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# 2026

# CGPSC

## CHHATTISGARH

# STATE FOREST SERVICE

## Module - I

**Single-Source Solution for *Forestry Optional***

This study material not only covers the entire syllabus and previous years' questions in a structured, topic-wise manner but also includes several emerging and important areas that are not explicitly mentioned in the **APPSC RFO/FSO 2025** examination syllabus but from which questions are likely to be asked.

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**Assistant Conservator of Forest (ACF) – 2023**

# CGPSC

## STATE FOREST SERVICE (ACF/RFO)

# FORESTRY

**MODULE – 1**

**EDITION : 2026**

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MODULE 1

# PREVIOUS YEAR QUESTIONS

## SYLLABUS

- ***General Forestry*** – History and background of forest and Forestry in India and CG.
- ***Silviculture*** – Definitions, terminology, objective of forestry, role of forest (productive, protective and ameliorative), Locality factors, influence of forest on environment, Forest Succession, forest types of India and CG, Regeneration, Choice of species, Seed Supply, Nursery operations, Tending operations, Miyawaki forests.
- ***Mangroves*** & Cold desert – Introduction, distribution,
- ***Silviculture System*** : Introduction, Clear felling system, Shelterwood, Selection and coppice wood systems.
- ***Important Indian tree Species*** – Important commercial tree species of India and CG.

CGPSC के आधिकारिक पाठ्यक्रम (Syllabus) में तो वानिकी के इन विषयों के केवल नाम दिये गये हैं। यहाँ उनके साथ संक्षेप में दिया गया पाठ्यक्रम, इन्हीं विषयों से संबंधित PYQs के विश्लेषण के आधार पर तैयार किया गया है, ताकि परीक्षार्थियों को एक सामान्य समझ विकसित हो सके।

## PYQs Analysis

### CGPSC STATE FOREST SERVICE 2016 (DoE : 28/08/2016)

उस समय, वानिकी (फॉरेस्ट्री) का विषय सीधे तौर पर पाठ्यक्रम का हिस्सा नहीं था, लेकिन इससे जुड़े प्रश्न सामान्य अध्ययन (प्रश्न पत्र 1), व जीव विज्ञान, प्रौद्योगिकी और पर्यावरण (प्रश्न पत्र 2) के अंतर्गत पूछे गये थे और इस मॉड्यूल की पृष्ठभूमि से संबंधित हैं।

#### *General Forestry*

**1.** One horned Rhinoceros are preserved in
- (a) Gir Forests
- (b) Kaziranga National Park
- (c) Ranthambore Park
- (d) Corbett National Park
- (e) None of the above

**2.** Wild Life symbol of WWF is
- (a) Red Panda
- (b) One horned Rhinoceros
- (c) Dodo of Mauritius
- (d) Great Indian Buster
- (e) None of the above

**3.** What for the abbreviation IBWL stands?
- (a) Indian Board of Wild Life
- (b) Indian Bureau of Wild Life
- (c) Investigation Bureau on Wild Life Extinction
- (d) International Board on Wild Life
- (e) None of the above

**4.** Full form of CPCB is
- (a) Central Pollution Control Board
- (b) Central Potential Control Base
- (c) Centre Permission Control Boss
- (d) Centre Prevention Control Base
- (e) None of the above

**5.** Which of the following is also called as Rio + 10?
- (a) The Earth Summit (2002) in Rio de Janeiro
- (b) The World Summit on Sustainable Development in Johannesberg
- (c) United Nations Conference on Sustainable Development in Rio de Janeiro
- (d) CITES in Washington
- (e) None of the above

**6.** The World Environmental Day is on
- (a) 10$^{th}$ June
- (b) 10$^{th}$ January
- (c) 5$^{th}$ June
- (d) 5$^{th}$ August
- (e) None of these

**7.** World Population Day is on
- (a) 11$^{th}$ July
- (b) 11$^{th}$ January
- (c) 11$^{th}$ April
- (d) 11$^{th}$ August
- (e) None of these

**8.** The World Food Day is on
- (a) 16$^{th}$ October

(b) 16th January
(c) 16th June
(d) 16th December
(e) None of the above

**State Special**

**9.** How much percentage of forest area is in the total geographical area of the State?
(a) 40.21
(b) 23.38
(c) 43.85
(d) 32.85
(e) None of these

**10.** According to ***Forest Area*** Chhattisgarh stands at which place in India
(a) Fourth
(b) Third
(c) Second
(d) First
(e) None of these

**11.** By which of the following name Chhattisgarh was known in the Vedic Age?
(a) Dakshin Kosala
(b) Chedisgarh
(c) Dandakaranya
(d) Gondwana
(e) None of these

**12.** How many ***Forest Project Mandals*** are there in Chhattisgarh State?
(a) 4
(b) 5
(c) 6
(d) 7
(e) None of these

**13.** How many ***Forest Mandal's Home Herbal Gardens*** are established in Chhattisgarh State?
(a) 6
(b) 7
(c) 8
(d) 9
(e) None of these

**14.** How many areas (in lakh hectare) covered in joined forest management in the Chhattisgarh State?
(a) 40.5
(b) 23.3
(c) 18.2
(d) 30.4
(e) None of these

**Silviculture**

**15.** If staminate and pistillate flowers are born on separate plants the taxon is
(a) Dioecious
(b) Hypogynous
(c) Monoecious
(d) Epigynous
(e) None of these

**16.** Second generation biofuels are made from
(a) Oil crops
(b) Sugar crops
(c) Vegetable oils
(d) Non-food lignocellulosic materials
(e) None of these

## CGPSC STATE FOREST SERVICE 2017 (DoE : 25/03/2018)

उस समय, वानिकी (फॉरेस्ट्री) का विषय सीधे तौर पर पाठ्यक्रम का हिस्सा नहीं था, लेकिन इससे जुड़े प्रश्न सामान्य अध्ययन (प्रश्न पत्र 1), व जीव विज्ञान, प्रौद्योगिकी और पर्यावरण (प्रश्न पत्र 2) के अंतर्गत पूछे गये थे और इस मॉड्यूल की पृष्ठभूमि से संबंधित हैं।

**General Forestry**

**17.** Who is the President of the 'Council of Scientific and Industrial Research' India?
(a) President of India
(b) Vice President of India
(c) Prime Minister of India
(d) Union Minister of Science and Technology
(e) State Minister of Science and Technology

**18.** "Biodiversity Act of India" was passed by the Parliament in the year
(a) 1998
(b) 1992
(c) 2000
(d) 2002
(e) 2014

**19.** The "World Earth Day" is celebrated on
(a) 5th June
(b) 16th September
(c) 1st July
(d) 22nd April
(e) None of these

**State Special**

**20.** What is the rank of Chhattisgarh State in India as per forest area?
(a) First
(b) Second
(c) Third
(d) Fourth
(e) None of these

**21.** In which of the following month and year, the Chhattisgarh ***State Forest Development Corporation*** came into existence?
(a) January, 2001
(b) February, 2001
(c) October, 2001
(d) November, 2001
(e) None of these

**22.** At present, how many ***Forest Pariyojana Mandals*** are in existence in Chhattisgarh State?
(a) 7
(b) 6
(c) 8
(d) 9
(e) None of these

**23.** How many ***work plans*** are sanctioned by the Government in Chhattisgarh State for scientific management of forests ?


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(a) 05
(b) 06
(c) 07
(d) 09
(e) None of these

**24.** In how many forest mandals, "***Home Herbal Gardens***" are established in Chhattisgarh State during rainy season of 2017?
(a) 8
(b) 9
(c) 10
(d) 11
(e) None of these

**25.** "***Sitanadi Sanctuary***" is situated in which district of Chhattisgarh State ?
(a) Mahasamund
(b) Dhamtari
(c) Dantewada
(d) Bilaspur
(e) None of these

## *Silviculture*

**26.** Which plant hormone is responsible for ripening of fruit?
(a) Auxin
(b) Gibberellin
(c) Cytokinin
(d) Ethylene
(e) Abscissic Acid

**27.** Edible part of coconut is
(a) Mesocarp
(b) Endocarp
(c) Cotyledon
(d) Embryo
(e) None of these

**28.** Which of the following is a petro-crop?
(a) Wheat
(b) Potato
(c) Rice
(d) Jatropha
(e) None of these

**29.** Which of the following observations are correct regarding the neem coated urea?
1. Reduces pest attack
2. Diversion of neem coated urea to non-agricultural uses.
3. Improves soil quality.

Chose correct one :
(a) 2, 3
(b) 1, 2
(c) 1,3
(d) 1,2,3
(e) None of them

**30.** The rate of transpiration in plants decreases with increase in
(a) Speed of wind
(b) Intensity of light
(c) Humidity of air
(d) Temperature of environment
(e) None of the above

**31.** Which one of the following is a correct matching pair of organisms and the type of association?
(a) An Orchid on a Tree - Parasitism
(b) Rhizobia in nodules of Pea - Symbiosis
(c) Dodder plant on Duranta - Epiphytism
(d) Sea anemone on Hermit Crab = Commensalism
(e) Both b and d

## CGPSC Ass. Professor 2019 (DoE : Nov 2020)

इस परीक्षा में वानिकी (फॉरेस्ट्री) एक वैकल्पिक विषय के रूप में था जिससे 100 प्रश्न पूछे गये।

## *General Forestry*

**32.** Most of the global industrial timber comes from which forest?
(a) Deciduous forest
(b) Conifer forest
(c) Tropical forest
(d) None of these

**33.** Chipko movement is related to
(a) Forest conservation
(b) Soil conservation
(c) Water conservation
(d) Wetland conservation

**34.** ICFRE was established in the year of
(a) 1980
(b) 1986
(c) 1975
(d) 1982

**35.** Forest research institute is located at
(a) Jodhpur
(b) Jhansi
(c) Dehradun
(d) New Delhi

**36.** Tropical forest research institute is located at
(a) Kanpur
(b) Jodhpur
(c) Delhi
(d) Jabalpur

**37.** In India, common type of forest is
(a) Tropical thorn forests
(b) Sal and Teak forests
(c) Tropical moist deciduous forest
(d) Tropical dry deciduous forest

**38.** First forest policy in India is adopted in which year
(a) 1890
(b) 1894
(c) 1927
(d) 1955

**39.** Forest conservation Act was enacted during
(a) 1980
(b) 1880
(c) 1780
(d) 1680

**40.** Wildlife protection Act was enacted during
(a) 1975
(b) 1980
(c) 1972
(d) 1995

**62.** Based on the coppicing ability the species which belongs to strong coppice category is
(a) *Madhuca indica*
(b) *Bombax ceiba*
(c) *Morus alba*
(d) *Adina cordifolia*

**63.** Dalbergia seeds are dispersed by
(a) Wind
(b) Animals
(c) Water
(d) Sand

**64.** The correct set of information to be recorded during seed collection is
(a) Species, location, time and temperature
(b) Species, location, Soil type and Number of parent trees
(c) Species, location, Soil type and Temperature
(d) Species, location, Soil type and name of the collector

**65.** Which of the following is related to Sal tree
1. Tree belongs to family Dipterocarpaceae
2. Germination is hypogeous
3. Seed is orthodox
4. Wood is diffused porous
(a) 1,3 and 4 only
(b) 1,2 and 3 only
(c) 1 and 2 only
(d) 1,2, and 4 only

**66.** Topographical tetrazolium Test is used to asses
(a) Seed Vigor
(b) Seed germination
(c) Seed viability
(d) Seed health

**67.** The most limiting element of all the environmental factors on the growth of trees is
(a) Carbon dioxide
(b) Moisture
(c) Day length
(d) Neutral

**68.** The number of plants per hectare, when teak is planted at 2m x 3m spacing is
(a) 666
(b) 1666
(c) 3666
(d) 2666

**69.** Which of the following statements is incorrect about weeding process in forest crop
(a) Weeding must be done in plantations during rains and stopped by the end of September
(b) Fast-growing species requires more weeding than the slow-growing species
(c) It is carried out for three years from planting
(d) Fast-growing species requires less weeding than the slow growing species

**70.** Name of the term used for removing trees with undesirable type or less desirable types, from seed orchard is
(a) Self – thinning
(b) Rouging
(c) Weeding
(d) Selfing

**71.** Girdling is a method use to
(a) Kill unwanted trees
(b) Harvest mature trees
(c) Produce knot-free lumber
(d) None of these

**72.** Removal of lower branches of a tree is called
(a) Pruning
(b) Thinning
(c) Cutting
(d) Pinching

**73.** The objectives of thinning are
1. To improve hygienic condition
2. To create best conditions of growth
3. Salvage the anticipated losses of the merchantable volume of timber
4. Retaining seed bearers
(a) 1,2 and 3 only
(b) 1 and 4 only
(c) 2 and 3 only
(d) 1,2,3 and

## *Mangroves & Cold desert*

**74.** In which of the following mangrove forests in India is maximum?
(a) Sundarbans Delta
(b) Mahanadi Delta
(c) Godavari Delta
(d) None of these

**75.** The incorrect adaptation exhibited by mangroves is
(a) Succulent leaves
(b) Aerial breathing roots called pneumatophores
(c) Oviparity
(d) Sunken stomata

## *Silvicultur systems*

**76.** System of successive regeneration felling is known as
(a) Improvement felling
(b) Tree improvement
(c) Shelterwood system
(d) Pastoral system

**77.** Which law is used for estimating the proportionate distribution of trees in selection forests?
(a) Mayer's law
(b) De Liocourt's law
(c) Wallace's law
(d) Fastman's law

## CGPSC STATE FOREST SERVICE 2020 (DoE : 5 December 2021)

इस परीक्षा में वानिकी (Forestry) विषय को पहली बार शामिल किया गया था और इससे संबंधित कुल 20 प्रश्न पूछे गये। इसके अतिरिक्त कृषि, जीव विज्ञान, विज्ञान एवं प्रौद्योगिकी तथा पर्यावरण विषयों के अंतर्गत पूछे गये 6 प्रश्नों की प्रकृति भी वानिकी से ही जुड़ी थी, तो उन्हें भी इसीके अंतर्गत रख लिया गया है। प्रस्तुत मॉड्यूल (Module) की विषय-वस्तु से कुल 12 प्रश्न संबंधित हैं।

(a) 62.69 kg/hectare
(b) 64.69 kg/hectare
(c) 66.69 kg/hectare
(d) 68.69 kg/hectare

**88.** Match List-I (Parasitic weed) with List-II (Nature) and select the correct answer using the code given below the lists :

*List-I : Parasitic weed*

(A) Striga
(B) Cuscuta
(C) Loranthus
(D) Orobanche

*List-II : Nature*

(i) Semi-parasite on stem
(ii) Semi-parasite on root
(iii) Total parasite on root
(iv) Total parasite on stem

Select the correct code

| | (A) | (B) | (C) | (D) |
|---|---|---|---|---|
| (a) | (ii) | (iv) | (i) | (iii) |
| (b) | (ii) | (iv) | (iii) | (i) |
| (c) | (i) | (iii) | (ii) | (iv) |
| (d) | (ii) | (iii) | (iv) | (i) |

**89.** The change of resistance with age in host plant is known as
(a) Ontogenic resistance
(b) Systemic acquired resistance
(c) Induce systemic resistance
(d) Major gene resistance

## CG VYAPAM ASS. MANAGER (PROCUREMENT) 2022 (DoE : 13/06/2023)

छत्तीसगढ़ राज्य लघु वनोपज (व्यापार एवं विकास) सहकारी संघ मर्यादित द्वारा आयोजित सहायक प्रबंधक (उपार्जन) भर्ती परीक्षा–2022 के पाठ्यक्रम में वानिकी (Forestry) Discipline के अंतर्गत पाँच प्रमुख विषय—(1) Silviculture, (2) Plantation Forestry, (3) Forest Pathology, (4) Utilization of Non-Timber Forest Products तथा (5) Medicinal & Aromatic Plants—शामिल थे। इनमें से प्रत्येक विषय से 15-15 प्रश्न पूछे गए थे। इसके अतिरिक्त, कृषि (Agriculture), बागवानी (Horticulture) तथा सामान्य ज्ञान (General Knowledge) खंडों में भी कुछ ऐसे प्रश्न पूछे गये, जिनकी विषय-वस्तु प्रत्यक्ष अथवा अप्रत्यक्ष रूप से वानिकी से संबंधित थी। अतः अध्ययन एवं विश्लेषण की सुविधा के लिए ऐसे प्रश्नों को भी वानिकी विषय के अंतर्गत सम्मिलित किया गया है।

### General Forestry

**90.** Eucalyptus were first introduced in India around the year
(a) 1880
(b) 1720
(c) 1790
(d) 1830

**91.** Taungya started in Bengal for the first time for the plantation of 'Sal' in the year
(a) 1912
(b) 1911
(c) 1913
(d) 1910

**92.** According to India Forest Status Report (IFSR) 2021, how much is the recorded forest of Chhattisgarh state?
(a) 59772 $km^2$
(b) 55972 $km^2$
(c) 59816 $km^2$
(d) 58916 $km^2$

**93.** As per the report of India state of forest, forest cover of Chhattisgarh
(a) 48.00%
(b) 46.07%
(c) 44.21%
(d) 43.55%

**94.** Earth day is celebrated on
(a) 21 April
(b) 22 April
(c) 23 April
(d) 22 May

**95.** World Ozone day is celebrated on
(a) 15 September
(b) 16 September
(c) 18 September
(d) 25 September

**96.** Sweet revolution is related with
(a) Apiculture
(b) Floriculture
(c) Aquaculture
(d) Sugarcane

**97.** Golden Revolution' is related to ____
(a) Precious minerals
(b) Pulses
(c) Jute
(d) Horticulture & Honey

### State Special

**98.** Which one is dominant forest tree in Chhattisgarh?
(a) Sal
(b) Sagon
(c) Sisham
(d) Haldu

**99.** Which of the following tree species is included in the nationalized tree list in Chhattisgarh?
(a) Sal
(b) Teak
(c) Khair
(d) All of the above

**100.** Kanger valley national park is situated in
(a) Bastar
(b) Bilaspur
(c) Dantewada
(d) Dhamtari

**101.** In which district is *Tamor Pingla Wildlife Sanctuary* located?
(a) Surajpur District
(b) Surguja District
(c) Sukma District
(d) None of the above

### Silviculture

**102.** Classification of forest based on method of regeneration is known as
(a) High forest and coppice forest
(b) Pure forest and mixed forest
(c) Normal forest and abnormal forest
(d) State forest and community forest

(b) 3 x 3 m
(c) 2 x 2 m
(d) 2 x 1 m

**126.** The planting pattern in which an extra plant is placed in the centre of each square of the four plants is called
(a) Line planting
(b) Square planting
(c) Quincunx planting
(d) Triangular planting

**127.** How much does a bamboo live?
(a) 120 years
(b) 20 years
(c) 10 years
(d) 5 years

**128.** In Madhya Pradesh, formula N = $(150)^2$ / D +4, is used for mechanical thinning for which of the following species?
(a) Shorea robusta
(b) Terminalia tomentosa
(c) Tectona grandis
(d) Anogeissus latifolia

**129.** Which of the following formula is used for Sissoo in mechanical thinning and known as Howard's formula?
(a) D = 2(d + 3)
(b) D = d
(c) D = 2d
(d) D 1.5 (d + 4)

**130.** Singling operation is performed in early stages of the life of a tree when it is
(a) 4-5 m tall
(b) 2-4 m tall
(c) 1-2 m tall
(d) upto 1 m tall

## CG VYAPAM PROJECT RANGER / ASS. PROJECT RANGE 2021

इन परीक्षाओं के syllabus में वानिकी (Forestry) विषय जुड़ा था हालांकि basic प्रश्न ही पूछे गये। प्रस्तुत Module की विषय-वस्तु से कुल 12 प्रश्न संबंधित हैं।

### General Forestry

**131.** When was Joint Forest Management concept introduced in India? [CG Vyapam Project Ranger 2021]
(a) 1970s
(b) 1980s
(c) 1990s
(d) 1960s

**132.** Green revolution started in India [CG Vyapam Forest guard 2021]
(a) 1960-65
(b) 1965-70
(c) 1970-75
(d) 1975-80

**133.** Which Indian state has highest forest cover ? [CG Vyapam Ass. Project Ranger 2021]
(a) Chhattisgarh
(b) Andhra Pradesh
(c) Assam
(d) Madhya Pradesh

**134.** What is the rank of Chhattisgarh state in India as per forest area? [CG Vyapam Forest guard 2021]
(a) $5^{th}$
(b) $4^{th}$
(c) $3^{rd}$
(d) $2^{nd}$

**135.** The State of India which have all the three species of crocodile and started crocodile project is [CG Vyapam Project Ranger 2021]
(a) Uttar Pradesh
(b) Maharashtra
(c) Kerala
(d) Rajasthan

### State Special

**136.** What is the state tree of Chhattisgarh? [CG Vyapam Project Ranger 2021]
(a) Sal Tree
(b) Teak Tree
(c) Peepal Tree
(d) Banyan Tree

**137.** In which district of this State, first bird festival was organized ? [CG Vyapam Project Ranger 2021]
(a) Kawardha
(b) Bemetara
(c) Dhamtari
(d) Raigarh

**138.** About what percentage of the total forest area of Chhattisgarh is covered with ***Sal forest***? [CG Vyapam Project Ranger 2021]
(a) 36.6
(b) 40.6
(c) 44.6
(d) 48.6

**139.** The species/wild animals which are in danger of extinction of Chhattisgarh is [CG Vyapam Project Ranger 2021]
(a) Frog (Hoplobatrachus tigerinus)
(b) Tortoise
(c) Wild Elephants
(d) Bear

**140.** The number of Tiger Reserve in this State is [CG Vyapam Ass. Project Ranger 2021]
(a) 3
(b) 4
(c) 2
(d) 1

**141.** Office of state Bio-diversity board of Chhattisgarh is located at [CG Vyapam Ass. Project Ranger 2021]
(a) Aranay Bhavan, Raipur
(b) IGKV, Raipur
(c) NIBSM Baronda, Raipur
(d) Shivnath Bhavan Naya, Raipur

### Silviculture

**142.** Which of the following is not under the development of social forestry programme? [CG Vyapam Ass. Project Ranger 2021]
(a) Farm Forestry
(b) Community Forestry
(c) Strip Plantations
(d) Control of Government

**143.** The branch of study that deals

CHAPTER 1

# GENERAL FORESTRY

Our religious texts, such as the ***Vedas***, ***Aranyakas*** (Aranya means "forest" in Sanskrit), ***Upanishads***, and ***Smritis***, contain many references to the use and management of forests. These texts also highlight the importance of sustainable use and conservation of forest resources.

According to Vedic tradition, a village was considered complete only when different types of forests or sacred groves—such as ***Mahavan***, ***Shrivan***, and ***Tapovan***—were protected and maintained within and around the village.




In the ***Vishnu Purana***—one of the **18** ***Mahapuranas***—there is a description of ***13 types of forests*** found in different regions of ancient India. Some of these include – ◈ ***Angireya*** Vana (Bengal and Assam), ◈ ***Prachya*** Vana (Bihar, Uttar Pradesh, Nepal), ◈ *Naimisharanya* (Central Uttar Pradesh), ◈ *Panchanada* Vana (Punjab and Jammu & Kashmir), ◈ ***Aparantaka*** Vana (Wester coast), ◈ ***Dandakaranya*** Vana, ◈ *Kalinga* Vana, ◈ *Saurashtra* Vana, ◈ *Kalesha* Vana (south of the Narmada River), ◈ ***Vaman*** Vana (near Gwalior), ◈ ***Dasarnaka*** Vana (around Bhopal, Sagar, Damoh), ◈ *Mahakantaka* Vana (Kalahandi, Koraput, and Bastar districts in Odisha and Chhattisgarh), and ◈ *Karusha* Vana (Baghelkhand and Bundelkhand regions).

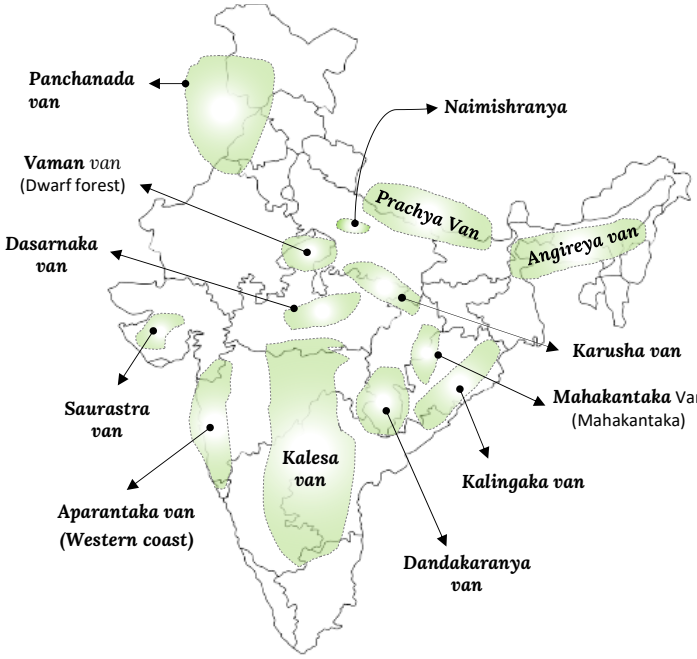
These forests were broadly classified into two main types—

(a) ***Kunjar Vana****** – ***Elephant forests***, characterized by dense vegetation that provides shelter and sustenance for wild elephants.

## Chapter Outline


**1.1** Historical background
**1.2** Forestry & Wildlife after independence
**1.3** MoEFCC & Its Sub-ordinated bodies
**1.4** Forestry Education system
**1.5** Forest Survey of India
**1.6** FAO & Its State of the world forest report
**1.7** Forest types in India
**1.8** Forest & wildlife related acts, policies & missions
**1.9** Wildlife projects
**1.10** National & International days & years
**1.11** International Organizations
**1.12** Superlatives in Forestry
**1.13** Remarks

(b) ***Kantak Vana***[***] – ***Thorny scrub forests***, consisting of arid or semi-arid vegetation.




**Mahāvan** (*Great Natural Forest*)

A large natural forest that provided a protected habitat for plants and animals. It can be compared with present-day *protected forests*, where human interference is kept to a minimum and natural ecosystems are allowed to remain largely undisturbed.

**Shrīvan** (*Forest of Prosperity*)

A managed forest meant to meet the needs of local communities. Villagers could sustainably collect fuelwood, fodder, medicinal herbs, timber, and other forest products without causing serious damage to the forest ecosystem.

**Tapovan** (*Forest for Penance*)

A sacred forest or grove reserved for sages, meditation, and spiritual activities. Plants and animals in such areas were given special protection, and activities that could harm them were generally restricted.

► **MAURYA PERIOD** : When **Chandragupta Maurya** came to power around 300 BC, he recognised the importance of forests. He appointed a **Kupyadhyaksha**[***] (head of the forest department) to manage and supervise the forests with the help of several ***van-pals*** (forest guards). According to Kautilya's Arthashastra, during this period, the king generally divided the forests into four Bhag (parts) : ◈ One part was reserved for the king for hunting and personal use. ◈ The second part was reserved for the State, *i.e.*, Magadh. ◈ The third part was kept for donation purposes, mainly for Monks and Brahmins. ◈ The fourth part was meant for public use.

► **GUPTA PERIOD** : During the Gupta period, ***Brahmadeya*** land grants encouraged the expansion of agriculture into some forest and uncultivated areas, leading to forest clearance. The Gupta rulers also came into conflict with the ***Atavika Rajyas***[***] (forest kingdoms) of Central India, many of which were brought under Gupta control.

► **DURING COLONIAL RULE**

| | |
|---|---|
| 1790 | ***Eucalyptus***[***] = introduced in **1790** by ***Tipu Sultan***, around his summer palace at ***Nandi Hills*** (then known as ***Nandi-Durga***). Later historical accounts claim that he planted around 16 species, possibly using seeds obtained through his *French allies*.<br><br>*Our own world*<br><br>During the 1930s, a few old and decaying Eucalyptus trees were reportedly found in the *Nandi Hills* region. Annual-ring counts suggested that some of these trees could possibly date back to around 1780–1800. However, this evidence did not establish who planted these trees, how they reached Nandi Hills, or how many species were originally introduced.<br><br>Interestingly, neither the accounts of British troops operating in the region nor contemporary British records provide any description of the Eucalyptus at Nandi Hills during Tipu Sultan's period, including |


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**1950**

conservation of forests and planting of trees. It is observed in the ***1st week of July***[***].



The main objectives of the planting of trees during Van Mahotsav are –

- Provide ***fuel***
- Increase the production of fruits and add to the potential ***food resources*** of the country.
- Help creation of ***shelter-belts*** around agricultural fields to increase their productivity.
- Provide ***fodder leaves for cattle*** to relieve the intensity of grazing over reserved forests.
- Provide shade and ***ornamental trees*** for the landscape.
- Provide ***small poles*** and ***timber*** for agricultural implements, house construction, and fencing.
- Help ***conservation of soil*** and prevent further deterioration of soil fertility.
- Inculcate tree consciousness and love of trees among the people.
- Popularize the planting and tending of trees in farms, villages, municipal and public lands for their aesthetic, economic and protective needs.

**1952**

- The ***2nd National Forest Policy*** came up with the target of bringing **33 %** of the ***Geographical area under forest cover***.
- The ***Indian Board of Wildlife (IBWL)*** was set up under the ***Chairmanship***[***] of the ***Minister of Agriculture***[***] [At that time, the forest was a department under the Ministry of Agriculture].

**1954**

- **4th World Forestry Conference** held in Dehradun

| World forestry congress | Year | Place |
|---|---|---|
| 1st | 1926 | Rome, Italy |
| 3rd | 1949 | Helsinki, Finland |
| 4th | 1954 | ***Dehradun*** |
| 15th | 2022 | Seoul, South Korea |

Generally been held at about *six-year*[***] intervals

A Magazine published by Food and Agriculture Organization (FAO), Rome, Italy is ***UnaSylva***.

**1960**

- ***Prevention of Cruelty to Animals Act***[***] passed
  - Animal welfare board : Chennai (1962) ----> Ballabhgarh (Haryana).
  - 28 Members @ 3 Years.

**1965**

A centre called the ***Pre-Investment Survey of Forest Resources*** **(PISFR)** was established in **FRI (Dehradun)** building as a joint project of the **FAO**, the ***Government of India***, and the **UNDP**. Based on the recommendations of the ***National Commission on Agriculture*** **(NCA) Report, 1976**, this centre was reorganized and upgraded to form the ***Forest Survey of India (FSI)*** in **1981**.

— **HQ** : ***New Delhi***,

— A specialized agency to combat organized wildlife crime.

► The ***National Museum of Natural History*** was established in ***New Delhi*** in ***1972***, on the occasion of the ***25th anniversary of India's Independence***. The objective was to create a museum that would showcase the country's rich **flora, fauna,** and **mineral wealth**. The museum was formally ***inaugurated in 1978***.

## 1.4 FORESTRY EDUCATION SYSTEM




Background

- In 1878, the Establishment of a "*Forest School*" in *Dehradun*. Which was later renamed *Imperial Forest School* in 1884.
- ***Imperial Forest Research Institute***[***] was established in **1906**[***].
- ***Directorate of forest education*** (1953)[***] = ACF/RFO training
- **1985** : MoEF established.
- **1986** : ***Indian Council of Forestry Research and Education*** (ICFRE)[***], ***Dehradun***[***], established. Become Autonomous in **1991**[***]
- **1987** : ***Indira Gandhi***[***] ***National Forest Academy*** (IGNFA) ***Dehradun***[***], established = IFoS training.

Sub-ordinated institutes of ICFRE

- ***Forest Research Institute*** (FRI)[***], ***Dehradun*** (1906)[***]
- ***Tropical*** FRI, ***Jabalpur***[***] (MP, 1988)
- ***Arid*** FRI, ***Jodhpur***[***] (Rajasthan)
- ***Rain*** FRI, ***Jorhat***[***]
- Institute of ***Forest Genetics and Tree Breeding***, ***Coimbatore***[***] (TN)
- Institute of ***Wood Science & Tech*** (IWST), ***Bengaluru***[***]
- ***Himalayan*** FRI, Shimla (Himachal)
- Institute of ***Forest Productivity***, ***Ranchi***[***], Jharkhand.
- Institute of ***Forest Biodiversity***, **2012@** ***Hyderabad***

> ***I**ndian **P**lywood **I**ndustries **R**esearch and **T**raining **I**nstitute* (**IPIRTI**), **Bengaluru** — in research, training, testing, and technology development for plywood and other wood-based panel products. It was merged with IWST, in 2022. [CSIR --> ICFRE]

Forest research centres (FRC)

- FRC for *Skill development*, *Chindwada* (MP)[***]
- FRC for ***Bamboo & Rattan***, in 2004 at ***Aizawl***, Mizoram, as a unit of RFRI, Jorhat, Assam.
- ***Livelihood Extension*** Centre ***Agartala***, 2012, Under RFRI, Jorhat.
- RFC for *Eco-Rehabilitation*, *Allahabad* : In 1992, Under FRI, Dehradun.
- *Coastal Ecosystem* Centre, *Visakhapatnam*.

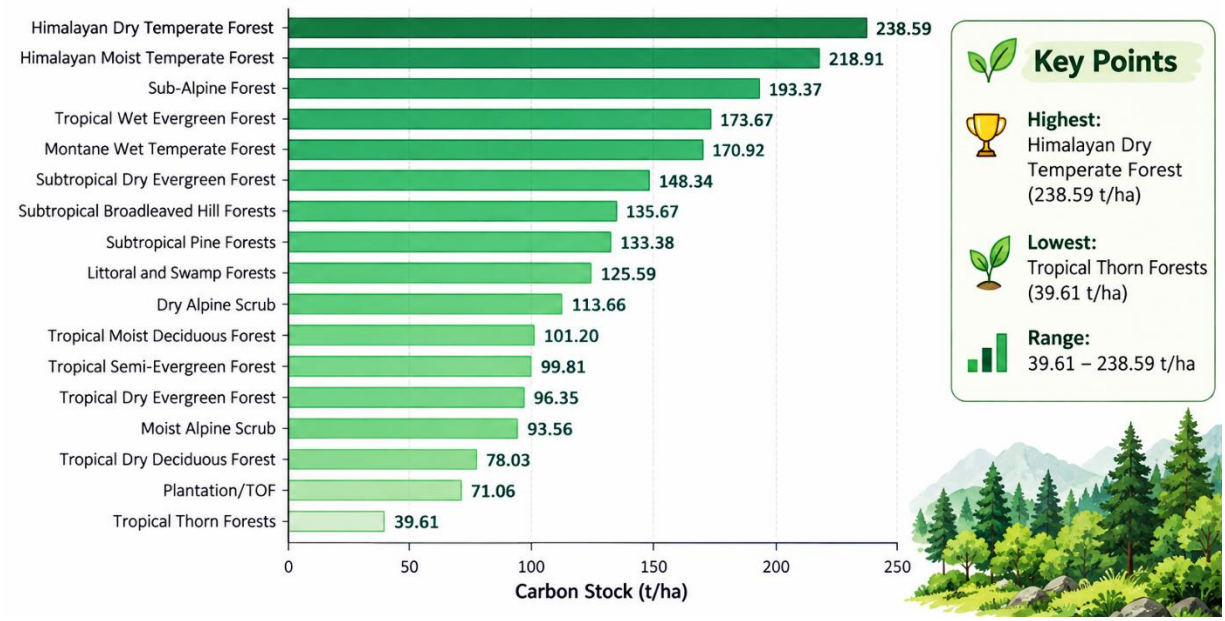
Other Important Institutes under ICAR, CSIR, ISRO and other govt ministries

- The ***Indian Institute of Natural Resins and Gums***, formerly known as the ***Indian Lac Research Institute***, is an autonomous institute established under the umbrella of the ***Indian Council of Agricultural Research*** (ICAR) by the Ministry of Agriculture, Government of India, for advanced research on lac and other natural resins and gums. The Institute is located at ***Namkum***, ***Ranchi*** in ***Jharkhand***, India.
- ***Central Sericultural Research & Training Institute*** (CSRTI), Mysuru
- The ***Centre for Environment Education*** (CEE) : established in **1984**[***] at ***Ahmedabad***[***]

► **CARBON STOCK** : Total : ***7.2 Billion tonnes***[***]. (***Annual Increase = 40 Mt***[***] = 149 Mt of Co2 Equivalent)

| Component | Carbon stock in Forest in 2023 | % of total | Remarks |
|---|---|---|---|
| Above Ground Biomass | 2374 | 32.7 % | |
| Below ground Biomass | 735 | 10 % | |
| Dead wood | 56.4 | 0.78 % | |
| Litter | 107.8 | 1.5 % | |
| Soil organic carbon % | 4011 | **55.6 %** | Mainly in *Lignin*[***] (Slow decomposition) |
| Total | **7285** | 100 % | |

(In million tonnes)




- State wise : Arunachal (1 Billion tonnes) > MP (0.6 B tonnes) > CG (0.5 B tonnes).
- Paris Agreement (2015) = INDC = 2.5 - 3.0 B tonnes of $CO^2e$ @2030 ← Addi carbon sink.
  Updated (in April 2026) = **3.5 – 4 BTs** of **$CO^2e$ @2035**.

➔ How much carbon do forest ecosystem absorb annually? [Nagaland PSC CTSE 2024]

(a) 3 billion tons (b) 4 billion tons (c) 5 billion tons (d) 6 billion tons

**Global forests** : Sink ≈**16 Gt $CO_2e$**/yr + Release ≈**8 Gt $CO_2e$**/yr (*i.e.*, wildfires). Net sequestration ≈**7.6 Gt $CO_2e$** or **2 Gt C/yr.** [1 Ton of carbon ≈ 3.67 tons of $CO_2$].

## 1.6 FAO & ITS "*The State of The World Forest Report 2024 & 2026*"

Forests currently cover ***30.8 % of the global land area*** (FAO, 2022). The total forest area is ***4.06 billion hectares***, or approximately ***0.5 ha per person (5000 $m^3$)*** ***, but forests are not equally distributed around the globe. More than half of the world's forests are found in only five countries (the Russian Federation, Brazil, Canada, the United States of America, and China), and $^2/_3$ ***(66 %)*** of forests are found in ***10 countries***.

- Global forest = **93%** Naturally regenerated*** + **3%** Plantations*** + **4%** other planted forests.
- Type wise = Tropical (45%) + ***Boreal*** (27%)*** + Temperate (16%) + Sub-tropical (11%).
- Ownership (world) : ¾ Govt + ¼ Private.


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CHAPTER 2

# CHHATTISGARH

## 2.1 BACKGROUND

- Carved out from Madhya Pradesh : **1st Nov 2000.** MP Reorganisation Act, 2000 = 26th state
- Rajyotsava is celebrated on 1 November.
- Name : "Chhattisgarh" = 36 garhs (forts). Ancient (Vedic/epic period) name : ***Dakshin Kosala****; the southern forest tract was part of Dandakaranya.
- Biogeographic zone : *Deccan Peninsula*** (Rodgers & Panwar).
- Planning Commission agro-climatic region : *Eastern Plateau* & *Hills Region* (Region VII).

Chapter Outline


**2.1** Background
**2.2** Forest Department
**2.3** Forest Resources
**2.4** Minor forest produce
**2.5** Protected areas (in Short)
**2.6** Schemes.


### ► STATE SYMBOLS

| Symbol | English Name | Scientific name | Family |
|---|---|---|---|
| Stare Tree*** | Sal / Sarai (Kalpavriksha of Bastar) | *Shorea robusta* | Dipterocarpaceae |
| State animal*** | Wild Buffalo (Van Bhainsa) | Bubalus arnee | Bovidae + WPA Schedule I + IUCN: Endangered |
| State Bird*** | Pahadi Maina / Bastar Hill Myna (Declared 2002) | *Gracula religiosa peninsularis* | WPA Schedule I |

***State Emblem**** (adopted **4 September 2001**) : a circular seal with the *Lion Capital of Ashoka* and Satyamev Jayate, encircled by *ears of paddy* (agriculture, "rice bowl of India"); *three wavy lines* in the colours of the national flag, represent the three major rivers of the state - the *Mahanadi*, the *Sheonath*, and the *Kanhar*. *Two lightning bolts* (energy-surplus state); and an outer ring of *36 green forts* (*garhs*), the green depicting the state's forest wealth.




### ► CLIMATE & MONSOON

— Climate type : *tropical monsoon* = *sub-humid continental* climate***. Southern CG falls in the *tropical moist deciduous* climatic zone***.
Koeppen : mostly Aw*** (tropical savanna);

— Monsoon onset : around **10–15 June** (enters through Bastar). Rainy period: mid-June to September; withdrawal by mid-October.

— Average annual rainfall : about 1,300–1,325 **mm***** (Economic Survey: 1,200–1,500 mm).

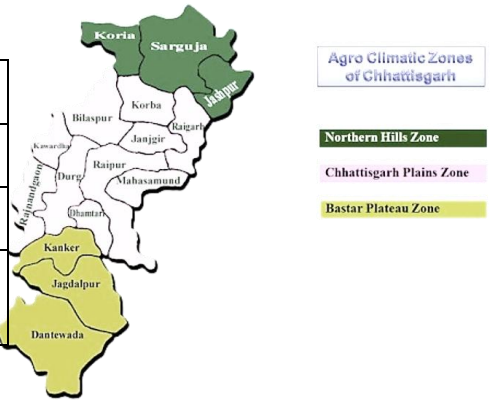
— Source of rain : about **90%** from the *Bay of Bengal branch* of the south-west monsoon and about 10% from the Arabian Sea branch***. North-east (winter) monsoon does not reach CG***.

— Highest rainfall: *Abujhmarh hills* (Narayanpur), about 187.5 cm, called the *Cherrapunji of Chhattisgarh*[***]. Highest district average: ***Narayanpur***[*].

- Lowest rainfall / rain-shadow : *eastern slopes of the Maikal range* (*Kabirdham*, *western Rajnandgaon* / *KCG*). Among agro-climatic zones the **Chhattisgarh Plains** get the least rainfall[*].

► **AGRO-CLIMATIC ZONES = 3**[***]

| SN | Agro-climatic zone | Soil type | Rainfall (mm) |
|---|---|---|---|
| 1. | Chhattisgarh Plains (largest zone) | Matasi, Dorsa, Kanhar, Bhata | 1,200–1,400 |
| 2. | Northern Hills | Red-yellow, laterite, red sandy | 1,200–1,600 |
| 3. | Bastar Plateau | Red loamy, laterite; Marhan, Tikra, Mal, Gabhar | 1,400–1,600 |




## 2.2 FOREST DEPARTMENT

The Chhattisgarh Forest Department came into existence with the state on *1 November 2000*. *Dr. R.C. Sharma*, IFS, was the first Principal Chief Conservator of Forests (PCCF). The department is now styled the *Forest & Climate Change Department*; headquarters: *Aranya Bhawan*, *Nava Raipur Atal Nagar*.

- Territorial Circles = 6 : Raipur, Durg, Bilaspur, Surguja (Ambikapur), Bastar (Jagdalpur), Kanker. Largest circle by forest area: *Bilaspur*[*], followed by Jagdalpur (*Bastar*)[*].

### CORPORATIONS, BOARDS AND INSTITUTIONS

- ***CG Rajya Van Vikas Nigam Ltd.*** (State Forest Development Corporation)[***] = 2001.
  - — Carved out of MP Rajya Van Vikas Nigam (MP Reorganisation Act 2000). HQ *Nava Raipur*[**].
  - — Manages ≈ 2.1 lakh hac. Forest area handed over by the Forest Department through *Van Pariyojana Mandals* (project divisions)[***]
  - — Pariyojna mandal : 9[***]

| SN | Project division | Constituted | Remarks |
|---|---|---|---|
| 1 | Barnawapara, Raipur | 30-10-1975 | Oldest |
| 2 | Kota, Bilaspur | 30-10-1975 | Oldest |
| 3 | Panabaras, Rajnandgaon | 1976 | Largest area transferred |
| 4 | Antagarh, Bhanupratappur | 1976 | |
| 5 | Kawardha | 2003 | |
| 6 | Sarguja, Ambikapur | 2003 | |
| 7 | Industrial plantation division, Korba | 2001 | Areas are transferred temporarily for raising plantations in industrial areas |
| 8 | Industrial plantation division, Jagdalpur | 2016 | |
| 9 | Industrial plantation division, Raigarh | | |

- CG State Minor Forest Produce (Trading & Development) Co-operative Federation[***] = 2000 =
  - — Three-tier : apex federation (Raipur) → 31 district unions → 902 primary societies, ≈ 10,600 phads (collection centres).
  - — Brand : Chhattisgarh Herbals
- *CG State Biodiversity Board*[***]@2006[***] = Raipur

CHAPTER 1

# FOREST FORESTRY & SILVICULTURE

## 1.1 INTRODUCTION

The term *Forest* has its roots in early medieval European society. The increasing population and the rise of new kingdoms and serfdoms, based on the heavy exploitation of natural resources, caused a severe loss of natural vegetation (that we called in India - *Jungles*) to meet their growing demands for food, fodder, fuel, and timber. The shrinking areas of natural vegetation created a shortage of fuelwood and timber in their ruling regions. As a result, they began designating parts of the land, usually unproductive and located at the boundaries of village territories, for growing tree crops, which became known as *Woodlands* or *Forests*, to produce the required resources.

- *Forest* term derived from a *Latin**** word *Foris**** which means *outside of village boundary****.

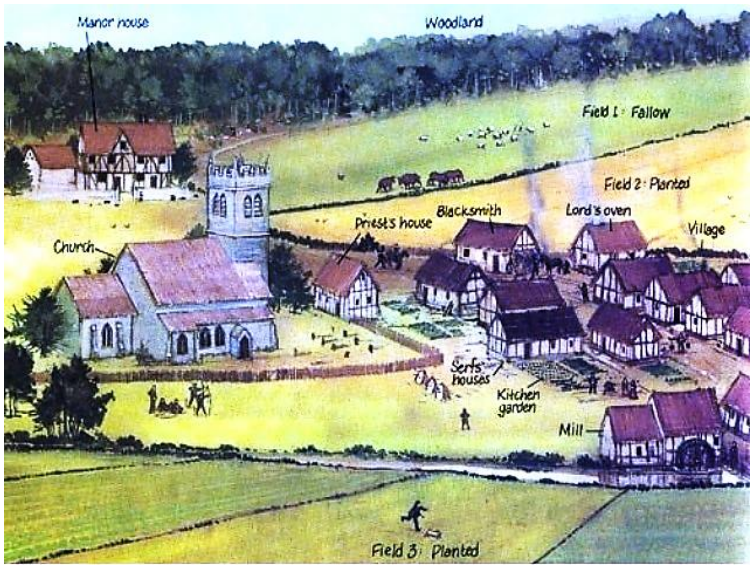



Figure 1.1 : A medieval European village

### ► DEFINITION

– Forest is an *area set aside* for the *production of timber* and other forest produce or to get other *indirect benefits* from it [Technical definition].

Chapter Outline

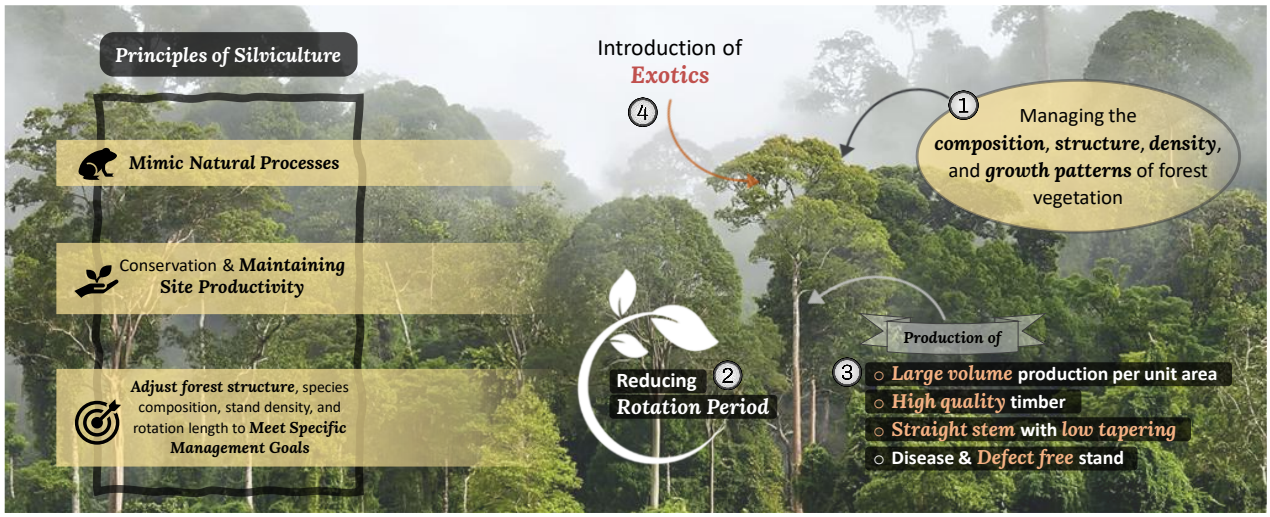

1.1 Forest
1.2 Forest Classification
1.3 Forestry
1.4 Silviculture
1.5 Role of Forest
1.6 Forestry development through ages
1.7 Important terminology
- Precision Silviculture
- Sacred Groves

- Reducing *rotation period* : It involves shortening the time it takes for trees to reach harvestable size, increasing the frequency of timber harvests, and improving economic returns.

⊳ *Site Protection* : Involves minimizing soil erosion, maintaining soil fertility, and protecting water quality.

⊳ Introduction of *exotics*, *i.e.*, Poplar, Eucalyptus.

⊳ Creation of *Man-made Forest* in place of Natural Forest (Afforestation, reforestation), *i.e.*, Nilambur teak, to prevent *habitat fragmentation*.



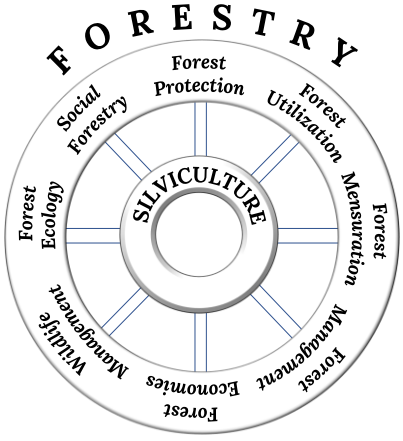

## SILVICS & SILVICULTURE : TWO SIDES OF THE SAME COIN

Silvics is primarily concerned with understanding the biological and ecological processes that govern forest growth and development. Silviculture, on the other hand, is focused on applying that knowledge to achieve specific management objectives. A simple analogy to understand the difference between silvics and silviculture is to think of a doctor and a surgeon. Silvics is like the study of human anatomy and physiology – the doctor's understanding of how the body works. Silviculture is like surgery – the application of that knowledge to treat a patient.

Silvics provides the knowledge base for understanding how forests function, while silviculture provides the tools for manipulating forest stands to achieve desired outcomes.

## SILVICULTURE & OTHER BRANCHES OF FORESTRY

Silviculture is the hub (Backbone) of the forestry wheel. Other forestry branches, *i.e.*, Forest protection, Forest Management, Forest Mensuration, Forest Economics, etc., are supported by Silviculture.

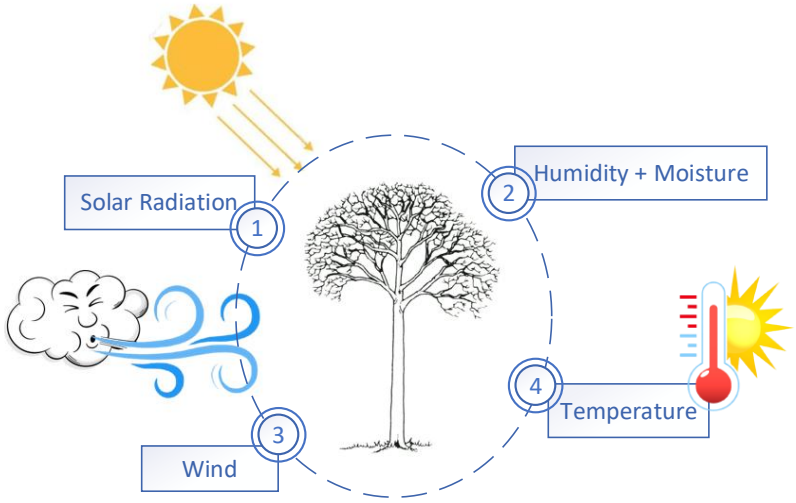



➢ **Silviculture & Forest protection** : Forest protection is a branch of forestry which concerned with the activities directed to the prevention & control of damage caused by humans, insects, pests, animals, or fire. Here, Silvicultural principles help us to - (a) mix the crop composition to increase insect/pest resistance, (b) introduction of evergreen species for controlling forest fire, and (c) growing of live fencings to prevent animal damage.

CHAPTER 3

# CLIMATIC FACTORS

Climate is the average weather prevalent in any locality that influences our forest vegetation, *i.e.*, light, atmospheric temperature, pressure & humidity, wind, etc.




S

**Figure 3.1** : Climatic factors

## 3.1 SOLAR RADIATION

Solar radiation is the primary source of energy for photosynthesis. Factors such as ***Quality***, ***Intensity***, and ***Duration*** of light affect the vegetation or indirectly the entire forest ecosystem.

### IMPORTANCE OF SOLAR RADIATION

Plants depend upon solar radiation not only to synthesize food but also to regulate many other metabolic reactions. Such as –

- *Essential for* ***basic metabolic activities*** like photosynthesis, transpiration, and the opening and closing of photoactive stomata.
- Light is crucial for the ***synthesis of chlorophyll molecules***. A prolonged absence of light results in the degeneration of chlorophyll, turning the leaves yellow—a phenomenon known as ***Etiolation***.
- Intense ***light increases the rate of transpiration***, leading to

## Chapter Outline


**3.1** Solar radiation
- Importance
- Light Increment
- Natural pruning
- Species behaviour toward light

**3.2** Temperature
- Importance
- Frost : Types, Resistance & Species behaviour
- Snow : its beneficial & harmful effects

**3.3** Wind
- Beneficial & harmful effects

**3.4** Moisture
- Types of precipitation
- Source of Moisture
- Importance of water
- Water-logging / Flood
- Drought
- Water tapper, Saver and Storer plants

- India received most of its rainfall (80 %) during : ***July to September***
- Maximum RF = W. Ghat + Meghalaya
- Monsoon withdrawal starts on ***September 17th*** [Newly revised dateline]. Withdrawal from the entire country on **19 Oct 2023**.

**WHY IN NEWS?**

The India Meteorological Department (IMD) announced the onset of the southwest monsoon over Kerala on **May 24**, 2025, marking the earliest arrival since 2009. This early onset is significant as the monsoon delivers over 80% of India's annual rainfall, crucial for agriculture and the economy.

**CRITERIA FOR DECLARING MONSOON ONSET**

IMD declares the monsoon onset any time after May 10 based on the following criteria

- ***Rainfall*** : At least 60% of 14 designated weather stations in Kerala and surrounding areas (e.g., Thiruvananthapuram, Kochi, Mangalore) must record $\geq 2.5\ mm\ of\ rainfall$ for two consecutive days.
- ***Wind Field*** : The **westerly wind field** at lower and mid-levels (up to 600 hPa) was established earlier than usual. These winds are critical for transporting moisture-laden air from the Arabian Sea and Bay of Bengal toward the Indian subcontinent. In 2025, the winds likely intensified sooner due to a **stronger pressure gradient** between the landmass and the Indian Ocean, driven by rapid land-sea temperature contrasts in the Arabian Sea.
- ***Outgoing Longwave Radiation (OLR)*** : The OLR value should be below $200\ watts\ per\ square\ meter\ (W/m^2)$ in the region between 5°N–10°N latitude and 70°E–75°E longitude, indicating sufficient atmospheric heat conducive to rainfall.

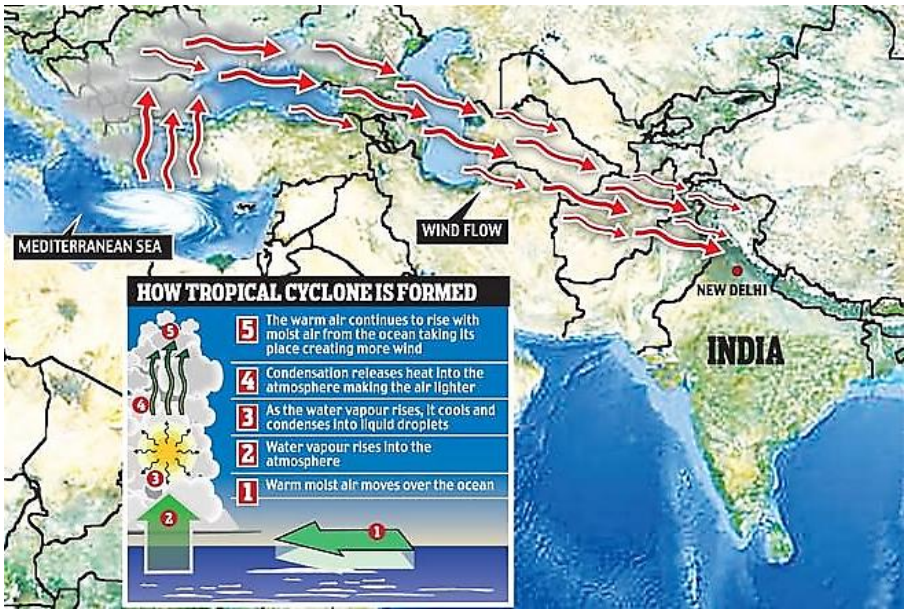
Once these conditions are met on two consecutive days, IMD declares the monsoon onset.

❑ **NE MONSOON**

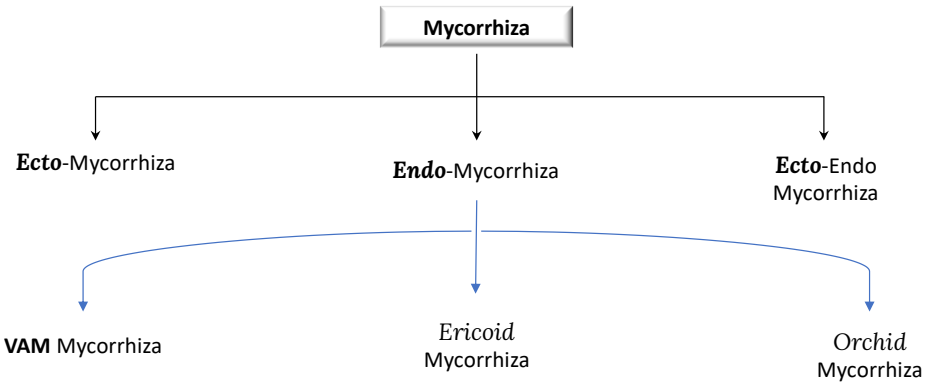
- Tamil Nadu (TN) gets maximum rainfall by this (+ Also in Kerala and Karnataka)
- Rainfall from : September to December/January
- 12-15 % of rainfall

❑ **WESTERLY DISTURBANCES** : Importance – provide moisture for winter crops, *i.e.*, Wheat.

➲ Average rainfall of India = **119 cm**
World = **100 cm**



*penetrate between the cortical cells, surrounding them by forming a network of hyphae called the* ***Hartig net*** (as it forms a net-like structure). Remember where *fungal hyphae did not establish direct cytoplasmic contact with cortex cells*. The amount of fungal mycelium is often so extensive that its total mass is comparable to that of the roots themselves. The fungal mycelium also extends into the soil, away from this compact mantle. External fungal hyphae that are much finer than plant roots and can reach beyond the areas of nutrient-depleted soil near the roots improve the root system's capacity to absorb nutrients.




- Fungal partners : **Ascomycetes** & **Basidiomycetes** (Amanita, Boletus, etc.).
- Higher plants : **Most common in conifers** (**Pinaceae**** family), *i.e.*, **Pinus roxburghii** (*Chir-Pine*), **Cedrus deodara** (*Deodar*), **Abies pindrow** (*Silver-Fir*), **Spruce**, etc. In **Salix alba** (*Salix*), *Casuarina equisetifolia* (*Beefwood*), **Eucalyptus**, and several members of **Caesalpiniaceae** and **Dipterocarpaceae**.

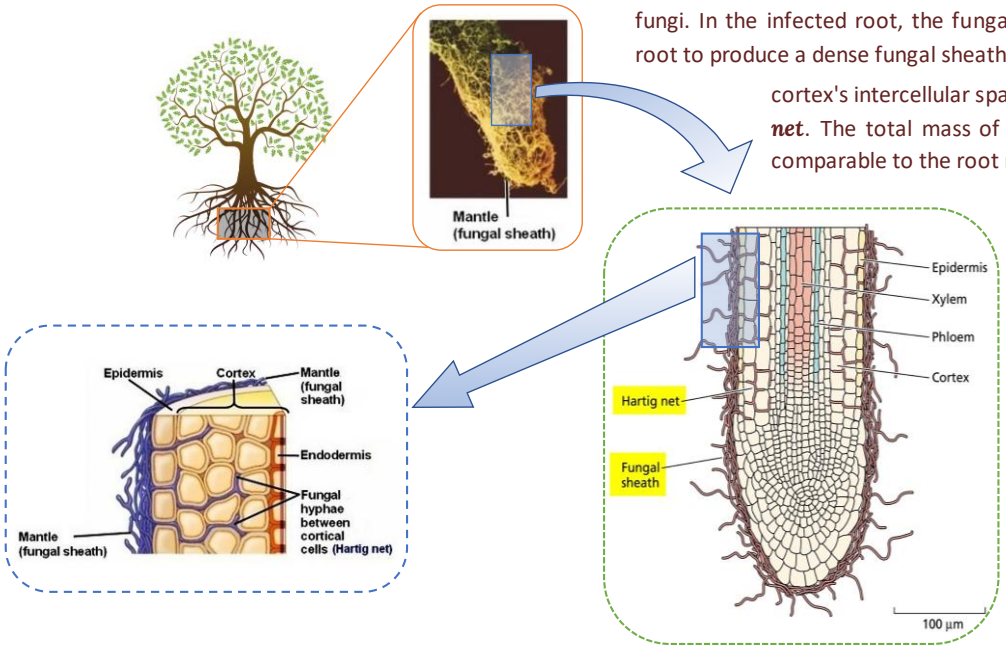
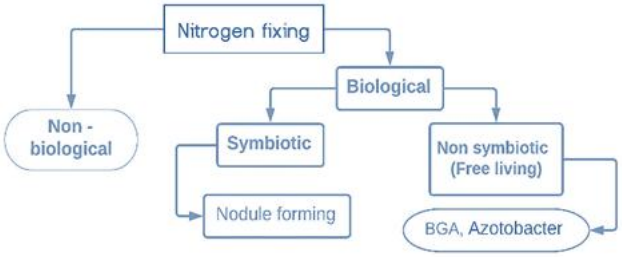



**FIGURE 4.3** : Root infected with ***Ecto-Trophic*** mycorrhizal fungi. In the infected root, the fungal hyphae surround the root to produce a dense fungal sheath and penetrate the cortex's intercellular spaces to form the ***Hartig net***. The total mass of fungal hyphae may be comparable to the root mass itself.

▶ **ENDO-MYCORRHIZA** : under this, Fungal hyphae entered the cell and *established direct contact with the cortex cells' cytoplasm*. As they established direct contact, there is *no need to form a Herting net or fungal Mantle*.

Common leguminous hosts include species of the family Leguminosae such as ***Acacia nilotica***, ***Cassia fistula***, ***Delonix regia***, ***Dalbergia sissoo***, ***Robinia pseudoacacia*** (Black locust). Another nitrogen-fixing bacterium, ***Frankia***, also forms root nodules but in ***non-leguminous*** plants such as ***Casuarina*** and ***Alnus nepalensis***. If you cut and open these nodules, you'll notice that the central portion appears *red* or *pink* due to the presence of *leghemoglobin* (also called *leguminous hemoglobin*), which absorbs oxygen and creates an anaerobic environment necessary for the enzyme nitrogenase to function. Nitrogenase then converts atmospheric nitrogen into nitrate and nitrite forms usable by the plant.



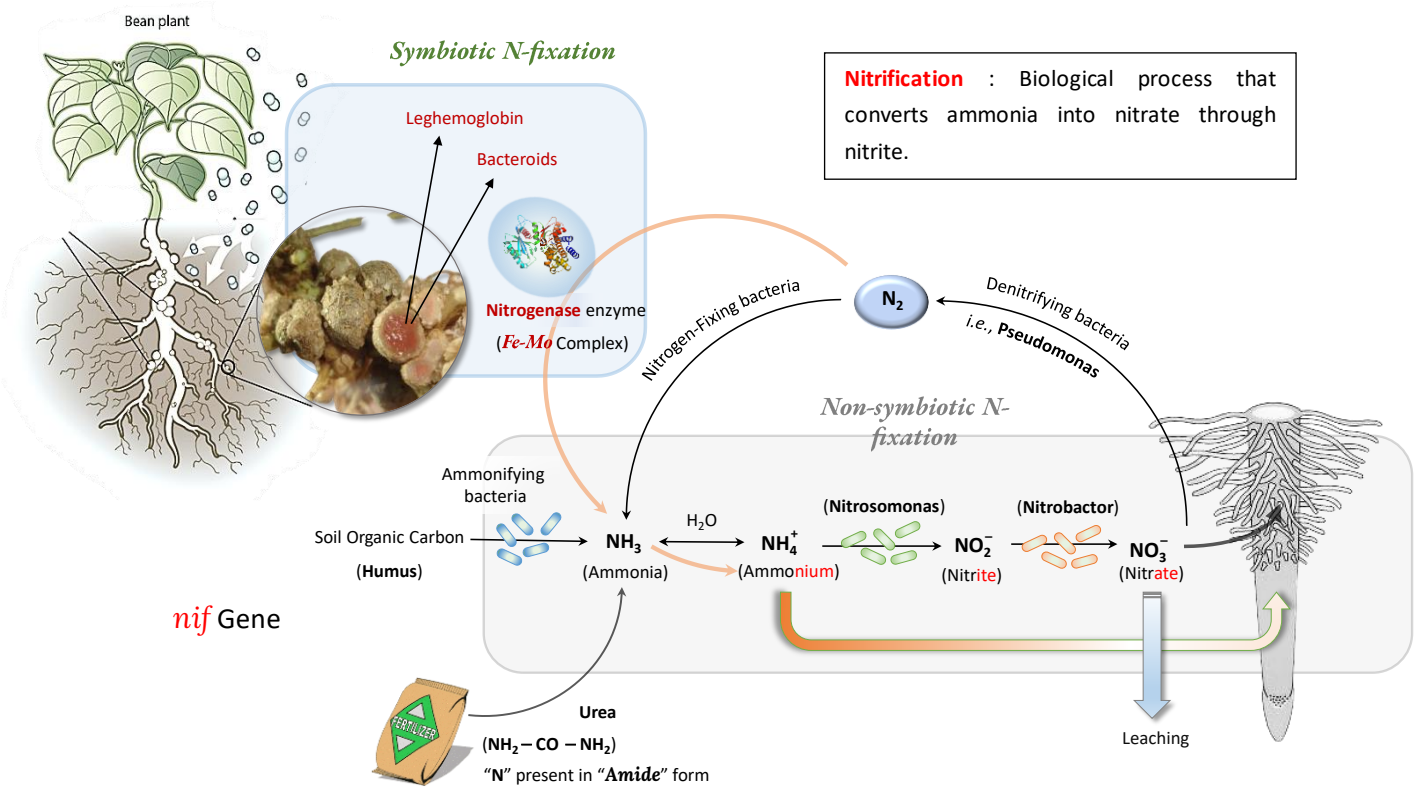




**Figure 4.10** : Development of root nodules in sweet pea plant.

Some free-living microorganisms such as ***Azotobacter***, ***Azospirillum***, and ***blue-green algae*** (BGA) also fix atmospheric nitrogen. Unlike symbiotic bacteria, they are not associated with any specific plant species and exist independently in the soil or water.

## 4.4 SOIL NUTRIENTS

The plant body contains about $30^{+}$ elements. However, not all of them are essential for the functioning of the plant's metabolic reactions. Only ***17 elements*** are considered essential for a plant's basic functioning—these are known as ***essential elements*** or ***essential nutrients***. Their absence causes specific deficiency symptoms or diseases.

**CRITERIA OF ESSENTIALITY** : Proposed by ***Arnon*** (1954).


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CHAPTER 5

# PHYSIOGRAPHIC FACTORS

The factors concerned with topography or physical features of an area are called **topographic** or **Physiographic** factors, including height, the direction of slope, and slopes' steepness. The topographic factors are also called ***indirect factors*** as they influence the growth and development of forest vegetation by bringing variations in climatic factors.

These factors are -

- Configuration or arrangement of the land surface, *i.e.*, hills & valleys
- Altitude
- Latitude
- Slopes
- Aspect & Exposure

## 5.1 CONFIGURATION OF LAND SURFACE

The arrangement of hills and valleys affects the local climate by influencing ***rainfall patterns***, ***temperature***, ***solar radiation***, and ***soil profile depth***. It also impacts ***wind direction***, which is essential for pollination and seed dispersal in conifers. Himalayan valleys are cooler in winter, and ***Pool frost*** is common; whereas in summer, the surrounding hills make the valleys extremely hot. The soil in valleys is deeper, more fertile and productive, and supports dense vegetation.

Chapter Outline


**5.1** Configuration of land surface
**5.2** Altitude
- Effect
- Zonation

**5.3** Latitude
**5.4** Slopes
**5.5** Aspect & Exposure

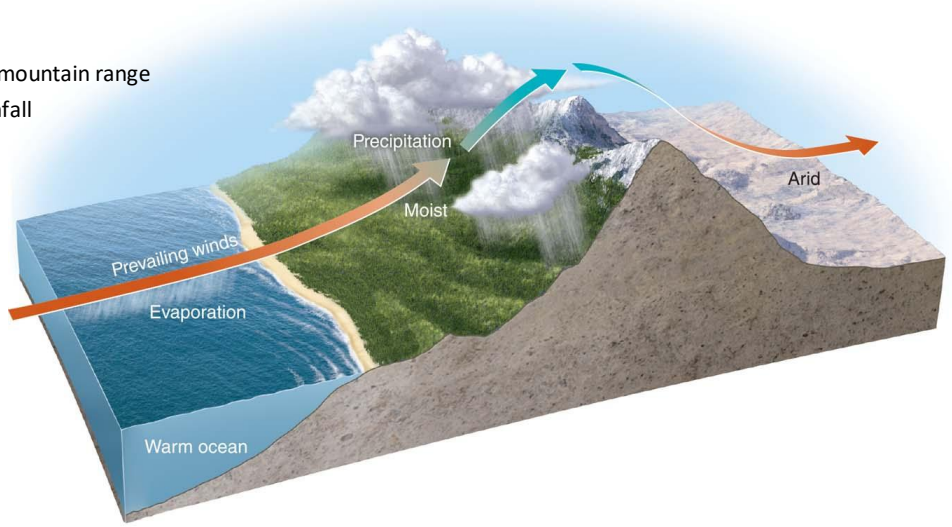




**Figure 5.1** : Effect of mountain range on the pattern of rainfall

- ***Soil Moisture*** : Forest vegetation improves soil moisture percentage by (1) reducing water run-off, (2) improving water percolation & infiltration rate into the soil, (3) loosening the soil mass so it improves its water holding capacity, and (4) it also reduces water loss through evaporation.
- ***Microbial Activity*** : Forest improves soil flora and fauna by providing them nutrients, food, shelter, and protection.
- **Soil erosion** : Forest increases interception = less water available for run-off = Control soil erosion and flood in lower reaches.

  Examples : The dense forest in the Himalayas reduces the flooding issue in the North Indian plain. Heavy destruction & deforestation in the Western Ghats induced flood problems in Kerala and Chennai.

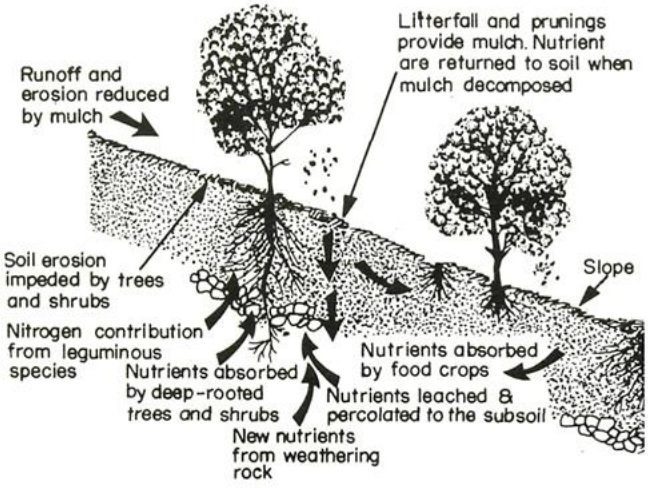
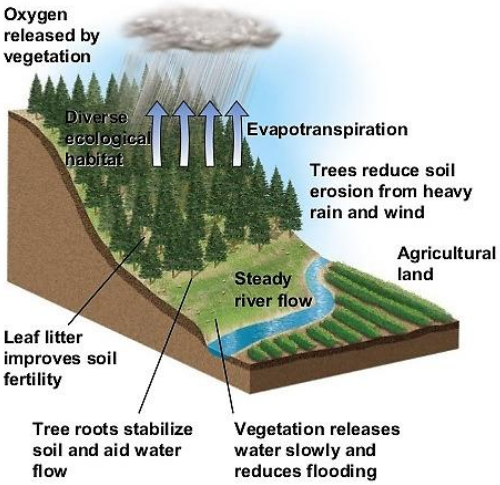
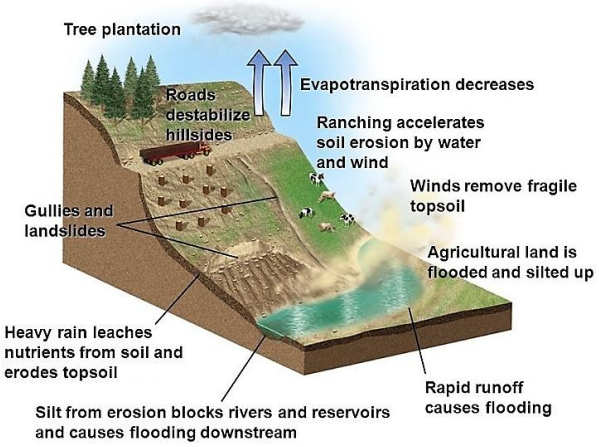



**Figure 7.2 :** Effect of tree on forest soil




*Hills Before Deforestation*




*After Deforestation*

## 7.3 EFFECT OF FORESTS ON THE WATER CYCLE

*Hydrology is the scientific study of the movement, distribution and management of water on the Earth's surface and beneath the surface, including the study of its physical & chemical properties, and its relationship with the living and material components of the forest ecosystem*. Forest affects the hydrological cycle considerably through the mechanism of interception, stem flow, Percolation, and infiltration. Because of this, a significant portion of rainfall is retained in the **local area** [Use the term *Forest Stand* instead of *Forest* in your exam].

### ASSOCIATED TERMINOLOGY

- ***Precipitation*** : It is a major factor controlling the hydrology of a forest ecosystem. It is the main input of water to the Earth's surface, forest, and to processes such as evaporation and streamflow. Knowledge of rainfall patterns in space and time is essential for understanding soil moisture, groundwater recharge, and river flows.

CHAPTER 8

# TREE'S STRUCTURE & GROWTH FORMS

## 8.1 WHAT IS A TREE?

Trees are woody plants having one *erect perennial stem or trunk* at least three inches (7.5 cm) in diameter at breast height, a more or less *defined formed crown* of foliage, and a *height of at least 12 ft* (4 m).

### CROWN

The crown encompasses all the above-ground parts of a tree, including branches, leaves, and reproductive structures.

### FORMS OF TREE CROWN

A crown is an upper branchy part of a tree above the bole. It is the result of branching behaviour in the bole. In some trees, *i.e.*, *Phoenix*, *Cocos*, *Borassas*, etc., there is no branching behaviour in the stem and the crown is formed by larger leaves which come out from the top of the unbranched stems. In other trees crown may be – ◈ ***Conical*** as in the case of *Pines*, and *Deodar*, ◈ ***Cylindrical*** as in *silver fir*, *Eucalyptus*, *Ashoka*, etc. ◈ ***Spherical*** in *mango*, *neem*, *Imli*, *Mahua*, etc., ◈ ***Broad & Flat topped*** in *Acacia planifrons*, *Albizzia spp.*, ◈ ***Broom shape*** as in *Acacia nilotica* (*Babool*), and ◈ ***Frondose crown*** as in *Prosopis juliflora*.

*Chapter Outline*


**8.1** What is a tree?
**8.2** Basic terminology
**8.3** Tree's growth phases
**8.4** Tree's growth stages
**8.5** Reproduction
**8.6** Exercise


*Phoenix, Coconut, Borassus*



**Unbranched stem of Coconut**




**Conical shape**

*Abies pindrow* (Silver Fir), Eucalyptus, Ashoka



**Cylindrical shape**

*Mango, Neem, Imli, Mahua, etc.*



**Spherical shape**

Trees

- Gymnosperms : Pine, Confiners = ***Naked seeded*** plants***
- Angiosperms : Dicot (*Mango**), Monocot (*Grasses**, *Bamboo**, Wheat, etc)

CHAPTER 10

# FORESR SUCCESSION

***Succession*** is the process by which ***one set of biotic communities*** is ***gradually replaced*** by ***another, more advanced*** and ***distinct nature*** biotic community.

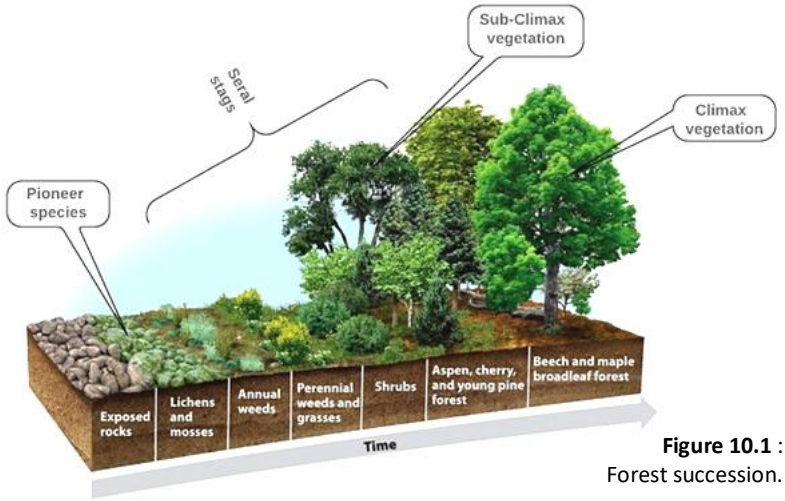



**Figure 10.1** : Forest succession.

The 1st species that encroach upon and begin to grow (establish themselves) in a new area are called ***Colonizer**** or ***Pioneer**** species. ***Sere*** or ***Seral Stages*** (sometimes referred to as the ***Consolidation Phases***) are the intermediate stages during which plant communities develop, improve soil conditions, and gradually transform into more advanced and stable communities.

- **Climax Stage** – This is the final, mature, and stable community that can sustain itself over a long period while remaining in balance with the existing environmental conditions.
- **Succession** – The process of development and transition of vegetation from one stage to another (e.g., from grassland to woodland) is called **succession**.
- With each stage of succession, ***Complexity*** and ***Biodiversity Increase***.
- When a **colonizer** species begins to grow on barren land where there is **no trace of previous organic matter**, it is called ***Primary Succession***.
- If succession begins in an area that **already contains remnants**

## Chapter Outline


**10.1** Process of Succession
**10.2** Types of Succession
**10.3** Causes of Succession
**10.4** Examples of various types of Succession
- Mt. Temperate Forest
- Riverain forest
- Estuarine succession
- Sand dunes

**10.5** Theories
- Mono-climax theory
- Poly-climax theory
- Climax pattern hypothesis
- Information theory
- Mosaic theory


Succession term was given by "Hault".

CHAPTER 11

# FOREST TYPES

The forest type is a forest category defined with reference to its geographic allocation, climatic and edaphic features, composition, and condition. **Champion and Seth** defined it as 'A unit of vegetation which possesses (broad) characteristics in physiognomy structure sufficiently pronounced to permit its differentiation from other such units.

- **Definition** : Forest type is the categorization of forest vegetation with particular reference to their physiognomic characters, structures, geographical allocation, and specific edapho-climatic conditions; that permit us to differentiate this vegetation.

- **NEEDS OF SUCH CLASSIFICATION?**

  With only 2.4% of the world's land area, India accounts for 7 % of the world's recorded species. This tremendous biodiversity and ecosystems with extensive geographical and local variations creating issues during conservation, management, and understanding the mechanism and dynamics of the natural ecosystem, especially with the emerging challenge of climate change.

  - It helps us understand our forest, its composition, and species-specific variations to comprehend species dynamics with changing environment and forest management.
  - It helps to understand how climatic, edaphic, topographic, and biotic factors affect forest vegetation; and how they are responsible for its distribution, composition, and complexity of our forest ecosystem.
  - Our 10.8 % tribal population lives in these areas. We depend upon it for food, fodder, medicinal plants, water resources, and cultural values. That directly or indirectly play a role at the grass-root level.

Chapter Outline

**Sclerophyll** is a type of vegetation that is adapted to long periods of dryness and heat.

CHAPTER 13

# ARTIFICIAL REGENERATION

The renewal of a forest crop by sowing, planting or other artificial means is called *artificial regeneration* (synonyms = plantation). It includes both (i) reforestation and (ii) afforestation. *Reforestation* is the restocking of a felled or cleared forest by artificial means. *Afforestation* is the establishment of a forest by artificial means on a non-forest area (the area from which forest vegetation has been absent).

Chapter Outline


**13.1** Objectives of AR
**13.2** AR *v/s* NR
**13.3** Factors affecting plantation activities
- Russian poplar

**13.4** Plantation organization
**13.5** Plantation schedule
**13.6** Success of Plantation
**13.7** Advantages of plantation


## 13.1 OBJECTIVES OF ARTIFICIAL REGENERATION

- **Supplement natural regeneration** : Natural regeneration is a slow and challenging process, and often it does not give adequate and uniform stocking over the area. We cannot rely only upon it; we have to supplement it by artificial means. The natural regeneration in Sal-bearing moist deciduous forests in Uttar Pradesh has always been a problem; fir and spruce forests in Himachal Pradesh are also facing the same issue.
- **Replacing Natural Regeneration** by artificial means : Due to an increase in the biotic pressure, natural regeneration in several areas is lacking, slow, and uncertain. Therefore, it is necessary to regenerate that area with the help of artificial means to speed up the regeneration process (Remember, here we do not just supplement the natural regeneration process. We actually remove the majority of natural seedlings and replace them with plantation).
- **Restocking** & **revegetate** (Reforestation) our degraded and overexploited forest. That was damaged due to heavy biotic pressure. We already have a target of *26 million hectares* of degraded land that should be reforested by 2030.
- **Reclamation** & **Afforestation of Wastelands**, abandoned mining areas, and industrial dumping grounds.
- **Increasing Proportion of Valuable Species** : called - *Forest enrichment****, it also helps in making forest fire-resistant by planting evergreen trees.

CHAPTER 15

# SEED SUPPLY

**WHY WE REQUIRE SEED SUPPLY ?**

- Our forests were already experiencing very heavy biotic pressure and other stresses. Now, climate change and global warming are further stressing them. The result? Most of our natural forests are now failing to regenerate naturally. Therefore, if we want to sustain our forests and ecosystems, we must artificially supplement them through nursery-raised plantations. (Can you recall the issue of ***Cardinal Temperature*** that we discussed in Chapter 3?).
- Restoration of wastelands, abandoned mines, industrial dumping grounds, etc., requires artificially raised planting material.
- Our commitment to the INDC (under the Paris Agreement) includes the creation of 2.5 to 3 billion tonnes of additional $CO_2$ sinks by 2030. In addition, we have committed to restoring 26 million hectares of degraded land by 2030 under the UNCCD (2019, Greater Noida).
- Artificial plantation is also required under CAMPA, the National Green Highway Project, and to meet the rising industrial demand for timber, pulp, and paper.

*Chapter Outline*


**15.2** Seed

**15.3** Seed collection

- Requirements?
- Collection methods
- Time

**15.4** Seed Processing

**15.5** Seed Storage

- Orthodox v/s Recalci
- Types of storage

**15.6** Seed treatment

- Seed dormancy
- Seed dressing

**15.7** Seed Testing

- Purity test
- Germination test
- Viability test
- Moisture content

**15.8** Eg


**STEPS** (A review of this chapter)

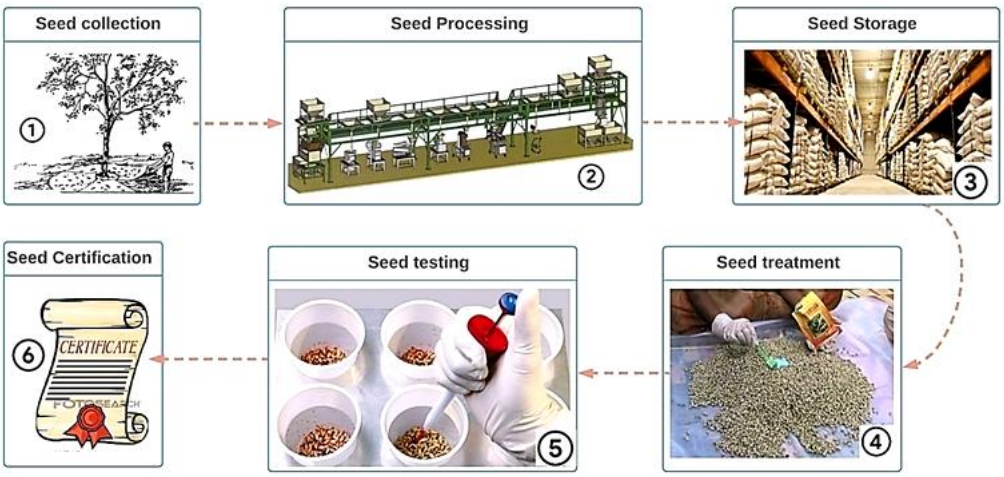



**Figure 15.1** : basic steps in the seed collection process

CHAPTER 17

# VEGETATIVE PROPAGATION

A Forest nursery is an area where plants are growing for transplanting for use as stocks for vegetative reproduction (*i.e.*, budding, grafting).

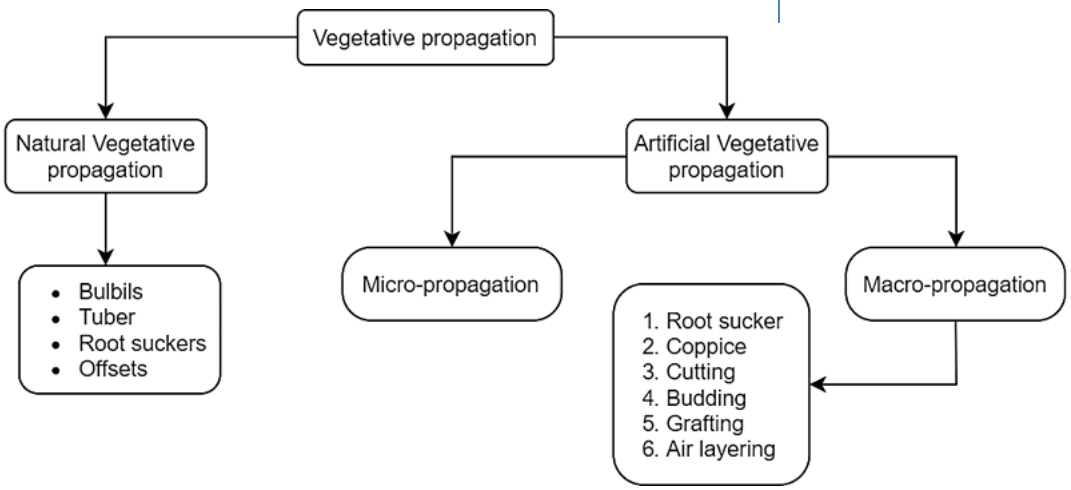
Chapter Outline


**17.2** Macro Propagation

- Root Sucker
- Coppice
- Cutting
- Budding
- Grafting
- Layering

**17.3** Micro-Propagation


- **Objective of plant propagation ?**
  - Increase the number of plants of the same species
  - Preserving the essential characteristics of the plants
  - Way to introduce exotics
- **Methods of plant propagation?**
  - Sexual : by seeds
  - Asexual : by vegetative parts like cutting, Root suckers, etc.
- **Vegetative propagation?**
  - *The method to regenerate the new independent plant from the body tissue of the parent plant*.
  - Also known as *asexual propagation*.
- **Methods of vegetative propagation ?**




**Advantages of vegetative propagation**

- Vegetative propagation helps to produce genetically identical plants.
- This method eliminates variability and maintains clonal fidelity.

CHAPTER 18

# SOWING & PLANTING

## 18.1 SITE SELECTION

The selection of a site is one of the vital considerations in the success of the plantation program. If the plantation is raised in a regeneration area or under a CAMPA plantation, the area is generally known.

Plantation sites are usually of four types - (a) degraded forest areas, where soil conditions are generally poor, and soil erosion is rampant, (b) wastelands where sites have one or several limiting factors, (c) forest area where the plantation is to be established either due to absence of natural regeneration or replacement of existing crop and (iv) plantation work along the rail, road, canal sides and agroforestry plantation in agricultural lands.

In most cases, the following points must be taken into consideration in the selection of a site :

- The sites for the plantation, as far as possible, should be easily approachable. If the site is not approachable, there are problems in the transport of planting stock, plantation work, weeding, and other operations. There is a problem in the disposal of produce also.
- There must be enough area for undertaking plantation for several years. It facilitates supervision and protection.
- The site selected should be such that it is easy to obtain participation and involvement of the local population.

Chapter Outline


**18.1** Site selection, including planting survey

**18.2** Site Preparation

- Soil working
- Staking

**18.3** Seed sowing

- Direct sowing
- Hydro
- Aerial

**18.4** Planting-out : When ? /Size/Age, Method, Spacing, Planting pattern

**18.5** Plantation journal


Site Selection

**Site allotted by the Govt.**





**Green Highway Corridor**



**CAMPA Forest**

**PRE-PLANTING SURVEY**

CHAPTER 20

# TENDING OPERATION

## 20.1 TENDING OPERATION ?

From the ***Seedling Stage*** to the ***Final Harvesting Stage***, various operations are carried out at different stages of the forest crop to ensure its healthy growth. Such operations, covering both the crop itself and the competing vegetation, are known as ***Tending Operations***.

Tending operations include ***Weeding***, ***Cleaning***, ***Thinning***, ***Improvement Fellings***, ***Pruning***, ***Climber Cutting***, and ***Girdling*** of unwanted growth.

However, tending does ***not include*** regeneration fellings or ground operations such as soil working, drainage, irrigation, and controlled burning.

### CULTURAL OPERATIONS

Cultural operations are an "*operations, as a rule not directly remunerative, undertaken to assist or complete existing regeneration, to promote the proper development of the crop, or to minimize the after-effects of felling damage*"

Cultural operations include subsidiary felling, weeding, cleaning, unremunerative improvement fellings, thinning in groups of advance growth, girdling or poisoning of unwanted growth, climber cutting, piling of felling debris, and controlled burning. They are generally associated with silvicultural systems relying primarily on natural regeneration.

### TENDING *v/s* CULTURAL OPERATIONS

| Criterion | Tending | Cultural Operations |
|---|---|---|
| Definition | Operations for the ***benefit of a crop*** from ***seedling to mature stages*** | Operations to ***assist regeneration*** and ***promote crop development*** |
| Primary aim | Creating best possible growth conditions for the existing crop | Assisting natural regeneration. |
| Includes pruning? | Yes | Usually not |
| Includes controlled burning? | No | Yes |
| Includes regeneration? | No | No, but it helps in ***creating hygienic*** conditions conducive to proper crop growth |
| Scope | Focuses on crop and competing vegetation. | Includes ground operations and post-felling damage minimization |

Chapter Outline


**20.1** Tending Operations
- Cultural Operations
- Tending v/s Cultural

**20.2** Weeding

**20.3** Cleaning
- Weeding v/s Cleaning

**20.4** Climber cutting

**20.5** Pruning
- Pruning v/s Lopping

**20.6** Improvement felling
- Salvage cutting
- Increment felling

**20.7** Girdling & Pollarding

**20.8** Thinning
- Mechanical
- Ordinary / German
- Crown / French
- Free / Elite
- Maximum
- Advance / Craib
- Numerical
- Selection thinning

**20.9** Factors affecting thinning practices

**20.10** Effect of thinning on Growth

CHAPTER 1

# MANGROVES

Mangroves form the coastal and estuarine *wetland ecosystems* in the tropical and subtropical regions of the world. This unique *intertidal ecosystem* acts as a safeguard to the coastlines from the disasters of cyclones, tsunamis, and storm surges. They are one of the most productive and biologically complex ecosystems on earth, providing critical *ecosystem services* including coastal protection, carbon sequestration, fisheries support, and biodiversity conservation.

- Mangroves are a diverse group of *salt-tolerant (Helophytic) evergreen plant communities* found in the *tropical* and *subtropical coastal* and *intertidal zone* of the world, occurring mainly between *latitudes* 24°N and 32°S.

## 1.1 HABITAT

Mangroves inhabit the *intertidal zone* of coastal and estuarine mudflats, where unique environmental conditions create a highly specialised habitat

- Diurnal ***tidal inundation*** of marine water, making the soil loose, very wet, salty, and low in oxygen (*anaerobic*) = *Redox reaction sequence*.
- The soil ***lacks available minerals*** like nitrogen (N), phosphorus (P), potassium (K), iron (Fe), and sulfur (S) due to *leaching* and anaerobic conditions.
- Area experiences ***strong winds*** from *cyclones and tsunamis*.
- The temperature ranges from **25-35°C**, and there is ***1000 to 3000 mm of rainfall*** annually.
- ***Rich biodiversity*** because of the edge effect (ecotone between terrestrial and marine ecosystems).
- ***Salt spray***

## 1.2 DISTRIBUTION

Mangrove distribution is primarily controlled by three factors : ① *Temperature* — Determines latitudinal limits, ② *Tidal regime* — Determines species zonation; ③ *Salinity* — Salt excluder/excreter strategy determines species composition.

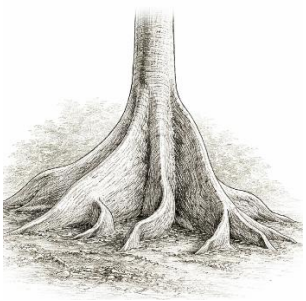
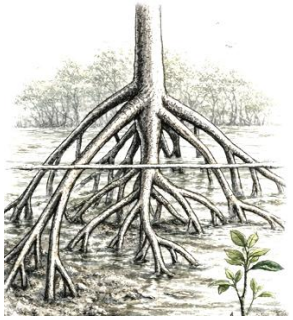
Chapter Outline


1.1 Habitat
1.2 Distribution
1.3 Characteristics of mangroves forest
- Salt regulation mechanism
- Pneumatophores.
- Vivipary

1.4 Mangroves forest classification
1.5 Threats to Mangroves

otherwise be severely limited by the waterlogged, anaerobic soil conditions.

Thus, lenticels and aerenchyma together constitute an efficient aeration mechanism in mangrove roots — lenticels enabling the entry of air from the atmosphere, and aerenchyma facilitating its internal distribution to the living tissues below.

| Buttress roots*** | Knee roots*** | Pneumatophores*** | Prop or Stilt roots*** |
|---|---|---|---|
|  |  |  |  |
| *Heretiera***, *Xylocarpus* | *Bruguera**** | *Avicennia**** | *Rhizophora**** |

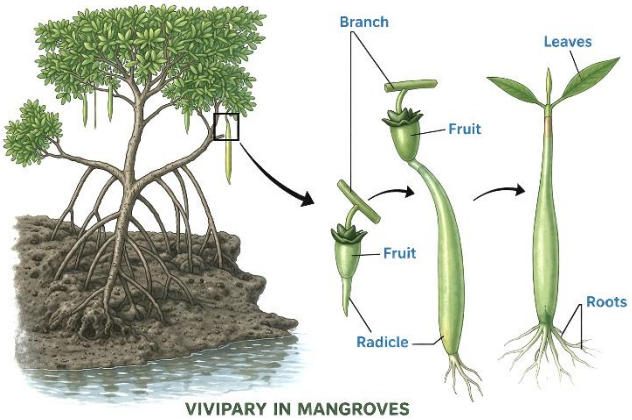
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*Vivipary* refers to the *germination of a seed while it is still attached to the parent plant (in situ)*. In mangrove ecosystems, vivipary represents a crucial reproductive adaptation to *high salinity, anaerobic (oxygen-deficient) substrates, and unstable muddy conditions* of intertidal zones.

In this process, the embryo does not undergo dormancy; instead, it continues to grow within the seed, which itself remains enclosed inside the fruit attached to the parent tree. The most prominent feature of vivipary is the *elongation of the hypocotyl*, which emerges from the fruit as a cylindrical structure. As the hypocotyl elongates, it pushes the radicle outward, forming a well-developed propagule even before detachment.

The increasing size and weight of the propagule facilitate its eventual detachment. Upon falling, it typically *penetrates the soft, saline mud in a vertical orientation*, ensuring that the *plumule remains above the water surface*, thereby avoiding prolonged saltwater submergence. The exposed radicle rapidly develops into roots, anchoring the seedling firmly in the substratum and enabling early establishment.

This strategy significantly enhances the chances of survival by *bypassing the vulnerable seed stage* and allowing immediate establishment in a hostile environment.



VIVIPARY IN MANGROVES

***Pollination** in **mangroves** is diverse and species-specific, including :*

- — ***Anemophily*** (wind pollination) – *e.g.*, in *Rhizophora*
- — ***Entomophily*** (insect-mediated pollination) – *e.g.*, in *Avicennia* and *Bruguiera.*

## 1.4 MANGROVE FOREST CLASSIFICATION

- **ECOLOGICAL BASIS** : Under the Champion & Seth classification, mangroves are included in ***Type Group-4 : Littoral & Swamp Forests***.

CHAPTER 24

# IMPORTANT INDIAN TREE SPECIES

## 24.1 ACACIA NILOTICA (BABOOL)




- *Syn. Acacia arabica*[***] = Gum arabic[***]
- **Family :** *Mimosaceae*[***] (Leguminosae).
- **Distribution :** A tree of *Semi-arid region*[***]**.** Hardy to handle damages created by cracking in *black cotton soil*[***], drought, and moderate frost, so, widely distributed over the north Indian plains, Rajasthan, MP, MH, etc.
- **Fruit :** *Lomentum*[***] type
- **Phenology :** medium-size *deciduous* tree with brood shape crown
    - Leaf fall : April – May
    - Leaf renewal : May - June
    - Flowering : January to March
    - Fruiting : ripen from April to June
    - *Thorny branches*.



- **SILVICULTURAL CHARACTERISTICS**
    - Drought hardy.
    - Frost resistant
    - Light demanded
    - Good copper
    - Root suckers

**Phenology**[***] is the seasonal changes in the plant behaviors over a year; it is the study of when plants start flowering, fruiting, leaves shedding, etc.

- **UTILIZATION** : **Gum**[***] (Ladoo making), leaves **Fodder**, **Fuelwood**[***], and **Timber** for farm implements. ***Tannins*** *from Bark and Pods*[***].

## 24.2 AZADIRACHTA INDICA (NEEM)

- **Family** : *Meliaceae*[***] [Non-Leguminous = Rhizobium × = Nitrogen Fixation ×][***]
- **Distribution** : Neem generally grows in tropical dry deciduous and thorn forests in drier parts up to 1500 m.
- **Phenology** : Neem is a medium size (12 – 15 m) with a broad rounded crown.




    - It is an almost evergreen tree but becomes near leafless in dry localities for a short period during February – march [*Deciduous Tree*[***]]
    - Flowing occurs from January to March. In south India, it is in January and progressively delayed toward the north up to the Himalayan subtract where it is in 1st week of May.

| Scientific name | Common name | English name | Family |
|---|---|---|---|
| *Abies pindrow*[***] | Silver fir | fir | Coniferae/Pinaceae |
| *Acacia nilotica*[***] (syn. Acacia *arabic*a | Indian gum Arabic | Babool, Kikar | Mimosaceae |
| *Acacia catechu*[***] | Catechu | Khair | Mimosaceae |
| *Acacia chundra*[***] | | Lal khair | Mimosaceae |
| *Acacia auriculiformis* | Australian wattle | Australian babool | Mimosaceae |
| *Acacia concinna*[***] | Soap pod | Shikakai | Mimosaceae |
| *Adina cordifolia*[***] | | Haldu | Rubiaceae |
| *Aegle marmelos*[***] | Bengal quince | Bel, Bilva | Rutaceae |
| *Ailanthus excelsa*[***] | Tree of heaven | Maharukh | Simaroubaceae |
| *Albizzia lebbeck*[***] | Women's tongue tree[***] | Kala siris | Mimosaceae |
| *Albizia procera* | White siris | Safed siris | Mimosaceae |
| *Anacardium occidentale* | Cashew nut | Kaju | Anacardiaceae |
| *Anogeissus latifolia* | Axle wood[***] | Dhawada, Ghatti fum | Combretaceae |
| *Areca catechu* | Betal palm | Supari | Palmae |
| *Artocarpus heterophyllus* | Jack fruit | Kathal | Moraceae |
| *Azadirachta indica* | Margosa tree | Neem | Meliaceae |
| *Bambusa bamboo* | Thorny bamboo | Kakila bans | Gramineae/Poaceae |
| *Bambusa vulgaris* | Yellow/Golden bamboo | Kalaka | Gramineae |
| *Bixa orellana* | Annatto | Bixa | Bixaceae |
| *Borassus flabellifera* | Fan palm | Taad | Palmae |
| *Boswellia serrata* | Indian frankincense | Salai | Burseraceae |
| *Butea monosperma* | Flame of the forest | Palas, Dhak | Papilionaceae |
| *Butea superbha* | | Palas bel | Papilionaceae |
| *Cassia fistula* | Golden shower | Amaltas | Caesalpiniaceae |
| *Casuarina equisetifolia* | Sea oak | Seru | Casuarinaceae |
| *Cedrus deodara* | Himalayan cedar | Deodar | Pinaceae |
| *Ceiba pentandra* | Silk cotton | Kapok | Bombaceae |
| *Cinnamomum camphora*[***] | Camphor tree | Kapoor | Lauraceae |
| *Cocus nucifera*[***] | Coconut | Nariyal | Palmae |
| *Coffea arabica*[***] | | Coffee | Rubiaceae |
| *Dalbergia latifolia*[***] | Rose wood[***] | Shisham | Papilionaceae |
| *Dalbergia sissoo* | Sissoo | Sissoo | Papilionaceae |
| *Delonix regia*[***] | Flamboyant tree | Gulmohar | Papilionaceae |
| *Dendrocalamus strictus*[***] | Male bamboo[***] | Bans | Gramineae |
| *Dendrocalamus giganteas* | Giant bamboo | | Gramineae |
| *Diospyros melanoxylon*[***] | Coromandel ebony | Tendu | Ebenaceae[***] |
| *Elaeocarpus gantrus*[***] | Sacred bead tree | Rudraksh | Elaeocarpaceae |
| *Emblica officinalis* | Emblic myrobalam | Amla, Aonla | Euphorbiaceae[***] |
| *Eucalyptus camaldulensis* | | Nilgiri, Safeda | Myrtaceae |
| *Eucalyptus globulus* | Blue gum | Nilgiri, Safeda | Myrtaceae[***] |
| *Eucalyptus tereticornis* | Gray gum | Nilgiri, Safeda | Myrtaceae |
| *Ficus benghalensis* | Banyan tree | Bad, Bargad | Moraceae |
| *Ficus eleastica*[***] | Indian rubber tree | Rubber | Euphorbiaceae[***] |
| *Ficus religiosa* | Botree | Pepal | Moraceae[***] |
| *Gmelina arborea* | | Shewan sag, Safed teak | Verbenaceae[***] |
| *Grevillea robusta* | Silver oak | Oak | Proteaceae |
| *Hardwickia binata* | | Anjan | Caesalpiniaceae[***] |
| *Hopea parviflora* | Iron wood of malabar | | Dipterocarpaceae |
| *Indigofera tinctorial*[***] | Indigo | Neel | Papilionaceae |


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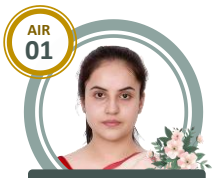



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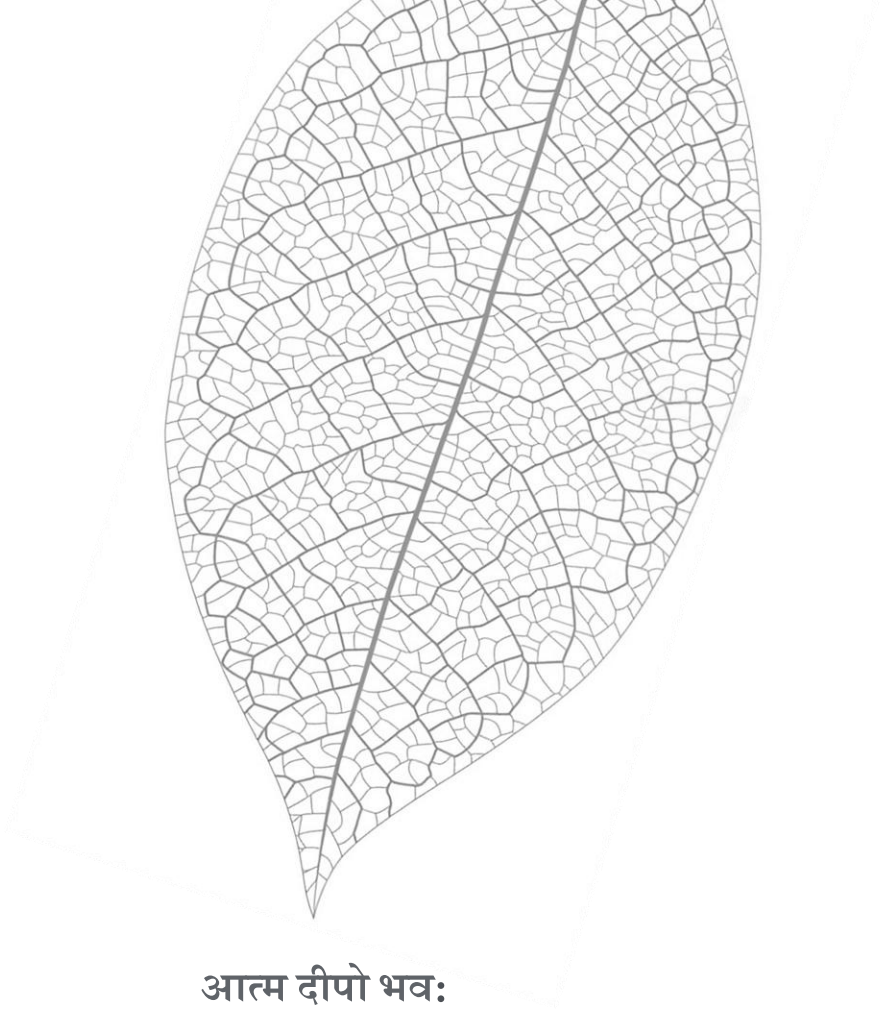



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