

UPSC INDIAN FOREST SERVICE TOOLKIT

The Ultimate Guide to Success

Module - 2

Mangroves & Cold desert

Silviculture systems

Important Indian tree species

Agroforestry & Social Forestry

Module - 2

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Mangrove and Cold desert

Paper - 1 | Section - A



EDITION : 2024

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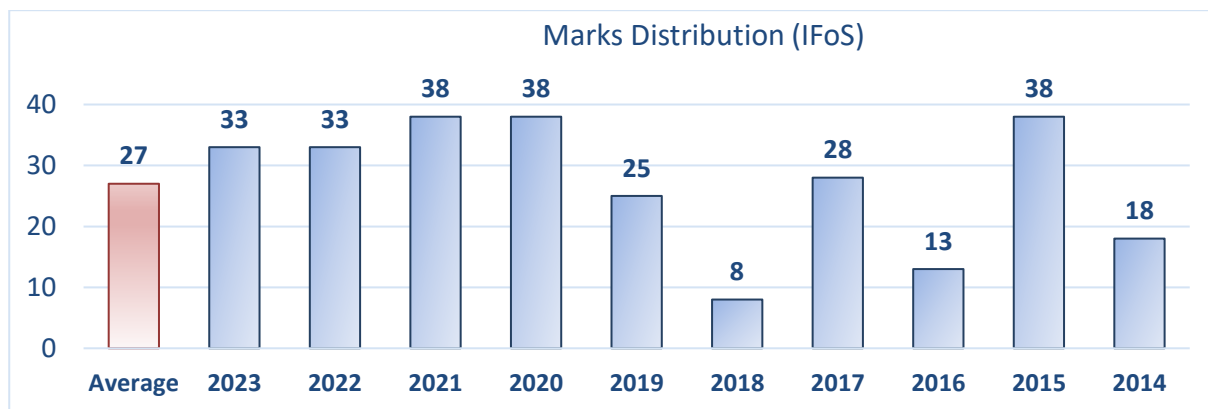
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SYLLABUS

<p>Indian Forest Service (IFoS) [Paper 1 Section A]</p>	<ul style="list-style-type: none"> ▪ Mangrove : Habitat and characteristics of mangrove, plantation-establishment, and rehabilitation of degraded mangrove formations; silvicultural systems for mangrove; protection of habitats against natural disasters. ▪ Cold Desert - Characteristics, identification and management of species.
<p>Odisha PSC Civil service (Main) examination [Paper 1 Part A]</p>	<p>Forest classification and distribution : Mangrove forest.</p>

MODULE - 2 | MANGROVES & COLD DESERT

SN	Chapter	Page No
1.	Mangrove forest	5 – 20
2.	Cold desert	21 – 28



IFoS PYQs [2006 to 2023]

2023	<ul style="list-style-type: none"> • What are mangroves? Write their ecological implications [8 M] • What are the sequences of operations followed in mangrove afforestation? Discuss in detail the <i>fishbone technique</i> of mangrove plantation [10 M]. • What is a cold desert ? Describe the distribution pattern of cold desert species in India. How are cold desert areas afforested? [15 M].
2022	<ul style="list-style-type: none"> • What are the <i>major threats</i> to mangrove forests? (8 m) • Describe the <i>characteristics of cold desert</i>. How does choice of species play an important role in cold desert afforestation programme? How are cold desert areas afforested? (15 m) • Is coastal <i>rehabilitation using mangrove species</i> a success? Explain the plantation technique for degraded mangrove forest (10 m)
2021	<ul style="list-style-type: none"> • Why is it difficult to carryout <i>afforestation programmes</i> in cold deserts ? (8m). • What is the <i>ecological significance of cold deserts</i>? How do plants adapt and survive under cold and harsh desert conditions? Provide a list of common native species of a cold desert (15m). • What are the <i>characteristics and significance of mangrove forests</i> ? Discuss important species formation in mangrove forests (15 m).
2020	<ul style="list-style-type: none"> • Describe the <i>reforestation techniques of mangrove forests</i>. Explain the following mangrove habitats : (i) Deltaic mangrove habitat, (ii) Coastal mangrove habitat (15 m). • Describe the various causes of <i>degradation of mangrove forests</i>. Discuss the factors responsible for mangrove species regeneration and growth. Write the scientific names of five woody shrubs/tree species of cold desert (15m). • Write the adaptive <i>characteristics of plant species of cold desert</i> (8 m).
2019	<ul style="list-style-type: none"> • What are the <i>major causes of degradation of mangrove forest</i>? Discuss in brief the methods of rehabilitation of degraded mangroves (15 m). • What are the <i>characteristic features of cold deserts</i> of the Himalayas? Write the scientific names of <i>any 5 tree species</i> of cold desert (10 m).
2018	<ul style="list-style-type: none"> • Define the <i>characteristics of mangrove forest</i> (8m).
2017	<ul style="list-style-type: none"> • Describe the unique <i>characteristics of mangrove forest</i> vegetation (10 m). • Enlist <i>6 genera of mangroves</i>. Name 2 state and 1 UT with the large area under mangrove forest (8m). • <i>Where are cold desert</i> found in India ? explain <i>site characteristics</i> of cold desert and stem suggested to overcome problems in their afforestation (10 m).
2016	<ul style="list-style-type: none"> • Write the <i>scientific name of 5 trees / shrubs</i> each for the cold desert and mangrove forest (5- 5m) • Write the <i>characteristics of cold desert</i>. Discuss soil working and planting techniques for cold desert (8m).

2015	<ul style="list-style-type: none"> Discuss the <i>sustainable management of mangrove forest</i> in India (8 m). How is the accrual of <i>tangible and intangible benefits of mangroves forest</i> being affected by their degradation? (10 m) Give the scientific name of – (a) 5 species of mangrove forest, (b) Five tree/Shrub species of the cold desert (10 m). Comment upon the adaptation and <i>survival strategies of the plant species</i> endemic to the cold desert area of the western Himalaya (10 m).
2014	<ul style="list-style-type: none"> Discuss the <i>characteristics of mangrove forest</i> with examples (8m). Describe the following – (a), (b) <i>fish bone technique</i> (2.5m) Discuss the <i>importance of willow cultivation</i> in cold desert (8m).
2013	<ul style="list-style-type: none"> Explain the following mangrove habitat (8 m). <ul style="list-style-type: none"> (a) Deltaic mangrove habitat (b) Coastal mangrove habit (both east & west) What are the specific <i>problems of the wetland</i>? Suggest at least 3 species for planting in each of them [<i>Linked Q</i>]. Write about the species diversity and centre of origin of Willows (<i>Salix</i> species). Describe its various uses under short rotation forestry (8 m). <i>Willow is the life line in dry temperate region</i> (Lahul-Spiti) but its large-scale drying is causing great concern. Give your viewpoints (8 m).
2012	<ul style="list-style-type: none"> How are the mangrove forest managed in India? (5 m).
2011	<ul style="list-style-type: none"> Suggest measures to <i>rehabilitate degraded mangroves forest</i> (10 m). Define a forest types, Discuss the different <i>forest types found along tidal swamp forest</i> with their species composition. Give a note on how <i>rhizophora racemosa</i> in mangroves is managed in mangrove forest of Sundarbans.
2010	<ul style="list-style-type: none"> Comment on - Mangrove ecosystems have physiologically dry soil (5m) Give the zonation of land-sea interface in a typical mangrove eco-system with its characteristics How and why should cold desert forest ecosystem be conserved? (10 m)
2009	<ul style="list-style-type: none"> Describe the <i>characteristics of Mangrove Forest</i>. Explain the silvicultural system followed to manage the mangrove forest. Write short notes on - Cold desert (5 m).
2008	<ul style="list-style-type: none"> Discuss the <i>characteristics of cold desert</i> in India. Suggest any two species suitable for plantation in the cold desert, their importance and system of management (20m).
2007	<ul style="list-style-type: none"> Discuss the silvicultural system for managing mangrove forests of India
2006	<ul style="list-style-type: none"> How degraded mangrove formations can be rehabilitated. Discuss <i>afforestation of cold deserts</i> with suitable tree species



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 disastrous effects of storm surges, erosion, and floods. Some mangroves occur along open coasts, subject to moderate wave processes, while most of them grow in sheltered, muddy tracts that are either regularly or occasionally immersed by tides

Definition : Mangroves are a diverse group of *salt-tolerant plant communities* found in the *tropical and subtropical coastal* and *intertidal zone* of the world, occurring mainly between *latitudes 24° N and 38° S*.

1.1 HABITAT

- The intertidal zone of coastal and estuarine mudflats.
- Diurnal tidal inundation of marine water, making the soil loose, very wet, salty, and low in oxygen.
- The soil lacks minerals like nitrogen (N), phosphorus (P), potassium (K), iron (Fe), and sulfur (S).
- Area experiences strong winds from cyclones and tsunamis.
- The temperature ranges from 25-35°C, and there is 100 to 300 cm of rainfall annually
- Rich biodiversity because of the edge effect.



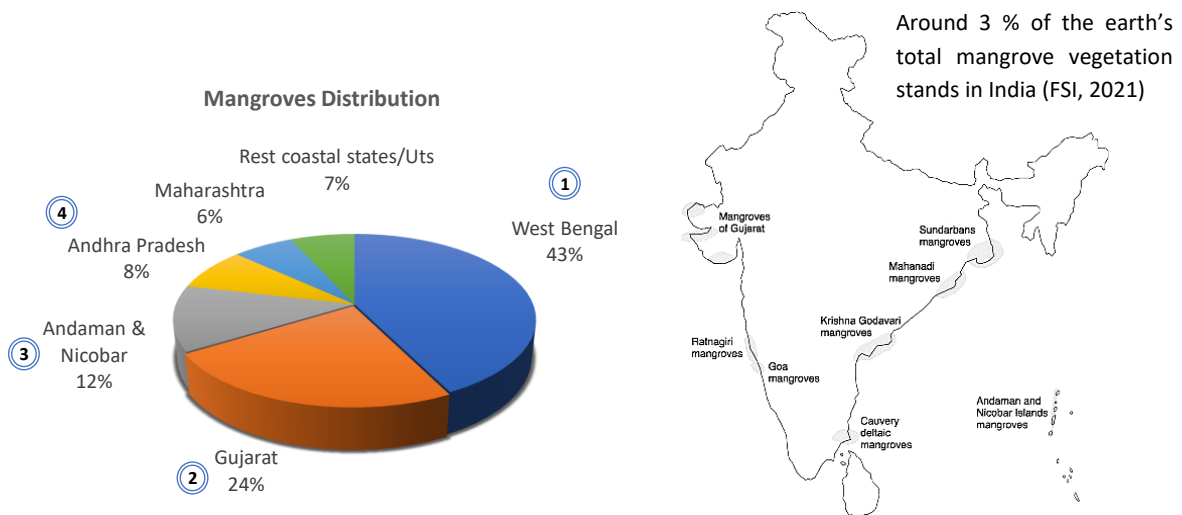
Figure 1.1 : Mangroves habitat

1.2 DISTRIBUTION

- ▶ **INDIA** : 4992 km², which is 0.15% of the country's total geographical area. *Very Dense mangrove* comprises 1476 sq. km (≈ 29.5%) of the mangrove cover, *Moderately Dense mangrove* is 1481 km² (29.7%), while *Open mangroves* constitute an area of 2036 km² (≈ 40%). There has been a net increase of 17 km² (1.1 %) in the country's mangrove cover compared to the 2019 assessment [*Data as per Indian state of forest report 2021*].

STATE/UTS-WISE : West Bengal = 2114 km² (42.5 % of total mangroves in India) > Gujarat = 1175 km² (23.66 %) > A & N = 616 km² (12.5 %). *South 24 Parganas* district of *West Bengal* alone accounts for *41.75 % Mangrove cover* of the country.

IFoS 2017 : Enlist 6 genera of mangroves. Name 2 state and 1 UT with the large area under mangrove forest [8m]. [OPSC Civil (Main) 2018, 2019].



WHY DO MANGROVES GROW MORE ON THE EAST COAST THAN THE WEST COAST EVEN THE EASTERN COAST FACE MORE STRONG DISTURBANCES LIKE CYCLONES, TSUNAMIS, ETC.?

Mangroves are more abundant on the east coast of India than on the west coast, despite the east coast facing stronger disturbances like cyclones and tsunamis. India has approximately 4,975 km² of mangrove vegetation. Of this, about 56% is found along the east coast, 31% along the west coast (Arabian Sea), and 12.5% on the Andaman and Nicobar Islands.

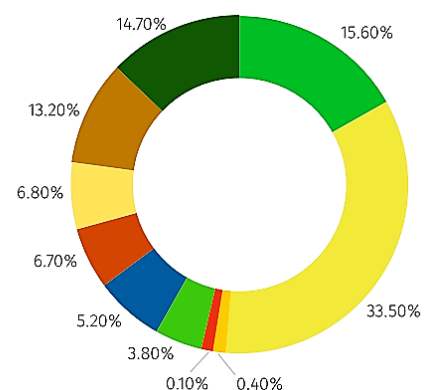
- The east coast of India features a widespread, nutrient-rich continental shelf formed by various rivers. providing more suitable shallow waters for mangrove growth. In contrast, the west coast lacks significant deltas with alluvial deposits. Instead, the west coast is characterised by funnel-shaped estuaries, backwaters, and creeks.
- The eastern coast of India has a smooth, gradual slope and a long coastline, providing a larger area for mangrove colonization. In contrast, the west coast has a steep, vertical slope.
- Mangroves thrive in areas with regular tidal inundation, which is more consistent on the east coast.
- The east coast has more brackish water areas where the salinity levels are optimal for mangroves. The mixing of fresh and saltwater creates ideal conditions for these plants.

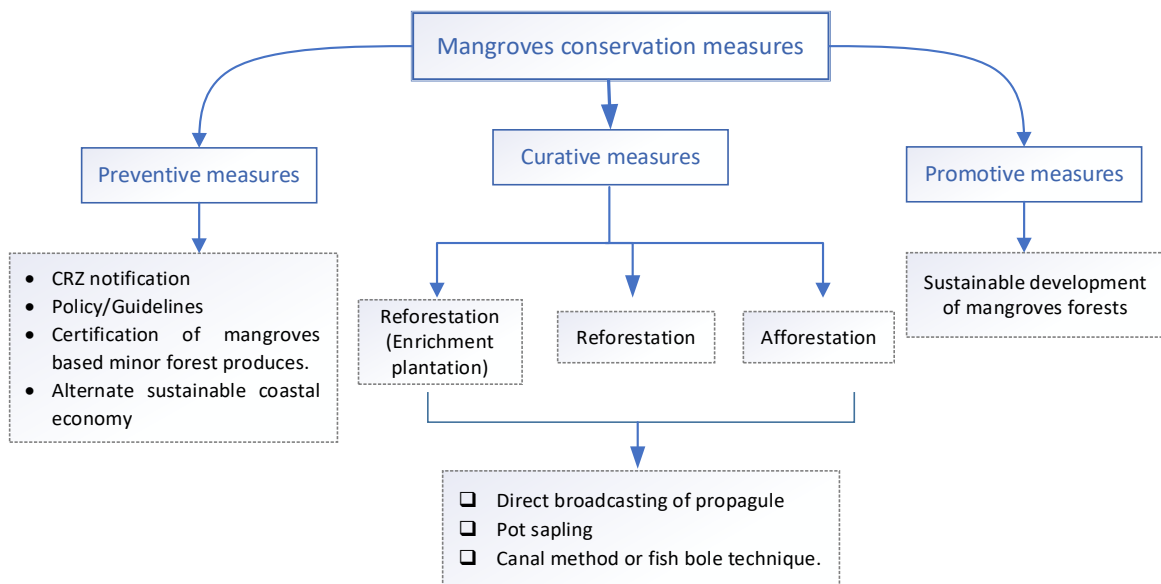
► **WORLD** : The total Mangrove cover in the world is *15 million ha*. which is 1% of the Tropical Forests of the World. Mangroves are primarily distributed over 123 countries and territories in the tropical and sub-tropical regions (between latitudes 24° N and 38° S). Asia has the largest extent of the world's mangroves.

About 40% of the world's Mangrove Cover is found in Southeast Asia and South Asia, followed by South America, North Central America, and West and Central Africa.

Figure: 3.1
World Mangrove Distribution
Total 150,000 sq. km.

- North and central America
- West and Central Africa
- South Asia
- Australia/New Zealand
- East and South Africa
- Pacific Ocean
- East Asia
- Middle east
- South East Asia
- South America





► AFFORESTATION

- Site selection
- Site preparation & Mapping
- Species selection
- Artificial regeneration : Rhizophora does not require any nursery. Small-seeded species like *Sonneratia* and *Avicennia* require a nursery because the water easily washes off their seeds. Spacing varies with species and its silvicultural characteristics. The standard spacing adopted is as follows -
 - * *R. apiculata* - 1.5 x 1.5 m
 - * *R. mucronata* - 1.8 1.8 m
- Aerial seeding of *A. alba* and *A. officinalis* are also carried out in mangroves which gave about 50% success in seedling establishment.
- Planting technique : Planting is done in the monsoon season. In low tidal zones, seedlings are planted at a spacing of 2 x 2 m. Rhizophora planted by crowbar hole planting or by manual pushing into the mud.
- Stacking, Beating up/refilling casualties.

IFoS 2023 : What are the sequences of operations followed in mangrove afforestation? Discuss in detail the *fishbone technique* of mangrove plantation [10 M].

IFoS 2023 : Is coastal *rehabilitation using mangrove species* a success? Explain the plantation technique for degraded mangrove forest (10 m)

IFoS 2020 : Describe the reforestation techniques of mangrove forests. Explain the following _____ (15 m).

IFoS 2014 : Describe fish bone technique (2.5 m)

IFoS 2011 : Suggest measures to rehabilitate degraded mangroves forest (10 m).

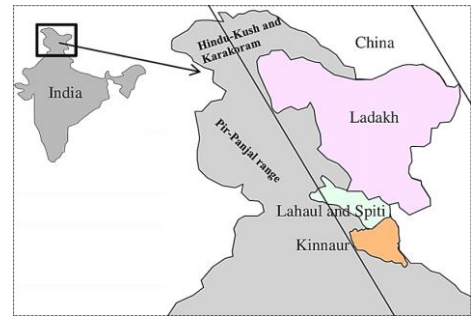
🌿 What are the characteristics and role of mangrove forest? Write down the methods of afforestation of degraded mangrove forest [OPSC Forest service (Main) 2015-16 | 20 m].

The cold desert is an area that experiences extreme cold weather and denuded terrain. It is also known as a 'temperate desert'. Cold deserts in India have been formed primarily due to the rain-shadow effects of the towering main Himalayan mountains wall, and its offshoot ranges run in an arcuate shape from the Indus gap to the Brahmaputra gap. Here, climate and soil are not suitable for plant growth. Hence land is barren of vegetation except for isolated, scattered, and overgrazed herbaceous shrubs.

2.1 DISTRIBUTION

There are two physiographic divisions of cold deserts in India –

- ▶ **The Trans-Himalayan zone** : about 2 % of the Geographical area forms a part of the Tibetan plateau, *i.e.*, Leh-Ladakh region, Lahul-Spiti Valley, and Pin Valley region of Himachal Pradesh.
- ▶ **Inner dry valleys** : smaller valleys within the main Himalayan range that lie in the rain shadow zone, *i.e.*, Kinnaur, Chamba (H.P.), Uttarkashi, Chamoli, Munsiri, Pithoragarh (U.K.), and Northern Sikkim.



IFoS 2017 : Where are cold deserts found in India? Explain site characteristics encountered in a cold desert and steps suggested to overcome problems in their afforestation (10).

2.2 HABITAT CHARACTERISTICS

- ▶ **HARSH CLIMATE** : Unlike other parts of the country, the cold deserts experience *two pronounced seasons, viz., summer and winter*. The summer usually begins around May and continues till September. Winter commences from November to early May.
 - Being a rain shadow area for both the monsoon and the monsoon depression, rainfall is very low (below 60 cm). The melting of snow is the only primary source of moisture.
 - The temperature is usually below 0°C.
 - Short growing season = 3 to 5 Months, mostly during summer season.
 - High insolation due to low thickness of the atmosphere.

IFoS 2019 : What are the characteristic features of cold deserts of the Himalayas? _____ (10 m).

IFoS 2017 : Where are cold deserts found in India? Explain site characteristics encountered in a cold desert and steps suggested to overcome problems in their afforestation (10 m).

IFoS 2016 : Write the characteristics of a cold desert. Discuss soil working and planting techniques for cold desert (8 m).

IFoS 2008 : Discuss the characteristics of cold desert in India. _____ (20 m).

SILVICULTURE SYSTEM

Paper – 1 | Section – A



EDITION : 2024

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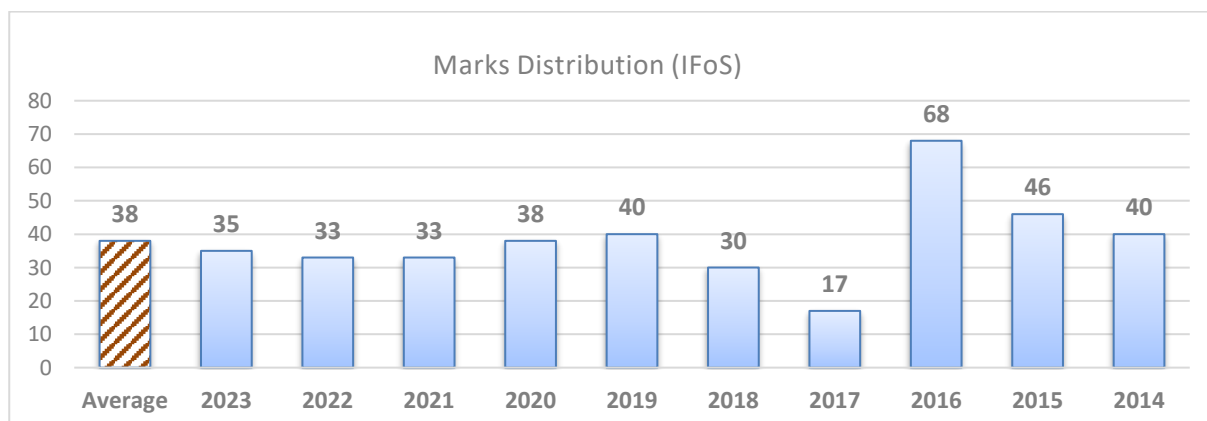
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SYLLABUS

Indian Forest Service (IFoS) [Paper 1 Section A]	<ul style="list-style-type: none"> ▪ SILVICULTURE SYSTEMS : Clear felling, uniform shelter wood selection, coppice and conversion systems, Management of silviculture systems of temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantation silviculture, choice of species, establishment and management of standards, enrichment methods, technical constraints, intensive mechanized methods, aerial seeding, thinning
Odisha PSC Civil service (Main) examination [Paper 1 Part B]	<ul style="list-style-type: none"> ▪ FOREST MANAGEMENT SYSTEM : Clear felling system, Uniform shelterwood system, Selection system. Coppice system - Single coppice, Coppice with Standard system, and Coppice with reserve system. Choice of silvicultural system - systems of management in important forest types.

SUBJECT INDEX

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INDIAN FOREST SERVICE (IFoS) PYQs [2010 to 2023]

2023	<ul style="list-style-type: none"> • What are <i>Accessory Systems</i>? Describe the two-storeyed high forest system [10 M]. • Who developed the <i>Andaman Canopy Lifting Shelterwood System</i>? Describe the different operations being followed in the system [15 M]. • What is <i>Clear Felling System</i>? Describe the pattern of felling and methods of obtaining regeneration under clear felling system [10 M].
2022	<ul style="list-style-type: none"> • <i>Improvement felling</i> is not considered as a silvicultural system. Why? (8m) • Differentiate between <i>coppice with standards</i> and <i>coppice with reserves</i>. Explain in detail the coppice with two rotations and pollard system (15 m) • Explain the following – (a) Selection felling, (b) Regeneration felling, (c) Selective felling, (d) Enrichment planting (10 m)
2021	<ul style="list-style-type: none"> • ‘An appropriate silviculture system promotes better regeneration of forest stand’ Comment (8m). • Elucidate the pattern of felling and mode of regeneration adopted under <i>selection system</i> of management (10 m). • What are the conditions on which the <i>choice of a particular silvicultural system</i> to be adopted for specific species in any locality depends? (15 m).
2020	<ul style="list-style-type: none"> • Explaining the factors which affect the <i>length of regeneration period</i> in a periodic block (8). • Define <i>coppice with standard</i> system. What are the advantages and disadvantages? Differentiate it from <i>coppice with two rotation system</i> (15 m). • Enumerate the objectives of <i>management of canal plantations</i>. Explain the silviculture system to manage them (15 m).
2019	<ul style="list-style-type: none"> • Write the special characteristics of <i>Indian Irregular Shelterwood System</i> and differentiate it from Uniform System (15 m). • “Felling height and felling intensity play a major role in the advantages sustainability of clumps of bamboo species” Comment (10 m). • Explain the <i>alternative strip system</i> and the clear strip system. Write the advantages and disadvantages of clear-felling system (15 m).
2018	<ul style="list-style-type: none"> • Enlist the <i>classification of silvicultural systems</i> on the basis of mode of regeneration and pattern of felling (15 m). • What is conversion? Discuss the need of conversion of one silvicultural system to another (15 m).
2017	<ul style="list-style-type: none"> • Enlist the general rules governing the felling of bamboo in forests. What are the consequences of gregarious flowering of bamboo? What special measures would you take in the event of gregarious flowering? (15 m)
2016	<ul style="list-style-type: none"> • Define <i>clear felling system</i>. How is Saransa sal (<i>Shorea robusta</i>) forest managed under clear felling followed by natural regeneration? (8) • Describe the silvicultural system which may be introduced to manage a plantation forest of <i>Azadirachta indica</i> (20M). • Discuss in brief the <i>Simple Coppice System</i>. Write different types of Coppice System (20). • Describe kinds and pattern of fellings followed in <i>Shelterwood Uniform System</i>. Explain

	Uniform System which is followed to manage (<i>Pinus roxburghii</i>) forests of Himachal Pradesh (20 M).
2015	<ul style="list-style-type: none"> Describe the major factors which affect the <i>length of the regeneration</i> period in a Periodic Block (8 m). Comment upon the variations practised in the silvicultural system of <i>Shorea robusta</i> in the States of UP, Bihar, Odisha and West Bengal (8 m). How can a forest with shade bearer and light demander tree species be managed under <i>Uniform Shelterwood System</i>? (10 M). Describe the silvicultural system which is introduced to manage <i>Shorea robusta</i> forest after the failure of Uniform System (10 M). How is <i>Tectona grandis</i> forest managed under <i>clear felling followed by artificial regeneration</i>? (10 m).
2014	<ul style="list-style-type: none"> Discuss the <i>uniform system with artificial regeneration</i> (10 m). Explain the forest conversion process of <i>coppice system to Uniform</i> broad-leaved high forest by natural regeneration (20 m). Discuss <i>two stories high forest</i> and explain its advantages (10 m).
2013	<ul style="list-style-type: none"> Explain the factors which affect the length of regeneration period in a Periodic Block. What is the effect of regeneration period on the form of crop? (8m). How is allotment of areas made in Permanent and Floating Periodic Blocks? (10 m). Describe the method followed to introduce the uniform Shelterwood System in a forest where <i>Cedrus deodara</i> is mixed with <i>Pinus wallichiana</i> (10 m). Write about the impact of felling height and felling intensity on the sustainability of bamboo's clump (10 m).
2012	<ul style="list-style-type: none"> Successful regeneration in a forest depends upon silvicultural. System. (5 m) How will. you classify a silvicultural system? Discuss important features of Uniform system with 'reference to <i>Pinus roxburghii</i> and give its merits and demerits (4+8+4 = 16) briefly describe the clear-felling silvicultural system with particular reference to – (a) Nature of crop produced, (b) Felling system, (c) Tending, (d) Regeneration, (e) Advantages and disadvantages (10 m).
2011	<ul style="list-style-type: none"> Define forest conversion. Explain the adverse situations under which conversion is advisable. Write in brief the general techniques of forest conversion (2 + 4 + 4 = 10 m). Briefly describe the selection system with particular reference to the following - (i) Character of crop produced, (ii) Felling cycle, (iii) Tending, (iv) Regeneration, (v) Advantages and disadvantages (2 × 5 = 10 m).
2010	<ul style="list-style-type: none"> Briefly discuss a silvicultural system in which equal or equi-productive areas of mature crops are successfully felled (5 m). Successful regeneration in a forest stand depends upon judicious choice of a silviculture system. Comment (10 m). Comment upon, Conversion” is an accepted silvicultural system (5 m).

SILVICULTURE SYSTEM

INTRODUCTION

Silviculture is the art and science of cultivating forest crops. It encompasses the natural laws governing tree and forest growth, the influence of environmental factors, and the techniques for both natural and artificial regeneration, as well as ongoing forest management.

Due to the diverse nature of forest types and their specific environmental conditions, a variety of silvicultural methods are required to effectively regenerate and manage different forest sub-types in varying locations. These specific methods or techniques are known as *Silvicultural Systems*.

- **SILVICULTURAL SYSTEM** : *a method of the silvicultural procedure worked out in accordance with accepted sets of silvicultural principles, by which crops constituting forests are tended, harvested and replaced by new crops of distinctive forms.*

OR

Silviculture system is a planned silvicultural treatment which is applied to a forest crop, throughout its life, so that it assumes a distinctive form. It begins with regeneration felling, tending the crop to its final felling.

✎ Silviculture system deals with the removal of a forest crop.

1.1 CLASSIFICATION

In India, silvicultural Systems have been classified primarily based on the ① mode of regeneration and then the ② pattern of felling.

HIGH FOREST SYSTEMS : All those silvicultural systems in which the regeneration is usually of seedling origin, either natural or artificial^{***} (or a combination of both). So, rotation is generally long. These are further classified based on the pattern of felling, which in turn, affects the concentration or diffusion of regeneration and characteristics of the new crop [Figure 1.1].

COPPICE SYSTEMS : In these silvicultural systems, the crop originates from coppice growth^{***}, leading to a shorter rotation period compared to high forest systems. Coppice systems are further categorized based on the pattern of felling into the

IFoS 2018 : Enlist the classification of silvicultural systems on the basis of mode of regeneration and pattern of felling (15 m).

Hints : For questions like this, we can start answer writing by defining the silviculture system as its introduction part (the most straightforward way), then classified it into two major groups based on regeneration (as per given 1st basis); The 1st one is High forest system, and another one is coppice system, then further divide them according to the mode of felling.

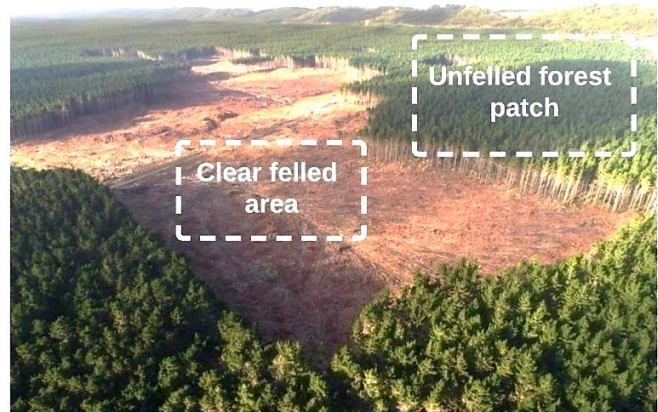
CLEAR FELLING SYSTEM

The Clear-felling system is defined as *a silvicultural system in which equal or equi-productive areas of mature crops are successively clear-felled in one operation and regenerated, most frequently, artificially but sometimes naturally*

- ✎ The area to be clear-felled each year in uniformly productive sites is $1/n$ of the total area allotted to this system, where n is the number of years in the rotation and is usually referred to as the **Annual Coupe*****

2.1 SPECIFICATIONS

- **Removal or felling of the mature crop** : The *coupe should be felled and removed in a single operation*. However, some mature trees may be retained as a frost protection measure or as insurance against failure, but their number should be minimal.



- Methods of obtaining regeneration :-

(a) **Artificial regeneration** : Primarily

achieved through artificial means, either by departmental plantations or through various Tungya methods (village Tungya, lease Tungya, departmental Tungya).

(b) **Natural regeneration** : Occasionally supplemented by seeds stored in the area or received from outside sources.

✎ The clear-felling system was introduced for the first time by **Heinrich Von Cotta** in Saxony (Germany).

- Tending : Employed as a crucial *tool to control weed growth* and its detrimental effects on plantation efforts. The frequency (Number) of weeding is determined by the growth rate and density of weeds, alongside the growth rate of the forest plants themselves. Cleaning, climber cutting, replacement of old casualties, thinning, etc. followed subsequently.
- Characteristics of the new crop : **Absolutely Even-Aged**. If there is no regeneration failure or forest fire accident, the system gives a *normal series of age gradation*.

2.2 ADVANTAGES

- It is one of the *simplest types of silviculture systems*. All things are removed in one operation. So, it does not require a *high degree of skill* in marking and cutting.



Cedrus deodara is mixed with *Pinus wallichiana* (10 m).

IFoS 2013 : Explain the *factors which affect the length of the regeneration period* in a Periodic Block. What is the effect of the regeneration period on the form of the crop? (8m).

IFoS 2013 : How is the allotment of areas made in *Permanent* and *Floating Periodic Blocks*? (10).

IFoS 2012 : How will you *classify a silvicultural system* ? Discuss important *features of Uniform system* with reference to *Pinus roxburghii* and give its *merits and demerits* (4+8+4 = 16).

IFoS 2010 : Briefly discuss a silviculture system in which equal or *equi-productive* areas of mature crops are successful.

IFoS 2009 : Comment upon '*Permanent* and *floating periodic blocks*.

IFoS 2009 : Explain terms – (1) Seeding felling, (2) Secondary felling, (3) Final felling

IFoS 2007 : Discuss the *salient features of shelterwood system* of forest management with its merits and demerits

IFoS 2006 : Explain the kinds and *pattern of felling in uniform system*.

IFoS 2005 : Describe different *kinds* and *pattern of felling*.

- ✿ Discuss natural regeneration under shelter wood system [OPSC Civil (Main) 2016].
- ✿ What are different systems of forest management discuss uniform system [OPSC Civil (Main) 2006].
- ✿ What is regular shelter wood system [MPPSC ACF 2017].

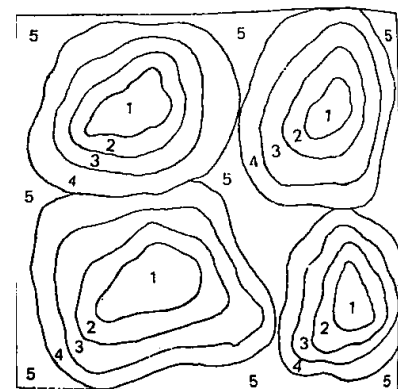
3.2 THE GROUP SYSTEM

A silvicultural system in which regeneration fellings, instead of being done uniformly all over the compartment, are *carried out in scattered groups*, either because of the presence of advance growth in those groups or to induce regeneration *denovo* so that these foci of regeneration can be enlarged centrifugally to merge with each other ultimately.

- ✗ This system was first developed by **Karl Gayer** in Bavaria (Germany).
- ✗ Also known as **Gayer's** or **Bavarian femelschlag**.

▷ PATTERN OF FELLING :

- Initial seedling felling done in the nuclei area to promote growth.
- At the time of secondary felling in *Ring no. 1*, seeding felling will be done in *Ring no. 2* to enlarge the nucleus.
- At the time of final felling in *Ring no. 1*, and secondary felling in *Ring no. 2*, seeding felling will be done in *Ring no. 3*.
- At the time of final felling in *Ring no. 2*, secondary felling will be done in *Ring no. 3* and a seeding felling in *Ring no. 4*.
- At the time of final felling in ring No. 3, secondary felling will be done in ring No. 4 and seeding felling in the area numbered as 5.
- After this, final fellings will be done in ring No. 4 and secondary felling in space No. 5.
- Ultimately final felling will be done in areas marked 5.



MANAGEMENT OF BAMBOO SYSTEM

Bamboo is considered minor forest produce and plays a crucial role in our national economy. It serves as the common man's timber, widely used in house construction and for numerous other purposes. Additionally, bamboo is a significant long-fibered cellulosic raw material for the paper and pulp industry. Among the more than 100 species of bamboo found in Indian forests, *Dendrocalamus strictus* stands out as the most important and widely distributed species.

- ▶ **Silviculture system** : As bamboo, fellings are done on a selection basis in such a way that the production of new culms takes place continually = **Culm Selection System**.

In some working plans, foresters also used the term "**Selection cutting**" combined with **Cleaning and Cultural Operations** for this, but it didn't get popularity.

- ▶ **Felling (cutting) cycle and felling rules** : Bamboos are generally worked on felling (cutting) cycles of **3 or 4 years**, and of these two, or four years is usually adopted in a central Indian forest. The felling rules vary from state to state. Here, we give standard felling rules that are used in north India.
 - Restriction on the cutting of one-year-old culms (In MP it's called *Kurla*, in UP *Nauda*), and sometimes even two-year-old (*Mahila*).
 - Retention of some older bamboo for support of immature culms.
 - Prohibition on the digging of rhizomes.
 - Regulation of the height at which bamboo should be cut. The minimum height at which the bamboo should be cut is generally 15 cm, with the condition that at least one node should be left. The maximum height varies from place to place, *i.e.*, **25 cm in U.P.** and 45 cm in M.P.
 - Insistence on cutting with a sharp instrument so that the stump does not split.
 - In the case of flowering, the bamboo should be cut only when the seed has been shed.
 - The period of working : in winter
- ▶ **Method of Regeneration** : by **Rhizomes**. New clumps are formed by natural **Seedlings** resulting after sporadic flowering. In the case of gregarious flowering, when all the clumps in the area die, regeneration comes up profusely from the seeds, so they need some protection against rodents before germination and against cattle grazing after germination.
- ▶ **Tending** : In fully developed clumps, bamboo does not require weeding and cleaning in the same sense as is required by tree species, as it grows very fast and attains its total height by the end of rains. But cleaning and tending of clumps have to be done to facilitate the growth of new culms. + in areas where natural seedlings appear gaps, gap-planting & three weeding also required for 1st year.
- ▶ **Character of the crop** : **uneven-aged** = Rhizome produces CULMS every year.

SILVICULTURE OF TREES

Paper - 1 | Section - A



EDITION : 2024

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SYLLABUS

<p>Indian Forest Service (IFoS) [Paper 1 Section A]</p>	<p>SILVICULTURE OF TREES : Traditional and recent advances in tropical silvicultural research and practices.</p> <ul style="list-style-type: none"> Silviculture of some of the economically important species in India such as <i>Acacia catechu</i>, <i>Acacia nilotica</i>, <i>Acacia auriculiformis</i>, <i>Albizia lebbek</i>, <i>Albizia procera</i>, <i>Anthocephalus Cadamba</i>, <i>Anogeissus latifolia</i>, <i>Azadirachta indica</i>, <i>Bamboo spp.</i>, <i>Butea monosperma</i>, <i>Cassia siamea</i>, <i>Casuarina equisetifolia</i>, <i>Cedrus deodara</i>, <i>Chukrasia tabularis</i>, <i>Dalbergia sissoo</i>, <i>Dipterocarpus spp.</i>, <i>Emblica officinalis</i>, <i>Eucalyptus spp.</i>, <i>Gmelina Arborea</i>, <i>Hardwickia binata</i>, <i>Lagerstroemia Lanceolata</i>, <i>Pinus roxburghii</i>, <i>Populus spp.</i>, <i>Pterocarpus marsupium</i>, <i>Prosopis juliflora</i>, <i>Santalum album</i>, <i>Semecarpus anacardium</i>, <i>Shorea robusta</i>, <i>Salmalia malabaricum</i>, <i>Tectona grandis</i>, <i>Terminalis tomentosa</i>, <i>Tamarindus indica</i>.
<p>Odisha PSC Civil service (Main) examination [Paper 1 Part A]</p>	<p>Silviculture of Tree species : Definition, objects of study, relation of silviculture with forestry and its branches.</p> <ul style="list-style-type: none"> Silviculture of important tree species such as <i>Acacia auriculiformis</i>, <i>Acacia nilotica</i>, <i>Leucaena leucocephala</i>, <i>Sesbania grandiflora</i>, <i>Cassia siamea</i>, <i>Eucalyptus spp.</i>, <i>Casuarina equisetifolia</i>, <i>Shorea robusta</i>, <i>Tectona grandis</i>, <i>Dalbergia sissoo</i>, <i>Gmelina arborea</i>, <i>Adina cordifolia</i>, <i>Melia azadirachta</i>, <i>Bambusa arundinacea</i>, <i>Dendrocalamus strictus</i>, <i>Terminaeia species</i>, <i>Albizia lebbek</i>, <i>Samanea saman</i>, <i>Lagerstroemia flosreginae</i>, <i>Salmalia malbarica</i>.

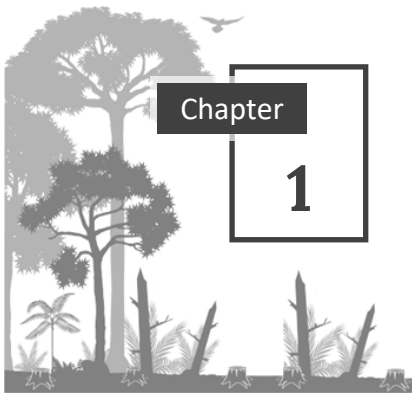
MODULE – 2 : INDIAN TREE SPECIES

SN	Chapter	Page No
1.	Introduction	73 – 75
2.	Peninsular tree species	76 – 90
3.	Tree species growing in North Indian plains	91 – 101
4.	Species of semi-arid tropics	102 – 105
5.	Exotic tree species	106 – 111
6.	Conifers	112 – 114
7.	Bamboo	115 – 117

INDIAN FOREST SERVICE (IFoS) PYQs [2008 to 2023]

2023	<ul style="list-style-type: none"> The shoot portion of seedlings of some tree species like <i>Sal</i> and <i>Sandal</i>, under natural regeneration, keeps on drying year after year but the roots remain alive. Discuss [Linked Q 8 M] Write the factors which affect the natural regeneration of <i>Sal</i> (<i>Shorea robusta</i>). Discuss the procedure to obtain natural regeneration of moist <i>Sal</i> forests [Linked Q 15 M]. Write the economic importance of the following tree species [15 M]. <ol style="list-style-type: none"> <i>Acacia catechu</i> <i>Casuarina equisetifolia</i> <i>Hardwickia binate</i> <i>Butea monosperma</i> <i>Tamarindus indica</i>
2022	<ul style="list-style-type: none"> Explain the techniques for the upgradation and hardening of nursery seedlings of <i>Lagerstroemia lanceolata</i> [Linked Q 8 M] How are nurseries classified in India? What is a clonal nursery? Explain the nursery technique for <i>Casuarina equisetifolia</i> [Linked Q 15 M]
2021	<ul style="list-style-type: none"> Discuss the phenology, Silvicultural characters and regeneration methods of – (i) <i>Gmelina arborea</i>, (b) <i>Pinus roxburghii</i> [15 M]. Elucidate the distribution, Nursery techniques and economic importance of – (i) <i>Cedrus deodara</i>, (ii) <i>Acacia catechu</i>, (iii) <i>Casuarina equisetifolia</i> [15 M].
2020	<ul style="list-style-type: none"> Describe the methods of artificial regeneration of <i>Tamarindus indica</i> [8 M]. Give a brief account of the silvicultural characters and regeneration methods for the following species - (a) <i>Acacia catechu</i>, (b) <i>Populus deltoides</i> [15 M].
2019	<ul style="list-style-type: none"> Write a brief account of the phenology, silvicultural characters and methods of regeneration of <i>Dalbergia sissoo</i> (8 m). Discuss in details silviculture of <i>Albizia lebbek</i> [15 M]. Give a brief account of origin and natural distribution of the following - (a) <i>Adina cordifolia</i>, (b) <i>Cedrus deodara</i> and (c) <i>Santalum album</i> [15 M].
2018	<ul style="list-style-type: none"> Discuss the physiology of <i>root parasitism</i> in sandal tree (8M). Write the <i>phenology</i> of the following (5M) – (a) <i>Tectona grandis</i>, (b) <i>Melia dubia</i>, (c) <i>Shorea robusta</i>, (d) <i>Cedrus deodara</i>. Give the <i>silvicultural characteristics</i> and <i>economic importance</i> of the following (10) <ol style="list-style-type: none"> <i>Azadirachta indica</i> <i>Acacia catechu</i>
2017	<ul style="list-style-type: none"> Describe the natural distribution of - <i>Shorea robusta</i>, and <i>Azadirachta indica</i>. (10 M). Write silvicultural characters of <i>Casuarina equisetifolia</i> and <i>Abies pindrow</i> (10 M).

2016	<ul style="list-style-type: none"> Describe in brief the distribution, phenology, silvicultural characteristics, artificial regeneration and uses of the following species - (a) <i>Tectona grandis</i> (2) <i>Santalum albus</i> [20m].
2015	<ul style="list-style-type: none"> Briefly Describe the silviculture characters and natural regeneration of the following – (a) <i>Dendrocalamus hamiltonii</i>, (b) <i>Acacia auriculiformis</i>, (c) <i>Dalbergia sissoo</i> [10 M]. Describe in brief the phenology, silvicultural characteristics and artificial regeneration of the following tree species – (a) <i>Pinus roxburghii</i>, (b) <i>Cedrus deodara</i>, (c) <i>Albizia lebbek</i> [10 M].
2012	<ul style="list-style-type: none"> Give <i>distribution, phenology, method of regeneration</i> and brief silvicultural management of two tree species belonging to each family below - (a) <i>Meliaceae</i> (b) <i>Papilionaceae</i>, grown in India [4 x 4 = 16 M]. Discuss in brief the <i>silviculture</i> of the following species - (a) <i>Shorea robusta</i> (b) <i>Bamboo species</i> [2 x 4 = 8 M].
2011	<ul style="list-style-type: none"> Describe the silvics of <i>Tectona grandis</i> under the following heads [5 x 4 = 20 m]. (a) Distribution and morphology, (b) Silvicultural characters, (c) Silvicultural system and management, (d) Utilization. Describe the silvics of <i>Casuarina equisetifolia</i> under the following heads [5x4 = 20]. (a) Ecology and distribution, (b) Propagation and management, (c) Functional uses, (d) Pests and disease.
2010	<ul style="list-style-type: none"> “Indian Sandalwood (<i>Santalum album</i>) is the most valuable wood in India. However, silvicultural production of this species is not satisfactory.” Discuss the above in relation to the phenology of <i>Santalum album</i> and the forest laws governing its cultivation and trade Give climatic requirement, rotation age, spacing, tending operations and yield of the following forest species – (a) <i>Populus deltoides</i>, (b) <i>Casuarina equisetifolia</i>.
2009	<ul style="list-style-type: none"> Write the phenology, regeneration and silviculture characteristics of any four of the following species (a) <i>Azadirachta indica</i>, (b) <i>Pinus roxburghii</i>, (c) <i>Tectona grandis</i>, (d) <i>Gmelina arborea</i>, (e) <i>Dendrocalamus hamiltonii</i> (4 x 10 = 40m).
2008	<ul style="list-style-type: none"> Narrate the silviculture practices followed in any four of the following – (a) <i>Santalum album</i>, (b) <i>Acacia catechu</i>, (c) <i>Shorea robusta</i>, (d) <i>Dalbergia latifolia</i>. (40 m). What is controlled burning? Discuss the advantages and disadvantages of burning in pine forests (10 m) [Linked Q].

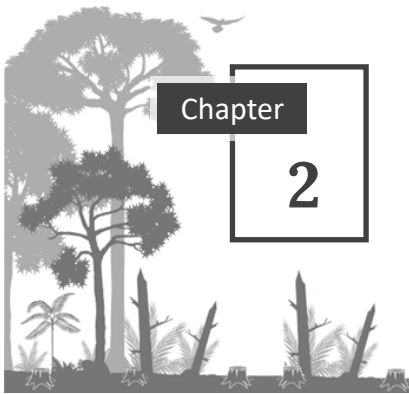


INTRODUCTION

There are 32 species listed in our IFoS syllabus, and in addition to these, we also need to discuss 4 or 5 more species to cover this section properly. However, we all have significantly less time to prepare for them one by one in a traditional, structured way, especially after the preliminary examination. Furthermore, if we do not study them properly, it can cause terrible confusion, with information about one species merging with another. To avoid this, we need to study all of them in groups by using some common characteristics.

1.1 A BASIC FRAMEWORK FOR THE STUDY OF EACH SPECIES

- ▶ **Scientific name**
- ▶ **Common name**
- ▶ **Family**
- ▶ **Distribution**
 - Distribution map [A map should be draw where you can]
 - Enlist all the locality factors that a species requires for its proper growth and development with some factual details, like -
 - Climatic factors**, *i.e.*, Rainfall (above 2000 mm rainfall), temperature, light demander, etc. **Edaphic factors**, *i.e.*, Soil type, well-aerated or poor water table, specific condition if any.
 - Topographic factors**, *i.e.*, Gentle slopes, altitude, etc.
 - Biotic factors**, *i.e.*, Forest types and associated species, wildlife, etc.
- ▶ **Phenology**
 - General description of the tree
 - Leaf fall & reappear season
 - Flowering season
 - Fruiting season
 - Seed collection, Good seed year
- ▶ **Silvicultural characters**
 - Coppicing, pollarding, root sucker's property.
 - Properties like light demander/shade bearer, Drought hardy/ Frost resistant, etc.
 - Biotic factors like damages caused by wild animals, Insect – pests and Parasitism (if any).
- ▶ **Natural regeneration**
 - **Seeds** :
 - **Vegetative** : Rhizome, Coppice, Propagule (Mangroves)



PENINSULAR TREE SPECIES



There is no any such classification that divides our trees into North Indian, South Indian, Himalayan Indian, etc. We are here creating this arbitrary to make the species easier to understand, remember, and reproduce in the main exam. Species that primarily grow in the peninsular region are :

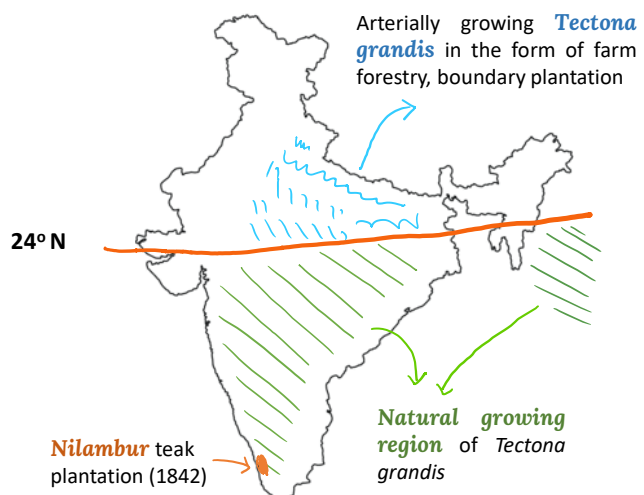
- ▶ *Tectona grandis* (Teak) & *Gmelina arborea* (Gamhari, Safed teak)
- ▶ *Albizia lebbek* (Kala Siris) & *Albizia procera* (Safed siris)
- ▶ *Santalum album*
- ▶ *Lagerstroemia Lanceolata*
- ▶ *Bombax Ceiba Syn. Salmalia malabaricum*
- ▶ *Butea monosperma*
- ▶ *Semecarpus anacardium*
- ▶ *Pterocarpus marsupium*

2.1 *Tectona grandis* (Teak)

- ▶ **Vernacular / Local Name** : Sagwan (Hindi), Sagaun (Kannada), Singuru (Oriya), Tekkumaram (Tamil)
- ▶ **Family** : Verbenaceae.
- ▶ **DISTRIBUTION** : Teak is a *Large, deciduous, and light-demanding* tree that naturally grows *below 24° North latitude* on the Indian peninsula and in Myanmar, where a warm tropical climate with *100–500 cm of rainfall* and temperatures ranging from *10°C to 40°C* provides the perfect growing conditions. Therefore, most of our teak forests are located in *Madhya Pradesh, Maharashtra, Karnataka, etc.,* where the tropical conditions are suitable for their strong light-demanding nature.

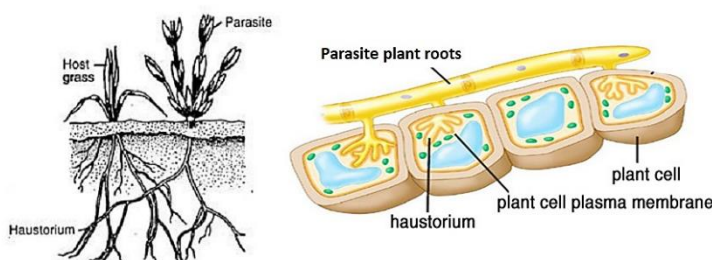
As market demand and popularity have increased, *block and boundary plantations* have become common in the North Indian plains. Teak trees can attain a *height of 40 meters* and a *girth of more than 1.5 meters*.

- **Climate** : Thrives best in a *fairly moist, warm tropical climate*.
- **Altitude** : Generally grows *below 800 meters*, but it may perform well up to 1200 meters in the Western Ghats.
- **Geology & soil** : Teak grows on a wide



Plants that derive their food from other plants or animals are known as *Parasites*, and the plants on which these parasites grow are called *Hosts*. The mechanism by which a parasite derives its food from the host is called *Parasitism*. For example, the sandalwood tree is a *partial root parasite* because it can photosynthesize its own food but siphon off a significant part of its water and inorganic nutrients (nitrogen and phosphorus) from host roots with the help of haustoria. This occurs due to the fewer number of root hairs in the sandalwood tree = Inadequate Nutrient and water absorption capacity.

This partial parasitism is an evolutionary adaptation that allows sandalwood to thrive in nutrient-poor soils where independent survival might be challenging [Survival Strategy].



- ***Haustoria*** : A *modified root structure* with the primary aim to attached and make cell sap connection with the host plant.
- The ***formation of haustoria*** is a multi-step process initiated by the recognition of a suitable host root by the sandalwood root. Chemical signals from the host plant play a role in attracting and guiding the sandalwood root towards the host. Once contact is established, the sandalwood root undergoes morphological changes, forming a swollen structure that develops into a haustorium.
- **Physiological Exchange** : Generally, the sandalwood draws water and nutrients from the host, while the host may experience reduced growth and vigour due to the loss of resources. The host plant responds to the parasitic attack by activating various defense mechanisms. These mechanisms may include the production of antimicrobial compounds, physical barriers, and changes in gene expression. However, the effectiveness of these defenses varies depending on the host species and its susceptibility to sandalwood parasitism.

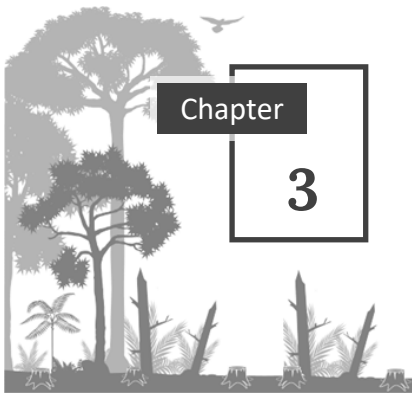
A high level of sandalwood plantations failed because of the absence of a host tree and shade during the early stages of growth. The faulty tending of such plantations also contributed to their widespread failure.



INVISIBLE KILLER THREATENS INDIA'S SANDALWOOD FORESTS

Dreaded Sandalwood Spike Disease has resurfaced, seriously infecting natural habitats in Karnataka, Kerala, say scientists.

Sandalwood Spike Disease (SSD) has been one of the major causes of the decline in sandalwood production in the country for over a century. With 1 to 5% of sandalwood trees lost every year due to the disease, scientists warn that it could wipe out the entire natural population if measures are not taken to prevent its spread. The current rapid spread of the infection is largely due to restrictions on **Green Felling** in forests, which have allowed vectors to spread the disease to healthy trees, according to an IWST study.



TREE SPECIES GROWING IN THE NORTH INDIAN PLAINS



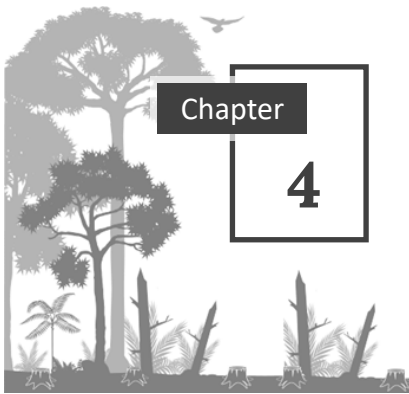
Species that are pre-dominant in the Indo-Gangatic planes are –

- Shorea robusta* (Sal)
- Dipterocarpus* spp.
- Dalbergia sissoo*
- Anogeissus latifolia*
- Tamarindus indica*
- Emblica officinalis*
- Hardwickia binata*
- Chukrasia tabularis*
- Terminalia tomentosa*
- Anthocephalus Cadamba* (Kadam)

3.1 *Shorea robusta* (Sal)

- ▶ **Common / Local Name** : Sal, Sakhu
- ▶ **Family** : Dipterocarpaceae.
- ▶ **DISTRIBUTION** : Sal is naturally grown above the tropic of cancer from Punjab to Assam Valley, where a warm Sub-tropical climate provides the best growing conditions.
 - **Climate** : 5°C - 40°C temperature
 - **Rainfall** : 100 – 300 cm
 - **Altitude** : up to 1000 meters.
 - **Geology & soil** : it favours growing under *sandy loam soil of Shivalik foothills to the quartzite of central India*. Does not thrive well over hard calcareous pan (Chambal ravines).
- ▶ **PHENOLOGY** : It is a strong *light demander*, *medium size* (10-15 m height), *deciduous tree* with a *round crown*, and a *clean bole*.
 - **Leaf-shedding** : In dry localities, leaf fall takes place in March. It is *relatively evergreen in moist/wet localities* as leaf shedding, and *renewable of new leaves come simultaneously*.
 - **New leaves** : Feb to May (Late in dry localities).
 - **Flowering** : February-April (Earlier in dry localities).
 - **Fruit ripening** : May–June.





SPECIES OF SEMI-ARID TROPICS

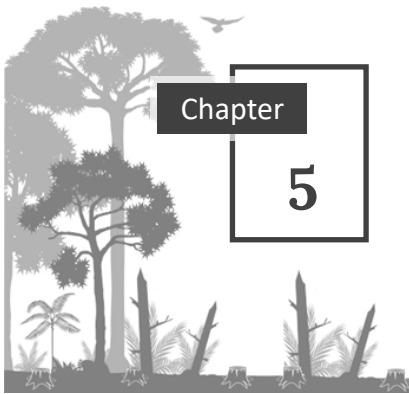


Species that are predominant in the Indo-Gangatic planes are –

- Acacia nilotica*
- Acacia catechu*
- Azadirachta indica*
- Prosopis juliflora*

4.1 *Acacia nilotica* (Syn. *Vachellia nilotica*)

- ▶ **Common / Local Name** : Babool, Gum Arabic tree, Desi babool
- ▶ **FAMILY** : Mimosaceae (Leguminosae).
- ▶ **DISTRIBUTION** : hardy to handle damages created by cracking's in black cotton soil, drought, and moderate frost, so, widely distributed over the North Indian plains, Rajasthan, MP, MH, etc.
 - **Climate** : Tropical dry deciduous and subtropical dry deciduous conditions.
 - **Rainfall** : 25 to 160 cm.
 - **Temperature** : 18 to 45° C
 - **Geology & Soil** : Alkaline to neutral, deep black, and fertile alluvial soil.
- ▶ **PHENOLOGY** : A *medium-size deciduous* tree with a *brood-shaped crown* and *thorny branches*. It attains a height of 20-25 m but may remain a shrub in poor growing conditions.
 - Leaf fall : April – May
 - Leaf renewal : May – June
 - Flowering : January to March
 - Fruiting : ripen in April – May
 - *Thorny branches*.
- ▶ **SILVICULTURAL CHARACTERISTICS**
 - Drought hardy.
 - Frost resistant
 - Light demanded
 - Poor copper
 - Root suckers ✓
- ▶ **NATURAL REGENERATION** : by seed + Coppice
- ▶ **ARTIFICIAL REGENERATION** : By direct seed sowing (Soaking in cold water for 48 hours at room temperature, or keeping the seeds in a moist cow dung heap for 2 to 3 days to remove seed coat dormancy).



EXOTIC TREE SPECIES



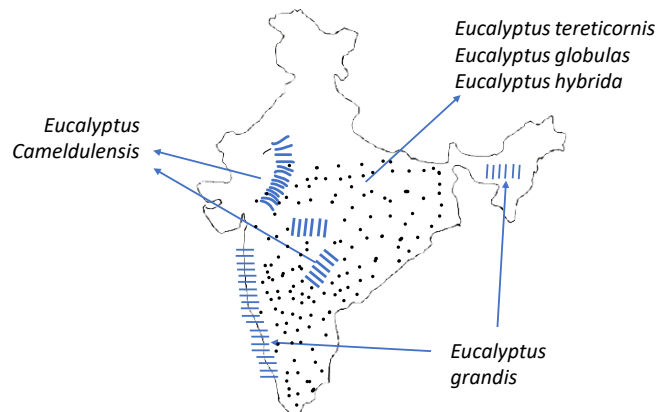
Species that are introduced in our country for Industrial, Commercial, aesthetic or any other purposes –

- Eucalyptus spp.*
- Populus spp.*
- Casuarina equisetifolia* (Kadam)
- Prosopis juliflora*
- Acacia auriculiformis* (Sal)

5.1 *Eucalyptus* species (Safeda, Nilgiri)

- ▶ **Vernacular / Local Name** : Nilgiri and Safeda. Individually, *Eucalyptus tereticornis* is known as *Mysore gum* while *Eucalyptus camaldulensis* is called *Red gum* or River red gum. *E. delgupta* = *Rainbow tree*.
- ▶ **FAMILY** : *Myrtaceae*.
- ▶ **NATIVE** : Australian
- ▶ **DISTRIBUTION** : *Eucalyptus* is not confined to any particular geographical locality. However, species like *E. cameldulensis* that can sustain under semi-arid conditions popularly growing in the semi-arid region of Rajasthan, Telangana, and the Vidarbha region of Maharashtra, where water scarcity is an emerging issue.

Species	Distribution
<i>E. hybrid</i> , <i>E. tereticornis</i> , <i>E. globulus</i>	≈ weather, pan India
<i>E. cameldulensis</i>	In Semi-arid region
<i>E. Grandis</i>	In High rainfall area



- ▶ **PHENOLOGY** : A fast-growing, Medium-Large sized (20 to 50 m height and up to 2 m girth), Evergreens, light demander species.
 - Flowering : July – August
 - Fruiting : September – October
- ▶ **SILVICULTURAL CHARACTERISTICS** : It is a *light demander*, *Large size* (15-20 m height), *deciduous tree* with *Cylindrical crown*, and inability to tolerate much shade.
 - **Wind firm**
 - Root system : fairly **widespread root system**, both vertically and horizontally.
 - Moderately drought and salt tolerance.



CONIFERS

Species that are growing inside the Himalayan Mountain range –

- Pinus roxburghii*
- Cedrus deodara*
- Abies pindrow* [Not in the syllabus]

6.1 *Pinus roxburghii* (Chir pine)

- ▶ **FAMILY** : Pinaceae
- ▶ **DISTRIBUTION** : the Chir-pine is distributed over the outer Himalayan ranges (Shivalik's foothills) from Jammu and Kashmir to Bhutan.
 - **Climate** : Sub-tropical habitat, the maximum temperature range from 33°C to 40°C and the minimum temperature is about 4°C.
 - **Annual rainfall** : 100 to 300 cm.
 - **Soil** : prefer quartzite-sandstone-mica schist soil.
- ▶ **PHENOLOGY**
 - **Leaf shedding** : new leaves come in January and persist for the next 16 to 26 Months.
 - **Male flower** : occurs in the form of inflorescence which is 6 to 10 cm long and 3 to 5 cm in diameter.
 - **Female flower** : occurs either solitary or in pairs, begins to appear from February
 - Pollination takes place in between February to April depending upon the local climate.
- ▶ **SILVICULTURAL CHARACTERISTICS**
 - **Light** : Strong light demander and attains best growth under conditions of overhead light.
 - **Wind** : The root system is extensively developed both horizontally as well as vertically. So, by large, Chir-pine is a wind firm.
 - Frost hardy species
 - Chir-pine did not face heavy snowfall.
 - Fire hardy due to thick corky bark
- ▶ **NATURAL REGENERATION** : by seed
- ▶ **ARTIFICIAL REGENERATION** : by (1) Direct seed sowing, (2) Planting, etc.
- ▶ **UTILIZATION** : Furniture manufacturing, Packaging cases, house construction, railway sleepers, and the important source of resin.

AGRO-FORESTRY, & SOCIAL-FORESTRY

Paper - 1 | Section - B



EDITION : 2024

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SYLLABUS

<p>Indian Forest Service (IFoS) [Paper 1 Section B]</p>	<ul style="list-style-type: none"> ▶ AGROFORESTRY – Scope and necessity; role in the life of people and domestic animals and in integrated land use, planning especially related to (i) soil and water conservation; (ii) water recharge; (iii) nutrient availability to crops; (iv) nature and eco-system preservation including ecological balances through pest-predator relationships and (v) Providing opportunities for enhancing biodiversity, medicinal and other flora and fauna. Agroforestry systems under different agro-ecological zones; selection of species and role of multipurpose trees and NTFPs, techniques, food, fodder and fuel security. Research and Extension needs. ▶ SOCIAL / URBAN FORESTRY - Objectives, scope and necessity; People's participation.
<p>Odisha PSC Civil service (Main) examination [Paper 1 Part A]</p>	<ul style="list-style-type: none"> ▶ AGROFORESTRY : concepts, classification, scope and management; Agroforestry systems under different agroecological zones, selection of species and role of multipurpose trees and Non wood Forest products. Food, folder, and fuelwood security, Research and extension needs; ▶ FARM FORESTRY ▶ SOCIAL FORESTRY : Objectives, scope and benefits
<p>Himachal PSC Civil Service (Main) Examination [Paper 1]</p>	<ul style="list-style-type: none"> ▶ SOCIAL FORESTRY – definition scope and objectives. Role of social forestry in meeting energy, small timber requirement of rural India, environment amelioration, water regulation and checking of erosion. Place of social forestry in the National Forest Policy. Species for social forestry plantation. <i>Social forestry in Himachal Pradesh.</i>

AGROFORESTRY, & SOCIAL FORESTRY

Agroforestry		
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Social Forestry		
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INDIAN FOREST SERVICE (IFoS) PYQs [2008 to 2022]
AGROFORESTRY

2023	<ul style="list-style-type: none"> • Explain the role of windbreaks and shelterbelts in Agroforestry. Name two tree species for each [8 M]. • Discuss the role of Agroforestry in the well-being of mankind [15M].
2022	<ul style="list-style-type: none"> • What are the differences between traditional agroforestry and ethno-agroforestry? Explain in brief, below-ground and above-ground, tree-crop interactions in agroforestry systems (20 m) • What are the constraints in the value chain under industrial agroforestry? (10 m) • How does agroforestry help to achieve the United Nations' Sustainable Development Goals? (8 m)
2021	<ul style="list-style-type: none"> • How do agroforestry wood perennials protect the understorey crops? (8m) • How does agroforestry promote the sustainable livelihood of marginal farmers? (10 m) • How does crop rotation and mixed farming improve soil productivity? (15 m)
2020	<ul style="list-style-type: none"> • “Agroforestry system conserves soil and moisture” Justify the statement (8m). • Write the <i>tangible and intangible benefits</i> of agroforestry (8m). • “<i>Taungya cultivation</i> is a type of traditional agroforestry system” Justify the statement (15 m). • Write the scientific names of any five multipurpose tree species suitable for agroforestry system in (i) Arid and semi-arid and (ii) Sub-tropical Hills of India (10 m). • How does shifting cultivation support community livelihood and biodiversity conservation? (8m).
2019	<ul style="list-style-type: none"> • Agroforestry is a better land-use system for <i>climate change mitigation</i> and adaptability. Justify (8 m). • What are MPTs ? explain their role in social forestry (10 m).
2018	<ul style="list-style-type: none"> • Write about the <i>diagnostic and design</i> survey of agroforestry. Can it help the farmers in the integration of tree with crops to enhance the crop productivity in agroforestry system? Justify (10 m).
2017	<ul style="list-style-type: none"> • Discuss the impact of <i>agroforestry</i> practices on the environment in general and on soil properties in particular, with a suitable example (8 m). • Differentiate between <i>Windbreaks</i> and <i>Shelterbelts</i>. Discuss in brief, their impact on the environment (10m).

2016	<ul style="list-style-type: none"> Discuss the role of <i>agroforestry</i> in nutrient cycling and soil conservation. How is saline soil reclaimed? (20 m)
2015	<ul style="list-style-type: none"> Discuss the needs and <i>scope</i> of <i>agro-forestry</i> for the benefits of people (8 m) Elaborate upon the <i>social objectives</i> of agroforestry (8m). The adoption of agroforestry practices by the farming community is the result of increasing human and cattle populations. Discuss (10 m). Outline the role of <i>tree architecture</i> in agroforestry (10 m).
2014	<ul style="list-style-type: none"> Describe the <i>benefits</i> and <i>constraints</i> of <i>agroforestry</i> (8 m). Why are agroforestry systems becoming popular in Himalayan <i>Tarai regions</i>, Western plains and Southern parts of India? Discuss your answer with reasons and tree-crop combinations adopted in these regions and parts of the country (20 m).
2013	<ul style="list-style-type: none"> What are the unique <i>requirements for tree improvement</i> in agroforestry? (8m). Describe tree-crop <i>allelopathy</i> in agroforestry (8m). What are the fundamental bases of <i>classification</i> of agroforestry systems? (10 m).
2012	<ul style="list-style-type: none"> How <i>shelterbelt</i> and <i>windbreaks</i> are helpful in sand dune stabilization and desert control ? (5m). What do you know about <i>recent progress in Agroforestry</i> research and development in our country for sustainable development? (5m). what is <i>D & D</i> ? Who can make use of <i>D & D</i> and How? (10 m).
2011	<ul style="list-style-type: none"> While <i>selecting the species</i> for agroforestry, the below-ground and above ground interaction between the component species need to be considered. Discuss (10 m). Write short notes on – (i) <i>Aquaforestry</i>,..... (iv) <i>Home gardens</i> (2 ½ × 2 = 5 m). Explain the various components of a <i>hydrological model</i> for an agroforestry system (10m). Compare <i>nutrient cycling</i> in a natural forest, an agroforestry system and an agriculture field. Discuss how it helps to sustain soil fertility (10 m).
2010	<ul style="list-style-type: none"> Comment on - The needs of research in Agroforestry in India. Explain diagnosis and design in Agroforestry.
2009	<ul style="list-style-type: none"> Describe the traditional Agroforestry system practised in North-East India (10m). Write the Scientific name of 10 Multipurpose tree species (MPTs) commonly planted in social forestry (10 m). Define Agroforestry. Describe an agroforestry model suitable to rehabilitate degraded hills. Discuss the gains of Agroforestry system (2+10+8 = 20). Write short-notes on – Agro-ecological zone (5m).

2008	<ul style="list-style-type: none"> Differentiate between Windbreaks and shelterbelts. Give design and layout of windbreaks and shelterbelts. Suggest suitable tree species with their characters (20m).
------	--

SOCIAL FORESTRY

2022	<ul style="list-style-type: none"> Discuss the key problems to expand tree cover in urban areas. Explain the role of urban trees in abating soil pollutants (15 m).
2021	<ul style="list-style-type: none"> Discuss the problem of commons in social forestry. Suggest some effective strategies to overcome these problems (15 m).
2019	<ul style="list-style-type: none"> Briefly describe the <i>Aim, objectives and scope</i> of urban forestry in India (8 m).
2018	<ul style="list-style-type: none"> What is <i>farm forestry</i>? Write about the objectives, difficulties and financial return from the farm forestry (10 m).
2017	<ul style="list-style-type: none"> Explain the scope and aims of <i>Urban forestry</i>. Discuss the need of urban forestry in the improvement of city environment (20 m).
2016	<ul style="list-style-type: none"> Briefly discuss aims, objectives and scope of <i>social forestry</i>. Why is people's participation must in social forestry? (10m).
2012	<ul style="list-style-type: none"> How <i>social forestry</i> differs from other types of forestry? (5m).
2011	<ul style="list-style-type: none"> Management <i>challenges in the urban forestry</i> are unique as compared to other social forestry programs. Discuss (10m).
2010	<ul style="list-style-type: none"> <i>Drawback of social forestry programs</i> in India. Short notes on – management of urban forestry.
2009	<ul style="list-style-type: none"> Discuss various approaches required to motivate the members of a tribal community to introduce social forestry plantation in their farmland (10 m)
2008	<ul style="list-style-type: none"> What is extension forestry ? List constraints in obtaining people participation in social forestry (10).

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CHAPTER

1

AGROFORESTRY

[INTRODUCTION]

Agroforestry is a collective name for sustainable land-use systems involving trees combined with crops and/or animals on the same unit of land. It combines the -

- The production system of food crops with protection covers of trees especially in fragile ecosystems.
- Emphasis on the use of indigenous trees has multi-purpose uses (MPFTs) and High yield short rotation (HYSR) tree varieties.
- It is structurally and functionally more complex than monoculture.
- It also provides alternative investment opportunities with insurance coverage that if our main agricultural crops fail, we still have the trees covered to sell them and sustain their house economy.
- This concept is based on our ancient tradition and Socio-cultural values, to grow trees on the boundaries of the farm, protect them and harvest them at a necessary point in time to reduce village dependency on the Forest.

- **DEFINITION** : Agroforestry is a sustainable land-use system that maintains or increases total yields by combining food crops (annuals) with tree crops (perennials) and/or livestock on the same unit of land, either alternately or at the same time while using management practices that suit the local social-cultural characteristics of society and Economic and ecological conditions of the area.

Remember "Crop + Tree ± Domestic animals". 1st two are the essential requirement, 3rd component is optional it may be present or absent.

Nair (1979) defines agroforestry as a land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers

Land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers [**Bene, et.al.**]

► **ATTRIBUTES OF AGROFORESTRY**

Productivity : maintain or increase the production of preferred crops & productivity of the soil.

Sustainability : By conserving the production potential of the resource base, mainly through the beneficial effects of woody perennials on soils; **Cornerstone of agroforestry**]

Adaptability : The word "adopt" here means "accept" (not "modify" or "change). The implication here is that improved or new agroforestry technologies that are introduced into new areas should also conform to local farming practices.

- **SCOPE/NECESSITY** : Agroforestry has an excellent scope in the context of Indian Agriculture due to its intrinsic relation with traditional agricultural practices. Agroforestry practices are beneficial in –



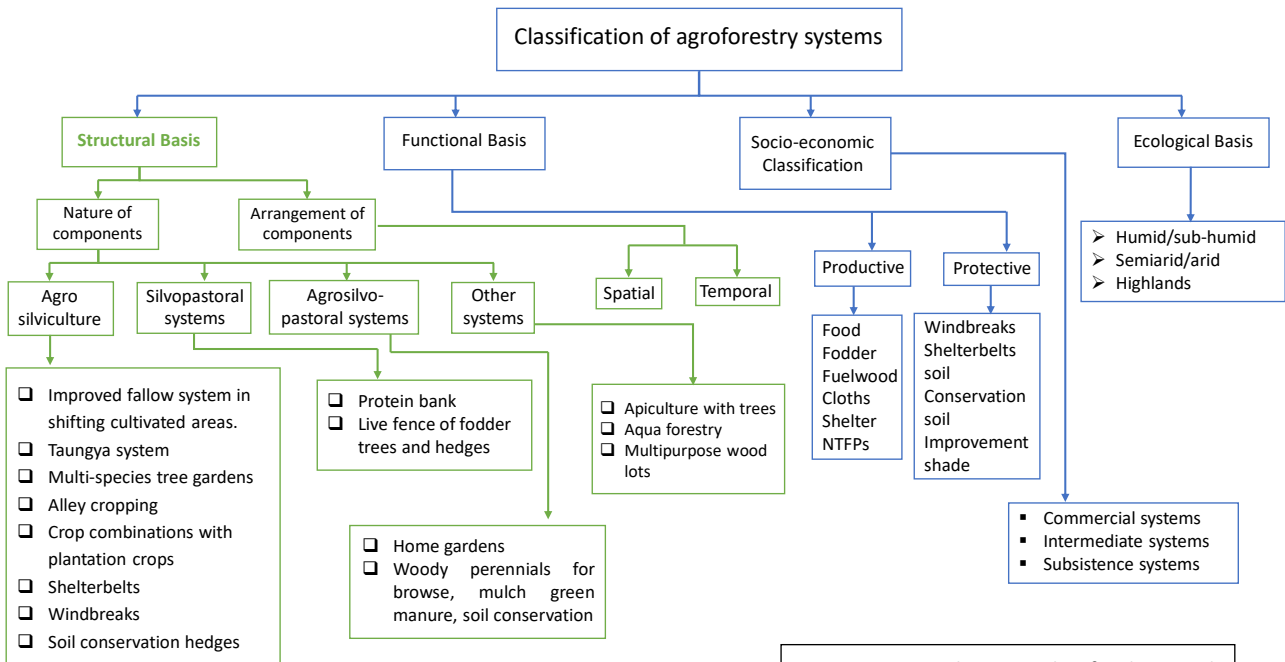
CHAPTER
2

CLASSIFICATION OF AGROFORESTRY

According to **Nair** (1987), the Agroforestry system can be classified according to the following four bases -

- ▶ Structural Basis
- ▶ Functional basis
- ▶ Socio-economic Basis
- ▶ Ecological basis

Tejwani (1994) Classified Agroforestry systems into (1) Structural Basis, (2) Functional basis, (3) Socio-economic Basis, (4) Ecological basis, and (5) Physiognomic basis.



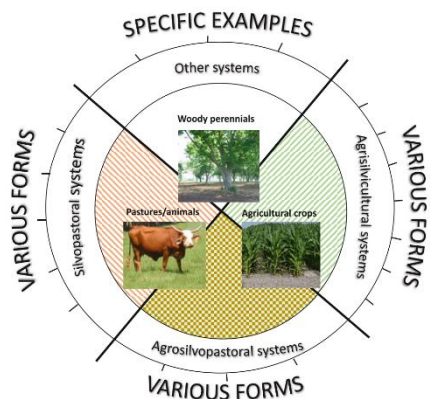
IFoS 2013 : What are the fundamental bases of the **classification** of agroforestry systems? (10 m).

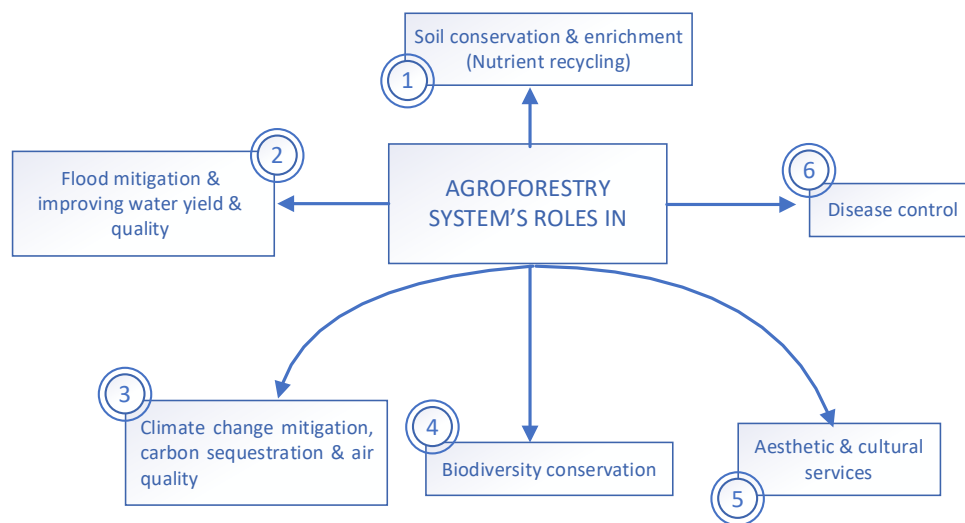
2.1 | STRUCTURAL CLASSIFICATION

Based on the types of components and their arrangements, it is further divided into – (a) the nature of the component, and (b) the arrangement of components.

2.1.1 | NATURE OF COMPONENT

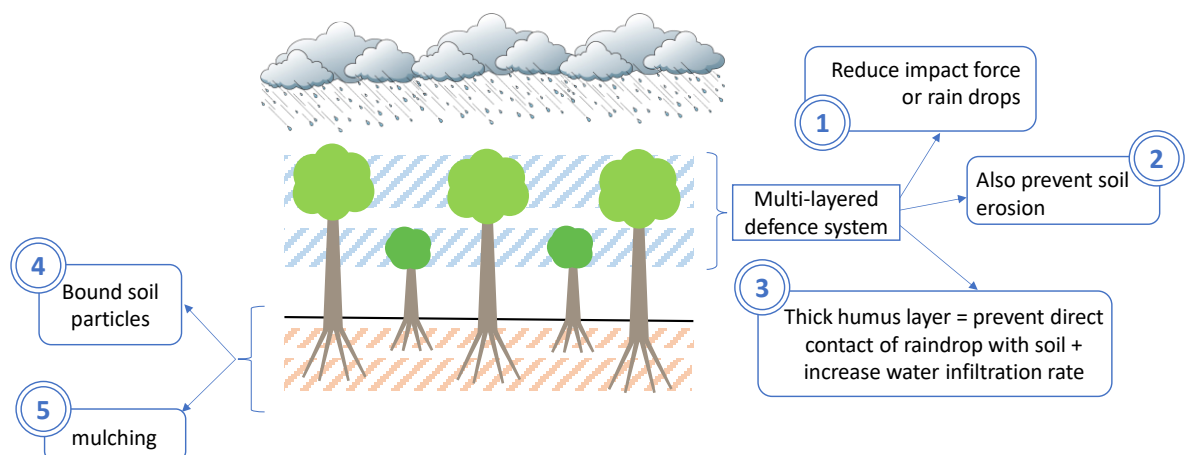
(1) Agri-silviculture system, (2) Silvi-pasture, (3) Agro-Silvi-pasture, and (4) other systems.





► **ROLE OF TREES IN SOIL CONSERVATION** : Trees play an important role in soil and water conservation by providing *multi-layered defence* against the impact of raindrops and strong winds.

- Different layers of the canopy progressively reduce the force of the raindrops and wind pressure. Furthermore, the bulk of leaves litters, and organic matter on the soil surface act as a cushion against soil erosion and increase water infiltration time.



- In the root zone, the framework of roots tightly bonded the soil particles that stabilized the soil structure.
- Added a significant amount of above-ground and below-ground organic matter, looting soil and improving soil physical and biological properties.



CHAPTER

7

DIAGNOSIS & DESIGN

Diagnosis and Design (D & D) is a methodology for diagnosing land management problems and the design of agroforestry solutions. It was developed by ICRAF (by J. B. Raintree) to assist agroforestry researchers and development field workers in planning and implementing effective research and development projects.

► PURPOSE/GOALS

- To describe and analyse the existing land use system
- To design appropriate agroforestry technologies to alleviate those constraints.
- To design appropriate research work, such as trials and surveying.

► THE KEY FEATURES OF THE D & D

- **Flexibility** : in procedure & adaptability so adapted to fit the needs and resources of different users.
- **Speed** : D a 'rapid appraisal' application at the planning stage of a project with in-depth follow-up during project implementation.
- **Repetition** : D&D is an open-ended learning process. Since initial designs can almost always be improved, the D&D process need not end until further improvements are no longer necessary.

► CRITERIA OF A GOOD AGROFORESTRY DESIGN : There is no substitute for good design. A good agroforestry design should fulfil the following requirements -

- **Productivity** : it should improve net productivity from a unit area with its protective role. With this increased output of tree products, improved yields of associated crops, reduction of cropping system inputs, increased labour efficiency, diversification of production, the satisfaction of basic needs, and other economic efficiency measures or achievement of biological potential.
- **Sustainability** : it has to improve the sustainability of production systems and their conservation role to motivate low-income farmers, who may not always be interested in conservation for its own sake.
- **Adaptability** : No matter how technically elegant or environmentally sound an agroforestry design may be, nothing practical is achieved unless its intended users adopt it. This means that the

IFoS 2018 : Write about the **diagnostic and design** survey of agroforestry. Can it help the farmers in the integration of tree with crops to enhance the crop productivity in agroforestry system? Justify (10 m).

IFoS 2012 : what is **D & D** ? Who can make use of D & D and How? (10 m).

IFoS 2010 : Explain diagnosis and design in Agroforestry.

IFoS 2005 : Short notes on **D & D** In the agroforestry system (8 m).

🌿 Explain D and D exercise in agroforestry? Discuss the criteria of a good agro-forestry model [OPSC Civil (Main) 2017].

🌿 What is diagnosis and design (D&D) methodology in agroforestry and explain the different procedures in it.

🌿 Explain the procedure for diagnosis and design of agroforestry [Arunachal PSC Civil (Main) 2017-18].

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