

## Chapter – 2

# Planting Design Consideration

(Source : NBC)

**The following criteria shall be considered in planting design :**

1. Plant Material
2. Soil conditions
3. Availability and quality of water
4. Availability of sunlight
5. Quality of air
6. Maintenance
7. Functional Aspects of Design with Plants
8. Planting for Shelter and Soil Conservation
9. Air Pollution Control by Plants

### **1. Plant Material**

The major sets of factors that influence the choice of plant material are related to the characteristics, both botanical and physical of plant material and the context in which the plant material is to be used. The inter-relationship of these sets of factors is the basis for developing a sound approach to the process of designing with plants.

#### **– Physical and Botanical Characteristics of Plant Material**

The information on plant material should be available in a systematic format to include definition, significance and design implications of the following aspects :

- (a) Nomenclature (botanical and trade-name);
- (b) Origin, family and natural habitat;
- (c) Growth characteristic and form as a function of habitat;
- (d) Physical characteristics, for example bark, texture, foliage, etc.
- (e) Propagation and maintenance; and
- (f) Use in landscape design.

#### **– Vegetation Types (Evergreen and deciduous) : Some examples of the functional implications of using evergreen and deciduous plant material for specific situations are :**

##### **(a) Evergreen trees for :**

- (i) Places requiring shade throughout the year,
- (ii) Strong visual screening
- (iii) Part of windbreak or shelter planting, and
- (iv) Areas where leaf litter is to be discouraged.

##### **(b) Deciduous trees for :**

- (i) Greater visual variety,
- (ii) Partial visual barrier,
- (iii) Areas where under-planting is to be encouraged (for example grass),

- (iv) Emphasis on branching and flowering pattern, and
  - (v) Areas where shade is not required throughout the year.
- **Growth Rate and Age of Vegetation :** Growth rate is directly related to the life span of tree and slower growing trees have a life span extending to hundreds of years. The fast growing trees to the exclusion of slower growing varieties is not recommended. Landscapes are developed to sustain future generations; slow growing long lived native trees shall be emphatically included in all major planting schemes.
  - **Growth Habits of Various Kinds of Vegetation and Their Form :** The overall physical form of a plant is usually the result of the foliage density and branching pattern. It may also be expressed as the proportionate relations between height and canopy spread. The latter is direct expression of growth habit. The following classification into basic types may be useful (Also Refer : Chapter on List of Trees)
    - (a) **Trees of fastigited or columnar habit –**

Examples of trees of this type are :

Casurina esquiritifolia (beet wood)

Grevillea robusta (Silver Oak)

Polyathia logifolia (Ashok)

Populus species (Poplar)

Though the branching pattern of each is different, the overall shape is similar
    - (b) **Tall trees with canopy –**

Examples of trees of this type are :

Dalbergia sissoo (Sheesham)

Tamarindus indica (Imli)

Terminalia arjuna (Arjun)

The canopy shape does not fit into any specific geometrical category
    - (c) **Trees of spreading habit –**

Examples of trees of this type are :

Delonix regia (Gulmohar)

Lagerstroemia flosreginae (pride of India)

Pithecellobium saman (Rain Tree)

Though these trees vary greatly in size, their basic form is similar
    - (d) **Trees of weeping habit –**

Examples of trees of this type are :

Callistemon lanceolatus (Bottle brush)

Salix babylonica (Weeping willow / Peking willow).

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The above classification is helpful in choosing various combinations of the above types to achieve desired function and visual objectives.

## 2. Soil Conditions

Physical as well as chemical properties of the available soil are important. These may or may not be amenable to change; they would therefore affect the choice of plant material considerably. Physical properties include consideration of light (for example sandy) and heavy (for example clayey) soils, and their structure. Chemical properties pertain to the presence or absence of nutrients and salts; soil, alkalinity or acidity. Effective planting schemes.

## 3. Availability and Quality of Water

The water requirement may be derived by data of humidity and rainfall of plants natural habitat. The water table of the area where the plantation is to be done has a crucial bearing on the design with plants as well as a financial implication for reduced maintenance if planted appropriately.

## 4. Availability of Sunlight

The growth rate of plants are directly related to sunlight availability; such as plants that require (a) full sunlight, (b) partial sunlight, (c) predominantly shade, and (d) complete shade.

## 5. Quality of Air

Growth may be affected by chemical pollutants such as sulphur dioxide or physical pollution such as dust. Certain plants have the ability to withstand pollution, such plants are imperative for industrial areas, roads, highways, etc.

## 6. Maintenance

The success of a designed landscape depends upon the growth of vegetation over an extended period of time; therefore maintenance of landscape is also a design component.

## 7. Functional Aspects of Design with Plants

- (a) Improve existing environmental conditions with respect to soil, drainage, microclimate, air pollution;
- (b) Create a designed physical environment through the organization of open space; and
- (c) Interpret and express the contemporary understanding of the man-nature relationship, that is, design with plants on an ecological rather than horticulture basis.

### ■ Shrubs

- The functions are similar to those of trees. Shrubs may be used together with trees to reinforce the functions, for example, noise barrier, shelter belts, enclosures, etc.

Other forms in which shrubs may be used are:

- (a) **Hedges** : These require regular maintenance
- (b) **Shrubbery** : Here plants are allowed to retain their natural shape; they therefore require little maintenance.

Shrubs provide barrier, which may either be visual or physical (hedges). Barriers may be required in a range of situations, for example they may be only for defining space, or they may be required for security and have to be, therefore, necessarily impenetrable.

- **Groundcover**

- Groundcover plants are those which naturally grow to a very low height. Some of the uses for which they may be used are:
  - (a) Stabilization soil on steep slopes such as embankments.
  - (b) As a low maintenance substitute for grass (where the surface is not to be used).
  - (c) For providing variety in surface treatment.
  - (d) Contrast with paving materials, for example to soften rigid lines of paving.
  - (e) As a subtle means of demarcating space, as for example, in places where tall plants would be visually intrusive.
  - (f) In combination with other plants to provide contrast or harmony in form.

- **Climbers** : Certain climbers because of their spreading habits may also be used as ground cover(for example Asparagus spp.) Climbers are useful for shading exposed walls from direct sunlight. They may also be used for stabilizing soil on embankments (for example, ficus stipulate, Ipomea biloba). On sites where a high degree of security makes fencing necessary, climbers and spreading plants like Bougainvillea species, may be trained on boundary wall.

## 8. Planting for Shelter and Soil Conservation

The use of vegetation for controlling wind is widely recognized as an effective way of conserving soil and reducing erosion by wind. Vegetation may therefore be used for modifying the microclimate, by obstructing, guiding, deflecting or filtering wind current.

Vegetation areas designed to fulfill these general functions are usually classified as windbreakers and shelterbelts. Windbreaker is grown protective planting around gardens and orchards. Windbreakers generally consist of single or double row of trees. Shelterbelt provides an extensive barrier of trees with several rows of trees. Plant species are chosen with particular regard to their physical and growth characteristics, and their effectiveness in achieving the desired results.

- **Function** : Windbreakers and shelterbelts fulfill essential microclimatic functions in rural and urban environments. Benefits accruing from plantation of shelter planting may be as follows :

- (a) Reduction in wind velocity resulting in the arrest of movements of soil particles.
- (b) Prevention of soil erosion.
- (c) Modification of micro- climate; moderation of change in air temperature.
- (d) Protection of crops from being blown by high winds.
- (e) Reduction in evaporation of soil moisture. Increase in soil moisture content varies from 3 percent to 7.8 percent Water loss due to evaporation is lessened.

- (f) Increase in soil moisture due to greater dew fall in sheltered areas has been found to be 200 percent higher than on exposed ground; heaviest dew fall is over a distance of 2 to 3 times the height of the shelterbelt.
  - (g) Beneficial effect on growth of plants that are affected by high winds.
  - (h) The zone of influence of shelterbelt on crop yield extends to a distance of 20 times the height of the belt, with the maximum effect being observed 10 times the height of the tree belt, on the leeward side.
- **Wind Erosion :** Some of the basic functions of windbreaks and shelterbelts in arid and semi-arid areas are to conserve soil and reduce erosion by wind. The latter is a natural phenomenon in lands having very little rainfall (125 mm- 250 mm) and in areas adjoining a river, lake or sea. Wind erosion is a serious problem in areas where the ground is virtually bare and devoid of vegetation.
- **Techniques for control of wind erosion :** The principal method of reducing surface velocity of wind, upon which depends the abrasive and transportation capacity of wind, is by vegetation measures.
- (a) Porosity is important in the effectiveness of shelterbelt and proper selection of tree species is necessary. Porosity near ground level is desirable.
  - (b) Effectiveness of shelter planting depends more on height and permeability than on width. The width influences the general microclimate but above a certain minimum width, it does not affect greater reduction in wind velocity.

Protection obtained varies in relation to height (H) of shelterbelts as given below :

Distance	Wind Reduced by (in percent)
H	90
2H	75
5H	50
10H	20

This indicates that it is better to have several windbreaks 5H to 6H apart rather than large forest stands with wide open spaces in between.

■ **Species suitable for wind breaks are :**

**(a) For Dry and Arid Regions**

- (i) *Acacia auriculiformis* (Australian Blackwood)
- (ii) *Ailanthus excelsa* (Maharukh)
- (iii) *Albizia lebbeck* (Siris)
- (iv) *Azadirachta indica* (Neem)
- (v) *Casuarina equisetifolia* (Beef- wood)
- (vi) *Dalbergia sissoo* (Sheesham)
- (vii) *Eugenia Jambolana* (Jamun)

- (viii) **Grevillea robusta** (Silver oak)
- (ix) **Peltophorum ferrugineum** (Cooper pod)
- (x) **Tamarindus indica** (Imli)
- (xi) **Pongamia glabra** (Indian beech)
- (xii) **Tamarix articulata** (Tamarisk)

**(b) For Coastal Area**

- (i) **Anacardium occidentale** (Cashew)
- (ii) **Ailanthus malabarica** (Alston)
- (iii) **Cassuarina equisetifolia** (Beef-wood)
- (iv) **Pongamia glabra** (India beech)
- (v) **Sesbania aculeate** (Sesban)
- (vi) **Thevetia Peruviana** (Yellow oleander)
- (vii) **Thespesia populnea** (Indian Tulip)
- (viii) **Vitex negundo** (Sephalii)

## **10. Air Pollution Control by Plants**

Air pollution may be caused by areas or point sources such as cities, industrial areas, factories or by linear sources such as highways. Vegetation buffers can minimize the build-up of pollution levels in urban areas, by acting as pollution sinks.

- **Effect of Plants :** Plant leaves function as efficient gas exchange systems. Their internal structure allows rapid diffusion of water-soluble gases. These characteristics allow the plant to respire and photosynthesize, and they can also remove pollution from the air. Some of the beneficial results of plantations may be:
  - (a) They are good absorbers of sulphur dioxide.
  - (b) Parks with trees have an SO<sub>2</sub> level lower than city streets.
  - (c) Roadside hedges can reduce traffic generated air borne lead, on leeward side.
  - (d) Heavy roadside planting in the form of shelterbelts can result in a reduction in airborne lead.
  - (e) Complete dust interception can be achieved by a 30m belt of trees. Even a single row of trees may bring about 25% reduction in airborne particulate.

## Chapter – 3

# Role of Vegetation in Landscape Design

(P.S.Sodhi, M. Arch. (Landscape), Architect, CPWD)

With the advent of technology, the man is becoming isolated from nature day by day. The rapid urbanisation has resulted in diminishing the landscape features. The early culture of India is full of plant love, intimately concerned with the day to day life. With the increase in population and large scale Urban Development has taken a heavy toll on the green areas and has alienated the people from nature.

The trees play a vital role in a community's scenic beauty, the character of the local landscape and the overall quality of the environment. Despite their benefits, trees are disappearing faster than we think.

**Just imagine what our streets and neighbourhoods would be like without trees!**

### Benefits of Planting and Protecting Trees

- **Environmental Value :** Trees provide a variety of environmental values, including screening of unpleasant odours, absorption of noise and reduction of pollution and temperatures in the cities as described below :
- **Air Quality :** Trees are an efficient and cost-effective way for a community to improve its air quality and reduce pollution. A mature tree absorbs between 120-240 pounds per year of small particles and gases, like carbon dioxide, which are released into the air by automobiles and industries. In addition, a single tree produces nearly three-quarters of the oxygen required for a person; and a canopy of trees in an urban environment can slash smog levels up to 6%.
- **Water Quality :** Trees help anchor soil and reduce storm water runoff, saving the high costs of drainage ditches, storm sewers, and other "engineered solutions" to storm water management. A street lined with 32' tall trees can reduce runoff by almost 327 gallons, allowing cities to install smaller and less expensive water management systems. Reducing runoff also decreases topsoil erosion and the amount of silt and other pollutants washed into streams, rivers and lakes.
- **Lower Heating and Cooling Costs :** Trees have demonstrated the ability to reduce heating and cooling costs and counteract the "heat island" effect in urban environments. Urban areas with little vegetation can experience temperatures of up to seven degrees higher than those with tree cover. This translates into significantly higher energy costs to cool buildings. Properly planted trees can cut heating and cooling costs by as much as 12 % and reduce overall power demand.
- **Reduced Noise Pollution :** Noise pollution is an often overlooked problem. Excessive or unwanted sound has negative physical and psychological effects. Noise can come from many sources, especially roads and highways. Trees can play an important role in deadening unwanted noise. Sound waves are absorbed by a tree's leaves, branches, and twigs. Studies suggest that belts of trees 100' wide and 45' long can cut highway noise to half.

- **Ecological Value :** Plants provide significant values to all sectors of natural environment in cities. The loss of vegetation cover adversely affects the soil, Air & Water balance.
- One of the major values of plants is improving of urban soil conditions. Urban soils are often buried beneath the sidewalks, streets and buildings. However, a significant portion in many urban areas remain exposed to environmental conditions which helps in improving urban soil conditions by building the Soil with roof system, by checking the loss of surface particles, by increasing the organic material contents in soil and retaining the water for longer period, to increase the ground water table. Soil benefits from trees, as their far-reaching roots hold the soil in place, preventing erosion. Trees improve soil quality as their leaf litter makes perfect compost. Some trees, for example acacias, have bacteria living in their roots. The bacteria convert nitrogen from the air into nitrates, which the tree can use to grow and reproduce, whilst the soil is also enriched.
- Plants also help to control the extreme fluctuation in temperature and reduction of pollution level in urban atmosphere. Plants have a useful effect upon the climate e.g. a comparison of the temperature difference in summer, between a planted area of urban landscape and built-up central area is likely to be 2-3°C lower with a 5% increase in relative humidity.
- During the process of photosynthesis all green plants take in carbon dioxide and give off oxygen. Primitive plants were responsible for converting the poisonous atmosphere of early Earth into an oxygen-rich atmosphere that supports animal life. Trees help to maintain low levels of carbon dioxide, thereby reducing the greenhouse effect which threatens to make the Earth uncomfortably warm.
- Trees provide nest sites for birds. The leafy branches make good hiding places and are difficult for most predators to reach - even non-breeding birds roost in trees at night.
- **Health Value :** There is mounting evidence that stress and noise have an impact on our physical and psychological health. Trees and vegetation can affect our mood and help relieve stress.
- **Economic Value :** Trees are a major economic asset to a community, building a positive community image which is a key factor in attracting residents, businesses, and visitors alike. The attractively tree-lined public areas are more desirable than those areas without trees. The landscaped areas enjoy higher occupancy and rental/lease rates than identical properties that lack landscaping.
- **Shelter :** The shade of trees is welcomed by man and beast alike, providing essential shelter in the hottest climates. Trees are often used as windbreaks to shelter sensitive crops.
- **Aesthetic Value :** Trees provide a variety of aesthetic values and accentuate the architectural design of buildings. For all their values to which a price tag can be attached, trees have one more contribution to make: their beauty and variety of form. Some species are tall and thin, others flat-topped and spreading, leaves come in every shape and size, flowers and fruits are frequently decorative. These qualities make trees ideal for beautifying gardens, cities, and even industrial estates.

Planting is much more than a cosmetic treatment to be applied to in different or insensitive architecture and engineering etc. It plays a major role in integrating structure into

environment, providing a setting and reducing their visual intrusions within the functional requirement of any single area. Plants are growing, ever changing, interacting organism and plant communities are in a constant state of flux. Plants, whether trees, shrubs, climbers, groundcovers have to be placed at suitable location so that the desired purpose is served.

The efficient and successful choice of plants should be made on the basis of their design characteristics :

1. **Functional & Structural Characteristics** : Plants in combination and individually, create space beneath, between & sometimes within the bulk of their canopies. Plants create landscape structure, which both defines spaces and serves the required function.

Trees, in the city are living building material used to establish spatial boundaries. They create spatial rhythms to heighten the experience of moving through the outdoor spaces, its ability to shelter, screen or shade, density of roof growth which will determine its ability to bind the soil and protect against erosion. Plants also provide a fitting environment for human activities while avoiding damage to ecology of the landscape.

2. **Visual & Other Sensory** : Plants offer an enormous wealth of aesthetic characteristics, the appearance of their leaves, twigs, bark, flower & fruit, the fragrance of flower and aromatic foliage, the physical texture of bark & leaves even the sound of leaves when stirred by the wind or beaten by the rain.

3. **Plant Growth Habit & Cultural Requirement** : There is enormous diversity of size, habit foliage & other characteristics among the range of species; that helps to determine the habitat & ecological niche. In the first place, planting design can help us make the best use of our environment. Secondly, it helps to restore the balance between people, nature and in some extent to the wild life and finally it offers many opportunities for enjoyment of aesthetic delights.

4. **Plants and Their Uses** : Plants are positive design elements in any environment and they can enhance the environment, if used with proper understanding

- **Trees (basic planting)** : This relates to the contemporary requirement in landscape design for mass planting of large groups, woodlands, which with the topography or land form, produce the large scale spatial arrangement of the landscape. The species selected for this group should be hardy, vigorous in growth, indigenous for ecological reasons and exotics which have become established as part of local scene.

e.g.- *Acacia auriculiformis*, *Lagerstroemia flos reginae* (pride of india), *Pterospermum acerifolium* (kanak champa), *Alstonia scholaris*, *Putranjiva roxburghii* (jalpitri), *Azadirachata indica* (neem), *Dalbergia sissoo* (sheesham) etc.

- **Trees (special effects)** : Trees in this section should include those sufficiently individualistic, spectacular or strong in character to occupy the isolated positions, either because of these qualities or because they do not mix easily in visual sense with other trees.

e.g.- *Ficus bengalensis* (banyan tree), *Cassia fistula* (amaltas), *Bombax malabaricum* (silk cotton tree), *Cassia nodosa* (pink javanica), *Jacaranda mimosaeifolia* (neeli gulmohar). *Chrosia speciosa*, *Mimusops elengi* (mulsari) *Callistemon lanceolatus* (bottle brush) etc.

- **Trees (barriers) :** Barriers formed with plants are needed in landscape for screening the unpleasant views, for dividing up the landscape into spaces, for providing shelter from wind, for protection against pollution, for defining boundaries and for assisting in the creation of beautiful landscape.  
e.g.- *Casuarina equisetifolia*, *Grevillea robusta* (*silver oak*), *Ficus benjamina*, *Polyalthia longifolia* (*ashok*), *Putranjiva roxburghii*, *Schleichera trijuga* (*kusum*), *Golden bamboo* etc.
- **Shrubs (basic planting) :** The use of shrubs in the mass as a basic constituent of the planting of Landscapes. It should have the qualities of hardiness, vigorous growth with a greater emphasis on evergreen plants.  
e.g.- varieties of *Acalypha*, *Bougainvillea*, *Cassia biflora*, *Cassia alata*, *Duranta*, *Ficus* *panda*, *Euphorbia*, *Thevetia*, *Taberneamontana* (*chandni*), Palms such as *areca*, *china*, *phoenix*, *rhaps* etc.
- **Shrubs (special effects) :** Similar principles of selection apply to this as for trees (special effects), but at the same time it should be noted down that a number of shrubs planted together can produce special effects specially at the time of flowering.  
e.g. – *Caesalpinia pulcherrima* (*peacock flower*), *Calliandra haematocephala*, *Poinsettia*, *Mussaenda*, *Justicia*, *Ixora*, *Bamboo-buddha valley*, *Franciscea latifolia* (*yesterday, today and tomorrow*), etc.
- **Shrubs (barriers) :** Impenetrability is essential unless the barrier is for visual purpose, thus the twigs or thorns are considered as an advantage. Other things to consider are the ability of the plant to accept pruning, either to control growth or to produce topiary effects.  
e.g. – *Bougainvillea*, *Duranta plumieri*, *Duranta plumieri varigata*, *Duranta goldeana*, *Murraya* etc.
- **Shrubs (edging) :** To outline the flower beds or other kinds of plants and to create line effects.  
e.g. – *Duranta goldeana* etc.

## Selection of Plant Material for Landscape

(Sudhir Kamal Seem, M. Arch. (Landscape), Senior Architect, CPWD)

The success of landscape design with plants depends on how to choose the appropriate plants for a particular situation. Thoughtful selection of the trees, shrubs, climbers, bulbs, foliage plants, grass, groundcover and aquatic plants transform the barren landscape into meaningful landscape. Efforts should be made to select an appropriate plant material for the given situation based on the following criteria :

- |           |  |                           |
|-----------|--|---------------------------|
| (i) Habit | (ii) Colour  | (iii) Season of flowering |
| (iv) Form | (v) Rate of growth and Environmental considerations. |                           |

### 1. Trees

The selection of trees should be based on season, size, form, situational preferences of surroundings and artifacts.

#### 1.1 Flower Colour

- **White** : *Alstonia scholaris*, *Bauhinia minor*, *Magnolia pterocarpa*, *Milingtonia hortensis* and *plumeria acutiflora*.
- **Yellow** : *Cassia fistula*, *Bauhinia tomentosa*, *Saraca indica*, *Peltophorum pterocarpum* and *Tabebuia spectabilis*.
- **Red** : *Bombax ceiba*, *Amberstia nobilis*, *Cassia marginata*
- **Scarlet** : *Barningtonia monandra*, *Cassia pavonina Crennigena*, *Kelobia hospita*.
- **Purple** :
   
*Lagerstroemia speciosa*, *Bauhinia purpurea*, *Melia azadirach*, *Pachira, rosea* and *Tabebuia rosea*.
- **Orange, Red, Crimson, Scarlet** : *Butea monosperma*, *Colvillea racemosa* and *spathodea campanulata*.
- **Blue, Mauve, Violet** :
   
*Jacaranda aquatica*, *Guaicum officinale*, *Millenia albiloba* and *Solanum granatum*



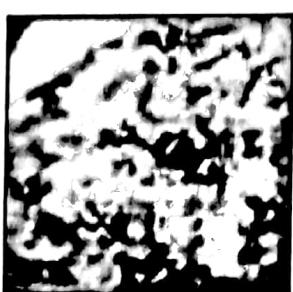
*Alstonia scholaris*



*Cassia fistula*



*Bombax ceiba*



*Lagerstroemia speciosa*



*Butea monosperma*

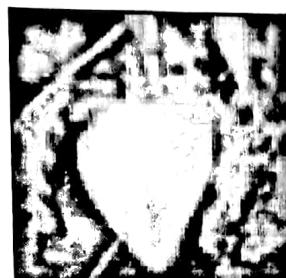


*Jacaranda*

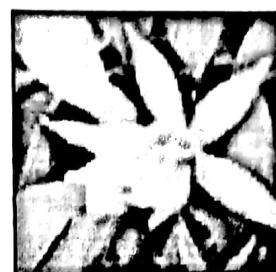


*Barningtonia monandra*

- **Greenish Yellow** : *Monodora grandiflora*, *Casuarina*,
- **Creamy White or Yellow** : *Michelia champaca*, *Madhuca Indica*, *Magnolia grandiflora*, and *Terminalia Arjuna*.



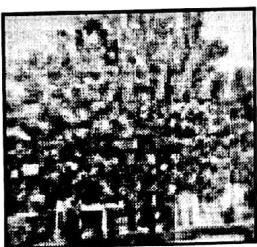
Monodora grandiflora



Michelia champaca

## 1.2 Season of blooming

- **Ever blooming** : *Callisetermon lanceolatus*, *Mimusops elengi*, *Plumenia acuminata* and *Thespesia populnea*.
- **Winter blooming** : *Bauhinia purpurea*, *Butea monosperma*, *Monodora grandiflora*
- **Spring blooming** : *Tabebuia*, *Amheristia niobilis*, *Bombax ceiba*, *Jacaranda*, *Saraca indica*, *Spathodea*
- **Summer Blooming** : *Eriothrina indica*, *Cassia*, *Jacaranda*, *Lagerstroemia spp.*
- **Rainy season Blooming** : *Plumeria alba*, *Anthocephelus cadamba*, *Barringtonia racemosa*, *Casia Marginata*, *P. rubra*, *Covillea racemosa*.

Callisetermon  
lanceolatusBauhinia  
purpurea

Tabebuia

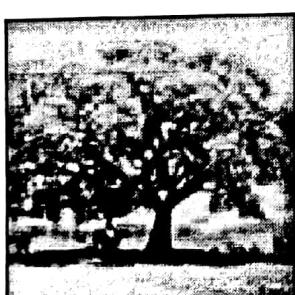


Eriothrina Indica



Plumeria alba

## 1.3 Range of Tree sizes



Albizia lebbek



Cassia fistula



Peltophorum



Ficus bengalensis

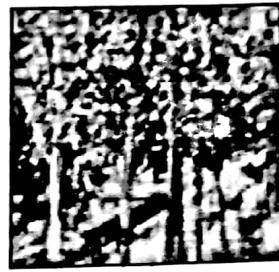
- **Dwarf trees (3 to 5m tall)** : *Albizia lebbek*, *Bisantha*, *Bixa orellana*, *Brownera grande*, *Croton sebestena*, *Wetmorea blackeana*, *Parkinsonia acuminata*, *Plumeria rubra*.
- **Medium size (6 to 10m tall)** : *Caesalpinia*, *Lagerstromia thorelii*, *Melia azadirach*, *Plumeria acuminata*, *Saraca Indica*, *Tabea spectabilis*.

- **Tall tress (more than 110 m tall)** : *Peltophorum roxburghii*, *Bombax malabaricum*, *Cassia monisia*, *Chorisia speciosa*, *Jacaranda*, *Millingtonia hortensis*, and *spatholea campanulata*.
- **Giant trees** : *Ficus bengalensis*, *Bombax ceiba*, *Colvillea racemosa*,

#### 1.4 Growth Habit of Trees

- **Oval** : These plants are suitable for frame or screen.

*Populus alba*, *Albizia julibrissin*, *Crataeqs cerusoalli* *Comus sp.*, *Betula pendula* *Cassia fistula*



*Populus alba*

- **Vase shaped** : They can be used above the large shrubs or small trees.

*Melia azadirach*, *Plumeria acutifolia*. *P.alba*. *P.obtusa*, *Saraca Indica*. *Almus Americana*.



*Melia azadirach*

- **Pyramidal** : It can be used as an accent plant.

*Pinus roxburghii*, *Araucaria cooki*. *Thuja compacta*, *Quercus palustris*, *Stercula foedtida*, *Polyalthia longifolia*.



*Pinus roxburghii*

- **Round** : These plants can be used in the lawn as specimen.

*Plumeria alba*, *Chorisia speciosa* *Mimusops elengi*. *Morus rubra*, *Quercus*.

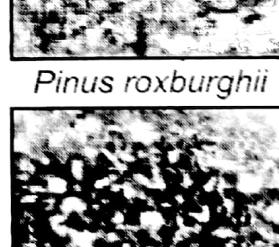


*Plumeria alba*

- **Columnar** : They frame the views and structure in the landscape setting. *Juniperus chinensis*, *Betula pendula*, *Quercus robusta*, *Eucalyptus robusta*, *polyelthia pendula*.

- **Weeping** : It can be used as a focal point.

*Salix Babylonica*, *S. alba*. *Putranjiva roxburghii*, *callistemon lanceolatus* *Tecomelia*.



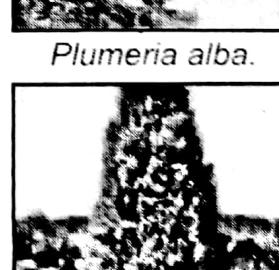
- **Round to spreading** : These plants mass well to create grove effect. *Dalbergia sisso*, *Dillenia Indica*, *Ficus glomerata*, *Thespesia populnea*.

- **Fan shaped** : They can be used as a focal point.

*Cucus revoluta*, *Borassus fladellifer*, *Oreodoxa regia*.

#### 1.5 Trees with scented flowers

: *Anthocephalus cadamba*, *Alstonia scholaris*, *Canarium odoratum* *Michelia champaca*, *Mimusops*



*Dalbergia sisso*



*Cucus revoluta*



*Juniperus chinensis*

*elengi, Dillenia indica, Gardenia latifolia, Custravia augusta, Magnolia grandiflora, Nyctanthes arbortristis.*

**1.6 Wind Resistant trees :** *Eugenia jambolana, Caesalpinia pulcharima, Peltophorum pterocarpum.*



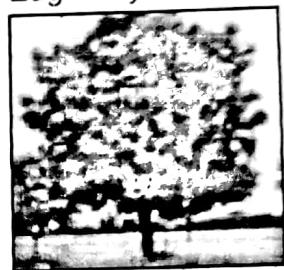
*Anthocephalus cadamba*

**1.7 Salt Resistant trees :** *Azadirachta Indica, Acacia sp., Butea monosperma, Azadirachta. Indica, Bassia Latifolia, Eucalyptus citriodora, Phonix dactylofera and Phyllanthus emblica.*



*Eugenia jambolana*

**1.8 Drought Resistant :** *Butea monosperm, Acacia sp., Albizzia lebbek, Casuarina equisetifolia, Crataeva religiosa, Tecomelia.*



*Azadirachta indica*

**1.9 Wet Land trees :** *Nyctanthes arbortristis, Dillenia Indica, Michelia champaca, Saraca Indica, Thespesia populnea, Salyx Babylonica, Ecualyptus eostata, Guaicum officinalis.*



*Pteropsporum acerifolium*

**1.10 Fast Growing Trees :** *Pongamia glabra, Sesbania grandiflora, Cananqium odoratum, Eritrina Indica, Thespesia populnea, Populus sp., Salix sp., Euclyptus sp., Thuja compacta.*

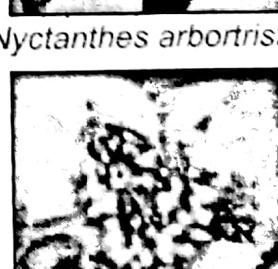
**1.11 Shade givers :** *Pteropsperum acerifolium, Albizzia lebbek, Peleptophorum, Michelia champaca, Anthocephalus cadamba, Dalbergia sisso, Glyricidia Maculata acer sp., Cornus florida.*



*Butea monosperm*

**1.12 Trees tolerant to Dust and Smoke :** *Acacia auriculiformis, Alstonia soholaris, Butea monosperma, Ficus Benjamina, F. benghalensis, Madhuca Indica, Pongamia glabra, Ficus religiosa, Terminalia Arjuna, Albizzia lebbek, Bombax ceiba.*

**1.13 Trees for Noise Reduction :** *Terminalia Arjuna, Alstonia scholaris, Azadirachta Indica, Butea Monosperma, Mangifer Indica, Madhuca Indica, Juniperus chinesis, Eucalyptus Citradora, Kigelia pinnata*



*Nyctanthes arbortristis*



*Pteropsporum acerifolium*



*Acacia auriculiformis*



*Terminalia Arjuna.*



*Pongamia glabra*