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FORESTRY

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UKPSC
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STATE FOREST SERVICE

2025

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

Module - 3

- Forest Management
- Yield Regulation
- Working Plan
- Forest Mensuration
- Remote sensing

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FORESTRY

UKPSC STATE FOREST SERVICE (MAIN) 2025

EDITION : 2025

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SYLLABUS

Uttarakhand PSC Assistant Conservator of Forest, Logging Officer & Forest Range Officer Combined Examination–2025 [Paper 2]	***Forest Management*** ◈ Objectives, principles and techniques of forest management. ◈ Units of administration and management. ◈ Forest stands, structure and dynamics. ◈ Principles of sustained yield. ◈ Normal forests. ◈ Rotation. ◈ Analysis of ideal tree wealth. ◈ Yield regulation. ◈ Management of forest plantations and commercial forests. ◈ Working plans and their role in scientific management, annual plan and its operation. ◈ ~~Nature conservation, bio-diversity and other dimensions~~. ◈ Principles of joint forest management, methodology, usefulness and its role, village forest (Van Panchayat) - committee arrangement. ***Forest Mensuration and Remote Sensing*** ◈ Methods and use of tools in diameter, girth, height, age, growth and volume measurements of trees. ◈ Tree multiplier, current, annual and average annual increment. ◈ Sampling methods and sample plots. ◈ Yield calculation and stand table, yield regulation mechanism and its use. ◈ Site quality analysis, remote/distant sensing principles, schemes and contingencies. ◈ Forest cover monitoring through remote sensing. Geographical information system for forest management.

Module - 3

CONTENTS

CHAPTER 0

UKPSC STATE FOREST SERVICE (MAIN) EXAMINATION

Forest Management + Yield regulation + Working plan + JFM

RFO 2021	• What is Joint Forest Management? Describe methodology, formation of village forest committee and usefulness of joint forest management / संयुक्त वन प्रबन्धन क्या है? संयुक्त वन प्रबन्धन की कार्यविधि, ग्राम वन समिति की रचना एवं उपयोगिता का वर्णन कीजिए। [5(b) | 20 M]. • What is increment percent? Discuss the relationship between CAI and MAI of a forest stand / संवृद्धि प्रतिशत क्या है ? फॉरेस्ट स्टैन्ड की तात्कालिक वार्षिक संवृद्धि एवं माध्य (औसत) वार्षिक संवृद्धि में सम्बन्धों पर चर्चा करें। [6(a) | 10 M]. • Define Working Plan. Discuss objectives and scope of working plan. Also enlist the salient features of a good working plan / कार्य योजना को परिभाषित कीजिए। कार्य योजना के उद्देश्यों और कार्यक्षेत्र की व्यापकता का वर्णन कीजिए। एक अच्छी कार्य योजना की मुख्य विशेषताओं का सूचीबद्ध उल्लेख करें। [6(b) | 20 M]. • Explain the concept of rotation and its application in regular and irregular forests / आवर्तन (रोटेशन) की अवधारणा की व्याख्या कीजिए और नियमित एवं अनियमित वनों में इसकी प्रयोजना (अनुप्रयोग) की व्याख्या करें। [6(c) | 10 M].
ACF 2019	• Write about general principles of benefit sharing under joint forest management / संयुक्त वन प्रबंधन के अन्तर्गत उपज नियमन के सिद्धांतों के बारे में लिखें। [5(a) | 15 M].
RFO 2015	• What is rotation in forestry? Explain various types of rotations recognized in forestry / वानिकी में आवर्ती क्या है? वानिकी में प्रचलित विभिन्न प्रकारों की आवर्तियों के बारे में लिखें [5(a) | 20 M]. • Write down a short note on yield regulation and enlist various methods of yield regulation / उपज नियमों पर एक संक्षिप्त टिप्पणी लिखें और उपज नियमन के विभिन्न तरीकों की सारिणी बनायें। [5(b) | 20 M]. • Write short note on the followings / निम्नलिखित पर संक्षिप्त टिप्पणी लिखें (a) Growing Stock in Forests / बनों में बढती फसल का संचय [6(c) | 10 M].
RFO 2012	• Is progressive sustained yield from forests possible? If yes, explain the measures to be taken / क्या वनों से प्रगतिशील स्थायी उपज संभव है? यदि हाँ तो सम्भावित उपायों का विवरण दें। [5(a) | 20 M]. • How C.A.I. (current annual increment) and M.A.I. (mean annual increment) influence the rotation age of a species? Explain the factors responsible for enhanced increment of a stand / वर्तमान वार्षिक वृद्धि और औसत वार्षिक वृद्धि कैसे वन्य पेड़ों की कटान आयु को प्रभावित करती हैं? किसी पेड़ समूह की ज्यादा बढ़ोतरी के लिए कौन-कौन से तत्त्व उत्तरदायी होते हैं, वर्णन करें। [8(b) | 10 M]. • How JFM (Joint Forest Management) is helpful in present day management of forests? Explain / वर्तमान वन-प्रबंधन में संयुवत वन-प्रबंधन कैसे लाभदायक है? वर्णन करें। [8(d) | 10 M].

Forest Mensuration + Remote sensing + GIS/GPS

RFO 2021	• Explain Metzger's theory of tree form and its significance in volume calculation / मेटजगर वृक्ष आकार (ट्री फौरम) सिद्धान्त की व्याख्या कीजिए और इस सिद्धान्त की आयतन गणना (कैल्कुलेशन) में महत्ता स्पष्ट कीजिए। [8(a) | 10 M].
ACF 2019	• Derive quarter girth formula of volume estimation from basal area and length of a log / लट्ठे के आधारीय क्षेत्र और लम्बाई से आयतन का चौथाई घेरा सूत्र निकालें। [5(b) | 10 M]. • Explain the role of G.I.S. in forest management / भौगोलिक सूचना पद्धति का वन प्रबंधन में योगदान का विवरण दें। [5(c) | 15 M].
RFO 2015	• Write short note on the followings / निम्नलिखित पर संक्षिप्त टिप्पणी लिखें (b) Remote sensing and its advantages / रिमोट सेंसिंग और इसके फायदे [6(b) | 10 M]. (c) Stand tables / स्टैड तालिका [6(d) | 10 M].
RFO 2012	• Explain the role of GIS (Geographic Information System) in forest management / भौगोलिक सूचना प्रणाली की वन-प्रबंधन में भूमिका का विवरण दें। [8(a) | 10 M]. • Calculate the wood volume (in cubic metres) of a tree having D.B.H. of 51 cm, average bark thickness of 0.5 cm, height of 30 m and form factor of 0.7 / एक पेड़ जिसका डी.बी.एच. 51 से.मी., औसत छाल की मोटाई 0.5 से.मी., पेड़ की ऊँचाई 30 मी. और फार्म फैक्टर 0.7 है उसकी काष्ठ का आयतन घन मीटर में ज्ञात करें। [8(c) | 10 M].

CHAPTER 1

INTRODUCTION

Chapter outline

1.1 HISTORICAL BACKGROUND

Britishers look over our natural forest resource as a source of timber to feed the growing demand of the British royal navy and industries like railway sleepers, power-supply poles, domestic furniture demands, etc. Therefore, they start managing our forest resources just like agriculture practices over the vast natural area through –

(a) Establishing a monopoly over the production and harvesting of timber resources,

(b) Production should be sustainable in the sense of harvesting an equal amount of wood annually or periodically (and not in the modern sense of sustainability).

(c) Exploiting timber without giving much importance to its negative impact on the wildlife habitat, tribal economy, local watershed, and forest ecology.

To handle this, they compiled the contemporary European knowledge of various subjects of forestry, including silviculture systems and yield regulation, with some modified and original Indian versions in a linear structural format to systematize knowledge that make them easy to train next-generation foresters. That's why we often see this type of outdated content in our Indian academic textbooks.

However, this colonial legacy remained continued till the 1970s. as there were few major changes happening in Indian perspectives.

- Raise of many International and national organizations working on forest and wildlife sectors after the Stockholm conference (1972) on the human environment.
- Legislative changes : like shifting forest and wildlife subjects from the state list to the concurrent list (1976), passing the Wildlife protection act (1972), Water Act (1974), Forest conservation act (1980), Air act (1981), environment protection act (1986), Biodiversity conservation and many more.
- Achieved food security after the success of the green revolution. Therefore, the need to prioritize food production over forestry remains

CHAPTER 2

FOREST ORGANIZATION

Chapter outline

In 1806 the government of Madras appointed Captain Watson as the first conservator of forest, which laid the foundation of modern-day forests 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 areas are 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 geographically** 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.

CHAPTER 3

SUSTAINABLE YIELD [EVEN FLOW]

Chapter outline

In Europe, forestry emerged as a profession and national forests were created based on the belief that unregulated markets would result in forest devastation. It was believed governments must own or regulate forests to perpetuate timber resources. This belief is still widely held and is the basis for extensive public forest ownership in Europe, India, and elsewhere. The profession of forestry began somewhere in Germany several centuries ago. Before the industrial revolution, forest management practised by professional foresters had spread from Germany to most other parts of Europe and the world.

A common forest management philosophy like the concept of sustained yield, yield regulation, and many other associated ideas emerged in this environment that continues to have a major and most unfortunate impact on forestry today.

3.1 SUSTAINABLE YIELD

[Concepts/Principle] It is the theoretical equilibrium concept, and according to it, a forest should be managed in such a way that the *annual or periodic* (when the period is short) *removal* of mature timber does not exceed the annual or periodic *stock growth* under the *existing environmental conditions*, and at a given *intensity of management*, without *harming its renewable process* and *productivity* of the forest area. In other words, Sustainable yield can be expressed as the allowable cut which may differ slightly from net increment (*i.e.*, gross increment minus natural losses due to fire, wind, epidemics, etc.) depending on the growing stock and distribution of age-classes.

[Definition] The *regular* and *fixed supply* of the desired forest produce with *its full capacity without harming the productivity* of forest crop or soil is called sustainable yield.

MAXIMUM SUSTAINABLE YIELD

The maximum sustainable yield (MSY) is defined as the *highest average yield* one can harvest from the forest over an indefinite period.

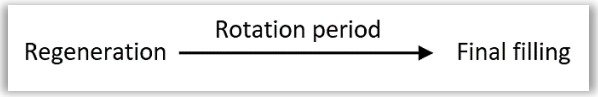
CHAPTER 4

ROTATION [PRODUCTION PERIOD]

Chapter outline

4.1 ROTATION

A rotation or production period is the *time period* which a *forest crop* takes between its *formation* and *final felling*. Put simply, it is the period of time a crop of trees is allowed to grow.



The number of years fixed by the *working plan* between its regeneration and the final felling of a crop **[Brasnett]**.

The rotation or Production period is the interval of time between the formation of a young crop by seeding, planting, or other means and its final harvesting **[Osmaston]**.

Rotation age is the age of trees or crops at which when they are felled, objects of management, for the time being, are best served **[Knuchel]**.

Rotation is the period which elapses between the formation of wood and the time when it is finally cut over **[Jerram]**.

Term **rotation** is correctly applied for **regular crop only** (*i.e.,* clear-felling system or plantation), where entire crops of a sizable area felled at a time or periodically (in the shelterwood system). For uneven or irregular forest, term "exploitable age" or "utilizable size/age" is used

ROTATION PERIOD	EXPLOITABLE AGE
The time period is taken by forest crop between its formation and final felling	Age at which tree attains the size required to fulfill the object of management
Applicable : Regular crop ✓	Regular crop ✗
Individual tree ✗	Individual tree ✓

CHAPTER 6

GROWING STOCK

Chapter Outline

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 sustainable use of the forest resources.

(a) 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.

CHAPTER 10

FOREST COVER MONITORING

Chapter Outline

SYLLABUS

Forest cover monitoring. Approaches *viz.*, (i) site-specific planning, (ii) strategic planning, (iii) Approval, sanction, and expenditure. (iv) Monitoring (v) Reporting and governance.

10.1 INTRODUCTION

Forest Cover : All lands more than 1 hectare in an area with tree canopy density of 10 % or more, irrespective of land ownership, use, and legal status.

Forest Cover Monitoring : it is the process to check or record forest cover regularly by using modern tools to understand the scenario and effects of various causes over forest cover.

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

METHODS OF FOREST COVER MONITORING

- **Traditional Methods** : Collecting and assessing data manually. The use of airborne remote sensing, including balloons and Dakota aircraft, has been limited. We relied on this method until 1981 when FSI began developing and using space-based remote sensing.

  Issues with this ?

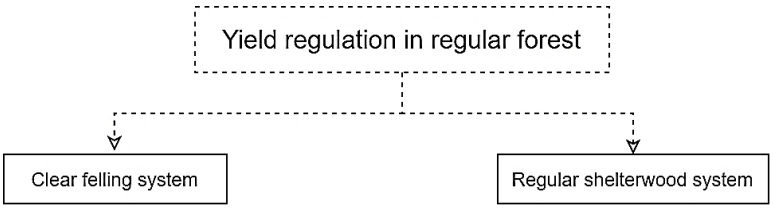
  - Less effective, time-consuming, and too expensive.
  - The majority of aerial remote sensing data is recorded in the black and white spectrum. Because of this, it is virtually impossible to identify invasive species, detect stress on the forest ecosystem, and trees species these days.

CHAPTER 12

YIELD REGULATION IN REGULAR FOREST

Chapter Outline

Even-aged management deals with forests composed of even-aged stands. In such stand, individual trees originate at about the same time, either naturally or artificially. In addition, stands have a specific termination date at which time all remaining trees are cut. This complete harvest is called a *cleat-cut*.



12.1 YIELD REGULATION IN CLEAR-FELLING SYSTEM

- **Annual coupes by gross area** : Under this, a forest area is divided into a number of *equi-extensive* annual coupes. The number of coupes is equal to the rotation age, so we can cut one coupe every year.

  The *simplest and oldest method*. *Suitable for coppice forests and high forests* that are managed under a clear-fell system. Except for the first rotation where crops are usually irregular both in composition and density, this method ensures a sustainable yield from the second rotation onward.

- **Annual coupes by reduced area** : Site quality and crop density may vary from coupe to coupe. Hence, felling of *equi-extensive* annual coupes may not guarantee equal volume of timber every year. In order to achieve this, we adjust the boundaries of an annual coupe in a way to get areas of equal productivity.

ADVANTAGES OF YIELD REGULATION BY AREA

- Easy to apply
- Site preparation and planting can be done economically over large areas, using machinery and fire.

CHAPTER 13

YIELD REGULATION IN IRREGULAR FOREST

Chapter Outline

13.1 INTRODUCTION

Uneven-aged or irregular forests (a) are those forests containing more than two or three distinct age classes or age cohorts. (b) Forest stand consists of trees of all ages. The range of difference is usually more than 20 years and, in the case of long rotation crops, more than 25 % of rotation age.

Uneven-aged management is the process of making decisions to best achieve ownership objectives while maintaining an uneven-aged structure. These objectives might include maintaining constant forest cover, earning more frequent income from the stand, providing a specific type of wildlife habitat or a specific set of plant communities, or studying uneven-aged management techniques.

Advantages of Uneven Forest Management

- Uneven-aged stands have a diverse structure, with small, medium and large trees providing a multi-layered canopy. This forest structure provides habitat for many plant and wildlife species.
- Because the site is always occupied by trees = provides continuous cover on a site, reducing problems with erosion and excessive run-off after heavy rains.
- It provides more frequent cash flow, and, because it typically relies on natural regeneration, it has relatively low investment requirements.
- Many people are offended by the sight of a clearcut. With uneven-aged management, the stand is never clearcut = Socially more acceptable.

Disadvantages

- It does not work well when light demander species are desired. Example Teak, Sal, Chir-pine, etc.
- Uneven-aged management is complex and difficult to maintain.

CHAPTER 16

SURVEY & ASSESSMENT OF FOREST RESOURCES

Chapter Outline

► **EXAMINATION OF TERRITORIAL UNITS** : WPO will inspect and examine the forest area (including range, beat, sub beat), village, block, compartment and sub-compartment and ascertain that the extent of forest cover is properly maintained. Also check –

- Area of forests under different legal classes (RF, PF, UF and others), Site quality assessment,
- Forest area under different working circle/ management plan
- Land use, land use change and forestry
- Distribution of different forest types
- Marking compartment boundaries

► **FOREST RESOURCE ASSESSMENT** : On the basis of this assessment, past performance is evaluated and future management will be prescribed

- **Conservation and enhancement of Biodiversity** : Forest composition and distribution, plant species diversity, status of biodiversity conservation of forests, status of species prone to overexploitation, conservation of genetic resources, fauna and their habitats, threats and challenges to wildlife, protection and management of fauna.
- **Enhancement of Forest health and vitality** : Status of regeneration, area affected by forest fires, area damaged by natural calamities, area protected from grazing, lopping practices, area infested by invasive weed species in forests, Incidences of pests and diseases, forest degradation and its drivers.
- **Conservation and Maintenance of Soil and Water Resources**: Assessment of excess runoff from discharge zone and conservation measures for soil, groundwater, and soil moisture.
- **Maintenance and Enhancement of Forest Resource Productivity** : Growing stock of wood/bamboo, increment in

CHAPTER 19

IMPORTANCE OF WORKING PLAN

Chapter Outline

19.1 ROLE OF A WORKING PLAN IN FOREST CONSERVATION

The working plan enhances the conservation of forests through the following means -

- It gives information about past management and its result. Accordingly, it facilitates future management by avoiding errors in management, if any.
- It prescribes the management practices according to the site conditions.
- It shows the information on degraded lands. That will helps the afforestation as well as the reforestation program in the correct orientation.
- It gives the information on regeneration status, and thus by this, we can determine which areas require supplementary plantation and which require protection.
- It gives information on forest composition, its distribution, and geographical challenges that can help in managing them more effectively.
- The working plan also gives information about the local people and their demands. Hence, local people are effectively managed, and people's cooperation is enhanced towards the conservation of forests.
- Information on soil, climate, slope, and site quality is helpful for the selection of crops for afforestation as well as conservation program.
- All these favorable points favor the conservation of the forest ecosystem with the help of a working plan

19.2 WORKING PLAN AS A TOOL FOR FOREST MANAGEMENT

As forestry is a long term enterprise, it needs a specific written plan for its management, so a working plan -

- provide a summary of past work and results. This serves as primary data for future planning.

CHAPTER 3

Non-Governmental Organizations (NGOs)

Chapter outline

- Need of NGOs IN JFM
- Activities undertaken by NGOs
- Issue with NGOs

Non-governmental organizations (NGOs) refer to not-for-profit organizations that pursue activities to relieve suffering, promote the interests of the poor, protect the environment, provide essential social services, or undertake community development.

- These organizations are not a part of the government, have legal status, and are registered under the specific Act (Societies Registration Act, 1860 in India).
- In India, based on the law under which they operate and the kind of activities they take up, civil society groups can be classified into the following broad categories -
  - Registered Societies formed for specific purposes
  - Charitable Organizations and Trusts
  - Local Stakeholders Groups, Microcredit, and Thrift Enterprises, Self Help Groups.
  - Professional Self-Regulatory Bodies
  - Cooperatives
  - Bodies without having any formal organizational structure

- **NEED OF NGOs IN JFM** : NGO's plays a significant role in JFM. They are members of VFC. They are involved in all the conservation and preservation activities. They improve the relationship between the department and the village people. They act as a moderator.
  - NGO acts as a *buffering layer* between the forest department and local peoples.
  - NGO's *promote awareness* about the importance of forests among the people.
  - They improve the *confidence-building* between the people and forest department officials.
  - They provide beneficial *information to forest officials* for the protection and improvement of forests.
  - They conduct many *awareness and training camps* in forest villages.

CHAPTER 2

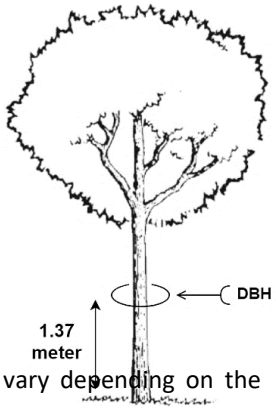
DIAMETER & GIRTH MEASUREMENT

2.1 OBJECTIVES BEHIND DIAMETER/GIRTH MEASUREMENT

- To estimate the quantity of timber, firewood, and other forest produce, *i.e.*, Cubic feet wood in a teak tree.
- Measure the rate of tapering, its form, and the shape of logs that will help in determining timber quality (Volume of logs).
- To know the basal area of trees/crop
- It helps in making an inventory of growing stock as well as correlating height – Volume – Age –increment of a tree or crop.

2.2 CONCEPT OF DBH AND GBH

► **BREAST HEIGHT (BH)** is a universally accepted standard height above ground level for measurement of Girth, Diameter, and basal area of standing trees. If we take the diameter at that height, we call it *diameter at breast height* (DBH), and if we take the girth, it calls *girth at breast height* (GBH).



In India***, Burma, S. Africa, USA & other British colonies	In UK, Europe & FAO***
BH = 1.37 m (4 feet 6 Inches)***	BH = 1.30 m (4 feet 3 Inch)***

It is important to note that the place of measurement of diameter/girth may vary depending on the conditions –

► **THE BREAST HEIGHT HAS BEEN ACCEPTED AS THE STANDARD FOR DIAMETER & GIRTH MEASUREMENT BECAUSE OF THE FOLLOWING REASONS**

- The bases of the trees are generally covered with grasses, shrubs, and thorns sometimes, so the measurement of Diameter or Girth at the base is usually challenging and requires extra effort to clear these before the measurement.
- Many trees develop root swellings, Buttressing, and fluted stems near the base and may extend to several meters above ground, especially in tropical rainforests. These create difficulties in getting the actual diameter.
- It gives a uniform point of measurement and therefore standardizes diameter measurements of trees overall the world.

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.
- **CROWN HEIGHT** : The height of the crown as measured vertically from the ground level to the point halfway between the lowest green branches forming a green crown all around.
- **CROWN WIDTH** : the maximum spread of crown along its widest diameter.
- **CROWN COVER** : The horizontal projection on the ground of the tree crown

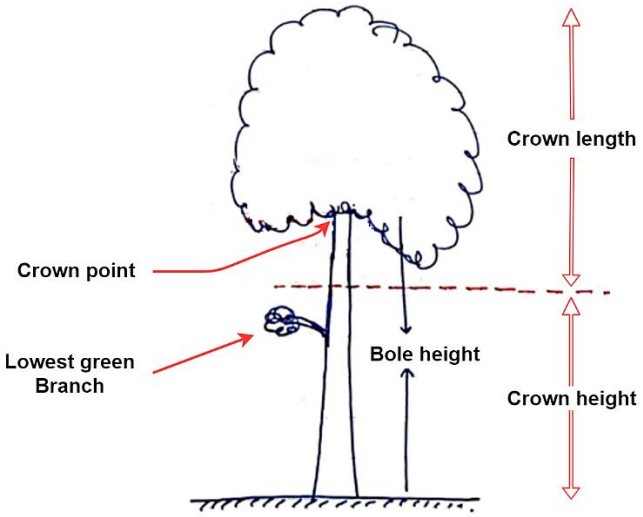


Figure 3.1 : Various terminology

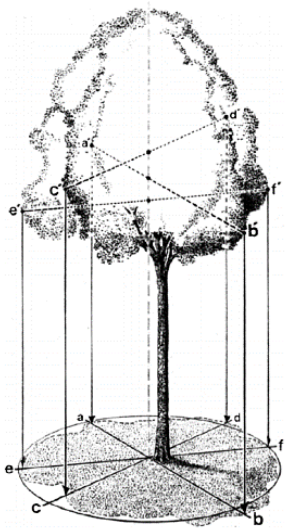


Figure 3.2: Horizontal crown projection

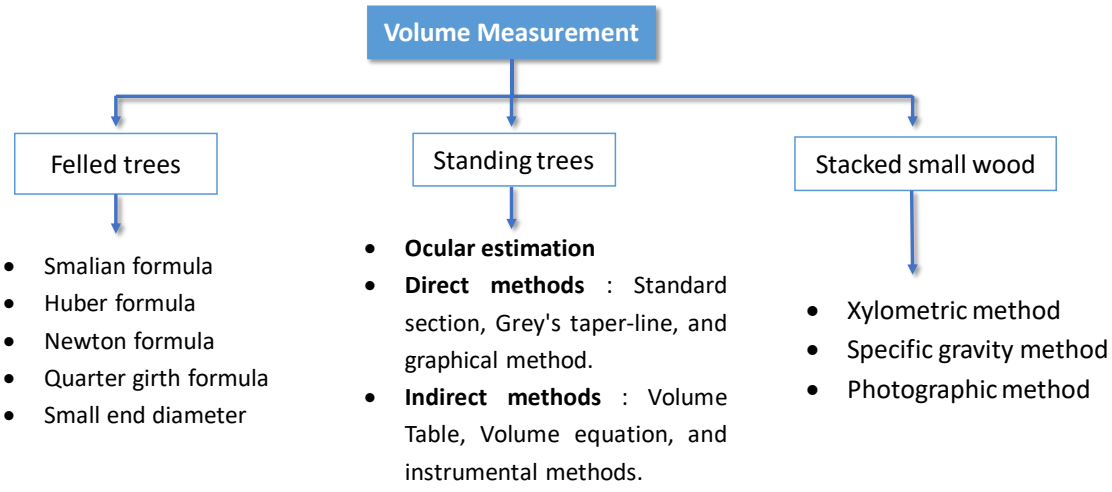
CHAPTER 5

VOLUME MEASUREMENT

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

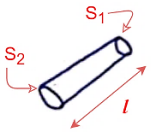
- Volume calculation of both – Felled and Standing tree.
- Volume measurement of fuelwood stocks and billets
- Volume table
- Related terminology

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 can not 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

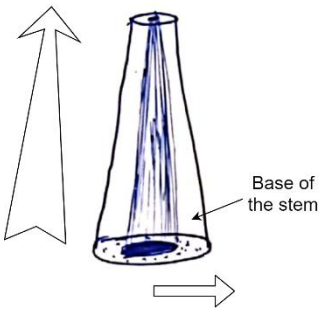
- The method is fast, requires no special handling, and saves time for both buyer and seller.
- It encourages the delivery of freshly cut wood to the mill.
- Wood-yard inventories are more easily maintained because of greater uniformity in record keeping

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* = $\frac{\text{Density of wood}}{\text{Density of water}}$

- **Moisture** : Moisture content in hardwood is lower than in softwood.
- **Bark thickness** : The bark acts as a defense layer to protect living tissue against adverse weather and forest fires. Usually, smaller diameter trees have higher bark % than more giant-sized trees. In addition, Bark is a source of tannin, cork, and medicinal properties, so it has commercial value, and we need to calculate it.
- Any foreign material.



6.2 ESTIMATION OF FOREST BIOMASS

Biomass is the weight of the above-ground vegetative matter produces per unit area. It is broadly divided into two components –

Above ground biomass : Contain the part of vegetation above the ground e.g. Timber, Branches, bark, leaves, stums, deadwood, etc.

CHAPTER 10

POINT SAMPLING

Since the inception of this subject, our primary objective has been to measure stand volume, and it's always a difficult task. Because, for this we need to measure the basal area and stem height of each tree in a forest stand.

Therefore, forest scientists always try to develop an alternative method that can give almost the same results with very little effort and time. Such a successful effort was first made by the Austrian forester *Bitterlich*, in 1948……..that is, *point sampling*.

Bitterlich has proved that counting from a random point the number of trees whose breast height cross-section exceeds a certain critical angle when multiplied by a constant factor gives an unbiased estimate of basal area per ha.

► **Definition** : *Point sampling is a method of quickly estimating basal area per hectare directly by standing at a point to selecting trees on the basis of their size rather than by their frequency of occurrence through using angle gauge or wedge prism of known basal area factor (BAF).*

Point sampling is also known as - *angle-gauge cruising*, *Angle count sampling*, *pointless cruising*, *plotless sampling*, *variable plot cruising*, *Bitterlich sampling,* and P.P.S. (probability proportional to size) sampling, etc.

► **TYPES**

- Horizontal point sampling : Given by *Bitterlich*, and useful in the estimation of basal area or diameter.
- Vertical point sampling : given by *Hirata*, and useful for Tree height measurement [by Conimeter***]

HORIZONTAL POINT SAMPLING

► **Concept** : In horizontal point sampling, a series of sampling points are selected randomly or systematically distributed over the entire area. Trees around these points are viewed through an angle gauge (wedge prism) at breast height and all trees forming an angle bigger than the critical angle of the instrument are counted.

It may be noted in the below figure that even though all the trees are of the same basal area, some are counted in the tally while others are not because being far away from the sampling point they did not form an angle higher than the critical angle of the instrument. On the other

CHAPTER

12

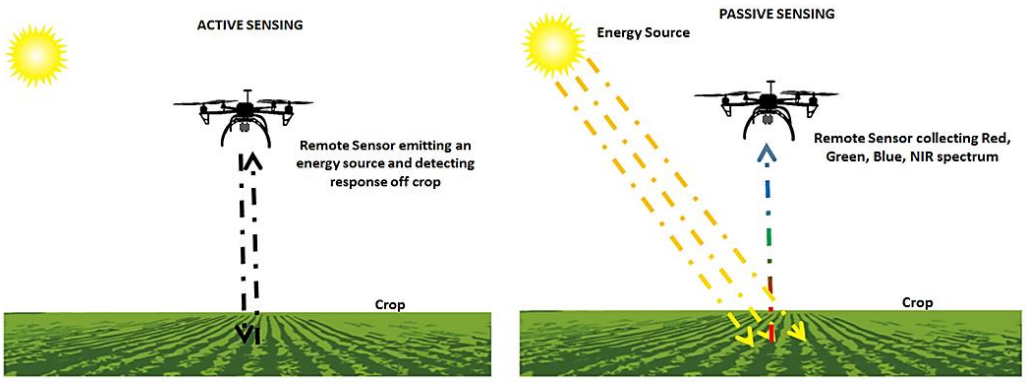
REMOTE SENSING [INTRODUCTION]

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 : like radar, when sensor used active energy to get information
- Passive remote sensing : like your eye, the sensor does not use energy to get radiation it used EMR.



► **Based on platform**

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

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

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

► **Classification based on the number of bands**

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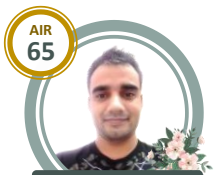

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