ADVANCED

FORESTS and FORESTRY

WE NEED FORESTS

- A dense forest is like an umbrella. The trees provide shade and prevent the soil from drying up, thereby maintaining the moisture content of the soil.
- Forests lower the temperature and reduce sunlight.
- The increased humidity results in the formation of fog and dew in nearby cultivated land.
- Forests reduce the velocity of wind and rainfall, thereby preventing soil erosion.
- The dry leaves and other organic matter from the trees get decomposed and mix with the soil to form humus which is fertile and can absorb large quantities of water. Thus the soil under the forest becomes a giant sponge which absorbs water during the rainy season for the hot summer months.

FORESTS AND RAINFALL

- The water from the soil is absorbed by the tree.
- This water is released into the atmosphere through the process of transpiration, thereby increasing the moisture content of the atmosphere and bringing rainfall.
- Deforestation could lead to changes in surface conditions, which would increase the intensity and decrease the duration of rainfall, thereby increasing run-off. This causes soil erosion, leading to silting of river beds. This is how floods occur.
- Floods cause a lot of damage to the standing crops and there can be drought even after a heavy rain. This is because the number of rainy days is reduced, leading to drought conditions and water scarcity.
- When drought occurs, dust is formed, leading to desertification, because the dust particles lead to dessication which dries the land.

DO YOU KNOW

- 50 acres of tropical rain forests are cut down every minute all over the world.
- There will be no rain forests left 20 years from now.
- The world's oxygen balance depends on trees and forests.
- According to India's National Forest Policy (1952), 33% of the land should be under forest cover, but, at present, the area under forest cover in India is only 10%.
- India is losing 1.5 million hectares (mha) of forests per year, thereby bringing down the total forest area from 74 mha to 40 mha.
- Deforestation causes loss of top soil to the tune of 12,000 million tonnes.
- Due to deforestation, India loses Rs.10,000 crores every year in the form of damage by floods.
- Large-scale felling of trees causes irreparable loss of organic resources.
- India requires 80 million m3 of fuelwood every year.
- The Government of India promulgated the Forest (Conservation) Act in 1980 to check indiscriminate deforestation/diversion of forest land to non-forest purposes.

PHOTOSYNTHESIS

Carbohydrates are synthesized from carbon dioxide and water by utilizing the radiant energy of light, which is captured by the chlorophyll in the cells of the green leaves. Photochemical reactions are initiated by which oxygen is released from water and light energy is converted to chemical energy, and amino acids are synthesized by the combination of intermediate products with elements such as nitrogen, derived from mineral salts. Most of the oxygen in the atmosphere is derived from photosynthesis. This makes trees and plants essential for our survival.

FORESTS AND THE GREENHOUSE EFFECT

- The burning-up of fossil fuels releases a lot of carbon dioxide (CO2) into the atmosphere. This CO2 acts as a one-way shield, which allows the sunlight to pass through it and is reflected by the surface of the earth back to the atmosphere.
- The CO2 shield does not allow this reflected light to escape and, thereby, warms up the atmosphere, leading to an increase in the global temperature.
- This increase in temperature may cause the melting of the polar ice-caps, leading to a rise in the ocean levels, which can be catastrophic.
- Forests and trees can greatly reduce this danger. As all of us know, trees absorb CO2 from the atmosphere during the day time, use it for photosynthesis and give out oxygen. If the number of trees and forests increase, the CO2 levels will come down. Thus the Green House Effect can be mitigated.

AFFORESTATION

The prosperity and economic growth of a country depends, to a large extent, on its forest wealth. The forest is an important natural resource for any country and deforestation retards a country's development. To meet the demands of the expanding population, basic resources can be obtained only through afforestation. Nurseries play an important role in increasing forest cover. As necessary as it is for a child to get through her/his tender age at a nursery, so is it for plants to grow under proper care and protection. This prepares them to withstand adverse situations during planting.

There are greater possibilities of plants getting destroyed by natural factors such as storms and wind, grazing by cattle etc., during direct sowing. Eventually, not only the seeds but our efforts also are wasted. Hence a successful afforestation programme can be achieved only through proper initial care.

SETTING UP A NURSERY

The proper growth of a tree depends on the quality of the seeds and the nursery techniques that are implemented. Therefore it is advisable to follow certain guidelines while raising nurseries.

Developing nurseries is not a difficult occupation, though it needs proper selection, care and maintenance.

Selection of site

The first necessary ingredient for nursery raising is the selection of site. The site can be near the plantation area to facilitate easy transportation at the time of planting. However, the basic facilities that are to be looked into are good sunlight, enough water resources and land (smooth and not undulating or rocky).

Nature of soil

If the soil is found to be fertile, there is no necessity to buy manure from outside. Otherwise soil should be prepared by mixing manure, sand and soil together.

Fencing

Since it is important to protect tender plants from being browsed by cattle or stolen, a proper fencing method should be adapted such as live fencing (the cheapest), stone wall, barbed wire, etc.

Implements

Spade, basin, sieve, sprinkler, sickle, scissors, etc. are the prerequisites for starting the nurseries.

Seed collection and storage

Seeds can be obtained from the nearest forest department or seed bank. If the nursery is a considerably large one seeds can be collected by the raisers and stored.

Collection of seeds

Seeds should be collected only from a healthy and properly grown tree. Do not collect seeds from very young or very old trees.

Selection of seeds

While selecting seeds, care should be taken to avoid mutilated, broken or pest-affected seeds as they will not germinate, eventually leading to waste of time, money and man power.

After selection, seeds having thick seed coats should be broken and be partially exposed to facilitate easy germination.

If the seeds are not sown immediately they should be dried in open sunlight, packed and stored in air tight containers free from pest. If the seeds or the containers are moist, there will be fungal growth.

Sowing

If the seeds are to be sown soon after collection, proper seed treatment is necessary. Some seeds which are tender and soft can be sown without prior treatment. But where seeds are strong and thick they need to be soaked in either cold water or in hot water for not more than 3 minutes or bathed in dilute sulphuric acid. Such treatment will help the seeds to germinate at a faster rate.

Preparation of bed

The preparation of the beds before sowing the seeds is important. The normal size of a bed is 1 - 1 1/2 metres and 2 to 4 metres in length. The bed should be made with a slight slope and flattened in order to facilitate proper drainage and infiltration. After the measurements are done, the bed has to be cleared of weeds, stones and pebbles.

If the soil is good, then the same soil can be used for the beds. Otherwise, good manure has to be added. Later, seeds can be sown. If the seeds are large, holes can be made with a small stick or pole on the bed and the seeds can be sown in a straight line.

If the seeds are very small, they can be sprayed over the bed and covered with soil.

After sowing the seeds, the bed can be covered with hay or coconut leaves to protect them from excess heat and pests (birds).

When the seeds germinate, a small roof made of coconut palm leaves can be constructed over the bed to prevent the tender plants from getting burned by direct sunlight.

Instead of watering directly, if water is sprinkled with a sprinkler, the seeds will not get dispersed or washed away.

Sowing in plastic bags

The normal size of plastic bags is 10 cm. width by 20 cm. length. However, the sizes will vary according to the species grown. Normally, a bag of 20 by 30 cms. (guage 250) is preferred.

Three holes should be made at the bottom of the bag to help the excess water to drain.

While filling up soil in the bag, the composition of the soil should be equal quantities of loam, sand and manure.

Before being filled in the bags, the soil should be dried and mixed well and filtered through a sieve to remove stones and pebbles and any other solid matter.

This fine mixture should be filled in airtight plastic bags. The bags should be arranged neatly in rows.

Two or three seeds should be sown in each bag, not very deep in the soil but the depth will vary according to their size. A name board should be kept for each species grown.

Once the seeds sprout, regular attention should be paid to check for weeds, pests and disease.

The polythene bags should be shifted regularly to avoid roots penetrating into the soil and the plants should be pruned periodically.

They should be arranged according to their height, to ensure adequate sunlight for all the plants.

While transplanting small saplings from beds to polybags, the bed should be watered so that the plants can be pulled up easily. The plant should be removed carefully without causing any damage to the roots. While transplanting them care should be taken that the main root does not bend and enough depth is provided for the plant.

Holding the stem or the tip of the plant while plucking for transplantation should be avoided. Instead, the middle part of the plant should be used as a grip to pluck it from the ground.

Plants can also be grown through grafting. A healthy branch of the selected species can be cut and the corners of the branch can be sliced off.

The sliced portion can be inserted into a soil filled plastic bag or seed bed.

Finally, while transporting the saplings from the nursery site to the plantation area, the plastic bags should be stacked properly in basins and transported, otherwise the plants could get damaged and die during transportation.

Planting

While planting the saplings the plastic bag should be cut vertically, on two sides and pulled apart. The sapling should be planted along with the soil.

TREE PLANTING AND AFTER CARE

To regenerate wastelands, planting can be done using traditional techniques but it is more time consuming, labour intensive and economically not viable. A more modern and efficient method is transplanting saplings from the nursery to wastelands which are a few hundred hectares, for which some alternative techniques can be employed.

Before taking up this planting programme, the site should be surveyed and live fencing established if possible. Soil samples should be tested for the fertility status with special reference to nitrogen, phosphorus and potassium. Most tropical soils lack nitrogen. To supplement and enrich this, one can prepare the soil by sowing large quantities of Crotolaria and Medicago sativa (Alfa-Alfa) seeds (about 10 kg per hectare). These are termed nurse crops. This sowing can be done with the onset of the monsoon or the first shower. Allow these plants to grow for 3-4 months and plough it possible into the soil. Once this operation is completed, pits can be dug. The size of the pits should be the size of the saplings raised in the polythene bags. For example, saplings raised in a polythene bag of 30 by 20 cm. can be transferred into a pit of a similar size or slightly more than this. The lower half of the polythene bag can be cut and then transferred into the pit. This technique of plantation saves time and labour. The density of plant saplings per hectare varies from plant to plant. For instance, Subabul can be planted at a density of 10000 plants per hectare i.e., 1 plant per sq.m., whereas Tamarind can be planted at a rate of 1500 to 2000 plants per hectare. Generally, to get an ideal tree cover, one can plant around 2000 plants per hectare.

The transplanting operation can be done during the monsoon, that is, October/November, and nature can be allowed to take care of the plants after that. If the transplanted saplings are kept away from cattle and interference from man, it is quite likely that the survival rate will be 70% to 80%.

Occasional watering can be done during the summer months. Weeding can also be avoided, if it does not hamper the growth of the plants. Pruning, thinning and replacement of dead plants can be done in the following year.

One of the other factors that ensures the survival rate is the age of saplings. Saplings more than six months or a year old, will definitely have more survival capacity than saplings which are just two or three months old. On lands with an undulating surface, planting can be done as shown in the figure below. This method would check soil erosion and allow more water infiltration.

A tree can be planted anywhere, in any place, provided the following basic amenities are available.

- Proper soil
- Priority of species
- Water facilities
- Maintenance or after care
- Marketing opportunities
- Maintenance

Each plot should be well laid out. Proper spacing of plants helps in good management of the orchard.

Different trees require difference spacing and pit sizes. The positions of pits are marked before digging begins.

Trees	Spacing	Bit sizes
Mango	30' x 30'	3' x 3' x 3'
Lemon	15' x 15'	2' x 2' x 2'
Guava	20' x 20'	3' x 3' x 3'
Sapodilla	25' x 25'	3' x 3' x 3'
Papaya	8' x 8'	2' x 2' x 2'
Pomegranate	15' x 15'	2' x 2' x 2'
Jackfruit	30' x 30'	3' x 3' x 3'
Indian Jujube	20' x 20'	2' x 2' x 2'

(These are common trees of the Indian plains.)

Digging of pits

Pits for fruit trees are always large (size: 2' x 2' x 2' or 3' x 3' x 3').

While digging, different layers of soil are piled in different heaps. Only the better soil is used for filling.

Filling of pits: 1

Before filling, the pits are dusted with pesticides to keep out white ants. The pits are then filled, preferably with silt or top soil excavated from the pit or collected from the surrounding land.

Filling of pits: 2

The lower half of the pit is filled with good soil. The next nine inches are filled with a mixture of soil and a small amount of superphosphate (100 g). The next six inches have a layer of leaf litter and green manure. The top layer of six inches contains a mixture of soil, superphosphate (1 kg), neem or castor cake (1 kg) and farmyard manure (1 basket).

Planting method: 1

Dig out a pit large enough for the sapling. Planting is done preferably in the evening. Fill the pit with water and cut open the polybag, place the sapling in the pit without damaging the roots and fill the pit with soil.

Planting method: 2

The soil filled in the pit is to be compacted to remove any air pockets. The sapling is to be watered regularly. Loss of soil moisture by evaporation can be prevented by mulching. A black plastic sheet covering the sapling basin prevents evaporation of soil moisture and suppresses weed growth. Straw can also be used for mulching.

Aftercare: 1

First, the basin is shaped. As the tree grows, the basin is shaped into a ring and irrigation is done within the ring. The sapling is watered as per requirement. Regular maintenance of the basin is essential. The soil has to be loosened and weeded regularly.

Aftercare: 2

Regular application of fertilizer in appropriate doses is essential for good growth. Nitrogen and Potassium can be applied in the ring basin and mixed with the soil. Superphosphate is filled in holes about nine inches deep. Green manuring helps in improving the soil structure.

Aftercare: 3

The pruning of the lower branches helps in proper management of each plant. The species planted will depend on the quality of the soil. All these trees need proper maintenance and care. Since each has a unique function to perform, after care also needs to be done according to the purpose of the plantation.

Coppicing:

Individual trees are cut at the base between 15 to 75 cm. above ground level. New shoots develop from the stumps. When the sprouts develop if it is grown for pole production, only 2 to 3 sprouts need to be allowed to grow. Accordingly for fuel too required sprouts can be allowed to grow. Several rotations of coppicing are usually possible with most species. *Eg.: Subabul, Acacia nilotica.*

Pollarding:

In this system, all the branches including the top of the tree, are removed at a height of approximately 2-3 metres above ground level. The main stem continues to increase in diameter, though not in height. The main stem can be cut for poles and an advantage of this is that new shoots are high enough from the ground to prevent them from being browsed by cattle. This can also be used for the management of living fences. Eg.: Azadirachta indica, Eucalyptus, Gliricidia sepium, Cassia siamia.

Lopping:

When wood is mainly used for fuel and leaves for fodder, this sytem of removing most of the branches is useful.

Pruning:

For maintaining fruit trees and trees for forage and for cropping and in fences, this system of pruning or removing smaller branches and stems is useful. Eg.: Subabul, Gliricidia Acacia.

Thinning:

This method is practiced to maintain desirable trees, by removing the poor and diseased trees and thereby reducing the competition for light and nutrients. This can be done according to the plant density.

Trees that can be grown in Marshy Areas

- Acacia auriculiformis : Babul
- Dendrocalmus strictus : Bamboo
- Derris indica : Pongamia

Trees that can be grown in Sandy Soils

- Anacardium occidentale : Cashew
- Casuarine equisetifolia : Casuarina
- Eucalyptus Sp. : Eucalyptus

Trees that can be grown in Acidic Soils

- Tamarindus indica : Tamarind
- Gliricidia sepium : Gliricidia
- Albizia procera : White Siris

Trees that can be grown in Alkaline and Saline Soils

- Acacia nilotica : Babul
- Azardirachta indica : Neem
- Cassia siamea : Kashod
- Leuchaena leucocephala : Subabul
- Prosophis juliflora : Vilayati Babul

Trees that can be grown in Clayey Soils

- Alibizia lebbeck : Siris
- Pithecellobium dulce : Madras Thorn
- Acacia nilotica : Babul
- Azadirachta indica : Neem

TREE SPECIES FOR WASTELAND DEVELOPMENT

Acacia nilotica

Common Name: Babul
Soil requirements: Grows in arid, low rainfall areas having long dry seasons. Thrives on a wide range of soils from heavy clayey to rocky soils.
Uses: It is a high calorific value food, it is useful for fuel, to make farm equipment, and in timber and pulp production. The foliage and pods are good food for livestock.

Leucaena leucocephala

Common Name: White Babul
Soil requirements: Grows in high pH soils and limestone and rocky soils but cannot tolerate high acidic or water-logged soils.
Uses: Salvador type is the fast growing one. The wood is good for fuel, pole, timber and furniture. Foliage is used as fodder for livestock. It controls soil erosion and is useful in reforesting degraded pastures.

Prosopis juliflora

Common Name: Mesquite
Soil requirements: Grows in all kinds of soils.
Uses: Useful as fuel, light timber and in fencing; pods are a source of food for livestock. Foliage is not browsed.

Casuarina equisetifolia

Common Name: Casuarina
Soil requirements: Adapted to a wide range of soils including calcareous, saline and seashore areas.
Uses: Good for fuel, poles, timber and as raw material for pulp. Foliage is not browsed by livestock. It controls soil erosion, acts as a wind breaker and can withstand a polluted atmosphere.

Albizia lebbek

Common Name: Siris
Soil requirements: It requires well drained soil, and the trees grow well near sea shores and on dry, alkaline soils.
Uses: It is useful for fuel, furniture and timber. The bark is used in tanning. It has high medicinal properties. The foliage is browsed on by animals.

Artocarpus heterophyllus

Common Name: Jack Fruit
Soil requirements: Requires deep soils, but adapted to alkaline, acidic, laterite, sandy and clayey soils.
Uses : Useful for furniture, foliage browsed by livestock, fruits are edible.

Melia azadirach

Common Name: Persian Lilac or China Berry
Soil requirements: Grows in saline, alkaline and slightly acidic soils.
Uses: Good for fuel, timber and paper production. Foliage is browsed by livestock and it is good for agro-forestry.

Samanea saman

Common Name: Rain Tree
Soil requirements: Grows on poor soils, alkaline conditions. Not in water-logged areas.
Uses: Good as fuel wood and for furniture making. Foliage is browsed. Pods make nutritious food for livestock.

Thespesia populnea

Common Name: Portia Tree
Soil requirements: Grows in sandy, laterite, alluvial black clay, marshy and acidic soils and on land flooded by salt water.
Uses: The trunk is used in making bullock carts, central bars, match sticks, etc. Foliage is a good fodder.

Gliricidia sepium

Common Name: Mexican Lilac
Soil requirements: Grows well in all kinds of soils like dry, moist, eroded, sandy and lime stone soils.
Uses: Good for fuel and to make furniture and tools. Foliage is browsed by animals. This is good for live fencing and for control of soil erosion.

Bambusa arundinacea

Common Name: Bamboo
Soil requirements: Grows in deep, well drained, sandy loams, but can be grown in clayey, acidic and alkaline soils too. Does not grow well on shallow and gravelly soils.
Uses : Used for constructing houses, basket making and for making quality paper. Foliage is a fodder for livestock.

Terminalia arjuna

Common Name: Arjun
Soil requirements: Grows in humid, tropical conditions, cannot withstand drought, but grows well in a variety of soils like saline, alkaline, gravelly, etc.
Uses: Leaves are a good fodder for livestock. The wood is good for fuel and to make furniture.

Tectona grandis

Common Name: Teak
Soil requirements: Grows on a variety of soils, laterite, gravelly, acidic and alkaline.
Uses: Wood is used for timber and is highly durable.

Moringa oleifera

Common Name: *Drumstick Tree*
Soil requirements: Grows in all soil conditions but not in water-logged soils.
Uses: Eaten as a vegetable, good species for agro-forestry and for control of soil erosion.

Azadirachta indica

Common Name: Neem
Soil requirements: It is suitable for areas with long, dry seasons. It grows on a wide range of soils including dry, clayey, shallow, rocky and sandy soils. It does not grow in water-logged, saline or deep, dry areas. *Uses:* Resistant to pests, good for fuel and timber and to make furniture. The oil is used for soap. The cake is used for manure and to control soil-borne pests.

Mangifera indica

Common Name: Mango
Soil requirements: Grows on a variety of soils but prefers deep, well drained soils.
Uses: Good for fuel, timber and medium quality furniture. Foliage is browsed by livestock. Fruits provide a substantial income.

Ziziphus jujuba

Common Name: Indian Jujube
Soil requirements: Grows in a variety of soils from sandy, gravelly to clayey, saline, alkaline and dry soils.
Uses: Wood is good for fuel. The wood is also used for making agricultural implements. Fruits are edible and the leaves are browsed by livestock.

Tamrindus indica

Common Name: Tamarind
Soil requirements: Grows in a variety of soils from gravelly, sandy and deep clayey to acidic and alkaline soils.
Uses: Wood is heavy and is excellent timber. The fruits are edible. The pulp is used in cooking. Foliage is browsed by livestock.

Emblica officinalis

Common Name: Gooseberry
Soil requirements: Grows in all kinds of soil.
Uses: Good fuel, foliage is browsed by livestock. Fruits are rich in Vitamin C and are edible.

Syzygium cumini

Common Name: Jamun
Soil requirements: Grows in sandy, limestone and alkaline soils. A full-grown tree can withstand drought and flood conditions.
Uses: Wood is used for fuel. The bark contains tannin. Fruits are edible and the foliage is browsed by livestock.

Pongamia pinnata

Common Name: Pungam
Soil requirements: Grows in a variety of soils and can even tolerate acidic soils.
Uses: Used as firewood. Foliage is browsed by livestock and it has medicinal properties.