

Year - 2020

Vol. 7, No. 2

(ISSN 2395 - 468X)

Issue: February 2020

# Van Sangyan

*A monthly open access e-magazine*



Indexed in:



COSMOS  
Foundation  
(Germany)



International  
Inst. of Org. Res.  
(Australia)



**Tropical Forest Research Institute**  
(Indian Council of Forestry Research and Education)  
Ministry of Environment, Forests and Climate Change (MoEFCC)  
PO RFRC, Mandla Road, Jabalpur – 482021, India



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**Note to Authors:**

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

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The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

**Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve**

**Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)**

**From the Editor's desk**

*Nurseries that work to strengthen and expand the presence of tropical native species are concerned about fostering diverse, strong, and well-adapted populations. For many tropical plants, however, the natural diversity of wild populations has been depleted. Habitat loss has reduced the range and sheer numbers of plants. For plants with commercial value, unsustainable harvesting practices may have reduced the numbers of plants with desirable characteristics while leaving behind inferior plants. The process of depleting a population of the best genetic properties so that future populations are weaker than the original populations is called genetic degradation.*

*Seed collection for plant propagation is an opportunity to reverse trends of genetic degradation and species loss. Nurseries have a key role in conserving the gene pool of native plants. Seed collection began as an art during the stone age. Later, it became a science when the need for improved seeds arose. The aim of seed collection is to obtain large quantities of seed of the best genetic quality. To minimize seedling variation, seeds should be collected from suitable sources.*

*Before creating a strategy for collecting native plant seeds, it is important to understand some key points regarding genetics and collection ethics. Seed collection strategies must protect genetic diversity for the future both at the collection sites and in the places where the offspring will be planted. On the outplanting sites, good seed collection practices ensure that inbreeding will not become a problem and that plant populations will be genetically viable to survive and adapt to new stresses. For restoration and conservation projects, maintaining genetic diversity is a key part of project objectives and of the target plant requirements*

*In line with the above this issue of Van Sangyan contains an article on Seed collection, processing and nursery techniques for *Anogeissus latifolia* – an important multipurpose tree species. There also useful articles viz., Horti-pastoral system: An alternative to fodder security in arid and semi-arid regions, Sandalwood: A Promising Economical Tree of India, *Pongamia pinnata* (karanja) tree and वेद एवं वृक्ष (in Hindi).*

*I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.*

*Looking forward to meet you all through forthcoming issues*

**Dr. Pawan Rana**  
Scientist 'E' & Chief Editor

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## Seed collection, processing and nursery techniques for *Anogeissus latifolia* – an important multipurpose tree species

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### About the species

*Anogeissus latifolia* (Roxb. ex DC.) Wall ex Guill and Perr commonly known as Axle wood is a small to medium-sized tree up to 20-36 m tall, with a straight and cylindrical bole up to 80-100 cm in diameter. Its wide leaves (that give it the name *latifolia*) are opposite or sub-opposite, simple with grayish-yellow or whitish hairs below. The fruit is a 2-winged pseudo-achene, packed into a dense head with a single seed. *A. latifolia* timber gives a heavy hardwood, good charcoal and firewood. It provides a gum that is a good substitute for gum arabic.

Its leaves give tannins used for tanning and dyeing. *A. latifolia* is used as fodder for cattle, buffaloes and other ruminants. In certain areas of the subtropical forest of the Himalayan foothills of India, *A. latifolia* is the most important fodder, fuel and timber tree, and excessive lopping of leaves and cutting of saplings and branches for firewood may cause poor regeneration. In these regions, *A. latifolia* may be a major fodder tree for buffaloes in pastoralist communities.

*A. latifolia* is native to India, Myanmar, Nepal and Sri Lanka, and found throughout tropical Asia. A tree of tropical and subtropical climates, it is found in deciduous or semi-evergreen forests. It is a common element in teak forests but also occurs in the under storey of dipterocarp

forests, in bamboo forests. It is also present in vegetation under semi-arid conditions such as savanna woodland and dry rocky hills.

It is usually associated with *Albizia lebbbeck*, *Dalbergia* spp., *Grewia tiliaefolia*, *Albizia amara*, *Gyrocarpus jacquini* and *Mesua ferrea*. In India, it grows in most parts of the country except in arid areas and moist areas of North-West India. *A. latifolia* grows up to an altitude of 1200 m, with an average annual temperature of 38-45°C and an average rainfall of 625-2250 mm. It is found on a variety of soil types but prefers deep alluvial soils. It does not tolerate water logging.

In India, *A. latifolia* is leafless in February-May, flowers in June-September depending on locality, and mature fruits are present in December-March. Leaf flushing begins in the dry season, reaching a peak time before the onset of rains (Edgaonkar, 1995).

### Natural regeneration

Natural regeneration of this species is very good, though young trees are very intolerant of weed competition. The tree produces root suckers, coppices and pollards well, but this exhibit great seasonal variability. Coppicing and pollarding should not be done during the rainy season. Thinning of coppice is necessary. Coppicing is relied upon to regenerate natural stands, coppice shoots

grow fairly quickly. Trees are easily damaged by fire. Requirements for the establishment of natural regeneration are sufficient light, moisture, good drainage and the lack of thick weeds or in growth. Coppicing is invoked to regenerate the natural stands of coppice shoots grow quickly. Dilution of coppice shoots is necessary, as the number of coppice growth is usually produced by more than two.

#### **Seed collection and storage**

Generally, seed viability is low but increases after very dry seasons. Germination rates can be increased by pre-soaking the seeds for 3 minutes in hot water. Fruits should be collected only when they are fully ripe as immature seeds fail to germinate. The ripe fruits are collected from the trees, dried in the sun and then stored. Seed storage in metal tins or polythene containers is the best.

The fruits should be collected when the heads start to break up and not earlier. The seeds of *A. latifolia* mature in second fortnight of March each year when the seed moisture content is around 12 per cent and colour of fruits turns to blackish green. Seeds are about 95% empty when collected from the trees.

The germination percentage of seeds is only 1-2 per cent; however 50% seeds are sound and viable. Seeds can easily be stored at 15<sup>o</sup> C in refrigerator in polythene bags at a moisture content of 9% with slight decrease in viability up to two years. Then the seeds are dried and stored in gunny bags. The seeds should be sown immediately as it loose its viability very soon. Approximately one kilogram seed contains 1,08,000 to 1,35,000 seeds (Aswathanarayana, 1997).

#### **Nursery Technique**

The seeds are sown densely on raised beds, the soil being mixed with large quantity of coarse sand. The bed is well-shaded and 45 cm above the ground. Germination is fairly quick. The seedlings are extremely liable to insect damage. The development of the seedlings is very slow.

#### **Planting techniques and maintenance**

Planting and maintenance techniques: Planting is done in July and August after the onset of monsoon rains. Planting seedlings or stem is in pits of size 30 cm<sup>3</sup> pits dug in advance at a spacing of 3 x 3 m. Although the use of bare seed for planting, the seedlings must be torn from the nursery beds with balls of earth, carefully wrapped and transported and planted.

Good rainfall after planting ensures good survival rate. Planting operations should be suspended if no rain is expected for a few days of planting. Bush cutting and weeding are necessary to prevent the removal of seedlings. The planting areas are in need of protection against pests and fire.

#### **Uses**

It is one of the most useful trees in India. Its leaves contain large amounts of tannins, and are used in India for tanning. The tree is the source of Indian gum, also known as 'gum ghatti', which is used for the printing of banners and other uses.

*A. latifolia* yields good charcoal and firewood with an energy value of 17 600-20 500 kJ kg<sup>-1</sup>.

It produces a heavy hardwood with a density of 760-940 kg/cu m. Heartwood absent or small; texture fine to medium and even. Shrinkage upon seasoning is moderate to high, and the wood is difficult to season as it is liable to warping, splitting and surface checking. It is possible to

modify surface checking completely by soaking in solutions of 50% polyethylene glycol-600 for 1 day. The wood is hard, strong, and can be difficult to saw. When mixed with other woods can make good packing and writing paper.

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*Anogeissus latifolia*



*A. latifolia* tree



*A. latifolia* flower



*A. latifolia* bark



*A. latifolia* seeds



*A. latifolia* trunk

## Horti-pastoral system: An alternative to fodder security in arid and semi-arid regions

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The farming systems in rainfed areas are quite diverse with a variety of crops, cropping systems, agroforestry, horticulture and livestock production. Among the livestock, small ruminants are very important resources and contribute meat, milk, fiber and other functions that are significant to the productivity, stability and sustenance of many farming systems more so on dry lands. Livestock often constitute the main capital reserve of farming households, serving as a strategic reserve that reduces risk and adds stability to the overall farming system. For these reasons, livestock remain an integral part of most rural agricultural systems. The human population in India is expected to reach around 1.48 billion by 2025 with the shift in lifestyle and feeding habits towards milk products, meat products and eggs led to increase in demand of livestock. India supports about 20 per cent of the world's livestock population and 16.8 per cent human population on a land area of only 2.3 per cent. India is leader in cattle (16%) and buffalo (55%) population Kumar *et al.* (2012) and having world's second largest goat (20%) and fourth largest sheep (5%) population (Prajapati *et al.*, 2016). According to IGRFI Vision 2050, there is a net deficit of 61.1% green fodder, 21.9% dry crop residues and 64% feeds (Kumar *et al.*, 2018). India has recently emerged as

largest producer of milk (187.7 million tonnes) in the world but livestock productivity is very low as compared to the developed countries. Malnutrition or under nutrition due to large gap in demand and supply of feed and fodder in the country is the main reason for the low productivity of our livestock. But the critical challenge with us is to improve the livestock productivity with the existing fodder resources and feeding strategy by technological intervention including agroforestry potential by inducing the fruit trees based horti-pastoral systems. Hence, it is suggested to develop horti-pastoral systems/model by introducing pasture and foliage component under trees so as to provide nutritious green forage and foliage to livestock and small ruminants for getting higher production from unit of land in rainfed areas.

### Horti-pastoral system

Horti-pastoral system, where in the inter spaces between fruit trees species are utilized for cultivation of grasses, legumes and grass legume mixtures. Only during dormant season of the fruit tree, the livestock are allowed to graze on the available pasture for a period of 3-4 months in a year. Fruit trees are suitable for arid and semi-arid region given below with nutritive value (El-Siddiq *et al.*, 2006;

Pareek, 1983; Saha *et al.*, 1998; Swami *et al.*, 2012; Wood *et al.*, 2000).

**Mulberry (*Morus alba*)** is reported to be a good quality leaf fodder and can be profitably utilized as a supplement to poor quality roughages. It coppices and pollards very well. It can withstand light frost. It is susceptible to browsing damage. Leaf yield varies with fertility of the soil, irrigation and frequency of plucking of the leaves. The leaves contain crude protein, crude fiber, N-free extract, ether extract, total carbohydrates, total ash, calcium and phosphorus. The tannin accounts for 0.80 per cent.

**Lasoda (*Cordi adichotoma*)** is another fruit tree of which leaves yield good fodder and are lopped for this purpose. It coppices and pollards well. Young plants are susceptible to browsing damage and fire, but they exhibit good power of recovery from such injuries. The leaves contain crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus. The tannin is about 0.84% in the leaves.

**Bael (*Aegle marmelos*)** is a good fodder tree. It has shallow root system, coppices well and produces root suckers in abundance. It is resistant to drought and can grow in dry localities. The leaves contain crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus. Tannin content of leaves is 1.21 percent.

**Jackfruit (*Artocarpus heterophyllus*)** seedlings and saplings are readily browsed by cattle and tree coppices well. Leaves are lopped for fodder in Kerala, Maharashtra, Odisha and West Bengal. Ripe fruits can also be fed to cattle. Elephants also eat the bark besides leaves and fruits. Young plants are very badly browsed by deer and domestic cattle. The

chemical composition of leaves varies with the locality and the season of lopping. They contain crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus. Crude protein content decreases as the leaves mature. October lopped leaves have higher crude protein than November lopped ones.

**Gular (*Ficus glomerata* Roxb./ *F. recimosa* Linn.)** coppices well with slow growth rate and its leaf is generally rated as good fodder. The seedlings and saplings are easily browsed by cattle. It is extensively lopped for fodder in Assam, West Bengal, Madhya Pradesh, Maharashtra, Odisha, Punjab and Uttar Pradesh. The leaves contain crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus. The tannin accounts for 0.76% in dry leaves.

**Mahua (*Madhuca longifolia*)** seedlings and saplings are readily browsed by cattle and wild animals. The tree coppices well if felled in the hot season. The tree is lopped for leaf fodder in Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh. In Maharashtra, it is lopped only in times of scarcity. Its flower and fruits can also be fed to cattle. The leaves contain crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus on dry matter basis.

**Mango (*Mangifera indica*)** is shade bearer and unable to withstand severe frost or drought. It grows well in moist warm climate. The mango tree is lopped for fodder during fodder scarcity. The chemical analysis of leaves resulted that it has crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus.

**Khirni (*Manilkara hexandra*)** is a light demander and seedlings and saplings suppressed under heavy shade. The



seedlings and saplings are susceptible to browsing. It pollards but shows poor coppicing power. It is reported to be lopped to feed buffaloes in Maharashtra. The leaves contain crude protein, crude fiber, N-free extract, ether extract, total ash, calcium and phosphorus.

**Jamun** (*Syzygiumcumini*) has good coppicing power and a large numbers of shoots arise along the cut stump. Even large stumps produce coppice shoots. The leaves are lopped for fodder and the nutritive value of the leaves differ according to the locality. The leaves contain crude protein, crude fiber, total ash, calcium, phosphorus, total minerals (5.31%), reducing sugar (2.40%), total sugar (6.89%) and starch (15.90%). The tannin in the leaves constitute about 7.57 percent.

**Ber** (*Zizyphus spp.*) leaves are considered to be a good fodder for cattle and goats and in some part of Rajasthan it forms almost the sole green fodder available to the animals. The tree has remarkable power of recovery from injury by frost, fire or grazing. The tree coppices and suckers well. The leaves of *Zizyphusnummularia* contain crude protein, crude fiber, N free extract, ether extract, total ash, calcium and phosphorus whereas analysis of *Zizyphusmauritanaleaves* resulted crude protein 15.37%, crude fiber 15.76%, total minerals 6.66%, reducing sugar 1.87%, total sugars 7.57%, starch 16.84% and tannin 1.79% in dry matter of leaves.

**Imli** (*Tamarindusindica*) leaves are regarded as good fodder and the chemical composition of leaves varies with the locality and season of lopping. The tender leaves of imli contains moisture 70.50% and crude protein 13.14%, fat 2.10%, crude fiber 17.70%, N-free extract

52.40%, ether extract 7.00%, total ash 9.50%, other carbohydrates 18.20% and minerals 1.50%. The other constituents are calcium 101, magnesium 71, phosphorus 140, iron 5.2, copper 2.09, chlorine 94, sulphur 63, thiamine 0.24, riboflavin 0.17, niacin 4.1, and vitamin C 3.0 mg/100gm.

### Grasses and Shrubs

Suitable species of grasses and shrubs for arid and semi-arid region are given below:

**Arid desert and sand dunes:** It occupies about 30 million ha area under arid zone of the *Thar* desert is sandy plains, sandy hummocks and sanddunes. The major problems of the desert are stabilization and utilization of shifting sand dunes, increasing fuel wood resources and development of livestock industry.

### Suitable species

Grasses: *Lasiurussindicus*,  
*cenchrusciliaris*, *cenchrussetigerus*.

Legumes: *Atylosiascarabaeoides*,  
*clitoriaternatia*, *Lablabpurpureus*.

### Ravine lands

In India, there are about 4.0 million ha area of ravine lands, a major of which is confined to Uttar Pradesh, Madhya Pradesh, Rajasthan and Gujarat. These lands are below their economic utilization.

### Suitable species

Grasses: *Cenchrusciliaris*, *C.*  
*setigerus*, *Pennisetumpedicelatum*,  
*Chrysopogonfulvus*.

Legumes: *Stylosanthes humilis*, *S.gravilis*,  
*Atylosiascarabaeoides*,  
*Macroptiliumatropurpureum*,  
*Alysicarpusmonilifer*,  
*Stizolobiumdeeringeanum*.

### Semi-arid, rocky and gravelly areas

A vast area of the country comes under semi-arid zones, where lot of area is rocky and gravelly.



**Suitable species**

Grasses: *Lasiurus indicus*,  
*Centrosema viride*, *Centrosema*

Legumes: *Atylosia scarabaeoides*,  
*Stylosanthes hamata*, *Stylosanthes humilis*,  
*Macroptilium atropurpureum*,  
*Macroptilium lathyroides*, *Lablab*  
*purpureus*

**Salt affected lands**

These are about 8.0 million ha of area affected by saline and alkali soils in the country.

**Suitable species**

Grasses: *Cynodactylon*, *C. plectostachyon*, *Paspalum notatum*, *P. dilatatum*, *Chloris gayana*,  
*Brachiaria mutica*, *Sporobolus marginatus*,  
*Urochloa mosambicensis*.

Legumes: *Glycine javanica*, *Macroptilium*  
*spp.*, *Stylosanthes humilis*,  
*Phaeolus lunatus*, *Lotononis bainesii*

**Conclusion**

Importance of forage production in maintaining food security as well as nutritional

security has been felt since long. The overall scene of forage production is very alarming

and corrective measures have to be taken to improve this problem. Suitable and appropriate site specific Agroforestry system (Horti-pastoral) is to be developed. Farmers are to be motivated in bringing more area wasteland under horti-pastoral system. Research organization and fruit based industries are to be directly linked with the farmers. Fruit trees are generally considered to be nutrition garden for human but timely view on its potentiality as a fodder resource obviously will be treated as an intelligent choice and judicious agro-managerial option for the future.

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## Sandalwood: A Promising Economical Tree of India

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### Abstract

Sandalwood tree (*Santalum album*) and its wood is a part of Indian tradition and known to have medicinal as well as cosmetic usage besides there environmental and ecological benefits. This tree is great important due to its economic, social and cultural values towardshuman welfare. The present article describes the economical as well as various ecological aspects of sandalwood.Sandalwood when cultivated promisingly it may good fortune to cultivator as it has wide scope and market globally. Sandal tree also look attentively at sacred.Sandalwood already usedin differentoccasion that include birth and even cremation ceremonies.The best quality of sandalwood is attaining from an Indian variety (*Santalum album*).Sandalwood istop rated species among the fragrant woods. Its timber is heavy, creamy yellowish and small particles, butdifferent from a large number of another fragrant tree, it retains its aroma to prolonged time that may last more than decades.Oil of sandalwood is much valuable and can obtain by steam distillation of heartwood.Essential oil of sandal is used in various industries(perfume, herbal medicine, cosmetic, etc.).It has wide economic value and the grower can increase his economic gain when proper scientific management implication and farming practices are applied.

**Keywords:** Essential oil, Sandalwood, Livelihood

### Introduction

“Sandal” is derived from Sanskrit word “Chandana”. Its wood and oil a used as medicines in India from ancient times.It has been said that the wood of sandal tree is fully utilize throughout the life of a person, in tradition of our country it is used throughout the life of a person i.e., from “Cradle to Cremation”. Sandalwood is a profit-oriented (economically) and ethnic vital tree species. Sandalwood plant semi parasitic tree is a member of Santalaceae family and its genus is *Santalum* (Bishtet al., 2019).

Oil of sandalwood is obtainedfromheartwood.Heartwood powder is also fetches good economic gain. Colour of essential oil is (pale yellow-yellow gelatinous liquid) having likeable, scent, pungent, lukewarm, arboraceous, animalise, lacteous, and eccentric note. Sandalwood oil is used in variousindustries like medicine,scent and perfumery, spiritualrituals,and oil is also used in cultural goal over various time frames in India(KC, 2019).

Sandalwoodoil in India is widely utilized in the maquillage manufacturing industry.Mainly Arab and Asian regions,sandalwood powder and its wood is used for, spirituals, cultural andmedicinal goals (KC, 2019).The reason behind economical and beneficial assessment of essential oil holds by the

timber of sandalwood, for the most part in the heartwood. Oil content in heartwood varies as per species, growing habitat, age, climatic scenario, and growing environment, etc. Indian sandalwood is eminent for its oil, having various properties (sweetness, scent, likeable, fixative property, etc.) which is in the great demand and makes it valuable as well as high economic and promising species. Sandal oil reported to have nearly 90% of santalol and alpha ( $\alpha$ ) santalol (Lefort *et al.*, 2017). Overall oil

content in heartwood in all the girth classes ranged between 1.0 to 4.0% (Mishra *et al.*, 2018). Sandal tree and its wood is a part of Indian tradition and is known to have medicinal as well as cosmetic usage, which can be used economically for welfare of human being.

**Sandalwood worldwide distribution**

There are around 18 sandalwood species belonging to the genus *Santalum* which are presented in the Table 1 (Vieillard, 1861; Little and Skolmen, 1989; Lani, 1990; Cheng *et al.*, 2017; Ken, 2020).

**Table 1: Sandalwood distribution across the globe**

Species	Location/Region	Remarks
<i>S. freycinetianum</i>	Hawaiian	Hard, yellowish-brown wood Included as endangered spp (red list of IUCN)
<i>S. haleakalae</i>	Islands of Hawaii	Included as “Vulnerable” (red list of IUCN). A shampoo made from a leaf infusion. Edible seed.
<i>S. ellipticum</i>	Hawaiian	Listed as endemic spp in Hawaiian (coastal sandalwood)
<i>S. peniculatum</i>	Hawaiian Islands, Pacific	Contain top quality essential oil gained from the heartwood.
<i>S. pyrularium</i>	Hawaii	In wet forest island of Kauai listed as endemic spp.
<i>S. involutum</i>	U.S. States and Canadian Provinces	Extremely rare and has variable floral variation
<i>S. boninese</i>	Ogasawara–shoto	Listed as both endangered and endemic.
<i>S. insulare</i>	Cook island, Pitcairn island	Low quality and economic value of its oil. Species possess short leave.
<i>S. austrocaledonicum</i>	Islands of new Caledonia	Gray bark and green leaves. Average height about 5-12m flowering occurs after 6-7 years.
<i>S. yasi</i>	Pacific – Niue, Tonga and Fiji	This is fast growing tree. Growing slightly warm to hot lowland region.
<i>S. macgregorii</i>	Indonesia and Papua new guinea	This species is threatened by its habitat losses.
<i>S. accuminatum</i>	Central desert and southern areas of Australia	The species, especially its edible fruit
<i>S. murrayanum</i>	Australia	Plant known as Ming and

		hermaphrodite in nature. Its fruits are bitter in taste.
<i>S. obtusifolium</i>	Eastern Australia	It may grow 2.5 m high, is a shrub known as the blunt sandalwood
<i>S. lanceolatum</i>	Northern Australia	It is known as true sandalwood, height of this plant varies 1-7 meter
<i>S. fernandezianum</i>	Juan Fernandez islands	Known as Chile sandalwood and have good aromatic wood
<i>S. salicifolium</i>	U.S. States And Canadian Provenance	This species woody and flowering plant.
<i>S. spicatum</i>	Australia	Essential oil uses for aroma therapy and manufacturing of perfume, and chewing tobacco industry.

### Botanical description

The generic name is derived from the Greek 'santalum' meaning 'sandalwood', and the species name from the Latin 'albus' meaning 'white', in allusion to the bark (George and Hewson, 1984). Sandalwood is a small evergreen tree and starts flowering generally at an early age of 2-3 years. Trees flower twice in a year from March-May, and

September-December. Sometimes the two flushes of flower production may overlap each other so knowing the species distribution and natural habitat morphology and phenology that the same tree may show all stages of development of flower initiation to mature fruits at one time (Teixeira *et al.*, 2016). The attributes of Indian sandalwood is given in Table 2.

**Table 2: Indian sandalwood tree attributes (Source: Warriar *et al.*, 1996)**

Characteristics	Remark
Height	Up to 18-20 meter
Girth (meter)	Up to 2.0-2.4 m
Leaves	elliptical, 3-8 x 3-5 cm
Flowers	purplish-brown, about 4-6 mm long
Flowering	March to April in India
Fruit	Fleshy drupe; red, about 1-5 cm in diameter
Desirable/Quality seed production	After five years
Fruiting time / Fruit maturity	March to April And June to September.
Seed dispersal	By birds (Frugivory)



### Ecological description

Sandalwood is indigenous to the tropical belt of the Indian peninsula, eastern Indonesia and northern Australia. There is still debate as to whether Sandalwood is endemic to Australia or was introduced by fishermen or birds from eastern Indonesia centuries ago. The main distribution is in the drier tropical regions of India and the Indonesian islands of Timor and Sumba. The principal sandal tracts are most parts of Karnataka and adjoining districts of Maharashtra, Tamil Nadu and Andhra Pradesh in India. *S. album* is found in dry deciduous and scrub forests in the above mentioned region. Sandalwood is also reported to grow on coastal sand dunes immediately above the normal high water mark and close to the mangroves. It also grows on low lateritic cliffs above the beach. The sandalwood shows diverse eco-environmental requirements for its growth, development, distribution and adaptation in varying eco-habitat (Table 3).

Some of the sandalwood ecology and population studies were conducted on regional and broader sense or basis. The study of Sinha (1991) on sandalwood in Bundelkhand Forest Division, Uttar Pradesh of India, *S. album* profile study

conducted in Pondicherry region of India. Balachandran and Kichenamourthy (2007) worked the dendrological research on *S. paniculatum* in the dry Montane forests of Mauna Loa of Hawaii Island conducted by Senock (2012), and sandalwood resources and its management in East Nusa Tenggara, Timor Province of Indonesia by Septiani (2012). A large extent of ecological research of sandalwood species have been conducted in more broader manner, e.g., distribution and ecology of *S. insulare* by Butaud (2004); distribution and status of sandalwood in Hawaii by Stemmermann (1990).

It is a partial parasite that attaches to the roots of other trees; it needs 'nurse' species in the area of planting out. Host plants that fix nitrogen and provide light shade are preferred. *Senna siamea* is good for this, and a most probable natural host is *Drypetes lasiogyne*, observed to be the most prolific species in the vicinity of Sandalwood. It does not tolerate frost or water logging, but is drought-hardy and is a light demander in sapling and later stages. Prolonged drought and fire kill trees (Balachandran and Kichenamourthy, 2007).

**Table 3: Eco-environmental requirement or description of Indian sandalwood (Source: Balachandran and Kichenamourthy, 2007)**

Description	Remark
Range of altitude	600 -1200 mean
Temperature(annually)	2-38 <sup>0</sup> C
Rainfall (annually)	400-3000 millimetre
Types of soil	Sandy or Rocky Red Soil Zones
pH value	6-6.5
Sandalwood not found in	Black soil

### Production of sandalwood

Global production of sandalwood is about 4,000 tonnes. Officially, India produces

about 400 tonnes (2000-2007). Australia produces about 1,800 tonnes of the Australian variety; about 350 tonnes comes from Timor, Malaysia, Cambodia, Vietnam, Thailand and Myanmar India, Indonesia major exporters; China and Taiwan are the largest consumers of sandalwood (Figure 1). USA and France are the largest importers of sandalwood oil. The first commercial harvest of *S. album* from Australian plantations in 2014 was estimated about 400 tonnes. Countries like Australia are encouraging companies who enters into the plantation crops by extending huge rebates from income tax in the context of investment made towards the maintenance of eco-balance. Such kind of rebates should be given by Indian government also to encourage the sandalwood plantations in India. However, our government encourages the farmers for cultivation of the *S. album*. Department of AYUSH has announced subsidy up to 75% to the growers of *S. album* plantations in states like Maharashtra and Gujarat. Many farmers have taken up the plantations of sandalwood tree in states like Gujarat, Maharashtra, Karnataka and Kerala. In 2010, cricketer Adam Craig Gilchrist owned the TSF Company of Australia. The TSF Company grows Indian sandalwood in 10,500 hectare land which is world's largest Indian sandalwood plantation. He is now Brand ambassador of that company. He earned moreover 17 crores of rupees in 6 months (DivyaBhaskar-Gujarat newspaper dtd. 19.09.2016) several countries such as China, Australia, Thailand, Costarica, Cambodia, and Srilanka are also venturing into *S. album*

plantation because of its fragrance characteristics and high demand for natural products. Jain *et al.* (2003) reported that heartwood of *S. album* was priced ₹12 lakhs per tonne and oil was priced at ₹22,000 per kg. However, the prices are highly depended on the quality and its marketing.

According to Ananthapathmanabha (2012), *S. album* x *S. yasi* hybrid called F1 shows a more vigour and an average of 7% oil which is not able to occur obtain from the parent trees. McComb and Jones (1998) attempted to form a hybrid using *S. album* and *S. spicatum* using in vitro culture method (Zhang *et al.*, 2016). A trial established in Hawaiian ethno botanical garden of Honolulu in 1959 in hybridisation of *S. freycinetianum* and *S. album* is still present. However, there is a debate on the quality of the oil produced by those hybrids and further; there is a fear among the top level sandalwood merchants in entering low quality sandalwood oils by the hybrid species to the market. Biotechnological approaches were also attempted to propagate *S. album* in mass scale by many scientists. Subbaet *al.* (2018) conducted detailed studies on that aspect in India. Sandalwood trees are considered to be growing very slowly; it takes 8 to 10 years for Heartwood formation. The growth rate of sandalwood tree will be 1cm girth per year in forest conditions while the growth rate is 4cm to 5cm girth per year under favourable moisture and soil conditions along with good farming practices. Table 4 revealed sandal tree age, girth and yield at different growth phase.

Figure1: Global scenario of sandalwood production (tonne/year) (Source: Wiersema and Leon, 2013)

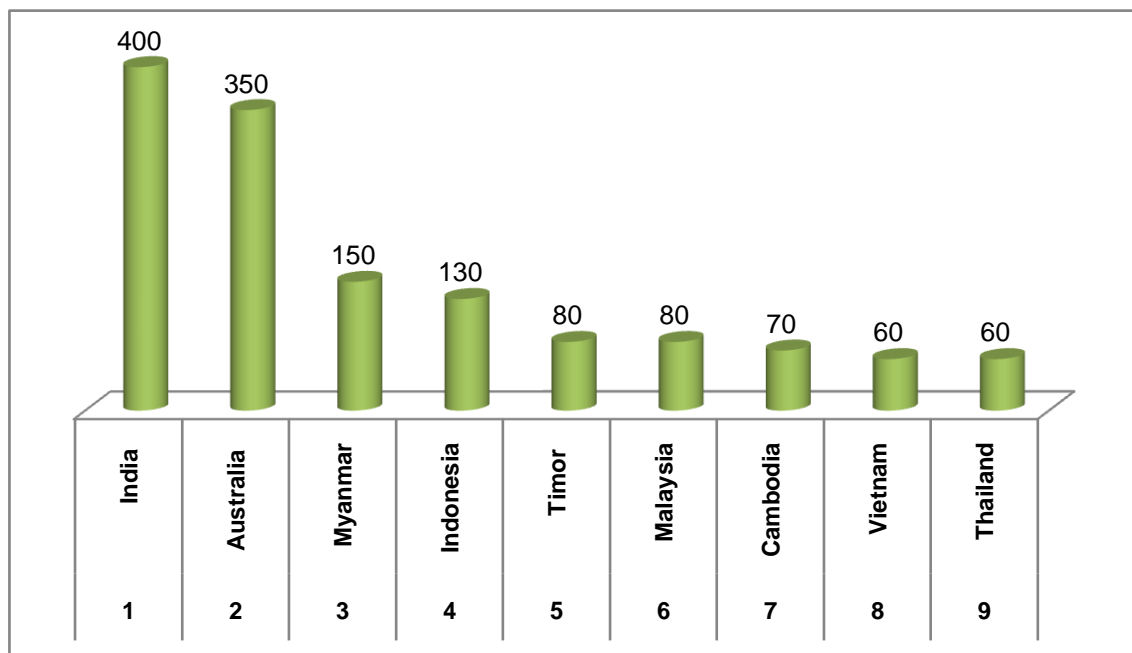


Table 4: Sandalwood growth attributes in different age-series with associated economics (Source: Reddy, 2018)

Tree Age (in years)	Girth (at breast height in cm)	Heartwood Yield (in kg)	Income-Expenditure	
10	10 – 12	1	<b>Particulars</b>	<b>Cost (₹/ Acre)</b>
20	20 – 22	4	Total income	3,44,40,000/-
30	30 – 33	10	Total cost	7,60,000/-
40	40 – 44	20	<b>Total Profit</b>	<b>3,36,80,000/-</b>
50	50 – 55	30		

**Major sandalwood oil market distributor and manufacturer**

The major sandalwood oil market distributor and manufacturer are Quintis (TFS Corporation)(Australia), Santanol Group (Australia), RK-Essential Oils Company (India), Meena Perfumery (India), Naresh International (India), Essentially Australia (Australia), Katyani Exports (India), KS&DL (Karnataka Soaps & Detergents Limited)(India), Sandalwood Forest (Qingyuan) (China), Jiangxi Jishui

Natural Essential oil Factory (China), JinagxiXuesong (China).

**Sandalwood: A promising economical tree in India for human welfare**

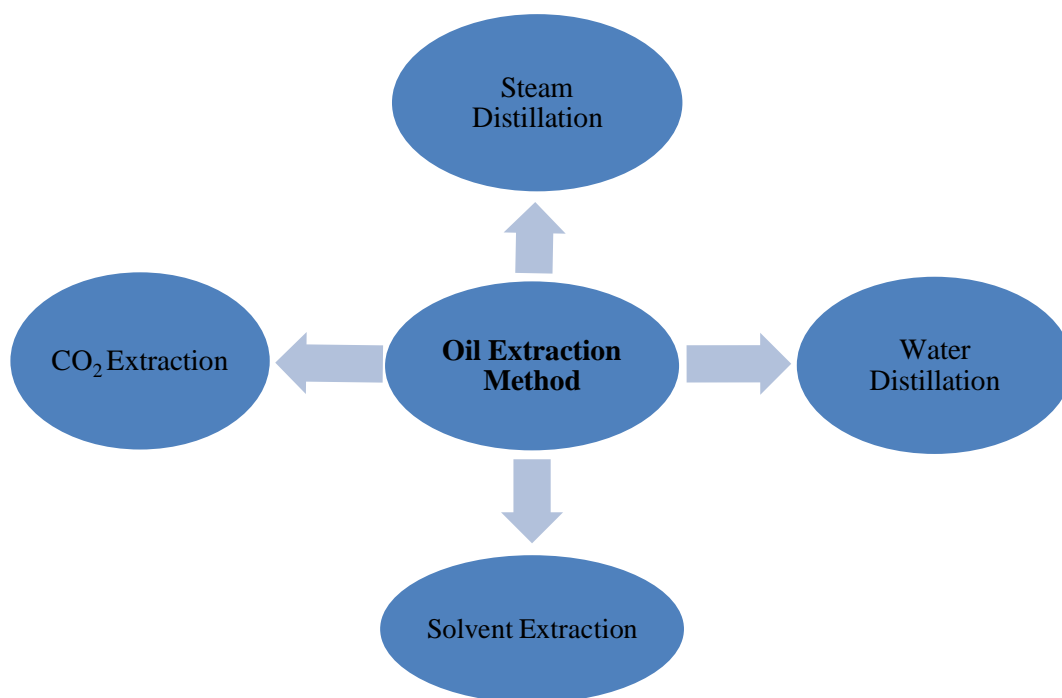
Sandal tree and its wood is a part of Indian tradition and are known to have medicinal as well as cosmetic usage that can be used economically for welfare of human being. Sandalwood tree when cultivated promises a very good fortune to the cultivator as it has wide scope and market in India and Abroad. Jain *et al.*(2003)

noted that the market price of one tonne heartwood is ₹12.00 lacks in Indian market, its one kg of essential oil market price at twenty two thousand. Sandalwood timber and its essential oil market price are extremely determined by the quality. These studies pay particular attention to production of sandalwood essential oil with its good life span.

#### Sandalwood oil extraction methods

Oil extraction of sandalwood is done by the process of distillation. Various processes by which oil can be extracted are presented in Figure 2. Steam Distillation is a most widely adopted method. Extraction of sandalwood oil takes place in four steps

boiling, steaming, condensation and separation. Boiling water at (140-212<sup>0</sup>F) is passed through the wood. The oil which is tightly bound to the cellular structure of the wood then comes in contact with the high temperature steam. The oil gets volatile and then is condensed and collected. The process takes about 14 to 36 hours to complete, and produces high quality oil. In older days traditional method of sandalwood oil extraction where used called hydro distillation in which the wood was soaked in water and boil till the oil got released. This method is not used now a day due to its high amount of fuel and long duration.



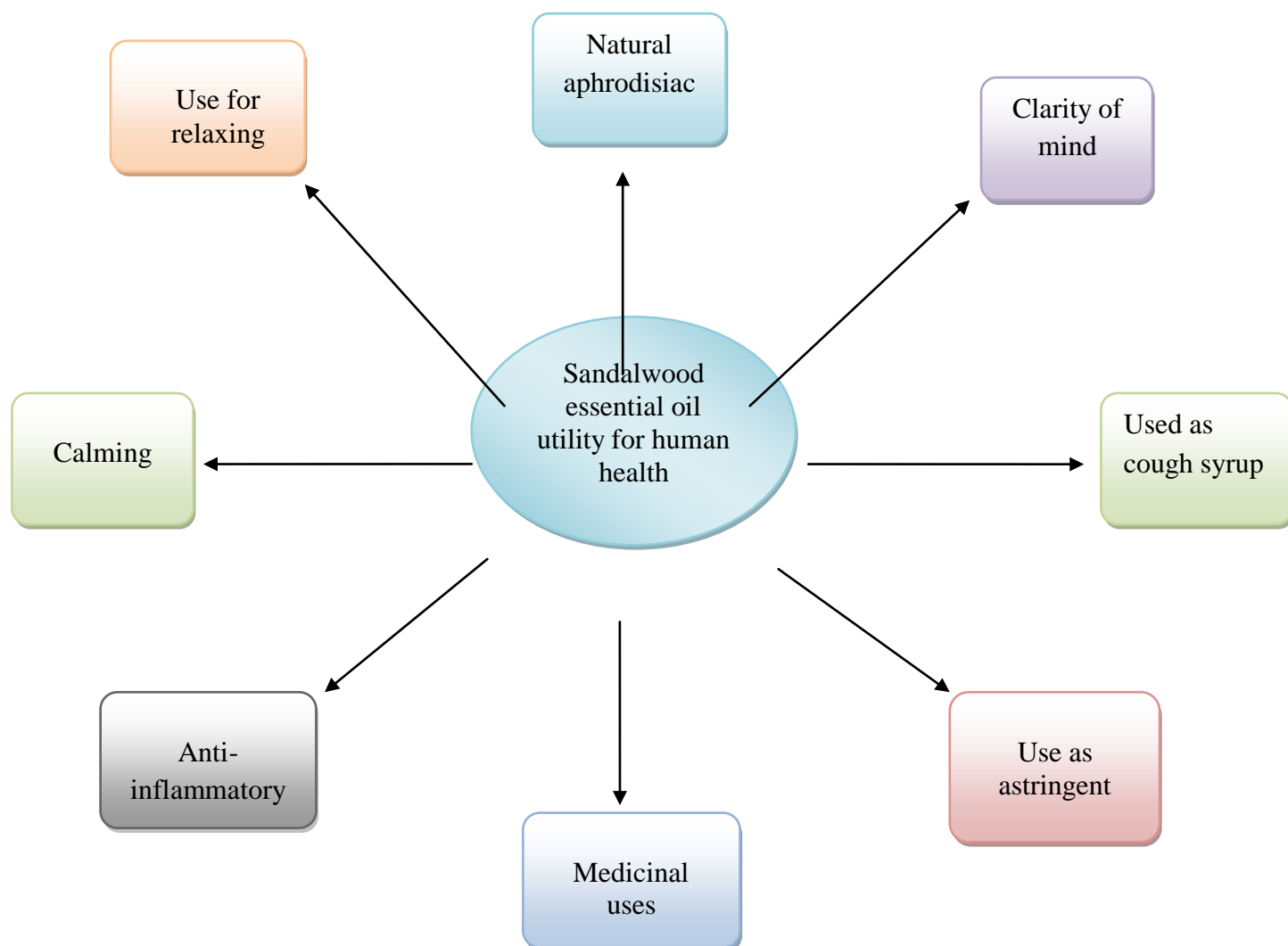
**Figure 2: Schematic diagram of sandalwood oil extraction process**

#### Utility of sandalwood oil for human health

Sandalwood oil is very beneficial for the health of human besides providing economic benefits to the growers, because

it has medicinal properties. Sandalwood oil is helpful in relieving symptoms of various diseases as described below in Figure 3.





**Figure 3: Sandalwood oil utilization in human health**

#### Uses of sandalwood essential oil in various industries

Sandalwood oil along with different flower extract like rose oil, jasmine, kewda, lavender, etc, creates attar. Attar is been used and manufactured in India for centuries, the quality of attar depends upon the concentration and volume of sandalwood oil and the effervescence that flower essence creates with sandalwood oil. Sandalwood oil having a strong aroma is used in various mouth fresheners and Pan Masala to add a distinct flavour to a

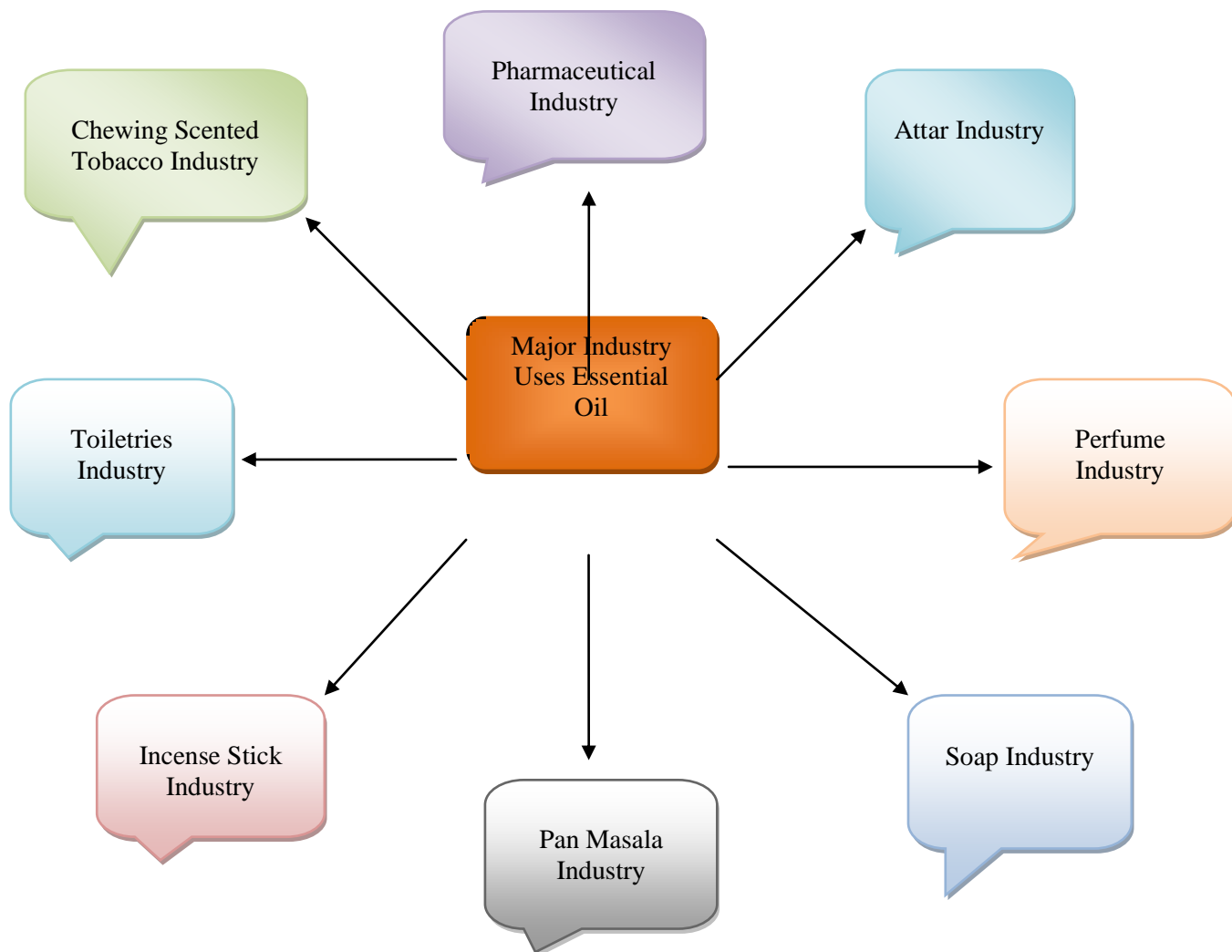
chewable product commonly known as Gutka. It is also used in preparation of incense sticks.

Sandalwood oil is natural top class fixative that knows good perfume can lack in its composition. The East Indian sandalwood is claimed to be one of the best sandalwood oil and is demand at highly by perfumery industry. It gets easily blend into all composition and thus used widely in soap industry.

Now a day's Indian sandalwood oil uses has declined due to the subsidence

faced by Eruption perfumery houses as the availability of Indian sandalwood oil is quite low and limiting, this shows the high demand of sandalwood oil in perfumery industry in and abroad, thus the commercial cultivation of sandalwood will not only be a great economic deal but will

also help to conserve various species of sandalwood as it is at the verge of extinction and is notified in the green book. Due to aroma and medicinal properties of sandalwood oil is used in many industries (Figure 4).



**Figure 4: Utilization of essential oil in different industries**

**Scope and opportunity for cultivation of sandalwood**

- The scope of sandalwood cultivation is a promising fortune.
- High demand and low supply creates sandalwood cultivation a good business.

- Govt. of India encourages sandalwood cultivation by extending the subsidy through National Medicinal Plant Board and National Horticultural Mission for the growers along with other horticultural plants.

- Generates green cover, reduces ecological impact, conserves, *S. album* species from the verge of extinction.
- This would also facilitate the poverty alleviation, rural employment and economic empowerment of the growers.

### Conclusion

The cultivation of sandal tree has wide scope from social, economical and environmental point of view. The benefits to cost ratio is quite high that indicates market feasibility and promises good fortune for the cultivators. With proper knowledge and correct marketing sandalwood cultivation can serve as a prominent source of income. The supply of sandalwood and its by product is very low with respect to the demand of the same. Looking at the current scenario any one can clearly observe the opportunities in sandalwood cultivation.

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## *Pongamia pinnata* (Karanja) tree

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The nature has bestowed our country India with the wealth of flora. Although, there exist so much diversity, from north to south and even from east to west but each and every species infolds the huge and greatest importance for livelihood and natural ecosystem management. The present study describes about one of such species *Pongamia pinnata* (Karanja) which is not only the source of valuable medicine, various carpentry items and wood furnitures, tannin but also a popular source of biodiesel after *Jatropha curcas*. Also, well known species for areas affected by changing climatic conditions like drought, waterlogging and slight saline affected areas.

### **Introduction**

The Karanja tree species belongs to the very famous Pea family (Fabaceae) is one of the richest and brightest tree of India. It is a fast-growing, medium-sized, evergreen or briefly deciduous and glabrous tree species, widely distributed in the Indian subcontinent, south-east Asia, Fiji, Myanmar, northern Australia, the East-African coast, southern China and the Seychelles Islands. In India, this tree is distributed throughout the country except for temperate regions and is considered to be native to Western Ghats.

Karanja is famous for infolding multipurpose qualities. The species is valued for oil, dyestuff, wood, fuel, insect repellent, medicines and various other

commodities. It is a good nitrogen-fixing tree species with a dense network of lateral roots which helps in controlling soil erosion and binding sand dunes. The tree is often planted in the homes as an ornamental tree, roadsides, along the stream and canal banks and in the areas suffering from problems like salinity, waterlogged, cold, drought, frost, heat, limestone, sand and shade.

### **Products**

All parts of *Pongamia pinnata* are used to produce the variety of products.

### **Medicine**

Different parts of the plant have been used as a medicine against various diseases and disorders. The leaves are used to cure cold, cough, diarrhoea, dyspepsia, gonorrhoea, piles, wounds and other inflammations. Flowers are prescribed for glycosuria and a remedy for diabetes. The bark is used internally for bleeding piles, beriberi and diabetes and as an antimicrobial medicine. The seeds are used as a tonic and in bronchitis, whooping cough, itches and other skin diseases. Roots are utilized for cleaning gums, teeth and ulcers.

### **Timber**

The wood is used for cabinet making, cartwheels, posts, agricultural implements, tool handles and combs. The ash generated from burning wood is used for dyeing.

### **Fodder**

The leaves are used as fodder for cattle especially readily consumed by goats



whereas de-oiled cakes are used as poultry and also as cattle feed.

#### **Fuel**

Karanja is commonly used as a fuel-wood. The seed oil is used as fuel for cooking and seed cake used for biogas production.

#### **Fibre**

The bark fibre is used for making string, twine or rope, and the wood provides paper pulp.

#### **Tannin or dyestuff**

Roots yield a natural pigment, pinnatin which is used as tannin. The wood ash is also employed in dyeing. The seed oil is often utilized for leather dressing in tanning industries.

#### **Apiculture**

Flowers are considered a good source of pollen for honeybees in India and they yield adequate nectar.

#### **Oil**

The nonedible, bitter in taste and offensive in smell seed oil is used for lamp fuel and production of biodiesel. Furthermore, it is also used as a lubricant, water-paint binder, in leather dressing, soap-making, candles, and tanning industries. Crude Karanja oil (CKO) is used in making body oils, salves, lotions, hair tonics, shampoos, and pesticides.

#### **Poison**

The press-cake is used as a pesticide, especially against nematodes while dried leaves are stored with grain to repel insects. The pounded and roasted seeds are utilized as fish poison.

#### **Services**

This species provide variety of services which contributes in the management of natural environment, have been discussed below-

#### **Nitrogen fixing**

The atmospheric nitrogen is naturally fixed in the roots of Karanja like Pea species which helps in maintaining the growth and development of species and also the soil fertility.

#### **Soil improver**

Incorporation of leaves, flowers and the press-cake into soils improves fertility and also used by villagers on slopy uplands to bind the soil.

#### **Erosion control**

Karanja is a preferred species for controlled soil erosion and binding sand dunes because of its extensive network of lateral roots.

#### **Reclamation**

Karanja trees have been used for soil reclamation in the degraded or moderate salinity soil areas, around coal mines and reforestation of marginal land.

#### **Biodiesel**

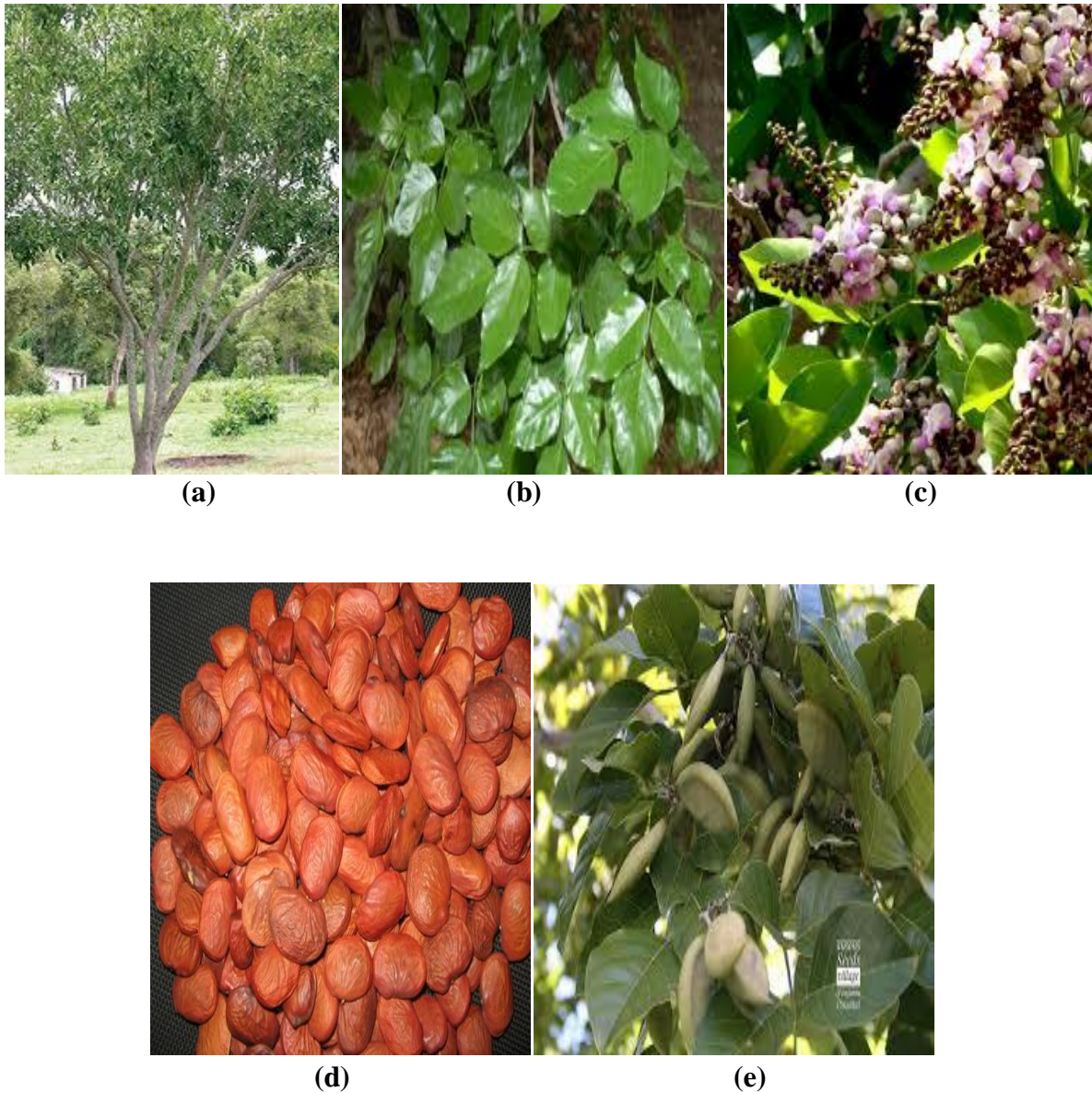
The seeds of *Pongamia pinnata* is a source of nonedible vegetable oil and used as an alternative liquid fuel against diesel and kerosene.

#### **Shade or shelter**

The tree is commonly planted for shade in pastures.

#### **Ornamental**

Karanja is often planted in homes as an ornamental tree and along roadsides, stream and canal banks.



**Figure 1:** *Pongamia pinnata* (a) Tree (b) Leaves (c) Flowers (d) Seeds with cover (e) Mature seeds after removal of cover

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## वेद एवं वृक्ष

राजेश कुमार मिश्रा

उष्णकटिबंधीय वन अनुसंधान संस्थान

(भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार)

जबलपुर

भारतीय संस्कृति वृक्ष-पूजक संस्कृति है। वृक्षों में देवत्व की अवधारणा और उसकी पूजा की परम्परा हमारे देश में प्राचीन काल से रही है। भारतीय संस्कृति वृक्ष-पूजक संस्कृति है। वृक्षों में देवत्व की अवधारणा और उसकी पूजा की परम्परा हमारे देश में प्राचीन काल से रही है। वृक्षों की पूजा प्रकृति के प्रति आदर प्रकट करने का सरल माध्यम है, वृक्षों के प्रति केसा प्रेम शायद ही किसी देश की संस्कृति में हो जहां वृक्ष को मनुष्य से भी ऊंचा स्थान दिया गया है।

वैदिक काल में प्रकृति के आराधक भारतीय ऋषि भी अपने अनुष्ठानों में वनस्पति पूजा को विशेष महत्व देते थे। वेदों और आरण्यक ग्रंथों में प्रकृति की महिमा का सर्वाधिक गुणगान है। इस काल में वृक्षों को लोक देवता की मान्यता दी गयी थी। वृक्षों में देवत्व की अवधारणा का उल्लेख वेदों के अतिरिक्त प्रमुख रूप से मत्स्यपुराण, अग्निपुराण, भविष्यपुराण, नारदपुराण, रामायण, भगवद्गीता और शतपथ ब्राह्मण आदि ग्रंथों में मिलता है। मोटे रूप में देखे तो वेद, पुराण, संस्कृत और सूफी साहित्य, आगम, पंचतंत्र, जातक कथायें, कुरान, बाइबिल, गुरुग्रंथ साहब हो या अन्य कोई धार्मिक ग्रंथ हो सभी में वृक्षों में लोक मंगलकारी स्वरूप का परिचय मिलता है।

दुनिया में सभी प्राचीन सभ्यताओं का आधार मनुष्य का प्रकृति के प्रति प्रेम और आदर का रिश्ता है। इसी कारण पेड़, पहाड़, नदी और मनुष्येत्तर प्राणियों की पूजा की परम्परा का प्रचलन हुआ। मोहनजोदड़ों और हड़प्पा की खुदाई से मिले अवशेषों से पता चलता है कि उस समय समाज में मूर्ति पूजा के साथ ही पेड़-पौधों एवं जीव जन्तुओं की पूजा की परम्परा भी थी। भारतीय प्राचीन साहित्यिक ग्रंथों में चित्रकला, वास्तुकला और वृक्ष पूजा के अनेक प्रसंग मिलते हैं। अंजता के गुफा, चित्रों और सांची के तोरण स्तंभों की विभिन्न आकृतियों में वृक्ष-पूजा के अनेक प्रसंग मिलते हैं। अंजता के गुफा चित्रों और सांची में तोरण स्तंभों की विभिन्न आकृतियों में वृक्ष-पूजा के दृश्य हैं। जैन और बौद्ध साहित्य में वृक्ष-पूजा का विशेष स्थान रहा है।

हमारे सबसे प्राचीन ग्रंथ वेद में प्रकृतिकी परमात्मा स्वरूप में स्तुति है। इसके बाद वाल्मिकी रामायण, महाभारत, मनुस्मृति और नारद संहिता में वृक्ष-पूजा की विविध विधियों का विस्तार से वर्णन है। सभी धार्मिक आयोजनों एवं पूजा पाठ में पंच पल्लव (पीपल, गुलर, पलाश, आम और वट वृक्ष के पत्ते)की उपस्थिति अनिवार्य होती है। हमारे प्राचीन साहित्य में

जिन पवित्र और अलौकिक वृक्षों का उल्लेख है उनमें कल्पवृक्ष प्रमुख है। कल्पवृक्ष को देवताओं का वृक्ष कहा जाता है। पौराणिक ग्रंथ स्कंदपुराण में पांच पवित्र छायादार वृक्षों (पीपल, बेल, बरगद, आंवला व अशोक) के समुह को पंचवटी कहा गया है। हमारे सभी धर्मग्रंथ पेड़ पौधों के प्रति प्रेम और आदर का पाठ पढ़ाते हैं। भगवान बुद्ध के जीवन की सभी घटनायें वृक्षों की छाया में घटी थी। आपका बचपन साकवन में बीता, इसके बाद प्रथम समाधि जामुन वृक्ष की छाया में, बोधि प्राप्ति पीपल की छाया में और निर्वाण साल वृक्ष की छाया में हुआ। भगवान बुद्ध ने भ्रमणकाल में अनेकों वनोंबागों में प्रवास किया था इनमें वैशाली की आम्रपाली का ताम्रवन, पिपिला का सखादेव आम्रवन और नालंदा में पुखारीन आम्रवन के नाम उल्लेखनीय हैं। जैन धर्म में जैन शब्द जिन से बना है, इसका अर्थ है समस्त मानवीय वासनाओं पर विजय प्राप्त करने वाला। तीर्थ का शाब्दिक अर्थ है नदी पार करने का स्थान अर्थात् घाट। धर्म रूपी तीर्थ का जो प्रवर्तन करते हैं वे तीर्थकर कहलाते हैं। तपस्या के पश्चात् सभी तीर्थकरों को कैवल्य ज्ञान (विशुद्ध ज्ञान) की प्राप्ति किसी न किसी वृक्ष की छाया में हुई थी, इन वृक्षों को कैवलीवृक्ष कहा जाता है। सिख धर्म में वृक्षों का अत्याधिक महत्व है, देशभर में 48 गुरुद्वारों का नाम वृक्ष पर है। वृक्ष को देवता और धर्मस्थल के पास स्थित वृक्ष समूह को गुरु के बाग कहा जाता है। इनमें गुरु से जुड़े कुछ प्रमुख वृक्ष हैं - नानकममता का पीपल वृक्ष,

रीढा साहब का रीढा वृक्ष, टाली साख का शीशम, और बेर साहब का बेर का वृक्ष प्रमुख है। इसके साथ ही कुछ अन्य पूजनीय वृक्षों में दुख भंजनी बेरी, बाबा की बेरी और मेहताब सिंह की बेरी प्रमुख हैं। पृथ्वी पर पाये जाने वाले जिन पेड़-पौधों का नाम कुरान-मजीद में आया है, उन पेड़ों को मुस्लिम धर्मवावलंबी पूजनीय मानते हैं। इन पवित्र पेड़ों में खजूर, बेरी, पीलू, मेहंदी, जैतून, अनार, अंजीर, बबूल, अंगूर और तुलसी प्रमुख हैं। इनमें से कुछ पेड़ों के बारे में मोहम्मद साहब (रहमतुल्लाह अलैहे) ने वर्णन किया है, इस कारण इन पेड़-पौधों का महत्व और भी बढ़ जाता है। भारतीय संस्कृति की परम्परा वृक्षों के साथ सह-जीवन की रही है। पेड़ संस्कृति के वाहक हैं। प्रकृति और संस्कृति के साहचर्य से ही सभ्यता दीर्घजीवी होती है। इसलिए जंभोजी महाराज की सीख में कहा गया है सिर सारे रूख रहे तो सस्ते जाण, इसी म में धराड़ी और ओरण जैसी परम्पराओं ने जातीय चेतना को प्रकृति चेतना से आत्मसात कर वृक्ष पूजा और वृक्षा रक्षा से जीवन में सुख-समृद्धि और आनंद की कामना की है। आज इसी भावना को विस्तारित कर हम मानवता के भविष्य को सुरक्षित रख सकते हैं। भारतीय संस्कृति एवं परम्पराओं में पेड़ों को विशिष्ट महत्ता प्रदान की गई है। पेड़ हमारी संस्कृति के संरक्षक भी माने जाते हैं। हमारे साधु संतों और महात्माओं ने पेड़ों की छत्रछाया में ही साधना करते हुए ज्ञान प्राप्त किया था। भारत भूमि पर वृक्षों, वनों, पौधों और पत्तों को देवतुल्य



मानकर पूजा जाता रहा है। प्रत्येक माँगलिक अवसरों पर घरों के दरवाजों पर कनेर, आम तथा अशोक और केले के पत्तों से सजावट होती रही है। विशेष पर्वों और उत्सवों पर वृक्षों की पूजा अर्चना की जाती है। “ परम्परा से आशय उस परिपाटी से है जो निश्चित सांस्कृतिक मूल्यों के निर्वाह तथा उन्हें पीढ़ी दर पीढ़ी आगे से आगे हस्तांतरित करने के उद्देश्य से समाज में निश्चित अवसर पर निश्चित विधि से अपनाई जाती है।” हमारे प्राचीन धार्मिक ग्रन्थों और वेदों में भी उल्लेख है कि मानव शुद्ध वायु में श्वास ले, शुद्ध जलपान करे, शुद्ध अन्न फल, भोजन करे, शुद्ध मिट्टी में खेले कूदे व कृषि करें तब ही वेद प्रतिपादित उसकी आयु “ शतम् जीवेम् शरदः शतम्” हो सकती हैं। हिन्दु धर्म में तो कई देव मन्दिरों में पेड़ को भी देवता का प्रतीक माना जाता है। पीपल, तुलसी, वट वृक्षों की पूजा अर्चना पर्यावरण सुरक्षा का ही परिचायक हैं। हमारे धर्मशास्त्रों में महामनीषियों ने वापी, पाली और जलाशय बनाकर वहाँ वृक्षारोपण करना किसी यज्ञ के पूण्य से कम नहीं माना है। ऋषि आश्रमों में यज्ञ हवन आदि में समिधा का प्रयोग होता है वह भी वृक्षों की देन है। जिसे पवित्र मानकर उपयोग किया जाता है। वृक्ष एक ओर जहाँ हमारे जीविकोपार्जन के साधन है वहीं दूसरी ओर हमारे जीवन के भी आधार है। वृक्षारोपण और जलाशय निर्माण को पुनीत कार्य माना जाता है। हमारे राजा-महाराजाओं ने प्रजा की सुख सुविधा के लिए न केवल सड़कों का ही निर्माण कराया

बल्कि इनके किनारे छायादार वृक्ष व जलाशयों की व्यवस्था भी की थी। सम्राट अशोक ने समूचे राज्य में पर्यावरण संरक्षण की दिशा में जगह-जगह फलदार व छायादार वृक्ष लगाकर वन्य जीवों और जीव जन्तुओं को आश्रय प्रदान किया है। “ वृक्ष हमारे जीवन के सहचर हैं हमारा जीवन वृक्षों के अस्तित्व पर निर्भर है। वृक्षों की छोड़ी गई प्रश्वास हमारी श्वास है। वृक्षों के मूल, तना, पत्र, पुष्प, फल हमारे जीवन की अनेक आवश्यकताओं की पूर्ति करते हैं। वृक्षों की छाया हमें शीतलता प्रदान करती हैं। वृक्ष मेघों को आकर्षित कर हमारे लिए प्राकृत जल की व्यवस्था करते हैं” – वृक्ष पुराण भारतीय समाज में पेड़ों की पूजा व नदियों को माँ का दर्जा देना प्रकृति संरक्षण ही का परिचायक हैं। गंगा , यमुना, सरस्वती आदि पवित्र नदियों का उल्लेख शास्त्रों में पूज्य भाव से हैं। रामायण में काण्ड, महाभारत में पर्व और श्रीमद् भागवत् में स्कन्ध शब्दों का प्रयोग हुआ है जिसका अर्थ क्रमशः तना, पोर और प्रधान शाखा से हैं। कण्व की पुत्री शकुन्तला का पूरा बचपन वृक्षों की छाया तले ही व्यतीत हुआ। उसकी विदाई के समय वृक्षों की पत्तियों से आँसू टपक रहे थे। उसने वृक्षों से गले मिलकर विदा ली थी। रामायण काल में राम का वनों में निवास करना और वृक्षों को अपना आश्रय बनाना उनके प्रकृति प्रेम का ही सूचक है। लंका में अशोक वाटिका में सीता का ठहराव वृक्षों की महत्ता प्रतिपादित करता है। वृक्ष व वनस्पति रूद्र के रूप में मानी गई है क्योंकि ये विषैली गैस पीकर



अमृतमयी गैस निकालते हैं अतः वृक्षों को सिंचना नीलकण्ठ महादेव को जल चढ़ाना ही माना गया है। विष्णु पुराण में उल्लेख किया गया है कि सौ पुत्रों की प्राप्ति से भी बढ़कर एक वृक्ष लगाना और उसका पालन पोषण करना पुण्य माना गया है। चरक संहिता में प्राकृतिक औषधियां व जड़ी बूटियों का चिकित्सकीय दृष्टि से उपयोग बताया गया है। नींबू, आँवला, पपीता, सेब, पालक, चंदलाई आदि शरीर के लिए पौष्टिक एवं स्वास्थ्य वर्धक हैं। मत्स्य पुराण में दस पुत्रों, बावड़ियों एवं पुत्रों से बढ़कर एक वृक्ष माना गया है। वृक्षों के प्रति विशेष प्रेम से प्रेरित होकर राम ने दण्डकारण्य, इन्द्र ने नन्दनवन, कृष्ण ने वृंदावन, सौनकादि ऋषियों ने नेमिशारण्य वन तथा पाण्डवों ने खाण्डक वनों का निर्माण किया है। वर्षा का आव्हान, भूस्खलन का बचाव, प्राणवायु का दान और जीव जन्तुओं का संरक्षण आदि कार्य भी वृक्षों द्वारा की सम्पादित होते हैं। हमारी सांस्कृतिक परम्पराओं में प्रकृति प्रेम की अनेक गाथाएं भरी पड़ी हैं जिनके क्रियान्वयन से मानव जीवन को सुखी, समृद्ध बनाने हेतु प्रकृति प्रदत्त साधनों के संरक्षण की व्यवस्था बनाई गई है। हमारी परम्पराओं में वृक्षों की पूजा का विशेष महत्व रहा है जो पारिवारिक एवं सामाजिक जीवन को सुखी व स्वस्थ बनाने की दिशा में सफल है। वृक्ष पूजा की परम्परा में कार्तिक मास में महिलाएं पीपल व वट वृक्ष की पूजा कर पानी सिंचती हैं तो पुत्र रत्न की प्राप्ति होती है। कदम्ब के पेड़ के नीचे परिवार सहित भोजन किया जाए

तो परिवार फलता फूलता है। जिस घर में तुलसी की पूजा होती है उस घर में यमराज प्रवेश नहीं करता है। प्राचीन काल में प्रत्येक शिवालय के पास विल्व पत्र का वृक्ष लगाया जाता था जिसकी पत्तियाँ शिवजी को अर्पित होती हैं। तुलसी एकादशी के दिन तुलसी के पौधों की अपनी पुत्री के समान विवाह की रस्म सम्पन्न की जाती है। शास्त्रवेत्ताओं का कथन है कि पथ पर वृक्षारोपण करने से दुर्गम फल की प्राप्ति होती है जो फल अग्निहोत्र करने से भी उपलब्ध नहीं होता वह मार्ग पर पेड़ लगाने से मिल जाता है। ब्रह्माण्ड पुराण में लक्ष्मी को कदम्ब वनवासिनी कहा गया है। कदम्ब के पुष्पों से भगवान विष्णु की पूजा की जाती है। बृहदारण्यक उपनिषद् में पुरुष को वृक्ष का स्वरूप माना गया है। पद्म पुराण में भगवान विष्णु को पीपल वृक्ष, भगवान शंकर को वटवृक्ष और ब्रह्मा जी को पलाश वृक्ष के रूप में प्रतिष्ठापित किया गया है। घर में वास्तु दोषों को नष्ट करने के लिए तुलसी का पौधा सक्षम है। माता लक्ष्मी को प्रसन्न करने के लिए घर में श्वेत आक, केला, आँवला, हरसिंगार, अशोक, कमल आदि का रोपण शुभ मुहूर्त में करने का विधान है। आन्ध्र प्रदेश में तो नीम के पेड़ को राज्य वृक्ष माना गया है। शास्त्रानुसार ईशान कोण में आँवला नेरत्य में इमली, आग्नेय में अनार, वायव्य में वेल, उत्तर में केथ व पाकर, पूर्व में बरगद, दक्षिण में गुगल और गुलाब तथा पश्चिम में पीपल का वृक्ष लगाना शुभ माना गया है। तुलसी को विष्णु प्रिया, केला को बृहस्पति और सन्तान

दाता तथा पीपल को ब्रह्मा, विष्णु, महेश के निवास के रूप में पूजा जाता है। चन्दन भक्त और भगवान के माथे की शोभा है। कार्तिक मास की शुक्ल पक्ष की नवमी को आँवला नवमी कहते हैं। कहते हैं कि पीपल के पेड़ को नियम पूर्वक जल चढ़ाया जाए तो शनि का दुष्प्रभाव समाप्त हो जाता है। चैत्र मास की कृष्ण पक्ष की दशमी को “दशामाता” कहा जाता है। स्त्रियाँ इस रोज पीपल पूजा करती हैं। ज्येष्ठ मास की पूर्णिमा को स्त्रियाँ वटवासिनी का व्रत रखती हैं। वट वृक्ष को जल सींचती हैं। हरियाली अमावस्या और बसंत पंचमी आदि पर्वों पर व्रत उपवास के साथ वनस्पति पूजा होती है। छत्तीसगढ़ के रतनपुर क्षेत्र के ग्रामीण इलाकों में आम के पेड़ से आम तोड़ने से पहले उसके विवाह की विधि सम्पन्न की जाती है। बढ़ती जनसंख्या और भौतिक वादी व्यवस्थाओं के फलस्वरूप वृक्षों की अन्धाधुंध कटाई हो रही है। प्रकृति से निर्दयता पूर्वक छेड़छाड़ की जा रही है अतः आज प्रदुषण की भयावही समस्याओं का सामना करना पड़ रहा है। गाँधीजी ने कहा था “ प्रकृति सभी जीवों का भरण पोषण तो करती है किन्तु एक भी लालची की तृष्णा शांत करने में अक्षम है। पीपल बरगद को ब्राह्मण माना जाता था उन्हें काटना ब्रह्म हत्या के समान माना जाता है। जिन पेड़ों पर पक्षियों के घोंसले हो तथा देवालय और श्मशान भूमि पर लगे पेड़ों को काटना शास्त्रानुकूल नहीं है साथ ही दूध वाले वृक्ष जैसे बड़, पीपल, बहेड़ा, अरड़, नीम आदि को काटने पर पाप का

भागीदार होता है किसी कारण से वृक्ष काटना ही हो तो वृक्ष पर निवास करने वाले जीव जन्तुओं से क्षमा प्रार्थना करते हुए अन्यत्र वृक्षारोपण की व्यवस्था की जानी चाहिए। जोधपुर जिले की खेजड़ली ग्राम में संवत् 1780 में 363 वीर-वीरांगनाओं ने अपने सिर कटवाकर मरुस्थल में खेजड़ी के वृक्षों की रक्षा की थी। आज भी विश्वाँई सम्प्रदाय के लोग खेजड़ी के पेड़ की सुरक्षा हेतु समर्पित है। पेड़ों को नष्ट होने से बचाने के लिए ही ओरण, डोली तथा गोचर व्यवस्था की परम्परा का विकास हुआ था। ओरण एक संरक्षित वन हैं जो किसी देव स्थान से जुड़ा होता है। डोली किसी मठ या मन्दिर के पुजारी को व्यक्तिगत सम्पत्ति के रूप में दी जाती है ताकि वन संरक्षण होता रहे। बढ़ती जनसंख्या और भौतिकवादी व्यवस्थाओं के फलस्वरूप वृक्षों की अन्धाधुंध कटाई हो रही है। बढ़ते हुए सड़को के जाल, उद्योगों की स्थापना, बाँधों के निर्माण तथा रेल्वे लाइनों के विस्तार के कारण वृक्षों की अपार कटाई हो रही है अतः नष्ट हो रहे वृक्षों के स्थान पर नये वृक्षारोपण पर ध्यान दिया जाए तथा कानूनों का कठोरता से पालन किया जाना आवश्यक है अन्यथा वह दिन दूर नहीं हैं जब प्रकृति प्रकोप से पूरा प्राणी जगत प्रभावित हो जाएगा और हमारे अस्तित्व को खतरा उत्पन्न होगा अतः वृक्षों के बचाव हेतु सभी को कृत संकल्प होना चाहिए।

हमारे जीवन का पालन-पोषण करने के लिये हमारी धरती माँ की तरफ से वास्तव में हमें बहुत

सारे बहुमूल्य उपहार दिये गये हैं। उनमें से एक सबसे महत्वपूर्ण उपहार पेड़ है। हमें अपने जीवन में पेड़ के महत्व को समझना चाहिये और जीवन को बचाने के लिये, धरती पर पर्यावरण को बचाने के लिये और पृथ्वी को हरित पृथ्वी बनाने के लिये पेड़ों को बचाने के लिये अपना सबसे बेहतर प्रयास करना चाहिये। पेड़ सोने की तरह मूल्यवान है इसी वजह से इन्हें धरती पर “हरा सोना” कहा जाता है। संपत्ति के साथ ही हमारी सेहत का ये वास्तविक स्रोत हैं क्योंकि ये ऑक्सीजन, ठंडी हवा, फल, मसाले, सब्जी, दवा, पानी, लड़की, फर्नीचर, छाया, जलाने के लिये ईंधन, घर, जानवरों के लिये चारा आदि बहुत कुछ उपयोगी देता है। पेड़ सभी CO<sub>2</sub> उपभोग करता है, जहरीले गैसों से हवा को ताजा करता है और हमें वायु प्रदूषण से बचाता है। पेड़ हमें प्रत्यक्ष और अप्रत्यक्ष जीवन प्रदान करता है क्योंकि ये ऑक्सीजन उत्पादन, कार्बन डाई आक्साइड उपभोग का स्रोत, और बारिश का स्रोत है। धरती पर इंसान सबसे बुद्धिमान प्राणी के रूप में जाना जाता है।

पेड़ प्रकृति का आधार हैं। पेड़ों के बिना प्रकृति के संरक्षण एवं संवर्धन की कल्पना भी नहीं की जा सकती है। इसीलिए हमारे पूर्वजों ने पेड़ों को पूरा महत्व दिया। पुराणों में स्पष्ट तौर पर लिखा है कि एक पेड़ लगाने से उतना ही पुण्य मिलता है, जितना कि दस गुणवान पुत्रों से यश की प्राप्ति होती है। इसलिए, जिस प्रकार हम अपने बच्चों को

पैदा करने के बाद उनकी परवरिश बड़ी तन्मयता से करते हैं, उसी तन्मयता से हमें जीवन में एक पेड़ तो जरूर लगाना चाहिए और पेड़ लगाने के बाद उसकी सेवा व सुरक्षा करनी चाहिए। तभी हमें पेड़ लगाने का परम पुण्य हासिल होता है। भविष्य पुराण में वर्णन मिलता है कि जिसकी संतान नहीं है, उसके लिए वृक्ष ही संतान है। वृक्ष एक तरह से संतान की तरह ही मानव की उम्रभर सेवा करते हैं। इसलिए प्रत्येक व्यक्ति को एक पेड़ अवश्य लगाना चाहिए। पद्म पुराण में तो यहां तक लिखा है कि जलाशय (तालाब/बावड़ी) के निकट पीपल का पेड़ लगाने से व्यक्ति को सैंकड़ों यज्ञों के बराबर पुण्य की प्राप्ति होती है। केवल इतना ही नहीं भारतीय संस्कृति में एक पेड़ लगाना, सौ गायों का दान देने के समान माना गया है।

धरती पर सब कुछ एक-दूसरे से जुड़ी हुई है और प्रकृति के संतुलन से चलता है, अगर इसके साथ कोई गड़बड़ी होती है, पूरा पर्यावरण बाधित हो सकता है और धरती पर जीवन को नुकसान पहुँचा सकता है। पेड़ हमें बहुत सारी प्राकृतिक आपदाओं से सुरक्षित रखता है और बहुत तरीकों से हमारे जीवन का पालन-पोषण करता है। ये मृदा अपरदन होने से भी बचाते हैं और प्रदूषण से बचाने के द्वारा पर्यावरण को ताजा रखते हैं। पेड़ बहुत मददगार होते हैं तथा मानवता के उपयोगी मित्र होते हैं।



**Published by:**



**Tropical Forest Research Institute  
(Indian Council of Forestry Research & Education)  
(An autonomous council under Ministry of Environment, Forests and Climate Change)  
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