

FORESTRY



APSC
ASSAM PSC



STATE FOREST SERVICE
2025

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study material



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Concepts with
PYQs



Infused with
Infographics &
Maps

Module - 4

- Forest protection
- Wildlife biology
- Forest economics

- Forest legislation
- Dendrology

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FORESTRY

FOREST RANGER / SOIL CONSERVATION RANGER



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Module ~ 4

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FOREST PROTECTION

INTRODUCTION

1.1 FOREST DISASTERS

HAZARD : A dangerous event, natural or man-induced, that could cause injuries, loss of life, damage of property, livelihood, or environment in a definite area. Events may be –

- **Natural**, e.g., Tsunami, Volcanic eruption, Earthquake, etc.
- **Man-induced**, e.g., Pollution, Flood, Drought, etc.

DISASTER : When a *natural* or *human-induced event* causes *widespread human loss*, accompanied by loss of livelihood, property, and the environment *in a definite area*.

- Means that an event becomes a disaster only when it happens at such a wide scale that the forest ecosystem is unable to cope with it, causing complete disruption of the normal functioning of the forest ecosystem.

[A **forest disaster** is a large-scale event that causes significant damage to a forest ecosystem]

TYPES OF FOREST DISASTERS

Based on speed

- Slow onset : Takes months/Years – Drought, Environmental / Forest degradation.
- Rapid onset : Triggered instantaneous – Cyclone, Landslide, Forest fire, etc.

Based on the agency

- Natural : Tsunami, Cyclones
- Man-induced : Forest fire

Based on the area of damage

- Climatic disasters : Drought, Flood in the Low lying area, Cyclone, Hail storm, Heatwave
- Geological disasters : Landslides, Volcanic eruptions, etc.
- Hydrological disasters : Tsunami, Limnic eruptions, etc.
- Man-induced : Forest fire, Heavy metal poisoning, etc.



Mt. Merapi volcano erupts, Indonesia, March 2023



Bhopal gas tragedy



The U.S. military used **Agent Orange**, a herbicide and defoliant, during the Vietnam War from 1962 to 1971.

PROTECTION AGAINST INJURIES BY MAN

On the one hand, man is responsible for the establishment and cultivation of new forests, as well as the regeneration and sustainable management of natural forests in a scientific manner. However, on the other hand, man is also the primary cause of damage and destruction to these forests. Due to human activities, numerous forests around the world have already vanished, and some continue to be destroyed even today.

KINDS OF DAMAGES BY MAN (ANTHROPOGENIC)

- Deforestation
- Shifting cultivation
- Illicit felling and illicit removal of forest produce
- Forest fire
- Encroachment
- Defective management
- Other damages, such as lopping, removal of leaf litter, removal of flowers and fruits, poaching, environmental pollution, etc.

10.1 | DEFORESTATION

DEFINITION : Deforestation is defined as the *removal of tree crops* from a piece of land *without the intention of reforesting*. The damaging or removal of forest vegetation to such an extent that it failed to support its natural flora and fauna.

CAUSES OF DEFORESTATION

➤ *Diversion of forest land for non-forestry purposes* – like river valley projects, *Dams, Roads, Communication Lines, Railway Tracks, Mining*, etc. which have done a lot of damage to the forests. Since independence about. [Major causes = Expansion of Agriculture land]

Example : Establishment of fruit belts in hills, i.e., Chamba-Mussoorie fruit belt of UP govt during the 1960s clear large area of deodar-oak forest of Shivalik and lesser.

About **7.5 million hectares** of forest land has been diverted for non-forestry uses since independence, of which approximately **4.5 million ha** was diverted between 1950-1980 and **2.8 million hectares** from 1980 to 2000. The central government admitted that *in 2019, 11500 hectares of forest land had been diverted in 22 states*.

➤ *Forest Fire* : both natural and accidental. In 2016, about a 4500-hectare area was burnt in Uttarakhand due to a forest fire. The fire in Australia (2020) destroyed 18.6 million hectares of land and killed nearly three billion terrestrial vertebrates.

PROTECTION AGAINST INJURIES BY ANIMALS

Animals cause damage to forests through grazing, browsing, debarking, trampling of plantations, and new growth.

Domestic animals often enter the forest to graze, which can have significant negative impacts on both the forest and its wild inhabitants. One major concern is the potential spread of diseases from domestic animals to wild animals. Additionally, domestic animals can inadvertently introduce new weed species by carrying the seeds on their bodies.

3.1 GRAZING

Grazing refers to feeding leaves and twigs of plants such as grasses and herbs.

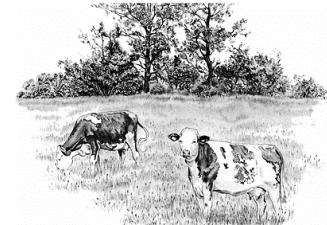
Grazing Animals : Cow, Buffalo, etc.

SIGNIFICANCE

- The backbone of the rural economy by providing milk, food, meat, and workforce.
- Contribute 6 % of GDP and 25 % of agricultural GDP.

GRAZING PATTERN

- (1) **Migratory grazing** : In this grazing, animals move from a higher to a lower altitude in winter seasons to avoid cool weather conditions uphill and go back to hills in summer (i.e., Bakarwals in HP, Van Gujjar in JK).
 - ☞ **Kharak** system in Uttarakhand, **Gol** system in Rajasthan,
- (2) **24 hour grazing** : In this, livestock remains inside the forest throughout the day. After the end of the designated period, animals are captured again for domestic use.
- (3) **Day grazing** : Here, animals are allowed inside the forest in the daytime for grazing. In the nighttime, livestock is returned back to cattle sheds located near the human settlements.
- (4) **Penning and stall feeding** : In this kind, fodder is collected from the forest and fed to the cattle in the cattle shed itself. Animals are not allowed to go out of the cattle shed.



Grazing



Browsing :
[Goat, Elephant, Camel, etc.]

► GRAZING SYSTEM

- (1) **Continuous grazing** : In this grazing, the area subjected is *allowed for grazing throughout the year* without any control or regulation measures. This is not advisable because *continuous grazing*

PROTECTION AGAINST INJURIES BY AINSECTS

Insects are a significant threat to forests as they cause a lot of damage. They can harm plants at any stage of growth, from the time the seeds are planted until the final product is ready. Some insects like weevils and moths can even attack the seeds before they are collected. The deterioration of seeds due to insect infestation can continue during storage as well.

4.1 HARPFUL POLYPHAGOUS INSECTS

- **Termites (White ant)** : Species - *Odontotermes* obesus & *Microtermes* mycophagus
 - ❖ Order : Isoptera
 - ❖ Harmful stage : Larvae / Pupae / Adult only / All
 - ❖ Caste responsible for all types of damages : Larvae / Workers / Queen / Soldiers.
 - ❖ Termite problems are more serious in *Arid and Semi-arid* conditions/Sandy and Sandy loam soil.
 - ❖ Positive Role of Termite in *Nutrient Recycling*
 - ❖ Chemical control can be achieved by spraying *Aldrin* and *Chloropyriphos*.
- **White Grub or Chaffer Beetle or June Beetle or Cock Chaffer** : It is a **soil-dwelling root feeder polyphagous** larva.
 - ❖ Order : Coleoptera
 - ❖ Example : *Holotrichia Consanquinea****
 - ❖ Serious Nursery paste of *Teak, Sal, Deodar, Babool, Ber and Khejari*.
 - ❖ Attackers stage : Grub (Root feeder, attack on seedlings), Adult (Leaf feeder).
- **Cut-worm (*Agrotis ipsilon*)** : The caterpillar is mainly active during the night and cut young shoots near the base to suck sap.
 - ❖ It attacks primarily on - Acacia, Albizzia, Prosopis (AAP), and Eucalyptus.
- **Bark-eating caterpillar (*Xyleborous*)** : Caterpillars such as the *Inderbela quadrinotata* consume the bark of many species and form shelters around it.
 - ❖ Attacks on Acacia, Albizzia, Prosopis (AAP), and Ziziphus.



Termite



White grub



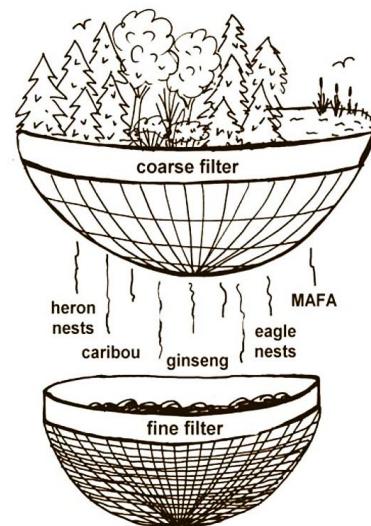
Cut-worm



Inderbela quadrinotata

In the Gir Forest regions, there exist hundreds of animal species. Therefore, when it comes to wildlife management, it is impossible to take a species-by-species approach to manage their habitat. However, it is possible to achieve this through the hierarchical application of carefully chosen guidelines that serve as both **coarse** and **fine filters**.

- The concept of coarse and fine filters was popularized by Hunter (1990).
- Coarse filter = captures the requirements of a broad array of species by maintaining a broad array of forest conditions.
- Fine filter = Ensures that no species falls through the cracks because of particular specialized requirements



The Coarse Filter

Forest composition

- maintenance of habitat

Age Class Structure

- movement toward natural
- maintenance of older ages

Forest Patches

- shape
- range of sizes
- amount and size of mature habitat patches
- placement (natural landscape texture)
- fire salvage
- prescribed burns

Residual patches

- peninsular
- insular
- riparian buffers

The Fine Filter

Vulnerable, Threatened & Endangered species

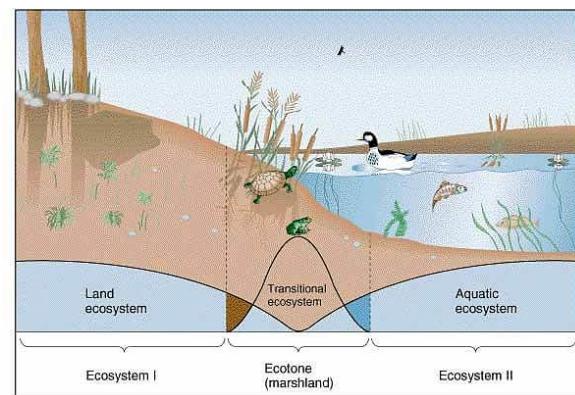
- patch size for caribou
- site-specific habitat protection (e.g., bald eagle, red-shouldered hawk, ginseng and other plants)
- peregrine falcon nest site management plan
- landscape-level habitat supply (e.g., red-shouldered hawk)

Featured Species

- landscape-level habitat supply (e.g., marten, moose, pileated woodpecker)
- deer yard management plans
- site-specific habitat protection (e.g., moose aquatic feeding areas, mineral licks, osprey nests, heronries, goshawk nests, fish spawning areas)

► IMPORTANT TERMINOLOGY

- **Edge effects** : The boundary line of two or more than two different types of habitat is called an **edge**, which is generally formed by microclimate, aspect, soil, or abrupt physical changes. On either side of such edge, a belt is found or formed which has characters and vegetations of both the habitats and is called **ecotone**. The ecotone is narrower than its adjacent habitats. Thus, the ecotone is the juncture of two different vegetation-type habitats (areas). The diversity of vegetation in ecotone is very beneficial and attractive for certain animal species. This diversity invites different types (varieties) of animals



WILDLIFE PROJECTS

3.1 PROJECT TIGER

'Project Tiger' is one of the most successful wildlife conservation projects being run in this country over the years. Tigers are present at the apex of the food chain and, hence, are considered as an indicator of the stability of the ecosystem.

Tiger reserves : Areas notified under **Section 38V** of the Wildlife Protection Act 1972, are termed as a tiger reserve

ORIGIN OF 'PROJECT TIGER'

A national ban on tiger hunting was imposed in 1970. In 1972, the Wildlife (Protection) Act came into force, and initially, a task force was set up to formulate a project for tiger conservation with an ecological approach. The first ever all-India tiger census was conducted in 1972, which revealed the existence of only 1827 tigers. Subsequently, 'Project Tiger' was launched on **April 1, 1973**

OBJECTIVES /SIGNIFICANCE OF PROJECT TIGER

- Identifying the limiting factors and mitigating them
- Elimination of all forms of biotic disturbances from the core area
- Rationalization of activities in the buffer zone.
- Carry out research about wildlife behaviour
- Carefully avoiding the management practices, which tend to push the wildlife populations beyond the carrying capacity of the habitat.
- Captive breeding = rebuild natural population
- Increasing the number of trained personnel on the project site

TIGER CENSUS 2023 (5th Cycle)

- Population = 3167, which is about 70 % of the global tiger population (13 tiger range countries).
- Growth rate 6.7 %
- There has been a significant increase in the tiger population in the Shivalik Hills and Gangetic Plains, while tiger occupancy in Jharkhand, Odisha, Chhattisgarh, and Telangana showed a decline
- Nilgiri cluster is the largest tiger population in the world, contributing significantly to the colonisation of tigers in neighbouring areas. Significant declines were observed in the Wayanad landscape and in the Biligiriranga Hills.

SN	Census	After every _____ years
1	Human	10
2	Animal	5
3	Tiger	4

WHAT IS THE NEED FOR CONSERVING TIGERS?

- To protect elephants, their habitat & corridors
- To address issues of man-animal conflict
- The welfare of captive Elephant

Census

- The elephant census was conducted every five years, and the tiger census every four years. Now both are merged in 2022.
- Total elephant reserve = 33
- Number of elephant reserves : 32 (Largest = Shivalik elephant reserve – UP/UK)
- Population : 29,964 elephants (2017 Census)
- Method : new feature DNA profiling of the elephants is being used | data is not out yet.

The Indian Elephant *Elephas maximus* occurs in the central and southern Western Ghats, Northeast India, eastern India and northern India, and some parts of southern peninsular India. It is included in *Schedule I of the Indian Wildlife (Protection) Act, 1972*, and in *Appendix I* of the Convention on International Trade in Endangered Species of Flora and Fauna (**CITES**).

Activities involving Project Elephant are as follows

- Research on Elephant management related issues
- Public education and awareness program
- Eco-development
- Veterinary Care
- Elephant Rehabilitation/ Rescue centers
- Ecological restoration of existing natural habitats and migratory
- routes of Elephants
- Development of scientific and planned management for the conservation of elephant habitats and viable population of wild Asiatic elephants in India.
- Promotion of mitigation of man-elephant conflict in crucial habitats and moderating pressures of human and domestic stock activities in critical elephant habitats.
- Strengthening measures to protect Wild Elephants from Poachers and unnatural causes of death.



Elephant-8 (or E-8) : it is a consortium of 8 elephant countries. It is hosted by *the Ministry of Environment and Forests, Government of India, in collaboration with the National Tiger Conservation Authority (NTCA), the Wildlife Institute of India (WII), and the Wildlife Trust of India (WTI)*. The countries included are **India**, Botswana, the Republic of Congo, Indonesia, Kenya, Sri Lanka, Tanzania and Thailand. Under the recommendation of this E-8 meeting, [Haathi Mere saathi campaign](#) was launched. The countries present here represent two-thirds of the world's wild elephant population.

Haathi Mere Saathi Campaign : it was launched on **24 May 2011**, by the Government of India and the Wildlife Trust of India (WTI). The campaign is an extension of the Project Elephant, which India had launched in 1992. This *Project offers monetary support to the elephant states (range states)* in the country to operate and sustain protected areas, make secure the habitats and elephant corridors, and handle human-animal conflicts. The campaign also aims to improve the human-elephant relationship from mere friendship to companionship.

FOREST ECONOMICS

INTRODUCTION

SYLLABUS : Fundamental principles, cost-benefit analyses. Estimation of demand and supply

- ▶ **FOREST ECONOMICS :** Application of the principles and practice of economics to the management of forestry (Biological resources).

Application

- * Managing the demand and supply of forest products.
- * Planning and development of forest operations from the harvesting to the marketing & sale of forest products.
- * Capital budgeting and resource allocation.
- * Sustainable management and exploitation of forest resources.
- * Economic management of Human resources (including forest labour), Infrastructure & associated problems, and forest operations.
- * Value addition in forest products.

- ▶ **PRODUCTION :** it means transforming inputs into outputs such as planted saplings growing into a tree and being harvested after a specific time period.

Factors of production : production factors mean inputs required for the production of a good or service.

In the case of forestry, we required -

1. Land
2. Labour : The form of human resources that work in the forest during the production of goods (*i.e.*, Timber) or forest-based service (*i.e.*, Ecotourism).
3. Capital : the monetary resources that are used for the production of something
4. Planting material
5. Technical inputs

- ▶ **PRODUCTION FUNCTION :** a production function is a technological or engineering relation between quantities of physical inputs and quantities of the output of goods. As long as the natural laws of technology remain unchanged, the production function remains unchanged.

Example : Consider a manufacturer who produces shoes. She employs two workers – worker 1 and worker 2, two machines – machine 1 and machine 2, and 10 kilograms of raw materials. Worker 1 is good in operating machine 1 and worker 2 is good at operating machine 2. If worker 1 uses machine 1 and worker 2 uses machine 2, then with 10 kilograms of raw materials, they can produce 10 pairs of shoes. However, if worker 1 uses machine 2 and worker 2 uses machine 1, which they are not good at operating, with the same 10 kilograms of raw materials, they will end up producing only 8 pairs of shoes.

FOREST MARKET

SYLLABUS : Analysis of trends in the national and international market and changes in production and consumption patterns. Assessment and projection of market structures.

- ❖ **MARKET** : an area or place where buying and selling of various goods and commodities taken place.
- ❖ **MARKET STRUCTURE** : The term *structure* refers to something that has organization and dimension (*i.e.*, shape, size and design), and which is evolved for the purpose of performing a function. By the term *market structure*, we refer to *the organizational characteristics of a market including its size, design and manner of operation that affect the nature of competition and pricing, and the operations of business firms*.

COMPONENTS OF MARKET STRUCTURE

1. Concentration of Market Power – means, the element that determining the nature of competition, Conduct & performance of the market. This is measured by the number and size of firms existing in the market. A high degree of market concentration restricts the movement of goods between buyers and sellers at fair and competitive prices, and creates an **oligopoly***** or **oligopsony***** situation in the market.
2. Degree of Product Differentiation - Homogeneous or other nature of the product affects the market structure. If products are homogeneous, the price variations in the market will not be wide. When products are heterogeneous, firms have the tendency to charge different prices for their products.
3. Conditions for entry of Firms in the Market - Sometimes, a few big firms do not allow new firms to enter the market or make their entry difficult by their dominance in the market.
4. Flow of Market Information - A well-organized market intelligence information system helps all the buyers and sellers to freely interact with one another in arriving at prices and striking deals.
5. Degree of Integration - The behavior of an integrated market will be different from that of a market where there is no or less integration either among the firms or of their activities. Firms plan their strategies in respect to the methods to be employed

Monopoly (mono = Single + Poly = Supplier) : a market situation where a specific person or enterprise is the only supplier of a particular commodity.

Oligopoly (some suppliers) - a market situation when there are only a few suppliers (sellers) for the supply of goods or services

Monopsony (Single buyer) - a market situation where a specific person or enterprise is the only buyers of a particular commodity

Oligopsony = few buyer

Perfect (Open) market : a market structure, where a large number of small firms compete against each other. In this scenario, a single firm does not have any significant market power.

CHAPTER 3

FOREST POLICIES

SYLLABUS : History of forest development; Essene of Indian Forest Policy of 1894, 1952 and 1988. National Forest Policy 1988.

1.1 HISTORY OF FOREST ADMINISTRATION

- Chandragupta Maurya was the first king who made an effort to look after the forest of his kingdom by appointing Kupiyadhyaksha.

Kautilya *Arthashastra* : head of forest dept "Kupiyadhyaksha" assisted by several *vanpalas* (Forest guards). They classified forest into four parts (1) forest reserve for the king, (2) reserve forest for the state, (3) forest donated to the Brahmins, and (4) forest for the public.

- **GUPTA PERIOD** (4th – 5th Century AD)

- **DURING ISLAMIC RULE**

- **BRITISH RULE** : The destruction of forests began during colonial rule, fuelled by the Industrial Revolution, politics, religion, and greed.

In 1890, the colonial government appointed Dr. Volker to study Indian agriculture. This was due to the rise of Congress and nationalism. Dr. Volker presented his report "Reforms in Indian Agriculture" in 1893. The report included a separate chapter on forests (Chapter 8), which laid the foundation for the forest policy of 1894. The report aimed to suggest ways to improve Indian agriculture.

1.2 FOREST POLICY 1894***

- ▶ **BACKGROUND** : Dr. Voelker's report (1893) on Indian agriculture.

- ▶ **SALIENT FEATURES**

- The main object of forest management is – to promote the general well-being of the country.
- The maintenance of adequate forests is dictated primarily for the preservation of the climatic and physical conditions of the country and also for meeting the basic requirements of the people.
- The government-owned forests have been classified in this forest policy as -
- Preservation of the climatic and physical conditions of the country

Function

- (1) Forests whose preservation is required on climatic and physical grounds.
- (2) Forests for supplying valuable timber for commercial purposes.
- (3) Minor forests.
- (4) Pasture lands.

	<p>SECTION 36 C : Declaration and management of COMMUNITY RESERVE*** : State govt, declares any <i>private or community land</i> not comprised within a National Park, sanctuary or conservation reserve, as a community reserve.</p> <p>[36D] <u>Community reserve management committee</u> - consists of owners of land + representatives nominated by the Village Panchayat/Gram Sabha + Representative of the state forests or wildlife Department. The committee shall elect a Chairman who shall also be the Honorary Wild Life Warden on the community reserve.</p> <p>SECTION 38 : Central govt may declare any area – SANCTUARY or NATIONAL PARK.</p>
<p>CHAPTER 4A : CENTRAL ZOO AUTHORITY and recognition of zoos [by 1991 Amendment Act]***</p>	<p>SECTION 38 A*** : Central govt shall constitute a body - CENTRAL ZOO AUTHORITY, consisting</p> <ul style="list-style-type: none"> • Chairperson [Minister, MoEFCC] • Upto 10 members • Member – secretary <p>[38B] Office tenure : 3 years***</p> <p>[38 C] Functions of Authority</p> <ul style="list-style-type: none"> * Specify the minimum standards for housing, upkeep and veterinary care of the animals kept in a zoo. * Evaluate and assess the functioning of zoos with respect to the standards prescribed. * Recognize or derecognize zoo * <u>Identify endangered species of wild animals for purposes of captive breeding</u> and assign responsibility in this regard to a zoo; * Co-ordinate the acquisition, exchange and loaning of animals for breeding purposes. * Ensure maintenance of study books of endangered species of wild animals bred in captivity. * Coordinate training of zoo personnel in India and outside India. * Co-ordinate research in captive breeding and educational programs for the purposes of zoos. * Provide technical and other assistance to zoos for their proper management and development on scientific lines; * Perform such other functions as may be necessary to carry out the purposes of this Act with regard to zoos. <p>[38 J] Prohibiting of teasing, etc., in a Zoo</p>
<p>CENTRAL ZOO AUTHORITY</p> <ul style="list-style-type: none"> ❖ Statutory body, under MoEFCC ❖ Chairperson : Minister of MoEFCC ❖ Established in 1992 ❖ Every zoo in the country is required to obtain recognition from the authority for its operation. 	 <p>Central Zoo Authority केन्द्रीय चिडियाघर प्राधिकरण</p>

CHAPTER 1

Chapter outline

- 1.1 Taxonomy
 - ↳ Dendrology
 - ↳ Systematics
- 1.2 Types of taxonomy
 - ↳ New systematics
 - ↳ Taxonomic categories
- 1.3 Importance of taxonomy
- 1.4 Identification of species
- 1.5 Nomenclature
 - ↳ ICBN Rule
- 1.6 System of Classification
 - ↳ Artificial system classification
 - ↳ Natural system of classification
 - ↳ Phylogenetic system of classification
- 1.7 Exercise

TAXONOMY

1.1 TAXONOMY

Taxis (Arrangement) + nomos (Law)

Taxonomy is the study of principles and procedures of plant identification, nomenclature, and classification.

So, Key elements of Taxonomy –

- ▶ **Identification** : A process by which an organism is recognized from the others by an already known organism and is assigned to a particular taxonomic group is called identification.
- ▶ **Nomenclature** : Naming an organism according to international scientific rules is called nomenclature.
- ▶ **Classification** : A process by which an organism is grouped into convenient categories on the basis of some easily observable characters.

Note : **Dendrology** : A branch of forestry that deals with the taxonomy of trees and other woody, plants including nomenclature, classification, identification, and distribution.
(Virtually dendrology works as a branch of taxonomy that deals with trees).

Systematics : A branch of taxonomy deals with the study of diversity of an organism as well as establishing comparative and evolutionary relationships among them based on its anatomy, ecology, physiology and biochemistry comparison.

1.2 TYPES OF TAXONOMY

Alpha taxonomy : The identification and classification of organisms based on only morphological characters is called alpha taxonomy.

Beta taxonomy : It involved not only gross morphological features but also genetic, anatomical, cytological, palynological (pollen and pores study), physiological and other characteristics. It is also called **biosystematics**.

Omega taxonomy : Analysis and synthesis of all information and types of data to develop a classification system based on phylogenetic relationships.

INDIAN FOREST SERVICE (IFOS) 2023



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Divyanshu Pal Nagar

Forestry Comprehensive Course



Akanksha Puwar

Forestry Comprehensive Course



Yogesh Rajoriya

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Kanishak Aggarwal

Forestry Comprehensive Course



Shashi Shekhar

Forestry Comprehensive Course



Vinay Budanur

Forestry Comprehensive Course



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