IRC:SP:103-2014

GUIDELINES ON TREE PLANTATION ALONG RURAL ROADS

(The Official amendments to this document would be published by the IRC in its periodical, 'Indian Highways' which shall be considered as effective and as part of the code/guidelines/manual, etc. from the date specified therein)

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GUIDELINES ON TREE PLANTATION ALONG RURAL ROADS

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GUIDELINES ON TREE PLANTATION ALONG RURAL ROADS

INTRODUCTION

The Guidelines on Landscaping and Tree Plantation, First Revision (IRC:SP:21-2009) published in November 2009 provides comprehensive guidance on landscaping and roadside arboriculture along highways. The Ministry of Rural Development (MoRD), Government of India requested that the Indian Roads Congress may consider bringing out a special publication on plantation of trees along rural roads as the focus of the current publication appears to be more towards roads of higher categories.

In view of the urgency expressed on this requirement, the Ministry of Rural Development set up a small group comprising a few domain experts from the forest sector to provide inputs to the IRC for consideration. (List of Members at Appendix-I).

It was decided to have the Guidelines for Tree Plantation along Rural Roads formulated by the Rural Roads Committee (H-5) keeping in view the already published document of the IRC on the subject and the special inputs of the Group constituted by the MoRD.

The draft of the said Guidelines was prepared by a small group comprising Shri N.C. Solanki, Director (Projects-I), NRRDA and Member-Secretary, H-5 Committee; Dr. I.K. Pateriya, Director (Technical), NRRDA and Member H-5 Committee; Dr. B. Mukhopadhyay, Deputy General Manager (NHAI) and Members of the group constituted by the MoRD.

The draft was discussed by the H-5 Committee during its meeting held on 1st August, 2014. The Committee deliberated over the draft and approved it with some suggestions. The Convenor was authorised to modify the same by suitably incorporating the suggestions made in the meeting.

The Personnel of the Rural Roads Committee (H-5) is given below:

Gupta, D.P.	--------	Convenor
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Gupta, S.K.	Sarkar, Prof. A.K.
Jain, Dr. M.C.	Satish, J.

The draft finalized by the Rural Roads Committee was discussed by the Highways Specifications and Standards Committee (HSS) in its meeting held on 9th August, 2014. The document finalized by the HSS Committee was approved by the Executive Committee in its meeting held on 18th August, 2014. The IRC Council in its meeting held at New Delhi on 19th August, 2014 approved the draft IRC:SP:103-2014 "Guidelines on Tree Plantation along Rural Roads" for publishing.

1 SCOPE

1.1 India is witnessing a major development of road infrastructure to catalyse its socio-economic development. In order to give a boost to rural connectivity, a Rural Roads Programme known as the Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched in December, 2000. Another programme known as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is being implemented as a rights-based, demand-driven and self-selecting scheme with a view to enhance livelihood security to rural households. Some roads are being built under this programme. Side by side, several States have taken up the construction and improvement of rural roads to all-weather standards to provide connectivity to lower size habitations not covered under the PMGSY eligibility criteria. Roadside plantation will check deterioration of roads and will contribute to strengthening ecological balance and reducing global warming.

1.2 The Indian Roads Congress (IRC) brought out a document entitled "Guidelines on Landscaping and Tree Plantation" (First Revision) in the year 2009 as a special publication, IRC:SP:21-2009. This document provides guidelines for plantation of trees and strategies for landscaping along highways. This is serving as a very useful guide to the road agencies particularly dealing with main roads (National Highways, State Highways, Major District Roads) and roads in urban areas. It also covers guidelines on selection of tree species in different areas of the country but lacks focus on guidance for rural roads. It is, therefore, felt

that a separate document on the Guidelines for Plantation of Trees along Rural Roads may be prepared that would provide guidance to the road agencies that are implementing the PMGSY and other rural roads programmes in the country. This document has been prepared and finalized accordingly.

1.3 It needs to be pointed out that unlike main roads, the rural roads being upgraded or constructed under the various programmes rely mostly on voluntary donation of land by the local communities. As such, there could be situations where the available Right-of-Way is not sufficient enough to accommodate any tree plantation.

1.4 It is not possible to lay down rigid and uniform standards for tree plantation along rural roads, as the plantation scheme to be adopted may vary from place to place depending upon the topography, climate and other environmental features. As such, this document lays down broad guidelines subject to such modifications as may be governed by local site conditions. It would be productive and useful, if the road agencies keep in contact with the departments dealing with Forest and Agriculture for seeking their advice as to the selection of species and methods of plantation.

1.5 These guidelines are divided into seven sections to focus attention on different aspects of plantation relevant to rural roads, types of species, spacing of plantations, maintenance, bio-engineering measures for slope protection duly drawing reference to the material already contained in the Special Publication IRC:SP:21-2009 and MoRD Specifications for Rural Roads, First Revision (2014).

2 IMPORTANT ASPECTS IN RESPECT OF RURAL ROADS

2.1 The plantation of trees along rural roads is to be confined to the available Right-of-Way. No attempt should be made to acquire additional land for the purpose of tree plantation.

2.2 In view of the limited space likely to be available along the PMGSY and other rural roads, only single row of plants would generally be provided. A spacing of 4 m to 6 m between tree plants may be adopted. In case block areas are available along the road side, the spacing grid of 3 m x 3 m may be adopted. Two rows of trees along rural roads may be provided where there is adequate Right-of-Way already available for two rows of trees.

2.3 It should be borne in mind that for plantation, the strategy of using saplings of minimum 1.2 m height proves much more effective in reducing the mortality rate. The use of seedlings (less than 900 mm in height) shall be avoided in case of rural roads. The mortality of such seedlings along the road side is rather high.

2.4 Sapling should be procured preferably from nursery of the forest department or any other Government Department. Further, for providing saplings in the plantations, a dedicated nursery of suitable capacity should also be raised. Schemes such as MGNREGS can be availed of for such purposes.

2.5 Only quality planting material should be used for plantation.

2.6 The plantation should be maintained for a period of four years from the year of planting. Vacancy filling/replacement should be carried out regularly from second year onwards. During initial stages of plantation, sometimes weeding and other plant diseases could occur. This will require particular attention.

2.7 The raising of avenue plantation should form an integral component of rural road including PMGSY. Proper monitoring and evaluation of the plantation should be done as a follow-up.

2.8 Nature has devised vegetation in a manner that only specific varieties thrive in particular climates. Planting of vegetation as a part of landscaping along rural roads should, therefore, be restricted as far as possible to local species already thriving in the area served by the road.

3 GENERAL CONSIDERATIONS NEEDING ATTENTION

3.1 Existing features along a road alignment, whether natural or man-made, can contribute significantly to general road landscape and every effort should be made to preserve, incorporate and integrate these into the landscape. A reconnaissance survey should be made to identify all valuable natural features such as natural wooded areas, streams, ponds, rock outcrops, scenic vistas etc., in addition to man-made features like historical buildings, monuments, gardens, etc. During design, and later during construction, every care should be taken to avoid damage to them.

3.2 Conservation of existing grass and plant growth needs no emphasis. In all road cuttings, top soil should be preserved and reapplied after completion of grading operations, on slopes etc., to help growth of vegetation.

3.3 While constructing roads in forest areas, felling of trees should be kept to bare minimum. Fire should never be used in cleaning operations as this will destroy natural regeneration of young trees and drive out wildlife. The effect of felling on undergrowth and wildlife also needs to be kept in view.

3.4 In the design and development of arboriculture, certain restrictions imposed by engineering, traffic and safety requirements should be kept in view. Some of these are:

- Trees should be planted minimum 0.5 meter beyond the toe of the roadway and as close to the edge of the Right-of-Way as possible so that they are not a safety hazard or affect the required sight distance.
- Considerations of sight distance and safety be primary.
- Shrubs and trees should be planted clear of roadside drains and other drainage structures so that their root system does not interfere with efficient working of the drainage facilities.

3.5 Typical cross-sections showing the location of trees on rural roads with different carriageway width and formation width are given in **Figs. 1 to 3**. To facilitate systematic execution of operations involved in roadside arboriculture, it will be advisable to prepare a detailed work plan including necessary drawings for field use. These should cover the scope and extent of the proposed activities, pattern, type and location of plantings, plant species to be used etc. and should be simple enough that can be easily understood by the field crews.

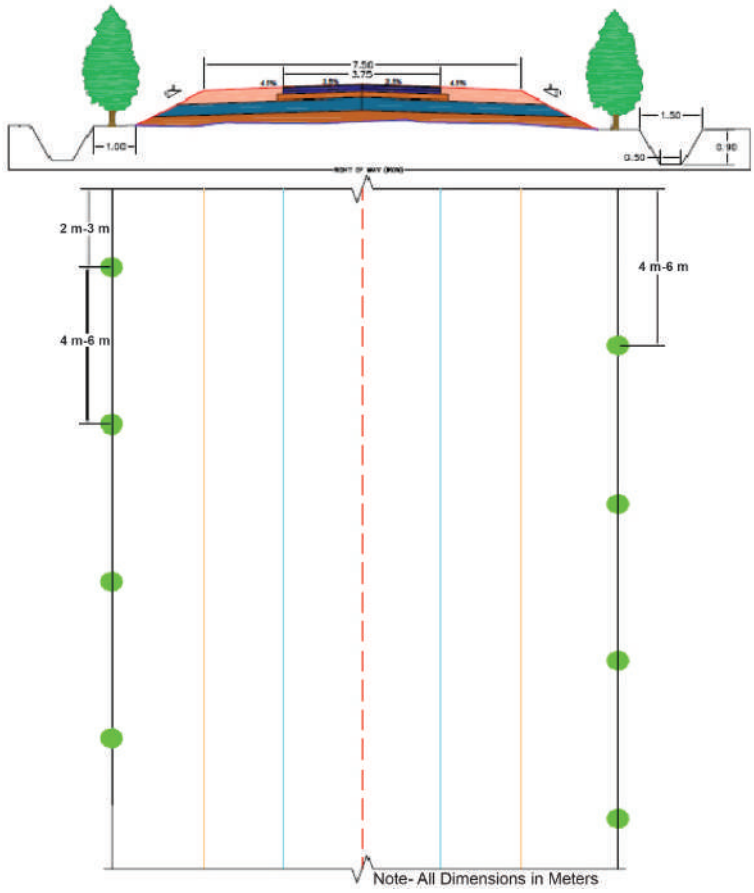

Fig. 1 Typical Cross-Section and Plan for Single Lane (3.75 m Carriageway) and 7.5 m Formation Width in Rural Area

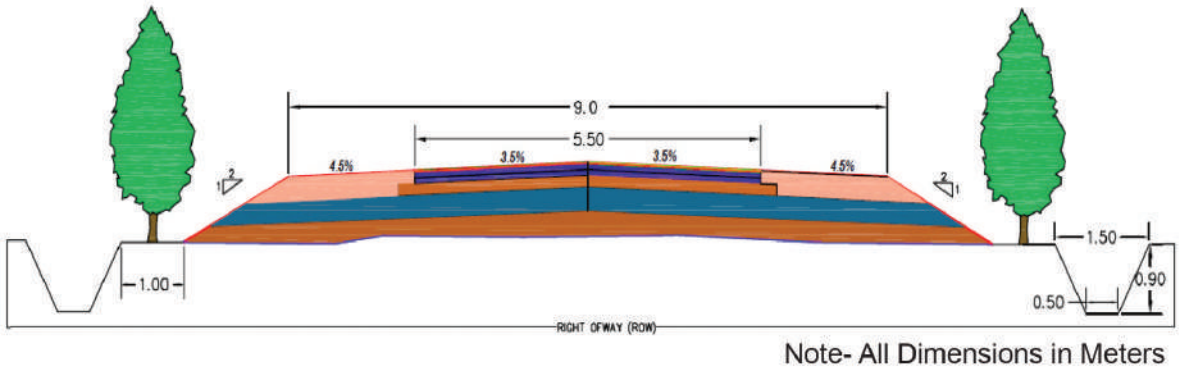

Fig. 2 Typical Cross-Section for Intermediate Lane (5.5 m Carriageway); with 9.0 m Formation Width in Rural Area

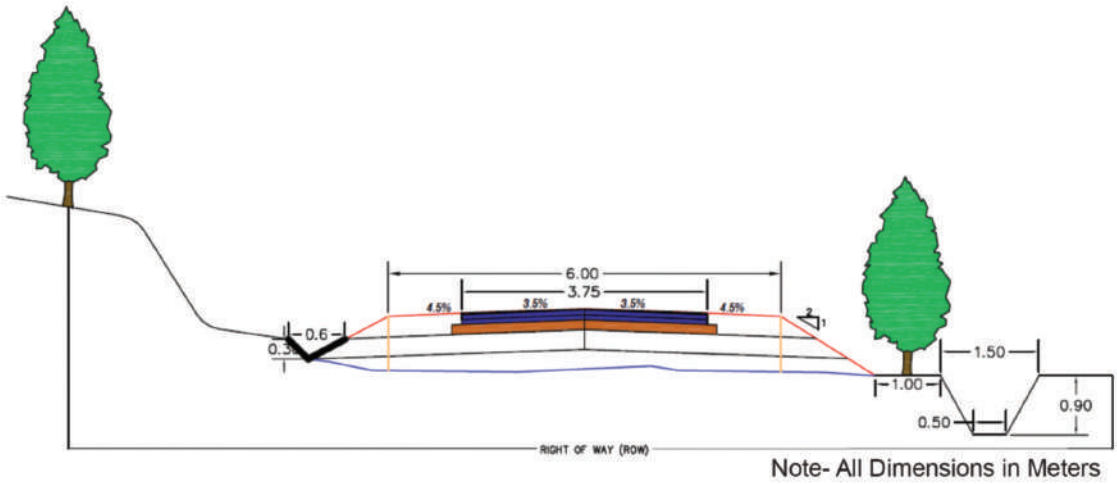

Fig. 3 Typical Cross-Section of Link Route with 6.0 m Formation Width in Rural Areas in Cutting

3.6 Ornamental and flowering species of plants should be selected for plantation along the road, near the entry of village and also near the junctions from the main roads. Species with aroma which do not attract cattle should normally be proposed along the road.

3.7 In areas where limited land is only available and farmers are reluctant for plantation because of shadow of plants, particular species like “Poplar” may be used for plantation, which leaves its leafs in winter avoiding shadow on crops in the nearby fields.

Photo 1 Road Side Plantation

4 BROAD GUIDELINES FOR ROADSIDE PLANTATION

4.1 General

4.1.1 This section gives broad guidelines about different aspects of roadside arboriculture. For proper selection of plant, species of native plants have been recommended for different climatic regions. In **Appendix-II**, principal details of each of the species such as their name in different languages, characteristics of growth, and the suggested location of use has been described. This Appendix is divided into two categories. Category 1 are the species that are to be provided normally in a single row along rural roads. Category 2 are the species which can be provided only where two rows are possible.

4.1.2 From the point of livelihood and nutrient angles, apart from the green factor, the plants can be divided into four categories (**Refer Appendix-III**).

4.2 Selection of Species for Plantation

Trees, shrubs and climbers have been used to enhance the soft natural ambience against harsh elements in most of the enhancement schemes. The planting species are decided based on the physical growth characteristics of trees, like form and shape, foliage pattern, growth rate, branching pattern, soil characteristics and conditions of the strip like water logged areas etc. The selection of plant types and planting arrangement should be based on the following considerations:

- shape (spread of the tree) and size.
- texture and colour of foliage/flower/fruits in different seasons and stages of growth.
- adaptability and suitability to agro-climatic regions/zones.
- growth rate (slow/fast), average age of maturity and replacement cycle.
- after-care and maintenance required for sustenance and growth.
- economic and other social/recreational benefits.
- drawbacks and demerits if any, like prone to insects/pests disease, animal grazing and human interference.

4.3 Other Considerations

Plantations along the embankment slopes and near major water bodies play a major role in the control of erosion. Similarly, green cover in the form of turfing stabilizes steep slopes and high embankments.

4.4 Ornamental Trees

Generally, only one row of trees would be possible on rural roads. In such cases, ornamental species should be planted instead of shade bearing species. A combination of ornamental, shade and screening trees have been recommended. The number of rows and the repetition of the trees and their type vary with the road cross section and the space available in the RoW for tree plantation.

Tables 1 and **2** list a few species, which can generally be planted throughout India for this purpose.

Table 1 Species Recommended for 1st Row of Avenue Plantations

S. No.	Soil	Botanical Name	Local Name	Flowering Month/ Colour
1.	Normal Loamy soils	Acacia auriculiformis	Vilayati babool	September-October/ Yellow
2.		Bauhinia sps.	Kachnar	February-March/Pink
3.		Cassia fistula	Amaltas	May/Yellow
4.		Cassia nodusa	Cassia	May-June/Pink
5.		Delonix regia	Gulmohar	May/Yellow
6.		Jacaranda mimosaefolia	Jacaranda	April/Blue
7.		Peltophorum ferrugineum	Peltophorum	October/Yellow
8.	Water logged areas	Cordia dicotma	Lasoda	
9.		Syzygium cuminii	Jamun	
10.		Terminalia arjuna	Arjun	
11.	Alkaline soils [Usar]	Albizzia lebbek	Kala Siris	
12		Pongamia pinnata	Kanji	
13.		Terminalia arjuna	Arjun	

Table 2 Species Recommended for 2nd Row of Avenue Plantations

1.	Normal Loamy Soils	Albizzia lebbek	Kala siris	
2.		Dalbergia sissoo	Shisham	
3.		Gravillea robusta	Silver Oak	
4.		Malia azadiracta	Bakain	
5.		Pongamia pinnata	Kanji	
6.		Terminalia arjuna	Arjun	

4.5 Shade Plants

The shade trees in the second row, where sufficient land is already available, should be planted at a spacing of 8 to 12 metres. These tree species should be of local significance and should be mostly evergreen in nature, which ensures no substantial leaf-fall in winters preventing the problem of blockage of roadside drains. Trees with the following characteristics should be planted as shade trees:

i. Trees with high crown forms secure better visibility and are therefore ideal.

ii. Trees that retain their foliage longest are preferred to deciduous trees.

iii. Trees with long gestation period and having rapid growth and capacity to resist fungal and insects attack form ideal avenues.

The tree species recommended as shade plants for roadside avenues are given in **Table 3**. These species can be planted almost throughout India.

Table 3 Shade Trees Recommended for Roadside Avenues

Soil	Species	
	Local name	Botanical Name
Loamy	Arjun	Terminelia arjuna
	Imli	Tamarindus indica
Water Logged Areas	Jamun	Syzynium cuminii
	Mahua	Madhuca indica
	Mango	Mangifera indica
Alkaline [Usar]	Neem	Azadirachta indica [at pH up to 8.5]
	Kanji	Pongamia pinnata [upto 9.0 pH]
	Peepal	Ficus religiosa
	Paker	Ficus infectoria
	Shisham	Dalberjia sissoo
	Neem	Azadirachta indica
Sandy	Shisham	Dalbergia sissoo

Region-wise specific lists have been provided in the **Annexes A** to **E**. It is recommended that local experts from the Forest department and Horticulture department should be consulted before finalizing the choice of species for a particular stretch.

4.5.1 *Fruit Bearing Trees*

Fruit bearing trees along the rural roads may be planted where sufficient land is available for planting of such trees in such a manner that they do not spread on to the road. For selection of fruit bearing trees reference may be made to **Appendix-III**. Fruit bearing trees and trees of medicinal values may also be preferred in case of block plantation. Community participation through social mobilization, in case of fruit bearing trees may be resorted to for safeguard of plants and fruits. This will also help in improvement of livelihood for rural people.

4.6 Plantation in Special Areas

4.6.1 *Water Logged Areas*

Waterlogged areas along the road are generally a result of inadequate drainage conditions, the road acting as a bund and contributing to water logging, high water table of the region or the low lying nature of the terrain itself. Planting in such sites after proper drainage is now a common practice. Jamun, Mahua and Mango are usually recommended for waterlogged areas. Bamboos can also be planted in such areas.

Soils become waterlogged when water builds up and is not able to drain away. This leaves no air spaces in the saturated soil, and plant roots literally drown. Waterlogging limits oxygen supply to the roots and prevents carbon dioxide from diffusing away. Root function is reduced

or it stops and the roots start to die off, allowing the invasion of rots and decay organisms. This has a subsequent effect on the visible parts of the plant, as the leaves and stems are unable to obtain enough water and nutrients.

Mounding is essential on wet sites. A study undertaken some time back showed that tree survival improved from 65 percent to over 95 percent by mounding on sites prone to seasonal waterlogging. On wet sites, mounds should be aligned to allow excess water to drain off the site without causing erosion. The drainage furrows created on each side of the mound provide important additional drainage. For maximum effect, these should be continuous, and connected into the drainage network. The mound should be constructed at least 200 mm to 300 mm high and about 1000 mm wide. Even larger mounds may be required on very wet sites.

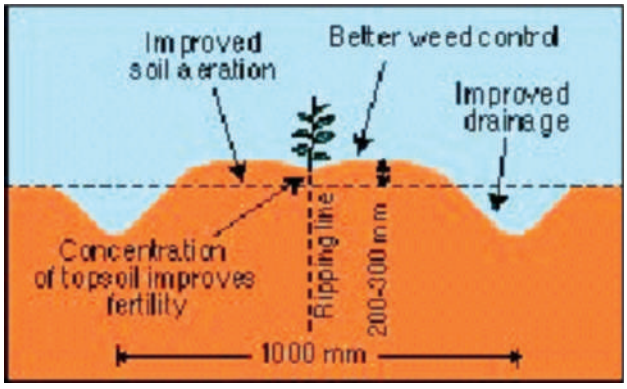

Fig. 4 Mounding on Wet Sites

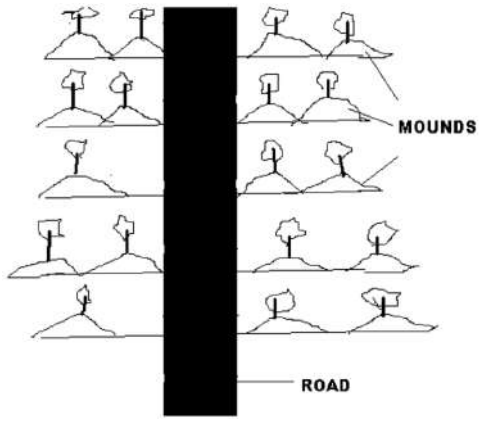

Fig. 5 Tree Planting in Waterlogged Areas

Photo 2 Mounds in Waterlogged Area

4.6.2 *Alkaline Soils*

Alkaline (Usar) soils are frequently encountered in some areas of the country. The species recommended for such soils include; Azadirachta indica, Ailanthus, Terminalia arjuna, Pongamia, Albizzia lebbeck, A. procera.

4.7 Specifications for Avenue Plantations

The technical specifications for plantations are given in **Table 4**.

Table 4 Technical Specifications for Plants

A Ornamental plants (Normally First Row)	
Distance from toe of embankment	Minimum 0.5 m away from the toe of the embankment and close to the edge of the Right of Way (ROW).
Spacing between plant to plant	4 m to 6 m
Spacing between rows	3 m minimum
Size of the pits	60 x 60 x 60 cms (in alkaline soils, kankar pans to be broken by augur. In waterlogged areas, mound with height varying depending on water level)
No. of plants per km	167 to 250 on one side
Height of the saplings at the time of planting	1.2 m to 2 m
Survival percentage of plantation	90% at any time
B Shade plants (Second row)	
Distance from preceding rows	3.0 m minimum
Spacing between plant to plant	8 m to 12 m (6 m if high mortality expected)
Size of the pits	60 x 60 x 60 cms (in alkaline soils, kankar pans to be broken by augur. In waterlogged areas, mound with height varying depending on water level)
No. of plants per km	84 to 125 (167 at 6 m spacing) on one side
Height of the saplings at the time of planting	More than 2 m
Survival percentage of plantation	90% after replacement of casualties in first two years. 80% afterwards

In localities where a really bad patch of saline soil (usar) occurs, there is a need to dig deep pits by augur (mechanical device) to break the kankar pan down below and replacing the soil by good quality soil. The pits should be filled with the soil amender Gypsum (1 to 3 kg per pit, depending on the pH) along with 2 kg compost and sand. The treatment helps in lowering down the pH and thus enabling better survival of plants.

4.8 Protection Measures

4.8.1 Brushwood fencing or live fencing should be used to prevent the browsing of saplings by the cattle. Bamboo or locally available material may be used for making the tree guard. RCC/MS angles should not be used for rural roads.

4.8.2 Brushwood fencing or live fencing – plantation of shrubs or hedge during the preparation of plantation site prior to tree plantation. These should be with spacing of 1 m, in two rows, with tree in between.

4.9 Specifications for Grass Turfing

4.9.1 The surface is to be prepared adequately for grass sowing. The grasses and shrubs planting is done to provide a strong surface cover but needs a well-prepared surface. All masses of loose debris should be removed. Any convexities should be removed and similarly any concavities are to be filled up by good soil. The surface should have sufficient layer of good quality soil (upto 450 mm) so as to have better growth and survival of grasses and shrubs.

4.9.2 Grass lines are used to provide a strong surface cover but need a well-prepared surface in which to be planted. If grass is to be an effective form, then it must be allowed to establish properly on a slope which does not subject to undue stress from erosion and mass movement in its initial stages.

i. Sowing of grasses is intended to create a strengthened surface that is resistant to erosion.

ii. The condition of the site is good enough for the successful establishment of grasses.

iii. A cover of 25 grams of grass seed per square meter of surface should be achieved.

iv. The timing of sowing is of utmost importance. The seed sowing must be carried out before the onset of monsoon (May & June) so that they yield desired results. The watering of the surface will be done by tankers till the onset of the monsoon.

v. After sowing, mulch of prepared and dried out herbs should be laid over the whole seeded area in a thin layer so that the direct sunlight and transpiration loss may not affect the grasses.

4.10 Activity Schedule

Plantation activities are highly time specific, as the plants respond to the seasonal variations in climatic conditions. Generally, plantation works are started in our country with the onset of monsoon. However, if it is possible to provide irrigation facilities, it is advisable to utilize the high temperatures of summers. Generally plants respond well to irrigation during peak summer seasons, as the conditions are very favourable for growth if moisture is not the limiting factor.

4.10.1 *Watering of Plants*

Water is an essential component of living organism, since it contains 30-40 percent of their body weight. Most of the organic and inorganic substances are sparingly, partly and completely soluble in it. It is a major raw material for the photosynthesis by which plants produce their food.

The essential nutrients for plants are mostly transported by the water either by itself or when water mixes with other constituents like elemental, molecular or compound form. Sometimes, it may act as a bridge between two or more intra or inter-constituents which will help to supply the desired nutrients from soil and also from atmosphere.

The quantity of water requirement depends largely on the nature of species, soil quality, depth of the first aquifer and on the climatic condition of that area. The relative humidity, temperature, wind speed and wind direction have major role in this regard. About 450 to 650 litres of water is required per plant per year since the very beginning of the plantation till it attains its normal safe size and growth i.e. about 6-7 years from the date of plantation. The external supply of water is to be continued till the roots of that species may be able to absorb the required quantity of water from the soil strata. The quantity and the frequency of watering is given in **Table 5**.

Table 5 Activities Schedule for Avenue Plantation

Year	Month		Activities to be done
1st Year	January-March	1	Surveying & cleaning of the area
		2	Digging of Pits
		3	Procurement of brushwood and live fencing
2nd Year	April-June	1	Purchase of Farm yard manure
		2	Fencing
		3	Plantation along the road
		4	Filling up of Pits with Farm Yard manure and Soil
	July-August	1	Transportation of Plants
		2	Planting of Saplings
		3	Watering
		4	Weeding and hoeing
	September-November	1	Weeding and hoeing
		2	Watering 4 times a month
	December-February	1	Weeding and hoeing
		2	Maintenance
	March	1	Watering 4 times a month
3rd year	April-June	1	Watering 6 times a month
	July-August	1	Casualty Replacement (20% of the total plants)
		2	Weeding
		3	Maintenance by Mali
	September-November	1	Watering 2 times a month
		2	Maintenance by Mali
	December-February	1	Maintenance by Mali
	March	1	Watering 4 times a month
		2	Maintenance by Mali
4th Year	April-March	1	Watering
		2	Casualty Replacement (10% of the total plants)
		3	Maintenance by Mali

4.11 Monitoring Requirements

The monitoring schedule, parameters for monitoring the progress and status of plantations are given in **Table 6**.

Table 6 Proposed Monitoring Arrangements

Phase	Monitoring Parameter
1st Year (Advance Soil Work)	Number of pits
2nd Year (Plantation of Saplings)	Survival percentage of saplings
3rd Year (Maintenance of Plantation)	Survival percentage before & after. Casualty replacement. Height of plants
4th Year (Maintenance of Plantation)	Survival percentage before & after. Casualty replacement. Height of plants

4.12 Training and Pruning of Shrubs

By nature of their growth, shrubs tend to take extra growth or unbalanced growth. Thus regular training and pruning by cutting and removal of undesired parts of twigs is required.

4.12.1 *Training*

The process of providing desired form and size to a shrub plant is training. This is done by cutting away all growth that does not come in the desired frame, shape and size. Training of plants is started when they are still young. 3-4 branches are allowed to grow from main stem near the ground, radially to different directions. These are further divided into 2-3 branches each making oval shape of 3 m diameter in spread near the ground and 1.5 to 2 m high. This process is completed in 3-4 operations of cutting and pruning in first 2 years of growth. When the plants take their final size and shape, they are annually cut to this shape by pruning extra growth once or twice a year.

4.12.2 *Pruning*

Pruning involves cutting and removal of parts, twigs, limbs or branches of shrubs. Besides giving desired shape and size, pruning helps in:

- Encouraging vigorous growth by allowing proper air, light and food to the parts retained.
- Removing over-crowding and weak branches.
- Removing dried up, diseased and pest infested parts.
- Regulating and increasing flowers/fruit production.

While doing operations of training/pruning; proper tools and implements like pruning knife, pruning saw, tree pruner, secateurs & shears etc. should be used. Care should be taken that bark of the plants is not damaged, ruptured, or pealed off. After deciding the framework to be retained, shoots should be cut back to desired size and shape. All the sick, thin and interwining twigs should be removed for allowing air and light to the desired ones.

Generally, flowering buds are produced in 6-8 months old shoots, which are usually cut away through repeated indiscriminate cutting without applying scientific principles of pruning. Consequently, neither these shrubs take their optimum spread (vertical & lateral) nor produce colourful flowers as required.

Time of pruning is important and it should be done only in the season of dormancy i.e. when the plants are not in active growth. This period comes usually from December to January & May to June. Blooming time is February to June & September to December. However, light pruning and pinching of tips can be done any time when it becomes necessary due to other emergent reasons of safety and sanitation etc.

5 BIO-ENGINEERING MEASURES IN SLOPE STABILIZATION AND PROTECTION

5.1 Bio-engineering measures involving use of living plants shall be undertaken in conjunction with engineering solutions for stabilization and protection of road side slopes against erosion and to improve drainage. Bio-engineering works would be complementary to civil engineering structures and would normally not replace them. The materials and skills involving execution of bio-engineering measures are available in rural areas. Plants used in bio-engineering would perform one or more of the required functions of anchoring and reinforcing the surface material by extending roots down below into firmer strata, catching erodible material or debris or draining the excess water discharge from the slopes. Plant types and the methodology adopted for the plantation vary in their ability to resolve the various slope stabilization requirements. Hence, selection of the plants and the methodology for their adoption is a vital function for the success of the bio-engineering techniques. For details refer to Section 16 (Clause 1612) of the MoRD Specifications for Rural Roads, First Revision, 2014.

6 BRIDGE STRUCTURES AND APPURTENANTS

6.1 Bridges and Approaches

For bridge structures and their approaches, the following points may be kept in view:

i. The bridge structure including appurtenants like railings, parapet walls etc. should be designed to contribute to the overall aesthetics of the road and landscape.

ii. Approaches to bridges should blend with the terrain of the land, retaining natural beauty of the surrounding areas. Where possible, the approaches to major bridges should be so aligned that the bridge is visible from a distance and catches the eye of the road users, thereby breaking the monotony of travel.

iii. Adequate planting and other landscape measures in the proximity of bridges can enhance the beauty of the area.

6.2 Intersections and Junctions with Main Roads

At intersections of rural roads with main roads, the plantation design should consider the basic standards of height limitations and appropriate sight lines. The intersection should be visible for sufficient distance from all the approaching roads.

7 MAINTENANCE OF ROADSIDE PLANTATION

7.1 Maintenance of roadside plantation includes a number of operations such as (i) tending saplings of trees and plants till they can stand by themselves, (ii) selective pruning of shrubs, trees etc., from considerations of traffic operations and safety, and (iii) maintenance of grass in turfed areas.

7.2 Selective pruning or cutting of trees and shrubs will be required in situations where these (i) interfere with sight distance, (ii) come in the way of effective street illumination, (iii) are too close to the carriageway so as to be hazardous, (iv) conceal desirable views and scenic vistas, and (v) have become too old or dead.

7.3 Maintenance of vegetation should be scheduled for the most effective seasons for each class of work. For example, grass mowing should be at intervals governed by growth rates, fertilizing of turf should precede maximum growth periods, and selective pruning of plants should precede the dormant period. Some items of roadside maintenance such as tree removal and tree care, which are not seasonal, may be scheduled for other periods.

7.4 The trees and plants should be maintained under the guidance of horticulture staff and new plants put up wherever necessary in adequate time, especially to replace the dead and old trees. Proper working plans should be prepared where the work involves felling of mature trees/plantation.

Photo 3 Grownup Plants

Annex-A

(Para 4.5)

List of Trees Suitable for Arid and Dry Regions of South Haryana, Rajasthan, Gujarat, Maharashtra and Central Plateau

	Botanical Name	Common Name
1.	Ailanthus excels	Maharukh
2.	Azadirachta indica	Neem
3.	Alstonia scholaris	
4.	Acacia auriculiformis	
5.	Butea monosperma	Palas
6.	Bombox ceiba	
7.	Cassia fistula	Labernum/Amaltash
8.	Cassia siamea	Siamese Cassia
9.	Calistemon viminalis	Bottle brush
10.	Calistemon citrinus	
11.	Ceiba pentandra	
12.	Cochlospermum religiosam	
13.	Casuarina equisetifolia	
14.	Dalbergia sissoo	Sheesham
15.	Erythrina variegate	
16.	Ficus sp	Peepal, Bargad, Pakur etc.
17.	Gmelina arborea	Gambhari
18.	Heterophragma adenophyllum	
19.	Moringa oleifera	Sahjan
20.	Melia azadirachta	Bakain
21.	Millingtonia hortensis	
22.	Pongamia pinnata	Karanj/Papari
23.	Plumerio sp.	
24.	Parkinsonia aculeate	
25.	Syzygium cumini	
26.	Tecoma undulata	Rohira
27.	Tamarindus india	Imli
28.	Terminalia sp.	

Shrubs

1.	Bougainvellia	Garden glory
2.	Cassia glauca	
3.	Cassia alata	
4.	Jatropa podagarica	
5.	Nerium oleander	Kaner
6.	Poinciana pulcherima	
7.	Thevetia nerifolia	Yellow Kane

Trees suitable for Moist Areas

Moist locality consists of areas where rainfall is high and of longer duration. The soil remains moist but not necessarily waterlogged. High humidity pervades the atmosphere. Trees suitable for moist areas are:

1. Alstonia scholaris
2. A. macrophylia
3. Amherstia nobilis
4. Barringtonia acitamgi;a
5. B.racemosa
6. Bauhinia variegate
7. B. pupurea
8. Brownea coccinea
9. B. ariza
10. Cassia marginata
11. C. javanica
12. C. nodosa
13. Colvillea recemosa
14. Delonix regia
15. Dillenia indica
16. Guaiacum officinale
17. Lagerstroemia speciosa
18. L. thorelli
19. Millettia peguensis
20. Peltophorum ferrugineum
21. Samanea saman
22. Polyalthia lognifolia

23. P. pendula
24. Pongamia pinnata
25. Putranjiva roxburghii
26. Saraca asoca
27. Terminalia arjuna
28. Tamarindus indica

Trees Suitable for Marshy Areas

Areas which remain waterlogged for a considerable period of the year come under this ecological environment. Trees suitable for such areas are:

1. Barringtonia acutangula
2. B. racemosa
3. Eucalyptus rostrate
4. Hibiscus tilliaceus
5. Salix babylonica
6. S. tetrasperma
7. Tamarix articulate

Of the above species eucalyptus rostrate can not only grow under marshy conditions, but has capacity to draw up large quantities of water for transpiration. Sometimes this species is used for drying up marshy land.

Trees Suitable for Saline Tracts

Saline tract is present along the coastal areas where the tidal waves submerge the land periodically. Besides, vast saline tracts are met within the country where waterlogging is a perennial problem. Here the accumulated body of water finds release mainly in to the atmosphere through evaporation leaving behind the salts on the surface. This condition for decades, or even for centuries, have turned the soil very saline. Trees suitable for such tracts are those that can stand drought as well as high concentration of salinity. The example of such trees are:

1. Acacia auriculiformis
2. Butea monosperma
3. Casuarina equisetifolia
4. Cochlospermum religiosum
5. Eucalyptus Citriodora
6. Heritiera macrophylla
7. Inga dulcis
8. Perkinsonia aculeate

9. Pongamia pinnata
10. Samanea saman
11. Tamarix articulate
12. Thespesia populnea
13. Tamarindus indica
14. Terminalia arjuna

Plants Disliked by Cattle

Truly speaking, this grouping of trees does not belong to the ecological classification. But this group is useful where stray cattles are plenty and pose a problem for the protection of trees, particularly at the young age. Selection of plants that are disliked by cattle will help toward off the menace from these animals. Some trees under this group are:

1. Cassia fistula
2. C. nodosa
3. C. javanica
4. C. siamea
5. C. renigera
6. C. multijuga
7. C. marginata
8. C. moschata
9. Holarrhena antidysenterica

List of Trees suitable for Arid and Dry Regions of South Haryana, Rajasthan, Gujarat, Maharashtra and Central Plateau

1. Acassia ausiculitrormis
2. Bombox ceaba
3. Callistemon citrinus
4. Ceiba pentandra
5. Cochlospermum religiosam
6. Erothrina variegatum
7. Heterosphrogma adenophyllum
8. Millingtonia hortensis
9. Pwmerio sp
10. Syzgium umini
11. Casurina equisetitioia
12. Perkirisonia aculiata

Annex-B

(Para 4.5)

Trees suitable for temperate and sub-tropical areas of North-West India, J&K, Punjab, Himachal Pradesh, Uttarakhand, Part of U.P.

	Botanical Name	Common Name
1.	Barringtonia accutangula	
2.	Cedrus Deodara	Devdar
3.	Delinia indica	Chilla
4.	Grevillea robusta	Silver Oak
5.	Holoptelia integrifolia	Papri
6.	Juglans regia	Akhrot (Walnut)
7.	Michelia champaka	
8.	Myrica nagi	Kaphal
9.	Pinus sp	Chir
10.	Pterospermum acerifolium	
11.	Salix sp	Soal
12.	Sapindus musorossi	Reetha
13.	Taxus baccata	Thuner

Shrubs

1.	Artabortrys odoratismis	
2.	Bougainvellia	Garden glory
3.	Hydrangea	
4.	Hibiscus sps.	
5.	Nerium oleander	Kaner
6.	Rhododendron/Azalias	
7.	Salix sps.	
8.	Thevetia nerifolia	Yellow Kaner
9.	TMC single and double	
10.	Tecoma	

Annex-C

(Para 4.5)

Trees suitable for Indo Gangetic Plains of Uttar Pradesh, Punjab, Bihar and West Bengal

	Botanical Name	Common Name
1.	Albizzia lebeck	Siris
2.	Albizzia proeera	Safed Siris
3.	Butea monosperma	Palash
4.	Bauhinia variegate	Kachnar (Pink)
5.	Cassia fistula	Labernum/Amaltash
6.	Cassia siamea	Siamese Cassia
7.	Cedrela toona	Toon
8.	Chikrassia tabularis	Chikasi
9.	Calistemon lanceolatus	Bottle Brush
10.	Dalbergia sissoo	Sheesham
11.	Emblica officinalis	Aonla
12.	Ficus sp	Peepal, Bagad, Pakur, etc.
13.	Gravellea robusta	Silver Oak
14.	Hardwickia pinnata	Malabar Mahagani
15.	Lagerstroemia thorli	Pride of India/Jarul
16.	Lagerstroemea floriginea	-do-
17.	Morus alba	Shahtoot
18.	Mengifera indica	Desi Mango
19.	Pterospermum acerifolium	Kanak Champa
20.	Putranjiva	
21.	Polyalthea longifolia	Ashok
22.	Syziguim cumini	Jamoon
23.	Terminalia arjuna	Arjun
24.	Terminalia belerica	Bahera
25.	Terminalia chebula	Harr/Myrobalam
26.	Tecoma argentia.	

Shrubs

1.	Bauhinia alba	
2.	Bauhinia acuminate	
3.	Bougainvellia	Garden glory
4.	Cassiabiflora	
5.	Cassia alata	
6.	Cassia lavigata	
7.	Calliandra	
8.	Duranta	
9.	Gardenia floria	
10.	Hamelia	
11.	Hibiscus sps.	
12.	Ixora	
13.	Nerium oleander	Kaner
14.	Thevetia nerifolia	Yellow Kaner
15.	Tecoma stans	
16.	TMS single and double	

Annex-D

(Para 4.5)

List of Trees suitable for North Eastern States, North Bengal, Assam, etc.

	Botanical Name	Common Name
1.	Alstonia scholaris	Chatuni/Saptparni
2.	Albizzia lebeck	Siris
3.	Cryptomeria japonica	Dhupi
4.	Colvelia racemosa	
5.	Cratevea religiosa	Barna
6.	Cinchona sps	Cinchona (Quinine tree)
7.	Lagerstroemea floriginea	Pride of India
8.	Lagerstroemea thorali	-do-
9.	Michelia champaka	Champa
10.	Pterospermum acerifolium	Kanak Champa
11.	Shorea robusta	Saal
Shrubs		
1.	Bauhinia alba	
2.	Bauhinia acuminate	
3.	Bougainvellia	Garden glory
4.	Calliandra	
5.	Duranta	
6.	Gardenia floria	
7.	Hibiscus sps.	
8.	Ixora	
9.	Nerium oleander	Kaner
10.	Thevetia nerifolia	Yellow Kaner
11.	TMS single and double	

Annex-E

(Para 4.5)

List of Trees suitable for Coastal Areas of Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Orissa, etc.

	Botanical Name	Common Name
1.	Anacardium occidentale	Cashew nut
2.	Cinamomum camphora	Kapoor
3.	Casurina equistifolia	Casuarina
4.	Dalbergia latifolia	Rosewood
5.	Mengifera indica	Mango
6.	Palms	
7.	Pterospermum acerifolium	
8.	Saraca indica	Sita Ashok
9.	Sweitenia mahogoni	Mahogoni
10.	Sweitenia macrophylla	-do-
11.	Tabubia spectibilis	
12.	Tabubea rosea	
Shurbs		
1.	Bougainvellia	Garden glory
2.	Bauhinia alba	
3.	Bauhinia acuminate	
4.	Calliandra	
5.	Crosandra	
6.	Gardenia floria	
7.	Hibiscus sps.	
8.	Hamelia	
9.	Musanda	
10.	Magnolia sps.	
11.	Nerium oleander	Kaner
12.	Tecoma stans	
13.	Tecoma capensis	
14.	TMS single and double	
15.	Thevetia nerifolia	Yellow Kaner

Appendix-I

List of Members of the Committee on Tree Plantation along Rural Roads constituted by Ministry of Rural Development for providing inputs to H-5 Committee of IRC

Convenor

1.	Shri D.P. Gupta	(Retd.) Director General (RD) & AS, MoRTH

Members

2.	Shri S.P. Vashishth	Director (MGNREGS) MoRD, New Delhi
3.	Shri R.P. Singh	Addl. Chief Executive Officer, BRRDA, Patna
4.	Dr. B. Mukhopadhyay	Deputy General Manager, NHAI, New Delhi
5.	Shri P.L. Kadu	Superintending Engineer (PMGSY), Nagpur
6.	Shri Ashish Kumar	Chairman, NGO Bargad, Patna
7.	Shri N.C. Solanki	Director (Projects-I), NRRDA
8.	Dr. I.K. Pateriya	Director (Technical), NRRDA
9.	Shri Chaman Lal	Director (Projects-III), NRRDA

Appendix-II

(Refer Para 4.1)

BROAD DETAILS OF PLANT SPECIES NATIVE IN INDIA

Abbreviations: Mar-Marathi Kan-Kannada Tam-Tamil Guj-Gujarati
Tel - Telugu Beng - Bengali Mal-Malayalam

A Category 1: For Single Row along rural roads

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
1.	Acacia Arabica		Kikar, Babul, Babul		Small, Thorny	Grows well in the plains of the Indo-Gangetic plain, especially the Punjab. It is also grown in U.P., Madhya Pradesh, Rajasthan and Maharashtra. Unsuitable for places of extreme winter frost. Its thorns and thinness of shade are drawbacks as an avenue tree, but it can be used in dry places for checking erosion since it sends deep roots. Good value for timber
2.	Acacia modesta		Phulai		Small, Thorny	Small sized hardy tree, found indigenously in the Punjab. Suitable for sowing on rocky and dry ground where irrigation is impossible. Does not have a smooth and flowing appearance and is ragged looking. Should be tried only when nothing better will grow
3.	Alstonia Scholaris	Devils tree	Chatium	Chattim (Beng)	Large sized, shady flowering	Large evergreen tree, straight growing, branches spread laterally in whorls giving dense shade underneath, leaves palmately compound. Produces greenish white fragrant flowers. Timber used for making boxes, black boards, etc.
4.	Anacardium occidentale	Cashewnut	Kaju	Munthri, Andimagottai (Tam) Jidimamidi Tel) Parangimavu (Mal) Geru (Kan) Kaju (Beng)	Medium sized edible fruits	Medium sized tree, yielding fruits ripening in May-July. Common in west coast of India. Thrives on sandy and gravelly soils. Ideal for preventing wind erosion in coastal belt. Not suitable for avenues.
5.	Bambusa bambos	Bamboo	Bans	Mungli (Tam) Bongu Meduru (Tel) Mola (Mal) Biduru (Kan)	Poor shade, economic value	Bamboo grows in fairly moist climate. Not good for shade as its spread is limited. Not a tree for avenue. Bamboo has good economic value.
6.	Bassia Latifolia	Mowa	Mowa	Illuppai (Tam) Kippa (Tel) Irippa (Mal) Ippegida (Kan) Mohua (Beng)	Medium sized thick foliage slow growth	Medium sized tree, common in the plains of India. Leaves fall off in February-April, and new ones appear in April-May. Affords good shade and is a good avenue tree.
7.	Bauhinia uariegata		Kachnar	Kandhan (Beng)	Small sized, quick grown light foliage, flowering	Common in the northern hills of the country though also found in the Indo-Gangetic Plains. An ornamental tree while in flower, end of moderate size.
8.	Bombax malabari cum	Red silk cotton	Regai Simal Simbal	Mulilavu (Tam) Mundla Burga (Tel) Pula (Mal) Mullu Buraga (Kan) Simul (Beng)	Large sized, quick growth, light foliage, flowering	Fast growing deciduous tree, but short-lived (life about 20 years). Tall tree with a straight bole and branches in whorls. Needs high water table and light rich soil. Timber has great economic value. Grown throughout India, except in arid climate. Fairly good shade. Rather a formal tree, but is useful to mix with others.
9.	Borassus Flabellifera	Palmyra Palm	Thar	Panai (Tam) Thati (Tel) Pana (Mal) Pane (Kan) Tab (Beng)	Palm, slow growth, unbranched, edible fruits	The tree has economic worth because of the juice tapped from it. Well grown trees have large luxuriant leaves. Long stems and sturdy trunks. Not for shade.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
10.	Callistemon lanceolatus	Bottle brush	Lal botal brush		Handsome, evergreen, flowering	A low evergreen tree with slender dropping twigs, bark very rough and deeply cleft vertically into narrow ridges. Narrow smooth leathery leaves are clustered near the ends of the twigs. Produces bright red bottle brush like flower in abundances. Suitable for avenue planting.
11.	Cassia auriculata	Tanner's Cassia	Tarvar	Avarai (Tam) Thanged (Tel) Avara (Mal) Avara (Kan)	Small sized, dense foliage, flowering	Small tree with dense foliage. Yellow flowers in winter make it attractive. An inhabitant of dry salt land. Very hardy plant, affording good ground cover against erosion.
12.	Cassia siamea		Chechwa		Small sized quick growth, light foliage, flowering	A small sized deciduous tree, leafless in February-March. The flowers are yellow colour when fresh, later turning to bright green. The tree gives good appearance because of colour of flowers. A good choice for ornamental planting but not suitable for avenue planting as it does not give much shade.
13.	Cassia siamea		Chechwa		Small sized, thick foliage, weak wood, flowering	Quick-growing tree, but short-lived and liable to damage from wind. A good shady tree in hot weather. Not a very good roadside avenue tree, but picturesque because of its yellow flowers in clusters. Drought resistant, grows in poor soils. Successful in Uttar Pradesh and Madhya Pradesh.
14.	Castanosper mum australe	Moretan Bay Chestnut			Medium sized evergreen, thick foliage	This middle sized evergreen tree has a straight trunk, smooth grey bark, rather drooping branches and dense handsome imparipinnate foliage, very suitable for tropics as shade tree owing to its dense and handsome foliage.
15.	Ceiba Pentandra	Kapok tree	Safed Simal	Swet Simal (Beng)	Tall, deciduous, flowering	A tall tree with straight trunk which is pickle when young. Numerous branches spring from the same level and radiate horizontally outwards. Leave fall in winter and creamy white flowers appear in clusters at ends of twigs before new leaves appear.
16.	Cocos nucifera	Coconut palm	Nariyal	Thenga (Tam) Kobbari, Tenkaya (Tel) Thenga (Mal) Tengina (Kan) Narikel (Beng)	Tall, unbranched, edible fruits	Grows ideally in coastal belt with heavy rainfall. Good economic yield.
17.	Cordia sebestena	Scarlet Cordia	Lal Lasora	Virigi (Tel) Acchinarurihli (Tam)	Small sized, flowering	A small tree, some times branching from the base. Has dark grey bark which is rought and marked with longitudinal furrows.
18.	Crataeva religiosa	Bengal quince	Barna	Barum (Beng) Bilpatre (Kan) Varmo (Guj) Mili (Mal)	Small sized, light foliage, slow growth, flowering	A spreading tree with medium height. Leaves triplicate and deciduous. Very beautiful when laden with cream coloured flowers in April. A shady tree in summer. Hardy and drought resistant.
19.	Dillenia indica	Elephant apple	Chalta	Chalita (Beng) Karambal (Guj) Akku (Tam) Kalinga (Tel)	Medium sized, thick foliage, slow growth flowering	A medium sized tree of compact habit and roundly shaped form. Leaves large with serrated margin. Flowers large, white and fragrant. Prefer moist localities.
20.	Diospyros embryopteris	River ebony	Gab	Gab (Beng)	Small sized, evergreen, thick foliage, slow growth	An evergreen tree with a dense rounded crown of dark green shiny with low spreading branches which sometimes touch the ground. New leaves are bright red.
21.	Ehretea serrata		Punyan	Kulaaja (Beng)	Medium sized, evergreen, flowering	An evergreen tree of moderate size having white grey bark marked with longitudinal cracks. Leave long narrow and pointed. Bears pretty white flowers.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
22.	Feronia elephantum	Woodapple	Dharkth Kaveet Bhel Katha	Vila (Tam) Velaga (Tel) Vilavu (Mal) Baelada (Kan) Kartbal (Beng)	Small sized, light foliage	Not a very shady trees. Grows in any soil and does not require much nursing and care. Not grow on the hills. Yields fruits having medicinal properties. Its leaves are used for workship in Hindu temples.
23.	Ficus glomerata	Country Fig	Gular, Dumer	Atthi (Tam) Medi (Tel) Atthi (Mal) Atthi (Kan) Umbar (Mar)	Medium sized, quick growth, shady, weak wood	Medium sized tree with green leaves. Best planted on camping grounds and near wells. Good shade-giver. Quick growing and semi-evergreen. Has weak wood and should not be used for road avenues.
24.	Gliricidia maculate	Madre tree			Small sized, flowering	A small-quick growing tree with long feathery leaves. Leaf-fall in February, followed by sprays of pale pink flowers. Suitable for inner avenues of urban roads.
25.	Gamelina arborea	Candahar tree	Gamhar		Medium sized, deciduous, fast growth	A fair sized deciduous fast growing tree having a whitish bark and spreading branches which form a large shady head. The large leaves are heart-shaped with long points. The tree is drought resistant.
26.	Grevillea robusta	Silver Oak			Tall, columnar, thick foliage, slow growth, flowering	A tall narrow graceful tree with rough barks, short branches and deeply divided fernline leaves which are dark green above and silvery below. The tree forms a beautiful conical shape. Bears orange flower in March-April.
27.	Harduickia binate		Anjan		Medium sized thin foliage	Not very large tree. Slow grower and not a good shade giver, but ornamental. Thrives on rick and sandy soil, but not in water logged locations. Planted in U.P., M.P. and Maharashtra.
28.	Hetrophragma adenophyllum				Medium sized, handsome, evergreen	A handsome evergreen tree of fair size with rough brownish bark marked with cracks, short branches dark green foliage consisting of very large leaves.
29.	Holarrhena antidysente rica	Eastern tree	Verra	Kurachi (Beng)	Small sized, flowering	This is a low tree with rather rough, pale brownish bark and large narrow leaves set practically without stalk in opposite pairs along the smaller branches. White scented flowers grow in loose clusters at the ends of the twigs.
30.	Holoptelea Integrifolia	Indial Elm			Sub-Himalayan, shadey	A sub-Himalayan tree, planted for shade. A good tree for avenue planting.
31.	Jacaranda mimofaefolia		Nili gulmohar		Small sized, flowering	A small tree with fern-like bipinnate leaves and pyramidal panicles of blue flowers. Suitable for dry areas. Bears violet blue flowers in March-April.
32.	Lagerstroemia flosreginae	Pride of India	Arjun	Jarul (Beng) Challa (Kan) Atampu (Mal) Kadalai (Tam)	Medium sized, light foliage, flowering	A medium sized evergreen tree with a short trunk and bushy crown. Leaves are narrow with blunt points., becomes red before fall, bears brilliant lilac flowers. Timber has good value. Moisture loving tree, thrives on river banks.
33.	Mangifera indica	Mango	Amaltas	Manga (Tam) Mamidi (Tel) Mayur (Mal) Mavina (Kan) Am (Beng)	Large sized, shade edible fruits	Large evergreen tree with a dense found crown of dark-green leaves. Essentially a shade tree and has economic value because of fruits and timber. Practically grows on any soil, but rich loamy soil is preferable. Moisture is essential but stagnant water near roots is fatal to be tree. It is very long-lived tree but tends to develop hollows with age. Grafting is necessary from trees of a good variety. One of the most useful trees for roadside avenues.
34.	Melia eradirachta	Persian Lilac tree	Bakain	Ghoraneem (Beng)	Medium sized, deciduous flowering	A handsome tree of moderate size, very fast growing, leaves divided into separate pointed leaflets. It resembles Neem. Deciduous, bears lilac coloured flowers in summer. Rather short lived.
35.	Mesua ferrea			Nagochampa (Mar) Naga Sampighi (Kan)	Small sized, quick growth light foliage, flowering	A small sized tree yielding highly scented flowers. Good for isolated plantings.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
36.	Michelia champaka		Champa	Champa (Mar) Sampighi (Kan)	Small sized flowering	A small sized tree yielding highly scented flowers. Good for isolated paintings.
37.	Milletia Ovalifolia	Moulmein rosewood			Small sized, light foliage, flowering	A very beautiful small tree with a rounded crown and branches that have a tendency to drop. Bear brilliant lilac flowers in March-April.
38.	Mimusops elengi	Elengi	Mulsari	Magizh (Tam) Mukuzha (Mal) Ranji or Bakur Bakul (Beng)	Medium sized thick foliage	Moderate sized tree, widely cultivated. Thrives in moist conditions.
39.	Nauclea Cadamba		Chota kadam		Medium sized flowering	The tree is of moderate size, having a short straight trunk, large broad rounded leaves covered with minute hairs on lower surface. Bears orange yellow scented flowers of compact spherical heads.
40.	Olea ouspidata	Olive	Kau		Medium sized thrives in hills	Medium sized tree common in the northern hills upto an altitude of 2000 m. Timber has good value.
41.	Parkinsonia aculeate		Vilayti babool		Small sized flowering	A small tree with drooping branches. Leaves are very finely divided, bears bright yellow flowers suitable for dry and saline tracts.
42.	Phoenix dactylifera	Date – Palm	Khajur	Perichchu (Tam) Karajuramu (Tel) Tenicheha (Mal) Kharjura (Kan) Khejur (Beng)	Salt and erosion resistant, Palm, edible fruits	Tree yields date fruits. Gives good protection against soil erosion. Thrives in arid regions.
43.	Phyllanthus emablica	Indian gooseberry	Amla	Nelli (Tam) Usirika (Tel) Nellikay (Mal) Nellikai (Kan) Amalaki (Beng)	Medium sized light foliage, quick growth, edible fruits	Medium sized tree yielding sour edible fruits. Not a shady tree.
44.	Pongamia glabra	Indian beech	Kanji	Pungu (Tam) Ganuga (Tel) Punja (Mal) Honge Gida (Kan) Karanj (Mar) Kanaj (Guj)	Medium sized, quick growth, shady, flowering	Moderated sized, nearly evergreen, fast growing tree with good shady crown. Prefers moist localities, though it grows also in dry places. Have good timber value and seeds yields oil.
45.	Populus alba		Poplar		Tall, handsome	A very tall, graceful tree, forming magnificent avenue on highways in the Kashmir valley.
46.	Prosopis apicigerra		Jand Cheonkar		Medium sized, thorny	A moderate sized thorny tree, native of dry regions of Rajasthan, Haryana and Punjab. The tree sends down deep roots and is well adapted for cultivation in dry districts.
47.	Pterospermum acerifolium		Much kund Kanak champa		Medium sized thick foliage, flowering	An elegant middle sized tree with large rounded leaves dark green above and white below. The tree forms a good crown and dense shade. Flowers cream coloured and fragrant, prefers moist climate.
48.	Putranjiva roxburghii	Child life tree	Jiva – putra		Medium sized, thick foliage, slow growth	This is a medium sized evergreen tree with dark grey bark, narrow shining dark green leaves which are arranged in two rows on either side of long drooping twigs. Provides dense shade, slow growing.
49.	Rhododend ron arboretum	Rhodod endron	Bars		Small sized flowering, thrives in hills	A small tree with grey foliage and handsome flowers. Thrives at altitudes 1500-2500 m. Suitable for growing in sheltered places on slopes of hills
50.	Robinia pseudocacia	Robinia			Thrives in northern hills	Suitable for roadside plantings in hills of the north. Thrives on loose soil, but needs fair amount of moisture.
51.	Salix babylonica	Weeping willow			Resistant to waterlogging and erosion	Generally thrives in moist soil in the immediate vicinity of rivers and ponds. Fast growing but short-lived tree. Good for checking erosion.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
52.	Salvadora persica		Pilu		Small sized drought resistant	Small evergreen tree, grown in drier parts of the northern plains. Gives good shade and when grown in groups, a handsome appearance.
53.	Sapindus detergens	Soapnut tree		Seege Kali (Kan) Chika Kai (Tam)	Medium sized, drought resistant	Grows in dry spots throughout the country, especially in the lower hills. Seeds have economic value.
54.	Saraca indica	Ashoka	Ashoka	Achenga (Kan) Ashopalava (Guj) Aemapushpam (Mal) Asogam (Tam) Ashokamu (Tel)	Small sized handsome thick foliage, flowering	A very handsome evergreen tree with thick shade. Branches spread in all directions. Flowers in large compact clusters in February-March. Sacred for Hindus.
55.	Thespesia populnea	Portia	Dumbla Paras Peepal	Behndi (Mar) Huvarasi (Kan) Puvarasu (Tak) Gangaregu (Tel)	Small sized thick foliage	Small evergreen tree with dense foliage. Not recommended for avenues because of twisted trunks and tendency to develop hollows.
56.	Ulmus leavigata	Small leaved Elm			Large sized thrives in northern hills	Large shade tree grown in hills.
57.	Zysyphus Jujuba	Jujuba	Beer, Ber	Illandai (Tam) Regu (Tel) Llanda (Mal) Bogari (Kan) Kul (Beng)	Small sized thorny edible fruits	Small thorny tree, having rapid growth. Not grown on hills. Timber and fruits have economic value. Grows fast and gives dense shade.

B Category 2: Suitable for Second Row where sufficient space is available

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
1.	Abies pindrow Abies Webbiana	Silver Fir			Larger, Shady	Large evergreen tree, suitable for roadside planting. Grown at altitudes 2500-4000 m.
2.	Adansonia Digitata	Monkey bread tree	Gorakh imli	Gorak chinch (Guj) Perauka (Tam)	Large sized, leafless in hot weather	A large deciduous tree with tapering trunk. Branches spread widely and form a mushroom show head. Leaves are divided into separate narrow leaf lets. Large white flowers are borne single on long stalk. Suitable for dry areas.
3.	Ailanthus excels		Coloo		Tall, deciduous, thrives in hot regions	A tall quick growing tree with a straight trunk and spreading branch, leaves compound with seated margin. Deciduous, suitable for hotter region. Wood used for making catamaran.
4.	Albizzia lebbek	Woman's tongue	Siris	Chichola (Mar) Vagai (Tam) Dirsanan (Tel) Vaga (Mal) Bage (Kan)	Flowering, fast growing, drought resistant, weak wood	Large, handsome deciduous tree with a straight bole and a broad-topped crown with spreading limbs. Leafless during January–March. Extensively found in sub-Himalayan tracts and widely planted throughout India. Fast grow but easily uprooted. Not a good shade tree as it loses leaves half-way through the cold weather.
5.	Albizzia Procera		Surfed Siris		Large sizes, handosme, quick growing	This is white-stemmed siris with good height. Grown in the Gangetic plains and nearby hill. An excellent roadside tree.
6.	Albizza richardina				-do-	A lofty quick growing tree with a straight trunk, branches go up almost vertically upwards giving the tree a stable shape. A deciduous tree suitable for roadside planting.
7.	Albizzia Stipulta		Ohi		Large sized, handsome quick growing	Large, handsome tree with bright green featleaves. Grows naturally in the low hills especially in Kangra (Himachal Pradesh), but does not thrive in the plains.
8.	Anogeissus acumenata		Dhao		Tall, evergreen, flowering	A tall evergreen tree with drooping branches. Leaves long and pointed, borne on short stalks. Timer very strong.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
9.	Anthogphal us cadamba		Kadamb	Kadam (Beng)	Large sized, flowering	A large tree, with beautiful flower which are orange coloured and ball shaped. Thrives best on light sandy soil.
10.	Artocarpus integrifolia	Jack	Kathal	Phanas (Mar) Pala (Tam) Panasa (Tel) Pilava (Mal) Halasu (Kan) Kathal (Beng)	Large sized thick foliage, edible fruits	Tree of considerable size with thick foliage of dark green leaves. Bears large size fruits. Grows in peninsular India, especially in the coastal belt where high rainfall and moist air prevails. It has both timber and fruit value.
11.	Azadirachit a Indica	Margosa	Neem	Vembur (Tam) Vepa (Tel) Veppa (Mal) Nim (Beng)	Medium sized, quick growing, drought resistant	Tree of good size and stately presence, ideally suited as an avenue tree. In summer months it is in thick leaf giving excellent shade. Stands a dry climate, but not suitable for water-logged and frost susceptible areas. Yields good timber.
12.	Barriangtonia racemosa	Indian Oak	Lijul	Samundra (Beng)	Tall, evergreen, flowering	Straight, evergreen with a straight trunk and numberous spreading branches. Leaves broad near the apex, cluster near the end of the branches on short stalk. Bears long pendulous cream rosy flowers.
13.	Callophyllum inophyllum	Alexandrion Laurel	Undi	Paunnai (Tam) Punnagamu (Tel) Punna (Mal)	Large sized	Tree of considerable size, commonly found near the sea coast. Particularly useful for conserving channel banks.
14.	Cedrela Toona		Tuna Tun	Todu (Mar) Tundu (Kan)	Large sized, quick growth, light foliage	A large, remarkably handsome tree. Can be grown in the plain regions of the country and in lower hills. Does not thrive in dry area as it needs moisture. Generally needs rich soil. Susceptible to attack by twigboring moth.
15.	Cedrus Deodara	Cedar	Deodar		Large sized, thrives in hills	Common in the slopes of Himalayan Hills at altitudes 1500-3000 m. Great economic value for timber. Large handsome, dark green tree. Suitable for roadside and groves in the hills.
16.	Chorisia speciosa	Mexican Silk Cotton tree	Vilayti Simal		Large sized, deciduous, light foliage	A beautiful tree bearing large pink flowers in October-November on leafless branches. Gives shade in summer months.
17.	Colvillea racemosa	Colville's glory	Kibli		Large sized, handsome, light foliage flowering	A handsome tall tree. Leaves larger and dark greyish than gulmohar. Bears orange-scarlet flowers in dropping racemes in August-September. Suited to moist or moderately dry low country.
18.	Couroupita guianensis	Cannon ball tree	Shiva-lingam	Nagalingam (Beng)	Tall, evergreen flowering	A tall evergreen tree with a stout straight trunk and rough brownish grey bark. Narrow pointed leaves cluster at the neds of short branches. The tree is remarkable due to its habit of bearing large and peculiar flowers on short twigs from the lower part of the trunk. The fruit is large, hard, brown and spherical. Flourishes only in moist tropical climate.
19.	Delbergia sissoo		Shisham, Siscoo		Large sized, good shade, economic value	Grows best in light sandy soil. Stiff soils do not suit it. Requires moisture and hence irrigation is needed in dry districts. Suitable for plains of Indo-Gangetic region for planting in avenues and in groups. Large branches and well developed crown. Leafless in January-February. Timber has economic value in furniture making.
20.	Enterolobium saman	Rain tree	Vitayti svis		Large sized flowering	A large tree with pinnate leaves, grows very rapidly; flowers appear in pate pink clusters. Wind resistant. Suitable for planting in exposed places. Suitable for avenue planting.
21.	Eucalyptus rostrate	Eucalyptus			Tall tree, quick growth, weak wood	Rapid growing tree, grows on ordinary soil. The tree has the disadvantage that large branches are liable to break off. A native of Australia, but has been successfully grown in various parts of the country.
22.	Ecucalyptus tereticerius	Grey gum			Tall tree, quick growth, weak wood	Elegant tall tree with think crown. Avenue may not be shady but appears elegant. A native of Australia, but has been successfully planted in different parts of the country.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
23.	Eugenia jambolana	Indian cherry	Jaman	Jambul (Mar) Nerate (Kan) Negai (Tam) Neredu (Tel) Naval (Mal) Jam (Beng)	Large sized, quick growing thick foliage, edible fruits	A fine large tree with shady evergreen foliage. Common in all parts of India except very dry areas. Yields edible fruits. Very suitable for shady avenues. Good value for timber.
24.	Ficus Bengalensis	Banyan	Banyan Bor Bargad	Ala (Tam) Marri (Tel) Aal (Mal) Alada (Kan) Wad (Mar) Bat (Beng)	Large sized, Shady, unwieldy for avenues	Large, spreading evergreen tree with aerial roots handing from branches. Not eminently suited for highway avenues as it becomes eventually unwieldy. Good for camping ground and as isolated plantings at intervals along highway avenues. Does not grow in extreme cold or extreme dry climates.
25.	Ficus Infectoria		Parkar	Pakur (Beng)	Large sized, thick foliage, quick growing	A large shady tree, practically evergreen. Grown in Uttar Pradesh, Maharashtra and Madhya Pradesh.
26.	Ficus religiosa		Pipal	Ashvatha (Mar) Arali (Kan) Peepul (Beng)	Large sized, light foliage	Large sized tree having religious significance for Hindus. Grows almost throughout the country in the plains. Suitable for roadside arboriculture. Does not look well when mixed with other species in avenues.
27.	Ficus retusa		Pilata	Nandruk (Mar)	Large sized, thick foliage, slow growth	Grows in the south and in the Indo-Gangetic plain. Fairly large tree with dense foliage. Frequently grown as an avenue tree. Grows well and is very hardy in tolerably warm climate.
28.	Juglans regia	Walnut	Akrot		Large sized, shady edible fruits	Suitable for roadside plants in the northern hills upto altitudes of 3000 m. High economic value because of nut and timber. Admirable roadside avenue tree.
29.	Millingtonia fortensis	Indian Cork Tree	Akas nim	Maramalli (Tam) Akasamalli (Tel) Katesam (Mal) Biratumara (Kan)	Large sized, light foliage, flowering	Lofty tree with exceedingly beautiful foliage. Tree is very brittle and shallow rooted and must be placed away from overhead utilities. Useful as an occasional avenue tree or group tree.
30.	Mimusops hexandra		Khirni	Rayan (Mar)	Large sized shady flowering	A large, ever green tree. Fruit is edible. Slow grower and requires initial watering for 2-3 years. Prefers moist alluvial soil. Grown in Maharashtra and Madhya Pradesh.
31.	Peltophorum ferrugineum	Rusty Shield bearer	Piligul – mohar	Ivalvagai (Tam) Kondachinta (Tel)	Large sized evergreen flowering handsome	A magnificent evergreen tree with smooth grey back, short branches and elegant dark green foliage. Makes a good crown and dense shade. Bears beautiful yellow scented flowers. Common in Bihar, Bengal and Western Ghats.
32.	Picea Smithiana	Spruce	Rai, Tos		Tall tree, thrives in hills	A large evergreen, coniferous tree with tall straight trunk. Common in hills at altitudes 2000-3500 m. Good roadside tree at high elevations.
33.	Pinus excels	Blue pine	Kail		-do-	Common altitudes of 1500-3500 m in the Himalayan Hills. Coniferous tree with graceful appearance.
34.	Pinus longifolia	Pine			-do-	Common in the Himalayan Hills at altitudes 600-1500 m. Coniferous tree with graceful shape. A good roadside tree on hill slopes.
35.	Plantanus orientalis	Plane tree	Chinar		Medium sized, thick foliage	Very shady tree with large lobed leaves, suited to northern cold parts of the country. Prefer damp climate.
36.	Polyalthia longifolia	Mast tree	Deodar	Debdaru (Beng)	Large sized, light foliage, quick growth	Tall, handsome, evergreen tree suitable for planting in avenues. A very common tree in Oudh and Allahabad.
37.	Quercus incana	Grey Oak	Ban		Large sized, thrives in hills	A large evergreen tree with grey foliage. Very common in the hills at altitudes 1000-2500 m where rainfall is heavy. Good roadside tree.
38.	Quercus semecarpif olia	Brown Oak	Karsu Kreu		Large sized, thrives in hills	Large tree found at altitudes 2500-3000 m. Suitable for roadside avenue or groves at high altitudes.

S. No.	Latin Name	English Name	Hindi Name	Name in other Languages	Main Characteristics in Brief	Brief Description, Important Habits and Suggested Locations for Use
39.	Schleichera trijuga	Gum Lac tree	Kusum		Medium sized thick foliage	This is a large tree with a dense shady crown, drops leaves only for a short period. Newly emerging leaves are bright red in colour for which the tree is very much preferred.
40.	Spathodea Campanulata	Tulip tree	Pichkari	Nirukavi (Kan) Patadi (Tel)	Tall, handsome, flowering	A fairly tall tree with short branches and dark green foliage. The large leaves are set in opposite pairs and divided into a number of pointed leaflets. It produces large cupshaped orange-crimson flowers on the top of the tree. Appears very attractive when grown in clumps or avenues.
41.	Sterculia alata	Buddha's coconut			Large sized, thick foliage, quick growth	A very handsome tall evergreen tree with erect growing habit leaves broad, quick growing, makes a very good avenue tree
42.	Sterculia mahagoni	Mahagoni	Mahagoni		Large sized, economic value	It is a magnificent tall and spreading evergreen tree with a stout trunk, forms a beautiful roundish crown. Leaves are delicately divided into narrow curved leaflets with tapering points. Produced one of the most famous timbers in the world
43.	Tamarindus Indica	Tamarindi	Imli	Puli (Tam) Chintamanu (Tel) Puli (Mal) Hunasehannue (Kan) Chinch (Mar) Tentub (Beng)	Large sized, light foliage, slow growth	Fairly big tree. Drought resistant and thrives in any soil. Not favoured in high altitudes and waterlogged areas. An excellent avenue tree. Has great economic value for fruit. Grows rather slowly.
44.	Tamarix articulate		Farash		Thrives in arid saline soil	A tree hardly, requiring little water when one established. Prefers a loamy soil, but grows when on saline soils, hard clay and sand. Rise to tall heights. Found in the northern plains of the country.
45.	Tectona grandis	Teak	Saguna	Thekku (Tam) Tekko (Tel) Thekka (Mal) Tegu (Kan) Segun (Beng)	Tall, poor shade, economic value	Tall tree with straight bole and foliage of large leaves. Does not yield good shade. Best planted in clusters for column effect. High economic value for timber
46.	Terminalia arjuna	Arjuna Myrabalan	Arjuna, Aajan, Kahu, Kornaua	Vella Maruthu (Tam) Madddi (Tel) Marutha(Mal) Kaidaryayu (Kan) Arjun (Beng)	Tall, thin foliage flowering	Tall, graceful tree and very good for avenue purposes, though does not yield much shade. Grows in any rich soil. Timber is valueable
47.	Terminalia belerica	Belleric Myrobalan	Behera	Balra Beheda (Mar) Jare (kan) Behera (Beng)	Quick growth	Easy to grow and makes excellent avenue tree
48.	Ulmus Wellichiana	Big-leaved Elm			Large sized, thrives in northern hills	Large, handsome, deciduous tree with large leaves. Grows in Himalayan hills at altitudes 1000 – 3000 m.

Appendix-III

(Refer Para 4.1)

Categories of Plants

The plants may be divided into four categories according to height and utility.

- The First category is of plants which will be used as a single row between embankment toe and Right-of-Way or it can also be used for toe plantation with canopy management.
- The Second Category is of big trees which will be planted farthest from the road provided sufficient land is available for second row.
- The Third category is of shrubs having max height up to 2 m. These will be planted on the toe of the embankment.
- The Fourth category is of grasses which can be utilized for plantation on embankment slope in staggered scheme for soil conservation and livelihood.

Category 1: First Row – (Height 2-6 m and above, Height can be restricted to 2-3 m by canopy management)

Fruit Plants

1. Drumstick (Moringa Olifera) – this tree is known as tree of life for its life saving properties, loaded with amino acids and nutritional properties to cover child and women malnutrition problems. New varieties are also available for round the year fruiting. Canopy management if required for good fruit bearing.
2. Aonla (Emlica Officianlis) – A tree, good for roadside plantation, as it is worshiped by villagers chances of tree cutting is minimum. Fruit is very good source of vitamin C and specially omega 3. Excellent medicinal and herbal properties.
3. Mango (Mangifera Indica) – We can use short variety mango trees like amrapali, mallica and prabhashankar.
4. Guava - guava is again a short term fruit bearing plant which is good for rural landscape.
5. Sitaphal (Annona squamosa) – It's more a shrub with branching and sweet fruit with good demand in market for making shakes.
6. Chiku - Evergreen plant with manageable topiary can be given shape by topiary management and good for landscaping along rural roads.

Firewood/Fuel species

1. Subabul (Leucaena Leucocephala) – Known as coffee bean plant native of Australia, can be planted demarking the border of road land with plant to plant distance 1m, canopy managed by cutting to the height of 6 ft letting the plant coppice. Firewood with low ash content and high calorie value.

Category 2: Trees for Second Row – (Height 8 m and above)

Fruit Plants

1. Mango (Mangifera Indica) – General variety from unidentified seed called (biju) should be used. These trees attain good height, are very strong and produces a chance of cross pollination for new varieties. Excellent for shade and fruit.
2. Jackfruit (Kathal) (Artocarpus heterophyllus) – Good erect tree survives in wild and requires less care once established. Jackfruits are very nutritious and a must for every village road. Leafs are very palatable fodder for goat and other animals and are saleable.
3. Jamun (Syzygium cumini) – The pollution mitigating capacity of this tree is significant beside bearing very tasty fruits which are good for many diseases. It is a hot selling item as number of trees are decreasing.
4. Mahua (Madhuca Indica) – Again a must for village roads, flowers and pods used for making highly nutritious food. Number one tree for nutrition value. Needs special emphasis as number of trees are fast depleting. Mahua takes 25 years to start fruiting, native to India.
5. Kadam (Anthocephalus cadamba) – Fast growing tree, soft wood used by industry, firewood from pruning of trees. Edible fruits and of medicinal use.
6. Tamarind (imli) (Tamarindus indica) – Again an essential for rural roads, survives in harsh condition, is tolerant to soil deficiency. Tamarind fruits are an essential item for every Indian household.
7. Shahtoot (Morus Alba) – Good for silviculture and berries multi nutritious.
8. Coconut Tree – For plantation in coconut plantation area.

Medicinal Plants

1. Neem (Azaridicta Indica) – Neem is one of plants needed for future of human being, especially rural life for getting natural insecticide and other medicinal values. Again a must for plantation in rural roads.
2. Arjun (Terminalia Arjuna) – One of the best options for waterlogged area. Very good medicinal value.
3. Harad (Terminalia Chebula) – Large tree, of high medicinal value.
4. Baheda (Terminalia Bellerica) – Large tree, of high medicinal value.

Firewood/Fuel species

1. Caseurina Equisetifolia - Long pollard tree with firewood production and poles for use by the villagers.
2. Eucalyptus Hybrid – This is fast growing variety, can be planted in waterlogged areas. Good for firewood, poles and wood for industry.

3. Poplar (Populus tremula) – Good agroforestry plant, can be used for bordering road land, no disturbance to farmland as it shed leaves in winter, climate conducive for selected.

Ornamental Species

1. Gulmohar (Delonix Regia) – Red flowering tree good for beginning of the road.
2. Amaltas (Cassia Fistula) – Yellow flowering tree good for monotony break and splash of color.
3. Tabeubia Species - Ornamental tree with more colors.
4. Cassia species – very hardy trees with prolific flowering capacity.

Category 3 : Shrubs for plantation on Toe of Road embankment (Height up to 2 m).

Fruit Shrubs

1. Karonda (Carissa carandas) - drought-tolerant plant that thrives well in a wide range of soils. The roots of the plant are heavily branched, making it valuable for stabilizing eroding slopes. Can also be utilised for natural fencing of the trees. Good for livelihood and high in iron and Vitamin C.
2. Anaar (Pomegranate) – bushy plant more like a shrub, can be extensively used long roadside.
3. Citrus varieties - Many varieties with regionwise performers, canopy management can be done and can be used as landscaping, emits good fragrance.
4. Sitaphal (Annona squamosa) – It's more a shrub with branching and sweet fruit with good demand in market for making shakes.

Ornamental shrubs

1. Beli (Mogra) – good aromatic value and source of livelihood.
2. Odhhul (Hibiscus Chinesis) – Good for garland and used highly for worship purpose.
3. Harsingar (Parijat) – aromatic shrub, flower utilized for die making, livelihood.
4. Chandani (Tabermontena) – perennial white flowering shrub.

Fodder varieties

1. Sesbania Grandiflora (August plant) – flower used as vegetable and goof fodder.

Category 4 : Grass Plantation on Road embankment for Slope stabilization and rural livelihood

Aromatic and Medicinal Grasses

1. Khus Grass (Vetiver Giginoids) - An established grass native to south India and exploited as bio-engineering all across world. Leafs are good fodder and long grass utilized as fuel and for roof thatching.

2. Lemon Grass – Can be planted from edge of road to embankment toe in staggered form, seasonal cutting very well utilized for oil extraction for livelihood of villager group.
3. Palma Rosa – Similar to lemon grass having rose scented oil extraction. Good for slope stabilization.
4. Citrenolla – Similar to lemon grass, good for slope and livelihood.
5. Patcholi – Can be planted in semi-shed area along rural roads. Good medicinal value.

Fodder Grasses

1. Hybrid Napier Grass – Very nutritious green fodder for livelihood and quality milk production.
2. Stylo hameta – Very good soil erosion checking grass and good green fodder.
3. Dinanath Grass – Good fodder grass
4. Cowpea – Good creeper along road embankment slope for livelihood and green fodder.