

## An Inventory of Multipurpose Avenue Trees of Urban Chandigarh, India

R.K. Kohli, H.P. Singh, and Daizy R. Batish

**Abstract.**—Trees in urban ecosystems play a very significant role in environmental protection by checking air and noise pollutants, abating wind, and handling many other functions. In India, Chandigarh is the most modern and environmentally safe city and qualifies to be called a GREEN CITY because of its rich tree component. This is so in spite of its high population density, currently over 9,443 people per square km, perhaps the highest in the country. It has nearly 42,000 trees growing along the roads in a systematic manner. The drives are identified with the type of multipurpose tree species. Nearly 66 tree species (over half indigenous) are seen along the roadsides; these trees provide shade, timber, fuel, fodder, fruit, medicine, and other benefits. In addition, the city is decorated with 11 gardens harboring over 200 types of trees.

The concept of urban forestry includes not only aesthetics, but also functions for environmental and socio-economic uplift. Trees in urban areas are very important in view of increasing population, urbanization, pollution levels, and diminishing forest areas. Trees serve many useful purposes, especially in urban areas where they improve air quality (Smith 1980) and microclimate (Nowak 1995), reduce noise levels, abate wind, and reduce stress on human beings (Ulrich 1985). They also improve aesthetic, architecture, landscape, wildlife, and recreational elements of the city (Kohli *et al.* 1996). In cities, the tree component could be established usually in the following three ways, depending upon the prevailing situations:

1. As clusters on the outskirts of cities/towns mainly for recreational visits of the locals, nesting and roosting of birds, shelter for game animals, and a sink for the city pollutants. This is more likely for old cities like Calcutta, New York, or Delhi that are relatively unplanned and overpopulated.
2. As managed vegetation on roadsides, in parks, gardens, homesteads, premises of institutions, industries, and religious places. This is likely for cities like Chandigarh and Islamabad, which are planned and not very old.
3. As a major biotic component when cities are carved within the forested areas, as in Scandinavian countries, which have low population density. Although the tree density in these countries is relatively high, the diversity remains limited since it results from the manipulation of natural forest dominants. On the other hand, in the first two alternatives, because of man's wider choices, the multipurpose species find relatively more representation.

Professor, Research Associate, and Lecturer, respectively, Unit of Ecology and Forestry, Botany Department, Panjab University, Chandigarh - 160 014, India.

This presentation aims at describing the rich diversity of multipurpose trees along the roads of a modern Indian city—Chandigarh—which in spite of its very high population density qualifies to be called an Environmentally Safe and Beautiful City.

### THE CITY

In India, only a few cities have been systematically planned, especially in the post-independence period. Chandigarh (30° 42' 25" N; 76° 48' 30" E; 333 m MSL), the capital of two progressive states Punjab and Haryana, is one such city. It was designed by French architect Le Corbusier in 1955. This city of 114 km<sup>2</sup> has an urban area of 78 km<sup>2</sup> (approx. 40.11 sq. miles), divided into 47 sectors, each approximately 246 acres (1,200 x 800 m). It is surrounded by 35 small rural areas covering 36 km<sup>2</sup>.

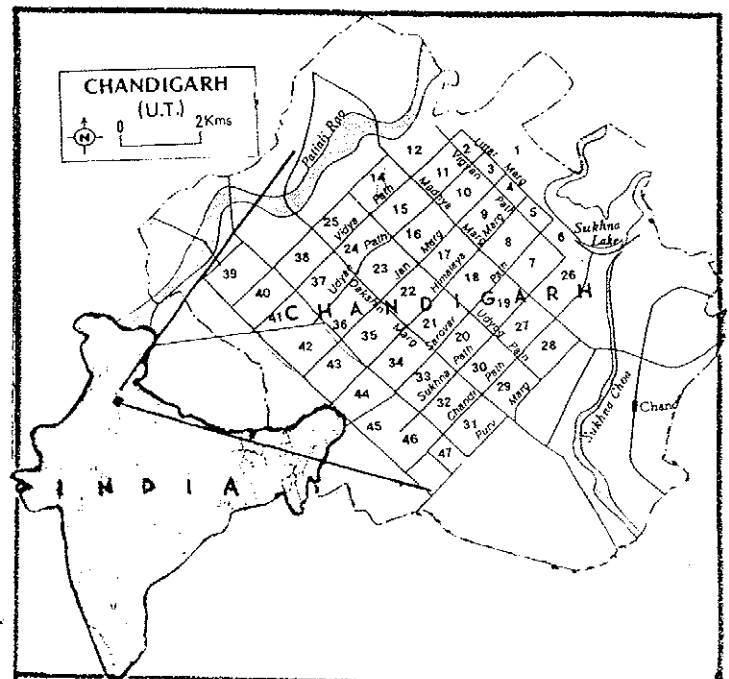


Figure 1.—Chandigarh, India.

Table 1.—Demographic characteristics of urban Chandigarh

• Population (projected as on March 1, 1998)	:	821,282 (575,829)*
• Decadal population growth	:	60.89 percent (42.16 percent)*
• Area	:	78 km <sup>2</sup>
• Population density projected as on March 1, 1998	:	10,529 per km <sup>2</sup> (7,382 per km <sup>2</sup> )*
• Total state-owned forests	:	77.71 acre
• Private forest	:	Nil
• Total livestock (projected as on March 1, 1998)	:	61,072 (52,190)*
• Total annual rainfall	:	1,220 mm
• Temperature range	:	1.7 to 44.2 °C

\* as per 1991 census.

The city was designed for 0.3 million people, but has over 0.82 million people in addition to a floating population of 0.22 million from the adjoining satellite towns of Panchkula (Haryana state) and Mohali (Punjab state) (table 1). The rate of population growth of the city had been unexpectedly rapid. In spite of the high population density of 10,529 persons per km<sup>2</sup>, air pollution is still at a sub-threshold level. Chandigarh is still considered an environmentally safe city, which is one of the reasons for its fast population influx. The city has alluvial soil, and it was a land of mango (*Mangifera indica*) and *Ficus* trees and crops of wheat, maize, and sugarcane. The locals on the slopes of the Shiwalik foothills have given it the greenery of neighborhood, mountain rivulets, and fresh air.

### City Roads

Basically, there are six type of roads, besides foot paths and cycle tracks, in the city. These are classified as: V<sub>1</sub> (state highways connecting city with other cities and towns); V<sub>2</sub> (arterial roads dividing the city into three parts north, middle, and south); V<sub>3</sub> (roads running on the outer periphery of the sectors, i.e., dividing the city into various sectors); V<sub>4</sub> (sector dividing roads or market roads splitting the sector into two halves); V<sub>5</sub> (circular roads within sectors); and V<sub>6</sub> (access roads to houses).

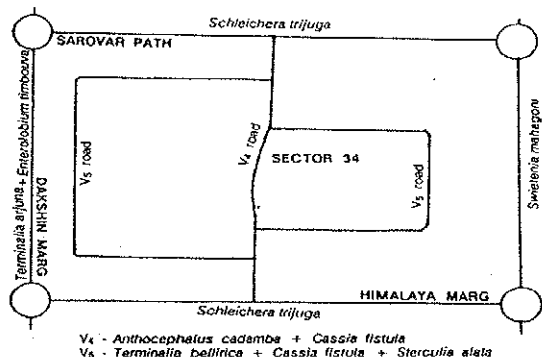


Figure 2.—Example section map.

### THE TREESCAPE

The city has no natural forest or a climax ecosystem. Agriculture or the agroforestry component is also totally lacking. Likewise, the social forestry, commercial, and farm forestry components are also missing. Nevertheless, the organized green character of Chandigarh is perhaps the richest (compared to any other Indian city), with ornamental, horticultural avenue trees and shrubs. Throughout the year, some part of the city is manifested with colorful landscape and blooming trees. The roads are mostly identified with the type of trees planted along their sides. For instance:

- V<sub>2</sub> - Southern Drive (Dakshin Marg) has *Terminalia arjuna* throughout
- V<sub>2</sub> - Northern Drive (Uttar Marg) has *Acrocarpus fraxinifolius*
- V<sub>3</sub> - Sukhna Lake Drive has *Tamarindus indica*
- V<sub>3</sub> - University Drive (Vidya Path) has *Heterophragma roxburghii*
- V<sub>4</sub> - Sector 34 has *Anthocephalus cadamba* + *Cassia fistula*
- V<sub>5</sub> - Sector 34 has *Terminalia bellerica* + *Cassia fistula* + *Sterculia alata*

Because of the longevity of trees, the relatively long time required for planting and later for acquiring maturity, and their varied impact on the city residents, tree species have been selected with care. The major considerations for the selection were:

- shape and size of the leaf and crown
- height of the tree
- tree character (deciduous or evergreen)
- aesthetics and architecture
- color and timing of flowering
- constraints of time, transport, and the availability of healthy planting material
- climatic adaptability

The city has around 100 types of trees, of which 66 are avenue trees planted along roadsides, 11 are forest trees and shrubs, and about 20-25 types of trees are grown in

the premises of city residents. The city is also characterized by the presence of 11 gardens covering a total area of about 400 acres and having nearly 240 types of trees (Kohli *et al.* 1994).

In all, there are about 42,000 avenue trees, in addition to about 32,000 in small clusters and in gardens and over 50,000 in the premises of institutions and houses. Depending on the site, the roadside trees of different height and architecture are in single, double, or multiple rows.

An inventory of the available avenue trees here in terms of their English name, botanical name, family and center of origin, flowering months in Chandigarh, and major uses is tabulated below (table 2).

Bougainvillea shrubs with a variety of colored flowers on the road dividers is a characteristic of the city. In addition, the city has 11 gardens each with a good number of trees of many types (table 3). Although these trees have not been planted for economic use, most of them have many uses.

Table 2.—*Species planted along roadsides as avenue trees in Chandigarh, India*

S. No	Botanical name	Family & country of origin (in parentheses)	English name(s)	Flowering months in Chandigarh	Economic importance
1.	<i>Acacia auriculiformis</i>	Mimosaceae (Australia)	Australian Acacia or Phyllode, Australian Wattle	September to November	Ornamental tree; fuel wood
2.	<i>Acrocarpus fraxinifolius</i>	Caesalpinaceae (Indo-Malaya)	Pink or red cedar, Shingle tree	December to February	Timber for making tea chests
3.	<i>Adina cordifolia</i>	Rubiaceae (India)	Saffron teak	June to July	Shade, Wood for carving, making combs, writing tablets and ornamental platters
4.	<i>Albizzia lebeck</i>	Mimosaceae (Tropical Asia)	East Indian walnut tree, parrot or fry wood or lebeck, woman's tongue or sizzling tree	April to August	Wood for furniture; leaves and branches as fodder, bark and seeds medicinal, also yields gum
5.	<i>Albizzia odoratissima</i>	Mimosaceae (Sub-Himalayan tracts of India)	Black siris	April to June	Wood for furniture; leaves and branches as fodder, bark and seeds medicinal, also yields gum
6.	<i>Albizzia procera</i>	Mimosaceae (India)	Stone siris, white siris	August to September	Timber, fodder, medicinal use, also yields charcoal and gum
7.	<i>Alstonia scholaris</i>	Apocynaceae (Penninsular India)	Scholar or devil's or dita bark tree, shaitan wood tree	December to March	Medicinal (vermifuge), wood used for making slates and blackboards, bark bitter and astringent
8.	<i>Anthocephalus chinensis</i> (= <i>A. cadamba</i> )	Rubiaceae (India)	Kadam	July to September	Wood for making match boxes, pulp; flowers sacred, fruits edible
9.	<i>Artocarpus heterophyllus</i>	Moraceae (India)	Jack fruit	November to January	Fruit and seeds edible, yields a yellow dye, timber for furniture
10.	<i>Azadirachta indica</i>	Meliaceae (India, probably Burma also)	Margosa tree, neem	April to May	Medicinal, insecticidal, yields neem oil used in soaps, pastes, tooth powder etc., nematocidal
11.	<i>Barringtonia acutangula</i>	Barringtoniaceae = Lecythidaceae (Sub-Himalayan regions of India)	Indian oak	May to July	Ornamental, bark used for stupefying fishes, wood used for making boats and well-work etc.

(table 1 continued )

S. No	Botanical name	Family & country of origin (in parentheses)	English name(s)	Flowering months in Chandigarh	Economic importance
12.	<i>Bauhinia purpurea</i>	Caesalpiniaceae (Foot hills of Himalayas)	Camel hoof, tree bean, geranium tree, purple bauhinia tree, mountain ebony	October to December	Leaves for fodder, floral buds as food
13.	<i>Bauhinia variegata</i>	Caesalpiniaceae (Hilly parts of India)	Variegated or buddhist bauhinia, orchid tree	March to April	Floral buds edible, pods and leaves used for fodder, sacred tree, timber wood
14.	<i>Bischofia javanica</i>	Euphorbiaceae = Bischofiaceae (Indo-Malaya)	Java cedar, bishop wood, west indian cedar, vinegar wood, red cedar	March to April	Timber for pile, foundation, railways etc., dye for rattan stuff
15.	<i>Callistemon viminalis</i>	Myrtaceae (Australia)	Scarlet bottle brush	March to August	Ornamental
16.	<i>Cassia fistula</i>	Caesalpiniaceae (India)	Golden shower tree, pudding pipe tree, Indian laburnum, purging cassia	May to July	Ornamental, seeds laxative, pods and bark yield dye and tan, dark brown sweet pulp of fruit is strong purgative
17.	<i>Cassia javanica</i>	Caesalpiniaceae (Java & Sumatra)	Java cassia, siboosook	May to July	Ornamental timber used in Java, fruit purgative
18.	<i>Cassia nodosa</i>	Caesalpiniaceae (Burma)	Pink mohur	May to July	Ornamental, timber for house building, fruit purgative
19.	<i>Cassia renigera</i>	Caesalpiniaceae (Burma)	Burmese pink cassia	April to May	Ornamental
20.	<i>Cassia siamea</i>	Caesalpiniaceae (Indo-China)	Kassod, djoowar	November to December	Ornamental, timber for bridges, props and telegraph poles also used as firewood
21.	<i>Chorisia speciosa</i>	Bombacaceae (Brazil, Argentina)	Mexican silk cotton tree	October to November	Ornamental, yields kapok and silky cotton
22.	<i>Chukrasia tabularis</i>	Meliaceae (Indo-Malaya, Sri Lanka & China)	Bastard cedar, Indian redwood, chittagong wood	March to May	Source of Chittagong wood for furniture, bark for tanning, flowers yield dye
23.	<i>Crateva nurvala</i> (= <i>C. religiosa</i> )	Capparidaceae (Deciduous forests of India)	Caper tree, sacred barna	April to May	Ornamental, sacred, bark and leaves medicinal, pulp of fruit mixed with mortar gives strong cement
24.	<i>Dalbergia sissoo</i>	Papilionaceae (India)	Rose wood, south Indian red wood, black wood tree	March to May	Shade, timber
25.	<i>Delonix regia</i>	Caesalpiniaceae (Madagascar)	Flame, flamboyant, royal poinciana or gold mohur, holy ghost, peacock flower tree	April to August	Ornamental

(table 1 continued on next page)

(table 1 continued)

S. No	Botanical name	Family & country of origin (in parentheses)	English name(s)	Flowering months in Chandigarh	Economic importance
26.	<i>Drypetes roxburghii</i>	Euphorbiaceae (Indo-Malaya)	Child-life tree, lucky bean tree, Indian amulet, wild olive tree	March to May	Ornamental tree, leaves as fodder
27.	<i>Emblica officinalis</i>	Euphorbiaceae (Tropical Asia)	Emblic myrobalan, cicca emblica	March to April	Fruit edible, bark yields dye, bark and fruit have medicinal value
28.	<i>Enterolobium timbouva</i>	Mimosaceae (Brazil)	Timbouva	March to June	Ornamental tree
29.	<i>Eucalyptus citriodora</i> <i>E. tereticornis</i>	Myrtaceae (Australia)	Blue gum tree, fever tree lemon-scented or citron-scented eucalypt	April to May (generally)	Source of timber, paper pulp, essential oils for cosmetic and pharmaceutical industries, ornamental tree
30.	<i>Eugenia jambolana</i>	Myrtaceae (India)	Indian blackberry, black plum, java plum	April to June	Fruit edible and has medicinal value, timber, fuelwood, dyes
31.	<i>Ficus benghalensis</i>	Moraceae (Sub-Himalayan Indian forests)	Banyan tree	Throughout the year	Religious, bark and aerial roots yield fiber, leaves as fodder, shade
32.	<i>Ficus benjamina</i>	Moraceae (Indo-Malaya, China)	Weeping or willow or java or golden fig, java willow, Benjamin tree	Throughout the year	Ornamental avenue tree
33.	<i>Ficus infectoria</i>	Moraceae (India)	Palakh	May to July	Ornamental, shade
34.	<i>Ficus religiosa</i>	Moraceae (India)	The bo-tree, The peepul tree	October to September (almost year round)	Sacred tree to Hindus and Buddhists, leaves used for miniature paintings, host for lac and silk worm insects, ornamental
35.	<i>Grevillea robusta</i>	Proteaceae (Eastern Australia)	Silver oak, silky oak	April to May	Ornamental, avenue, timber
36.	<i>Heterophragma roxburghii</i>	Bignoniaceae (India)	Monkey tail tree	March to June	Ornamental
37.	<i>Jacaranda mimosifolia</i>	Bignoniaceae (Brazil, Argentina)	Jacaranda, mimosa leafed jacaranda	April to May	Ornamental and avenue tree
38.	<i>Kigelia pinnata</i>	Bignoniaceae (Tropical Africa)	Sausage or fetish tree, cucumber tree	April to July	Ornamental and purgative
39.	<i>Koelreuteria apiculata</i>	Sapindaceae (Eastern China)	Chinese tallow tree	October to November	Ornamental, flowers source of yellow dye & medicine, seeds used as beads

(table 1 continued on next page)

(table 1 continued )

S. No	Botanical name	Family & country of origin (in parentheses)	English name(s)	Flowering months in Chandigarh	Economic importance
40.	<i>Lagerstroemia flos-reginae</i> (= <i>L. speciosa</i> )	Lythraceae (Western Ghats of India)	Pride of India, queen's flower, queen's crepe myrtle	May to October	Ornamental, timber, leaves and fruit for tanning
41.	<i>Lagerstroemia parviflora</i>	Lythraceae (India)	Lendia	April to June	Source of gum, fiber, timber, charcoal, used in tanning
42.	<i>Lagerstroemia thorelli</i>	Lythraceae (South East Asia)	Queen's flower, pride of India	May to November	Ornamental
43.	<i>Litchi chinensis</i>	Sapindaceae (China)	Litchi	April to May	Fruit edible and highly priced
44.	<i>Madhuca indica</i>	Sapotaceae (Indo-Malaya, Indo-China, Australia)	Indian butter tree, illupe nut tree, wild sapota tree	April to May	Seeds and Flowers yield oil (Phulwa oil), seed cake used as worm killer, flowers edible and yield a strong spirit, bark useful for tanning
45.	<i>Mangifera indica</i>	Anacardiaceae (India, Burma)	Mango, cupid's favorite, spring tree, cuckoo's joy	March to April	Fruit edible, timber, medicinal
46.	<i>Millettia ovalifolia</i>	Papilionaceae	Moulmein rosewood (Indo-China & Malaya)	April to May	Ornamental, insecticidal, fish and arrow poison
47.	<i>Millingtonia hortensis</i>	Bignoniaceae (Burma & Malaya)	Indian cork tree, jasmine tree	September to November	Ornamental, yields low quality cork, source of timber, leaves as substitute for opium in cigarettes
48.	<i>Mimusops elengi</i>	Sapotaceae (Indo-Malaya, Sri Lanka)	Indian medlar, bullet-wood tree, elengi	March to May	Ornamental, bark and fruit medicinal, fruit edible, timber, flowers used in perfumery and making garlands, oil from seeds
49.	<i>Polyalthia longifolia</i>	Annonaceae (South India and Sri Lanka)	Mast tree, Indian fir, asoka tree	February to May	Indian Sacred tree and ornamental
50.	<i>Pongamia pinnata</i>	Papilionaceae (Indo-Malaya)	Indian beech, poonga oil plant	May to July	Ornamental, shade, yields oil (Honga oil), source of timber and fuel wood, ash of tree used for dyeing
51.	<i>Populus nigra</i> <i>P. deltoides</i>	Salicaceae (Europe, North-West Asia, North China, Canada)	Poplar, black poplar, eastern cottonwood	November to January	Source of timber, resins and medicines
52.	<i>Pterospermum acerifolium</i>	Sterculiaceae (India)	Kanak - champa muchkand	March to May	Ornamental, leaves as fodder, for making plates & packing material, timber
53.	<i>Roystonea regia</i>	Arecaceae (West Indies)	Bottle palm, royal palm, mountain glory, palmiste	August to October	Ornamental

(table 1 continued)

S. No	Botanical name	Family & country of origin (in parentheses)	English name(s)	Flowering months in Chandigarh	Economic importance
54.	<i>Salmaal</i> <i>malabarica</i> (= <i>Bombax ceiba</i> )	Bombacaceae (India)	Silk-cotton tree, cotton wood tree, semal tree	February to March	Ornamental, medicinal, source of gum, timber, flowers edible, source of fiber, yield cotton (Kapok)
55.	<i>Sapium sebiferum</i>	Euphorbiaceae (China)	Chinese tree, vegetable tree, tallow tree	June to August	Ornamental, shade, fatty seed covering (Tallow) is used for candles and soap, leaves yield black dye
56.	<i>Schleichera</i> <i>oleosa</i>	Sapindaceae (Foot hills of Himalayas and Sri Lanka)	Lac tree, honey tree, Ceylon oak, kosumba tree	April to May	Seeds source of Macassar oil used in candles, hair-dressing, batik work, fruit edible, host of lac insect, yields priced Kusum lac
57.	<i>Spathodea</i> <i>campanulata</i>	Bignoniaceae (Tropical and Central Africa)	Uganda flame or African tulip or scarlet fountain or scarlet bell or squirt or syringe or bell flambeau tree	April to June	Ornamental
58.	<i>Sterculia alata</i>	Sterculiaceae (Tropical Asia)	Buddha's coconut	February to March	Ornamental
59.	<i>Sweitenia</i> <i>mahagoni</i>	Meliaceae (Central America)	Spanish mahogany, The mahogany	April to May	Timber
60.	<i>Tamarindus indica</i>	Caesalpiniaceae (Africa)	Indian date, The tamarind tree	June to August	Timber, fruit edible, used in culinary preparations, leaves yield dye
61.	<i>Tecoma argentea</i>	Bignoniaceae (Tropical America)	-	January to April	Ornamental
62.	<i>Tecomella</i> <i>undulata</i>	Bignoniaceae (India)	Wavy leafed tecomella	April to June	Ornamental, source of fuelwood
63.	<i>Terminalia arjuna</i>	Combretaceae (India)	Arjun tree	April to June	Bark and ash used in dyeing and tannin, gum, bark, leaves and fruit are medicinal (used for blood pressure)
64.	<i>Terminalia</i> <i>bellirica</i>	Combretaceae (India)	Belleric or bastard myrobalan, bedda nut	May to June	Timber, fruit source of tannin, black dye, ink, medicinal
65.	<i>Thespesia</i> <i>populnea</i>	Malvaceae (India)	Tulip or portia or umbrella or bhendi tree	November to January	Ornamental, hardwood is used for gun stocks
66.	<i>Toona ciliata</i> (= <i>Cedrella toona</i> )	Meliaceae (Indo-Malaya)	Toon or happy tree, moulmein or red or Singapore cedar, sandal nim Indian mahogany	March to April	Ornamental, good timber, flowers yield sulphur colored dye called basanti, bark is medicinal

Table 3.—Gardens of Chandigarh

Sr. No.	Garden	location (sector)	Area (acres)	Tree types (no.)
1	Rajindra Park	1	150	12
2	Bougainvillea Garden	3	30	26
3	Bulbous Garden	9	35	12
4	Leisure Valley	10	70	30
5	Museum and Art Gallery	10	7.5	23
6	Botanical Garden	14	16	209
7	Zakir Rose Garden	16	32	43
8	Terraced Garden	33	10	42
9	Topiary Garden	35	8	29
10	36 Garden	36	35	52
11	Hibiscus Garden	36	65	23

(from Kohli *et al.* 1994)

Of the above 66 tree types, over half are of Indian origin. Literally, every tree can be regarded as multipurpose. However, apart from the service of moderating microclimate, stabilizing soil, providing fuel for the poor, removing air pollutants, and reducing noise pollution in the cities, the avenue trees of Chandigarh perform other multiuse functions. Upon categorizing one finds 39 serving as ornamental, 34 yielding timber, 15 yielding food, 9 fodder, 6 fibers, 35 providing material for direct industrial (including medicinal) use, while miscellaneous functions like shade to pedestrians, shelter to wildlife, dyeing and tanning, etc., is provided by 33 types of the trees.

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