

**GOVERNMENT OF INDIA
CENTRAL VISTA OVERSIGHT COMMITTEE**



सत्यमेव जयते



**REPORT OF THE
SANDALWOOD DEVELOPMENT COMMITTEE**



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SANDALWOOD DEVELOPMENT COMMITTEE
DECEMBER, 2024**





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ABBREVIATIONS

ACF	Assistant Conservator of Forest
ADTH	Air Dry Tonnes of Heartwood
AICRP	All India Coordinated Research Project (Under ICAR)
AICTE	All India Council for Technical Education
APCCF (R&T)	Additional Principal Chief Conservator of Forests (Research & Training)
APCCF (SF)	Additional Principal Chief Conservator of Forests (Social Forestry)
BDC	Beekeeping Development Committee
BIS	Bureau of Indian Standards
CAGR	Compound Annual Growth Rate
CAU	Central Agricultural University
CAFRI	Central Agroforestry Research Institute, Jhansi
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CCF	Chief Conservator of Forest
CEO	Chief Executive Officer
CoC	Certificate of Conformity
COO	Certificate of Origin and Ownership
COVID-19	Corona Virus Disease 2019
CVOC	Central Vista Oversight Committee
DAC&FW	Department of Agriculture Cooperation and Farmers' Welfare
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DFO	District Forest Officer
DGFT	Directorate General of Foreign Trade
DST	Department of Science and Technology
EAC-PM	Economic Advisory Council to the Prime Minister
e-NAM	e- National Agriculture Market
FC&RI	Forest College and Research Institute, Mettupalayam
FMCS	Foreign Manufacturers Certification Scheme
FPC	Forests Product Commission of Western Australia
FPO	Farmer Producer Organization
FSSAI	Food Safety and Standards Authority of India



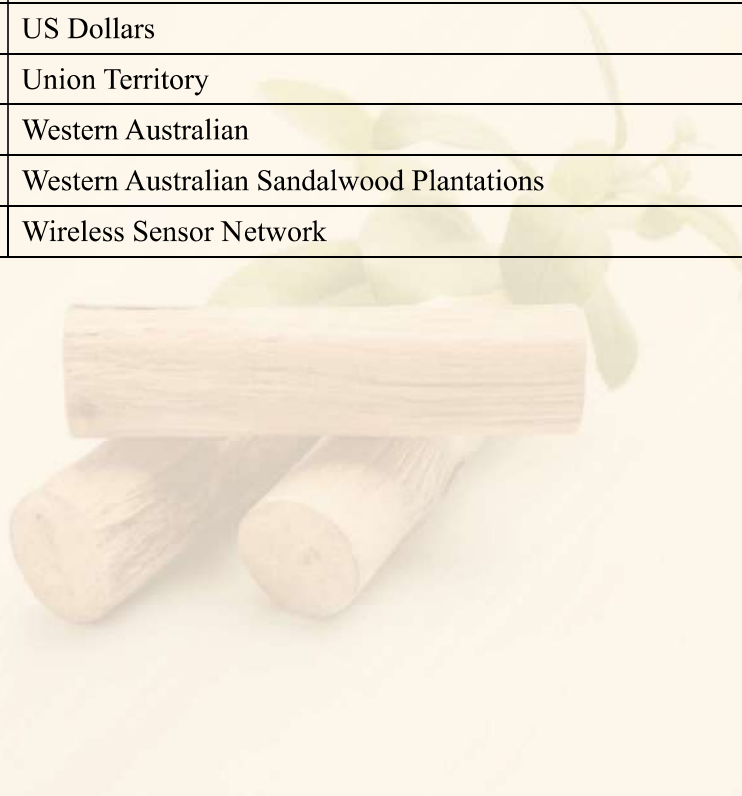


GLC	Gas Liquid Chromatography
GoI	Government of India
HYV	High Yielding Varieties
ICAR	Indian Council of Agricultural Research, New Delhi
ICFRE	Indian Council of Forestry Research and Education, Dehra Dun
IFA	Indian Forest Act, 1927
IFGTB	Institute of Forest Genetics and Tree Breeding, Coimbatore
IIT	Indian Institute of Technology
INR	Indian Rupee
IT	Information Technology
IWST	Institute of Wood Science and Technology, Bengaluru
KFRI	Kerala Forest Research Institute, Thrissur
KS&DL	Karnataka Soaps & Detergents Limited
KSHDC	Karnataka State Handicrafts Development Corporation
MHA	Ministry of Home Affairs
MoA&FW	Ministry of Agriculture and Farmers' Welfare
MoAYUSH	Ministry of AYUSH
MoC&I	Ministry of Commerce and Industry
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoMSME	Ministry of Micro, Small & Medium Enterprises
NABARD	National Bank for Agriculture and Rural Development
NITI Aayog	National Institution for Transforming India Aayog
NMPB	National Medicinal Plants Board, Government of India
NSR	Nachivayal Sandal Reserve, Marayoor, Kerala
PCCF & HoFF	Principal Chief Conservator of Forests (Head of Forest Force)
QCO	Quality Control Order
QPM	Quality Planting Material
R&D	Research and Development
RKVY	Rashtriya Krishi Vikas Yojana
SA	Sandalwood (Promotion and Facilitation) Act, 2024
SAU	State Agricultural Universities





SDC	Sandalwood Development Committee
SEZs	Special Economic Zones
SFAC	Small Farmers Agribusiness Consortium
SLSB	State-level Sandalwood Boards
SSD	Sandalwood Spike Disease
SWBI	Sandalwood Board of India
TNAU	Tamil Nadu Agricultural University, Coimbatore
TOFI	Trees Outside Forests in India
TOHFA	The Nilgiris Organic Horticulture Farmers' Association
USAID	The United States Agency for International Development
USD	US Dollars
UT	Union Territory
WA	Western Australian
WASP	Western Australian Sandalwood Plantations
WSN	Wireless Sensor Network





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No. CVOC/2024

31st December 2024

FOREWORD / ACKNOWLEDGEMENTS

Farming of sandalwood can act as a platform for rural employment generation and significant foreign exchange generation through exports of sandalwood and its various other by-products. India can be Atmanirbhar while meeting the Sandalwood needs of our society in the present and in the future. Several measures and reforms would be required to be undertaken by the Central and State Governments to regain the past glory of Indian Sandalwood.

2. With an aim to identify the issues being faced by the stakeholders and make recommendations for development of Sandalwood in the country, I took initiative as the Member Secretary of the erstwhile Economic Advisory Council to the Prime Minister (EAC-PM) and constituted the Sandalwood Development Committee (SDC) in March 2021. However, owing to the devastating COVID-19 second wave and completion of the term of the then EAC-PM, SDC could not proceed with its work. Subsequently, consequent to my appointment as Chairman of the Central Vista Oversight Committee (CVOC), SDC was reconstituted in March 2022 with me as Chairman and Shri K. Rajeswara Rao, Principal Adviser, CVOC as Member Convener. Apart from the experts in Sandalwood, representatives of various ministries / departments / organisations of the Government of India dealing with Sandalwood are Members of the SDC. As CVOC was busy with overseeing the construction work of the prestigious New Parliament Building (NPB), the reconstituted SDC started its work after the completion and inauguration of NPB by the Hon'ble Prime Minister in May 2023.

3. It gives me an immense pleasure to present this Report of the Sandalwood Development Committee. SDC held consultations with diverse stakeholders, assessed the status of Sandalwood and recommended appropriate measures in this Report for the development of Sandalwood in India.





4. I extend my heartfelt gratitude to all the Members of SDC for their enthusiastic participation in the discussions and for offering valuable insights into the challenges and potential solutions for advancing Sandalwood in the country. My appreciation and thanks to Dr. M.P. Singh, Former Director; Shri Rajesh Kallaje, Director; Dr. Arun Kumar A.N., Scientist-F and their team of Scientists/Officers in the Institute of Wood Science & Technology (IWST), Bengaluru for their consistent support and contribution towards completion of the work of SDC.

5. My special appreciation and thanks also to Dr. K.T. Parthiban, Former Dean and Professor, along with his team of officials and Research Scholars, Forest College & Research Institute (FC&RI), Mettupalayam for his immense contribution in drafting and finalising of this report. I also thank Shri Nihar Ranjan, Dean and Dr. A. Balasubramanian, former Dean of FCRI, Mettupalayam for their invaluable inputs. I must thank Dr. M.R. Srinivasan, Professor of Entomology, TNAU, Coimbatore for extending his invaluable support in fine tuning the SDC report. Thanks are due to the management of TNAU, Coimbatore for allowing FC&RI and Dr. M.R. Srinivasan to assist Shri K. Rajeswara Rao, Member Convener, SDC and associate with the work of SDC.

6. I would like to thank the State Governments, State Forest Departments, Sandalwood Experts, Scientists, Institutions, Farmers, Sandalwood Agencies/Federations, etc. for their participation in the stakeholder consultation meetings and providing valuable inputs and suggestions. Further, I thank Dr. Anantha Padmanabha, Australia Sandalwood Expert for providing valuable inputs about the current status of Sandalwood in Australia.

7. I am grateful to Shri K. Rajeswara Rao, Principal Adviser, CVOC and Member Convener, SDC for his tireless efforts in coordinating with various stakeholders and bringing together the complex issues involved while preparing this report with specific recommendations for development of Sandalwood in India. Without the excellent support and involvement of Shri Rajeswara Rao, it would have not been possible for the SDC to complete its work and bring out this report.

8. I sincerely urge the Central Government and the State Governments to make use of this report and take urgent necessary action in implementing the recommendations of the SDC.

Ratan P. Watal
(Ratan P. Watal)



EXECUTIVE SUMMARY



Sandalwood (*Santalum album* L.) is a prized gift of the plant kingdom integrated into the cultural and heritage system of India. It is one of the most valuable trees in the world. It exhibits a very long history of human use and appears in Sanskrit texts as early as 2000 BC. This sought after wood and the oil extracted from this wood are essential part in wide range of industrial applications. It is highly significant in religious and cultural festivals of not only in India but across the world. The Sandalwood is valued for its quality and found major utilization in carving and furniture. The aroma present in the oil has a profound utility in perfume and cosmetic industries which attracted a global market. The traditional medicines have also realized the potential of Sandalwood oil for its therapeutic uses as anti-bacterial, anti-inflammatory, antioxidant, anti-hyperglycemic and hemo-preventive effects. Such a pristine species with multitude of benefits have received both national and global attraction. Till the recent past, India was the largest producer and exporter but currently Australia leads the global market with a market share of about 69 % followed by India with a market share of about 20 % only.

The export and import of Sandalwood in India indicates that the export valued at USD 0.62 million and import at USD 5.59 million during the year 2023-24 (Soundarajan et al. 2015). The country once a major producer of Indian Sandalwood oil is slowly translated into a massive importer due to non-availability of wood. It is also witnessed that the global Sandalwood market is steadily increasing which was valued at USD 265.8 million in 2023 and is expected to grow to USD 502.2 million in 2030 witnessing CAGR of 9.4% during the forecasted period. All these developments indicated that Indian Sandalwood has to be brought once again into the limelight in order to reap the growing demand and capitalizing the domestic and global markets.

In India, Sandalwood predominantly grew in southern peninsular India with the natural distribution of 9600 Sq. Km mainly in the states of Karnataka, Kerala and Tamil Nadu. The species has been extensively exploited which resulted in removal of superior genetic stocks and leaving only an emaciated population. Simultaneously, the demand for Sandalwood has increased steadily both for domestic utilization and the global requirement. The decline in supply from the natural forests and increasing demand in the global market has ushered in a total mismatch between demand and supply. Considering this demand globally into an account, several international agencies from across several regions of the world have initiated Sandalwood plantation development programme and today most of these countries particularly companies in Australia take the pride of over 70% sandal market share in the global market. This resulted in loss of the glory of Indian Sandalwood and necessitated massive interventions to restore the glory once again in the global market. To regenerate and to promote Sandalwood plantations, several initiatives were taken by Government of India and State Governments





which attracted the promotion of Sandalwood plantations. Currently, many private institutions, organizations and farmers are involved in raising commercial large scale sandal plantation across the country particularly in non-traditional sandal growing states like Andhra Pradesh, Telangana, Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. It is estimated that Sandalwood development in farmlands has reached an area of over 30,000 hectares which is further expanding at the rate of 600 hectares per annum.

All these developments have attracted sandal-based tree husbandry by all sectors of stakeholders. However, the sandal growth, development, harvesting, and marketing are the major challenges faced by the farmers and other stakeholders involved in promotion and development of sandal farming. Several farmers and stakeholders in the country have been experiencing and witnessing the challenges which has been expressed to the Government in the form of petitions, memorandums and proposals. All these proposals and grievances expressed by the stakeholders are reviewed and Government of India through Central Vista Oversight Committee (CVOC), New Delhi constituted Sandalwood Development Committee (SDC) under the chairmanship of Shri Ratan P. Watal, Chairman, CVOC to review the current status, identify the issues and make recommendations in consultation with the stakeholders for making suitable changes in policy and legal frameworks by the central and state governments.

Accordingly, the committee conducted several stakeholder consultation meetings in major sandal growing states, reviewed the present status and development in both domestic and international market and made policy recommendations. These consultations were held in various locations viz., New Delhi, Bengaluru (Karnataka), Gandhinagar (Gujarat), Mettupalayam (Tamil Nadu) and Mumbai (Maharashtra) covering various states in different regions of India. During the several stakeholder consultations conducted across the country, the Sandalwood Development Committee identified the following challenges related to Sandalwood plantation development, trade and marketing:

- i. Dearth of quality planting materials and package of practises for Sandalwood cultivation
- ii. Illegal felling, theft and lack of plantations protection system
- iii. Lack of financial support, incentives and of insurance coverage
- iv. Legal issues related to harvesting, transportation and sale of farm-grown Sandalwood Need for further research and development on improved varieties and propagation methods, pest and diseases management and value chain system





v. Absence of market mechanism and price supportive system

vi. Absence of traceability and the associated certification standards

To bring back the glory of Indian Sandalwood and to make India play a vital role in global sandal market, the committee thoroughly reviewed the challenges and concerns that exists and expressed by the stakeholders from the entire Production to Consumption System in sandal cultivation and suggest the following recommendations:

1. Sandal wood cultivation needs to be promoted and developed through a technological advancement judiciously involving research and development institutions, forest department, farmers, organization and other institutions involved in sandal plantation development.
2. The Central and State Governments should ensure and revise the existing law and legislations to facilitate easy harvest, transportation and marketing of farm grown Sandalwood and treating farm grown Sandalwood as farm produce. The MoEF&CC should amend Indian Forest Act, 1927 exempting farm grown Sandalwood from the list of forest produce (Section 2 (4)) and from the list of timber (Section 2 (6)), and free it from the purview of forest products similar to the amendment made in case of Bamboo (*"In the Indian Forest Act, 1927, in section 2, in clause (7), the word "bamboos" shall be omitted"*).
3. The financial institutions should ensure necessary institutional credit and insurance mechanism for sandal plantation development by developing scale of finance and other input cost requirements.
4. The government implementing institutions should extend all incentive mechanism for Sandalwood plantation establishment and the associated value chain process.
5. Need for deregulating the restrictions of sandal import and exports particularly for farm grown sandal products.
6. The certification mechanism for QPM, Sandalwood plantation, CoC (Chain of Custody), products, etc. should have to be developed and implemented by the respective institutions
7. Need for a strong research and development mechanism with a continued funding support to R&D institutions to develop varieties, clones, value added products, agroforestry models, etc. to match the global competency. ICFRE, ICAR, SAUs could develop QPM standards, Agroforestry models and value addition technologies. R&D institutions should develop strategies for in-situ and ex-situ conservation of Sandalwood biodiversity.





8. The information access to market, pricing system and other value added products have to be created by the respective government institutions to ease the art-of Sandalwood business.
9. To attract sandal farming and the associated socio-economic developments, the committee suggests to create an exclusive Sandalwood Development Board along with regional centres by formulating necessary legal provisions. The committee also makes the following specific recommendations to promote sandal cultivation towards re-establishing the glory of Indian Sandalwood.
10. MoEF&CC, MoA&FW, MoAYUSH and NABARD could incorporate Sandalwood for extending institutional credit, incentives and insurance.
11. Relaxation of policy related to Sandalwood by different states and adoption of common legal system for Sandalwood across the country by enacting Sandalwood (Promotion and Facilitation) Act, 2025.
12. MoEF&CC, MoA&FW, MoAYUSH and MoCI could develop mechanisms for market and price supportive system.
13. MoA&FW should notify Sandalwood Oil Control Order to ensure that selling of certified oil conforming to BIS standards (IS 329:2004) only in the market.
14. MoEF&CC should develop standards for Sandalwood certification and MoA&FW to make necessary legal provisions for AGMARK certification of sandal and its by-products.
15. GoI should enact Sandalwood (Promotion and Facilitation) Act, 2025 as per the draft proposed (Enclosure-1) and establish a Sandalwood Board similar to various other Boards such as Tobacco Board, Spice Board and Coffee Board under the Ministry of Commerce & Industry, Government of India, to ease Sandalwood trade process and facilitate creation of sandal FPOs. This Sandalwood Board could play a pivotal role in making India a global leader in Sandalwood production and trade, ensuring the sustainable and equitable growth of this valuable resource. State Level Sandalwood Boards could also be established under the provisions of the above proposed Act.
16. If enacting the proposed Act takes longer time, SDC recommends that the Sandalwood Board could be established by the GoI under a policy decision as per the proposal in Enclosure-2.



Chapter 1



BACKGROUND

1.1. Introduction

Santalum album L., commonly known as Indian Sandalwood, is a tropical, medium sized, evergreen, partially root parasitic tree, renowned for its fragrant heartwood. It is an evergreen tree mostly grown for extraction of timber and essential oil. The tree is famously called white Sandalwood (in English), belongs to the Santalaceae family, Safed Chandan (in Hindi) and srigandha (in Sanskrit). Sandalwood has also been intricately associated with Indian history, culture, heritage, folklore and scriptures. It is widely accepted as the most precious and commercially valuable tree species for its fragrant heartwood and essential oil. Sandalwood is a tree which generally grows in the dry deciduous forests. It can grow to a height of 20 m and a girth of 1.5m. It thrives best under rainfall conditions of 500-2000 mm and at elevations of 650-1200m. Sandalwood is capable of growing in different kinds of soils.



About 50 year old Sandalwood tree with an approximate girth of 50 cm in Marayoor, Kerala



Sandalwood tree host association

Sandalwood flowers and fruits twice a year during March-April and September-October. In early stages, it grows well under partial shade, but at the middle and late stages, it shows intolerance for heavy over-head shade.

In India, the States of Tamil Nadu and Karnataka are the two largest repositories of Indian Sandalwood. Previously, more than 90 % of the Sandalwood was distributed in the states of Karnataka and Tamil Nadu covering around 9,000 km² of which more than 70 % occurred in Karnataka. Over a





About 150 year old Sandalwood tree with an approximate girth of 200 cm in NSR - 2, Marayoor, Kerala

period of time, it has been introduced to other parts of the country and is currently cultivated in Andhra Pradesh, Kerala, Jharkhand, Madhya Pradesh, Orissa, Uttar Pradesh, Uttarakhand, Chhattisgarh, Rajasthan, Bihar and Manipur. Currently, it is estimated that the Sandalwood development in farmlands has reached an area of 30,000 hectares, which is further growing at the rate of 600 hectare per annum.



Sandalwood tree planted near a Household in Marayoor, Kerala





1.2. Uniqueness of Indian Sandalwood

Worldwide, the distribution of Sandalwood is between 30°N and 40°S latitude. There are 17 species, 14 varieties and one extinct species reported in the genera *Santalum*. Of the 17 species, seven species are considered commercially important. Among them, the potential of *Santalum album* is very significant due to its high demand and higher price in the international market. This is primarily due to its high-quality oil and used as a premium standard to compare other Sandalwood oils. The species *Santalum album* is regarded as most valuable also because of high α and β -santalol content in the oil. Currently, *Santalum album* accounts for about 95 per cent of total global production.

The Indian Sandalwood has been acclaimed as the most precious and valuable among Indian forest trees since time immemorial. The oil extracted from the heartwood is in high demand by perfume manufacturers, and is also used in indigenous medicine. The heartwood is considered as one of the finest woods for carving. The following features make the Indian Sandalwood more special and unique and the most preferred *Santalum* species in the world.

Ability to grow under versatile growing conditions

Indian Sandalwood thrives in varied environmental conditions, including well-drained soils and a warm, tropical and subtropical climate. This ability of the plant to thrive in versatile growing conditions and yielding fragrant wood and oil makes it suitable species for growing across several states in the country.

Cultural Craftsmanship

Indian Sandalwood has been intricately woven into the cultural fabric of India, with skilled artisans and craftsmen utilizing its wood for carving, sculpture, and decorative arts. The craftsmanship associated with Indian Sandalwood adds an extra dimension of value and appreciation.

Distinctive Heartwood Color and Texture

The heartwood of Indian Sandalwood is prized for its rich golden-brown color and fine, even texture. The wood is highly valued in woodworking, carving, and furniture making, adding both aesthetic appeal and intrinsic value to crafted items.



Sandalwood stored in a State Forest Department in Marayoor, Kerala



High Oil Content

Indian Sandalwood typically contains a higher percentage of essential oil compared to other Sandalwood species. This high oil content contributes to its intense fragrance and therapeutic properties, making it a prized ingredient in perfumes, incense, and essential oils. The fragrant heartwood has oil content up to 6%.

Medicinal Properties

Indian Sandalwood has a long history of use in Ayurvedic medicine for its various therapeutic properties. It is believed to have antimicrobial, anti-inflammatory, and soothing properties, making it valuable for skincare, aromatherapy, and holistic healing practices.

1.3. Reasons for Decline in Sandalwood production in India

The commercial value of Sandalwood became known mostly in 1792 when Tipu Sultan, the then ruler of Mysore declared it as a 'Royal tree'. Due to this historical presence, Sandalwood has continued to remain under government control. However, the Sandalwood cultivation and the associated supply chain suffers due to wide range of challenges and constraints which led to decline in Sandalwood production. The following are some of the reasons for the decline of Sandalwood production in India

Excess harvesting

Historically, there has been significant overharvesting of Sandalwood trees due to high demand for their wood and oil. This unsustainable harvesting has led to the depletion of natural Sandalwood populations, particularly in regions where the trees were once abundant.

Illegal Logging and Smuggling

Illegal logging of Sandalwood trees continues to be a major problem in India. Smugglers often target mature Sandalwood trees for their valuable heartwood contributing to the decline in natural populations. This illegal trade undermines conservation efforts and perpetuates the depletion of Sandalwood resources.

Habitat Loss

Deforestation and habitat loss pose a significant threat to Sandalwood trees and their natural ecosystems. Rapid urbanization, agricultural expansion, and infrastructure development have resulted in the destruction of Sandalwood habitats, reducing the available area for natural regeneration and cultivation.





Slow Growth and Long Maturation Period

Sandalwood trees have a slow growth rate and a long maturation period, often taking several decades to reach harvestable maturity. This slow growth makes Sandalwood cultivation a long-term investment that requires patience and careful management. As a result, many farmers and landowners may prefer faster-growing and more lucrative crops, leading to a decline in Sandalwood cultivation.

Regulatory Challenges

Complex regulations and hurdles related to Sandalwood cultivation, harvesting and trade also hinders legitimate production efforts. Licensing requirements, permit systems, and government controls aimed at preventing illegal logging and smuggling also act as barriers for farmers and businesses interested in cultivating Sandalwood.

Pests and Diseases

Sandalwood trees are susceptible to various pests and diseases, which affect their growth and productivity. Infestations of insects, fungi, and other pathogens often damage Sandalwood trees, reducing their yield and quality. Lack of effective pest management practices and limited access to disease-resistant varieties may exacerbate the problem. Changing climatic conditions are responsible for status shift of minor pest to major pests as in case of red stem borer, *Polyphagozerra coffeae* especially in farmer field where Sandalwood is grown along with other horticultural crops pest shift to Sandalwood is also evidenced.

Lack of Incentives

Lack of sufficient incentives and support mechanisms for Sandalwood cultivation may deter farmers from investing in this crop. Limited access to financial resources, technical assistance, and market information also impedes efforts to expand Sandalwood production and encourage sustainable practices.

Now, India is hardly able to satisfy its domestic Sandalwood needs and rely mostly on Australia and African nations to meet its requirements. India faces a wide gap between demand and supply. India is a huge importer of Sandalwood oil and powder, especially from Australia, Ethiopia and Tanzania and Wooden Frames from China. Sandalwood is categorised as vulnerable by International Union for Conservation of Nature (IUCN).





1.4. Central Government agencies dealing with Sandalwood

There are several Central Government agencies such as MoEF&CC, MoA&FW, Ministry of AYUSH, Ministry of Commerce, National Medicinal Plant Board, etc. dealing with Sandalwood. There is a need for a single agency in the Government of India to govern the state-owned Sandalwood resources and to initiate policy making process.

1.5. Importance of developing Sandalwood plantation/industry

If India needs to compete against contenders like Australia and Africa whose export trends have seen a steep incline, India should attempt to augment production of Sandalwood. Efforts are required to grow Sandalwood under Agroforestry, farm forestry, corporate and government plantations. Moreover, Sandalwood has religious importance, apart from usage in traditional perfume or attar. Therefore, there is likely to be a huge domestic as well as international demand for superior quality Indian Sandalwood. India can become '*Atmanirbhar*' while meeting the Sandalwood needs of our society both in the present and also in the future.

All the above issues resulted in farmers expressing concerns and submitting proposals to various state government and central government to relax the existing rules and to resolve the various challenges and constraints faced by the sandal growing farmers.

Considering these challenges and grievances expressed by the Sandalwood growing farmers and other stakeholders across the country, the Government of India through Central Vista Oversight Committee, New Delhi constituted Sandalwood Development Committee to resolve the issues with a suitable policy and legal directions. Accordingly, the committee conducted several consultation workshops in major sandal growing states, reviewed the current status and development in both domestic and international market and drafted suggestive and policy notes which are presented in this report.





Chapter 2

SANDALWOOD PRODUCTS/BY-PRODUCTS AND THEIR USAGE

Sandalwood is much prized as a wood for carving and is used for making souvenirs and other items requiring fine workmanship. In India, sapwood of sandal is used for wood turning, particularly toy making: the wood comes mainly from trimmings and immature trees killed by spike disease. Sawdust from heartwood prepared for distillation is valuable enough to be collected and sold for use as incense for religious purposes as well as for scenting clothes and cupboards.

Outside India, where export of logs is prohibited, there is a thriving market for Sandalwood as incense in joss-stick manufacture. Australia supplies most of this market at present, mainly from *S. spicatum* which has a low oil content and which is, therefore, less attractive as a direct source of oil. Exports of logs from Western Australia were almost 2,000 tons in 1989, valued at USD 11.5 million (Adviser Edge (2008)). Log exports from other sources have amounted to a few hundred tons or less from individual species. The major commercial end uses of Sandalwood in western markets are used as a key component in fine fragrances, toiletries, aromatherapy and incense, and as an insect repellent. Factors influencing demand in Western markets include growing consumer preference for natural ingredients; manufacturer preference for sustainable, ethically produced ingredients; and a growing global beauty industry (Camin et al. 2017)



Sandalwood by-products





Sandalwood oil and Sandalwood paste

The Sandalwood oil is one of the most valuable essential oils, valued by perfumers for its woody notes, providing a deep rich base note to perfumes and acting as a natural fixative. Sandalwood oil is still one of the main remedies used in the Ayurveda system of medicine. Asians and Arabs use it in self-treatment for a great number of diseases. Traditionally Sandalwood has been used for treating digestive complications arising from diarrhea, nausea, colic and gastritis. It is listed as a carminative and digestive muscle relaxant. Its antiseptic properties have been used for treating genito-urinary infections Such as gonorrhoea and leucorrhoea. Indigenous physicians observed that the oil and heartwood possessed antispasmodic properties and so utilized it for treating bronchitis, coughs, sore throat and Related diseases. Its use in treatment of skin problems is legendary. It is an excellent moisturizer and nourishes all skin types. It's astringent, anti-inflammatory, antiseptic, and pain-relieving properties have been put to good use in healing wounds, scars, and acne. Applied to the forehead in the form of a paste it has a cooling effect and is used to bring down fevers. In cosmetic preparations, it is excellent for reducing wrinkles.

Value addition

Personal Care

Indian Sandalwood has been used for centuries in personal care products due to its therapeutic properties and luxurious aroma. It is known for its ability to soothe the skin and reduce inflammation, making it a great addition to skincare and haircare products.

Aromatherapy

Indian Sandalwood has proven therapeutic benefits that can be harnessed in aromatherapy. The calming and grounding properties of Sandalwood have been shown to reduce anxiety, decrease system arousal, and increase alertness and focus. It also aids learning and memory and improves sleep quality. It can also be added to massage oils or bath salts, providing a soothing and therapeutic experience for the body and mind.





Skincare and Cosmetics

Indian Sandalwood is a powerful ingredient for use in skincare and cosmetic products due to its active benefits for the skin. Its anti-inflammatory properties help to soothe and calm the skin, while its potent antioxidant properties make it an effective ingredient for reducing signs of aging such as fine lines and wrinkles. The versatility of Sandalwood allows it to be incorporated into various products, such as face creams, toners, serums, lip balms, and body lotions, providing long-lasting benefits to the skin (Kumar et al., 2012).

Fragrance and cosmetics

Indian Sandalwood is not only a hero ingredient in skincare and cosmetics, but it also has numerous benefits in fragrance. Its warm, woody, and earthy aroma makes it a popular choice in perfumes. As a base note in perfumes and colognes, Sandalwood can provide a deep and long-lasting scent. It is often combined with other woody scents such as cedarwood or patchouli to create a complex and intriguing fragrance. For those looking to incorporate Sandalwood into fragrance products, there are several options. Custom fragrances can be created using Sandalwood as a base note, or it can be incorporated into existing perfume lines to add a unique and impactful aroma. Additionally, Sandalwood can be used in other fragrance products such as candles, diffusers, and body sprays. Moreover, Sandalwood's fixative properties make it an excellent choice for perfumers, as it helps to enhance the longevity and sillage of fragrances, making them last longer and smell better.

Flavour

Indian Sandalwood's unique flavor and delicate aroma has made it a popular ingredient in Indian and Middle Eastern cuisine for centuries. In fact, research suggests that Indian Sandalwood's essential oil is used as a natural flavor enhancer in food products, adding both taste and health benefits (Kumar et al., 2012). Indian Sandalwood has been linked to improving digestion and reducing inflammation, making it an excellent choice for those looking to incorporate more natural and healthy ingredients into their diets.



Chapter 3



INTERNATIONAL SCENARIO - AUSTRALIAN MODEL OF SANDALWOOD PLANTATION AND MARKETING SANDALWOOD PRODUCTS AND THEIR USAGE

Sandalwood is an important international commodity, recognized for its aromatic oil which is a key ingredient in many fragrances and cosmetics. Western Australian (WA) Sandalwood (*Santalum spicatum*) is known to be a cheaper alternative for the superior Indian Sandalwood (*Santalum album*) as it has lower oil content and lower quality oil. The natural stocks of *S. album* have declined due to overharvesting, illegal felling (theft), mismanagement, and disease incidences. WA Sandalwood's natural stands have also reduced due to historical mismanagement. As a result, WA Sandalwood (*S. spicatum*) has been established in plantations in the southern half of WA to attempt to meet the demands of the Sandalwood industry. Plantations of WA Sandalwood is promoted to farmers as Agroforestry, with the promise of economic and environmental benefits. While these benefits are attractive, Sandalwood has an estimated 25-year rotation.

The Australian model of Sandalwood plantation has been a remarkable endeavor, particularly with regard to Indian Sandalwood (*Santalum album*).



Australian Sandalwood plantation



Pioneering Research:

- The Western Australian Forest Department initiated Indian Sandalwood research in the early 1980s.
- This research laid the foundation for the world's largest plantations and Sandalwood supply companies, primarily based in Western Australia.
- The government research plantations provided valuable insights into various aspects, including seed germination, seedling health, plantation design, irrigation, pest management, and silvicultural treatment.
- Harvested research trees contributed to developing growth, heartwood, and oil yield models.
- Armed with this knowledge, the emerging commercial plantation industry gained confidence to invest in Indian Sandalwood plantations in Australia.

Location

The wheat-sheep belt of Western Australia is the centre of the interest and expertise in Australian Sandalwood.

Establishment

The main consideration when selecting a site for growing Sandalwood is drainage. Soils prone to seasonal water logging are unsuitable as are very free draining sands. Whilst well-adapted to low rainfall areas, the higher the rainfall the greater the growth rates although there is some concern about the wood quality of Sandalwood growing in areas of more than 750mm. The rainfall in the Western Australian Wheatbelt ranges from between 300 and 600mm with a pronounced summer drought.

- WA Sandalwood Plantations (WASP), established in 2001, is a leading player in the Sandalwood industry and is the world's largest manager of Australian Sandalwood (*Santalum spicatum*).
- WASP owns and manages on behalf of sophisticated and institutional investors over 19 million trees grown on 15,126 hectares located in the central Wheatbelt of Western Australia where Sandalwood has naturally occurred for thousands of years.
- The WASP Sandalwood production system is the combination of more than 20 years of Sandalwood research, 15 years of developing commercial plantations and 7 years of managing





Market overview of Australian Sandalwood model

The natural range of Western Australian Sandalwood is throughout the medium and low rainfall regions of Western Australia from just north of Carnarvon, along the coast to above Albany, through the wheatbelt and goldfields to some small areas of South Australia.

Sandalwood of different varieties is also grown in the Indonesian archipelago and the Pacific Islands, but overexploitation and restrictions on harvesting has meant that the volume produced is minor. Current world market demand for Sandalwood is thought to be around 5,000-6,000 tons per year, with this figure incorporating demand for a number of different products, sourced from a variety of Sandalwood species.

Major market destinations for export of Sandalwood are Taiwan, China, Malaysia, Korea, Hong Kong and India. Australia is one of the major players in the international Sandalwood market, harvesting just over 2,000 tons of *S. spicatum* from Crown Land in Western Australia and 200 tons from private landholders in the same state and further 250 tons is harvested from Queensland plantations of *S. lanceolatum* (Thomson, 2020).

Private Sector Investment

The first privately owned commercial plantations of Indian Sandalwood were established in Australia in 1999. Over two decades later, Indian Sandalwood planting continues across the tropical northern half of Australia, including Western Australia, Northern Territory, and Queensland.

Suitable land for growing Indian Sandalwood is not abundant; factors such as climate, water availability, soil types, and competing agricultural land uses limit its expansion. While most Indian Sandalwood plantations are in the tropical northern two-thirds of the country, successful growth below the 30° latitude line is possible in frost-free areas, albeit usually for non-commercial garden-based trees.

Prospects of Sandalwood market

Prospects of Sandalwood market at present, is very encouraging and the price of one-kilogram Indian Sandalwood oil is about USD 3,000, or about five times as much as silver in 2017 (Durai, 2021; Thomson, 2020).

- Price is rising by at least 20 to 25% a year. Although Sandalwood products are consumed globally, Asia is the largest consumer, with China alone accounting for half of expected global demand growth.





- The demand for Sandalwood is expected to increase fivefold (20,000 tons per year) by 2025. Factors influencing demand in eastern markets include increasing prosperity, a growing market and consumer preference for natural products, and significant growth in demand from China.
- It is reported that future value of Sandalwood plantation from Australia range from 20,000 to 41,000 Australian dollar per ton for Indian Sandalwood (*S. album*) and 3,000 to 16,500 Australian dollar per ton for Australian Sandalwood (*S. Spicatum*).
- Although it is difficult to quantify the actual size of the global market for Sandalwood due to a lack of availability of trade data and illegal trade (likely around 33% of the total market), the most reasonable estimate of the annual global Sandalwood market in recent times is 6320 Air Dry Tonnes of Heartwood (ADTH) during 2011–2012.
- Price of Sandalwood rose rapidly during the year 2000 and the price of *S. album* Sandalwood in India increased at a compounded rate of 15.1% between 1992 and 2014 and the wholesale price for high-quality Indian Sandalwood oil reached more than or equal to USD 3000 kg⁻¹ (for perfumes and new pharmaceutical uses in the United States) in 2016.
- The global Sandalwood oil market is predicted to double in value over the next five years, to USD 197 million by the end of 2026. The price elasticity for Sandalwood products can be counterbalanced and buffered by both product diversification and regional market diversification with strong economies, such as China, Europe, India, the Middle East and North America.
- There are growing middle classes with high disposable incomes in China and India, nations with traditional cultural associations with Sandalwood, which will maintain upward pressure on price even as supply increases or if individual products or markets face a downturn.
- Nevertheless, Sandalwood is a luxury item, the price of and demand for which would inevitably decline to some extent in a major global economic downturn. It is likely that a range of new uses will be developed and traditional uses will be re-established when more reliable and consistent supplies of high-quality Sandalwood oil are generated through sustainably managed plantations.





- Due to the presence of a substantial unmet demand for high- and mid-range perfumes, body-care products, aromatherapy, traditional eastern medicines, new pharmaceutical products, and top-of-the-range solid furniture and associated increased demand in China, India and other Asian economies will help underpin the price of Sandalwood oil for the foreseeable future.
- The inferior oil quality species such as *S. spicatum*, may struggle to maintain their market share in the future, with lower grades of *S. album* products. Synthetic santalols are expensive to produce and in lesser demand in the perfume sector, which may help the Sandalwood to retain its market.

