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INDIAN FOREST SERVICE

INDIAN FOREST SERVICE

2025 - 26

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

Module - 2

◎ Mangroves Forest

◎ Cold desert vegetation

◎ Silviculture System

   ➤ Clear felling system

   ➤ Shelterwood System

   ➤ Selection System

   ➤ Accessory, Coppice & other Systems

◎ Important Indian Tree Species

◎ Agroforestry

   ➤ Agroforestry policy 2014

   ➤ Social Forestry

   ➤ Urban Forestry

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11 Out of **12** Total Selections in

Assistant Conservator of Forest (ACF) – 2023

Module - 2

CONTENTS

Mangroves & Cold Desert

Paper - 1 | Section - A

Hornbill
classes

EDITION : 2025

SYLLABUS

|	
Indian Forest Service (IFoS) [Paper 1 | Section A] **Jharkhand PSC ACF & RFO (Main) 2024**	*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.
Odisha PSC Civil service (Main) examination [Paper 1 | Part A]	*Forest classification and distribution* : Mangrove forest.

MODULE - 2 | MANGROVES & COLD DESERT

INDIAN FOREST SERVICE (IFoS) PYQs | 2010 – 2024

2024	• Briefly summarize the *Characteristic Features* of cold arid forest vegetation. Discuss their mechanism of survival under extreme cold temperatures [P1/1(b) | 8 M]. • Write in brief on the current scenario of the growth pattern of cold desert areas in India. Describe in detail, the *Causes of Desertification in cold areas*. Suggest suitable restoration plan [P1/2(b) | 15 M]. • What is the *Status of Mangrove Forests* in India? How are they associated with the sustainability of coastal areas? Enumerate the list of challenges faced by mangroves [P1/4 (a) | 15 M].
2023	• What are mangroves? Write their ecological implications [P1/1(c) | 8 M]. • What are the sequences of operations followed in mangrove afforestation? Discuss in detail the *Fishbone Technique* of mangrove plantation [P1/3(b) | 10 M]. • What is a cold desert? Describe the *Distribution Pattern* of cold desert species in India. How are cold desert areas afforested? [P1/4(a) | 15 M].
2022	• What are the *Major Threats* to mangrove forests? [P1/1(b) | 8 M]. • Describe the *Characteristics of Cold Desert*. How does choice of species play an important role in cold desert afforestation programme? How are cold desert areas afforested? [P1/2(b) | 15 M]. • Is coastal *Rehabilitation* using mangrove species a success? Explain the plantation technique for degraded mangrove forest [P1/3(c) | 10 M].
2021	• Why is it difficult to carryout *Afforestation Programmes* in cold deserts? [P1/1(a) | 8 M]. • What is the *Ecological Significance* of cold deserts? How do plants adapt and survive under cold and harsh desert conditions? Provide a list of common native species of a cold desert [P1/2(a) | 15 M]. • What are the *Characteristics and Significance* of mangrove forests ? Discuss important species formation in mangrove forests [P1/3(b) | 15 M].
2020	• Write the adaptive *Characteristics* of plant species of cold desert [*Linked* Q | P1/1(d) | 8 M]. • Describe the *Reforestation Techniques* of mangrove forests. Explain the following mangrove habitats : (i) Deltaic mangrove habitat, (ii) Coastal mangrove habitat [P1/2(b) | 15 M]. • Describe the various causes of *Degradation* of mangrove forests. Discuss the factors responsible for mangrove species regeneration and growth. Write the scientific names of five woody shrubs/tree species of cold desert [P1/4(c) | 15 M].
2019	• What are the *Major Causes of Degradation* of mangrove forest? Discuss in brief the methods of rehabilitation of degraded mangroves. [P1/3(c) | 15 M]. • What are the *Characteristic Features* of cold deserts of the Himalayas? Write the scientific names of *any 5 tree species* of cold desert. [P1/2(b) | 10 M].
2018	• Define the *Characteristics* of mangrove forest [P1/1(d) | 8 M].

2017	• Describe the unique *Characteristics* of mangrove forest vegetation. [P1/4(a)	10 M]. • Enlist *6 Genera of Mangroves*. Name 2 state and 1 UT with the large area under mangrove forest. [P1/1(d)	8 M]. • Where are cold desert found in India? explain *Site Characteristics* of cold desert and stem suggested to overcome problems in their afforestation. [P1/3(a)	10 M]. • A soil can be wet, yet *Physiologically Dry*. How? What steps are suggested to correct the problem? [P1/3(a)	10 M].
2016	• Write in details the term Girdling and Pruning. Write the *Scientific name of 5 trees / shrubs* each for the cold desert and mangrove forest. [*Linked Q*	P1/4 (a)	20 M]. • Write the *Characteristics* of cold desert. Discuss soil working and planting techniques for cold desert. [*Linked Q*	P1/1(d)	8 M].
2015	• Discuss the *Sustainable Management* of mangrove forest in India [P1/1(e)	8 M]. • How is the accrual of *Tangible and Intangible* benefits of mangroves forest being affected by their degradation? [P1/2(d)	10 M]. • Give the scientific name of – (a) 5 species of mangrove forest, (b) Five tree/Shrub species of the cold desert [P1/3(c)	10 M]. • Comment upon the adaptation and *Survival Strategies* of the plant species endemic to the cold desert area of the western Himalaya. [P1/4(c)	10 M].
2014	• Discuss the *Characteristics* of mangrove forest with examples [P1/5(e)	8 M]. • Describe the following – (a) ……, (b) *Fish Bone Technique* [P1/6(b)	2.5 M]. • Discuss the importance of *Willow Cultivation* in cold desert [P1/5(c)	8 M].

2013	• Explain the following mangrove habitat [P1/1(d)	8 M].
		   (a) Deltaic mangrove habitat
		   (b) Coastal mangrove habit (both east & west)
		• Write about the species diversity and centre of origin of Willows (*Salix* species). Describe its various uses under short rotation forestry. [P1/5 (c)
			8 M].
			• *Willow* is the life line in dry temperate region (Lahul-Spiti) but its large-scale drying is causing great concern. Give your viewpoints. [P2/8(c)
				8 M].

2012	• How are the mangrove forest managed in India? [P1/1 (c)	5 M].
2011	• Suggest measures to *Rehabilitate* degraded mangroves forest. [P1/1 (c)	10 M]. • Define a forest types, Discuss the different *Forest Types* found along tidal swamp forest with their species composition. Give a note on how *rhizophora racemosa* in mangroves is managed in mangrove forest of Sundarbans. [P1/3 (a)	3+12+5 = 20 M].
2010	• Comment on - Mangrove ecosystems have *Physiologically Dry* soil [P1/4 (a) *ii*	5 M]. • Give the *Zonation of Land-Sea* interface in a typical mangrove eco-system with its characteristics [P1/1 (d)	5 M]. • How and why should cold desert forest ecosystem be conserved? [P2/7(c)	10 M].
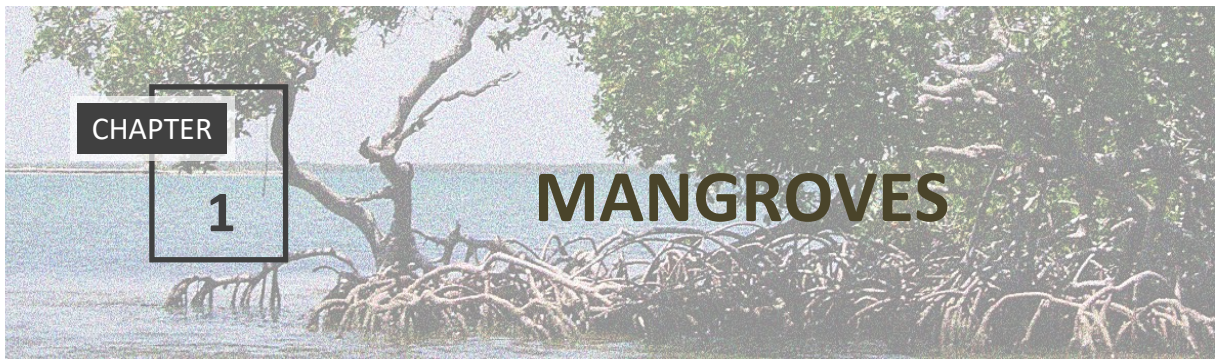
MANGROVES

Mangroves form the coastal and estuarine wetland ecosystems in the tropical and subtropical regions of the world. This unique intertidal ecosystem acts as a safeguard to the coastlines from the 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 24^0 N and 38^0 S.*

1.1 HABITAT

o The *intertidal zone* of coastal and estuarine mudflats.

o *Diurnal tidal inundation* of marine water, making the soil loose, very wet, salty, and low in oxygen.

o The *soil lacks minerals* like nitrogen (N), phosphorus (P), potassium (K), iron (Fe), and sulfur (S).

o Area *experiences strong winds* from cyclones and tsunamis.

o The temperature ranges from 25-35°C, and there is 100 to 300 cm of rainfall annually

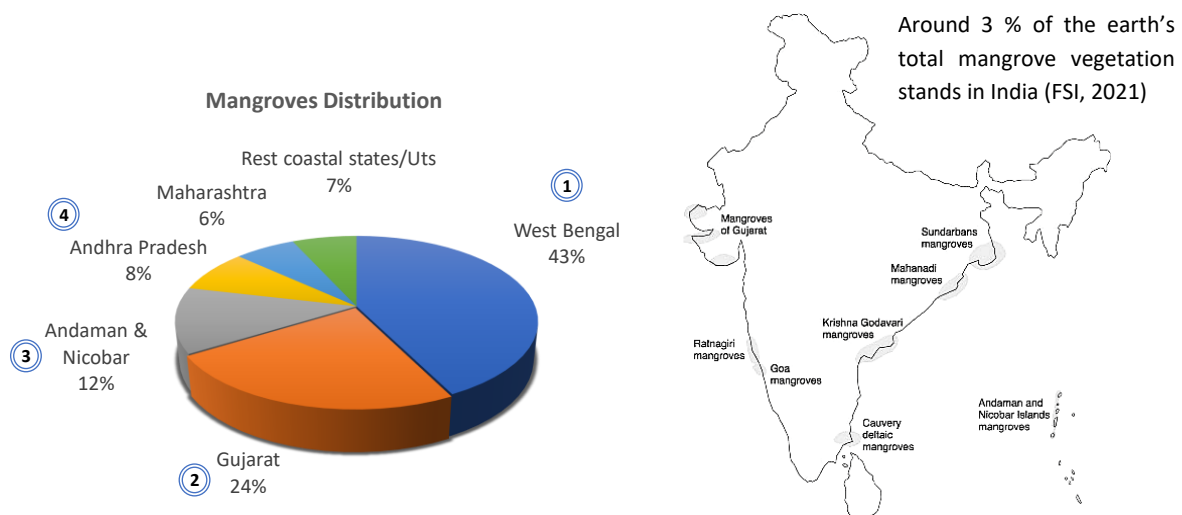o *Rich biodiversity* because of the edge effect.

Figure 1.1 : Mangroves habitat

1.2 DISTRIBUTION

► **INDIA** : *4992 km^2*, 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 km^2 (29.7%), while *Open mangroves* constitute an area of 2036 km^2 (≈ 40%). There has been a net increase of 17 km^2 (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 km^2 (42.5 % of total mangroves in India) > Gujarat = 1175 km^2 (23.66 %) > A & N = 616 km^2 (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].

Mangroves Distribution

Around 3 % of the earth's total mangrove vegetation stands in India (FSI, 2021)

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.
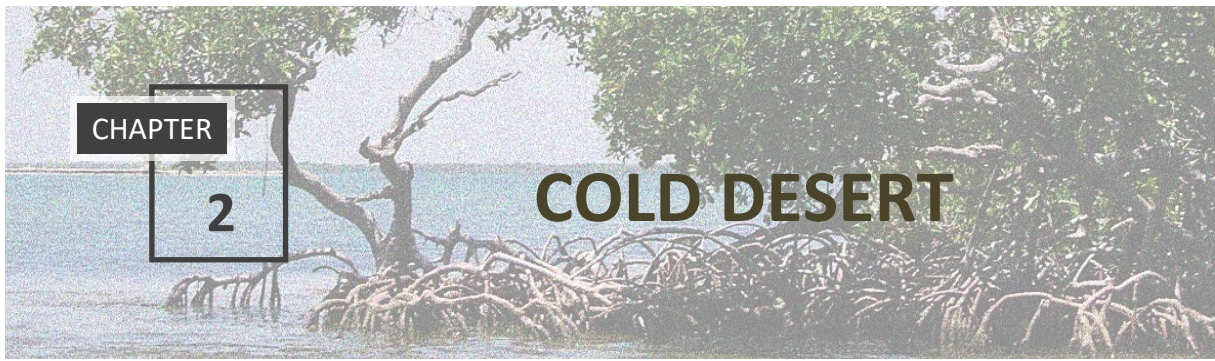
o   The east coast of India features a widespread, nutrient-rich continental shelf formed by various rivers. providing more suitable shallow waters for mangrove growth. In contrast, the west coast lacks significant deltas with alluvial deposits. Instead, the west coast is characterised by funnel-shaped estuaries, backwaters, and creeks.

o   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.

o   Mangroves thrive in areas with regular tidal inundation, which is more consistent on the east coast.

o   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

COLD DESERT

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, Munsiari, Pithoragarh (U.K.), and Northern Sikkim.
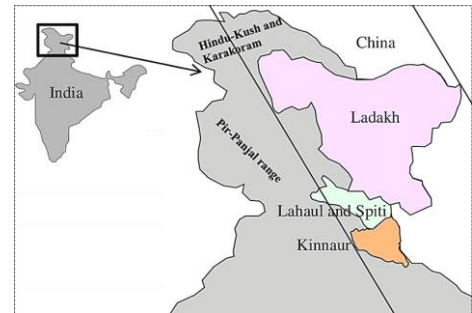
> **IFoS 2017** : *Where are cold deserts found in India*? Explain site characteristics encountered in a cold desert and steps suggested to overcome problems in their afforestation (10).

2.2 HABITAT CHARACTERISTICS

► **HARSH CLIMATE** : Unlike other parts of the country, the cold deserts experience <u>*two pronounced seasons, viz., summer and winter*</u>. The summer usually begins around May and continues till September. Winter commences from November to early May.

- Being a <u>*rain shadow area*</u> for both the monsoon and the monsoon depression, rainfall is very low (below 60 cm). The <u>*melting of snow is the only primary source of moisture*</u>.

- The <u>*temperature*</u> is usually below 0ºC.

- Short growing season = <u>*3 to 5 Months*</u>, mostly during summer season.

- <u>*High insolation*</u> 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).

- *Gravity wind* + Blizzards : the high-speed katabatic winds moving downwards from the mountain tops to the bottom of the valleys at night. These freezing winds cause considerable erosion as the mountain slopes are usually devoid of vegetation cover. They also cause a desiccating effect.
- Effect of *Jet stream* : High elevation commonly experienced snowfall with blizzards, snowstorms, and avalanches.
- Low atmospheric pressure = *High evaporation*.

► **SOIL** : *Un-weathered rock fragments* with *Low fertility*. **Brown soils** are found in inner dry valleys with mild acidic in nature. **High-altitude meadow soil** occurs under the alpine pasture near the snow line. **Alpine soil is** found above the snow line.

- High pH due to continuous addition of base from the rocks, and absence of leaching mechanism due to poor precipitation.

► Rugged topography : Landslide, cloud burst, heavy soil erosion. Heavy dust = visibility issues

► High biotic pressure

► Lack of irrigation facilities.

| 2.3 | SPECIES |

- *Hippophae rhamnoides* (Family - Elaeagnaceae) : Sea buckthorn,
- *Salix alba* (Family – Salicaceae) : Salix or willow,
- *Populus deltoids, P. Alba, P. Ciliata* (Family – Salicaceae) : Poplar
- *Pinus gerardiana* (family Pinaceae) : Chilgosa - Chilgosa fruit.
- *Betula utilis* (Betulaceae) : Birch
- *Rhododendron campanulatum* : Rhododendron

THEIR IMPORTANCE

- Food, Fodder, timber, fuel
- Soil binder = control soil erosion + increase soil fertility
- Carbon storage & Sequestration
- Shelter to wildlife, *i.e.*, Cheru.

| 2.4 | FOREST TYPES IN COLD DESERT |

Champion and Seth classified Indian cold forests under the following groups.

► **GROUP 13: HIMALAYAN DRY TEMPERATE FOREST**

This group occurs in the inner ranges of the Himalayas, where the S.W. monsoon gives very little rain, and the precipitation is mainly in the form of snow during winter. Thus, it occurs in Ladakh (Kashmir), Chamba (H.P.), inner Garhwal (U.P.), Sikkim, and Arunachal Pradesh.

SUB-GROUPS

[13/C₁] Dry broad-leaved and coniferous forest : This type occurs in the inner dry Himalayan valleys from 1600 m upwards, notably in the Kishtawar valleys; Overwood consists of *Pinus gerardiana*,

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> **IFoS 2020 :** _____ . Write the scientific names of five woody shrubs/tree species of cold desert (15m).
>
> **IFoS 2019** : _____ Write the scientific names of any 5 tree species of the cold desert (10 m).
>
> **IFoS 2016** : _____ , Write the scientific name of 5 trees/shrubs each for the cold desert and mangrove forest (5)
>
> **IFoS 2015** : Give names of - 5 species of cold deserts (5 m).
>
> **IFoS 2008** : _____. Suggest any two species suitable for plantation in the cold desert, their importance and system of management (20m).

> 🌿 What is a cold desert? What are its characteristics? explain, in detail the forest types of cold desert as per champion and Seth classification [OPSC Forest service 2015-16 | 20 m].

SILVICULTURE SYSTEMS

Paper – 1 | Section – A

EDITION : 2025

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SYLLABUS

Indian Forest Service (IFoS) [Paper 1 | Section A] Jharkhand PSC ACF & RFO (Main) 2024	▪ *Silviculture Systems* : ◈ *Clear feeling*, *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, and thinning.
Odisha PSC Civil service (Main) examination [Paper 1 | Part B]	▪ *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

INDIAN FOREST SERVICE (IFoS) PYQs | 2010 – 2024

2024	• What is **Conversion** in silvicultural systems? Explain with two examples [P1/1(e)	8 M].
		• Describe the following [P 1/2(a)
			15 M].
			  (*i*) Regeneration felling (*iv*) Secondary Felling
			  (*ii*) Felling Series (*v*) Felling Cycle
			  (*iii*) Seedling Felling
			• Give a detailed account of **Indian Irregular Shelterwood System** and its applications [P1/3(b)
				15 M].

2023	• What are **Accessory Systems**? Describe the two-storeyed high forest system [P1/2(c)	10 M]. • Who developed the **Andaman Canopy Lifting Shelterwood System**? Describe the different operations being followed in the system. [P1/3(c)	15 M]. • What is **Clear Felling System**? Describe the pattern of felling and methods of obtaining regeneration under clear felling system. [P1/4(b)	10 M].
2022	• **Improvement Felling** is not considered as a silvicultural system. Why? [P1/1(a)	8 M]. • Differentiate between **Coppice with Standards** and **Coppice with Reserves**. Explain in detail the coppice with two rotations and pollard system [P1/2(a)	15 M]. • Explain the following – (a) Selection felling, (b) Regeneration felling, (c) Selective felling, (d) Enrichment planting [P1/2(c)	10 M].
2021	• 'An appropriate silviculture system promotes better regeneration of forest stand' Comment. [P1/1(c)	8 M]. • Elucidate the pattern of felling and mode of regeneration adopted under **Selection System** of management [P1/2(c)	10 M]. • What are the conditions on which the **Choice of a Particular Silvicultural System** to be adopted for specific species in any locality depends? [P1/4(a)	15 M].
2020	• Explaining the factors which affect the **Length of Regeneration Period** in a periodic block [P1/1(c)	8 M]. • Define **Coppice With Standard** system. What are the advantages and disadvantages? Differentiate it from **Coppice with Two Rotation System**. [P1/3(b)	15 M]. • Enumerate the objectives of **Management of Canal Plantations**. Explain the silviculture system to manage them. [P1/4(b)	15 M].
2019	• Write the special characteristics of **Indian Irregular Shelterwood System** and differentiate it from Uniform System. [P1/2(a)	15 M]. • "Felling height and felling intensity play a major role in the advantages sustainability of clumps of bamboo species" Comment. [P1/3(a)	10 M]. • Explain the **Alternative Strip System** and the clear strip system. Write the advantages and disadvantages of clear-felling system. [P1/3(b)	15 M].
2018	• Enlist the **Classification of Silvicultural Systems** on the basis of mode of regeneration and pattern of felling. [P1/2(b)	15 M]. • What is **Conversion**? Discuss the need of conversion of one silvicultural system to another [P1/4(a)	15 M].
2017	• 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? [P1/3(c)	15 M].

CHAPTER 2

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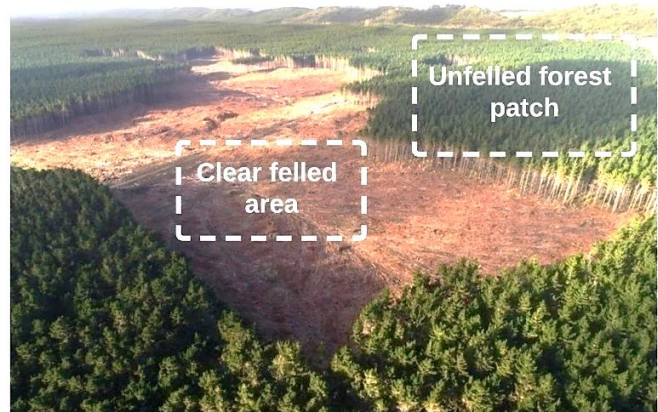
⬧ The clear-felling system was introduced for the first time by **Heinrich Von Cotta** in Saxony (Germany).

▪ 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.

CHAPTER 5

ACCESSORY SYSTEM

Accessory Systems refer to those *high forest systems* that *originate from other even-aged systems* by *modifying technique*, resulting in an irregular or two-storeyed high forest. These are –

5.1 TWO-STOREYED HIGH FOREST SYSTEM

Under this system, the formation of a two-storeyed forest. The canopy can be differentiated into two strata, and **each story is approximately even-aged** and usually **seedling in origin**.

▷ **Advantages / Aim**

o   The lower story crop can be used to *protect the soil* when the upper story of strong light-demanding species like teak is unable to do so.

o   Increasing the proportion of *valuable species* in the moist deciduous and semi-evergreen forests.

o   To *propagate shade-bearing or frost tender species* which cannot be grown without protection.

o   by growing two crops in the same area = *Increase production* = Income

o   To *change the species* gradually

o   To creates a *vertical mixture* in species composition

▷ **Disadvantages**

o   Very difficult in operation + require a very high level of skill + labour-intensive = likely to fail

o   Often under-story is damaged during thinning or fellings of upper-storey

o   Under-story crop may affect the growth of the upper story crop.

▷ **Application** : Examples of two-storeyed natural forests are not uncommon in India. For example, **Chir pine** and **Sal** are sometimes found growing together in certain localities in Tehri and Garhwal (UK). Deodar has come-up naturally under the pure crop of Chir. Oak growing under Deodar and Chir crop.

In Haldwani, Ramnagar, and some other divisions of Uttar Pradesh, *Teak* is being introduced in those *Sal* areas where all attempts to obtain natural *Sal* regeneration have failed. While the long-term goal is the gradual replacement of the current crop with an even-aged *Teak* Forest, *Teak* is currently being introduced under a canopy density of about 0.4 in the overwood, which translates to roughly 120 to 150 trees per hectare.

Since *Teak* is managed on a 50-year rotation and *Sal,* which is to be removed gradually, has a rotation of

CHOICE OF SILVICULTURE SYSTEM

The choice of silviculture system that we adapted to a particular area and species usually based on –

o   Suitability of system to that species

o   Soil & Topography

o   The resistance offered to external dangers

o   Objective of management

o   Economic consideration

o   Road and water transportation /communication

o   Availability of skill workforce

o   Existence of forest right

o   Aesthetic consideration

DAUERWALD CONCEPT ?

Dauerwald is a German term (meaning in English continuous forest), we used this term to refer to any silvicultural system, which does not involve clear-felling and exposure of soil.

Definition : A treatment of forest in such a way that a continuous and unbroken forest cover is maintained over the entire area.

On the basis of this concept, we Classified silvicultural systems broadly into two categories :-

   (i)   Dauerwald systems and
   (ii)   Clear-felling systems

IFoS 2021 : What are the conditions on which the *choice of a particular silvicultural system* to be adopted for specific species in any locality depends? (15 m).

IFoS 2021 : 'An appropriate silviculture system promotes better regeneration of forest stand' Comment (8m).

🌿   What are the criteria for choice of species to be raised in shelterbelt? [OPSC Civil (Main) 2021]

🌿   Successful regeneration is a forest stand depends upon judicious choice of silvicultural system comment [OPSC Civil (Main) 2011].

🌿   How does high forest system differ from coppice system? Discuss the various factors which affect the choice of silvicultural systems by giving suitable example [Himachal PSC Civil (Main) 2012].

🌿   Explain in brief the factors that decide the choice of a silvicultural system [Arunachal PSC Civil (mains) 2015-16].

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.

   o   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*).
   o   Retention of some older bamboo for support of immature culms.
   o   Prohibition on the digging of rhizomes.
   o   Regulation of the height at which bamboo should be cut. The <u>minimum height at which the bamboo should be cut is generally 15 cm</u>, 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.
   o   Insistence on cutting with a sharp instrument so that the stump does not split.
   o   In the case of flowering, the bamboo should be cut only when the seed has been shed.
   o   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

Hornbill
c l a s s e s

EDITION : 2025

📞 **+917223970423**   🌐 **Hornbillclasses.com**

Gole ka mandir, Morar, Gwalior (MP) 474005

SYLLABUS

|	
Indian Forest Service (IFoS) [Paper 1 | Section A] **Jharkhand PSC (ACF) Main 2024** [Paper 1 | Section A]	*Silviculture of Trees* : ❖ Traditional and recent advances in <u>tropical silvicultural research and practices</u>. ❖ Silviculture of some of the economically important species in India such as **A**cacia catechu, Acacia nilotica, Acacia auriculiformis, Albizzia lebbek, Albizzia procera, Anthocephalus Cadamba, Anogeissus latifolia, Azadirachta indica, **B**amboo spp., Butea monosperma, **C**assia siamea, Casuarina equisetifolia, Cedrus deodara, Chukrasia tabularis, **D**albergia sissoo, Dipterocarpus spp., **E**mblica officinalis, Eucalyptus spp., **G**melina Arborea, **H**ardwickia binata, **L**agerstroemia Lanceolata, **P**inus roxburghii, Populus spp., Pterocarpus marsupium, Prosopis juliflora, **S**antalum album, Semecarpus anacardium, Shorea robusta, Salmalia malabaricum, **T**ectona grandis, Terminalia tomemtosa, Tamarindus indica.
Jharkhand PSC RFO (Main) 2024 [Paper 1]	*Silviculture of Trees* : ❖ Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, Silvicultural Systems, Stand Management practices pest and diseases and economic importance of the following tree species of India. ❖ **Broadleaved species** : *Tectona grandis, Shorea robusta, Dalbergia latifolia, Dalbergia sissoo, Anogeissus spp., Terminalia spp., Santalum album, Swietenia macrophylla, Albizia spp., Pterocarpus marsupium, Gmelina arborea, Pterocarpus santalinus, Azadirachta indica, Hopea parviflora, Lagerstroemia microcarpa, Bamboos, reeds and rattan,* ❖ **Conifers** : *Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, Pinus wallichiana, Quercus spp.* ❖ **Fast growing MPTs** : *Tropical pines, Eucalyptus Spp., Casuarina equisetifolia, Leucaena leucocephala, Ailanthus triphysa, Grevillea robusta, Pongamia pinnata, Melia dubia, Acacia spp., Populus spp.*

MODULE – 2 : INDIAN TREE SPECIES

INDIAN FOREST SERVICE (IFoS) PYQs | 2010 – 2024

2024	• Elucidate the phenology, silvicultural characters and artificial regeneration of *Bamboos* [P1/1(a)	8 M].
		• Write in detail the distribution and importance of *Prosopis juliflora* and *Emblica officinalis* [P1/1(d)
			8 M].
			• Write the economic importance of the following tree species [P1/3(a)
				15 M].
				   (i) *Salmalia malabarica*
				   (ii) *Acacia nilotica*
				   (iii) *Largerstroemia lanceolata*
				   (iv) *Pterocarpus marsupium*
				   (v) *Chukrasia tabularis*
				• Discuss the distribution and regeneration of *Cedrus deodara* and *Pinus roxburghii* [P1/4(c)
					10 M].

2023	• The shoot portion of seedlings of some tree species like *Sal* and **Sandal**, under natural regeneration, keeps on drying year after year but the roots remain alive. Discuss [*Linked Q*	P1/1(a)	8 M].
			• Write the factors which affect the natural regeneration of **Sal (Shorea robusta)**. Discuss the procedure to obtain natural regeneration of moist Sal forests [*Linked Q*
				P1/2(b)	15 M].
					• Write the economic importance of the following tree species [P1/3(a)
						15 M].
						   (i) *Acacia catechu*
						   (ii) *Casuarina equisetifolia*
						   (iii) *Hardwickia binate*
						   (iv) *Butea monosperma*
						   (v) *Tamarindus indica*

2022	• Explain the techniques for the upgradation and hardening of nursery seedlings of *Lagerstroemia lanceolata* [*Linked Q*	P1/1(d)	8 M].
2021	• Discuss the phenology, Silvicultural characters and regeneration methods of – (i) *Gmelina arborea*, (b) *Pinus roxburghii*. [P1/2(b)	15 M]. • Elucidate the distribution, Nursery techniques and economic importance of – (i) *Cedrus deodara*, (ii) *Acacia catechu*, (iii) *Casuarina equisetifolia*. [P1/4(b)	15 M].
2020	• Describe the methods of artificial regeneration of *Tamarindus indica* [*Linked Q*	P1/1(e)	8 M]. • Give a brief account of the silvicultural characters and regeneration methods for the following species - (a) *Acacia catechu*, (b) *Populus deltoides* [P1/2(c)	15 M].
2019	• Write a brief account of the phenology, silvicultural characters and methods of regeneration of *Dalbergia sissoo* [P1/1(a)	8 M]. • Discuss in details silviculture of *Albizzia lebbeck* [P1/2(c)	15 M]. • Give a brief account of origin and natural distribution of the following - (a) *Adina cordifolia*, (b) *Cedrus deodara* and (c) *Santalum album* [P1/4(c)	15 M].
2018	• Discuss the physiology of *root parasitism* in **Sandal Tree** (8M). [P1/1(e)	8 M]. • Write the *phenology* of the following (5M) – (a) *Tectona grandis*, (b) *Melia dubia*, (c) **Shorea**
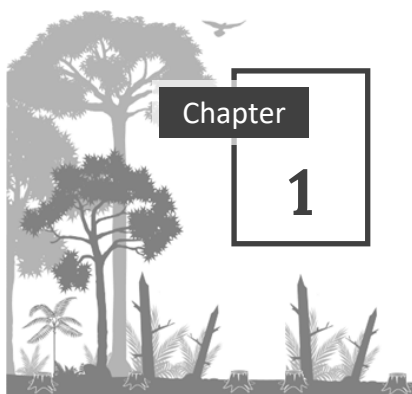
INTRODUCTION

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)

- It can *sustain in moderate drought*.

- **Animal damage** : Grazing and browsing by domestic cattle, deer, and antelopes.

- **Injury by man** : Due to its high value = illicit felling and lopping occur.

- **Spike disease** : by *Mycoplasma*.

- **Root parasite** : Sandalwood is an *obligatory root parasite*. At an early stage, its roots develop nodular growths, from which haustoria are formed. The haustoria of the rootlets attach themselves to the host tree's roots and draw nutrition from it.

  Hosts are classified as **primary hosts** or **pot hosts** (at Sapling stage) and **long-term** or **permanent** hosts. The suitable primary hosts are *Cajanus cajan*, and *Mimosa pudica*. The permanent hosts are to be selected that are suitable to the local conditions and agroclimatic zones. *Phyllanthus emblica* (Amla/Indian gooseberry); *Mangifera indica* (mango); *Zizyphus mauritiana* (Ber); *Moringa oleifera* (drumstick tree), *Casuarina equisetifolia, Acacia nilotica, Dalbergia latifolia, Azadirachta indica,* etc. are popular permanent hosts.
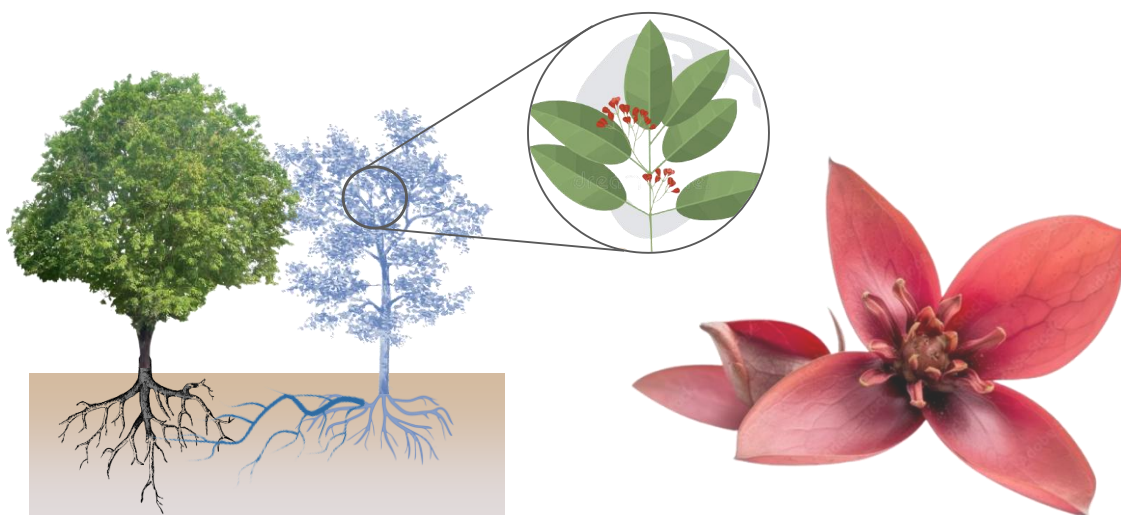
▶ **NATURAL REGENERATION** : Mainly through *Seeds*. Sometimes through *Root suckers*, but depends upon – (1) the host is essential in the later stages which are not readily available and (2) Climatic, Edaphic, topographic and Biotic factors.

▶ **ARTIFICIAL REGENERATION** : Direct *Seed Sowing* in April-may (before the onset of monsoon) + *poly-bag* planting (6 months old) + *Stump planting* (This method has shown over 90% success) + *Root suckers* + *Marcotting* (Air layering) + Grafting + *Planting root pieces*

- **Seed treatment** : pretreated with 500 ppm Gibberellic acid for 16 hrs.

- **Spacing** : depends on the soil fertility and the host preference. The ideal spacing is 5 × 5 m, but under certain situations, 4 × 6 m or 4 × 4 m spacing can also be adopted. However, narrow spacing (4 × 4 m) may lead to competition for light, water and nutrients between sandalwood and its intermediate and long-term hosts.

- Boundary, Block or bund plantation
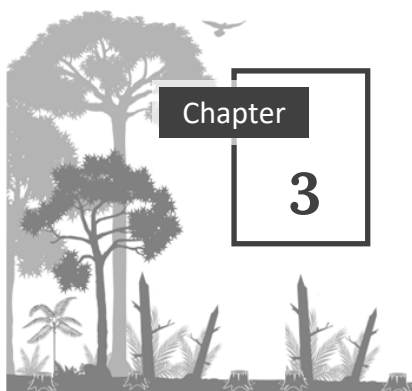
TREE SPECIES GROWING IN THE NORTH INDIAN PLAINS

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 leave 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.

Chapter 4
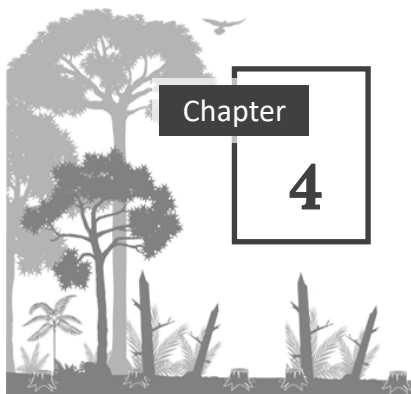
SPECIES OF SEMI-ARID TROPICS

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 45ºC
- **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).

BAMBOO

► **FAMILY :** Gramineae (old name Poaceae)

► **DISTRIBUTION** : The most commonly distributed bamboo of the Indian peninsula is Dendrocalamus strictus or male bamboo which is easily growing in the tropical dry deciduous locality. The culms in this bamboo are solid = and have high commercial value. The other common bamboo of the Indian peninsula is *B. Arundinaria (B. bamboo)* which is often grown in moist soil, along the river beds.

Some of the important bamboo in its growing region

SN	Scientific name	Common name	Distribution
1.	*Arundinaria falcata*	Ringal	The low-level bamboo of the western Himalayas, at elevations between 1000-2200 m. It grows gregariously, forming an undergrowth in the forests of deodar, oak, etc., usually in moist shady locations.
2.	*Arundinaria spathiflora*		
3.	*Arundinaria Wightiana*	Chevani	Nilgiri region
4.	*Bamboosa bamboo* (Syn. *B. Arundinaria*)	Thorny bamboo	Pan India particularly along the river valley and in moist locality *i.e.* Indo-Gangetic plains. Useful in paper manufacturing.
5.	*Bambusa vulgaris*	Yellow bamboo	
6.	*Bambusa tulda*		Common in alluvial flats along the stream *i.e.* Assam valley.
7.	*Bambusa Polymorpha*	Betua (Assame)	NE India. Uses - for paper, Agarbatti sticks, fiberboards, etc. tender shoots are of best quality for edible purposes.
8.	*Ochlandra travancorica*		This shrubby bamboo with culm up to 5 m height. Commonly growing in the Malabar region and Tamil Nadu.
9.	*Dendrocalamus giganteus*		Largest bamboo. Indigenous to Myanmar (Burma), in India, grows primarily in the NE region.
10.	*Dendrocalamus hamiltonii.*	Kaghzi Bans	found mainly in the northeastern Himalayas mostly between an altitude of 600-1200 m. The most important use is for paper manufacture.

SN	Scientific name	Distribution	Phenology	Silvicultural	Regeneration	Uses
1.	*Albizzia Lebbeck* Mimosaceae (Leguminosae)	**Pan India**, from sub- Himalayan tract to Andaman • Altitude Up to 1500 m • Rain fall = 80 to 300 cm • Temperature = 18 – 40^{0}C • Geology & soil = wide range , **Undulating topography**	**Medium size**①, **deciduous**② tree with relatively **well-developed crown**③ • Leaf fall = winter • New leaves = Summer start (March-April) • Flowering = Summer (April-May) • Fruiting = Monsoon end	• Light demander, • Forest sensitive (tender) • Superficial root system = not a wind firm + drought sensitive	**Natural Regeneration :** (1) by seed, (2) coppice, and (3) Root suckers	• Leaves Fodder • Fuel wood • Bark tannin • **Host for Lack insect** • Afforestation of coastal, dry & semi-area region
2.	*Albizia procera*		**Medium size**①, **deciduous**② tree with relatively **well-developed crown**③ • Leaf fall = Winter (April-June) • New leaf = Soon after leaf fall • Flowering = Monsoon (June-Sept) • Fruiting = winter (Oct-Jan)	• Light demander • Forest tender • Fairly drought Resistant • Moderately resistant to saline-alkaline conditions • Strong coppices + root sucker	**Artificial Regeneration :** (1) Direct seed sowing, (2) Nursery raised Plantation, (3) Stump planting.	• Leaves fodder • Fuel wood • Bark tannin • **High grade timber** = house construction, agricultural implements packing cases, etc. • White writing & **printing paper**
3	*Santalum album* (Sandalwood) Santalaceae	All over **peninsular India**, mainly in Karnataka, and Tamil Nadu. • **Climate** : Southern Tropical dry and moist deciduous forest. • **Rainfall** : 600 to 1200 mm • **Temperature** : 25 to 35º C • **Altitude** : 500 to 1000 m • Grow mainly over red soil and moist, fertile alluvial soil lies along the banks of rivers. • *Not able to tolerate conditions of salinity and waterlogging*.	**Small size**①, **Evergreen**② tree with relatively **well-developed crown**③ • Leaf fall : Around the year • Flowering : May - June • Fruiting : October - December	• Shade demander • Frost sensitive • High coppicer + Root sucker • Fire sensitive • Root parasite	**Natural Regeneration** : (1) by seed, (2) coppice, and (3) root suckers **Artificial Regeneration** : (1) Direct seed sowing, (2) Nursery raised Plantation, (3) Stump planting, (4) Root sucker, (5) Air layering	• Heartwood oil = perfumes + Confectionary + Fancywork • Wood : used in havan and Chandan making

AGRO-FORESTRY, & SOCIAL-FORESTRY

Paper – 1 | Section – B

EDITION : 2025

SYLLABUS

Indian Forest Service (IFoS) [Paper 1 | Section B] **Jharkhand PSC ACF & RFO (Main) 2024**	► *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 Non-Timber Forest Products (NTFPs), techniques, food, fodder and fuel security. ◈ *Research and Extension* needs. ► *Social / Urban Forestry* - Objectives, scope and necessity; People's participation.
Odisha PSC Civil service (Main) examination [Paper 1 | Part A]	► *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

AGROFORESTRY, & SOCIAL FORESTRY

INDIAN FOREST SERVICE (IFoS) PYQs | 2010 – 2024

AGROFORESTRY

2024	• How is **Shifting Cultivation** related with tribal society? Is it a good practice or bad, under present situation? Justify your claim [P1/5(c) | 8 M]. • What is agroforestry? Elucidate the scope, importance and **Role of Agroforestry** in climate amelioration [P1/7(a) | 15 M].
2023	• Explain the **Role** of **Windbreaks** and **Shelterbelts** in Agroforestry. Name two tree species for each [P1/5(a) | 8 M]. • Discuss the role of Agroforestry in the well-being of mankind. [P1/6(a) | 15 M].
2022	• How does agroforestry help to achieve the *United Nations'* **Sustainable Development Goals**? [P1/5 (a) | 8 M]. • What are the differences between **Traditional Agroforestry** and **Ethno-Agroforestry**? Explain in brief, below-ground and above-ground, tree-crop interactions in agroforestry systems [P1/6(a) | 20 M]. • What are the constraints in the **Value Chain** under **Industrial Agroforestry**? [P1/6(b) | 10 M].
2021	• How do agroforestry wood perennials protect the understorey crops? [P1/5(e) | 8 M]. • How does agroforestry promote the **Sustainable Livelihood** of marginal farmers? [P1/6(c) | 10 M]. • How does **Crop Rotation** and mixed farming improve soil productivity? [P1/8(b) | 15 M].
2020	• "Agroforestry system **Conserves Soil** *and* **Moisture**" Justify the statement [P1/5(b) | 8 M]. • Write the **Tangible** *and* **Intangible Benefits** of agroforestry. [P1/5(d) | 8 M]. • "**Taungya Cultivation** is a type of traditional agroforestry system" Justify the statement. [P1/6(b) | 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. [P1/7(c) | 10 M]. • How does **Shifting Cultivation** support community livelihood and biodiversity conservation? [**P2**/5(a) | 8 M].
2019	• Agroforestry is a better land-use system for **Climate Change Mitigation** and adaptability. Justify. [P1/5(a) | 8 M]. • What are **Multipurpose Tree Species** (MPTs)? explain their role in social forestry [P1/7(c) | 10 M].
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. [P1/6(a) | 10 M].
2017	• Discuss the impact of agroforestry practices on the environment in general and on soil properties in particular, with a suitable example. [P1/5(e) | 8 M]. • Differentiate between **Windbreaks** and **Shelterbelts**. Discuss in brief, their impact on the environment [P1/7(c) | 10 M].

- Differentiate between the following – (*i*) **Shelter Belts** and **Wind Breaks** [P1/3(a) | 4 M].
- What is integrated land use management? Give a plan of integrated land use management for 10 ha. of land in tropics and sub-tropics parts of India [P1/6(b)*ii* | 10 M].
- Comment on the needs of **Research** in Agroforestry in India [P1/7(b)*ii* | 5 M].
- Write short notes on - **Diagnosis** and **Design** in Agroforestry [P1/5(c) | 5 M].

SOCIAL FORESTRY

2024	• What do you mean by **Urban Forestry**? Discuss the choice of species for environmental conservation in these areas. [P1/5(a)	8 M].
2022	• Discuss the key problems to expand tree cover in urban areas. Explain the role of urban trees in abating soil pollutants [P1/8(a)	15 M].
2021	• Discuss the problem of commons in social forestry. Suggest some effective strategies to overcome these problems [P1/6(b)	15 M]. • What factors are considered important while choosing a species under **Avenue Plantation**? [P1/1(b)	8 M].
2019	• Briefly describe the **Aim, Objectives** and **Scope** of urban forestry in India. [P1/5(b)	8 M].
2018	• What is **Farm Forestry**? Write about the objectives, difficulties and financial return from the farm forestry [P1/8(c)	10 M].
2017	• Explain the scope and aims of **Urban forestry**. Discuss the need of urban forestry in the improvement of city environment [P1/6(b)	20 M].
2016	• Briefly discuss aims, objectives and scope of social forestry. Why is people's participation must in social forestry? [P1/8(b)	10 M].
2012	• How social forestry differs from other types of forestry? [P1/1(f)	5 M].
2011	• Management challenges in the urban forestry are unique as compared to other social forestry programs. Discuss [P1/6(c)	10 M].
2010	• Write Short notes on – (a) Management of urban forestry [P1/5(a)	5 M]. • Discuss the following – (*iv*) Drawback of social forestry programs in India [P1/6(a) *iv*	5 M].

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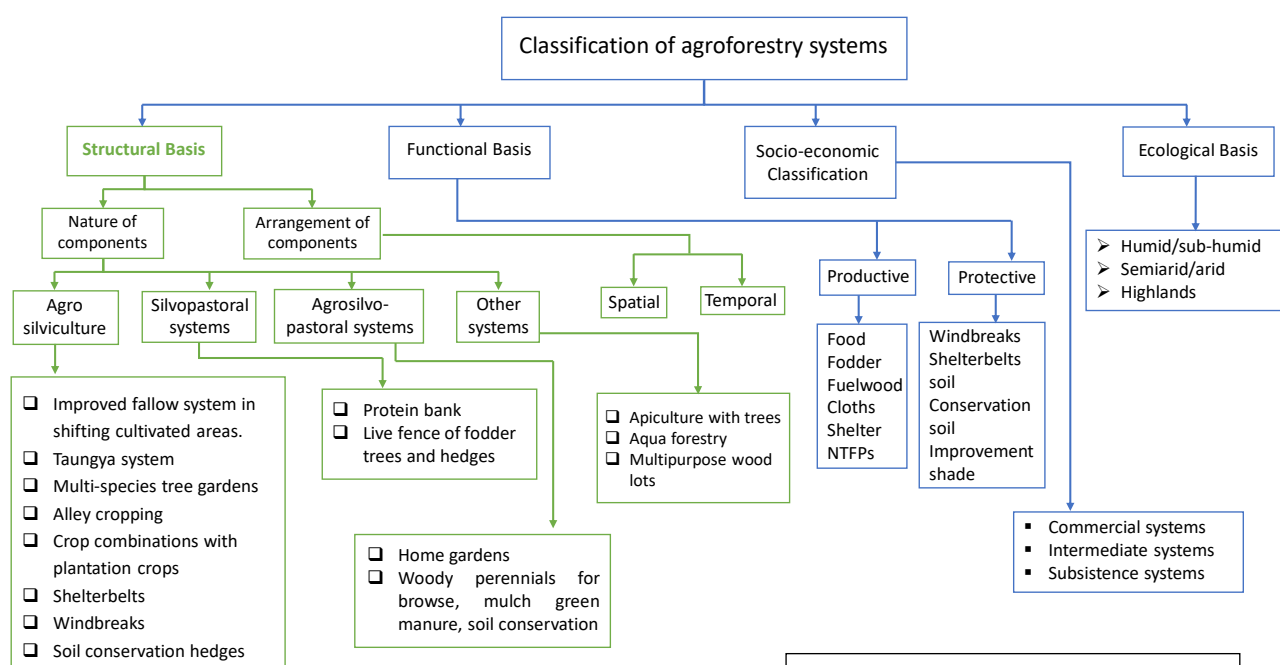
▶ **SCOPE/NECESSITY** : Agroforestry has an excellent scope in the context of Indian Agriculture due to its intrinsic relation with traditional agricultural practices. Agroforestry practices are beneficial in –

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.

Classification of agroforestry systems

Structural Basis
- Nature of components
- Arrangement of components

Functional Basis

Socio-economic Classification

Ecological Basis
➤ Humid/sub-humid
➤ Semiarid/arid
➤ Highlands

- Agro silviculture
- Silvopastoral systems
- Agrosilvo-pastoral systems
- Other systems

- Spatial
- Temporal

- Productive
- Protective

Agro silviculture
- ❑ Improved fallow system in shifting cultivated areas.
- ❑ Taungya system
- ❑ Multi-species tree gardens
- ❑ Alley cropping
- ❑ Crop combinations with plantation crops
- ❑ Shelterbelts
- ❑ Windbreaks
- ❑ Soil conservation hedges

- ❑ Protein bank
- ❑ Live fence of fodder trees and hedges

- ❑ Apiculture with trees
- ❑ Aqua forestry
- ❑ Multipurpose wood lots

Food
Fodder
Fuelwood
Cloths
Shelter
NTFPs

Windbreaks
Shelterbelts
soil
Conservation
soil
Improvement
shade

- ❑ Home gardens
- ❑ Woody perennials for browse, mulch green manure, soil conservation

- ▪ Commercial systems
- ▪ Intermediate systems
- ▪ Subsistence systems

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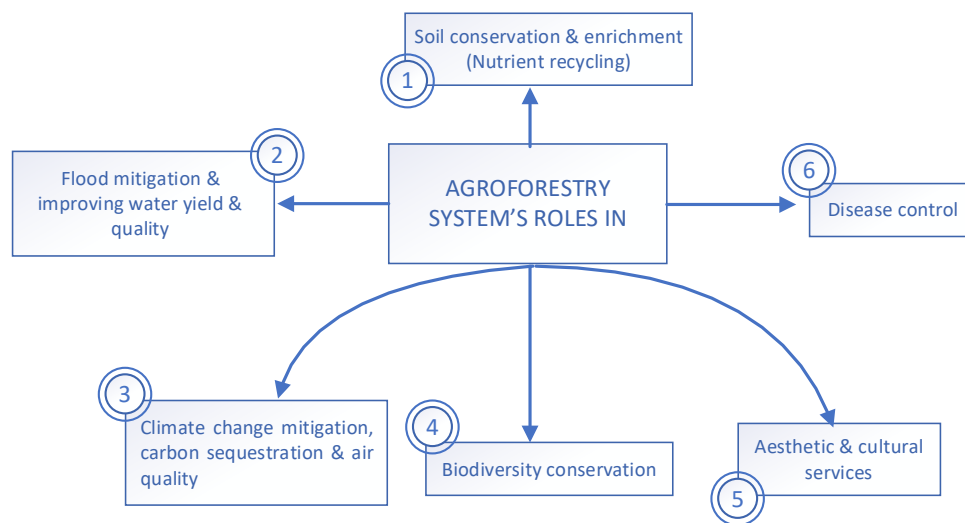
2.1 | STRUCTURAL CLASSIFICATION

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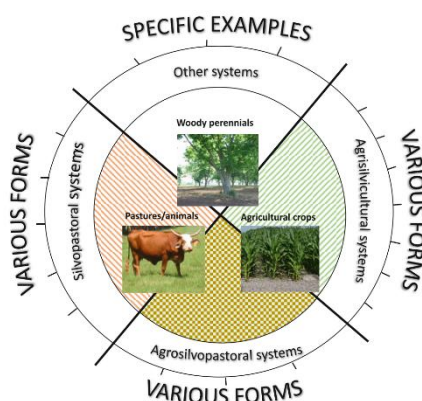
- ► **ROLE OF TREES IN SOIL CONSERVATION** : Trees play an important role in soil and water conservation by providing *multi-layered defense* against the impact of raindrops and strong winds.

- 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.
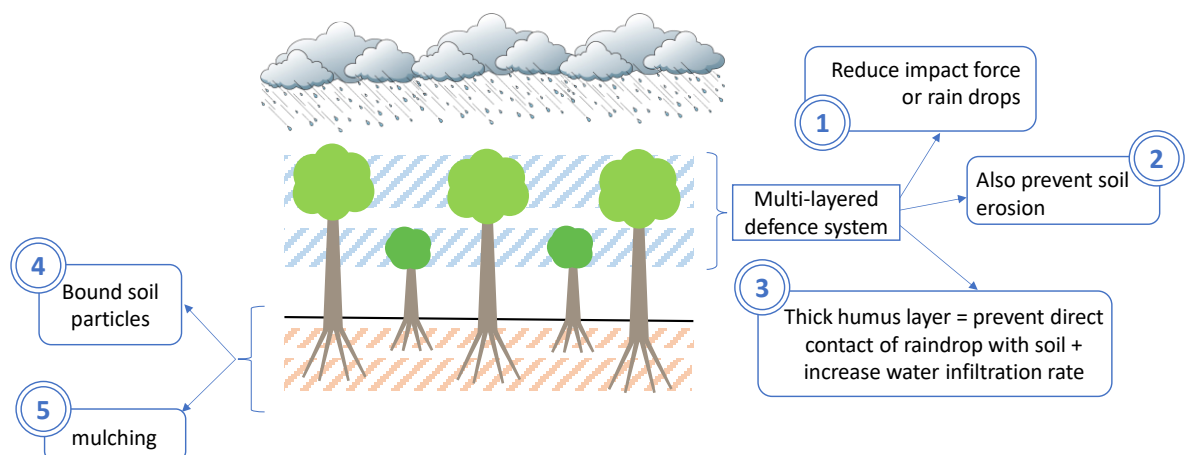
- In the root zone, the framework of roots tightly bonded the soil particles that stabilized the soil structure.

- Added a significant amount of above-ground and below-ground organic matter, looting soil and improving soil physical and biological properties.

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 a   dopt it. This means that the

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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 agro-forestry? 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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