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TREE SPECIES FOR PLANTING AT THE SIDES AND MEDIAN OF THE ROADS IN BENGALURU

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Bengaluru / Greater Bangalore / Bruhat Bengaluru / Bangalore (77°37'19.54'' E and 12°59'09.76'' N) is the principal administrative, cultural, commercial, industrial, and knowledge capital of Karnataka state. Bangalore city's population has increased enormously from 6,537,124 (in 2001) to 9,588,910 (in 2011), amounting to a decadal growth of 46.68%. With this, the population density has increased from as 10,732 (in 2001) to 13,392 (in 2011) persons per sq. km. The vegetation of Bangalore was classified as dry deciduous forest-type under the *Terminalia-Anogeissus latifolia-Tectona* series. The city had enjoyed salubrious climate throughout the year prior to the industrialization era. Land use analysis based on the fusion of Resourcesat-2 MSS data with Cartosat 2 shows that the spatial extent of tree vegetation in Bangalore is 100.02 sq.km (14.08%).

Urban vegetation includes trees, shrubs and herbs on public and private lands (parks, streets, backyards), all interspersed within a landscape dominated by paved surfaces. This kind of vegetation plays a vital role in moderating micro climate, sequestering greenhouse gases (CO₂, etc.) and also in aiding the percolation of water. Estimates indicate that about 6 tons of carbon is sequestered by 1 hectare of forests annually and

this averages out as the carbon sequestration of 6 kg/tree/year. Per capita respiratory carbon ranges from 192 to 328 kg/year depending on the physiology of humans. Generally, the carbon dissipated through respiration varies from 525 to 900 gm/day/person. This means 32 to 55 trees per person in a region is required to exclusively mitigate respiratory CO₂.

Maintenance of green cover is the need of the hour in urban areas with increase in paved surfaces due to urbanisation. Selection of plant species for planting at the sides and median also require utmost care. Exotic species flower greatly, but fail to stand during harsh wind and after certain age the strength of the root fails to hold the tree to the soil, and hence fall during monsoon, which creates major problem. In the past and also traditionally, native tree species were being selected for avenues and also at the fringes, which are quite strong, provides fruits and shade for the needy. These native tree species are a source of nectar, food for several species of birds and insects. In this regards, it is suggestible to plant native tree species at the sides and the median of ring roads. Median of the roads needs smaller trees that do not obstacle the movements of vehicles and do not cause problem further. Hence, selection of the plant species for median of the roads is also important. The following section, lists the tree species to be considered for planting along road sides and median.

Description of the trees suggested for planting at sides of the roads:

1. *Pongamia pinnata* (Honge Mara)



Description:

It is a deciduous tree that grows to about 15-25 meters in height with a large canopy of leaf cover that spreads equally wide. The leaves are a soft, shiny burgundy in early summer and mature to a glossy, deep green as the season progresses. Small clusters of white, purple, and pink flowers blossom on their branches throughout the year, maturing into brown seed pods. The tree is well suited to intense heat and sunlight and its dense network of lateral roots and its thick, long taproot make it drought tolerant. The dense shade it provides slows the evaporation of surface water and its root structures promote nitrogen fixation, which moves nutrients from the air into the soil.

Local names: Indian Beech, Pongam, Honge, Ponge, and Karanj

Flowers and Fruits: summer

2. *Artocarpus heterophyllus* (jackfruit)



Description: A tree with milky latex well suited to tropical lowlands. The leaves are dark green, leathery and shining. Its fruit is the largest, seldom less than about 25 cm (10 in) in diameter. Even a relatively thin tree, around 10 cm (4 in) diameter, can bear large fruit. The jackfruit is something of an acquired taste, but it is very popular in many parts of the world. The sweet yellow sheaths around the seeds are about 3–5 mm thick, but milder and less juicy.

Local names: Jack fruit; Katahal

Flowers and fruits: Summer

3. *Mangifera indica* (Mango trees)



Description:

Grows to 35-40 m in height, with a crown radius of 10 m. The leaves are dark green, alternate, simple, 15-35 cm long and 6-16 cm broad; when the leaves are young they are orange-pink, rapidly changing to a dark glossy red, then dark green as they mature. The flowers are produced in terminal clusters 10-40 cm long; each flower is small and white with five petals 5-10 mm long, with a mild sweet odor. After the flowers finish, the fruit takes from three to six months to ripen. The ripe fruit is variable in size (right image) and color, such as yellow, orange, red or purple.

Local names: Mango, Aam

Flowers and fruits: Winter to Summer

4. *Syzigium cumini* (Jamoon)



Description:

An evergreen tropical tree 50 to 100 ft. tall, with oblong opposite leaves that are smooth, glossy; they have a turpentine smell. The bark is scaly gray and the trunk forks into multiple trunks about 3 - 5' from the ground. Jamun has fragrant white flowers in branched clusters at stem tips and purplish-black oval edible berries. The juicy fruit-pulp contains resin, gallic acid and tannin; it tastes usually from acid to fairly sweet. The somewhat astringent, jamun fruit can be utilized for juice. This berry has only one seed.

Local names: Java plum, jamun, black plum, Indian blackberry

Flowers and fruits: Winter to summer

5. *Azadirachta indica* (Neem)



Description:

A fast growing tree that can reach a height of 15-20 m (about 50-65 feet). The branches are wide spread. The fairly dense canopy may reach the diameter of 15-20 m in old. The trunk is relatively short, straight and may reach a diameter of 1.2 m. The bark is hard, fissured or scaly, and whitish-grey to reddish-brown. The sapwood is greyish-white and the heartwood reddish when first exposed to the air becoming reddish-brown after exposure. The root system consists of a strong taproot and well developed lateral roots. The flowers (white and fragrant) are arranged more-or-less drooping clusters which are up to 25 cm long. The fruit is a smooth drupe which varies in shape from elongate oval to nearly roundish.

Local names: Neem, Bevu

Flowers and fruits: Winter to summer

6. *Ficus bengalensis* (Banyan)



Description:

The Banyan is a tree with a huge spread with characteristic aerial roots which upon touching and entering the earth, draws sustenance from the earth, thickens/lignifies and becomes a new trunk. The vine like aerial roots plunging down from the main limbs of the tree form a network of trunks with surface roots spreading in all direction. The leaves are leathery and oval shaped with the berry or figs emerging in pairs which are globose and ripen to a red colour. Typically the flowers – male and female and gall flowers all grow radially inwards towards the centre of the hollow berry or fig. The tree is evergreen though briefly leafless at the peak of the hot season in dry localities.

Local names: *Banyan, Nyagrodha, Bargad, Aladha mara*

Flowers and fruits: Throughout the year

7. *Ficus religiosa* (Sacred Fig, Pipal)



Description:

It is a large dry season-deciduous tree up to 30 m tall and with a trunk diameter of up to 3 m. The leaves are heart shaped with a distinctive extended tip; they are 10-17cm long and 8-12cm broad, with a 6-10cm petiole. The fruit is a small fig 1-1.5cm diameter, green ripening purple. This plant is considered sacred by the followers of Hinduism, Jainism and Buddhism, and hence the name 'Sacred Fig' was given to it. Siddhartha Gautama is referred to have been sitting underneath a Bo Tree when he was enlightened (Bodhi), or "awakened" (Buddha).

Local names: Bodhi, Pipal (peepal, peepul, pippala, pimpal, etc.), arali or Ashvastha

Flowers and fruits: December to March

8. *Michelia champaca* (Champak)



Description:

This small tree has alternate, lanceolate leaves to over 20 cm long that are slightly curved. The flowers are fragrant, a mustard yellow colour, and in each flower the ovaries are free from one another. The central stalk or receptacle elongates and bears the developing fruits along it. When fully developed each individual fruit is about 2.5 cm long, with a reddish tinge and whitish pustules; this follicle opens to release orange-red seeds.

Local names: champaka, champak or champac, champa, sampige and shamba

Flowers and fruits: December to April

9. *Ficus racemosa* (Fig)



Description:

Tree growing up to 10-16m tall with grayish bark. Leaves are 7.5-10cm long, ovate or elliptic in shape, dark green. Flowers are in the form of fruit, visible when cut open. The fruit in large clusters, arising from main trunk or large branches.

Local names: Indian Fig, Atthi mara, Udumbara

Flowers and fruits: Throughout the year

10. *Butea monosperma* (Flame of the forest)



Description:

It is a medium sized dry season-deciduous tree, growing to 15 m tall. The leaves are pinnate, with an 8-16 cm petiole and three leaflets, each leaflet 10-20 cm long. The flowers are 2.5 cm long, bright orange-red, and produced in racemes up to 15 cm long. The fruit is a pod 15-20 cm long and 4-5 cm broad. It is said that the tree is a form of Agnidev, God of Fire. It was a punishment given to Him by Goddess Parvati for disturbing Hers and Lord Shiva's privacy.

Local names: Flame of the forest, Mutthuga, Kinshuk, Palash, Dhak

Flowers and fruits: January to May

11. *Cassia fistula* (Golden Shower Tree)



Description:

It is a medium-sized tree growing to 10-20 m tall with fast growth. The leaves are deciduous or semi-evergreen, 15-60 cm long, pinnate with 3-8 pairs of leaflets, each leaflet 7-21 cm long and 4-9 cm broad. The flowers are produced in pendulous racemes 20-40 cm long, each flower 4-7 cm diameter with five yellow petals of equal size and shape. The fruit is a legume is 30-60 cm long and 1.5-2.5 cm broad, with a pungent odour and containing several seeds.

Local names: Kakke mara, suvarnaka, bendra lathi, golden shower, Indian laburnum

Flowers and fruits: March to May

12. *Polyalthia longifolia*



Description: It is erect tree up to 4 m high. Leaves alternate, narrow-lanceolate, simple, shortly-petiole, acute, shining. Inflorescence a panicle, sometimes in a short-peduncled umbel, sepals 3, free, triangular, apex reflexed. Fruit a berry, ovoid, reddish black, seeds smooth.

Local name: Ulkat, Kastadaruha (Sanskrit); Debdari, Ashoka (Hindi); Madras Ashoka (Kannada)

Flower, Fruit: March – April

13. *Bauhinia variegata*



Description: It attain moderate sized tree upto 6 m high. Leaves alternate, simple, coriaceous, cordate. Inflorescence corymbose raceme, terminal or axillary. Petals ovate-oblong, clawed, prominently nerved, usually one of them brightly coloured. Fruit a pod, flat, glabrous, prominently veined when dry dehiscent.

Local name: Kanchanara (Sanskrit), Kachnar (Hindi), Kempu mandara (Kannada)

Flower, Fruit: November – February

14. *Lagerstroemia speciosa* (Pride of India)



Description: A medium size handsome deciduous tree. Leaves are simple, large, elongate, elliptic, short-stalked that turn red before falling. The rose-like flowers (about 4.5-5 cm. across) with crinkly petals and numerous stamens are most attractive and are displayed on large, erect clusters at branch ends. Fruits are woody, spherical (about 2 cm. dia.) and dehisce into a fruit-cup-like structure with five or more spreading lobes of the fruit wall. Bark is pale-brown, smooth or flaking thinly.

Local name: Pride of India, Queen Crape Myrtle (English), Jarul (Hindi)

Flower, Fruit: March-June

Description of the trees suggested for planting at median of the roads:

1. *Muntingia calabura* (Singapore cherry)



Description:

It is a small tree 7-12 meters tall with tiered and slightly drooping branches. It has serrated leaves 2.5-15 cm long and 1-6.5 cm wide. The flowers are small and white, gives rise to 1-1.5 cm light red fruit. The fruit is edible, sweet and juicy, and contains a large number of tiny (0.5 mm) yellow seeds. It is a pioneer species that thrives in poor soil, able to tolerate acidic and alkaline conditions and drought. Its seeds are dispersed by birds and fruit bats. It is cultivated for its edible fruit, and has become naturalised in some other parts of the tropics, including southeastern Asia.

Local names: Gase hannu, Singapore cherry

Flowers and fruits: Throughout the year

2. *Gmelina arborea* (Gamhar, Shivani)



Description:

The tree attains moderate to large height up to 30 m with girth of 1.2 to 4.5 m with a clear bole of 9-15 m. It has a smooth whitish grey (ashy) corky bark, warty with lenticular tubercles exfoliating in regular patches when old. It is a treat to see the tree standing straight with clear bole having branches on top and thick foliage forming a conical crown on the top of the tall stem. Flowers are bright yellow coloured and attractive. The bark is light grey coloured, exfoliating in light coloured patches when old, blaze thick, a chlorophyll layer just under the outer bark, pale yellow white inside. wood is pale yellow to cream coloured or plukish-buff when fresh, turning yellowish brown on exposure and is soft to moderately hard, light to moderately heavy, lustrous when fresh, usually straight to irregular or rarely wavy grained and medium course textured.

Local names: gambar, khumbhari, kumbuda, kumulu, shivani

Flowers and fruits: February to April

3. *Saraca asoca* (Sita Ashoka Tree)



Description: The tree attain moderate height up to 7 m high. Bark pink-brown, relatively smooth, but inconspicuously and irregularly fissured. Leaves are large, compound, and alternate with strap-like leaflets. Flowers are 1.5 to 2 cm long, attractive and clustered in axillary inflorescences. Fruit is a few-seeded oblong pod.

Local name: Ashok, Anganapriya, kenkalimara (Kannada)

Flower and fruit: March to August

4. Pavetta indica (Paapate gida)



Description: It is an erect, nearly smooth or somewhat hairy shrub 2 to 4 meters or more in height. Bark grey, smooth and irregularly scaly when mature; blaze greenish cream. The leaves are elliptic-oblong to elliptic-lanceolate, 6-15 cm long, and pointed at both ends. The flowers are white, rather fragrant, and borne in considerable numbers in hairy terminal panicles. The sepals are very small, and toothed. The flower-tube is slender and about 1.5 cm long, with obtuse petals about half the length of the tube. The flowers attract butterflies and insects. The fruit is black when dry, and about 6 mm in diameter.

Common name: Indian Pavetta, Indian Pellet Shrub, Kankara, Kathachampa (Hindi), Pavati (Kannada).

5. *Ixora brachiate*



Description: It is a small tropical tree found in evergreen forests of southern parts of India, attain to 10 m tall. Oppositely arranged leaves, 14-16 x 3.5-6.5 cm, are elliptic-oblong or elliptic-obovate, with obtuse tip and acute base. Flowers are white, small, sessile, and fragrant, in terminal paniced cymes. The branches of the clusters are red in color and the flowers are tiny white. Flower tube is 5-6 mm long, narrow, with petals 2 mm long, oblong, bent abruptly backward. Berry, globose, 0.6 cm long, reddish when ripe.

Local name: Gorbale (Marathi)

Flowering: December-February.

6. *Nyctanthes arbor-tristis* (Parijata)



Description: *Nyctanthes arbor-tristis* is a shrub or a small tree growing to 10 m tall, with flaky grey bark. The leaves are opposite, simple, 2–6.5 cm broad, with an entire margin. The flowers are white corolla with an orange-red centre, five to eight lobed and fragrant, they are produced in clusters of two to seven together, with individual flowers opening at dusk and finishing at dawn. The fruit is a heart-shaped to round capsule 2 cm diameter, with two sections each containing a single seed.

Common name: Har singar, Coral Jasmine, Tree of Sorrow, Queen of the night, Har singar, Paarijat (Hindi)

7. *Gardenia gummifera*



Description: It is a small tree which grows up to 3 meters. They are evergreen shrubs and small trees growing to 1-15 m tall. The leaves are 5-50 cm long and 3-25 cm broad, dark green and glossy with a leathery texture, opposite or in whorls of three or four, calyx up to 1 cm long, pubescent, teeth 5-6, short, triangular. Corolla-tube 2.5 – 5 cm long, white, turning yellow. Berry ellipsoid or oblong upto 4 cm long striate, crowned with the persistent calyx.

Flower: March – May

Local name: Naadihingu (Sanskrit), Dikamali (Hindi), Bukki gida (Kannada)

8. *Ervatamia heyneana* (Nandi batlu gida)

Description:

A small deciduous tree with white flowers and orange-yellow follicles, the seed arils red. Bark grey, wood white and pale grey in streaks, smooth, moderately hard. Leaves elliptic-oblong or lanceolate, shortly acuminate at apex. Corolla- tube thick 8-1 in. long dilated at top, calyx-lobes obtuse or emarginated, thick,

Local name: Nag kuda

Prominent trees of Bangalore

Bauhinia purpurea L.

Common name: Butterfly tree

Family: Fabaceae

Description: A medium-sized tree up to 6.5 m high. Leaves alternate, simple, broadly ovate-orbicular, cleft to middle, lobes rounded. Inflorescence a raceme. Flowers are in a panicle, rose to pink. Fruit a pod, flat, pubescent.

Flowering and fruits: October and May

Native: India, Burma, Vietnam

Location: Malleshwaram, Mahalakshmiपुरam, Yeshwanthpura, Jaynagar East, Jayanagar, Rajarajeshwari nagar, Sadashiva Nagar. Cultivated as avenue tree.



Bombax malabaricum DC.

Common name: Red silk-cotton tree

Family: Bombacaceae

Description: A tall native with straight trunk that is covered with hard, sharp, conical prickles. Leaves are large with 3-7 lanceolate to oval leaflets having pointed apex. Flowers are large clustered at the end of branches. Fruit ovoid in shape with five partitions. Seeds are covered with silky white hairs.

Native: India

Flowering and fruits: February – March

Location: Malleshwaram, M.G Road, Sadashiva Nagar.

<i>Cassia spectabilis</i> DC. Common name: Popcorn bush cedar Family: Fabaceae Description: A medium sized tree with dense canopy. Leaves are pinnately compound. Flowers yellow in terminal corymbose panicles. Fruit is a long compressed and dehiscent pod. Flowering and Fruits: March –October Native: Tropical Southeast Asia Location: Malleshwaram, Sanjay Nagar, Sankey Road, M.G Road, Yeshwanthpur, Rajaji Nagar. Dr Rajkumar ward.	
	<i>Cocos nucifera</i> L. Common name: Coconut palm Family: Arecaceae Description: A monoecious palm with regular leaf scars. Leaves are pinnately compound. Flowers are in a branched spadix, male flowers are small and many. Fruit is a drupe. Endocarp is lined with hallow endosperm,, which is edibe. Flowering and Fruits: Throughout the year Native: Indo-Pacific Location: Rajaji Nagar, Mahalakshmi layout, Rajajeshwari Nagar, Basveshwara Nagar, Jayanagar, Yeshwanthpur, Yelahanka. Commonly occur in residential area.

Delonix regia (Bojer ex Hook.) Raf.

Common name: Gulmohur

Family: Fabaceae

Description: Moderate sized tree upto 9 m high.

Leaves alternate, bipinnate, upto 40 cm long.

Inflorescence a corymb. Fruit a pod, long, black, when dry, upto 50 cm long, septate within.

Flowering and fruits: April - June

Native: Madagascar

Location: Rajajeshwari Nagar, Malleshwaram, Rajaji Nagar, Shankar Mutt, Seshadripuram, Yelahanka. Cultivated as avenue tree.



Polyalthia longifolia (Sonn.) Thwaites

Common name: Mast tree

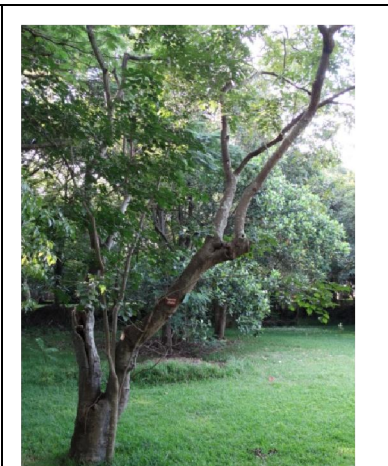
Family: Annonaceae

Description: Tree up to 4 m high. Leaves alternate, simple, shortly-petioled undulate, acute, shining, membranous when young. Inflorescence a panicle, sometimes in a short-peduncled umbel. Fruits a berry, ovoid, reddish black.

Flowering and Fruits: March –April; April –May

Native: South India

Location: Yeshwanthpur, Rajajinagar, Vijaynagar, Malleshwaram, Mahalakshmiapuram. Cultivated as avenue tree.

<i>Spathodea campanulata</i> P. Beauv. Common name: African tulip tree Family: Bignoniaceae Description: Glabrescent evergreen tree, upto 20 m high. Leaves opposite, imparipinnate, ovate-lanceolate, entire. Flowers in terminal racemes or panicles. Capsule linear-lanceolate, acuminate at both ends. Flowering: December –March Fruits: April-July Native: Tropical Africa Location: Malleshwaram, Rajajinagar, M.G Road, Sanjay Nagar, Sadashiva nagar, Raj Rajeshwari Nagar, Vijay nagar, Hebbal. Cultivated as avenue tree.	
	<i>Millingtonia hortensis</i> L.f. Common name: Indian cork tree Family: Bignoniaceae Description: Tree with drooping upto 16 m high. Leaves opposite, simple, 2-3-pinnate upto 30 cm. inflorescence a terminal corymbose panicle. Fruit an elongated capsule, flattened, dehiscent, leathery. Flowering and Fruits: April –May Native: Myanmar Location: Dr. Rajkumar ward, Malleshwaram, Yeshwanthpur, Jaynagar, Sadashiva nagar. Cultivated as avenue tree.
<i>Pongamia pinnata</i> Common name: Indian elm Family: Fabaceae Description: Moderate sized tree upto 7 m high. Leaves alternate, pinnate, stipules small, oblong, caducous. Inflorescence a panicle raceme, axillary and terminal. Fruit a pod, oblong-obovoid, compressed, woody. Seeds solitary, reniform, brown at both ends. Flowering and Fruits: March – April Native: India Location: Malleshwaram, Mahalakshmiapuram, Basaveshwara Nagar. Yelahanka.	

Sl. No	Species	Common Name	Flowering & Fruiting	Root	Benefits to ecosystem/ urban area	Dependent Species	Growth rate and requirements	Method of propagation	Rate	Trees/k m
Description of the trees suggested for planting at sides of the roads										
1	<i>Pongamia pinnata</i>	Indian Beech, Pongam, Honge, Ponge	Flower: March-April. Fruit: Summer	It has a good superficial thick long taproot and condensed network of lateral roots resist drought.	It is semi-deciduous, medium sized tree, nitrogen fixing leguminous tree. It is used as beautification, shade and tolerant to environmental stress. Helps in controlling soil erosion and binding sand due to its compressed network of rooting system.	It attracts bee species such as <i>Apis dorsata</i> , <i>A. cerana indica</i> , <i>Amegilla sp.</i> , <i>Megachile sp.</i> , <i>Xylocopa latipes</i> and <i>X. pubescens</i> .	Height: 9 to 12 m Spread: 9 to 12 m Growth rate: fast. Highest growth rates are observed on well drained soils with assured moisture. It can grow in any type of soil.	It is propagated by seeds and stem cuttings. The seeds can be sown in a pit directly. The seedlings are also raised in nursery bed and then transplanted to the field after one year. The fresh seeds are used for sowing in the month of May-June. One-year old seedling are planted in months of June-July. Young plants need water at an interval of 30 - 35 days at for one year depending on climatic conditions.	Rs.40/-, 100/-	83 trees/km

2	<i>Artocarpus heterophyllus</i>	Jack fruit; Katahal	Summer	The taproot is tuberous long further it tapers abruptly.	It offers many environmental services. It grows moderately rapid in early years and as it reach maturity growth slowdown. It is highly wind tolerant. The tree canopy provides perennial cover to the soil and absorbing the impact of rain on the soil. It also increases the soil fertility and provides the shade.	The small mammals such as common marmoset and coati depends on jack fruit. Also these mammals prey opportunistically on bird's eggs and nestlings, the supply of jackfruit as source of food has allowed them to expand their populations, to the detriment of the local bird populations.	Height: 8–25 m Diameter: 3.5–6.7 m at 5 years of age. Growth rate: fast It grows best in well drained, deep soils of moderate fertility but tolerates a wide range of soils types. It is cold tolerate and prefers sunlight for best growth.	The tree does not tolerate waterlogging or poor drainage. Seeds are sown at a depth of 2 cm and can be laid flat or planted with the hilum pointing down. When plants are not growing properly, about 10-15 kg of farmyard manure per plant should be applied. One year old bare seedlings can be planted in the field during monsoon season.	Rs.150/- (grafted)	82 trees/km
3	<i>Mangifera indica</i>	Mango, Aam	Winter to Summer	The mango has a long taproot that of ten branches just below	It is called “king of fruits”. It encourages water	Birds and small mammals dependent on the mango fruits. Honey bee	Height: 9 to 14 m Spread: 9 to 12 m. Plant at the beginning of the rainy season.	It is propagated by seeds and by vegetative. The seedling are sowed in the nursery bed	Rs.150/-	83 trees/km

				ground level.	Infiltration which will help to reduce flooding. Provides the shade.		Watering is necessary till the first year of the plant. Tree grows in full sun. Particular attention should be paid to weeding and uprooting of competing shrubs where grafted Mango has been planted. The ideal soil has a fairly loose, brittle, crumbly structure.	first then can be transplanted into the fields after 12 months. Planting is done during monsoon at a distance of 8-9 m in dry areas and 10-12 m in humid areas. Weeding should be done regularly to facilitate proper germination.		
4	<i>Syzygium cumini</i>	Java plum, jamun, black plum, Indian blackberry	Winter to summer	The taproot is strong, woody, and prominent.	The tree provides good wind breaks. It also provides shelter.	Frugivorous Birds are Red-Whiskered Bulbul (<i>Pycnonotus jocosus</i>), Blossom-Headed Parakeet (<i>Psittacula roseate</i>), White-Cheeked Barbet (<i>Megalaima viridis</i>), Oriental White-Eye	Growth rate: rapid Height: 10-30 m Diameter: 11-12 m. The tree favors moist, damp or marshy situations, where it tends to form gregarious crops.	It is generally propagated by seeds, where the soil is worked beforehand in lines about 30cm wide and 15 cm deep. The fresh seeds are sown because they lose their viability soon.	Rs.15 0/-, Rs.35 0/- (grafted) Rs 50/- (Seedlings)	50 trees/km

						(<i>Zosterops palpebrosus</i>), Crimson-Backed Sunbird (<i>Nectarinia minima</i>), Yellow-Browed Bulbul (<i>Iole indica</i>), Purple-Rumped Sunbird (<i>Nectarinia zeylonica</i>), Common Myna (<i>Acridotheres tristis</i>) and Coppersmith Barbet feeds on the fruits. Golden-Fronted Leafbird and Blue-Winged Leafbird were seen in the foliage of <i>S. cumini</i>. Bees are also attracted to the small whistle flowers.	Initially it needs shade. It tolerates prolonged flooding, and once established, it can tolerate drought.	Another method: The seedlings can be transplanted into the field when they reach height of 1 m or after 12 months. The spacing should be 20 m. the pit should contain red soil. The soil around the roots should be loosened during the first five years of growth. Planting is done in the beginning of rains.		
5	<i>Azadirachta indica</i>	Neem, Bevu	February – May. Fruit: winter to summer.	It has strong root system with an extensive deep root system and	The hardy Neem can grow luxuriantly even in marginal and leached soils.	Birds which feeds on neem fruits are Yellow-vented Bulbul (<i>Pycnonotus goiavier analis</i>), Black-naped	Height: 12 to 15 m Diameter: 15 to 20 m. A neem should be planted with a distance between tree rows of 25	The seeds can be sown directly at depth of 1 cm. It grows on saline and alkaline soils	Rs.40/-, Rs.12 5/-	50 trees/km

				lateral roots. It is a drought resistant with a well-developed root system.	Neem is a useful species for improving soil fertility due to the quality of its leaf litter. It is a good source of carbon sink. It is an effective shade tree widely planted as an avenue tree. Improve the quality of air. Reduced the noise pollution	Oriole (<i>Oriolus chinensis</i>), Common Myna (<i>Acridotheres tristis</i>), Asian Glossy Starling (<i>Aplonis panayensis strigata</i>), Pink-necked Green Pigeon (<i>Treron vernans</i>), Lineated Barbet (<i>Megalaima lineata hodgsoni</i>) and Common Asian Koel (<i>Eudynamys scolopacea</i>). The honey-scented white flowers, found in clusters, are a good source of nectar for bees.	m, a width of the rows of 0.5 m and distance between trees of 4.5 m. Young plants cannot tolerate intensive shade, frost or excessive cold. The tree needs little water and plenty of sunlight.	having pH up to 9.8. Planting should be done during July-August. If the seedlings are taken from nursery then one year old seedling can be transplanted into the field during monsoon season.		
6	<i>Ficus benghalensis</i>	Banyan, Nyagrodha, Bargad, Aladhamara	Throughout the year	The taproot is strong and thick more than twice of the thickness of stem.	Ficus is keystone species and have large influence over their ecosystem in relation to both their	The figs are eaten by the birds and mammals. Fruit are key resource for some frugivores includes bats,	Grows well in deep sandy loam soil. It requires light for the growth. It is very hard species can come	It is propagated by branch cuttings of 2m -3 m in length. Cuttings are planted in 30 cube pits filled with sand and	Rs.150/-	The crown of the tree covers nearly half a kilometre, so only 2 trees

					abundance and biomass. It is National tree of the country. It provides shelter. It has a very strong root system which improves the soil fertility and water retention capacity in soil.	capuchin monkeys, langur and mangabeys. It is important for some birds, Asian barbets, pigeons, hornbills, fig-parrots and bulbuls. The Lepidoptera caterpillars, crow butterflies, giant swallowtail, brown awl, moths feed on fig leaves.	up in crevices of rocks.	watering daily for first six weeks. The top end is sealed with cow dung and mud paste to avoid drying up. The suitable time for cutting is January – March. Watering should be done twice a day for the initial of 15-20 days after transplanting and then once in day till the seedlings attain a height of more than 1.5 m.		can grow in the 1 km.
7	<i>Ficus religiosa</i>	Bodhi, Pipal (peepal, peepul, pippala, pimpal, etc.), arali or Ashvastha	December to March	The root system is well developed.	Peepal is unrivalled for its antiquity and religious significance. <i>Ficus religiosa</i> is large deciduous tree which improve the ecological	The tree could be shelter for various birds (Yellow-footed Green Pigeon, Jungle Myna, and Chestnut-tailed Starling) and insects. Provides food for bats.	Height: 19 m Growth Rate: 0.6 per Season Longevity: 40 to 150 years. Sowing is normally carried out in March – April.	It is propagated from seeds as the cuttings do not form roots easily. Watering should be done twice a day for the initial of 15-20 days after	Rs.12 5/-	The crown of the tree is round. It covers appropriately 30-40 m. 25 trees /km

					sustainability by carbon sequestration. Peepal releases large quantities of Isoprene a volatile organic compound necessary for preventing depletion of ozone layer concluding that these trees play an important role in preserving ozone layer. Adaptable to a number of environments, so long as the climate is reasonably warm year-round. Tolerate to dust and smoke.		It grows on a wide variety of soils but prefer deep, alluvial sandy loam with good drainage. The seeds are spread on the surface and lightly covered with soil. The water is necessary till the tree attains maturity.	transplanting and then once in day till the seedlings attain a height of more than 1.5 m.		
8	<i>Michelia champaca</i>	champak, champak or champac, champac, sampige	December to April	The species has deep extensive taproot system.	Improves the soil fertility. It is planted in the avenue road for	It attracts birds	Growth rate: Moderate Height: 50 m	Nursery raised seedling either bare root or with a ball of earth can be planted.	Rs.15 0/- (grafted)	The crown shape will be conical to

		and shamba			ornamental purpose.		Watering can be reduced after establishment. A general fertilizer has to provide before new growth begins in spring.	The spacing should be 10-15 cm. It prefers shade during hot months hence it should be raised in gap-regeneration and under-planting areas. A regular watering is required during the first growing season.		cylindrical. The crown size is 5 – 10 m. Around 100 trees /km.
9	<i>Ficus racemosa</i>	Indian Fig, Atthimara, Udumbara	Throughout the year	It has a very strong taproot system which traveling far beyond the tree canopy.	It provides shelter from wind, protect against pollution, for defining boundaries and for assisting in the creation of beautiful landscape.	Birds, monkey, butterflies and other mammals feeds on the fruit and also provides shelter.	Watering is necessary at the initial stage of the sapling growth.	Propagation is commonly done by branch/stem cuttings. Cuttings of 2 m in length are planted in July. Cuttings are planted 50-60 cm deep.	Rs.12 5/-	The diameter of the crown is 40 to 45 m. Around 22 trees can be planted in 1 km.
10	<i>Butea monosperma</i>	Flame of the forest, Mutthuga, Kinshuk, Palash, Dhak	January to May	The tree is very drought resistant and frost hardy.	It is dry deciduous tree. Tolerant to dust and smoke and reduce noise pollution.	The flowers contain nectar which attracts frequent visits of many species of birds; sunbirds, mynahs,	Height: 13.7m Width: 18.3m Growth Rate: Medium	It is propagated by seeds and through suckers. The seeds are sown in the	Rs.12 5/-	The crown size is 10 m. About 100 trees/1

				The tap root develops like a tuber upto some length. It is thicker than the shoot.	It improves the quality of soil.	hummingbirds and babblers.	Water Requirement: Average Water Soil type: Loam, Sand Tolerances: Drought Seasonal Interest: Spring, Winter. Soil pH should be Acidic, Neutral and Well drained soil Drained.	nursery in the month June-July. One-year old seedlings are suitable for planting. The spacing between saplings should be 20 m apart.		km can be planted.
11	<i>Cassia fistula</i>	Kakke mara, suvarnaka, bendra lathi, golden shower, Indian laburnum	March to May	It has strong taproot system	It is deciduous tree, medium-sized tree. It is relatively drought tolerant and slightly salt tolerant. Minimize the pollution. The crown of the tree reduce high temperature. Provides shading, improve air quality.	These flowers are attractive to bees and butterflies.	Height: 5 m Rate of Growth: Fast It is salt tolerant at medium extant. Requires deep, well drained and moderately fertile soil. Water Requirements: Medium drought tolerance. Nutritional Requirements: Balanced liquid fertilizer monthly.	They are propagated by seeds. The seeds are sown in March-April at the distance of 25 cm. Pre-sowing seed treatment is done in water for better germination. Watering is required at the initial days. Full sunlight is required.	Rs.10 0/-	The crown shape is irregular and crown size is 5 – 10 m. 100 trees can be planted in 1 km.

12	<i>Polyalthia longifolia</i>	Ulkat, Kastadaru ha (S); Debdari, Ashoka (H); Madras Ashoka (K)	March -April	It has a single taproot that goes down till it hits water.	It is planted due to its effectiveness in alleviating noise pollution. It provides shade for pedestrians.	Fruits are eaten by birds or monkeys.	Height: 30 m Growth rate: very fast It requires full sun light and moderate amount of water. Proper pruning and cutting is necessary to avoid falling.	It is mainly propagated by seeds. Fresh seeds are sown because they lose their viability in short time. The seeds can also be sown directly at permanent sites.	Rs.10 0/-	The crown is conical in shape. The crown size is 2m. 333 trees can be planted in 1 km.
13	<i>Bauhinia variegata</i>	Kanchaval a, Kachnar	November - February	The taproot is strong.	It is medium-sized deciduous tree. It provides shade. It is grown as ornamental.	The flowers are fragrant, attractive to butterflies, bees and birds.	Height: 6m The taproot should be handled carefully during transplantation. It grows fast in first season. It is mainly propagated by seeds. The seeds are sown in April-May.	Direct sowing: The seeds are sown 3m apart, before commencement of the monsoon. Weeding and watering is essential during the first three months of growth. If the seeds are sown in raised nursery beds. After 12 months, seedlings can be transplanted into the fields.	Rs.10 0/-	The crown size is 3-6 m. 166 trees/ km

								It should be transplanted into 30 cm pits at a distance of 6-8 m.		
14	<i>Lagerstroemia speciosa</i>	Pride of India	March - June	It has wide spreading taproot system	It provides shade for pedestrians. It is tolerant to drought. It is grown for ornamental purpose.	It prevent soil erosion.	Height: 20 m It grows in drained soil with full sunlight.	The seedlings are raised in nursery bed and/or containers. One year old seedlings are suitable for planting. It gives better success from root and shoot cuttings when planted just before the onset of monsoon than during monsoon.	Rs.12 5/-	The crown diameter is 5 to 10 m. 100 trees/km
Description of the saplings suggested for planting at median of the roads										
1	<i>Muntingia calabura</i>	Gasgase hannu, Singapore cherry	Summer months. Fruit: throughout the year	Wood is compact, fine-grained, moderately strong and light in weight and durable.	It is drought-resistant but not salt-tolerant. Fast growing tree that makes for a favorable shade tree.	Fruits with sweet aroma are edible, and attract birds, bats, and monkeys.	Height: 3-12 m Width: 20 cm Growth rate: very fast The seed requires light to germinate. Seed requires high temperature and light conditions for germination.	The plant is propagated by cutting. The saplings should be planted 6-8 m apart, in a pit prepared with mixture of sil and decomposed	Rs.40/-	Crown is spreading and has drooping branches . The crown size is 5-10 m. about

							The seedlings do not tolerate shade. Water is provided in spring winter.	manure or other organic matter. Annual pruning has to be done to shorten branches to avoid breakage.		100 trees can be grown along the 1 km.
2	<i>Gmelina arborea</i>	gambar, khumbhari, kumbuda, kumulu, shivani	April – May. Fruit: May – June.	The roots are strong which are situated within 3 m below soil surface.	Helps to conserve soil. It is resistant to drought, fire, wind damage, and high intense heat.	The fruit of is edible, attract birds, bats and other mammals.	Height: 35m Diameter: more than 3 m Growth rate: Fast It grow well in wild sands on deep clay loams. Requires regular watering. It takes 2-3 months to raise Gmelina seedling in nursery. It does not grow in sandy soils.	It is propagated by seeds. The fresh seeds are sown directly in the permanent place.	Rs.10 0/-	The crown size is 5m. 200 trees/km .
3	<i>Saraca asoca</i>	Sita Ashok, Achenge	March – August. Fruit: August-September	It has well branched taproot system.	It is evergreen perennial tree. Air pollution tolerant species.	Tree produces large bunch of sweet smelling flowers throughout the year which attracts butterflies and birds. Bats disperse the fruits.	Height: 8.5m - 15.2m Growth Rate: Slow Soil pH: Acidic, Neutral Soil Drainage: Well Drained Soil type: Loam, Sand	The seedlings can be transplanted into the fields after they are one year old, during the monsoon season. It should be planted in 60	Rs.15 0/-	The crown size is 5-8 m. Along the 1 km road 125 trees can be grown.

						This tree also is the larval food plant of the Tailed Jay butterfly.	Water Requirements: Average Water. The tree grows well in partial sunlight. It requires organic-rich fertile, moist soil with an acid pH. Potassium fertilizer is required. Limited tolerance to drought.	cubic meter size pits. The spacing should be 10 m apart. The sapling cannot withstand direct sunlight and require a humid atmosphere in initial six months of growth.		
4	<i>Pavetta indica</i>	Indian Pavetta, Indian Pellet Shrub, Pavati	April -June	It has much branched taproot system.	It is evergreen shrub. Improve the fertility of soil. It is used as ornamental plant.	The flowers are white, sweetly scented flowers attract many pollinators such as birds, bees, wasps, beetles, ants and butterflies. These in turn attract birds and other predators. Birds love the fruits and these are obviously distributed by birds.	Height: 2-5 m	<i>Pavetta</i> is propagated by seed, and vegetatively by cuttings. Seeds of <i>Pavetta indica</i> are sown in a fibrous, loam-based medium, with added sharp sand and charcoal. Fertilizer can be added, but the presence of nitrogen-fixating bacteria enables <i>Pavetta</i>	Rs 50/-	The crown size is 5-8 m. 125 trees/km

								<i>indica</i> to thrive in a nitrogen-deficient soil as well.		
5	<i>Ixora brachiata</i>	Gorbale (Marathi), Gurani, Kurati (Konkani)	December-February	It has strong taproot system	A medium sized evergreen tree. It is endemic to Western Ghats. It is used for ornamental purpose.	Flowers are white, scented and fruit is edible which attracts birds and butterflies.	Height: 10 m It requires regular watering.		Rs.40/-	The crown size is 5m. 200 trees/km .
6	<i>Nyctanthes arbor-tristis</i>	Har singar, Coral Jasmine, Tree of Sorrow, Queen of the night	August, September-October. Fruit: April-May	The taproot is strong.	Nyctanthes arbor-tristis is a shrub or a small tree. It is used for ornamental purpose.	Flowers are small, delightful fragrant which attracts bees and butterflies.	Height: 10 m It grows well in a wide variety of loamy soils and it requires sunlight from full to partial shade. It require water regularly but not over watering. Proper training and purning is required.		Rs.40/-	The crown size is 5 m. About 200 trees can be grown along the 1 km.
7	<i>Gardenia gummifera</i>	Gummy gardenia, Cambi gum tree, Kad Bikke	February - October	The root system is strong and deep.	It is evergreen shrub. It is used for ornamental purpose.	It produces a small, sweet fruit.	Height: 3 m Regular watering is required and it requires sunlight from full to partial shade.	It is propagated from seeds or by layering.	Rs 40/-	The crown size is 5-6 m. 166 shrubs/k m.
8	<i>Ervatamia heyneana</i>	Nagarkuda ,	March -April		Endemic to the Western Ghats.	Night-flying moths are	Height: 2-5 m		Rs 40/-	The crown

		Pandrakur a			It is used for ornamental purpose.	attracted to the flowers.				size is 5- 8 m. 125 trees/km .
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Maintenance cost:

- 1) Each sapling need 2ft X 2ft width, 2ft depth pit.
- 2) Distance between 2 saplings is 15 to 20 feet.
- 3) Digging pits, Manuring, planting and closing the pit costs: Rs 200 per plant
- 4) Tree guard using natural material like bamboo and thorns costs: Rs 100 per plant; Using metal tree guard for 5 feet eight costs: Rs 1,000 per plants.
- 5) Maintenance for 3 years costs Rs 400 per plant.
- 6) Daily water during the first year
- 7) 2-3 days once watering in the 2nd and 3rd years

Sapling	200-400 Rs per sapling
Digging and planting	Rs 200 per sapling
Tree guard	Rs 100
Number of avenue trees	40-50 trees per km per side
Maintenance cost (watering, labour, etc.)	Rs. 150 per sapling during the first year Rs. 100 per sapling during the next year



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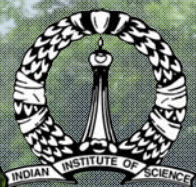
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