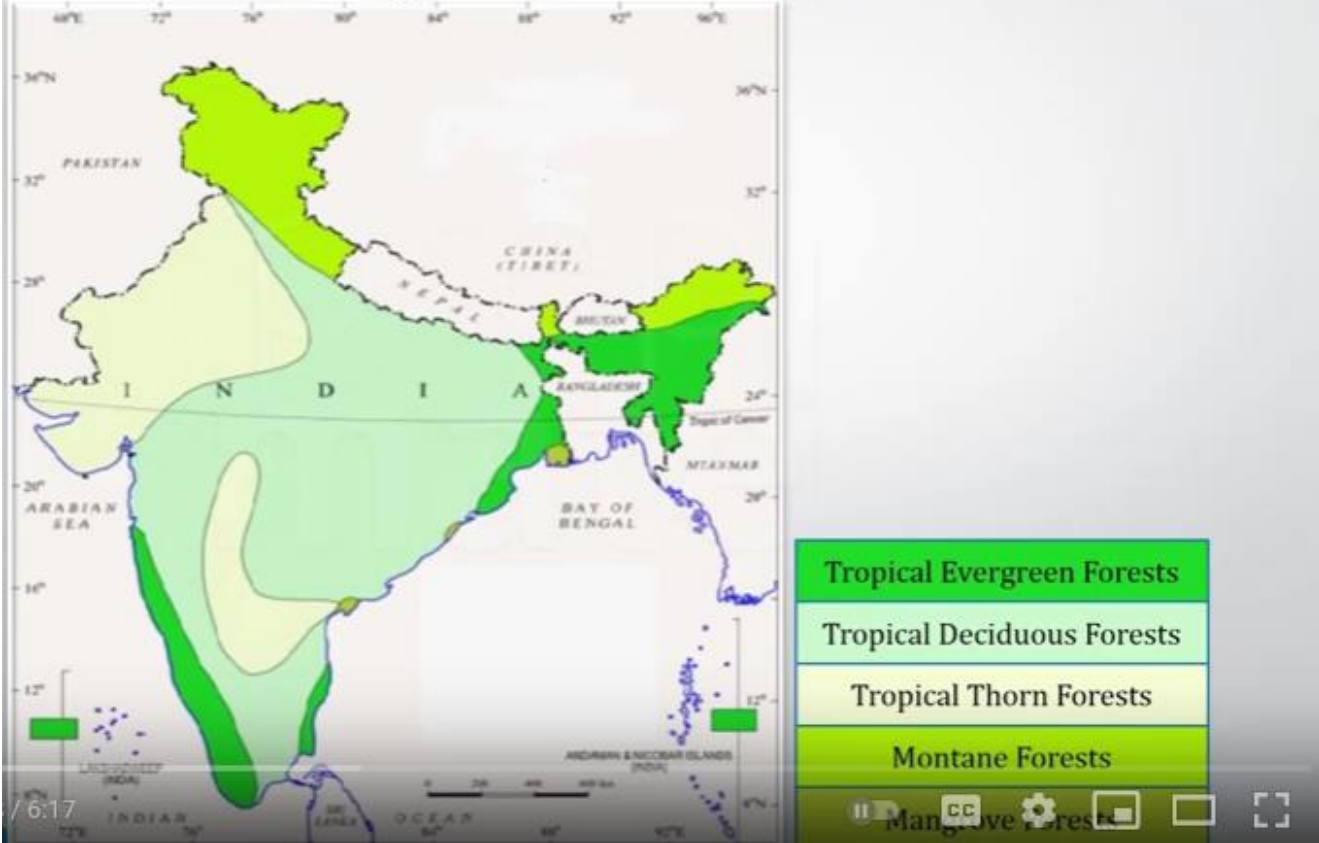


## **Unit – IV**

**Forestry:** Indian forest types and forest products of India; Deforestation, soil erosion and soil conservation; Forest genetic resources management: Scope and Objectives, Afforestation, Social forestry and Clonal forestry (selection and vegetative propagation); Mapping: Conservative method and Satellite Mapping. Exobiology; Remote sensing: Principle and GIS – application; Vegetation types: Rain forest, Deciduous forest, Mangroves and Scrub jungle.

# Map showing Distribution of Forests in India



# Tropical Evergreen Forests (Tropical Rainforests)

## Characteristics

- Location: Found on the western slopes of Western Ghats, parts of North East India, Andaman and Nicobar and Lakshadweep Islands.
- Climatic Conditions: Humid all through the year with annual rainfall of over 200 cm.
- Evergreen on account of availability of humidity throughout the year.
- Also called rainforests because they receive high rainfall all year long.



Rosewood



Mahogany



Ebony

# Tropical Evergreen Forests (Tropical Rainforests)

## Characteristics

Tallest trees reach about 150 feet. Have narrow trunks and widespread branches to receive maximum sunlight.

Smaller trees beneath taller trees. Receive less sunlight.

Shrubs and herbs at the lowest level, require and receive minimal sunlight.

No sunlight on ground due to dense cover. Hence, grass is absent.

Rich diversity of Flora but heterogeneous nature makes commercial exploitation difficult.

Wood is heavy and cannot be transported through water also.

Unchecked cutting could lead to sudden soil erosion due to absence of grass. Thus, regeneration of these forests is difficult.



Thick Canopy



Absence of Grass



Sub Levels



Erosion

# Semi-evergreen Forests



## Characteristics

- Found in the areas of evergreen forests, receiving relatively lesser rainfall.
- Contain both evergreen and deciduous trees.
- Undergrowth provides an evergreen character.



Cedar

# Tropical Deciduous Forests

## Characteristics

- Most widespread forests in India. Also called Tropical Monsoon Forests.
- Deciduous because trees shed their leaves after rainy season to adjust to dry period. Leaf shedding prevents moisture loss.
- Climatic Conditions: Grow in regions receiving rainfall between 50-200 cm.
- Moist deciduous forests: Areas of 100-200 cm rainfall. Important species: Teak, Sal, Sandalwood, Shisham, Mahua, Amla, etc.
- Dry deciduous forests: Areas of 50-100 cm rainfall. Important species: Tendu, Palas, Amaltas, Bel, Khair, etc.



Shisham



Mahua



Amaltas



Tendu

# *Tropical dry deciduous forests*



# Tropical Deciduous Forests



## Characteristics

- Forest remains green for four months during the rainy season, when there is concentrated rainfall.
- Less dense and Homogeneous in nature. Hence, lumbering and commercial exploitation is possible.
- Wood is light in weight and can be transported via river water.



Homogeneous,  
Less Dense



Dry Season



Lumbering



River  
Transport

# Tropical Thorn Forests

## Characteristics

- Location: semi arid and arid regions of Rajasthan, Northern Gujarat and South West Punjab.
- Consist of grassland and desert type vegetation.
- Climatic conditions: Exist in regions with less than 50 cm rainfall.
- Also called Savannah type of vegetation.



Babool



Ber



Neem



Khejri



# Tropical Thorn Forests



## Characteristics

- Grasslands: Coarse, long grass with long roots. Scattered short, deciduous trees with broad trunks.
- Desert Vegetation:
  - Well spaced plants with long roots.
  - Thick and waxy stem to store water and prevent deposition of desert sand.
  - Thorns instead of leaves to prevent water loss via transpiration.



Grasslands



Well Spaced  
Plants



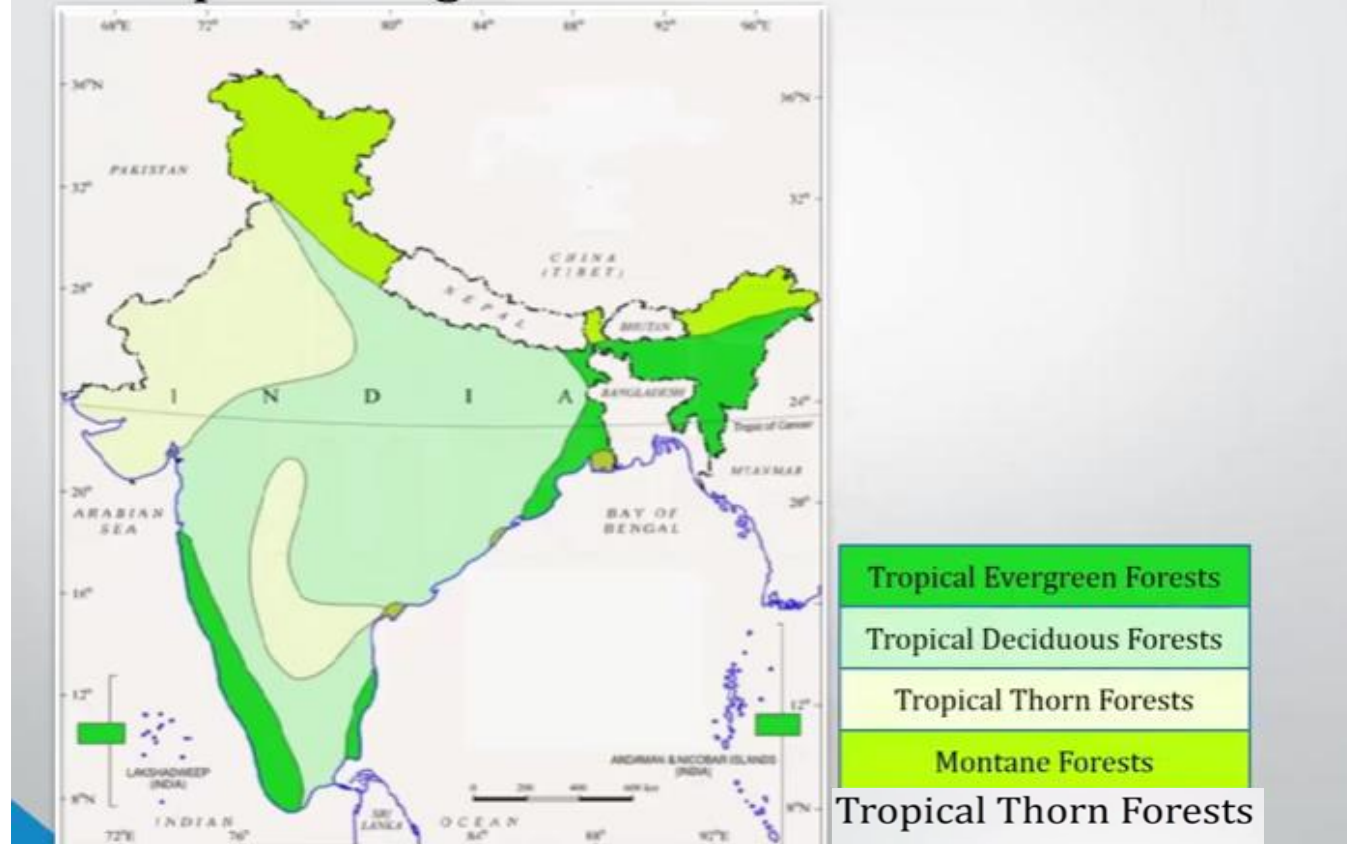
Thorns



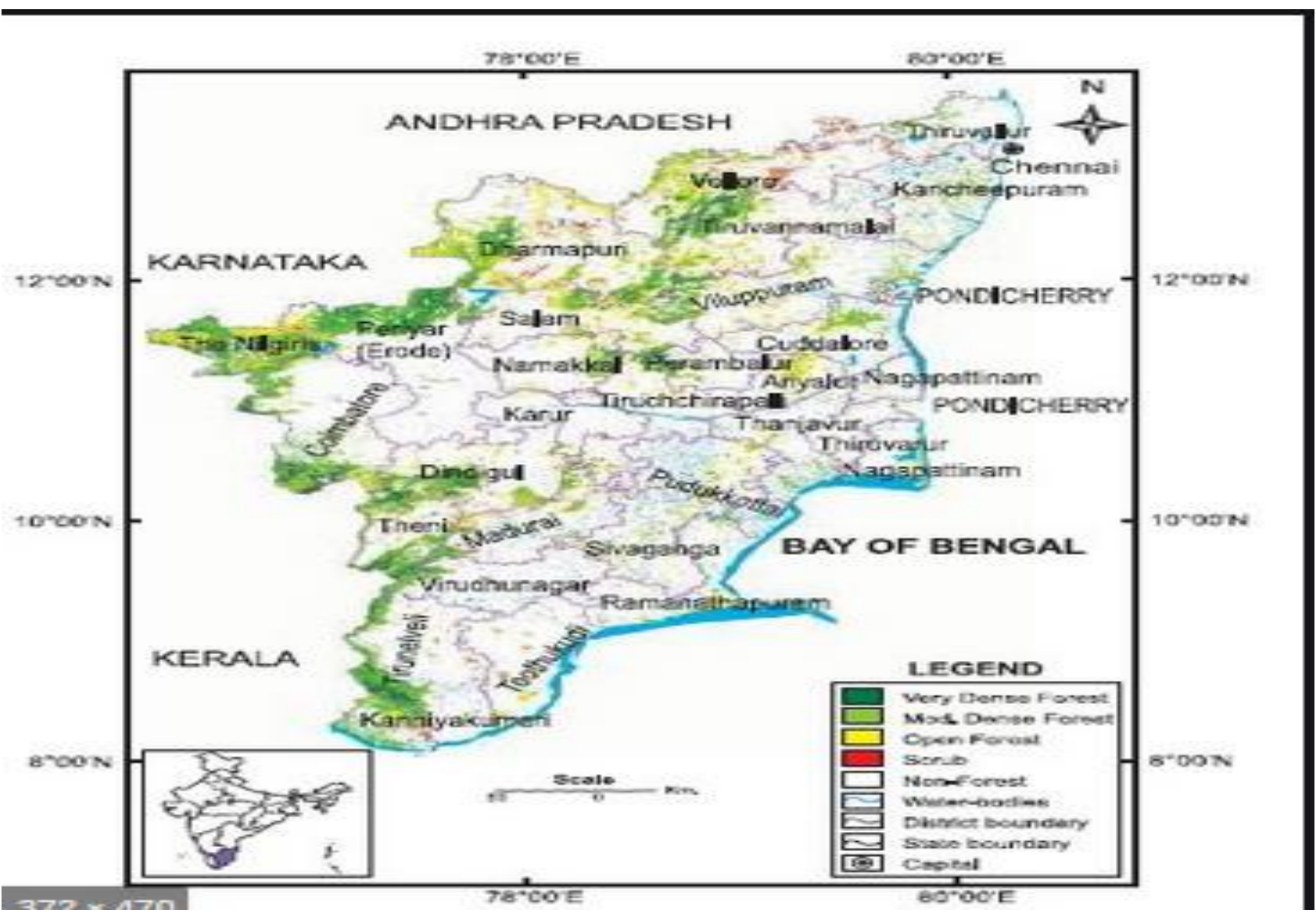
Root System  
and Spacing



## Map showing Distribution of Forests in India



Mapping the distribution of forest types in Tamilnadu.



## 1.TROPICAL EVERGREEN FOREST



This type of forest is present on the western ghats of Tirunelveli, Kanyakumarai, The Nilgiris and Coimbatore districts on the upper slopes and top hills and sometimes on the steep slope of lower down. Tree species present in this area are *Hopeaparvi flora*, *Artocarpus hirsuta*, *Syzygium cumini*, *Cinnamomum zeylanicum*.

## 2.TROPICAL SEMI EVERGREEN FOREST



This type occurs on slopes of hills and mountains usually up to 1000 m. Canopy are of two or three storeys. This forest type present in Coimbatore, Tirunelveli and Kanyakumari districts between western tropical evergreen and the moist deciduous type with mixture of occasional evergreen and abundant moist deciduous tree species. The species present in this type are *Artocarpus hirsuta*, *Hopea parviflora*, *Lagerstroemia lanceolata*, *Terminalia paniculata*

### 3. TROPICAL MOIST DECIDUOUS FORESTS



This type of forest lies below the zone of semi evergreen and evergreen forests. The trees reach a height of 30 to 30 m and are deciduous. *Bamboos* are common. *Bombax ceiba*, *Dillenia pentagyna*, *Mitragyna parviflora* and *Terminalia spp.*, are the common trees

## 4.LITTORAL AND SWAMP FORESTS



This type of forest is present in the coastal area in the river deltas along the edges of the delta streams, tails of islands and over sea face where accretion is in progress. The vegetation, typically evergreen of moderate height, with leathery leaves, vivipary usually, composed of trees specially adapted to survive on tidal mud, permanenetly wet with salt water and submerged every tide. The species present are *Rhizophor amucronata*, *R. apiculata*, *Avicennia officinalis*, *A. marina*, *Clerodendrum inereme*, *Acanthus ilicifolius* etc. Stilt roots are very typical notable in *Rhizophora* spp



## 5.TROPICAL DRY DECIDUOUS FORESTS



These forests are found at about 400 m and above. The canopy is closed. Most of the species are deciduous. The undergrowth is usually dense. The common trees are *Albizia amara*, *Anogeissus latifolia*, *Butea monosperma* and *Terminalia* spp., etc.

## 6.TROPICAL THORN FORESTS



Those forests are found from plains up to 400m the common trees of top storey are *Acacia ferruginea*, *Acacia leucophloea*, *Albizia amara* and *Azadirachta indica*

## 7.TROPICAL DRY EVERGREEN FORESTS



A low forest consisting mostly of small coriaceous leaved evergreen trees with short boles and spreading crowns. The proportion of deciduous species may be large locally and climbers are numerous. The important species are *Manilkara hexandra*, *Albizia amara*, *Memecylon umbellatum*, *Atlantia monophylla* and *Pheonix sylvestris*

## 8.MONTANE SUBTROPICAL FORESTS

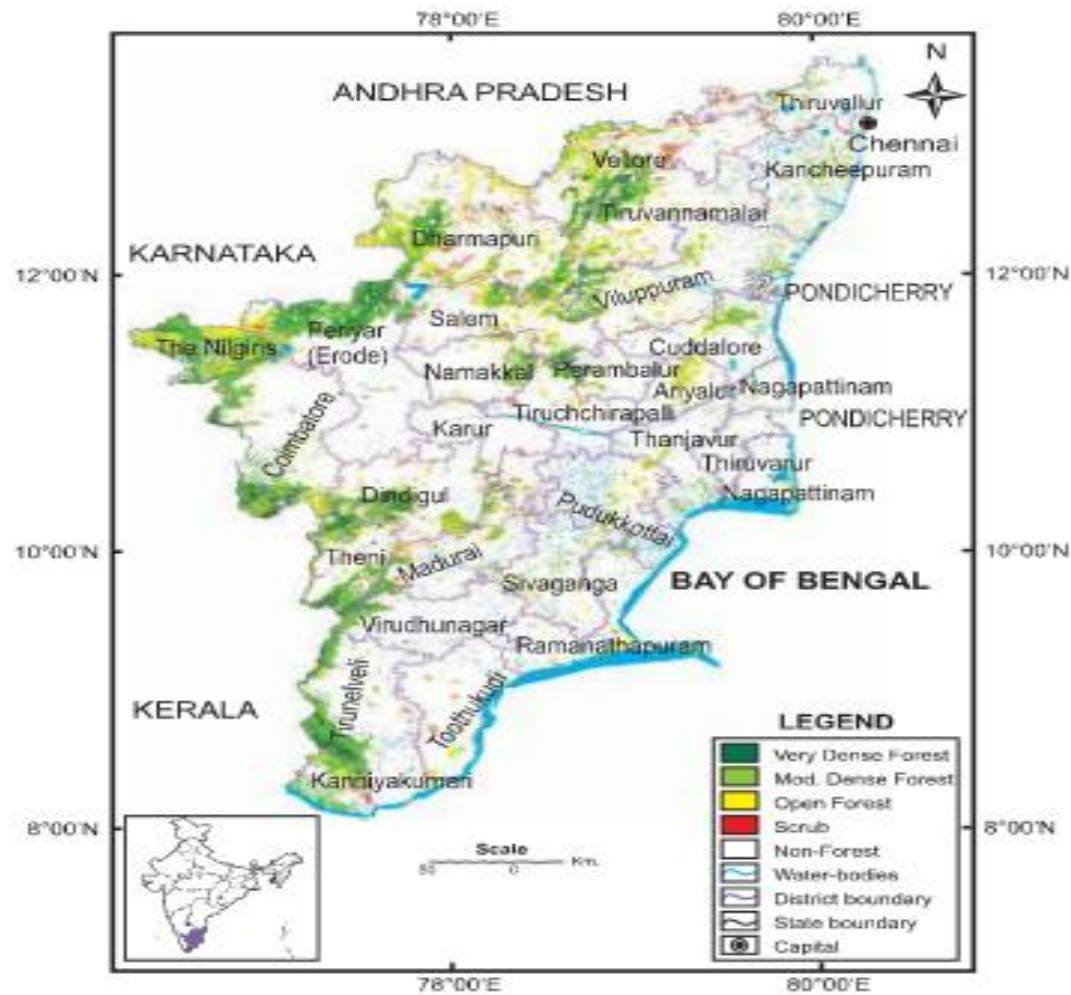


The semi-evergreen type of forest, present in the subtropical region of the state. In Eastern Ghats it is found in the upper slopes and Plateau of Shevaroy's, Kollimalai, and Pachamalai. Epiphytes are common. The important species are *Cedrella toona*, *Atrocarpus lakoocha*, *A.hirsuta*, *A.heterophyllus* and *Mangifera indica*.

## 9.MONTANE TEMPERATE FORESTS



The montane forest mostly confined to moist and sheltered valleys, glens and hollows as in the Anamalais, Nilgiri and Palani at above 1000 m. they are known in Tamil as ‘sholas’. The trees are evergreen and usually short boled. *Ilex denticulate*, *I.wigtiana*, *Michelia nilagrica* and *Syzygium spp.*, are the common trees.



**Fig 9.25 Forest Cover Map of Tamil Nadu**

# Deforestation



Deforestation, soil erosion  
and soil conservation

# Index

- Definition
- Causes of Deforestation
- Effects of Deforestation
- Forest Degradation in India
- Control of Deforestation



# What is Deforestation?

- Deforestation, clearance or clearing is the removal of a forest.
- Examples of deforestation include conversion of forestland to farms, ranches, or urban use.

## Causes of Deforestation

### 1) Shifting cultivation:-



## Causes of Deforestation

- Most of the clearing of forest is done for agricultural purposes.
- Poor farmers cut down trees or burn it and start agriculture.
- Intensive or modern agriculture destroy the forest on a large scale.
- It is principal cause of deforestation in some countries like America(35%), Asia(50%),Africa(70%).

## Causes of Deforestation

### 2) Commercial Logging:-



## Causes of Deforestation

- It involves cutting trees for sale as timber or pulp.
- It employs heavy machinery to remove cut trees and build roads.
- Logging roads enable people to access the interiors of the forest, which in results in deforestation .
- In Africa, 75% of land being cleared by poor farmers is land that has been previously logged.

## Causes of Deforestation

### 3) Mining and Dams:-



## Causes of Deforestation

- Mining, industrial development and hydroelectric power plant projects are also causes of deforestation.
- Dams open the previously inaccessible forest and damage ecosystems.
- In Brazil, the grand carajas project occupies 90,000 km<sup>2</sup>.
- It also affect 23 tribal groups and also cause the high soil, water and air pollution.



## Causes of Deforestation

- Deforestation also occurs due to overgrazing and conversion of forest to pasture for domestic animals .
- Expansion of agribusiness that grows oil palm , rubber, fruit trees and ornamental plants has also resulted in deforestation.
- Governmental sponsored programs that resettle landless farmers on forested sites have contributed to deforestation all around the world.
- Other reasons includes fire, pest, etc.

## Effects of Deforestation

- 1) Soil Erosion:- The soil gets washed away with rain water on sloppy area in the absence of trees leading to soil erosion.
- 2) Expansion of Deserts:- Due to action of strong wind mass of land gradually gets covered to sand deserts.
- 3) Decrease in Rainfall:- In the absence of forest, rainfall decreases considerably because forests bring rains and maintains high humidity in atmosphere.

## Effects of Deforestation

- 4) Loss of Fertile Land:- Less rainfall results into the loss of fertile land owing to less natural vegetation growth.
- 5) Effect on Climate:- Deforestation includes regional and global climate change. Climate has become warmer due to the lack of humidity in deforestation regions and also patterns of rainfall has changed. Droughts have become common.

## Effects of Deforestation

- 6) Economic Losses:- Deforestation will cause loss of industrial timber and non-timber products and loss of long term productivity on the site.
- 7) Loss of Bio-diversity:- Deforestation cause the bio-diversity leading to disturbances in ecological balance world wild.

## Effects of Deforestation

- 8) Loss of medical Plants:- There are many species of plants, which have been used in India for centuries as insecticide, fungicide, in medicine and in bio-fertilizers. Deforestation may lead to the extinction of these valuable plants.
- 9) Environmental Changes:- It will lead to increase in carbon dioxide concentration and other air pollutants. This would result in Global Warming.

## Effects of Deforestation

- 10) Change in living Habits:- This may force indigenous people to live a new life which they are not prepared. Disturbance in forest eco-system may result in other eco-systems that may be separated by great distances.

## Forest Degradation In India

- Depletion of forestry cover less than 90% is considered as forest degradation and more than 90% is considered as deforestation, according to Food and Agriculture Organisation(FAO) of the UN.
- Logging is considered as a forest degradation and not as a deforestation.
- In India timber is used for preparing plywood, veneer, boards, doors, windows and other furniture.

## Forest Degradation In India

- Wood is also used for cooking and heating.
- Population, rapid development and men's dependency on forest are mainly responsible for Forest Degradation.
- India has lost 3.4 million hectares of forest cover from the period of 1951-1970.
- Nearly 1% of land is turning barren per year due to deforestation.



## Control of Deforestation

- **Reforestation:-**  
Many countries in the world have started reforestation and forestry, and East Asian nations are leading in this regard. Many East Asian countries, including China, have successfully managed to reverse deforestation.
- **Legislation :-**  
By making suitable changes in the law, so that cutting trees in a forest will not only lead to deforestation being controlled in a major way, but its flow may also be reversed.

## Control of Deforestation

- **Wildlife Sanctuaries :-**  
Sanctuaries are very important, not only to save wildlife, but to save trees as well. Sanctuaries go a long way in protecting all wildlife.
- **Commercial Forest Plantations :-**  
There can be special forest plantations for all the wood that is needed for the industry. This way the wood can be cut in a controlled and regulated environment.

## Control of Deforestation

- Cities :-

All cities, let alone new cities, have to be managed properly. Their expansion has to be curtailed or at least done in a systematic manner, so that there is enough green cover, and new trees are planted where ever possible.

Incentive to Corporate :-

Tax cuts should be granted to corporations, to get them actively interested in reforestation.

## Control of Deforestation

- Water Management :-

Improper water management affects deforestation in a big way. If the wildlife doesn't have water, then the entire ecosystem will falter. The construction of new dams should be planned properly, so that any one area isn't deprived of water, while another area has abundance of it.

# INTRODUCTION

**Soil erosion:** Soil erosion is the detachment, transport and deposition of soil particles on land surface. Also termed as Loss of soil.

❑ Measured as Mass/unit area



# Soil Erosion is caused by:

## ❑ Natural Processes

- Water
- Wind



## ❑ Human Activities

- Overcropping
- Overgrazing
- Deforestation



# TYPES OF SOIL EROSION

(1) **Sheet erosion**- Sheet erosion is the removal of the thin layer of topsoil by raindrop splash or water run-off.



**(2) Gully erosion-** In Gully erosion, the surface run-off is very high.

Gullies resemble large ditches or small valleys; are metres to 10 metres in depth and width.



### (3) Rill erosion

If sheet erosion occurs with full force, the run off water moves rapidly over the soil surface. It cuts well-defined finger-shaped groove like structures, It appears as thin channels or streams. It is known as Rill erosion.



## (4) Stream bank erosion

The rivers during floods splash their water against the banks. In this way the water cuts through them. Particularly at curves, water strikes with great speed and the bank caves in alongside. This type of erosion is also known as **Riparian erosion**.





## ❖ Other Types-

✓ Wind Erosion-Soil erosion by wind is common in dry (arid) regions. Two characteristics of such region are:

(a) The soil is mainly sandy

(b) The vegetation is very poor or even absent

✓ Landslides or slip erosion-The hydraulic pressure which is caused by heavy rains increases the weight of the rocks at cliffs. As a result they come under the gravitational force and finally slip or fall off.



Fig. - Landslides or slip erosion

## Problems caused by soil erosion:

1. Loss of valuable topsoil.
2. Burying valuable topsoil.
3. Damage to fields.
4. Plant productivity decline.
5. Desertification.



# Case Study:

## Soil Erosion and Desertification in the Sahel

The Sahel stretches for 5,400km across Africa from the Atlantic Ocean in the West to the Red Sea in the East.

It includes countries such as Mali, Nigeria and Ethiopia.



# Video Clip

- 2009 – BBC News Report about the famine affecting Ethiopia.



# Case Study:

## Soil Erosion and Desertification in the Sahel

- **Soil erosion** (caused by overgrazing, overcropping and deforestation) is **leading to desertification** in the Sahel region of Africa.
- **Increased drought** in the Sahel region as a result of **climate change** is also causing soil erosion and desertification.



# Climate Change

- Global warming has caused a rise in the temperature of the atmosphere in the Sahel region.
- As a result the air can hold more water vapour and rain is less likely to occur.

***“The rain doesn’t come on time anymore. After we plant, the rain stops just as our crops start to grow. And it begins to rain after the crops have already been ruined.”***

- Quote from an Ethiopian farmer.

# METHODS OF CONSERVATION

Various methods of soil conservation may be broadly categorized into two types:

- (1) Agronomic Practices
- (2) Engineering practices

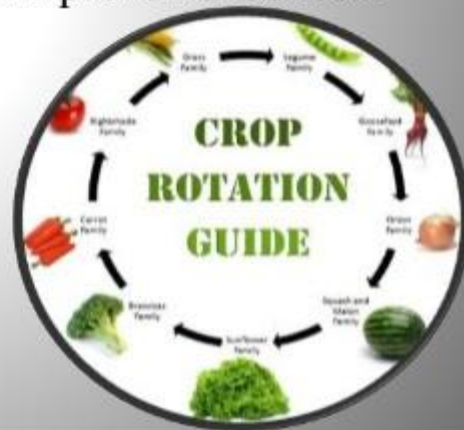


## (1) Agronomic Practices

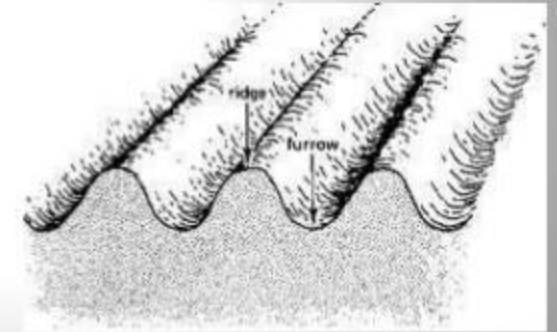
This method involves protection of the top soil by special methods and schemes of crop cultivation. These are-

(a) **Crop Rotation** - It is a method of growing a series of dissimilar crops in an area sequentially. Here different crops are grown in the same area by rotation, that is, one after another.

Crop rotation also helps in the improvement of soil structure and fertility.



(b) **Strip Cropping** - In this method, the cultivated crops and the cover crops are sown in alternate strips during the same period in the same field.



## Methods of Conservation: Windbreaks / Shelter Belts

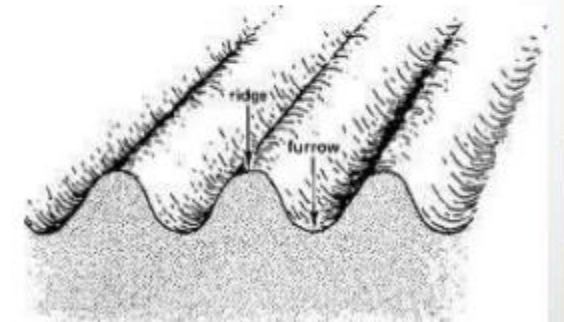
Barriers formed by  
trees and plants  
with many leaves.



## Methods of Conservation: Contour / Strip Ploughing



The tractor operator follows  
the contours of the hillside.  
The furrows thrown up by the  
plough (going in different  
directions) stop the flow of  
water and encourage  
percolation in the soil.



## (2) Engineering Practices

(a) **Excavation of ditches** – These are artificially created channels to divert the excess water . Two types of ditches are commonly made-

(i) **Diversion ditches** : diverting the run-off away from the field

(ii) **Interception ditches** : made at regular and suitable intervals across the cultivated field. These ditches do not allow formation of thick sheets of water .

(b) **Terraces construction** – Terraces are large steps cut into a hillside.

This reduces slope length and steepness to control the energy of running water and its ability to carry soil away.



(c) **Check Dams** – Small (sometimes temporary) check dams are constructed out of various materials like stones, timber, steel etc. to control erosion by reducing the velocity of water flow.



Fig. – A steel check dam



Fig. – A concrete check dam

(d) **Windbreaks / Shelter Belts** - Barriers formed by trees and plants with many leaves to control the wind velocity.





## Methods of Conservation: Terraces

- Large steps cut into a hillside.
- This reduces slope length and steepness to limit the energy of running water and its ability to carry soil away.



## Methods of Conservation: Stone Walls / Bunds

- Low walls placed along the contour of a hill.
- These walls capture water allowing it to filter into the soil rather than run off downhill.



## Methods of Conservation: Reduce ploughing in dry/windy weather

- Ploughing in dry and windy weather increases the risk of wind erosion.



# Ten ways to conserve soil

Plant trees



Terraces



No-till farming



Contour ploughing



Crop rotation



Soil pH



Water the soil



Salinity management



Soil organisms



Indigenous crops





# Advantages

1. protecting soil against erosion,
2. improving soil properties,
3. enhancing soil fertility,
4. suppressing weeds,
5. fixing N,
6. increasing soil organic matter content,
7. increasing crop yields,
8. recycling nutrients,
9. preventing leaching of nutrients, and
10. improving water quality



# Plant Trees



# TERRACE FARMING



## TERRACE FARMING

**Terraces:** Terracing is one of the very good methods of soil conservation.

- In terrace farming make or form (sloping land) into a number of level flat areas resembling a series of steps.
- **Explanation:** decreasing the slope by making it resemble “steps” which are commonly found on the side of a mountain or hill
- **Types of crops:** rice, cotton, sugar cane, wheat, potatoes
- Popular in **Eastern Asia**



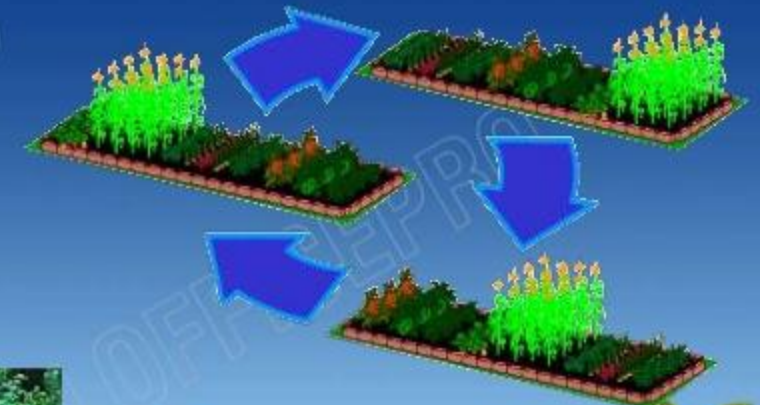
## Advantages:

- reduces erosion
- Contour farming effectively reduces rate of erosion in soils with slopes of up to 10%
- Holds rainwater which allows for the cultivation of water intensive crops as mentioned before.
- Farmers use this technique because it allows for the cultivation of water intensive crops in these areas because it helps trap and hold rainwater



# Crop Rotation

- **Crop rotation** is the practice of growing a **series of dissimilar** types of crops in the same area in sequential seasons.
- Continuous cultivation of the same crop also leads to an imbalance in the fertility demands of the soil. To prevent these adverse effects from taking place, crop rotation is practiced.
- It is a method of growing a series of dissimilar crops in an area sequentially.
- Planting three or more different crops before returning to the original crop constitutes long-term rotations



## Crop Rotation



## Advantages

1. reduce soil erosion,
2. improve soil properties,
3. increase organic matter content,
4. improve soil fertility,
5. increase crop yields,
6. reduce build-up of pests,
7. increase net profits,
8. improve wildlife habitat,
9. reduce use of chemicals, and
10. reduce water pollution.





# Intercropping



## Intercropping

- **Intercropping** is a **multiple cropping system** where two or more crops are grown simultaneously on the same field
- Intercropping takes into account all beneficial interactions between and among crops while creating possible negative interactions caused by the neighborly effects.
- For example, plant species such as garlic and onion repel certain insects and protect adjacent vegetables (e.g., tomato, lettuce, carrot) from pest attacks provided that the competition for light and water is negligible.
- Intercropping with legumes or deep-rooted plant species absorbs nutrients from deeper soil horizons and **reduces N** deficiencies among neighboring and succeeding non-legume crops.



## Advantages

- Reduces erosion and vulnerability.
- **Increases plant biodiversity to help disguise plants from insect species.**
- Improves the overall health of crops and decreases chance of disease.
- it minimizes pest problems and improves soil fertility





# SALINITY MANAGEMENT

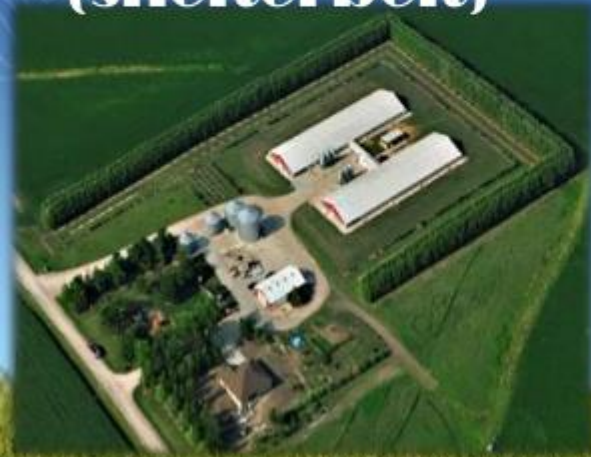


- The salinity of soil that is caused by the excessive accumulation of salts, has a negative effect on the metabolism of the crops in soil.
- Salinity of soil is detrimental to the vegetative life in the soil. The death of vegetation is bound to cause soil erosion.
- Hence, salinity management is one of the indirect ways to conserve soil.
- In this method Flushing soil & leaching salt away



## Windbreak

(shelterbelt)



## windbreak

- A **windbreak** (shelterbelt) is a plantation usually made up of one or more rows of trees or shrubs planted in such a manner as to provide shelter from the wind and to protect soil from erosion.
- They are commonly planted around the edges of fields on farms.
- If designed properly, windbreaks around a home can reduce the cost of heating and cooling and save energy.

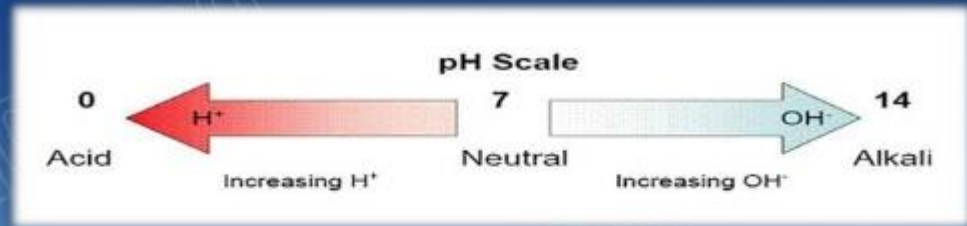


# Soil organisms



# Soil organisms

- Organisms like earthworms and others benefiting the soil should be promoted.
- Earthworms, through aeration of soil, enhance the availability of macronutrients in soil. They also enhance the porosity of soil.
- The helpful organisms of soil promote its fertility and form an element in the conservation of soil.



# Soil pH



# Soil pH

- The contamination of soil by addition of acidic or basic pollutants and acid rains has an adverse effect on the pH of soil.
- Soil pH is one of the determinants of the availability of nutrients in soil.
- The uptake of nutrients in plants is also governed to a certain extent, by the soil pH.
- The maintenance of the most suitable value of pH, is thus, essential for the conservation of soil.



## What is Forest Management?

- Forest management is the branch of forestry concerned with the overall administrative, economic, legal, and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection, and forest regulation.
- This includes management for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products, forest genetic resources and other forest resource values.
- Management can be based on conservation, economics, or a mixture of the two. Techniques include timber extraction, planting and replanting of various species, cutting roads and pathways through forests, and preventing fire.

**Afforestation** is the process of introducing trees and tree seedlings to an area that has previously not been forested. Afforestation can be done through tree planting and seeding, naturally or artificially.

Similarly, **reforestation** can be considered a form of afforestation. Reforestation is the alteration of a non-forested area to a forested area through tree planting and seeding. The difference is that reforestation is the **restoration** of an area that has been deforested

There are many reasons for restoring an area via afforestation and reforestation, however they vary based on the area. Generally it is done for either conservation or industrial-commercial purposes.

- Conservational** afforestation and reforestation is done in the best interest of the ecosystem. Its purpose is to restore an area that has been destroyed due to previous overuse of the land or to reduce the amount of erosion in the soil in an area and establish a more fertile and stable soil base.

- Industrial-commercial** afforestation and reforestation is done to maintain a good output of wood for pulp and timber demands in a specific area.

## Clonal propagation in trees

The clonal multiplication reproduces clones, which contain all the genetic information of the parent tree. The term clone is used to mean a genetically uniform plant material derived from a single individual and propagated exclusively by vegetative means. Clonal selection and deployment is receiving attention as an intensive forest management tool for increased wood production. Many wood based industries in particular, pulp and paper industries are involved in plantation establishment programme using clonal forestry approaches in the recent past.

## Vegetative propagation in forest trees

The goal of vegetative propagation is to reproduce progeny plants identical in genotype to a single source plant. The biological process is known as cloning and the resulting population of plants is called a clone. Cloning can occur in nature by special vegetative structures (bulbs, tip layers, rhizomes, and runners). These structures provide a special advantage for colonizing a specific site, but generally, cloning is not favoured in nature because the process does not provide opportunity for the variation and evolutionary advancement that result from sexual production. Vegetative propagation provides a powerful tool in the selection of clones grown in cultivation. Immediate selection of a single superior plant genotype is possible and can be followed by more or less indefinite multiplication. The following are the successful vegetative propagation methods that have been developed for economically important species.

Neem can be successfully propagated by means of hardwood, semi hardwood and softwood cuttings. Summer is the best season for collection of propagules.

- Hardwood cuttings** - 1-2 cm diameter hardwood cuttings are collected from healthy vigorously growing branches. The terminal portion of leaves is excised and branches are made into 15-20 cm long cuttings. 1000 ppm of IBA treatment has been given as basal dip. Then the cuttings are planted in nursery beds under 50-60% shade. The per cent of rooting is however, low (Mohinderpal, 1995).

- Semi Hardwood Cuttings** - These cuttings are collected from fresh growth during early morning hours and made into 10-15 cm long cuttings by retaining a pair of leaves near the upper end of the cuttings. 2000 ppm IBA is the best treatment which will give maximum rooting under mist. Rooting is taking place from 6 to 8 weeks.

- Softwood Cuttings** - Shoots from fresh growth flush are collected in the morning and the terminal softwood portions are used for making 4-7 cm long, binodal, leafy cuttings. These cuttings are planted in vermiculture or coarse sand medium and kept in mist chamber condition. The cutting roots within 4 weeks. This has to be hardened before planting in the main field.

## **Farm forestry**

At present in almost all the countries where social forestry programmes have been taken up, both commercial and non commercial farm forestry is being promoted in one form or the other. Individual farmers are being encouraged to plant trees on their own farmland to meet the domestic needs of the family. In many areas this tradition of growing trees on the farmland already exists. Non-commercial farm forestry is the main thrust of most of the social forestry projects in the country today. It is not always necessary that the farmer grows trees for fuel wood, but very often they are interested in growing trees without any economic motive. They may want it to provide shade for the agricultural crops; as wind shelters; soil conservation or to use wasteland.

## **Community forestry**

Another scheme taken up under the social forestry programme, is the raising of trees on community land and not on private land as in farm forestry. All these programmes aim to provide for the entire community and not for any individual. The government has the responsibility of providing seedlings, fertilizer but the community has to take responsibility of protecting the trees. Some communities manage the plantations sensibly and in a sustainable manner so that the village continues to benefit. Some others took advantage and sold the timber for a short-term individual profit. Common land being everyone's land is very easy to exploit. Over the last 20 years, large-scale planting of Eucalyptus, as a fast growing exotic, has occurred in India, making it a part of the drive to reforest the subcontinent, and create an adequate supply of timber for rural communities under the aegis of 'social forestry.

## **Extension forestry**

Planting of trees on the sides of roads, canals and railways, along with planting on wastelands is known as 'extension' forestry, increasing the boundaries of forests. Under this project there has been creation a of wood lots in the village common lands, government wastelands and panchayat lands.

Schemes for afforesting degraded government forests that are close to villages are being carried out all over the country.

## **Agro forestry**

Planting of trees on and around agricultural boundaries, and on marginal, private lands, in combination with agricultural crops is known as agro-forestry. Social forestry, schemes that have been started all over the country have made a considerable difference in overall forest cover in a short time.

Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Special cameras collect remotely sensed images, which help researchers "sense" things about the Earth. Some examples are:

- Cameras on satellites and airplanes take images of large areas on the Earth's surface, allowing us to see much more than we can see when standing on the ground.
- Sonar systems on ships can be used to create images of the ocean floor without needing to travel to the bottom of the ocean.
- Cameras on satellites can be used to make images of temperature changes in the oceans.

Some specific uses of remotely sensed images of the Earth include:

- Large forest fires can be mapped from space, allowing rangers to see a much larger area than from the ground.
- Tracking clouds to help predict the weather or watching erupting volcanoes, and help watching for dust storms.
- Tracking the growth of a city and changes in farmland or forests over several years or decades.
- Discovery and mapping of the rugged topography of the ocean floor (e.g., huge mountain ranges, deep canyons, and the “magnetic striping” on the ocean floor).



Use of GIS has seen unprecedented growth in the last ten years. With the powerful technology getting cheaper and system memories expanding, meaning that we can handle much bigger sets of data, some say that GIS is in a golden age. It was once the preserve of the cartographer - few outside would have used it or needed it, yet recently GIS has become a core part of modern environmental science degrees.

Geology, climatology, geography, statisticians, archaeology, oceanography, conservation based qualification and most other environmental sciences (1) now offer a module at undergraduate level. In the last five years, most universities have offered masters degrees specifically in GIS, or post-graduate certificates and diplomas with a prerequisite of environmental undergraduate degree.

It is surprising to many that this technology has been around for over fifty years (2) because to people outside of the relevant fields, and to some within fields who are just starting to learn about applications and potential for their work, it is still relatively new and exciting with endless possibilities. GIS is something that will make many jobs easier and faster and allow them to do more things in the same space of time with the click of a button. No longer are maps the exclusive preserve of the cartographer, now urban and rural developers, medical resource planners, conservation professionals, environment agency staff (to track and measure floodplains and the spread of protected species) archaeologists and utilities providers are just some of the environmentalist careers that can benefit from digital mapping.

## . Forest Vegetation

Champion and Seth (1968) recognized a total of 16 forest types in India, Whereas 9 types of them in Tamil Nadu.

### I) Moist Tropical Forests

It is in the warmer plains. It is characterised by very dense, multi-storeyed diverse trees, shrubs, lianas and scrub jungles. These areas experience a high rainfall and dry climate. These are further classified into the following types on the basis of wetness.

#### 1. Tropical wet evergreen forests

This type is found at an altitude of nearly 1500 m on the slopes of hills and mountains .These are also called tropical rain forests or tropical wet evergreen forests, where annual rainfall is more than 250 cm.. Vegetation consists of luxuriantly growing huge trees of more than 45 m in height, shrubs, lianas and abundant epiphytes. The common plants are *Dipterocarpus*, *Artocarpus*, *Mangifera*, *Emblica* and *Ixora*. These forests occur in Andaman and Nicobar Islands, Western Coasts, Anamalai hills and Assam. This type is also found in western ghats of Thirunelveli, Kanyakumari, Anamalai Hills of Tamil Nadu

## • **Tropical semi-evergreen forests**

This type occurs on the slopes of hills and mountain usually up to 1000 m altitude. The annual rainfall in these forests is between 200 to 250 cm. Vegetation consists of luxuriantly growing evergreen species of giant trees and shrubs. The common tree species are *Terminalia*, *Bambusa*, *Ixora*, *Artocarpus*, *Michelia*, *Eugenia*, and *Shorea*. Orchids, ferns, some grasses, and herbs are also dominant. These forest are found in Western Coasts, Eastern Orissa and Upper Assam. This type is also present in Coimbatore, Thirunelveli and Kanyakumar District of Tamil Nadu

## 3. **Tropical moist deciduous forests**

The annual rainfall of these forests is 100 to 200 cm with short dry periods. These are spread over an extensive part of the country. Many of the plants shed their leaves in hot summer. Some are ever green and semi-evergreen.

### **Alpine - Scrub**

This type of vegetation is found in the Himalayas at an altitude ranging from 3600 m to 4900 m. The height of the trees decreases with increasing altitudes. The common plants are small sized plants such as *Sedum*, *Primula*, *Saxifraga*, *Rhododendron*, *Juniperus* and with many types of lichens.