PRACTICAL MANUAL

ON

Introduction to Forestry

APF 179 2(1+1)

For B.Sc. Agriculture I Semester students

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2020

College of Horticulture & Forestry
RANI LAKSHMI BAI CENTRAL AGRICULTURAL UNIVERSITY, JHANSI

Introduction to Forestry APF 179 2(1+1)

Practical: Identification of tree-species. Diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees. Height measurement of standing trees by shadow method, single pole method and hypsometer. Volume measurement of logs using various formulae. Nursery lay out, seed sowing, vegetative propagation techniques. Forest plantations and their management. Visits of nearby forest based industries.

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Roll No. .....

Batch .....

Session .....

Semester .....

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Practical Exercise No. 1

Objective: To identify different multipurpose tree species

- Since the beginning, trees have furnished us with two of life's essentials, food and oxygen. As we evolved, they provided additional necessities such as shelter, medicine, and tools. Today, their value continues to increase and more benefits of trees are being discovered as their role expands to satisfy the needs created by our modern lifestyles.
- They occupy prime importance for having potential and vital role in sustainable agricultural development.
- Trees extremely vary for their natural distribution and variation, methods of exploration, collection and evaluation of their germplasm.

Advantages:

- **Community & Social Value:** Trees are an important part of every community. Our streets, parks, playgrounds and backyards.
- **Ecological & Environmental Value:** Trees contribute to their environment by providing oxygen, improving air quality etc.
- **Personal & Spiritual Value:** The main reason we like trees is because they are both beautiful and majestic.
- **Practical & Commercial Value:** Trees have supported and sustained life throughout our existence. They have a wide variety

Purpose: It is important to select the most suitable trees since it is not easy to replace them once they have been planted. The following factors should be kept in mind when selecting tree species

- Environmental adaptation
- Needs of farmers
- Ease of maintenance
- Availability of genetic materials

How to Identify Different Types of Trees:

- By leaf identification
- By leaf shape
- By bark colour
- By bark texture
- By bark variation with age
- By tree shape
- By flower
- By fruit type
- By seed comparison
- By leaf bud arrangement
- By leaf bud appearance

Field Exercise: Identification of some important MPTs

S. No.	Tree species		Image/Characteristics
1.	Common name		
	Scientific name		
	Family		
	Description	……..… ……..…… ……..……	
	Uses	……..…… ……..…	
2.	Common name		
	Scientific name		
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	Uses	…… ……	
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	Uses	…… ……	
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	Uses	…… ……	
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19.	Common name		
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20.	Common name		
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	Family		
	Description	…… ……	
	Uses	……	

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Practical Exercise No. 2

Objective: To identify different multipurpose tree species

Field Exercise: Identification of some important MPTs

S. No.	Tree species		Image/Characteristics
1.	Common name		
	Scientific name		
	Family		
	Description	…… …… ……	
	Uses	…… ……	
2.	Common name		
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	Family		
	Description	…… …… ……	
	Uses	…… ……	
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	Uses	…… ……	
20.	Common name		
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	Description	…… …… ……	
	Uses	…… ……	

Practical Exercise No. 3

Objective: To identify different multipurpose tree species

Field Exercise: Identification of some important MPTs

S. No.	**Tree species**		**Image/Characteristics**
1.	Common name		
	Scientific name		
	Family		
	Description	…… …… ……	
	Uses	…… ……	
2.	Common name		
	Scientific name		
	Family		
	Description	…… …… ……	
	Uses	…… ……	
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	Uses	…… ……	
19.	Common name		
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	Description	…… …… ……	
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20.	Common name		
	Scientific name		
	Family		
	Description	…… …… ……	
	Uses	…… ……	

Practical Exercise No. 4

Objective: To study the diameter measurement of trees using calipers

- Diameter at breast height, or DBH, is a standard method of expressing the diameter of the trunk or bole of a standing tree. DBH is one of the most common dendrometric measurements.
- Tree diameter measurements (along with heights of trees using hypsometers) when determining usable wood volume in standing trees.
- The tree's diameter is important to determine volume when trees are sold for pulp, lumber or hundreds of other volume determinations

Calipers:

- Calipers are comprised of a fixed arm, scale and moveable arm. The fixed arm is placed along one side of the tree at the desired height. The moveable arm is then placed flush against the other side of the tree and the scale is read directly.
- The calipers must be located perpendicular to the stem axis.
- The length of the caliper arms must be at least half the diameter of the tree. Biased estimates (underestimates) of the diameter will result if the arms are less than half the tree diameter. This limitation may restrict the use of calipers to smaller trees - the large diameter trees often found in natural eucalypt forests would require calipers arms in excess of 1 m which would be inconvenient.
- There are a wide variety of calipers available. The most widely used type is the light, hardwearing, metal alloy caliper.

Specification of calipers for measuring tree diameter:……....

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Procedure: :…….....

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Observation:

S. No.	Species	Condition of tree	Measuring Side	DBH (OB) in cm			Remarks (if any)
				Major axis	Minor axis	Average	
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Calculation:……

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Results:……...

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Conclusion:……

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Practical Exercise No. 5

Objective: To study the diameter measurement of trees using tape

- Diameter at breast height, or DBH, is a standard method of expressing the diameter of the trunk or bole of a standing tree. DBH is one of the most common dendrometric measurements.
- Tree diameter measurements (along with heights of trees using hypsometers) when determining usable wood volume in standing trees.
- The tree's diameter is important to determine volume when trees are sold for pulp, lumber or hundreds of other volume determinations

Measuring tape:

- A **diameter tape**, or **d-tape**, is the most common tool for measurement of tree diameter.
- The tape is wrapped around the tree, measuring its circumference. The tape is graduated to reflect a conversion from tree circumference to tree diameter. Thus, circumference is measured, but diameter can be recorded to the nearest 0.1 inch. Most trees are not perfect circles, so there is some error in this method.
- However, except on extremely irregular trees, this method seems to "average out" the tree's shape to an acceptable estimate.

Specification of diameter tape for measuring tree diameter:……

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Procedure: :……

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Observation:

S. No.	Species	Condition of tree	Measuring Side	DBH (OB) in cm			Remarks (if any)
				Major axis	Minor axis	Average	
1							
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Calculation:……

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Results:……...

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Conclusion:……

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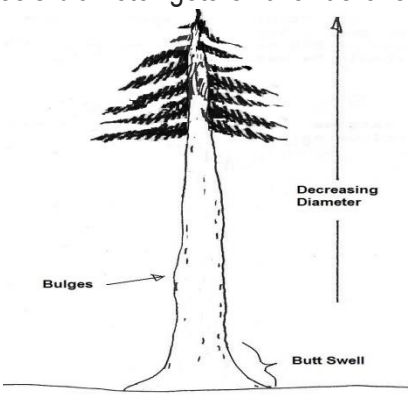
Practical Exercise No. 6

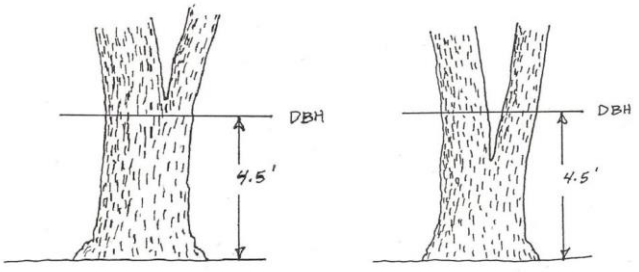
Objective: To study diameter measurements of forked trees

- Trees do not grow like cylinders, but rather taper upward; a tree's diameter gets smaller as one gets closer to the top of the tree. Trees also have **butt swell**, a thickening of the wood and bark at the base of the tree to support the tree's mass.
- Butt swell can create a very large diameter on trees exposed to heavy wind, on steep slopes and in sparsely populated stands. Thus, to obtain truly useful diameter data, the question becomes, "Where on the tree should I measure?"
- To make tree diameter measurements meaningful and easy to perform, a standard location and protocol have been developed. Diameters are measured outside the bark at 4.5 feet above the ground on the uphill side of the tree. This location, called **diameter at breast height** or **DBH,** is above most butt swell and brush. It is also at a comfortable arm position for most people.



Fork tree: Several cases exist, according to the point where the fork divides the stem.

- If the fork begins (the point where the core is divided) below 1.3 m height, each stem having the diameter required (≥20 cm in the whole plot, ≥10 cm for rectangular subplots) will be considered as a tree and will be measured. Diameter measurement of each stem will be taken at 1.3 m height.
- If the fork begins between 30 cm and 1.3 m, each stem will be considered as separate tree and will be measured. The diameter measurement will be taken at 1 meter above the fork origin.



- If the fork begins at 1.3 m or a little higher, the tree will be counted as a single tree. The diameter measurement is thus carried out below the fork intersection point, just below the bulge that could influence the Dbh.

Procedure: :……

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Observation:

S. No.	Species	Condition of tree	Measuring Side	DBH (OB) in cm			Remarks (if any)
				Major axis	Minor axis	Average	
1							
2							
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Calculation:……

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Results:……..

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Conclusion:……

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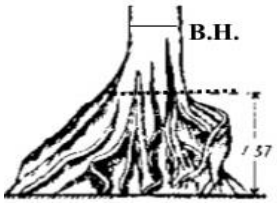
Practical Exercise No. 7

Objective: To study diameter measurements of buttressed and fluted trees

Buttressed trees: In case of buttressed tree, if the height of the buttress is more than 1m, then the breast height is measured from the point where buttress ends. In this case, reduction models are sometimes be applied with which the would-be diameter at breast height is estimated from the measurement of a diameter at another height.



DBH measured at the lowest point above which the abnormal formation is not likely to extend

Fluting stem: In the case of fluting:

Measure the diameter over the fluting; and

1. If the fluting occurs at various points around the bole and extends vertically to the top of the bole: Deduct: 2 x average depth of fluting, from the measured dbh.
2. If the fluting extends all the way round the bole and half way up the bole: Deduct: 1/2 x (2 x average depth of fluting), from the measured dbh.
3. If the fluting extends half way round the bole and half way up the bole: Deduct: 1/2 x (average depth of fluting), from the measured dbh.

Notes: Mark the depth of fluting and measure with a straight tape or ruler. If a diameter tape is used, ensure the correct side of the tape is used.

Procedure: :……

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Observation:

S. No.	Species	Condition of tree	Measuring Side	DBH (OB) in cm			Remarks (if any)
				Major axis	Minor axis	Average	
1							
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Calculation:……

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Results:……...

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Conclusion:……

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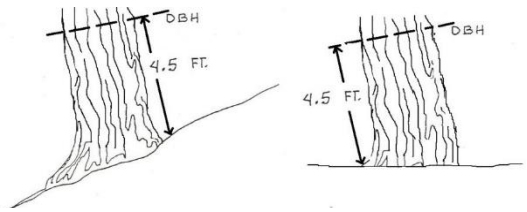
Practical Exercise No. 8

Objective: To study diameter measurements of leaning trees

Leaning tree: On leaning trees, the tape is held perpendicular to the tree bole, and is measured on the uphill side of the tree if on a slope (left); on the short side of the lean if on flat ground (right).



Procedure: ……

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Observation:

S. No.	Species	Condition of tree	Measuring Side	DBH (OB) in cm			Remarks (if any)
				Major axis	Minor axis	Average	
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Calculation:……

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Conclusion:……

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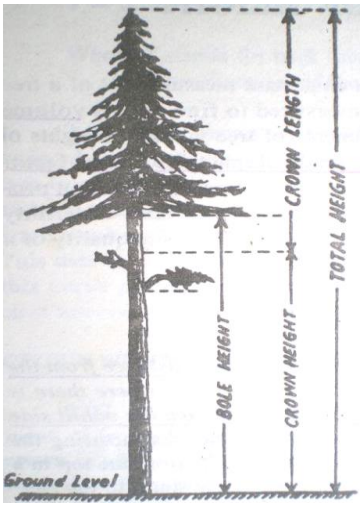
Practical Exercise No. 9

Objective: To study height measurement of standing trees by shadow method



- Tree height is the vertical distance between the base of the tree and the tip of the highest branch on the tree, and is difficult to measure accurately.
- Tree height is the vertical distance measured from the ground surface.
- Height of standing tree is measured to find out its volume. Height of selected trees in a forest is also required to read volume tables, form factor tables, yield tables etc.
- Lastly, heights of trees are required to find out productive capacity of site. Height is generally considered as an index of fertility and with the knowledge of age it gives a reliable measure of the site quality of a locality.

Total height of a standing tree is the distance along the axis of the tree stem between the ground and the tip of the tree.

Bole height is the distance along the axis of tree between ground level and crown point. (crown point is the position of the first crown forming branch).

Commercial bole height is the height of bole that is usually fit for utilization as timber.

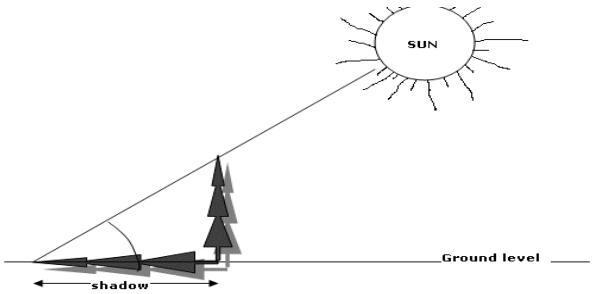
Height of standard timber bole is the height of the bole from the ground level up to the point where average diameter over bark is 20cm.

Stump height is the distance between the ground and basal position on the main stem where a tree is cut.

Crown length-The vertical measurement of the crown of the tree from the tip to the point half way between the lowest green branches forming green crown all round and the lowest green branch on the bole.

Crown height - The height of the crown as a measured vertically from the ground level to the point half way between the lowest green the lowest green branches forming green crown all round.

Shadow method: In this method, a pole of convenient length is fixed upright in the ground and its height above the ground is measured



Principle:……

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Procedure:……

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Observation:

S. No.	Species Name	Observer distance (m)	Height of tree (m)		
			Height above eye level (m) A	Height below eye level (m) B	Total height (m) A+B
1					
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Calculation:……

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Results:……

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Conclusion:……

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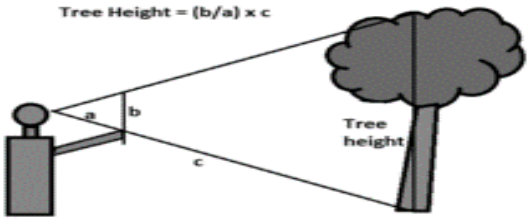
Practical Exercise No. 10

Objective: To study height measurement of standing trees by single pole method

- The ability to obtain accurate tree heights creates an opportunity for some interesting forest studies. One of these is the construction of a forest profile, in which all the tree species, large and small, are included.
- By including information on topography, exposure and soils for the tallest example of each tree species, those specimens may be arranged by height into habitat groups, which show the need for trees to find a niche in which they are height competitive, and can receive enough sunlight to survive.



Single pole method: Pole of about 1.5 m length vertically at arm's length in one hand in such a way that portion of the pole above the hand is equal in length to the distance of the pole from eye.

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Procedure:……

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Observation:

S. No.	Species Name	Observer distance (m)	Height of tree (m)		
			Height above eye level (m) A	Height below eye level (m) B	Total height (m) A+B
1					
2					
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Calculation:……

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Results:……...

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Conclusion:……

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Practical Exercise No. 11

Objective: To study height measurement of standing trees by hypsometer

- There are various instruments to measure height of the tree.
- Height measuring instruments are called hypsometer.
- Those instruments based on trigonometric principles are more accurate than the ones employing geometric principles.
- The Abney's level, Haga Altimeter, Blume-Leiss Altimeter and Sunto Clinometer are similar in accuracy.

Christen's Hypsometer

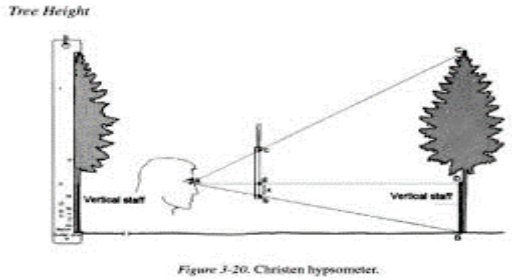

Figure 3-20. Christen hypsometer.

- It is based on the geometric relationships of similar triangles.
- Consists of a strip of metal, thin wood or card board about 2.5cm wide and 33 cm length.
- It has two flanges or protruding edges one at the top and other at the bottom.
- Each flange has a hole in it, the upper one to suspend the instrument by some thread passing through it at and the lower one to suspend a weight from it to prevent it from swinging.

Principle:……

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Procedure:……

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Observation:

S. No.	Species Name	Observer distance (m)	Height of tree (m)		
			Height above eye level (m) A	Height below eye level (m) B	Total height (m) A+B
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Calculation:……

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Results:……..

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Conclusion:……

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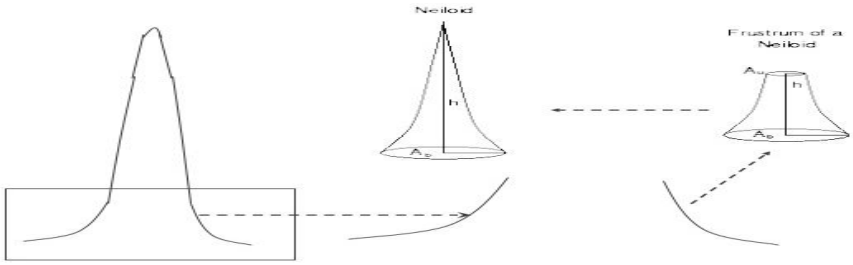
Practical Exercise No. 12

Objective: To study volume measurement of logs using various formulae



- The ultimate object of all mensuration activity in forest is to calculate or estimate quantity of wood contained in trees and consequently in crops not only for sale but also for research, predicting future yields, estimating increment to assess return on capital etc.
- Measurement of felled trees are to determine the quantity of merchantable volume to obtain statistical data that could be applied to standing trees for the purpose of estimation the yield, to estimate the growing stock and to estimate the increment of woods and forests.
- Volume estimation may be made most accurately when the logs are separated and accessible to the measurer

By General formula:

A) If the tree is in conical shape: $V = S \times H/3$

$= (\pi D^2/4) \times H/3$

$= \pi D^2 H/12$

Where, V= Volume of tree (m^3); S= Basal Area of tree (*i.e.* $S = \pi D^2/4$ & unit is m^2); H= Commercial bole height or height of tree (m).

B) If the tree is in cylindrical shape: $V = S \times H$

where V= Volume of tree (m^3); S= Basal Area of tree (*i.e.* $S = \pi D^2/4$ &
$= (\pi D^2/4) \times H$ unit is m^2) and
H= Commercial bole height or height of tree (m)

By Quarter Girth formula: $V = (G/4)^2 \times H$

Where, G= Girth at mid-point ($G = \pi d$ & unit is m; d is mid-point diameter);
H= Commercial bole height or height of tree (m)

Volume calculation by Quarter Girth formula:

Sl No	Species Name	Mid-point diameter (d) in cm	Commercial Bole height/ height of tree(H) in m	Mid-point girth in m (G = πd)	Volume (m^3) $V = (G/4)^2 \times H$
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

By Huber's formula:

$$V = S_m * l$$

Where,

V = Volume of Logs

Sm = the sectional area at the middle

l = the length or height of the solid

Volume calculation by Huber's formula

Sl No	Species Name	Sectional area at the middle	Height of tree	Volume (m^3) $V= g_m \times l$
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Prismoidal or Newton's formula

$$V = \frac{S_1 + 4S_m + S_2}{6} * l$$

Where,

V = Volume of Logs

S_1 = the sectional area at the thick end

S_m = the sectional area at the middle

S_2 = the sectional area at the thin end

l = the length or height of the solid

- It is the best and accurate method for volume calculation
- It gives particularly the volume of frustum of Neiloid (as well as other sections)
- It is only used to calculate the error in volume calculated by other formula
- It is difficult to apply particularly when the logs are stacked

Volume calculation by Prismoidal formula

S. No	Species Name	Sectional area at the thick end	Sectional area at the middle end	Sectional area at the thin end	The length of the tree	$V = \frac{S_1 + 4S_m + S_2}{6} * l$
1						
2						
3						
4						

5						
6						
7						
8						
9						
10						

Smalian's formula

$$V = \frac{S_1 + S_2}{2} * l$$

Where,

$V = \text{Volume of Logs}$

$S_1 = \text{the sectional area at the thick end}$

$S_2 = \text{the sectional area at the thin end}$

$l = \text{the length or height of the solid}$

- It gives the volume of frustum of paraboloid (also cylinder)
- It over estimates the volume
- It is used when the logs are stacked or lying on the ground

Volume calculation by Smalian's formula

Sl No	Species Name	Sectional area at the thick end	Sectional area at the thin end	The length of the tree	$V = \frac{S_1 + S_2}{2} * l$
1					
2					
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Practical Exercise No. 13

Objective: To study nursery lay out techniques.

Trees are essential to our lives and are an integral part of our landscape. They play many roles and confer a multitude of benefits to society such as food, shelter, shade, timber, natural beauty to the countryside, conservation of our soil and water resources and improved air quality

Purpose:

- The aim of this study is to provide basic about nursery and the steps involved in growing quality tree seedlings for survival under the often dry, nutrient deficient conditions in which the seedlings are sometimes planted.
- This study also useful to foresters, horticulturists and those involved in planning and managing the production and use of tree seedlings for any of the above-mentioned roles and benefits.

Choosing the nursery site:

Types of nurseries

The criteria for choosing the nursery site will be affected by the type of nursery to be established. For the purpose of this manual, two broad types of nurseries are recognised, namely:

- Small-scale nurseries
- Permanent nurseries

Some benefits of small-scale nurseries are:

- Nearness to planting site improves survival because transit time between nursery and plantation is short and plants suffer less from overheating, windburn, soil loss and vibration caused by long journeys
- Better provision for the range of species and numbers of seedlings required by different farmers
- Transport cost is less and capital investment is low
- Isolation of disease is much easier

The main advantages of permanent nurseries are:

- High production levels and high seedling survival rates resulting in a more efficient, reliable operation and consequently lower unit cost per plant
- The availability of permanent installations, propagation techniques and suitable modern equipment favouring higher quality seedlings and the production of a wide range of difficult species
- Risk of damage and theft minimised due to better on-site supervision Although the contents of this manual deal mainly with permanent nurseries, much of what is written applies equally to small-scale nurseries.

Important factors

Water……

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Location……..

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Topography……

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Size of the nursery……...

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Preparation of the site:…….....

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Design and layout of nursery…….

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Producing plants from seed:

The production of seedlings in the nursery is best described under the following stages of development and growth:
Stage 1: Seed Handling
Stage 2: The Germination Process
Stage 3: Transplanting the Young Seedlings
Stage 4: Tending the Seedlings

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Practical Exercise No. 14

Objective: To study the nursery seed sowing techniques

Method of Sowing: The two basic methods of sowing seed for container or bare root production are broadcast and direct sowing. The choice of method will depend on the local conditions and experience. It should be noted that:

- The yield of plantable seedlings from a given seed lot is usually much greater with broadcast sowing
- Development of transplants are sometimes slow compared with undisturbed direct sown seedlings
- There is a risk of root distortion during transplanting with broadcast sowing
- When seed is plentiful, of good quality and its cost is only a small proportion of total nursery costs, direct sowing is sometimes preferred.
- Direct sowing is also easier if the seed is large enough in size to be handled individually and the risk of root distortion is reduced with this method.

Broadcast methods……

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Direct sowing methods……

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Time of sowing……..

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Depth of sowing……

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Management practices……

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Practical Exercise No. 15

Objective: To study the vegetative propagation techniques

Vegetative reproduction is the method of producing plants without the use of seed. Otherwise called asexual reproduction, the methods most often used to produce trees are cuttings, air layering, grafting and micro propagation.

Cuttings:……

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Diagram:

Air layering:……

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Diagram:

Grafting:……

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Diagram:

Micro propagation:……

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Diagram:

Practical Exercise No. 16

Objective: To study the forest plantations and their management

- Plantation of forests can provide most goods and services that are provided by natural forests. These include timber, non timber forest products, protection of clean water and clean air, soil erosion control, biodiversity, esthetics, carbon sequestration, and climate control.
- Nonetheless, as the value of environmental services from natural forests is higher than that from forest plantations, the demand for conservation of natural forests is stronger. It is possible that a division of land, with some land specialized in timber production and other land in providing environmental services, would produce more forest-related goods and services to society.
- Because forest plantations grow much faster than natural forests, forest plantations are seen as an increasingly important source of timber supply. Should more forest plantations be developed, more natural forests might be saved.

To appreciate the need for forest plantations, the roles played by these plantations must be defined. Quite often, there are a number of roles (such as fuelwood or fodder production) which, through careful planning, can be combined to achieve multiple benefits.

Establishment and management techniques of forest plantations:

- Site reconnaissance
- Selection of the planting site
- Species selection
- Preparation of the planting site
- Time of planting
- Planting of containerized stock
- Spacing of plantings
- Maintenance of plantations
- Harvesting operation

Site reconnaissance……

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Selection of the planting site……

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Species selection……

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Preparation of the planting site……

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Practical Exercise No. 17

Objective: To study the forest plantations and their management

Establishment and management techniques of forest plantations:

Time of planting……

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Planting of containerized stock……

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Spacing of plantings……

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Maintenance of plantations……

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Harvesting operation……

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Practical Exercise No. 18

Objective: To visit nearby forest based industries.

- Forest based industry in India was initially confined to produce building materials, agriculture implements, bullock carts, and railway sleepers.
- Forest based industries were encouraged because of its rural identity and its ability to solve the problem of unemployment and poverty.
- In addition, the policy makers had also perceived that natural resource based industrial development is a pre-requisite for the economic development of less developed countries like India. Hence, the Government, both at the Centre and State encouraged establishment of small, medium, and large-scale forest based industries in the region. Due to this policy, the country witnessed heavy pressure of industries on forests for raw material purpose.

Policy directions:

National forest policy, 1988: Directed all the wood based industrial in the country to generate their own raw material needs without depending on the forest depart supply. It also facilitating quality seedling supply technological support, credit and insurance facility and promote agro-forestry plantations.

The national agro-forestry policy, 2014: Intensified the promotion of industrial agro-forestry plantations. It directed the government to liberalize the timber transit rules and attract farmers towards agro-forestry. It also directed to extend credit and insurance facilities to agro-forestry plantations besides establishing necessary market mechanism.

Field Exercise:

1. **Name of the visiting forest based industry:** …….
2. **Date of visit:** ……..
3. **Locality:** …….
4. **Area (m^2):** ……
5. **Observations**:

Resource and energy efficiency……..

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Raw materials……

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Logistics……

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Workforce……..

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Competition, trade and cooperation……...

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Information, communications and image……..

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