Hornbill Classes

2024

FORESTRY

CGPSC

STATE FOREST SERVICE

TOOLKIT

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

Paper - 3

- Tree improvement & Seed Technology
- Forest Management
- Working Plan
- Forest Mensuration
- Remote Sensing & GIS
- Forest Engineering

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FORESTRY

MODULE – 3

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Module - 3

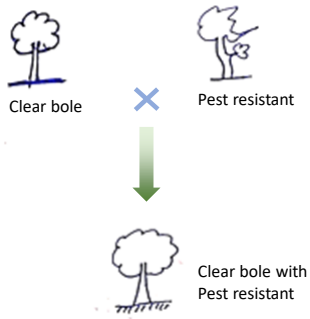
CONTENT

CHAPTER 1

TREE IMPROVEMENT INTRODUCTION

Tree improvement is the process of improving the genetic quality of a tree species. It is also referred to as genetic improvement. The process involves selecting the best trees in a population and using them as parents for the next generation of trees. The goal is to produce trees that are better adapted to their environment and have desirable characteristics such as faster growth, better form, and resistance to pests and diseases.

- *Genetics* is a branch of biology that deals with the study of heredity and variation.
- *Heredity* : It is the transmission of genetic characteristics from parents to the offspring. It deals with the phenomenon of 'like begets like', *i.e.*, human babies are like human beings in overall traits.
- *Variation* : Individuals of the same species have some differences; these are called variations, *i.e.*, Dogs come in many different sizes, People have many different hair colours, etc.
- *Forest Genetics* : Branch of forestry deals with the study of heredity and variation in a forest tree.
- *Tree Breeding* : Tree breeding is the application of genetic, reproductive biology, and economic principles to the genetic improvement and management of forest trees.
- *Tree Improvement* : Improvements in overall yield & quality of forest produce by combining silviculture, tree breeding, and forest management [The *Silvicultural tool* deals with the *genetic makeup* of trees]



► *Heritability* : it is a statistic used in the fields of breeding and genetics that *estimates the degree of variation in a phenotypic trait in a population due to genetic variation between individuals in that population*.

- Heritability is the degree to which progeny resemble their parents. Heritability is the proportion of the total phenotypic variation controlled by genetic rather than environmental factors.
- Values come in between 0 (Zero) to 1. "0" indicates the sampling population has only environmental variations, and there are no genetic variations in the inbreeding population. In contrast, "1" Indicates absolute genetic variations without any environmental effects.

Types of heritability

(a) *Broad sense heritability* – it is the ratio of total genetic variance to the total phenotypic variance.

$$H^2 = \frac{V_g}{V_p}$$

CHAPTER 3

INTRODUCTION OF EXOTICS

METHODS OF TREE IMPROVEMENTS

①	②	③	④
EXOTIC TREE INTRODUCTION	**SELECTION**	**HYBRIDIZATION**	**BIOTECHNOLOGICAL INTERVENTION**
To gain specific products / Quality, *i.e.*, Casuarina	Because they have already adopted the local environment	By breeding	By Tissue Culture, Somatic hybridization, etc.

Exotic plants refer to plant species that are not native to a particular region or ecosystem but have been introduced from other parts of the world. These plants are often sought after for their unique characteristics, aesthetic appeal, or potential economic value, *i.e.*, Teak is exotic in UP. But, for practical purposes, an exotic is defined as an introduction of a species from a foreign country.

FACTORS GOVERNING THE INTRODUCTION OF EXOTICS

- Economic importance
- Invasive potential : Their aggressive growth, lack of natural predators or diseases, and ability to adapt to new environments make them difficult to eradicate or control once established. Now they start disrupting native ecosystems, threatening biodiversity, and causing ecological imbalances.
- Management challenges [Requirement of Technical skill]
- Availability of fund
- Aesthetic value : often chosen for their distinctive features, such as vibrant flowers, unusual foliage, or striking growth habits. They are commonly used in gardens, parks, and landscaping projects to enhance visual appeal.

ADVANTAGES OF EXOTICS

- Exotics *Provide a much wider choice of species* suited to the site and other requirements, especially when there are no suitable indigenous species.
- *R & D of 1 country* can be shared and utilized by other countries.
- Some may *perform well in exotic land* than their natural habitat due to the *absence of pests* & diseases outside of their natural habitat, at least for some rotation, *i.e.*, The leaf-eating insect in Eucalyptus species is quite common in Australia, whereas in India, it is absent.
- *Fast-growing* + higher quality of product = increase *productivity and production* of our forest.
- It can also help to meet the immediate requirements of our industry.

DISADVANTAGES OF EXOTICS

CHAPTER 4

SELECTION METHOD

Selection means the process of assessing and choosing genotypic and phenotypic superior tree species in a natural or planted forest, often based on the growth rate, tree form, and site adaptation traits.

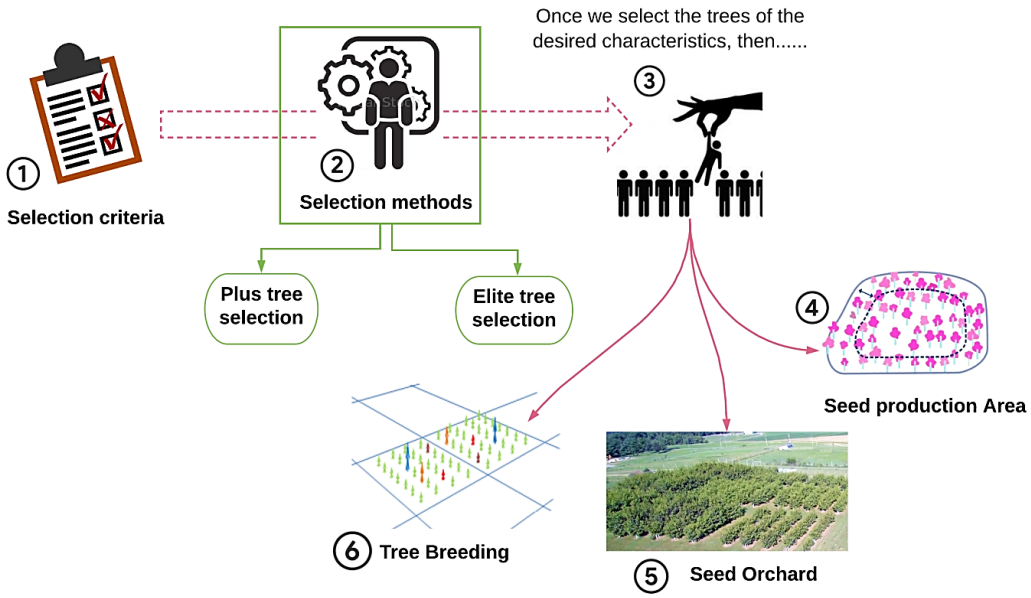


Figure 4.1 : Steps in tree improvement program

4.1 SELECTION CRITERIA

Sometimes, we do not obtain trees that possess the essential characteristics we need, even among exotic species. In such instances, we must undertake the development of these types of plants to fulfill our specific industrial requirements. However, prior to commencing a selection process for tree improvement endeavors, it is crucial to be aware of the desired requirements or characteristics that we intend to incorporate into a newly developed species. These may include properties such as insect-pest resistance, rapid growth rate, straight timber, high lignification, thornlessness, and other attributes based on our particular needs.

SELECTION CRITERIA FOR A TIMBER SPECIES

- Large size tree (in height)
- No forking,
- Fast-growing,
- Small and narrow crown,
- Straight and clean bole, thin-bark,
- Self-pruning habit,
- High insect-pest resistance,

CHAPTER 8

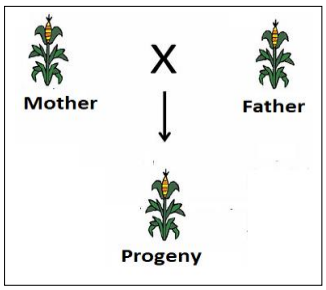
HYBRIDIZATION
[Tree Breeding]

Hybridization is the process of interbreeding between genetically divergent individuals from the same species (intraspecific hybridization) or individuals of different species (interspecific hybridization).

- Progeny or Offspring is known = *Hybrid*

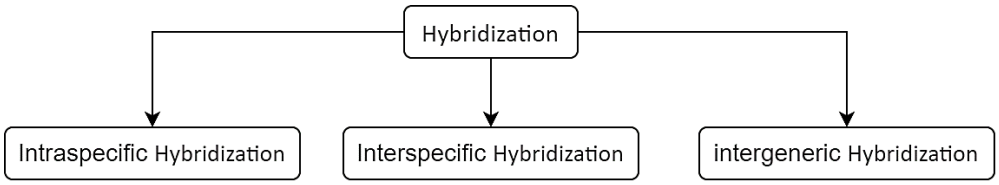
OBJECTIVES OF HYBRIDIZATION

our prime aim is to improve the various characteristics of plants so that they become more desirable silviculturally, ecologically, pathologically, and economically.



- Higher yields
- Improve quality
- Disease and insect resistance
- Reducing seed dormancy period and rotation age
- Improving its silvicultural characteristics like a small crown, low branching habit, tapering rate, strong and deep taproot system, etc.
- Development of photo and thermo-insensitive tree crops for making them climatically resilient.
- Development of varieties for afforestation of semi-arid and saline-alkaline area (moisture stress and salt tolerance).
- Elimination of allelopathic effects.

TYPES OF HYBRIDIZATION



- *Intraspecific hybridization* : interbreeding between the genetically divergent individuals of the same species.
- *Interspecific hybridization* : interbreeding between the individuals of different species.
- *Intergeneric hybridization* : it is a cross between plants in two different genera in the same family.

ADVANTAGES OF HYBRIDIZATION IN FORESTRY

- Heterosis = improve production and productivity = increase financial gain
- It can help in the reduction of rotation age by festering its growth rate.
- Production of triploids (3n) or Haploids (n) is possible by inducing polyploidy.

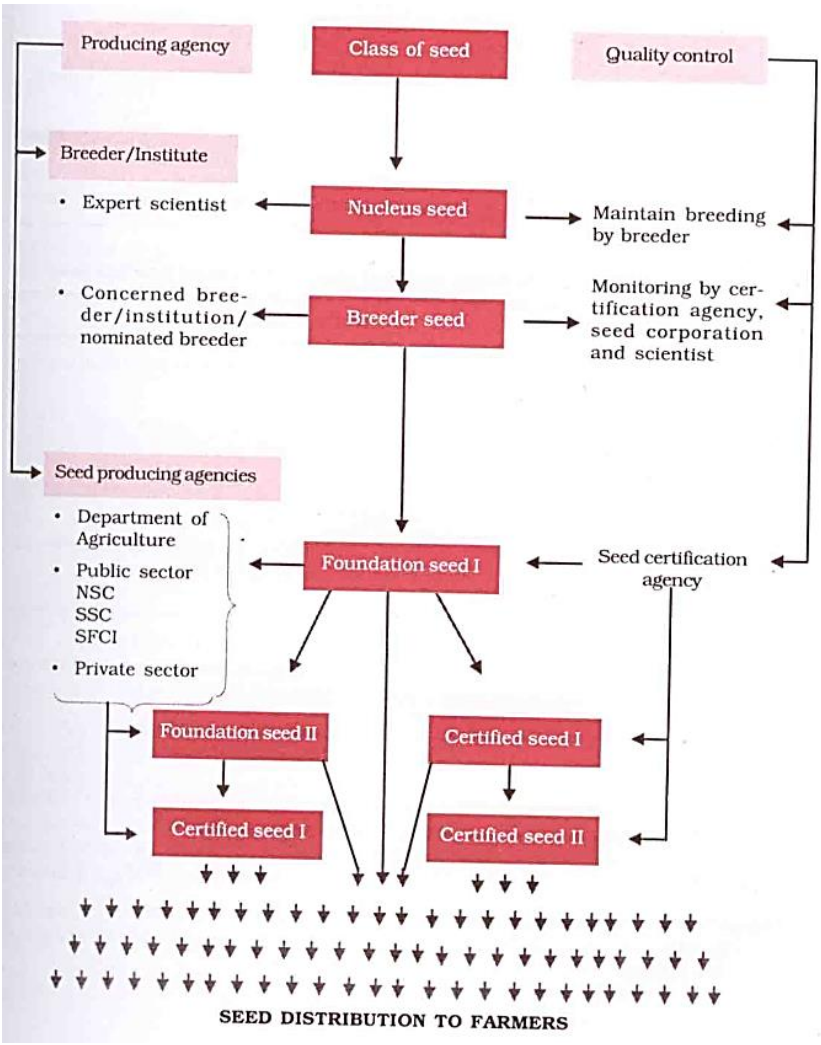
- We also required a most transparent and practical framework to promote foreign private firms to India in this sector (Forest), which almost has a negligible presence of private sectors except for Poplar, Salix, and eucalyptus.
- The emergence of Biotech, Genetic engineering, and nanotechnology may have great potential in developing Tree varieties in a short duration. This is one of the major hurdles in tree improvement programs as trees require a long time from their Regeneration to 1st- time good quality seed production (Almost 20/30 years, even more for many species).

► **IS THERE A FOREST SEED CERTIFICATION ACT IN INDIA?**

Answer : No, the Seed Certification Act for forestry seeds is not in force in this country. However, some state forest departments may certify seeds collected from their state.

► **SEED CERTIFICATION TAGS IN AGRICULTURE?**

- Nucleus seed : No Specific tag
- Breeder Seed : **Golden** Yello
- Foundation Seed : **White** tag
- Certified Seed : **Azure blue** tag
- Truthful labelled seed : Opel Green



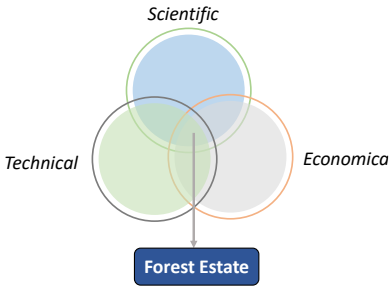
CHAPTER 1

FORESTRY MANAGEMENT
[INTRODUCTION]

The foundation of our policy shifted from a *production forestry* point of view to *protection forestry*. Even in the case of production forestry areas, we *started considering the impact of harvest practices on the local ecology and biodiversity, Wildlife, watershed, Tribal livelihood, and Carbon sequestration ability of forest*. These lay down the foundation for more smooth and sustainable regulation of forest resources with *strategic* and *Tactical harvest planning*.

1.1 DEFINITION

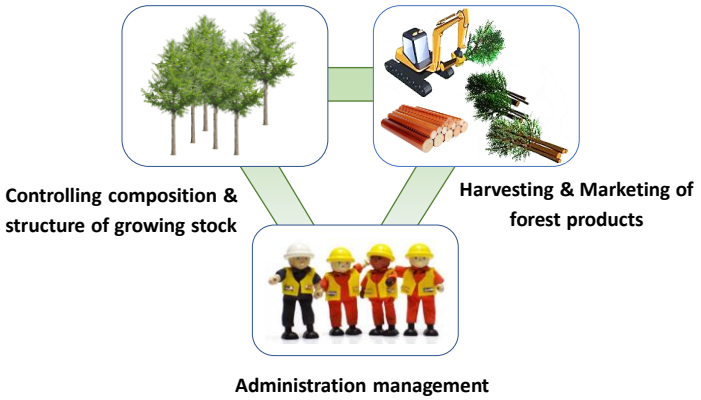
The *practical application* of the *scientific, technical,* and *economic principles* of forest estate for the achievement of *certain objectives*.



Forest Management is the application of *business methods* and *technical forestry* principles to the operation of a forest property.

1.2 SCOPE

Controlling the structure & composition of growing stock - through Site-selective tending operations, Choice of species, Regeneration methods, stand manipulation and Protection measures, etc.



Chapter Outline

CHAPTER 2

FOREST ORGANIZATION

In 1806 the government of Madras appointed Captain Watson as the first conservator of forest, which laid the foundation of modern-day forest administration. It was further strengthened with the establishment of the Indian Forest Service in 1867. For a *Better Description*, *Administration*, *Management*, and *Record-Keeping*, forest administration is generally divided into 3 major categories. These categories are –

A. Territorial classification or system
B. Administrative (or Organizational) structure
C. Management (or Silvicultural) classification

2.1 TERRITORIAL CLASSIFICATION

At range level, a forest area is divided into Blocks, Compartments, and Sub-Compartments based on its executive and protective functions.

- Forest **Block** : In general, A forest range is divided into 15 to 30 blocks, which are the *main territorial divisions*. A block usually has a distinct *clear-cut boundary* all around marked by numbered pillars and *has its Local proper name, i.e.*, Haldwani block.
- **Compartment** : A forest block is divided into several compartments, which are the permanently defined forest territorial Units for the purposes of administration and record.
  - A compartment is a ***permanent***, ***recognized geographic*** *unit of forest land* forming on the basis for planning, prescription, monitoring, and permanent record of all forest operations.
  - Use Arabic numbers 1, 2, 3, etc. for their naming
  - It is the **smallest permanent working plan unit** of management, Its Boundaries are chosen carefully on the ground and marked on the map. The boundaries are formed either by natural features such as ridges, valley bottoms, streams or artificial fire lines, etc.
  - The average size of the compartment : 100-500 hac., depending upon the aim and intensity of forest management.

Chapter Outline

CHAPTER 6

IMPORTANT TERMINOLOGY

6.1 GROWING STOCK

Growing Stock is the sum (Number or volume) of a total of trees growing in a forest or a specific part of it, which has more than a certain diameter at breast height (DBH).

Figure : Growing stock also known as **Forest Capital**

The concept of growing stock is relative, and what one can include in it and what cannot depend upon one's views and objects of forest management. I mean, if our object of forest management is the production of timber, then we count trees of specific diameter only (above specific DBH). If our forest management objectives are carbon capturing and storage, we estimate all above-ground and underground biomass in growing stock; it includes all trees, climbers, stumps, leaf litter, underground roots, etc.

IMPORTANCE OF GROWING STOCK

Periodic estimation of the growing stock is essential for developing national policies and strategies for the sustainable use of forest resources.

- Provides information about (i) the volume of wood available inside forests, (ii) Current Forest carbon storage and carbon sinking potential, (iii) the tangible economic value of forests. This will help in forest certification, carbon trading, and fulfilling our INDC's obligations (2.5 to 3 billion tonnes of carbon sink storage.
- It provides information about site productivity, species composition, and the value of our existing forest resources.

Chapter Outline

CHAPTER 8

WORKING PLAN

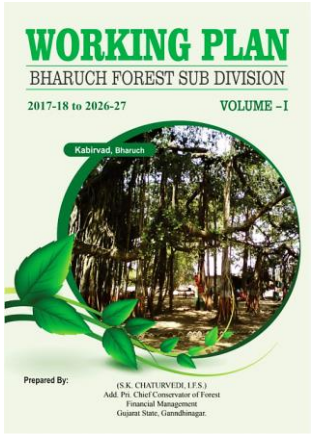
Let's suppose we wanted to initiate a commercial forest enterprise, similar to agriculture. In that case, systematic planning would be necessary, starting from site preparation and regrowth of vegetation to the final felling and marketing of the harvested products. Since a forest crop is not a seasonal or annual crop like wheat, and its rotation can be less than 40 to 50 years, in addition to production, we also consider other aspects such as protective measures, socio-economic development for tribals, and wildlife conservation. To achieve these goals, we require a brief yet detailed, fact-based plan that can effectively manage, regulate, control, and direct our operations for at least the next 10 to 15 years.

Chapter Outline

NEED

- It is common for foresters/IFoS officers to get transferred after 2/3 years (± promoted, retired, or die); then who would remember which treatment they have already given to the local stand and which is not?
- Forests are also facing high biotic pressure, soil erosion, climate change, and fire incidences. Therefore, they must also be managed in a certain way (in a sustainable manner) with long-term planning.
- Wildlife is also a component of the forest ecosystem; we cannot leave them or drive them out of the area.
- CAMPA plantation and REDD$^+$ type initiatives give much attention to the prevention of forest degradation.

Therefore, we needed a written document to establish a sustainable plan based on ground-based observations, all needed facts, and scientific principles, so no one could affect our continuity of operation, whether the officer was transferred, promoted, retired or died.



Working plan works as a tool for scientific forest management

► **DEFINITION** : A working plan is "***a written scheme of management aiming at the continuity of policy and action besides control treatment of a forest***".

► **OBJECTIVES**

CHAPTER

1

FORESTRY MENSURATION [INTRODUCTION]

The term mensuration has traditionally been defined as a branch of mathematics that deals with the measurement of lengths, areas, and volumes. In forestry, it encompasses determining the dimensions, form, weight, growth, volume, health, and age of trees, individually or collectively.

► **Definition :** Forest is the *branch of forestry that deals with the determination of dimensions (i.e., diameter, height, volume), form, age, and increment of a single tree, stand, or a whole forest, either standing or after felling****

FOREST BIOMETRY

Forest + Bio (living thing) + Metry = Measurement

Forest **Biometrics** is the science of **forest** (Bio) **measurement** (metrics). It includes quantifying the biological and physical attributes of trees and their vegetation, insects, diseases, wildlife, topography, soils, and climate, both individually and collectively. These characteristics include all quantifiable attributes within forestry, both temporal, and spatial.

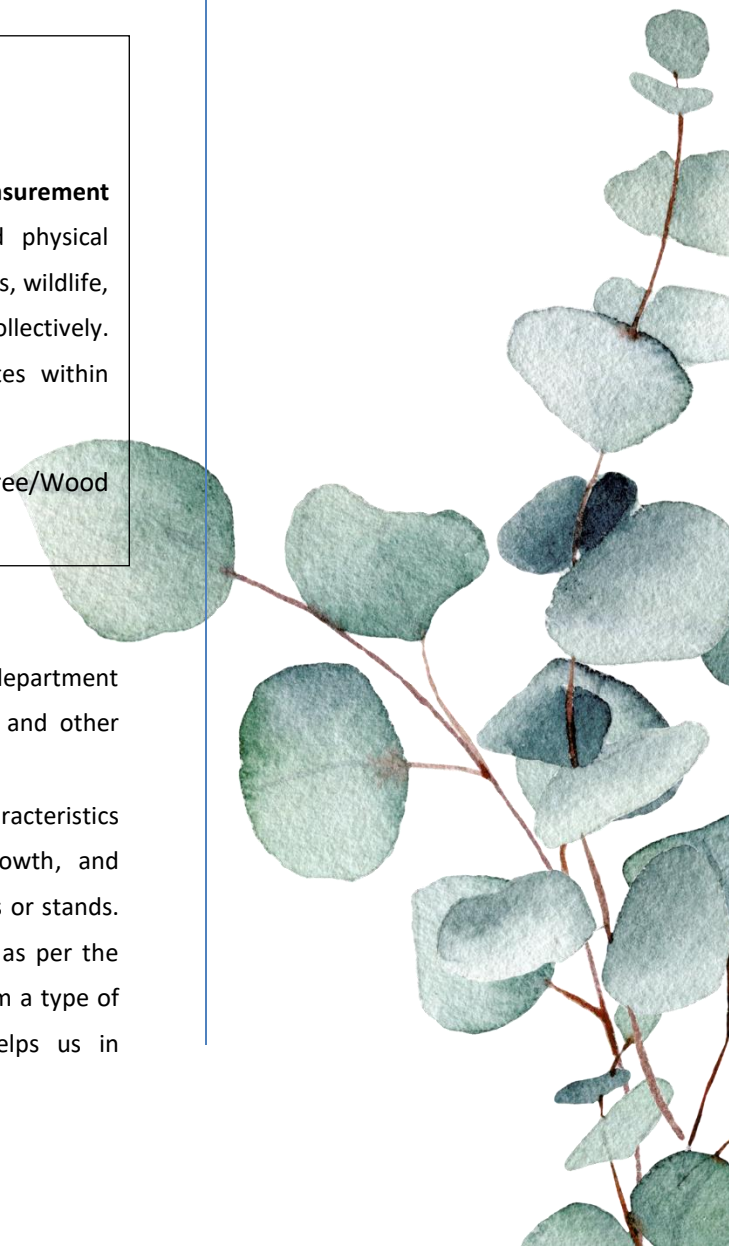
Similarly, Dendrometry : Dendron (Greek word) = tree/Wood
+ Metrum (Latin) = measure

► **OBJECTIVES**

- **The basis for sale** : Before any sale, the forest department estimates the quality and quantity of timber and other forest products and prices them accordingly.
- **For research** : (a) quantifying stand characteristics (volumes, weights, etc.), measuring past growth, and predicting the future growth of individual trees or stands. (b) To obtain a specific size or quality timber as per the requirement of our industries, after giving them a type of silvicultural treatment. Mensuration here helps us in

Chapter Outline

- Definition
- Objectives
- Scope
- Measuring units



CHAPTER

3

HEIGHT MEASUREMENT

3.1 BASIC TERMINOLOGY

- **TREE HEIGHT** : the straight line distance from the ground level to the tip of the leading shoot.
- **CROWN POINT** : Crown Point is the position of the first crown forming living or dead branch.
- **BOLE HEIGHT** : The distance between ground level and Crown Point.
  - *Commercial bole height* : the height of bole up to which it is usually fit for timber utilization.
  - *Standard Timber Bole Height* : The height of the bole from the ground level to the point where diameter over bark is 20cm (in case of Timber) or 10 cm (for pulpwood).
- **CROWN LENGTH** : The vertical measurement of the crown of the tree from the tip to the point halfway between the lower green branches forming green crown all round and the lowest green branch on the bole.

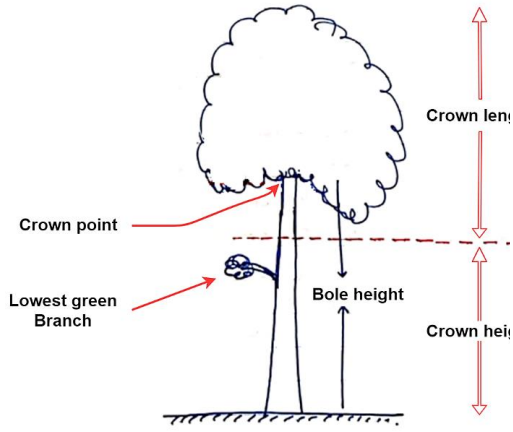


Figure 3.1 : Various terminology

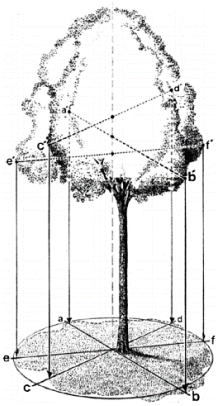


Figure 3.2: Horizontal crown projection

Chapter Outline

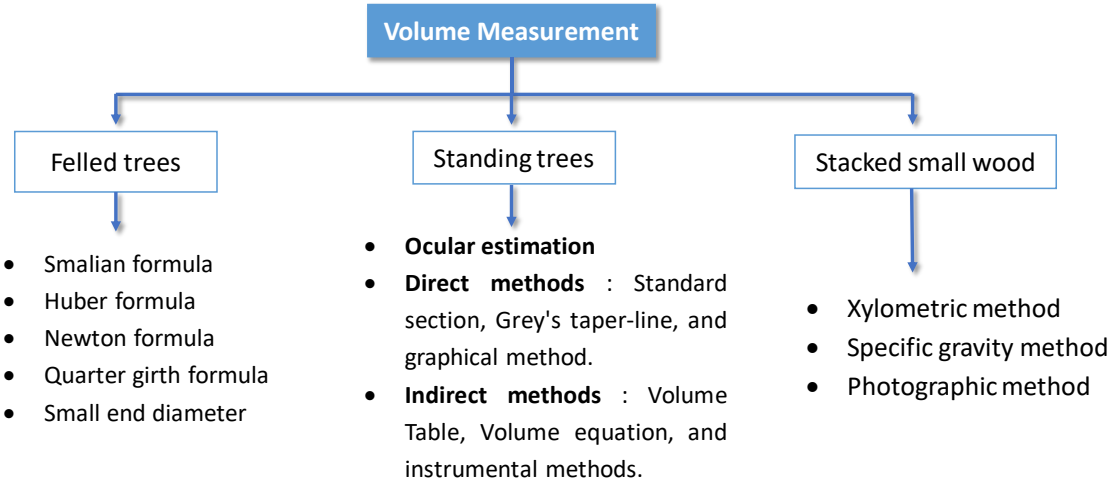
CHAPTER 5

VOLUME MEASUREMENT

We now reach our targeted chapter which discusses volume measurement under the following sub-headings –

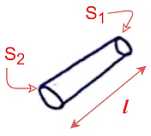
- Volume calculation of both – Felled and Standing tree.
- Volume measurement of fuelwood stocks and billets
- Volume table
- Related terminology

5.1 VOLUME CALCULATION



5.1.1 VOLUME MEASUREMENT OF FELLED TREES

As we know, the shape of felled log volume may be – Cylindrical, Paraboloid, Cone, or Neiloid, and they may be scatted on the ground or stocked during measurement.

SN	Method	Point of measurement	The volume of a frustum of solid	Applicability	Remarks
1.	***Smalian's*** formula		$V = \frac{S_1 + S_2}{2} \times l$ *l = Log length* *S = Cross-section area*	For solids of *Paraboloid* shape.	Only ends diameter are required.

CHAPTER 6

WEIGHT & BIOMASS

6.1 WEIGHT

The weight of a standing tree cannot be measured directly, but it can be predicted by using many other variables like tree diameter-weight relationship, Volume and Density relationship, etc.

Importance

- Purchasing and selling of small wood, Paper and pulp industry
- Most of the minor forest produce and fuelwood trade on a weight basis, *i.e.*, Grasses, gams, resin marketing.

Advantages of Weight Scaling

- The method is fast, requires no special handling, and saves time for both buyer and seller.
- It encourages the delivery of freshly cut wood to the mill.
- Wood-yard inventories are more easily maintained because of greater uniformity in record keeping

Factors Affecting Weight

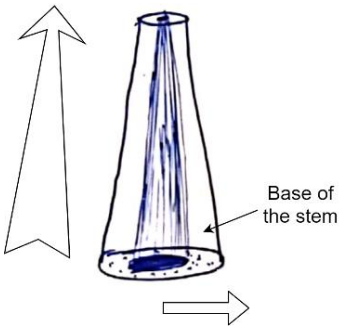
- **Density** : it is the mass of wood per unit volume. It decreases from the Base to the top and from the center to the outer surface of a log/stem.

  Note : *Specific gravity* or *Relative density* = $\frac{\text{Density of wood}}{\text{Density of water}}$

DENSITY OF CERTAIN IMPORTANT INDIAN TREE SPECIES

SN	Species	Specific gravity	Mass Per Unit volume
1.	*Abies pindrow*	0.37	
2.	*Cedrus deodara*	0.47	
3.	*Tectona grandis****	0.55	550 kg/m^3
4.	*Acacia nilotica****	0.67	670 kg/m^3
5.	*Dalbergia sissoo*	0.70	700 kg/m^3

Chapter Outline

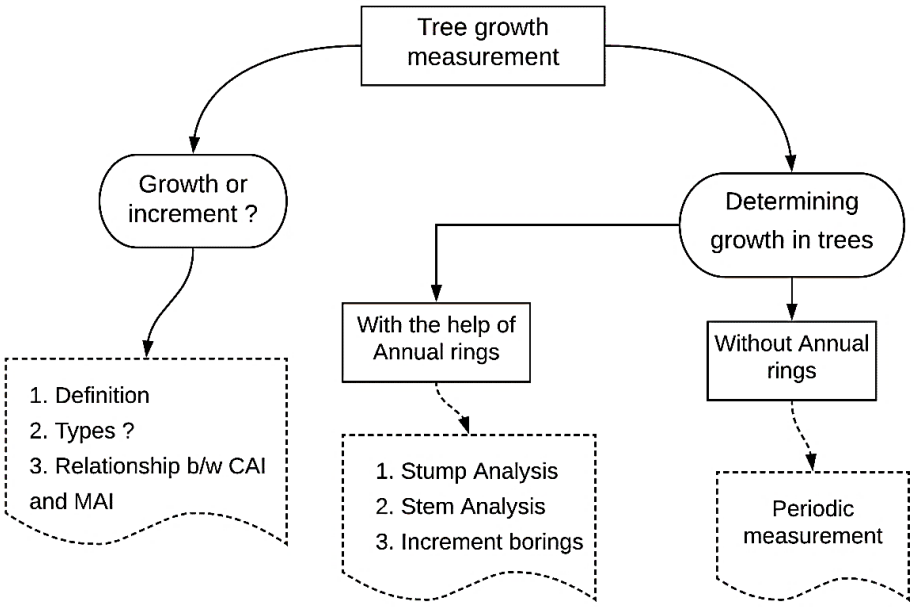


CHAPTER

8

TREE'S GROWTH DETERMINATION

Trees' growth means incrementing their size through elongation and thinking of roots, stems, and branches. So here we will study –



8.1 INCREMENT AND INCREMENT %

- **Increment** : means an increase in girth, diameter, basal area, height, and the volume of a tree during a given period of time.
- **Types** : Current annual increment (CAI), Mean annual increment (MAI), Periodic annual increment (PAI).
- **Increment percentage** : The average annual growth in diameter, basal area, or volume of a tree during a specific period of time expressed in % as it has at the beginning.

1. **Pressler's formula**[***]

   * Diameter increment % (P) = $\frac{200}{n} \times \frac{D-d}{D+d}$

   * Volume increment % (P) = $\frac{200}{n} \times \frac{V-v}{V+v}$

2. **Compound interest formula**[***]

   * Diameter increment % (P) = $100\left[\left(\frac{D}{d}\right)^{1/n} - 1\right]$

Where,

d = Initial diameter

D = end diameter

n = number of years

v = Initial volume

V = Volume after n year

n = number of years

(b) For Studying growth behaviors and the effect of certain treatments upon them.

(c) Estimate the condition of forests and estimates of change in these forest attributes and indicators of biodiversity.

(d) Site quality, Soil composition, and distribution.

- **Types of sample plot**

On the basis of shape : (a) Circular, (b) Square, (c) Rectangular, (d) Polygonal or (e) Strips

On the basis of time: (a) Temporary, (b) Permanent.

On the basis of Size : (a) Small, (b) Medium, (c) Large. [Standard size = 0.1 to 0.2 hec.]

PRESERVATION PLOTS

Preservation plots are *miniature nature reserves to represent ecological models of different forest types*. As per the revised classification of Champion and Seth (1968), there are 25 major forest types occurring in the Madhya Pradesh. In order to represent different forest types of the state, there are 39 preservation plots established in protected and unprotected forest areas of the state on the recommendation of 3rd All India Silvicultural Conference, 1929. Out of 39 preservation plots, 26 are of recent origin and rest are established from 1931 onwards. It is very essential to protect the plot from grazing, fire and illicit cuttings, preservation plots are valuable assets to conduct ecological studies. Growth data of miscellaneous species occurring in natural forests have not yet been recorded and can be recorded through these preservation plot. The preservation plots will serve the purpose to conduct growth and carbon sequestration studies.

The study of these preservation plots would be of vital importance for measuring potential of our forests to serve as not only a carbon offset both (above and below ground) and to determine the potential for mitigation of atmospheric CO2 emission but also successional pattern of different forest types of the state. Database on growth characteristics of naturally occurring miscellaneous species will also help to identify site specific species for plantation programmes and to determine the standing volumes of miscellaneous species in different edapho-climatic conditions.

Fencing in preservation plot

Shahdol (Karua) PP

Shahdol (Lamer) PP

Source : http://mpsfri.org/index.php/preservation-plot

CHAPTER 12

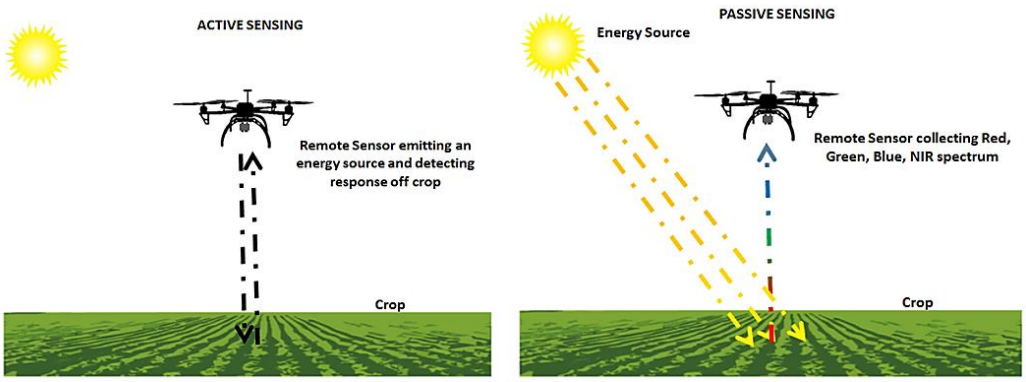
REMOTE SENSING
[INTRODUCTION]

Remote sensing is a technique of *acquiring information* about some property of an object *with the help of recording devices* such as camera, laser, radio frequency receiver, radar system, etc., *without any physical contact with them*.

12.1 TYPES OF REMOTE SENSING

► **Classification based on source of energy**

- Active remote sensing : Sensors emit their own energy, then analyze the reflected or scattered energy to gather information about the target. Examples include RADAR, LiDAR, and SONAR.
- Passive remote sensing : Passive sensors, such as microwave radiometers, do not emit energy to collect information but rely on natural energy sources like sunlight and thermal radiation to detect a target.



► **Based on platform**

- Ground borne platform : Platforms are used on the surface of the earth.
- Aerial or airborne remote sensing : The most common method, by using airplanes, balloons, drones etc.
- Space remote sensing – by using satellite-based sensors, *i.e.,* LANDSAT

► **Classification based on the region of the electromagnetic spectrum**

- Optical remote sensing
- *Microwave* remote sensing
- *Infra-red* remote sensing
- *Thermal* remote sensing
- LiDAR
- SONAR

CHAPTER 1

FOREST ROADS & BRIDGES

Chapter outline

1.1 FOREST ROADS

Road is an open and wide way connecting one place to another and makes it easy to move vehicles and people. If these roads are constructed in or around the forest areas, they are called **Forest roads**.

TYPES OF ROADS

- Based on the time period, it will be used.

TEMPORARY	PERMANENT
	
Usable only for dry & winter Months	All weathered and motorable road

- Based on **LOCATION** : (a) inside the forest, and (b) peripheral road
- Based on **USE**
  - (i) **Main motorable road** : main road connected HQ to the forest block, important rest houses and forest depots. They are the metalled road with well-drained and are being used throughout the year.
  - (ii) **Branch (Feeder) Jeepable road** : these are the feeder road connecting interior forest areas with the main road. These are the usual earth roads, though in some cases, the surface may be improvised by spreading sand, gravel, or laterite stones.
  - (iii) **Bridle paths** : Prepared for a quick and direct route from place to place to transport the timber by animals.
  - (iv) **Inspection paths** : the narrow path of 06 to 1-meter width, usually constructed in and around each sub-compartment, make them assessable

1.3 PYQs SUMMERY

- Earthen roads or low-cost roads are generally constructed as – **Village roads**
- The strip of land acquired and reserved for construction and future development of a road symmetrically about the central alignment is called – **Right-of-way**

  Right of Way (ROW) = Roadway + 2 (Margin)

  Right of way (ROW)= Carriage way + 2 (Shoulder) + 2 (Margin)
- The full width of road acquired before finalizing a highway is – **Right way**
- The road within a city or town is called as – **Urban Road**
- A road connecting one town with another town is called a – **Highway**
- The road connecting district headquarters of a state is – **State Highway**
- The portion of the road for high-speed vehicles is known as – **Express way**
- The maximum allowable width of any vehicle as per Indian Roads Congress – **2.5 m or 2.44 m**
- The road surfacing should be – **Impervious, Durable, Stable**
- Normal formation width of a hill road for one-way traffic, is – **4.8 m**
- Camber in the road is provided for – **effective drainage**
- Centre of the road is elevated with respect to edges, this is – **Camber**
- The highest point (in cross section) of a curved road surface, commonly at or near the centre is called as – **Crown**
- The slope of the road pavement in the longitudinal direction is called – **Gradient**
- The rate of rise of fall or road surface along its length with respect to the horizontal is – **gradient**
- It is defined as the total rise or fall between any two points chosen on the alignment divided by the horizontal distance between two points – **Average gradient**
- The portion of a road used by vehicular traffic is called – **carriage**
- To measure the covered distance, the vehicle's wheel is attached to the vehicle – **Odometer**
- Super elevation on road is – **Directly proportional to the speed of vehicle**
- The slope on the road surface generally provided on the curves is known as – **Angle of banking**
- The amount by which the outer end of the road or outer rail is raised above the inner one is known as - **Super-elevation**
- When the centrifugal ratio attains a value equal to the coefficient of lateral friction, there is a danger of – **Lateral skidding**
- The survey involves in the collection of information about the elevation of point is – **Topographic survey**
- Topographic map is prepared by – **Survey of India department**
- The correct sequential stages of engineering surveys to be done for a new highway alignment project – **Map study – Reconnaissance – Preliminary survey – Final location and Detailed survey**
- Road alignment assessment in hilly areas .... than in plain areas – **is more difficult**.
- The ideal alignment of highway between two towns should be – **short, easy, safe and economical**
- Alignment of road is finally decoded on the basis of – **Field survey**

CHAPTER 4

CHAIN SURVEY

Chapter outline

4.1 DEFINITION

Chain surveying is the method of land surveying in which only linear measurements are taken with the help of a chain and *no angular measurements are recorded*. Here, the tie lines and check lines control the accuracy of work.

4.2 PRINCIPLE

The principle of chain surveying is *triangulation*. This means the entire targeted area that needs to be surveyed is divided into a number of small triangles which should be well-conditioned.

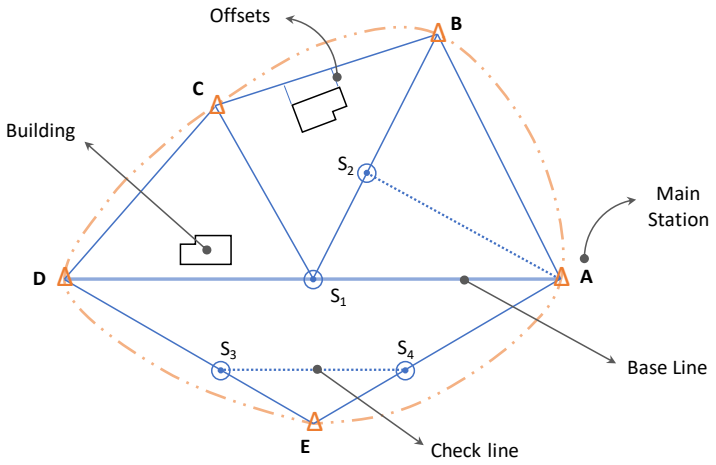


Figure : A network of triangles

A CHAIN SURVEY IS RECOMMENDED WHEN

- The ground surface is more or less level, *i.e.,* river flat plains or valleys.
- The surveyed area is small
- The formation of the well-conditioned triangle is easy
- When we required a small-scale map.

CHAPTER 5

COMPASS SURVEY

Chapter outline

In chain surveying, the area to be surveyed is divided into a number of triangles. Hence, this method is suitable for small areas of fairly level ground. When the area is large, undulated, and crowded with many details or follows a river or coastline, *triangulation* (which is the basic principle of chain surveys) is not feasible. In such an area, the method of *traversing* is adopted.

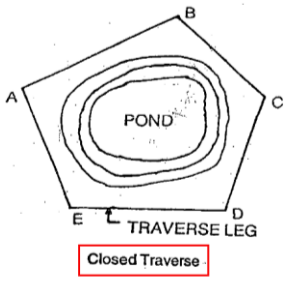
In traversing, the framework consists of a set of connected lines. Lengths are measured by chain or tape, and directions are identified by angle measuring instruments, such as a compass. Therefore, the process is called *compass traversing*.

5.1 DEFINITION

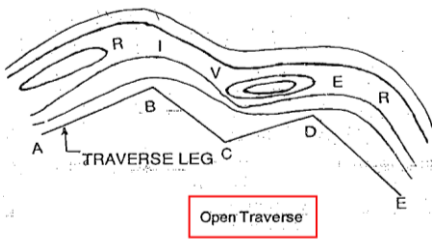
Compass surveying is a type of surveying in which the directions of surveying lines are determined with a magnetic compass, and the length of the surveying lines is measured with a tape or chain, or laser range finder.

5.2 PRINCIPLE OF COMPASS SURVEY

Traversing involves a series of connected lines. The distance of lines is measured by the chain, and the angle between lines are calculated by compass.



Closed Traverse



Open Traverse

5.3 RELATED IMPORTANT TERMINOLOGY

- **True meridian** : The line or plane passing through the geographical north pole and geographical south pole is known as the 'true meridian' or 'geographical meridian'.

CHAPTER 7

LEVELLING

Chapter outline

7.1 INTRODUCTION

LEVELLING is the art of determining the relative *vertical distances* of different points on the earth's surface. Therefore, in levelling, the measurements are taken only in the vertical plane.

Object

The aim of levelling is to determine the relative heights of different objects on or below the surface of the earth and to determine the undulation of the ground surface.

Importance

- To *prepare a contour map* for fixing sites for reservoirs, dams, barrages, etc. and to fix the alignment of roads, railways, irrigation canals, and so on.
- To *determine the altitudes* of different important points on a hill or to know the reduced levels of different points on or below the surface of the earth
- To prepare a *longitudinal section* and cross-sections of a project (roads, railways, irrigation canals, etc.) to determine the earthwork volume.
- To prepare a *layout map* for the new plantation site, water supply, and drainage, etc.

7.2 RELATED BASIC TERMINOLOGY

- **Level line** : Any line lying on a level surface is called a level line.
- **Horizontal plane** – any plane tangential to the level surface.
- **Vertical Plane** : Any plane passing through the vertical line is known as the vertical plane
- **Datum line*** : This is an ***imaginary level line*** from which the vertical distances of different points (above or below this line) are measured. In India, the datum adopted for the Great Trigonometrical Survey (GTS) is Karachi's mean sea level (MSL).

CHAPTER 9

BUILDING MATERIAL

Chapter outline

Building materials have an important role to play in this modern age of technology. Although their most important use is in construction activities

9.1 STONE

Stones used in construction are derived from the rocks forming the crust of the earth's surface.

TYPES OF ROCKS

- According to geological formation : (a) igneous rock, (b) Sedimentary rock and (c) Metamorphic rock.
- According to chemical composition : (a) Siliceous Rocks, *i.e.,* Granite. (b) Calcareous Rocks, *i.e.,* Limestone. (c) Argillaceous Rocks, *i.e.,* Slate.

9.2 BRICKS

It is the artificial block of burnt clay used for building purposes.

CONSTITUENTS OF BRICK EARTH

The main constituents of good brick earth are alumina, silica, lime, oxide of iron, and magnesia.

- Alumina : This is the main constituent of every kind of brick earth. This imparts plasticity to the earth so that it can be molded.
- Silica : It exists in brick earth as free sand. The presence of silica prevents cracking, shrinking and warping of raw bricks.
- Lime : It enables the silica to melt during burning and bind the particles together.
- Iron oxide : It acts as a flux and helps the grains of sand to melt and bind the particles of clay together. It is responsible for imparting a red color to the brick.
- Magnesia : create a yellow tint and decreases shrinkage. Excess of magnesia causes decay of bricks.

CHAPTER 10

BUILDING CONSTRUCTION

Chapter outline

10.1 INTRODUCTION

Forest managers are required to construct different types of building like office buildings, staff quarters, Nursery stores, rest houses, etc. in various localities. Hence the design, construction and maintenance of such buildings are very important aspects of their jobs which should be carried out properly and in a systematic manner

TYPES OF BUILDINGS

- Administration buildings
- Residential buildings, *i.e.*, Staff quarters, Hostels,
- Storage buildings, *i.e.*, Nursery storage
- Educational buildings, *i.e.*, Training center
- Forest chaukies

COMPONENTS OF BUILDING

- **Sub-structure** or **foundation** : It is the lower portion of a building, usually located below the ground level, which transmits the load of the super-structure to the supporting soil.
- **Super structure** : It is a part of structure which is above ground level, and which serves the purpose of its intended use.

A building has the following components : Foundations, Masonry (Walls & columns), Floor, Roof, Doors & Windows, Stairs, etc.

SITE SELECTION

The chief considerations that govern the choice of site for a forest building are

- Situation and Accessibility : Select a place near a forest village or strategic locations, *i.e.*, waterhole, Road-railway connectivity, entry gate of National parks or Wildlife sanctuaries, etc.
- Good water supply: For construction, Nursery and domestic use.

CHAPTER 11

CONTOURING

Chapter outline

11.1 CONTOUR LINE

The line of intersection of a level surface with the ground surface is known as the contour line or simply the contour. It can also be defined as a line passing through points of equal reduced levels. For example, a contour of 100 m indicates that all the points on this line have an RL of 100 m.

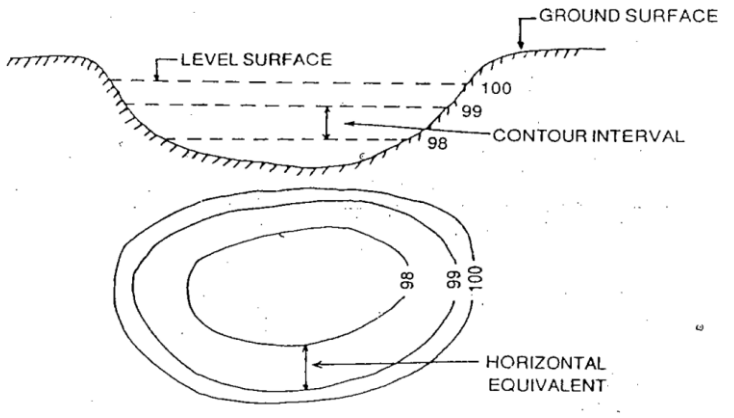


Figure 11.1 : Contour interval and Horizontal equivalent

CONTOUR INTERVAL

The *vertical distance between any two consecutive contours* is known as a contour interval. Suppose a map includes contour lines of 100 m, 98 m, 96 m, and so on. The contour interval here is 2 m. This interval depends upon: (i) the nature of the ground (*i.e.* whether flat or steep), (ii) the scale of the map, and (iii) the purpose of the survey. Contour intervals for flat country are generally small, *e.g.*, 0.25 m, 0.50 m, 0.75 m, etc. The contour interval for a steep slope in a hilly area is generally greater, *e.g.*, 5 m, 10 m, 15 m, etc.

HORIZONTAL EQUIVALENT

The horizontal distance between any two consecutive contours is known as horizontal equivalent. It is not constant. It varies according to the steepness of the ground. For steep slopes, the contour lines run close together, and for flatter slopes they are widely spaced.

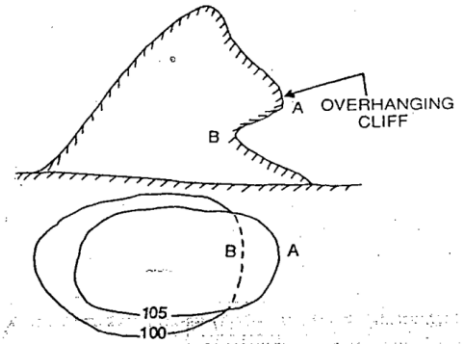


Figure 11.6 : Overhanging cliff

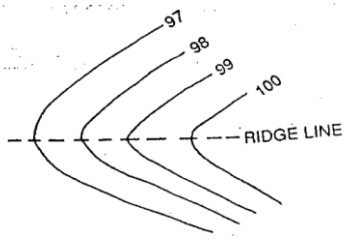


Figure 11.7 : Ridge line

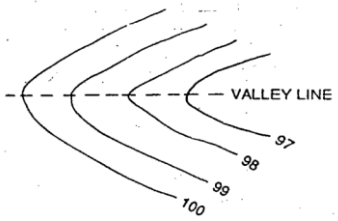


Figure 11.8 : Valley line

- A series of closed contours always indicates a depression or summit. The lower values being inside the loop indicates a depression and the higher values being inside the loop indicates a summit (Fig. 11.9).
- Depressions between summits are called saddles (Fig. 11.10).
- Contour lines meeting at a point indicate a vertical cliff (Fig. 11.11).

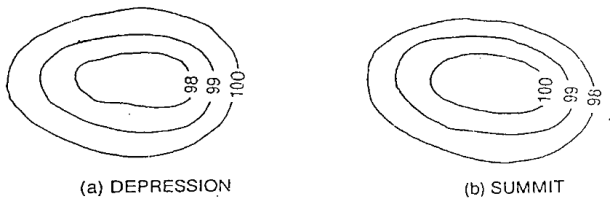


Figure 11.9 : Valley line

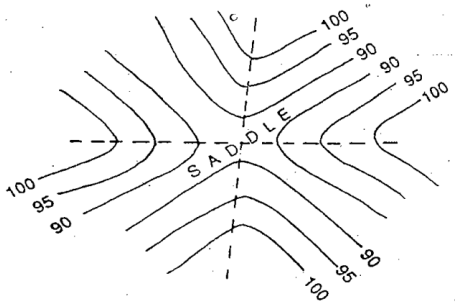
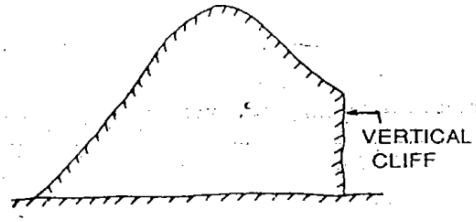


Figure 11.10 : Valley line



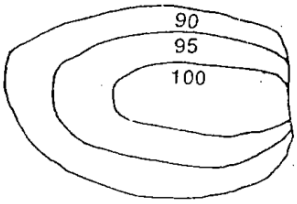


Figure 11.11 : Vertical cliff

What is not true about contour mapping? / समोच्च मानचित्रण के सन्दर्भ में क्या सही नहीं है ? [CGPSC ACF/RFO 2020]

(a) All points on a contour line are at same elevation / एक समोच्च रेखा में सभी बिन्दु समान ऊँचाई पर होते हैं

(b) On a map, closed circles indicate flat surface / मानचित्र पर अंकित बंद घेरा (वृत्त) समतल भूमि को दर्शाता है

(c) U-shaped lines indicate high contours / U-आकृति की रेखाएँ उच्च समोच्च को दर्शाती हैं

(d) In some conditions, one contour line can cut the other contour line / कुछ परिस्थितियों में एक समोच्च रेखा दूसरे समोच्च रेखा को काट सकती है

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