainfall varies from 60-160cm. In general, the sandal tree flourishes in regions where the climate is cool with moderate rainfall, plentiful sunshine and long periods of dry weather. The ideal temperature for its growth is between 12° and 30°C.

Points refer to dense (•), medium (▪) and sparse (▲) distribution [Source: Data obtained from flora, herbaria, books, forest department records and other published archrivals]. Though, the occurrence of sandal was also recorded in Northern (Uttar Pradesh) and Central (Maharashtra, Madhya Pradesh, Orissa) parts of India, their distribution was very sparse. In the study, critical information on the distribution and status of sandal resources throughout India were collected and a comprehensive distribution map was developed (Tab 1 and Fig.1& 2).

Timor Leste also has native resources of *S. album*, but it has been very heavily exploited in the past and now little remains. The Timor Island was a rich source of sandalwood, much prized for its scent and medicinal properties. There are several sources of good quality sandalwood from the Pacific region (*Santalum yasi* on Fiji and Tonga; *S. austrocaledonicum* on Vanuatu (Fig 3.1) and New Caledonia and *S. macgregori* in Papua New Guinea). A tree with very similar properties to sandalwood, *Osyris lanceolata*, is harvested from Chad, Sudan, Ethiopia, Uganda, Kenya and Tanzania in Africa (Tab 2).

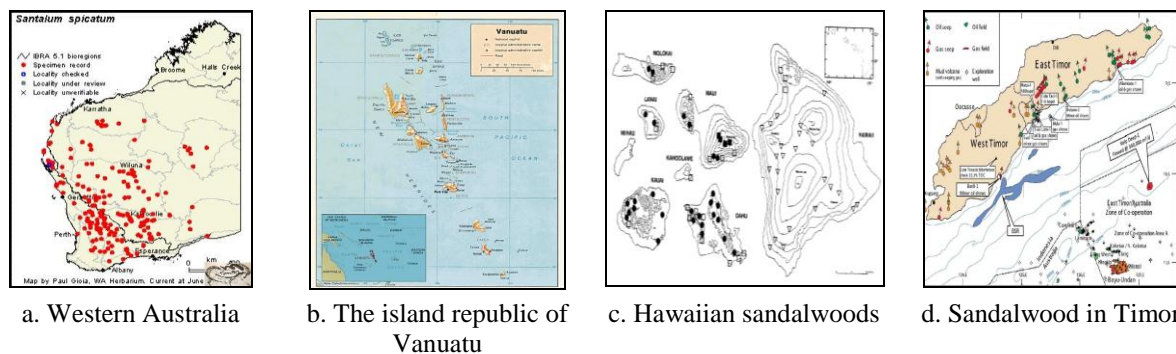


Fig 3. The global distribution of natural sandalwood resources in different countries in the world.

The present global distribution of *Santalum* species is listed below, with their approximate rainfall and elevational ranges (Fosberg and Sachet 1985, George 1984, Skottsberg 1930, Smith 1985, Sykes 1980,

Tuyama 1939, Yuncker 1971, and Wagner and others 1990). Species reported in the cited references but absent from this list are now considered to be included within the taxa in this list (Table 2).

Table 2. Present global distribution of *Santalum* species with their approximate rainfall and elevation ranges.

Sl. No.	Taxon and Authority	Rainfall Range (mm)	Elevation Range (m)	Distribution
1.	<i>Santalum acuminatum</i> (R. Br.) A. DC.	—	0-500	South Australia
2.	<i>Santalum album</i> L.	300-3000 ¹	0-700	India
		800-1500	0-2000	Indonesia, Timor, Sumba, Flores and now planted in Java, Bali, and elsewhere in Asia and the Pacific
		1400-1800	0-250	Australia
3.	<i>Santalum austrocaledonicum</i>			New Caledonia ²
	var. <i>austrocaledonicum</i>	-	-	New Caledonia and Isles Loyalty ²
	var. <i>minutum</i> Halle	800	100-200	Vanuatu
	var. <i>pilosulum</i> Halle	1000-2500	0-800	New Caledonia, Northeast part of island ²
4.	<i>Santalum boninense</i> (Nakai) Tuyama	1000	50-100	Ogasawara Island
5.	<i>Santalum ellipticum</i> Gaudichaud	50-1300	0-1390	Hawaiian Islands
6.	<i>Santalum fernandezianum</i> F. Philippi	-	-	Juan Fernandez (extinct)
7.	<i>Santalum freycinetianum</i> Gaudichaud			
	var. <i>freycinetianum</i>	760-3800	150-980	Moloka'i, O'ahu
	var. <i>lanaiense</i> Rock	500-1000	90-900	Lana'i, Maui
	var. <i>pyrularium</i> (Gray) Stemmermarm	900-3800	15-1150	Kaua'i
8.	<i>Santalum haleakalae</i> Hillebrand	850-1900	1800-2590	Maui
9.	<i>Santalum insulare</i> Bertero			
	var. <i>insulare</i>	-	<1000	Tahiti
	var. <i>alticola</i> Fosberg & Sachet	-	2000-2066	Tahiti
	var. <i>deckeri</i> Fosberg & Sachet	-	250-940	Marquesas
	var. <i>hendersonense</i> (F. Brown) Fosb. & Sachet	-	-	Henderson Island
	var. <i>marchionense</i> (Skoots.) Skottsberg	-	300-940	Marquesas
	var. <i>Margaretae</i> (F. Brown) Skottsberg	-	c.250	Austral Islands

	var. <i>mitiario</i> Sykes	-	0-10	Cook Islands
10.	<i>Santalum insulare</i> Bertero			
	var. <i>raiateense</i> (J. W. Moore) Fosberg & Sachet	-	200-500 c.60	Society Island (Raiatea)
	var. <i>raiavanse</i> F. Brown			Austral Islands
11.	<i>Santalum lanceolatum</i> R. Br. 3	300-1300	0-700	Australia
12.	<i>Santalum macgregorii</i> F. v. Mueller	1000-1500	200-1800	New Guinea
13.	<i>Santalum murrayanum</i> (Mitchell) C. Gardn.	-	0-500	S.W. Australia
14.	<i>Santalum obtusifolium</i> R.Br.	1400-2000	100-700	Australia
15.	<i>Santalum paniculatum</i> A. Gray			
	var. <i>paniculatum</i>	380-2550	38-2100	Hawai'i
	var. <i>pilgeri</i> (Rock) Stemmermann	760-1350	730-1970	Hawai'i
16.	<i>Santalum spicatum</i> (R. Br.) A. DC.	200-600	0-300	Australia
17.	<i>Santalum yasi</i> Seeman		0-200	Fiji
			0-100	Tonga

¹ These ranges are for India. Shobha Nath Rai has suggested that these are extreme values, with most of the cultivated stands occurring between 500 and 2000 mm rainfall and 300-600 m elevation. *S. album* has been planted in Makwanpur (2000 mm rainfall and 450 m elevation), Gorkha, China and elsewhere. ² Dr.J.F. Cherrierof Centre Technique Forestier Tropical in New Caledonia provided information through correspondence to Lawrence Hamilton in May 1990. ³ This is the most widespread of the Australian species, found from Cape York to W. Australia and S. Australia.

(Source: Rai, S. N.,1990)

Production and Trade

Producing commercially valuable sandalwood with high levels of fragrance oils, requires *Santalum* trees to be a minimum of fifteen years old (*Santalum album*) at which age they will harvested in Western Australia. However it is believed that Australia will be the largest producer of *Santalum album* by 2018, the majority grown around Kununurra, Western Australia. West Australian sandalwood is also grown in plantations in its traditional growing area east of Perth in the Wheatbelt where more than 15,000 hectares can be found in plantations. Currently WA Sandalwood is only wild harvested and can achieve upwards of \$16,000 AUD per tonne which has sparked a growing illegal trade speculated to be worth \$2.5 million AUD in 2012.

Sandalwood production in Karnataka and Tamil Nadu has dwindled considerably (Fig 3 and 4.). In

2011-12, 45.15 tonnes of sandalwood was extracted from Marayoor in Kerala (40 km from Munnar in Idukki district), where sandal trees grow naturally. It is encouraging to note that the quantity of illegal sandalwood seized in Karnataka has dropped from 76.75 tonnes in 1999-2000 to 3.52 tonnes in 2010-11 (Fig 5.). There is also a sharp decline in the availability of trees of optimal growth for felling in sandalwood habitats. The decline in sandalwood availability has also affected traditional artisans (gudigars) in Karnataka (Sirsi, Soraba, Sagar, Honnavar and Kumta places), whose means of livelihood was sandalwood carving for generations. Even though the annual requirement of Karnataka State Handicrafts Development Corporation has been fixed at 100 tonnes, of which the gudigars received a miserable quantity of 0.74 tonnes.

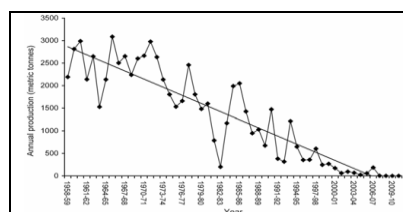


Fig 4. Annual production of sandalwood in Karnataka from 1958-59 to 2010-11.

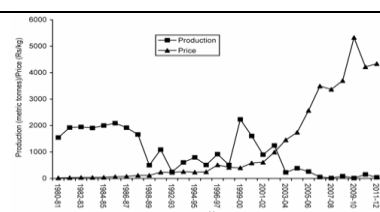


Fig 5. Annual production and price rise of auctioned sandalwood in Tamil Nadu from 1980-81 to 2011-12.

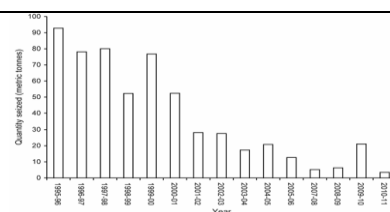


Fig 6. Quantity of smuggled sandalwood seized annually in Karnataka from 1995-96 to 2010-11.

(Source: Arun Kumar, A. N., Geeta Joshi and Mohan Ram., H. Y., 2012)

The monopolistic rule on sandalwood had prevented anyone excepting the personnel of Forest Department to harvest and sell it. Therefore, realizing the disadvantages of this rule, the Govt. of Karnataka and Govt. Tamil Nadu promulgated “The Karnataka Forest (Amendment) Act 2001” and “The Tamil Nadu Forest (Amendment) Act 2002” respectively. These amendments have paved the way for encouraging community and private entrepreneurs to cultivate sandalwood which is in great demand. Presently, the Government of Karnataka has authorized Karnataka Soaps and Detergents Limited and the Karnataka State Handicrafts Development Corporation to buy sandalwood directly from the landowners (Venkatesha Gowda, H. S., 2007). The policy of the Governments of Karnataka and Tamil Nadu to abolish their monopoly on sandalwood has generated interest in public and private sectors to raise sandalwood plantations. There is perpetual demand for genuine natural sandalwood oil for the world perfume industry and for traditional purposes. Even though Australia has been raising large scale sandalwood plantations, and may be able to meet the global demands, the Indian sandalwood fetches a premium price for its unique aroma. Australian sandalwood (*Santalum spicatum*) is sold at ~A\$10,000 a tonne, which is far lower compared to the cost of the premium East Indian sandalwood (equivalent of A\$73,000/tonne). Whereas there is no plantation of any substantial size in India, the world’s largest plantation of *S. album* has been established in the Kimberley, Western Australia. It is learnt that most mature trees in this plantation were reported to be harvested in 2012. There is a ban on export of sandalwood or sandalwood oil from India. There are









reports that some companies in India are even importing sandalwood from Australia to meet the high demand for domestic use (Arun Kumar, A. N., Geeta Joshi and Mohan Ram., H. Y., 2012)

Culture and Heritage Values of different Religions across the world

Sandalwood has held a religious significance within the Hindu and Buddhist communities for thousands of years.

Hinduism

Sandalwood paste is integral to rituals and ceremonies, to mark religious utensils and to decorate the icons of the deities. It is also distributed to devotees, who apply it to the forehead or the neck and chest. The paste is prepared by grinding wood by hand upon granite slabs (popularly known as *Saane kallu* in Kannada and *Ammi kallu* in Tamil) shaped for the purpose (Fig 6). With slow addition of water a thick paste results (called *Kalabham* in South India), which is mixed with saffron or other such pigments to make *Chandan*. *Chandan* further mixed with herbs, perfumes, pigments and some other compounds result in *Javadhu*. *Kalabham*, *Chandan* and *Javadhu* are dried and used as *Kalabham* powder, *Chandan* powder and *Javadhu* powder respectively. *Chandan* powder is very popular in North India and is also used in Nepal. In Thirupathi (AP) after religious tonsure, Sandal paste is applied to protect the skin. Sandalwood is considered in Hinduism and Ayurveda to bring one closer to the divine. Thus, sandal is one of the most used holy elements in the Hindu and Vedic society (Fig 6).

			
a. Sandalwood paste	b. Saane kallu (grinding sandalwood for paste)	c. Sandalwood sticks	d. Sandalwood powder
			
e. Vermillion, Turmeric and Sandalwood paste (Hinduism)	f. Sandalwood Paste Alankara to Lord Krishna.	g. Abhishekam of Siva Linga with Chandanam (Sandalwood Paste)	h. Gajraj (Elephant) in sandalwood carving

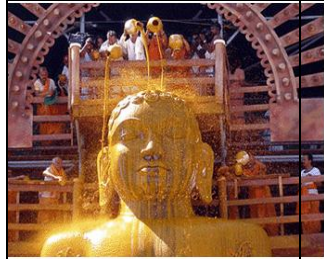







			
i. Gomateshwara statue bathed with sandalwood powder (Jainism)	j. Sandalwood scent	k. Sandalwood oil spray (USA)	l. Meditation beads (malas) in Islam
			
m. Incense sticks burnt at a Chinese Buddhist place of worship	n. Mehndi with Sandalwood paste (Islam)	o. Sandalwood Rosary Necklace and wood Cross (Zoroastrians)	p. Zoroastrians offer sandalwood twigs to the fire keeping priests

Fig 7. The different images depicting culture, heritage and religious values of sandalwood powder, paste, oil, scent, sticks, incense, beads and carving in different Religions in the world.

Jainism and Buddhism

Sandalwood is considered to be of the *padma* (lotus) group and attributed to Amitabha Buddha. Sandalwood scent is believed to transform one's desires and maintain a person's alertness while in meditation. Sandalwood is also one of the more popular scents used when offering incense to the Buddha. The Gomateshwara statue is bathed and anointed with milk, water and saffron paste and sprinkled with sandalwood powder, turmeric, and vermilion during Mahamastakabhisheka for every twelve years (Fig 6).

Islam

In sufi tradition sandalwood paste is applied on the sufi's grave by the disciples as a mark of devotion. It is practiced particularly among the Indian subcontinent sufi disciples. In some places sandalwood powder is burnt in Dargah for fragrance (Fig 6). In some parts of India during the Milad un Nabi in the early 19th century, the residents applied sandalwood paste on the decorated Buraq and the symbols of footprints of the Prophet Mohammed. In some places of India during the epidemic, it was common among the South Indian devotees of Abdul-Qadir Gilani (also known as *pir anay pir*) to prepare his imprint of a hand with sandalwood paste and parade along the bylines, which they believed would cause the epidemic to vanish and the sick to be

healed. A paste of turmeric and sandalwood powder is also applied on the girl's hands and body during the *Mehndi* (henna) ceremony in Muslim wedding (Fig 6).

Chinese and Japanese religions

Sandalwood, along with agarwood (*Aquilaria agallocha*), is the most commonly used incense material by the Chinese and Japanese in worship and various ceremonies (Fig 6). Incense burning is a common Chinese religious ritual in Chinese ancestor worship, Taoism and Buddhism. Incense use in religious ritual was simultaneously developed in China, and eventually transmitted to Korea, Japan, Vietnam and the Philippines.

Zoroastrianism

Zoroastrians offer sandalwood twigs to the fire keeping priests who offer the sandalwood to the fire which keep the fire burning (Fig 6). Sandalwood is offered to all of the three grades of fire in the Fire temple, including the Atash Dadgahs. Sandalwood is not offered to the divo, a homemade lamp. Often, money is offered to the mobad (for religious expenditures) along with the sandalwood (Fig 6). Sandalwood is called *Sukhar* in the Zoroastrian community. The sandalwood in the fire temple is often more expensive to buy than at a Zoroastrian

store. It is often a source of income for the fire temple.

Summary and Future Needs

Information on research and developmental work in sandal is still lacking from many of the countries in the world. The global resources of the higher quality (in terms of oil content) species of sandalwood are much reduced. A variety of pressures in different countries will ensure that there will be insufficient resources available to meet current and potential future market demands. Therefore, there is urgent need to protect, develop and enhance the abundance of this culturally and commercially valuable sandalwood with support by active participation of entrepreneurs, end-users and scientific institutions and local bodies which has genuine demand in the world with abundant import / export potential. An information network on individuals and institutions that carry out research or management of sandalwood should be established.

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