Hornbill Classes

FORESTRY

TOOL KIT SERIES

UKPSC
UTTARAKHAND

UTTARAKHAND PUBLIC SERVICE COMMISSION

STATE FOREST SERVICE

2026

Detailed Syllabus Based study material + **Linkage of Concepts with PYQs** + **Infused with Infographics & Maps**

Module - 1

- Silviculture
- Locality factors
- Tree crop morphology
- Forest Succession
- Forest types in India
- Forest Regeneration
- Forest Nursery
- Vegetative propagation
- Plantation & Maintenance works
- Tending operations
- Commercial Forestry
- Mangroves & Cold desert
- Important Indian tree species

MPPSC State Forest Service 2023


Rank – 1

Shashank Jain

Comprehensive Forestry Course + CIGP


Rank – 3

Jyoti Thakur

Comprehensive Forestry Course + CIGP


Rank – 4

Shivam Gautam

Comprehensive Interview Guidance Programme


Rank – 5

Nitin Patel

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Rank – 6

Ravi Kumar

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Ankur Gupta

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Deependra Lodhi

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Kapil Chauhan

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Rank – 10

Alok Kumar Jhariya

Comprehensive Forestry Course + CIGP


Rank – 11

Tarun Chouhan

Comprehensive Interview Guidance Programme + Test Series


Rank - 12

Raghvendra Thakur

Comprehensive Forestry Course + Test S. + CIGP

11 Out of 12 Total Selections in

Assistant Conservator of Forest (ACF)

108 Out of 126 Total Selections in

Range Forest Officer (RFO) 2023


Rank – 1

Arvind Ahirwar

Comprehensive Interview Guidance Programme + Test Series


Rank – 2

Pushpendra Singh Ahirwar

Comprehensive Forestry Course + CIGP


Rank – 3

Narendra Gunare

Comprehensive Interview Guidance Programme + Test Series


Rank – 4

Jitendra Kumar Verma

Comprehensive Forestry Course + CIGP


Rank – 5

Jaishrish Barethiya

Comprehensive Forestry Course + CIGP


Rank – 6

Bhavna Sehariya

Comprehensive Forestry Course + CIGP


Rank – 7

Pradeep Ahirwar

Comprehensive Forestry Course + CIGP


Rank – 8

Anil Kumar Gour

Comprehensive Forestry Course + CIGP


Rank – 9

Aakash Kumar Malviya

Comprehensive Forestry Course + CIGP


Rank - 11

Rajesh Kumar Jatav

Comprehensive Forestry Course + CIGP


Rank - 12

Veerendra Prajapati

Comprehensive Interview Guidance Programme + Test Series


Rank - 13

Dinesh Kumar

Test Series


Rank - 14

Niranjan Dehariya

Comprehensive Forestry Course + CIGP


Rank - 15

Abhinay Chouhan

Test Series


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Sher Singh Ahirwar

Comprehensive Forestry Course + CIGP


Rank - 19

Pradeep Jatav

Comprehensive Forestry Course + CIGP


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Amit Sisodiya

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Rank - 22

Abhishek Barodiya

Comprehensive Interview Guidance Programme


Rank - 24

Golu Goyal

Comprehensive Interview Guidance Programme + Test Series


Rank - 25

Pawan Raje

Comprehensive Interview Guidance Programme + Test Series

SILVICULTURE

Paper – 1 | Section – A

EDITION : 2025

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Gole ka mandir, Morar, Gwalior (MP) 474005

SYLLABUS

Indian Forest Service (IFoS) [Paper 1 | Section A]	***General Silvicultural Principles*** : Ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests; methods of propagation, grafting techniques; site factors; nursery and planting techniques. Nursery beds, polybags, and maintenance, water budgeting, grading and hardening of seedlings; special approaches; establishment and tending. Other state PSC exams also have similar syllabi to the IFoS exam, such as the ***Uttar Pradesh*** PSC State Forest Service [Paper 1, Section A]; ***Odisha PSC*** State Forest Service (Main) Examination [Paper 1 | Section A]; ***Jharkhand PSC*** State Forest Service (Main) Examination [Paper 1], ***Maharashtra PSC*** State Forest Service Examination [Unit – 1],
Uttarakhand PSC Assistant Conservator of Forest, Logging Officer & Forest Range Officer Combined Examination–2025 [Paper 1]	***General Silviculture*** ◈ Biotic and abiotic components of forest ecology. ◈ Forest community concepts, nutrient cycling and water relations, ecological succession and climax. ◈ Composition of forest types in India, composition and association, species identification. ◈ General principles of Silviculture, local factors influencing vegetation. ◈ Natural and artificial regeneration of forests, propagation techniques, forest nursery technique - nursery beds, poly bags and their maintenance, grading and hardening of seedlings, establishment and tending, felling climber, cutting. ◈ Principles of establishment of herbs and trees.

Module - 1

CONTENTS

UKPSC STATE FOREST SERVICE (MAIN) EXAMINATION

RFO 2021	• Describe important objectives of ***Thinning***. Differentiate crown thinning from ordinary thinning. Write grades (classes) of ordinary thinning / विरलन के महत्त्वपूर्ण उद्देश्यों का वर्णन कीजिए। छत्रक विरलन का सामान्य (साधारण) विरलन से विभेद कीजिए। सामान्य (साधारण) विरलन की श्रेणियों का उल्लेख कीजिए। [1(a) | 20 M]. • Discuss the importance and objectives of ***Forest Nurseries*** along with different types of nurseries / वन नर्सरी का महत्त्व एवं उद्देश्य, साथ ही विभिन्न प्रकार की नर्सरियों की चर्चा करें। [3(a) | 10 M].
ACF 2019	• Explain briefly the ***Tending Operations*** carried out in a forest / वन में टेंडिंग (Tending) कार्य-विधियों का संक्षिप्त विवरण दें। [1(a) | 20 M]. • Describe the effect of ***Temperature*** on tree life-cycle / पेड़ के जीवन चक्र में तापमान के महत्त्व का वर्णन करें। [1(b) | 20 M]. • How ***Micro-Organisms*** help soil amelioration? Write in detail / सूक्ष्म जीव किस तरह भूमि में सुधार लाते हैं ? विस्तार से लिखें। [3(a) | 20 M].
RFO 2015	• Explain the climax in ecological ***Succession***. Write down three prominent climax theories postulated by ecologists and write down about types of climax based on these theories / पारिस्थितिक उत्तराधिकार में चरमोत्कर्ष के बारे में बतायें। परिस्थितिकों द्वारा माने गये तीन प्रमुख चरमोत्कर्ष सिद्धांतों को लिखें और इन सिद्धांतों के आधार पर चरमोत्कर्ष के प्रकार के बारे में लिखें। [4(a) | 20 M]. • Write short note on the following / निम्नलिखित पर संक्षिप्त टिप्पणी लिखें (a) ***Exotic*** Trees in Forestry / वानिकी में विदेशी वृक्ष [2(a) | 10 M]. (b) ***Tending Operations*** / संचालन प्रवृत्त (टैंडिग आप्रेशन) [2(c) | 10 M]. • Comment on the statement that "***Vegetative Propagation*** is dead end to breeding" / "वनस्पति प्रचार प्रजनन का चरामात्त है।" इस ब्यान पर टिप्पणी करें। [4(b) | 10 M]. • Write down the various factors which affect the ***Choice of Species*** / प्रजातियों के चुनाव को प्रभावित करने वाले विभिन्न कारकों को लिखें। [4(d) | 10 M].
RFO 2012	• How ***Biotic Factors*** are influencing the maintenance of present-day forest communities? Explain / जैविक कारक कैसे वन समुदाय के अनुरक्षण को प्रभावित कर रहे हैं? वर्णन करें। [1(a) | 20 M]. • Compare ***Natural*** and ***Artificial Regeneration*** in forests with reference to forest development वनों की बढ़ोतरी के लिए प्राकृतिक एवं कृत्रिम पुनर्जनन की तुलना करें। [1(b) | 20 M]. • Write short notes on the following / निम्नलिखित पर संक्षिप्त टिप्पणियाँ लिखें : (a) ***High Forests*** / उच्च वन [2(a) | 10 M]. (b) ***Low Forests*** / निम्न वन [2(b) | 10 M]. (c) ***Multipurpose Trees*** / बहुउद्देशीय पेड़ [2(d) | 10 M]. • How ***Choice of Species*** influences success or failure of a forest regeneration drive? Explain / प्रजातियों का चयन वनों के पुनर्जनन की सफलता या असफलता को कैसे प्रभावित करता है ? विस्तार से लिखें। [4(d) | 10 M].

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*.

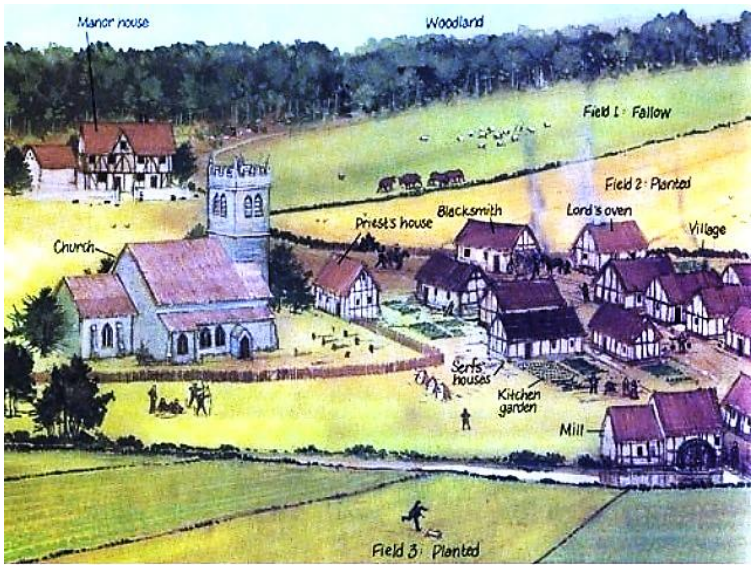

Figure 1.1 : A medieval European village

► 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

– Forest is an *uncultivated land* occupied by *natural vegetation* with a closed or partially *closed canopy*, which *provides shelter to the wildlife* [Ecological definition].

– Forest is any land area that has been *declared as a 'forest'* under any *central* or *state*, or *local laws* (*i.e.*, by Tribal council) [Legal definition]

1.2 FOREST CLASSIFICATION

Forests are classified into various categories to –

- Provide a ***Standardized*** *system for* ***Identifying***, ***Describing***, and ***Mapping*** different types of forests based on their characteristics, such as tree species composition, canopy structure, and ecological function. This information can be used in decision-making processes related to ***Conservation***, ***Management***, ***Administration***, ***Research***, ***Land-Use Planning*** and ***Record-Keeping***.
- Classification systems provide a *Baseline for tracking changes* in *Forest Health*, *Productivity*, and *Biodiversity*, enabling the monitoring of climate change effects and allowing managers to adapt their practices to changing conditions.
- *Comparability* : Enabling the comparison of forest resources and management practices across different areas is essential for understanding regional variations and identifying best practices.
- Identifying the *Areas of High Biodiversity* or *Ecological Significance* for conservation and sustainable management.
- *Developing sustainable management plans* : By understanding the characteristics of different forest types, managers can develop plans that are tailored to the specific needs of the forest ecosystem.

IFoS 2022 : What is the ***purpose of classifying forests*** ? How are the forests classified for silvicultural management? [Linked Q | 8 M].

IFoS 2012 : Basis of forest classification and why there is ***need for such classification*** [5 M].

- What are the ***Purposes of classifying*** various types of forests? [OPSC Civil (Main) 2022–23 | 5 M].
- What are the bases for the *classification of forests*? Why there is ***need of their classification***? Write the type groups of tropical forests and their distribution and species of the area [OPSC Forest (Main) 2019-20 | 20 M].
- What are the ***objectives of forest classification***? Classify forests on the basis of different criteria used with definition of each class [Arunachal PSC Civil (Main) 2017-18 | 20 M].

Forest may be classified on the basis of –

[A] Age
[B] Regeneration
[C] Composition
[D] Ownership
[E] Function
[F] Legality
[G] Growing stock
[H] Density of Forest cover
[I] Ecological or Ecosystem-based

► FOREST TYPES, BASED ON AGE

- **Even-Aged** or **Regular Forest** : A forest (or stand) composed of trees that are ***approximately the same age***. From a management perspective, a ***difference of up to 25%*** *of the rotation age is permissible, especially for stands not harvested for* ***100 years or more***. While nature does not naturally create even-aged forests, humans can achieve this through plantation efforts, such as the ***Nilambur*** teak plantation established in 1842. [In essence, *a truly Even-Aged Forest is typically Man-Made*].

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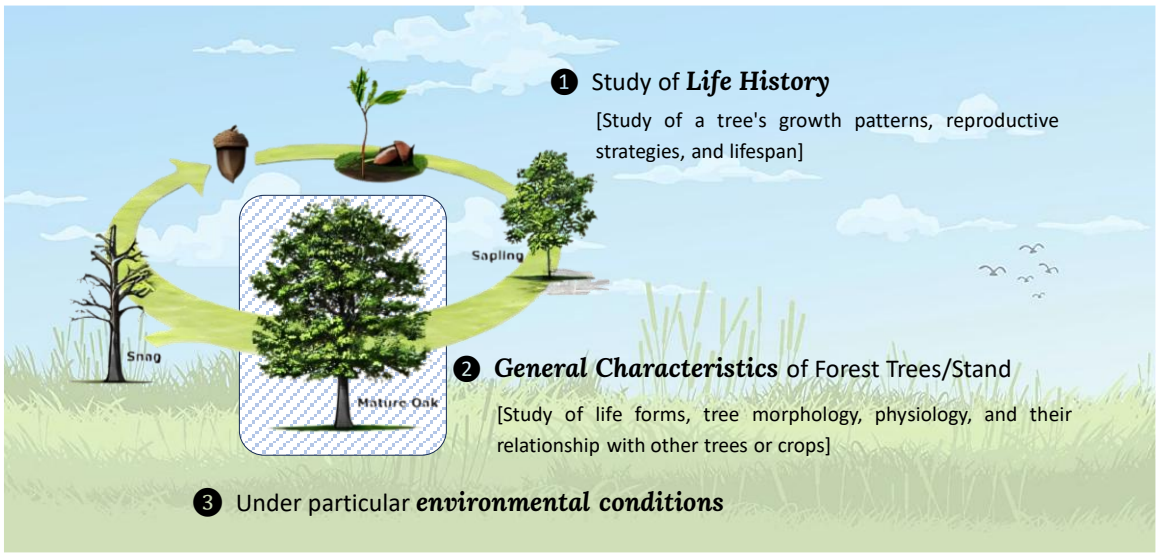
SILVICS

Silvics deals with the biological characteristics of individual trees and their communities. This includes how trees grow and reproduce and the ways that the physical environment influences their physiology and character. Further, it investigates how communities of trees modify the physical environment that supports them and studies the never-ending interaction between vegetation and the physical environment as forests develop and change over time.



Definition : *Silvics is the study of Life History and General Characteristics of forest trees and stand with particular reference to environmental factors*. It focuses on how trees grow, reproduce, and interact with their environment, including factors like climate, soil, and other organisms.

OBJECTIVES OF SILVICULTURAL STUDY

⊳ **Control**

- ***Crop composition*** : controlling the mix of tree species within a stand, promoting desirable species while suppressing unwanted ones.
- ***Stand structure*** & ***Density*** : Operations like thinning and pruning help in manipulate stand structure, arrangement and spatial distribution of trees within a stand.
- ***Growth*** : Silviculturists aim to optimize the growth and development of forest stand. This involves controlling factors that influence growth, such as competition, nutrient availability, and light.

IFoS 2024 : What is ***Silvics***? Explain its practical application. Discuss in brief the ***objects of study of silviculture*** [15 M].

Define Silviculture. What are the ***objectives of studying*** it? [GPSC RFO (Main) 2020-21].

What are the ***objectives of silviculture***? Describe the forest types of India [MPSC (ACF) 2012 | 15 m].

⊳ **Facilitation**

- Production of *large volume per unit area* by selecting appropriate tree species, optimizing stand density, and employing silvicultural systems that promote rapid growth.
- Increasing the *quality of timber*.
- 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.

other components of the forest ecosystem. This knowledge is critical for managing forests to maintain biodiversity and ecosystem services. promote carbon sequestration + making forest climatically more resilient.

IFoS 2018 : Justify that the study of *Silvics* is essential for the successful afforestation program in India [8m].

Intro — Silvics deals with the biological characteristics of individual trees and forest stand. This includes how trees grow and reproduce and how the physical environment influences their phenological behaviours and physiological character.

Body — The study of Silvics, or the ecological and physiological characteristics of trees and forests, is essential for the successful afforestation program in India for several reasons.

First, *understanding the specific needs and growth patterns of different tree species* is crucial for selecting the appropriate species for a particular location and soil type.

Second, silvics can inform *decisions on planting density, spacing, and pruning for optimal growth* and survival of the trees.

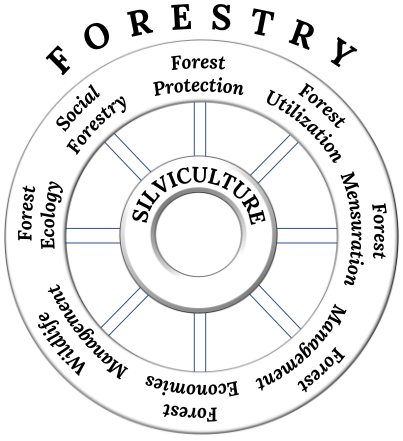
Third, silvics can provide information on the *potential for invasiveness of certain species*, as well as their potential to provide ecosystem services such as carbon sequestration and wildlife habitat.

Overall, incorporating knowledge of silvics into afforestation programs can improve the success rate and long-term sustainability of reforestation efforts in India.

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.



IFoS 2020 : Define Silviculture. Relate the applications of silvicultural to different branches of forestry (8m).

What is the relationship of silviculture with different branches of forestry? **[OPSC Civil (Main) 2016 | 20 m]**.

- **Silviculture and forest Utilization** : Here, silviculture helps in – (a) the cultivation of economically more valuable and high-grade forest produce. (b) Sustainable harvesting and extraction of forest products with reducing impact over local watershed and ecosystem.

2002	: *Biological Diversity Act* passed. *National Biodiversity Authority*, was established in Chennai (2003), Under the biodiversity act 2002.
2003	***National Board of Wildlife*** – came into effect. It is a "*Statutory Organization*" that was created under the *Wildlife Protection Act, 1972*. Theoretically, the board is "*advisory*" *in nature* and advises the Central Government on framing policies and measures for the conservation of wildlife in the country. *Chaired by India's Prime Minister* and its vice-chairman is the Minister of Environment.
2005	***Tiger Task Force*** : In 2005, After the exposure by the media on the sudden disappearance of the tigers from the Sariska Wildlife Reserve, The Prime Minister of India set up the Tiger Task Force to strengthen the conservation of Tigers in the country. ***National Tiger Conservation Authority*** (NTCA) was established in **December 2005** after the recommendation of the Tiger Task Force and became a statutory body in 2006 (under Wildlife Protection Act 1972).
2006	National Bamboo Mission + Forest Rights Act passed
2010	National Green Tribunal Act (NGT) passed
2017	By Indian Forest (Amendment) Act 2017, the word "***Bamboo***" has been omitted from the "***Tree***" list of Indian Forest act 1927 [Remember Palms, Stums, Brush-wood, and Canes (Ratanns) still under this "Tree" list].

1.7 IMPORTANT TERMINOLOGY

- ***Precision silviculture*** : It is an approach where inputs are utilised in precise amounts to get increased average growth, and produce yield compared to traditional silvicultural techniques.

  Why precision farming

  - To increase forest productivity
  - Prevents soil degradation
  - Reduction of chemical application in crop production
  - Efficient use of water resources
  - Reducing per unit cost of production
  - Precision silviculture changing the socio-economic status of farmers

  IFoS 2022 : What is ***Precision Silviculture***? Explain the silvicultural techniques for the following [15 m].

  Disadvantages

  - High initial cost = Difficult/costly for small land holdings
  - Lack of technical expertise knowledge and technology
  - Heterogeneity of cropping systems and market fluctuations.

IFoS 2011 : Write Short Notes on – (ii) ***Sacred Groves*** [2 ¼ M].

IFoS 2013 : Write critical notes on any four of the following – (i) Plants of ***Sacred Groves*** with two Examples well-known in the country [Paper – **2** | 2.5 M].

IFoS 2022 : How do ***Sacred Groves*** help in conservation of biodiversity? [8 M].

- Define sacred grove. Which common belief has protected such groves? Whether such groves get protection under any of the provision of Wild Life (Protection) Act, 1972? What are the threats to the existence of the sacred groves? [GPSC Forest Service (ACF) 2022-23; GS 3 | 10 M]

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WHY IN NEWS ?

On December 18, 2024, the Supreme Court of India issued a landmark ruling Court directed the ***Rajasthan*** and the ***Central Government*** to classify these ***Sacred Groves***, locally known as '***orans***', in Rajasthan as "***Forests***" and designate them, where suitable, as "***Community Reserves***" under the Wildlife Protection Act (WLPA) 1972. This decision safeguards them against ***encroachment and ecological degradation***.

Key Aspects of the Ruling

- **Legal Recognition** : Orans are now legally classified as forests, ensuring robust protection.
- **Comprehensive Mapping** : The ruling mandates detailed mapping through both ground assessments and satellite imagery, to be executed by an expert committee.
- **Community Empowerment** : The ruling emphasizes the importance of community participation in conserving these areas. The Court suggested empowering local communities to manage and protect their sacred groves, thereby reinforcing their cultural ties to the land.
- **National Initiative** : The Court directed the Ministry of Environment, Forest and Climate Change (MoEFCC) to conduct a nationwide survey of sacred groves in order to formulate a unified, comprehensive policy for their governance and management.

Definition : patches of forest that some ***Rural Communities*** protect and managed as abodes of deities, *i.e.,* ***Gompa forest*** in Arunachal Pradesh, "***Orans***" in Rajasthan, ***Sarna*** in Jharkhand.

Role in forest and wildlife conservation

- **Biodiversity Conservation** : serve as havens for a diverse range of plant and animal species. They act as a sanctuary for native flora and fauna, including endangered and rare species. These groves provide undisturbed habitats, ensuring the survival and maintenance of biodiversity.
- **Forest Ecosystem Conservation** : act as natural buffers, protecting the surrounding forest ecosystem from encroachments, logging, and other forms of human disturbance.
- **Ecological Balance** : Sacred groves act as a natural watersheds, helping to regulate water flow and prevent soil erosion. The preservation of these groves helps in maintaining local microclimates, nutrient cycling, and overall ecosystem stability.
- **Genetic Preservation** : Sacred groves often harbour ancient and rare species of plants and trees, including those with unique genetic traits.
- It holds immense **cultural and spiritual importance** for the communities that consider them sacred. These groves are often associated with religious or cultural practices, traditional knowledge, and rituals.
- **Education and Awareness** : Sacred groves serve as outdoor classrooms for learning about biodiversity, forest ecology, and traditional ecological knowledge.

1.8 EXERCISE

- Differentiate with suitable examples
  - (*a*) High forest and coppice forest [Himachal PSC Civil (Main) 2015; OPSC Civil (Main) 2020 – 21]
  - (*b*) Open forest and Scrub [Himachal PSC Civil (Main) 2020]
  - (*c*) Silvics and silviculture [Himachal PSC Civil (Main) 2014; Mizoram PSC Civil (Main) 2018 (Silviculture)].
  - (*d*) Tangible benefits and intangible benefits [Himachal PSC Civil (Main) 2018]
  - (*e*) Production forestry *v/s* Conservation forestry [OPSC Civil (Main) 2017].
  - (*f*) Social forestry and Van-Mahotsav [Himachal PSC Civil (Main) 2017].

CHAPTER 2

LOCALITY FACTORS

2.1 LOCALITY FACTORS

SITE or **LOCATION** is an area where you want to carry out plantation or management work.

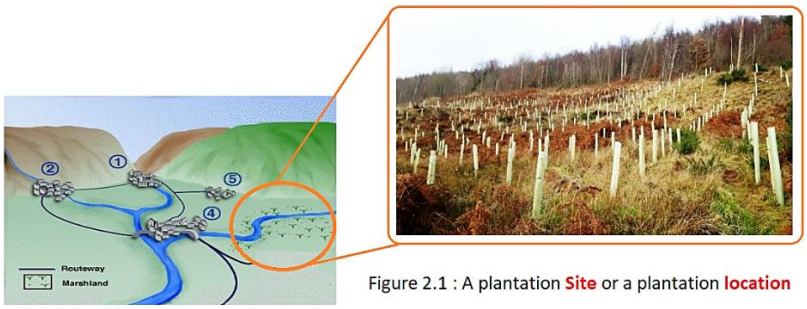


Figure 2.1 : A plantation **Site** or a plantation **location**

SITE FACTORS

The sum of all effective climatic, edaphic, topographic, and biotic conditions of a particular area under which a plant community lives. This means, Site factors are all biotic and abiotic factors of an area that interact and influence vegetation occurrence, distribution, and growth.

⊳ Site factors are also known as ***Locality Factors*** or ***Habitat Factors***.

These factors are –

1. Climatic factors : Solar radiation, rainfall, Wind speed, air temperature, etc.
2. Edaphic factors : Soil organic matter, soil texture, soil structure, mycorrhiza, waterlogging, salinity, etc.
3. Topographic or Physiographic factors : Mountains arrangement, Altitude, latitude, slope, aspects, exposure, etc.
4. Biotic factors : insects/pests attacks, invasion of exotics, grazing and browsing by wild and domestic animals, Human interference.

Chapter Outline

IFoS 2018 : Explain the *Eco-physiological factors* that are more concerned to Silviculturist (15 m).

IFoS 2011 : Why are *locality factors* considered important for any silvicultural operation? (10 m).

IFoS 2010 : What do you understand by the term *locality factors* ? how these affect the decision of plantations undertaking by the Silviculturist ? (10 m).

- Define the term *locality factors*. How do these factors affect the decision of plantation undertaken by a forester [Mizoram PSC Civil (mains) 2018 | 10 m]
- What are all the *biotic and abiotic factors*, responsible for tree/forest growth? Discuss [Himachal PSC ACF (Main) 2017| 15 m]

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.

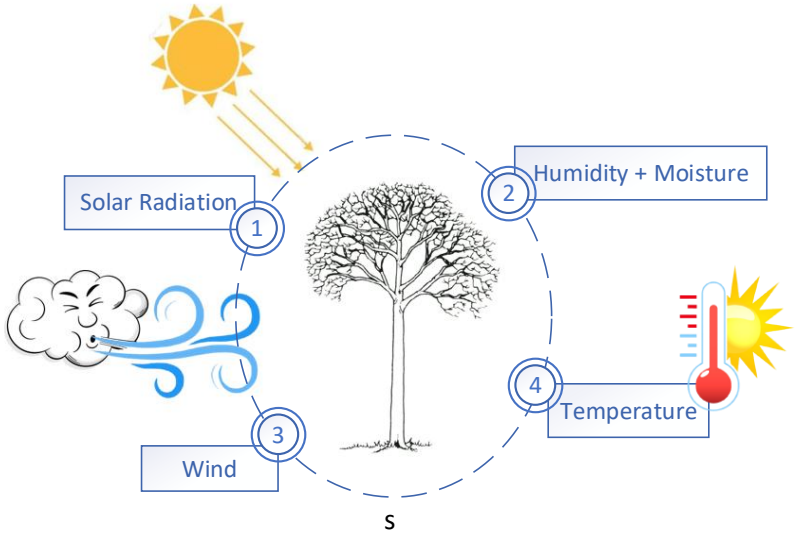


Figure 3.1 : Climatic factors

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 –

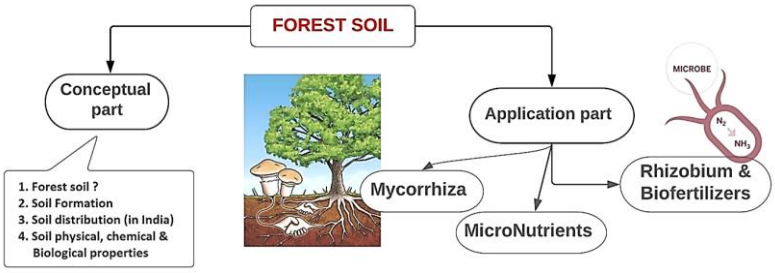
- *Essential for* ***basic metabolic activities*** like photosynthesis, transpiration, and the opening and closing of photoactive stomata.
- Light is crucial for the ***synthesis of chlorophyll molecules***. A prolonged absence of light results in the degeneration of chlorophyll, turning the leaves yellow—a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

Chapter Outline

CHAPTER 4

EDAPHIC FACTORS

Edaphic factors are the ecologically influenced characteristics of the soil brought about by its physical and chemical characteristics. These include soil texture, structure, soil water, temperature, porosity, salinity, pH, Electrical conductivity, etc.



4.1 CONCEPTUAL PART

- **Soil** : the uppermost weathered layer of the earth's crust.
- **Forest Soil** : A portion of the earth's surface serves as a medium for the growth and sustenance of forest vegetation.

  [Remaining parts such as soil formation, type, distribution, classification, properties, and conservation practices are a part of Soil Science, and, are required to be studied separately at a superficial level under different Sub-head 'Forest Soil'].

4.2 MYCORRHIZA

Mycorrhiza is the ***Symbiotic**** relationship between ***Fungi*** *and* ***Higher Plants*** (**Myco** = ***Fungi*** + ***Rhiza*** = ***Rhizome*** = **Roots**). Mycorrhizal fungi are composed of fine, tubular filaments called ***Hyphae*** (singular *Hypha*). The mass of hyphae that forms the fungus body is called ***Mycelium*** (plural *Mycelia*).

- ***Mycorrhiza*** term was given by – A. B. ***Frank****
- ***Symbiosis*** term was given by – Anton De ***Bary****
- The term ***Rhizosphere*** was first time coined by – Lorenz ***Hiltner****

TYPES OF MYCORRHIZAE

- **ECTO-MYCORRHIZA** : Under this, fungal mycelium forms a thick ***Mantle Sheath*** around the lateral roots, and some *mycelia*

Chapter Outline

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

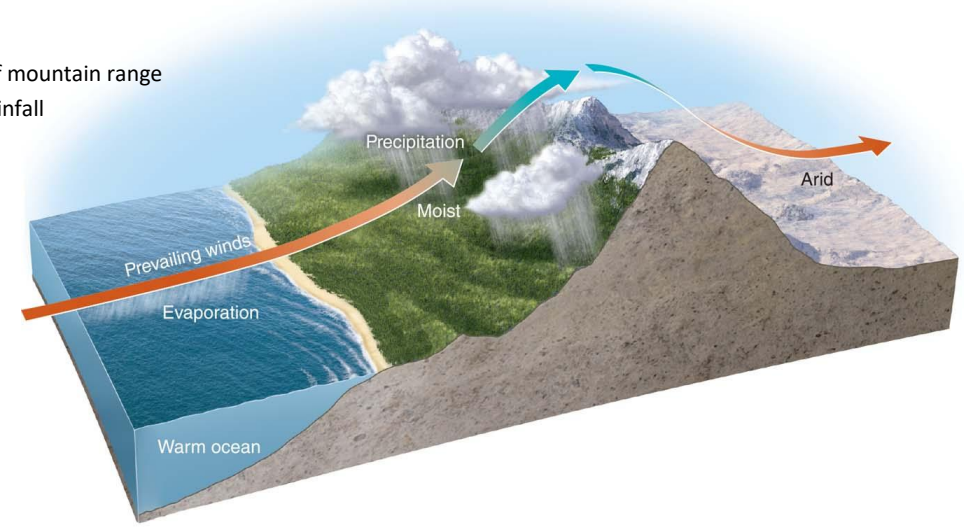
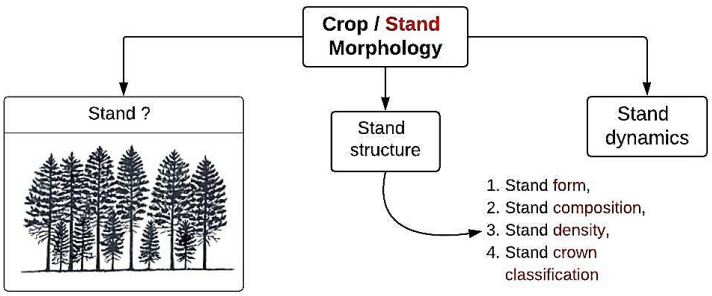


Figure 5.1 : Effect of mountain range on the pattern of rainfall

CHAPTER 9

TREE CROP MORPHOLOGY

Morphology means the science of form, especially studying the outer form (structure), inner structure, and development of their parts. *Crop morphology* means studying the outer form of forest crops and their development.



9.1 STAND ?

The **stand** concept has long been central to the practice of Silviculture and has traditionally been defined as *a group of trees that are relatively homogenous in composition, age-class distribution, and structure growing on a site of uniform quality*. Stands, as defined in this context, have served as the primary unit of forest management around the globe with the stand-by-stand application of silvicultural treatments for achieving a sustainable yield of produce.

Stand *v/s* Forest

A forest is a collection of stands. Remember that a stand is a unit of silvicultural interest. Forester's practice silvicultural operations on stands, but not on forests. It is not an ecological management unit.

9.2 STAND STRUCTURE

Stand Structure refers to the *overall look* of a forest stand. It is the *horizontal and vertical distribution of components* of a stand, including the height, diameter, crown layers and stems of trees,

Chapter Outline

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.

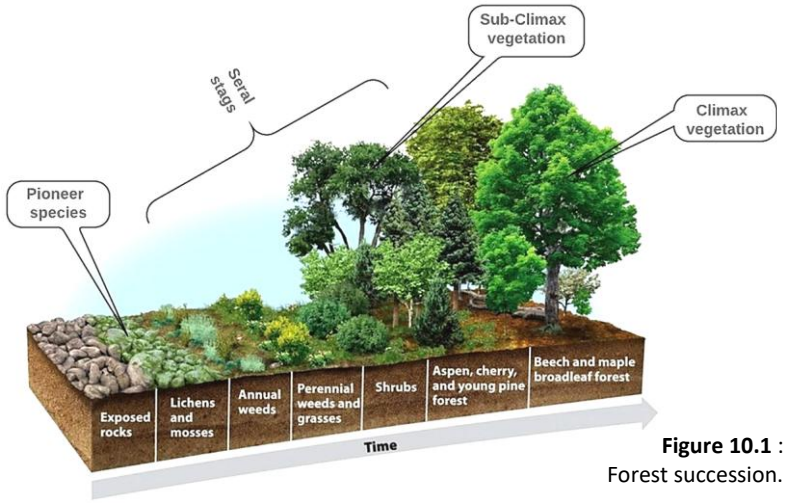


Figure 10.1 : Forest succession.

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***.

Chapter Outline

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).

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 Outline

IFoS 2022 : Explain the following – (iv) ***Enrichment Planting*** [10 M].

IFoS 2014 : Discuss in detail the ***objectives of artificial regeneration*** [10 m]

CHAPTER 16

FOREST NURSERY

Forest nurseries are dedicated enclosed facilities where planting material is grown for transplantation purposes. These nurseries play a vital role in afforestation, reforestation and enrichment plantation projects to maintain and enhance forest ecosystems.

Seedlings are young plants obtained from seed sowing. These young plants can be about one meter in height. ***Transplants*** are seedlings that have transferred from one bed to another to make the seedlings suitable for planting. Seedlings, transplants, and other planting material, *i.e.*, rooted cuttings etc., together are generally called ***planting stock***.

16.1 REQUIREMENTS OF NURSERY?

Artificial regeneration of forests and afforestation of wastelands is carried out either by sowing seeds directly in the field or/and planting nursery-raised seedlings, stumps, cuttings, etc. The easiest and cheapest method of artificial regeneration of forests and afforestation of wastelands is to sow the seeds of desired species directly in the field and tend them to grow after the seeds have germinated. Artificial regeneration by seed sowing has not shown the desired results in the case of several species due to several problems. Planting of Nursery-raised seedlings, stumps, cuttings, rhizomes, etc., offers several advantages over seed sowing. These advantages are as follows

- Several species are *initially slow-grown*. If seeds of these species are sown in the field, the seedlings are most likely to be swamped by weeds and *killed by intense competition*. The nursery-raised seedlings are better equipped to compete with weeds and tolerate adverse site factors, therefore, better success is ensured in planting nursery-raised seedlings.
- Several species *do not seed every year* and produce good quality seeds during a good seed year only. So, we can produce seedlings in the Nursery by collecting seeds through the years.

Chapter Outline

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

Site Selection

Site allotted by the Govt.

Green Highway Corridor

CAMPA Forest

CHAPTER 19

MAINTENANCE OF PLANTATION

After plantation work is over, several planted seedlings have died due to –

- Defective & carelessness in planting work, *i.e.*, root coiling, shallow planting, unfirm soil, etc.
- Poor soil conditions, *i.e.*, waterlogged, presence of injurious salt concentration, Sub-surface hardpan formation etc.
- Adverse post-planting weather, *i.e.*, Frost, drought
- Insect & pest attacks; Competitive weed growth; Grazing, browsing and trampling – by both domestic as well as wild animals.

IFoS 2012 : Comment upon – Failure of forest plantation (5 m).

IFoS 2012 : Reasons of dying *Dalbergia sissoo* (5 m) [*Linked* Q].

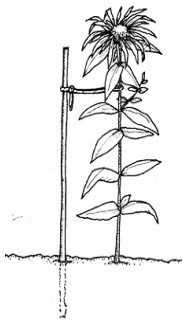
SOLUTIONS

- ***Replace Of Casualties*** : 'Refilling' process is also known as – Beating-up, Blanking, and In-felling.
- ***Weeding*** : removing the weeds. Types – Complete weeding, Line weeding, Spot weeding, Inter row weeding.
- ***Soil Working*** : : to improve infiltration rate, remove sub-surface **hardpan** and improve soil aeration.

- Define seedling establishment. Write in detail, about the various factors affecting establishment of seedlings [OPSC Forest service 2015-16 | 20 m].
- Why do plantations fall? Explain, in detail. With examples [IFoS 2014; OPSC Civil (Main) 2017].

- ***Watering*** : : During the dry season or in case of monsoon failure. Light soil requires more water than heavy soil.
- ***Abnormal Slow Growth*** –> Casualties replacement
- ***Staking*** : providing support to the plantation so it can withstand against a strong wind.
- ***Singling*** or ***Re-Spacing*** : carried out usually after 2/3 years of plantation.

Singling involves selecting the most vigorous and well-formed shoot from a coppice stool and removing the others. This practice ensures that the selected shoot can grow into a strong, single-stemmed tree, optimizing the quality and uniformity of the stand. The operation is typically performed when the shoots have reached a height of approximately 1 to 2 meters. At this stage, the shoots are sufficiently developed to assess their form and vigor, yet still young enough that removal of the undesired shoots causes minimal damage to the stool and the selected shoot.



Stacking of a plant

After harvesting apply **Wax** on the open part to ***prevent fungal infection***.

CHAPTER 21

PLANTATION FORESTRY

A forest plantation is an area of land of not less than one hectare owned by the govt. or private sector, upon which the owner proposes to develop and maintain a forest crop of usually even-aged and single species.

Plantation forestry, based on the successful breeding of superior tree genotypes, is becoming more widely used by international forestry companies since it offers the possibility to grow and manage forests of high economic value and superior quality. However, a number of highly desirable traits are not readily available in the breeding population and may be introduced using desirable genes from other organisms.

21.1 OBJECTIVES or NEEDS OF PLANTATION FORESTRY

> Explain the following – (a) Plantation Forestry [OPSC Civil (Main) 2020 | 10 m]

- *Production* purpose : for production of Timber, Fuel wood, fodder, Fibres, pulpwood, etc. to fulfil population demands with depressurized Forest resources.
- *Protection* against adverse weather, *i.e.*, Windbreak, planting a shade tree in Tea gardens (Usually *Albizzia* spp.), Soil and water *conservation* in a given watershed area.
- Forest enrichment and mixing species to control epidemics like the Sal heartwood borer attack in 1998 in central India.
- Climate change and global warming forced many species unsuitable for germinating naturally or sustained after germination, so they required human intervention.
- Our industrial and domestic demands are changing with time in quality, quantity, and requirement specific. We required the introduction of fast-growing species as well as new species.
- To create employment and investment opportunities.
- Environmental concern & Carbon storage purpose : Compensatory afforestation under CAMPA, fulfills our INDC obligations under the *Paris Agreement* by creating an additional carbon sink of **2.5 to 3 billion** tonnes of CO_2 equivalent till 2030. Our PM recently announced, "India will restore **26 m hac**. of degraded land by 2030" at the 14th CoP of UNCCD at Greater Noida.

21.2 PRODUCTIVITY OF INDIAN FOREST

Against the global average productivity of 2.1 million m^3/hectare/ year, the productivity of the Indian Forest is only 0.7 million m^3/hectare/ year.

Causes of Poor Productivity

- Unregulated grazing
- Uncontrolled fuelwood collection : Nearly 50% of the demand for fuel in rural India is being met from the adjoining forests. The annual demand for fuel wood is estimated nearly 250-300 million m^3. The recorded

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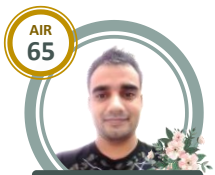

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