



# FOREST UTILIZATION



DIRECTORATE OF FORESTS  
GOVERNMENT OF WEST BENGAL



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## PREFACE

Forestry Utilization is the subject that deals with harvest, processing and disposal of forest produce. Although the focus till now has been on wood products, particularly timber, the economic and social importance of various non-wood products is now duly appreciated in the sphere of forest management. Under the JICA project on 'Capacity Development for Forest Management and Training of Personnel' being implemented by the Forest Department, Govt of West Bengal, this course material on Forest Utilization has been prepared for induction training of the Foresters and Forest Guards. The object of this training manual is to help the frontline forest personnel have a better perception about basic principles and procedures involved in forest utilization.

The subjects covered in these materials broadly conform to the syllabus laid down in the guidelines issued by the Ministry of Environment of Forests, Govt of India, vide the Ministry's No 3 -17/1999-RT dated 05.03.13. In dealing with some of the parts of the course though, the syllabus has been under minor revision to facilitate better understanding of the subjects and to provide their appropriate coverage. The revised syllabus, with such modifications, is appended.

The contents of the course material have been compiled and edited by A Basu Ray Chaudhuri, IFS (Retd). Books and literature that have been made use of in preparing this course material have been cited in the respective lessons. Shri A Basu Ray Chaudhuri is indebted to many forest officers who have helped in the preparation of this material.

The efforts that have gone into making this course material will be best rewarded if the frontline staff of the forest department find it useful in their day-to-day work.

Kolkata, 2015

**A Basu Ray Chaudhuri**, IFS (Retd)  
For IBRAD (Consultant)

**N K Pandey**, IFS  
Chairman, SPMU, Forest Department,  
Govt of West Bengal



## Syllabus (Revised)

### Forest Utilization

<b>Forest utilization (7hours), excursion 1 day, tour 2 days</b>		
1.Wood products (timber and firewood)	1.1 Implements used for felling -Axe - Saws-hand, power - Miscellaneous tools* 1-2 Felling* - Seasons - Procedure 1.3 Conversion -Logging Process, Purpose - Sawn timber 1.4 Extraction and Transport - Minor and Major Transportation* - Methods of Transport* 1.5 Passing and Storage of Produce* - Passing of forest produce - Depots Stacking, Formation of depot lots, Protection, Stock taking, Registers 1.6 Wood Improvement* - Wood seasoning - Wood preservation - Composite wood	4 hours
2.Non- wood forest produce	2.1.Vegetable products -bamboos -canes -fibres and flosses -tannins and dyes. -medicinal plant species -edible products -tendu (beedi) leaf -oil seeds - Cutch and Katha* 2.2.Animal products -honey -Lac - Silk 2.3. Mineral products	3 hours



Field Study	<ul style="list-style-type: none"><li>-Felling-logging, transport operation</li><li>- wood seasoning, wood preservation*</li><li>-Timber/ firewood depots</li><li>-various NWFP</li></ul>	
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\* These are modifications to the MoEF-prescribed syllabus, indicating revision/addition of topics



Lesson No.	Contents	Page No.
1	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Utilization of Wood products               <ul style="list-style-type: none"> <li>➤ Implements used in felling and conversion                   <ul style="list-style-type: none"> <li>✚ Axes                       <ul style="list-style-type: none"> <li>❖ Parts – Axe head, Axe handle</li> </ul> </li> <li>✚ Saws                       <ul style="list-style-type: none"> <li>❖ Hand saws</li> <li>❖ Power Saws – Advantages and disadvantages</li> </ul> </li> <li>✚ Miscellaneous tools</li> </ul> </li> </ul> </li> </ul>	1-8
2	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Utilization of Wood products (Continued)               <ul style="list-style-type: none"> <li>➤ Seasons for felling</li> <li>➤ Procedure of felling                   <ul style="list-style-type: none"> <li>✚ Felling rules</li> <li>✚ Stump height</li> <li>✚ Roping</li> <li>✚ Direction of fall</li> <li>✚ Felling with Axe and Saw</li> </ul> </li> <li>➤ Logging                   <ul style="list-style-type: none"> <li>✚ Process of logging</li> <li>✚ Purpose of Logging</li> <li>✚ Factors determining log length</li> </ul> </li> <li>➤ Conversion of Timber                   <ul style="list-style-type: none"> <li>✚ Sawn timber</li> </ul> </li> </ul> </li> </ul>	9-14
3	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Utilization of Wood products (Continued)               <ul style="list-style-type: none"> <li>➤ Extraction and Transport                   <ul style="list-style-type: none"> <li>✚ Minor and Major transportation</li> <li>✚ Methods of transport</li> </ul> </li> <li>➤ Passing and Storage of Produce                   <ul style="list-style-type: none"> <li>✚ Passing of timber/ forest produce from forest coupe</li> <li>✚ Depots - Transit depots, Sale/Permanent depots</li> <li>✚ Permanent Depots</li> </ul> </li> </ul> </li> </ul>	15-23
4	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Utilization of Wood products (Continued)               <ul style="list-style-type: none"> <li>➤ Wood Improvement                   <ul style="list-style-type: none"> <li>✚ Wood Seasoning</li> <li>✚ Wood Preservation</li> </ul> </li> </ul> </li> </ul>	24-32



	<ul style="list-style-type: none"> <li>➤ Composite wood <ul style="list-style-type: none"> <li>✚ Forms of composite wood</li> </ul> </li> </ul>	
5	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Non-wood Forest produce <ul style="list-style-type: none"> <li>➤ Vegetable products <ul style="list-style-type: none"> <li>✚ Bamboos</li> <li>✚ Canes</li> <li>✚ Fibres and Flosses</li> <li>✚ Tannins and Dyes</li> <li>✚ Oil Seeds</li> </ul> </li> </ul> </li> </ul>	33-39
6	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Non-wood Forest produce (Continued) <ul style="list-style-type: none"> <li>Vegetable products (continued) <ul style="list-style-type: none"> <li>➤ Medicinal Plant Species</li> <li>➤ Tendu (bidi) leaf</li> <li>➤ Cutch and Katha</li> </ul> </li> </ul> </li> </ul>	40-48
7	<ul style="list-style-type: none"> <li>• Lesson Plan</li> <li>• Non-wood Forest produce (Continued) <ul style="list-style-type: none"> <li>➤ Animal products <ul style="list-style-type: none"> <li>✚ Honey and Wax</li> <li>✚ Silk</li> <li>✚ Lac</li> </ul> </li> <li>➤ Mineral Products</li> </ul> </li> </ul>	49-55










## Lesson Plan

**To Study****Utilization of Wood products**

- Implements used in felling and conversion
  -  Axes
    - ❖ Parts – Axe head, Axe handle
  -  Saws
    - ❖ Hand saws
      - Cross cut saws – Tooth shape
      - Bow saw
      - Maintenance of saws
    - ❖ Power Saws – Advantages and disadvantages
  -  Miscellaneous tools
    - ❖ Wedges
    - ❖ Cant-Hook
    - ❖ Pickaroons
    - ❖ Debarking spade
    - ❖ Measuring stick
    - ❖ Log hook
    - ❖ Stem tightener





**Backward Linkage:** Nil

**Forward Linkage:** Observation of felling operation during Tour

**Material Required:**

- Copy of Lesson 1 to be circulated beforehand
- Demonstration of Implements as far as possible

**Allocation of Time:**

- Implements used in felling and conversion
  -  Axes 7mts
    - ❖ Parts – Axe head, Axe handle
  -  Saws 15 mts
    - ❖ Hand saws
      - Cross cut saws – Tooth shape
      - Bow saw
      - Maintenance of saws
    - ❖ Power Saws – Advantages and disadvantages 10 mts
  -  Miscellaneous tools 12 mts
    - ❖ Wedges
    - ❖ Cant-Hook
    - ❖ Pickaroons
    - ❖ Debarking spade
    - ❖ Measuring stick
    - ❖ Log hook
    - ❖ Stem tightener
-  Demonstration of implements 16 mts

## Utilization of Wood Products

### 1. Implements used in felling and conversion

The main cutting implements are **Axes** and **Saws**.

#### 1.1 Axes

Axes are used for (i) felling, (ii) trimming, (iii) splitting and (iv) grubbing. Felling axes are of different types, varying in size and shape. Depending on the job, one particular type would be more suitable than the other, though most felling axes can be used for any of the above purposes. An axe has two parts – (1) metal head and (2) handle. Please see **Fig.1.1**.

1.1.1 **Axe head** - The axe head has a cutting edge and its body has an eye or hole in order that the handle can be fixed into it. The best type of axe head is either a solid piece of iron with a steel wedge welt into it, or two tapering pieces of iron between which a steel wedge is introduced. The edge is carefully tempered and made strong. It should be sharp but not brittle. The edge should be slightly



**Fig.1.1 Felling Axe**

(Source: <http://www.amazon.com/Hultafors-Hand-forged-Swedish-Felling-American/dp/B002GKC0V4>)

curved as it facilitates penetration in the wood and protects the corner from breaking. The sides of the blade should be slightly convex to enter the wood easily and emerge clear. The weight of the head depends on the type of timber to be cut. Generally it weighs 1.5 to 2 kg.

1.1.2 **Axe handle** – Generally round handles are used in our country. Round handles are easy to fit and can also be easily replaced. However, round handles are liable to slide around the eye. The American and European handles are oval shaped and have less chance to slip. The length of the handle varies from 70 to 120 cm.

## 1.2 Saws

Saws are used for felling, crosscutting, and ripping logs into scantlings, sleepers and other converted materials. Saws come broadly under two categories – hand saw and power saw.

**1.2.1 Hand saws** are easy to use and maintain, and they are cheap. That is why even though the output of handsaws is low compared to power saw, handsaws are the most common implement for felling and conversion. Saws are called one –man or two-man, according to whether they require one man or two men to operate. A saw consists of a broad blade or plate of steel of small thickness, one edge of which is toothed.

### 1.2.2 Crosscut saws

A **crosscut saw** is a general term for any saw blade for cutting wood perpendicular (against) to the wood grain. While crosscut saws may be small for fine work like wood-working, in forest works they are generally large and used for coarse work like felling of trees and conversion into logs. Length, breadth, thickness and tooth form are the main characteristics of a saw blade and are to be chosen properly to suit the job in hand.

- **Length** – This is guided by the diameter of the tree and the ease of arm movement. Suitable stroke length lies in the range 80 to 100 cm. An allowance of 5 to 15 cm should be given at both ends for fixing handles and protection of arms. Crosscut saws of following length are found suitable for general requirement.

Length of saw (cm)	Diameter of stems (cm)
140-150	30
165-170	30-70
180-200	80-100 and over

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

- **Breadth** – Narrow felling saws face lesser friction in the cuts than the broad ones. The saws which are either 85 mm broad along the whole length, or 90 mm at the ends and 120 mm at the middle, have proved to be the best. (Tribhawan Mehta 1981 A Handbook of Forest Utilization)
- **Thickness** – Saw blade should not be very thin as it makes guiding and controlling the saw difficult. Again thick saws produce broad kerf (width of saw cut) and consume higher energy for sawing. For saws 80 mm broad and 165 cm length, a thickness of about 1.82 mm has proved quite suitable. (Tribhawan Mehta 1981 A Handbook of Forest Utilization)

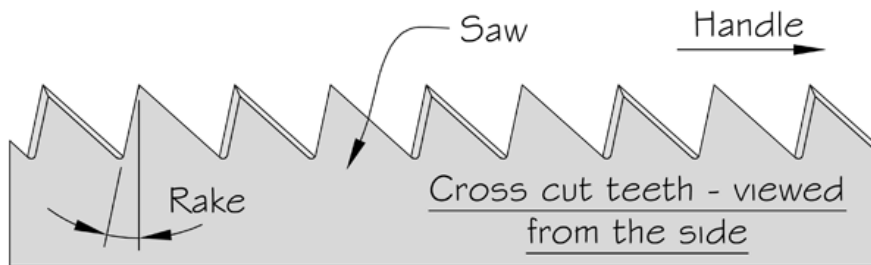


### 1.2.2.1 Peg tooth and Raker tooth

**Peg-tooth** type saws are common because they are easy to maintain. **Raker-tooth** type saws are preferred by professional workers. They cut faster but require more skill in maintenance. Saw teeth must do three things:

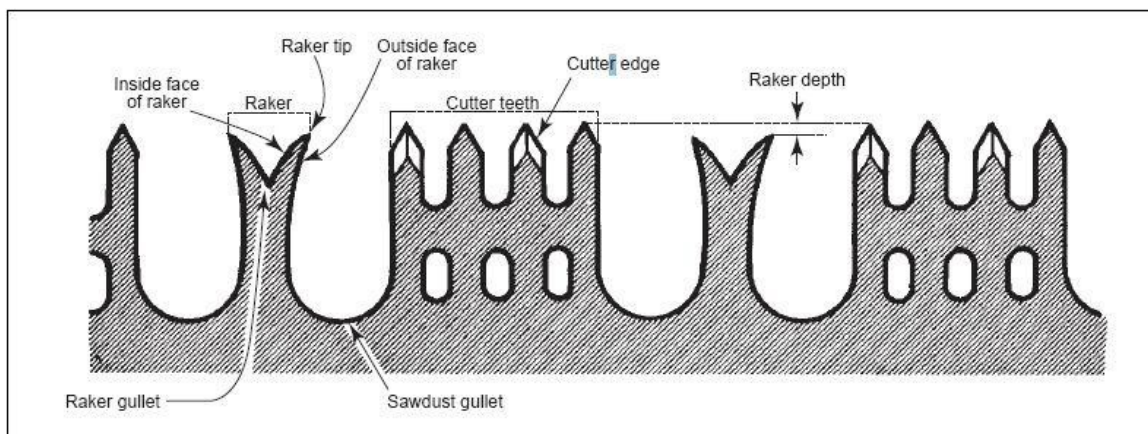
- cut through the fibres;
- break loose the cut fibres;
- remove the loose fibres (sawdust) from the kerf.

In **peg-tooth saws (Fig.1.2)**, these three things are done by one tooth. In **raker-tooth saws** the first of the three actions is done by a group of **cutters** cutting on alternate sides of the kerf. The second and third actions are done by the **raker** following the group of cutters.



**Fig.1.2 Peg tooth Crosscut saw**

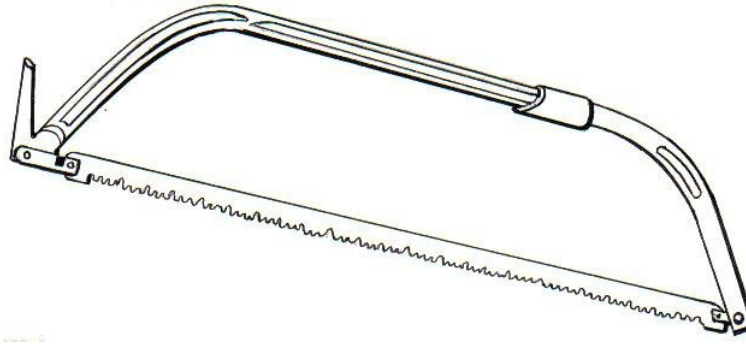
(Source:<http://www.blackburntools.com/articles/practical-cross-cut-saw-angles/index.html>)



**Fig.1.3 Rake-tooth crosscut saw** (Source:<http://www.terriau.org/joseph-theogenie/musee/two%20man%20saw%20teeth.jpg>)

### 1.2.3 Bow saw

Bow saw or one man saw is used for felling of small trees and poles or cutting other small sized products.



**Fig.1.4 Bow saw**

(Source: [https://commons.wikimedia.org/wiki/File:Bow\\_Saw\\_\(PSF\).jpg](https://commons.wikimedia.org/wiki/File:Bow_Saw_(PSF).jpg))

It carries a frame with a thin narrow saw blade. The oval section of the tubing makes a comfortable grip. The frame consists of two halves, one sliding into the other. The frame is thus adjustable and can be used with blades of different length. The blades of the bow saw are generally 90-105 cm long.

### 1.2.4 Maintenance of saws

Saws require regular maintenance. First of all, they should be protected from rust. That is why the saws should be stored in a dry place. Rubbing regularly with oil or grease provides protection. When the output of a saw decreases due to depression, deformity or any other physical defect, the saw should be immediately restored to its original good condition.

### 1.2.5 Power saws

With advancement in logging operation, power saws have been developed and brought to use. The power saws are either **chain, circular or drag type**, and are used mainly for felling and crosscutting. One man power saw is chainsaw type. A chainsaw is a portable, mechanical saw which cuts with a set of teeth attached to a rotating chain that runs along a guide bar. It is used in activities such as tree felling, logging, pruning etc. Power saws are generally supplied power by a small gasoline engine attached with the machine.





Fig. 1.5 Power Chain saw

(Source: <http://www.dreamstime.com/stock-illustration-chain-saw-hand-drawing-power-image41413531>)

#### 1.2.5.1 Advantages and Disadvantages of Power saws

##### Advantages

- Trees can be felled to lower stump;
- Production rate per hour is high;
- Light weight and therefore easily portable;
- Higher precision and less loss of wood;
- Can be used for sawing horizontally and vertically.

##### Disadvantages

- In rugged and sloping terrain and in places with heavy undergrowth, moving power saws from one tree to another is sometimes cumbersome and time consuming.
- Operating power saws requires skilled persons and such persons may not be always available.
- Maintenance and replacement of parts cannot be readily secured in interior locations.

#### 1.3 Miscellaneous tools

(Tribhawan Mehta 1981 A Handbook of Forest Utilization)

- **Wedges** – Wedges are used in felling trees and to prevent jamming of the saw in crosscutting or longitudinal splitting. Wedges are of various types in terms of size, shape and material. Metal wedges are made of steel or iron. **Wood** wedges with iron band are also used.
- **Cant-hook** – Purpose is to act as lever to roll, stop and turn logs.



**Fig.1.6 Cant Hook**

(Source:[http://www.forestry-suppliers.com/product\\_pages/Products.asp?mi=14892](http://www.forestry-suppliers.com/product_pages/Products.asp?mi=14892))

- **Pickaroons** - A **pickaroon** is a wood-handled, metal-topped log handling tool. It is a short pole, 85-100 cm long, with a recurved pike or hook for drawing or pulling small logs.



**Fig. 1.7 Pickaroon**

(Source: <http://www.leevalley.com/en/wood/page.aspx?p=51108&cat=1,41131>)

- **Debarking Spade** – It is fitted with a bent blade which is used for debarking logs.
- **Measuring stick** – Fitted with marking ends, it is used for measuring log length.
- **Log hook** – It is used for dragging, lifting and rolling.
- **Stem tightener** – Its function is to prevent the stems from splitting at butt ends. It consists of 13mm wire rope having a steel core. It is laid round the stem just above the felling cut and tightened with the help of a lever mechanism. The wire rope is held fast with the help of a clamping device which consists of a guide groove for the rope, a movable support and a wedge.





**Fig.1.8 Debarking spade**

(Source:[http://www.richmondsgroundcare.co.uk/index.php/site/product/category/forestry\\_hand\\_tools/](http://www.richmondsgroundcare.co.uk/index.php/site/product/category/forestry_hand_tools/))



**Fig. 1.9 Log hook**

(Source:<http://xinfairong.company.weiku.com/product/>)

**Reference Material:**

- (1) Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun
- (2) Websites cited in the lesson



## Lesson 2

1 Hour

### Lesson Plan

To Study

#### Utilization of Wood products

- Seasons for felling
- Procedure of felling
  - Felling rules
  - Stump height
  - Roping
  - Direction of fall
  - Felling with Axe and Saw
- Logging
  - Process of logging
  - Purpose of Logging
  - Factors determining log length
- Conversion of Timber
  - Sawn timber

**Backward Linkage:** Lesson 1 of Forest Utilisation

**Forward Linkage:** To observe and study felling and conversion operation during tour.

**Material Required:** Copy of Lesson 2 to be circulated beforehand.

#### Allocation of Time:

- |                                  |        |
|----------------------------------|--------|
| • Seasons for felling            | 5 mts  |
| • Procedure of felling           | 20 mts |
| • Felling rules                  |        |
| • Stump height                   |        |
| • Roping                         |        |
| • Direction of fall              |        |
| • Felling with Axe and Saw       |        |
| • Logging                        |        |
| • Process of logging             | 5 mts  |
| • Purpose of Logging             | 6 mts  |
| • Factors determining log length | 8 mts  |
| • Conversion of Timber           | 3 mts  |
| • Sawn timber                    | 5 mts  |
| • Discussion /Miscellaneous      | 8 mts  |



## Utilization of Wood products

### 1. Seasons for Felling

The season for felling is determined by climatic conditions and the growing season of trees. India has both tropical and temperate climates each characterized with well marked seasons. In areas above 2000 m altitude in the Himalayas, snowfall is heavy during winter, felling is usually done from April onwards and is generally completed before the rainy season. In the plains and submontane tract, felling is done in winter between October and March. Winter felling in general is advisable, as tree growth during this season is minimal. Felling in very hot weather is harmful from seasoning point of view, as the logs dry rapidly resulting in splitting and cracking.

### 2. Procedure of Felling

Felling of trees is a skilled operation, and unless done properly, causes considerable loss of timber. It is advisable that the wood cutter has the efficiency and experience in the use and maintenance of axe, saw and other implements.

#### 2.1 Felling Rules

The underlying principles of good felling technique are–

- Production of maximum volume of sound timber;
- Avoiding damage to the surrounding vegetation.

Based on the above principles, the following rules, in general, may be observed.

- (1) Trees should be felled as close to the ground as possible. In other words, stumps of felled trees should be as low as possible,
- (2) Trees should be felled in a manner and in a direction so that felling causes least damage to the trees being felled and the surrounding vegetation. Trees should not be felled across (i) other felled trees lying on the ground, (ii) boulders, and (iii) spurs or depressions. On hilly terrain, trees should be felled uphill.
- (3) Trees should not be felled into a place which is difficult to access.
- (4) Trees should not be felled during strong wind when it is difficult to guide felling in the desired direction.
- (5) Felling should usually start from the top of a slope and proceed downhill.
- (6) Felling should be concentrated as far as possible, restricted to sections that can be easily located, so as to facilitate supervision.

#### 2.2 Stump Height

High stumps left upon felling results in loss of considerable amount of valuable timber. When felling is done with axes alone, high stumps are usually left. With the help of saws and

other mechanized implements, stumps can be cut low and loss of timber from butt logs can be minimised.

### 2.3 Roping

In regeneration areas and sloping grounds, it is sometimes required to use ropes or cable puller to make the trees fall in the desired direction.

### 2.4 Direction of fall

It is first of all necessary to decide the direction of fall. It should be so chosen that –

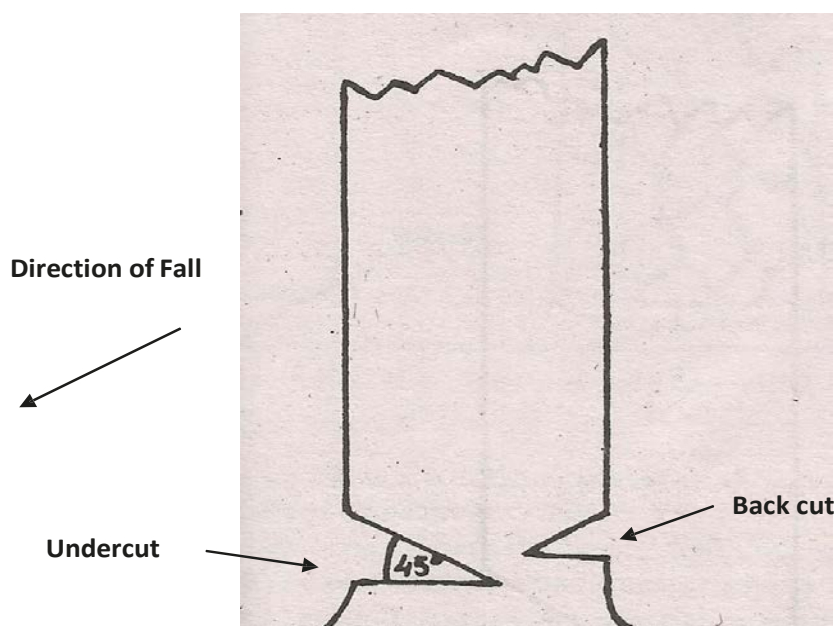
- The damage likely to be caused to the remaining stand and the regeneration is minimum;
- The stem is not damaged in the fall;
- The work to be done on the fallen stem becomes easy.

### 2.5 Clearing Work Space

Once the fall direction is decided, the working space around the tree's butt should be cleared and an escape path should be made. The weeds, shrubs and branches that hinder work should be clipped off and removed.

### 2.6 Felling with axe

On the trimmed stem, an undercut or notch is made on the side toward which the tree is to fall. Please see Fig.2.1. The traditional undercut has a horizontal base and a top sloping down to it at about a 45 degree angle. Undercutting provides a fulcrum and a hinge point on which to tip the tree off its stump in the desired direction. The notch is cut upto a depth of about 2/3 of the diameter of the tree.



**Fig. 2.1 Felling with Axe**

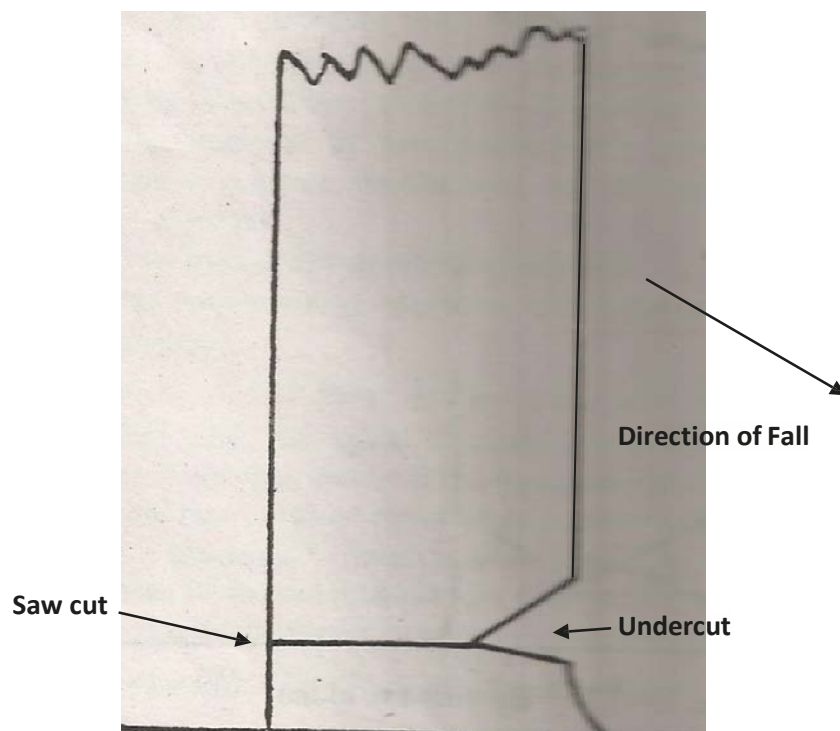
(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)



Then a back cut is made opposite to the undercut at a height about 10-15cm above the horizontal level of the undercut. The back cut should run parallel to the undercut. As the back cut reaches close to the notch, the tree begins to fall.

### 2.7 Felling with Axe and Saw

On the trimmed stem, a notch or undercut with axe is made on the side toward which the tree is intended to fall. The notch is flat and not too big. The saw cut is made with the help of a crosscut saw exactly opposite to the undercut at a level about 2.5 cm above the base of the undercut. Please see Fig.2.2. As the saw penetrates about double the width of the saw blade, a wedge is inserted and sawing continued. The deviation from the intended direction of fall is corrected by driving in wedges and sawing more or less in one or the other side. As the saw cut moves close to the undercut, the tree begins to fall.



**Fig.1.3 Felling with Axe and Saw**

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

### 2.8 Felling with Saw

In this case the saw cut is made and the tree is tipped by continuously pounding in the wedge. Alternatively, an undercut is made with a power saw as is done in the case of felling with axe and saw. The undercut is made deep enough to penetrate about  $1/4^{\text{th}}$  of the diameter of the butt. The saw cut is executed by two sawyers in the most comfortable position of standing or kneeling.

### 3. Logging

Trees as obtained on felling often cannot be transported and used as such. They need to be converted into such size and form as would be suitable for utilization. The first step for conversion is logging or log making, which renders logs or round timber of chosen dimensions. **Logging** or log making consists in cutting of felled trees into sections. The process includes trimming of branches, and sawing the clean bole and sometimes the larger branches into logs or round timber of required lengths.

- Trimming of branches is done by axe.
- After trimming, the places (cross sections) where the bole is to be cut are marked with the help of marking stick – the process is known as sectioning.
- The bole is cut at the marked sections with the help of cross cut saw. The cuts should be at right angles to the stem axis.
- After cutting, the logs are debarked if desired. Logs of miscellaneous species are not normally debarked.

#### 3.1 Purpose of Logging

The main purposes of logging are –

- **Division of weight of the whole tree** – By logging the entire tree bole into a number of parts, the weight of the tree is divided into units (logs) of smaller weights which can be manoeuvred and **transported easily and more economically**.
- **Elimination of defects** – Knots, bends, decay and other defects which reduce the marketability of otherwise straight and sound logs can be eliminated during logging.
- **Adaptation to methods of transportation** - The lengths of the logs are to be compatible with the mode of transport adopted.
- **Market requirement** – The most important purpose of logging is to produce lengths which have great demand in the market.

#### 3.2 Factors determining log lengths

Lengths of logs are primarily governed by the market demand and the ultimate end use of the material. Following points are worth consideration.

- **Straightness of log** – Straightness of logs enhances their market value. So the primary aim of logging should be to obtain sections as long as they remain straight. However, length of straight logs is restricted by the following factors:
  - Presence of bend, knot or other defects- defective portions have to be removed and thus length gets shortened.
  - Thickness of top end – even if straight, a log should not be extended to a thin end, as a thin top has hardly any timber value. It should be cut and used as firewood or otherwise.



- Transportability – in a given situation, the ease and cost of transport may restrict the length of logs to be produced.
- **Market demand** – In general, long straight logs have good demand in the market. For good timber species like Sal, Teak etc, logs of length 14, 16, 18, 20 feet fetch good price. In south West Bengal, where pole crop is predominant, poles of Sal and Eucalyptus of length 12, 14, 16, 18, 20 feet have good demand. Certain industries have again demand for small logs of length 8 to 10 feet. Logs intended for veneer industry are cut in special lengths. Pulpwood billets are usually 4 feet long. Firewood billets (with bark) are 2.5 feet long.
- **Mode of transport** – When it becomes unavoidable to carry logs by dragging, man-carriage or animal transport, long logs cannot be produced. With improvement in accessibility and mode of transport, logs of higher length can be extracted now.

#### 4. Conversion of Timber

Conversion of timber is normally done outside forest in sawmills. However, when the situation demands, timber can be squared in forest by means of axe to reduce the weight of timber and facilitate transport.

##### 4.1 Sawn Timber

By conversion, the logs (round timber) are converted into various sawn forms of cross sections which are either square or rectangular. Logs are transported to sawmill sites and conversion is done with the help of mechanised equipment and saws. Some of the common sizes and names of sawn timber are given below.

- **Beam** – Length more than 4 metre and any side of rectangular or square cross section not less than 15 cm.
- **Scantling** – cross section may be square or rectangular, any side of which is generally less than 15 cm.
- **Block** – Piece of short length with square surface
- **Plank** – wooden slab upto a maximum thickness of 5 cm with varying length and width.

#### Reference material

- (1) Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun
- (2) Websites cited in the lesson
- (3) [http://library.enlistment.us/field-manualsseries-2FM5\\_488CH5.PDF](http://library.enlistment.us/field-manualsseries-2FM5_488CH5.PDF)

**Lesson Plan**

**To Study**

**Utilization of Wood products**

- **Extraction and Transport**
  - ✚ Minor and Major transportation
  - ✚ Methods of transport
    - ❖ Transport by land
    - ❖ Water transportation
    - ❖ Overhead transportation
- **Passing and Storage of Produce**
  - ✚ Passing of timber/ forest produce from forest coupe
    - ❖ Record in measurement notebook
    - ❖ issue of transit challan
  - ✚ Depots - Transit depots, Sale/Permanent depots
  - ✚ Permanent Depots

**Backward Linkage:** Lesson 1 and 2 of Forest Utilisation

**Forward Linkage:** Observation and study, during tour, of felling and transit operation of forest produce and working of permanent depots

**Material Required:** Copy of Lesson 3 to be circulated beforehand

**Allocation of Time:**

- **Extraction and Transport** 20 mts
  - ✚ Minor and Major transportation
  - ✚ Methods of transport
    - ❖ Transport by land
    - ❖ Water transportation
    - ❖ Overhead transportation
- **Passing and Storage of Produce** 30 mts
  - ✚ Passing of timber/ forest produce from forest coupe
    - ❖ Record in measurement notebook,
    - ❖ issue of transit challan
  - ✚ Depots - Transit depots, Sale/Permanent depots
  - ✚ Permanent Depots
    - ❖ Stacking/Formation of Depot lots
    - ❖ Protection
    - ❖ Stock taking
    - ❖ Registers and records to be maintained
- **Discussion/Miscellaneous** 10mts



## Utilization of Wood products (Timber & Firewood)

### 1. Extraction and Transport

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

The main task of extraction of wood is the transportation of timber and other produce from forests to sawmill or timber depot or the market. The transportation constitutes a major expensive component in the whole process of delivery of forest produce to the consumers. The entire process of transport from stump to depot/consumer may be divided into two parts.

- (1) Minor Transportation – Also called “off road transportation”, it consists of assembling logs or other material from stump sites at some convenient points within the forest.
- (2) Major Transportation – It constitutes the final transport by truck or some major mode of transport, of the timber and other material from the points within the forest where produce has been assembled by minor transport, to the final destination.

### 2. Methods of Transport

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

The methods of transport can be broadly divided into three categories – (1) **transport by land**, (2) **water transportation**, and (3) **overhead transport**. The method to be adopted or which combination of the methods is to be adopted depends on (i) cost involved, (ii) topography of the tract, (iii) volume of material to be transported, (iv) time of delivery to the destination, and (v) available transport and transportation facilities like road, stream etc.

#### 2.1 Transport by land

Following methods may be used depending on suitability.

- **Carriage by men** – Adopted on sloping terrain for carrying small and medium sized timber.
- **Carriage by animals** – In plains and semi-hilly areas, bullocks, mules, camels and elephants are sometimes employed.
- **Carriage by carts** – In view of its mobility and ability to reach felling sites, cart hauled by a bullock/buffalo or a pair, is often used for carriage of timber and other produce.
- **Dragging** – Logs can be dragged on roads specially constructed for the purpose. Round billets are placed in front of logs to act as rollers. Chains, ropes, hooks and iron rings are used as dragging attachment. This mode of carriage is, however, not favoured, as it damages the log as well as the road.
- **Rolling** – In areas of gentle slope, logs can be rolled. However, this method also involves damage to the logs and vegetation.



- **Motor Transport** – With time, it has been possible to use more and more of hard surfaced roads as extraction path, and motor trucks of different size, power and efficiency have also been available in most of the forested locations. Thus motor trucks have become the most important means of timber transportation. Extensive use of motor truck has almost replaced all other methods including water transportation. Now-a-days a tractor is also an indispensable machine in mechanized logging, particularly in off-road transportation.

## 2.2 Water Transportation

Timber transport by water is the oldest and by far the cheapest mode of transport. It has been extensively used in North-West Himalayas, and to some extent in parts of peninsular India as well as eastern and Western Ghats. Construction of motorable roads over time has reduced the importance of water transportation. Following methods of water transport have been in practice.

- **Floating** – In this method, timber is hauled from the forest to stream bank, stacked and launched in the stream when sufficient water is available. Timber is allowed to drift with the current, piece by piece, without direct intervention, during its passage down the river. Floating method is generally resorted to in the upper reaches of rivers where they are narrow and flow of water is swift. The method of floating has limitations, as it is not suitable for large logs because of lack of availability of sufficient water and obstruction in riverbeds.
- **Rafting** – A quantity of wood firmly bound together is termed as a raft section, and a number of sections form a **raft**. (Tribhawan Mehta 1981 A Handbook of Forest Utilization). For example, **log rafts** are made of 6-10 sections and each section consists of 16-20 logs of more or less equal length which are laid parallel to each other and placed longitudinally with the stream. Logs in each section are tied with canes, chains or ropes. The raft is guided by 4-5 men crew with the help of oars. **Sawn timber rafts** consist of sawn timber of various forms (scantling, planks, sleepers etc.) fastened together in bundles with ropes or withes which are slid into water to form rafts. Rafting coupled with floating can be conveniently used for delivery of timber to depots located on the riverside. Singly floating timber is intercepted downstream in booms (a floating barricade across a river), and then rafts are made for movement down to depots.
- **Wetslides** – They are used for extraction of timber from nullahs having shallow water and many obstructions to floating. The use of this method is restricted to carriage of medium and short timber, scantlings, poles, posts etc. Water acts as a motive force in addition to gravity. The material is placed in water in the forest and by wetslide discharged in the main stream for floating. The efficiency of this method depends on water flow available and possibility of handling the material at the destination. When conditions are favourable to their construction and operation, wetslides are very economical.



## 2.3 Overhead Transportation

Aerial ropeways are used for carriage of material by carriers which are suspended from one or more ropes. There are two principal forms.

- Double or Multiple ropes – These consist of stationary suspension or track ropes and moving control or haulage ropes.
- Single ropes – They consist of a single moving rope to which the load is directly attached.

In both cases haulage power is derived from gravity and thus carriage downhill is possible, unless some form of power engine is available to haul the material up.

### 2.3.1 Donald Portable Gravity Ropeway

A combination of both the above types this ropeway has been in use in Himalayan regions for long. The ropeway consists of (i) three track ropes placed parallel to one another in the same plane, 1 m apart, supported at each end by simple wooden trestle, and (ii) an endless control rope placed under the **central** rope 2 metre below. The endless rope travels round a grooved wheel at each terminal. The speed is controlled by a hand brake at the lower terminal. The load is suspended crosswise below the three track ropes by three carriers. The carriers consist of a pulley and an attachment to which wire-slings fastened round the load can be hooked. Another wire-sling round the middle of the load is fastened to an eye-let into the control rope. Upon release from the upper terminal, the load moves down under gravity to the lower terminal. The load is removed and the carriers are attached to the control rope to be moved to the upper terminal for the next load.

### 2.3.2 Gravity Conveyor

While being similar to the Donald Ropeway, a gravity conveyor carries logs by means of a carriage which travels on a single track rope. The carriage is pulled back by means of a hauling line operated by a powered winch. The ropeway consists of a track rope supported at each end by trestles or trees. The winch is normally powered by a diesel engine.

### 2.3.3 Power Ropeways

As the name suggests, power ropeway is driven by a power machine. Fixed in a position the machine pulls in logs from a distance by means of a wire rope wound on a drum. The machine consists of two or more drums powered through gearing by an engine which may be steam engine or electric motor or internal combustion engine. The engine may be mounted on timber stack, truck or tractor. Power is transmitted from engine to wire ropes wound on the drums. A minimum of two drums is required, a main line drum for the log hauling line and a haul-back drum which pulls the main line out to where logs are lying.



### 3. Passing of forest produce from coupe

Before dispatch of any forest produce from coupe to depot, it is mandatory to **pass** the produce for such dispatch. Passing a forest produce is the act of authorising its transport from the coupe to specified depot.

#### 3.1 Procedure

Following felling and logging, the logs, poles, firewood etc. should be passed for carriage to depot. To start passing and carriage of produce, one should not wait till completion of felling-logging of the entire coupe. It is advisable to begin passing and carriage immediately after logging, as soon as produce, in quantity optimum for transport, is ready. This will prevent illicit removal of produce from the coupe. In other words, passing and carriage should follow closely felling-logging and go simultaneously. Following procedure for passing is observed.

- Forest produce is passed by a forest officer (Passing Officer), authorised in this behalf, by way of putting the mark of a **passing hammer** on the produce. The passing hammer is issued to the Passing Officer by the competent authority.
- The Passing Officer simultaneously records the act of passing in a Timber Measurement Notebook (TMNB) stating that the produce described in the TMNB has been passed for carriage to a specified depot. Records in the TMNB include –
  - Name of the coupe
  - Date of passing
  - Description of produce passed. Such description should indicate –
    - ✚ For logs, name of the species, length, mid-girth (over bark or under bark, as the case may be), and log number (marked on the cross-section face, for example, log no 167/2 would mean the second log from butt end of tree no 167)
    - ✚ For rough dressed timber, name of the species, and dimensions of the material.
    - ✚ For poles, name of the species, length and butt-end girth.
    - ✚ For firewood – name of the species and stack volume.
  - Facsimile of the passing hammer which has been marked on the passed produce.
  - Name, designation and signature of the Passing Officer.

### 4. Intermediate Transit Challan

While dispatching the passed produce from coupe to depot, the Passing Officer issues Intermediate Transit Challan (ITC) for forest produce of each individual carrier. In other words, each carrier should carry ITC describing the produce being carried. The purpose of ITC is to certify that the accompanying produce has been authorized for carriage from the coupe (specified) to depot (specified). The Passing Officer should record in the ITC –

- Date of issue
- Name of the coupe



- Name of the depot
- Description of the produce with such details as given in previous paragraph.
- Facsimile of passing hammer
- Name, designation and signature of issuing officer.

## 5. Depot

A depot is a place where wood or other forest produce is stored pending its disposal. The depots may be (1) **forest depots**, (2) **transit depots**, and (3) **sale depots or permanent depots**. Forest depots are temporary and formed for assembling and checking the produce before despatch from forest. Transit depots are intermediate depots inside or outside forest where the forest produce is temporarily stored pending its movement to destination. A forest depot may be called a transit depot. The purpose of transit depot is also collection of produce and checking before further movement.

### 5.1 Sale depot or permanent depot

These are the depots where forest produce is stored pending its disposal by sale. These depots are of permanent nature because produce stays in these depots for relatively longer time, and the depots are used for produce of a number of coupes over the years.

- **Staff** – Normally, an officer of the rank of Deputy Ranger/Forester remains in charge of a permanent depot. The depot officer in charge of the depot is assisted by other personnel depending on requirements.
- **Location and Layout** – Location and layout should be well planned. The location should be such that (i) it is not far off from the present and prospective coupes of near future so that extraction cost and time remain within reasonable limits, and (ii) it is well connected by metalled roads so that the buyers find it easy to transport produce from the depots.

**Layout** - The depots should be constructed over a site of relatively high level, which is not waterlogged and not prone to land slip or soil erosion. The depot area should be enough to accommodate produce of a number of coupes. The area should be divided into a number of plots or sections, serially numbered, allotted to produce of different coupes. The various plots/sections should be separated by a network of roads so that trucks or carts may ply along, and load or unload coupe produce with ease. For each plot there should be a signboard displaying the coupe name and the contents.

- **Stacking** – Following points are in general worth considering.
  - For the convenience of management and control of inventory, **produce of different coupes should be stored in separate plots/sections**. Within a plot(s), produce of a coupe should be **separated species wise and then product wise, i.e. logs, poles, firewood etc.**

- Before forming final stacks, material of the same product of a species is **further separated in terms of size and quality**. For example, logs of Sal coming from the same coupe are differentiated in terms of girth and length class and to the extent possible, inferior and defective logs are separated from the sound ones. In a word, **a stack should contain produce of comparable size and quality**.
- The stacks should be as close as possible, subject to inspection facility, to economise space. The logs and poles may be stacked in multiple layers with space between the individual pieces so as to permit measurement and inspection. Preferably, the lowest tier of logs should be kept off the ground by skids which can be round or square pieces. The firewood should be piled in stacks as compact as possible.
- **Formation of Lots** - After a coupe produce has been differentiated and stacked species wise, product wise, size and quality wise, in that order, **lots are formed**, which consist of one or more stacks of a particular product. To each lot a unique **lot number** is assigned; the number generally contains both numerical figures and words indicating some serial number, the coupe, year of extraction etc. For each lot, a **marking list** is prepared, which contains lot number and details of the produce forming the lot. Lots should be formed **as early as possible**. Lot formation should start as soon as a depot receives reasonable quantity of produce that permits grading of a product.
  - Lot size depends on (1) expected price of the lot vis-a-vis buying power of the merchants and 2) carrying capacity or full load capacity of the carriage (truck, tractor, cart etc.) prevalent in the locality.
- **Depot Register/Forms** – As during felling season timber and other produce is passed and transmitted from coupes, the depots start receiving the produce, thus adding to its stock. Again following sale of timber etc in auction or tender, the buyers of wood-lots begin lifting of lots from the depots, and the depot stock is reduced in the process. **Every movement of produce coming in or going out of a depot should be recorded in depot register/ forms prescribed in this regard**. The depot register should reflect
  - For incoming produce – name of the coupe, ITC reference, date of receipt, description of produce including measurement received date wise, depot serial number assigned for logs, plot or section number where stacked etc.
  - For outgoing produce – Lot reference, order of the competent authority, sale price, if applicable, buyer/recipient of produce, date of lifting, Transit Pass reference etc.

It is important to note that any record for influx or outflux of produce is done chronologically that is in the order of time they occur.



- **Stock verification or checking** has broadly the **following phases**–
  - (1) To verify whether the entire produce passed from a coupe has entered the depot under ITC.
  - (2) To verify whether the entire produce received in the depot has been formed into depot lots identifiable by respective unique lot numbers.
  - (3) Whether the unlifted lots which represent the balance stock at any point of time is physically present in the depot.

**Stock unit** of forest produce depends on the product. It is explained below.

**For logs, stock unit is individual piece.** That is, stock of logs in a depot is maintained and verified individual log wise. It is normally done as follows. The depot maintains a running serial number for logs. As and when logs arrive in the depot, each log is assigned a unique running serial number chronologically. The said serial number and the description as well as the measurements of the corresponding log are entered date wise (date of receipt) in the depot register of prescribed format. Thus each serial number corresponds to a particular log of species and dimensions recorded in the register and verifiable by physical measurement in the depot.

As Depot serial numbers of log are assigned chronologically, that is, in the order of arrival of logs in the depot, it is more likely that logs bearing successive serial numbers are of varying class and size and may also be of different species. Therefore, they get dispersed into different lots. The **process of stock verification then turns into (1) locating the depot serial numbers assigned to the logs of a coupe in the lot marking lists as well as physically in the lots so as to ensure that all logs of the coupe are accommodated in the lots formed of such coupe logs, and (2) physically checking the measurement of logs – a certain percentage chosen at random, if cent per cent checking is not feasible – in the lots formed.**

**For poles and posts, the stock unit for verification is the number belonging to a species and to a size class.** For example, while passing Eucalyptus poles from a coupe, species, and the number of poles including their height and butt-end girth class are recorded. As the poles arrive at the depot, the number of poles of the specified size class and the species is immediately recorded in the depot register. Such record of incoming poles is done chronologically. Later during the process of stacking and formation of lots, poles are graded in terms of species, size etc and get distributed into various lots. The process of verification then constitutes (i) adding up of number of poles of same size class and species from different lots and matching the number with what has been recorded as incoming produce in the depot register, and (2) physical verification of dimensions of the poles (a certain percentage selected at random, if cent per cent checking is not feasible or desirable).



**The stock unit of firewood is the stack volume belonging to a species.** Firewood is passed in terms of species and stack volume. The said parameters are also recorded in the Depot register as incoming produce. Normally a firewood lot consists of several stacks. Here the procedure of stock verification is to measure the stack volume; species wise, of all firewood formed into lots and match the figure with records of incoming firewood in the depot register.

Stock verification of permanent depots should be done periodically, or at least once a year.

- **Protection** – The two most important factors against which protection of depot is absolutely essential are **fire and theft**. Depots should be fenced with barbed wire. Every permanent depot should have arrangement for round-the-clock watch and ward. Big depots should be provided with watch tower located suitably in the depot so as to command good view of the entire depot area. Besides, there should be arrangement of electric lights for good visibility at night. The depot area should be kept clean from weeds and grasses, particularly in dry season. On the outside around the depot, a clear strip free from grass and shrubs may be maintained by occasional controlled burning. The depots should have provisions of fire fighting material like water, sand and fire extinguisher.

#### **Reference material**

Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun







## Lesson 4

1 Hour

### Lesson Plan

#### To Study

#### Utilization of Wood products

- **Wood Improvement**

- **Wood Seasoning**

- ❖ Moisture in wood
    - ❖ Seasoning defects
    - ❖ Air Seasoning
    - ❖ Kiln Seasoning

- **Wood Preservation**

- ❖ Wood Preservatives – types
    - ❖ Wood Preservation Processes

- **Composite wood**

- **Forms of composite wood**

- ❖ Plywood
    - ❖ Laminated wood
    - ❖ Fibre board
    - ❖ Particle board

**Backward Linkage:** Previous lessons of Forest Utilisation

**Forward Linkage:** Observation and study, during tour, of wood seasoning and wood preservation.

**Training Materials Required:** Copy of Lesson 4 to be circulated beforehand

#### Allocation of Time:

- **Wood Improvement**

- **Wood Seasoning** 20 mts

- Moisture in wood, Seasoning defects,  
Air Seasoning, Kiln Seasoning

- **Wood Preservation** 20 mts

- Wood Preservatives – types  
Wood Preservation Processes

- **Composite wood**

- **Forms of composite wood** 15 mts

- Plywood, Laminated wood  
Fibre board, Particle board

- **Discussion/Miscellaneous** 5 mts



## Utilization of Wood products

### 1. Wood Improvement

Wood, in its green state, the state in which it is obtained in forest after felling and conversion, is not ready or suitable for immediate use. In order to make permanent use of timber and make it durable, it is often required to subject the wood to physical and chemical treatment. The purpose of such treatment is to improve the quality of wood and enhance its workability and durability. There are various ways of treatment that are in vogue. The method of treatment to be used depends on the species, state of wood, cost, the time involved and the actual requirement.

### 2. Wood seasoning

Wood seasoning means removal of moisture present in the timber in its green state. Seasoning is a costly and time consuming process and should be employed when there are valid reasons why it is required. A few important reasons are that seasoning reduces gross weight and thereby subsequent transport and handling costs, imparts dimensional stability, increases most strength properties, increases fastener holding power and thereby joint strength, increases electrical resistance, improves paintability and glueability, and finally, improves the thermal properties of wood.

**2.1** Whether artificially seasoned or left to dry naturally in place, wood will ultimately assume a moisture content level that is consistent with the relative humidity of its surroundings. i.e., it will adsorb or desorb moisture from or to the atmosphere until the vapour pressure of the water in the wood just balances the partial pressure of the water vapour in the surrounding air.

(Source: <https://www.extension.purdue.edu/extmedia/FNR/FNR-155.pdf>)

### 2.2 Moisture in wood

Water in the wood is held as –

- (1) Free water, held by capillary action inside the free spaces in the cells and fibres;
- (2) Absorbed moisture, which is intimately absorbed by the substance of cell walls and distributed in the inter-molecular spaces between the ultimate particles of which wood substance is composed.

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

**2.2.1** Removal of so-called free water, or sap, from cell cavities has little effect on wood other than to lighten it. but removal of absorbed, or “hygroscopic”, moisture from the cell walls materially affects its physical and mechanical properties. Free water is removed first during seasoning since energy needed to break hygroscopic bonds is fully utilized

evaporating free water from the wood surface. The moisture content level at which all free water has been removed from the cell cavities but none of the hygroscopic moisture from the cell walls is referred to as the "**fibre saturation point**". For most species the fibre saturation point exists at a moisture content level of about 25- 30 percent (where moisture content is expressed as a percentage of the oven dry weight of the wood).

**2.2.2** When dried below the fibre saturation point, wood becomes dimensionally unstable and its volume, area, and length become a function of its moisture content.

(Source: <https://www.extension.purdue.edu/extmedia/FNR/FNR-155.pdf>)

### 2.3 Seasoning defects

Following are the common seasoning defects.

- **Shrinking and swelling** – Wood shrinks or swells as it loses or absorbs moisture. Different planes of the same specimen suffer varying swelling or shrinkage. Shrinkage along the circumference of a log, commonly known as tangential shrinkage, is much more than that in the radial direction.
- **Warping** – This is caused by unequal shrinkage or expansion across the grain. It is attributable to wood structure, sawing method, uneven drying or to combination of these. The types of wood warping include (Please see **Fig.4.1**):
  - bow : a warp along the length of the face of the wood
  - crook: a warp along the length of the edge of the wood
  - kink: a localized crook, often due to a knot
  - cup: a warp across the width of the face, in which the edges are higher or lower than the center of the wood
  - twist : a distortion in which the two ends do not lie on the same plane. (Source: [https://en.wikipedia.org/wiki/Wood\\_warping](https://en.wikipedia.org/wiki/Wood_warping))



**Fig.4.1 Wood warping**

(Source: [https://en.wikipedia.org/wiki/Wood\\_warping](https://en.wikipedia.org/wiki/Wood_warping))

- **Cracking and splitting** – This is caused as wood fibres separate from each other. Cracks occur mostly along radii and least parallel to growth rings.

The art of seasoning lies in controlling the rate of drying and regulating it within limits so that the wood seasons with the least possible damage. The **rate of drying is controlled** by



- Heat;
- Humidity in the air;
- Air circulation

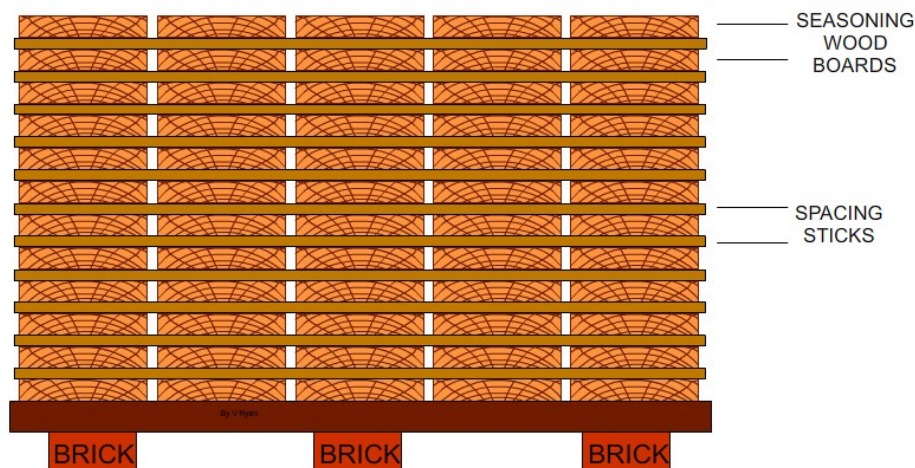
## 2.4 Methods of seasoning

- **Air Seasoning** (<http://www.aboutcivil.org/Natural%20air%20seasoning.html>)

The traditional method of seasoning timber was to stack it in air and let the heat of the atmosphere and the natural air movement around the stacked timber remove the moisture. The process has undergone a number of refinements over the years.

The basic principle is to stack the timber so that plenty of air can circulate around each piece. The timber is stacked with wide spaces between each piece horizontally, and with strips of wood (stickers) between each layer ensuring that there is a vertical separation too. (Please see **Fig.4.2**) Air can then circulate around and through the stack, to slowly remove moisture. In some cases, weights can be placed on top of the stacks to prevent warping of the timber as it dries. Moisture loss from the side of the wood is at about the right rate not to cause collapse of the cells, but near the ends of the wood, the moisture loss can prove to be too fast. Often the ends are wrapped or painted to slow the moisture loss from the end grain.

The stack is raised well clear of the ground, vegetation, etc to provide good air circulation and free from rising damp, frost, etc. and an **over head cover** is provided to protect from effects of direct sunlight and rains. .



**Fig.4.2 Air seasoning**

(Source: <http://www.technologystudent.com/joints/forest4a.html>)

- **Kiln Seasoning –**

(Source: <https://clounaghttechnology.wordpress.com/year-8/coat-hook/seasoning-of-timber/>)

The process of kiln drying consists basically of introducing heat. This may be directly, using natural gas and/or electricity or indirectly, through steam-heated heat exchangers, although solar energy is also possible. In the process, deliberate control of temperature, relative humidity and air circulation is provided to give conditions at various stages (moisture contents or times) of drying the timber to achieve effective drying. For this purpose, the timber is stacked in chambers, called wood drying kilns, which are fitted with equipment for manipulation and control of the temperature and the relative humidity of the drying air and its circulation rate through the timber stack.

**Advantages** - Kiln drying provides a means of overcoming the limitations imposed by erratic weather conditions. Timber can be dried to any desired low moisture content by kiln drying, but in air drying, moisture contents of less than 18% are difficult to attain for most locations. The drying times are considerably less in kiln drying than in air-drying.

### **3. Wood Preservation**

(Source: <http://www.epa.gov/ttnchie1/ap42/ch10/final/c10s08.pdf>)

The object of wood preservation is to prolong the life of perishable timbers. Wood preservation is the pressure or thermal impregnation of chemicals into wood to provide effective long-term resistance to attack by fungi, bacteria, insects, and marine borers. By extending the service life of timber products, wood preservation reduces the need for harvest of already stressed forestry resources, reduces operating costs in industries such as utilities and railroads, and ensures safe working conditions where timbers are used as support structures.

#### **3.1 Preservatives - types**

There are **two general classes** of wood preservatives: (1) oils, such as creosote and petroleum solutions of pentachlorophenol; and (2) waterborne salts that are applied as water solutions. The effectiveness of the preservatives varies greatly and can depend not only upon its composition, but also upon the quantity injected into the wood, the depth of penetration, and the conditions to which the treated material is exposed in service.

#### **3.2 Wood preservation processes**

##### **3.2.1 Conditioning**

With most wood treating methods, significant amounts of free water in the wood cell cavities may slow or prevent the entrance of the preservative chemical. Therefore, wood moisture content must be reduced prior to treatment. Moisture reduction can be accomplished by using artificial conditioning treatments or by air-seasoning (i.e., storing the untreated wood outdoors in piles). However, because certain wood species will rot before air drying can be completed in some climates, wood may be artificially conditioned by one



of three primary methods: (1) steaming-and-vacuum, (2) boiling-under-vacuum (commonly referred to as the Boulton process), and (3) kiln drying.

### 3.2.2 Treating

Most wood-preserving methods may be classified as either

- **Pressure processes**, in which the wood is placed in a treating cylinder or retort and impregnated with preservative under considerable force, or
- **Non-pressure processes**, which do not involve the use of induced pressure.

Non-pressure processes can be classified as

- **thermal processes**, in which heat is applied, and
- **non-thermal processes**, such as brushing, spraying, dipping, and soaking.

Non-pressure processes generally are used only with oil-borne preservatives.

#### 3.2.2.1 Pressure methods

The majority of wood is impregnated by pressure methods in closed cylinders. Pressure processes operate on the same general principle, though they may differ in the specifics of the process. The treatment is carried out in steel cylinders or retorts. Most units conform to size limits of 2 to 3 metres (m) (6 to 9 feet [ft]) in diameter and up to 46 m (150 ft) or more in length, and are built to withstand working pressures up to 1,720 kilopascals (kPa) (250 pounds per square inch [psi]). The wood is loaded on special tram cars and moved into the retort, which is then closed and filled with preservative. Applied pressure forces preservatives into the wood until the desired amount has been absorbed.

**3.2.2.1.1** Three processes, the **full-cell**, **modified full-cell**, and **empty-cell**, are in common use. These processes are distinguished by the sequence in which vacuum and pressure are applied to the retort. The terms “empty” and “full” refer to the level of preservative retained in the wood cells. The full-cell process achieves a high level of retention of preservative in the wood cells, but less penetration than the empty-cell process, and the empty-cell process achieves relatively deep penetration with less preservative retention than does the full-cell process.

- **Full-Cell Process** - The full-cell (Bethel) process is used when maximum preservative retention levels are desired, such as when treating timbers with creosote for protection against marine borers. In addition to creosote, the full-cell process also is used primarily with waterborne preservatives. The full-cell process steps are listed below:
  - (1) The charge of wood is sealed in the treating cylinder, and an **initial vacuum** is applied for approximately half an hour to remove as much air as possible from the wood and from the cylinder;
  - (2) The preservative, either heated or at ambient temperature depending on the system, enters the cylinder without breaking the vacuum;

- (3) After the cylinder is filled, the cylinder is pressurized until no more preservative will enter the wood or until the desired preservative retention is obtained;
  - (4) At the end of the pressure period, the pressure is released, and the preservative is removed from the cylinder; and
  - (5) A final vacuum may be applied to remove the excess preservative that would otherwise drip from the wood.
- **Modified Full-Cell Process** - The modified full-cell process generally is used for the application of waterborne preservatives. This method is **similar to the full-cell process except for the initial vacuum levels**. The modified full-cell process uses less vacuum than the full cell; the vacuum levels are determined by the wood species being treated and the preservative retention levels desired.
  - **Empty-Cell Process** - The empty-cell process obtains deep preservative penetration with a relatively low net preservative retention level. The **Rueping process** and the **Lowry process** are the two most commonly used empty-cell processes.
    - In the **Rueping process**, compressed air is forced into the treating cylinder containing the charge of wood to fill the wood cells with air prior to preservative injection. Pressurization times vary with wood species. After the initial pressurization period, preservative is pumped into the cylinder. As the preservative enters the treating cylinder, the air escapes into an equalizing or Rueping tank at a rate which maintains the pressure within the cylinder. When the treating cylinder is filled with preservative, the pressure is raised above that of the initial air and maintained until the wood will take no more preservative or until enough has been absorbed to leave the desired preservative retention level after the final vacuum. After the pressure period, the preservative is removed from the cylinder and surplus preservative is removed from the wood with a final vacuum.
    - **The Lowry process** is an empty-cell process without the initial air pressure. Preservative is pumped into the treating cylinder without either an initial air pressurization or vacuum, trapping the air that is already in the wood. After the cylinder is filled with the preservative, pressure is applied and the remainder of the process is identical to the Rueping process.

#### 4. Composite wood

Composite wood is a general term for built up bonded products consisting either wholly of natural wood or of wood in combination with metals, plastic etc. (Tribhawan Mehta 1981 A Handbook of Forest Utilization). Following are the forms of composite wood.



## 4.1 Plywood

(Source: <https://en.wikipedia.org/wiki/Plywood>;  
<http://www.epa.gov/ttn/chief/ap42/ch10/final/c10s05.pdf>)

Plywood is a sheet material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers having their wood grain rotated up to 90 degrees to one another. This alternation of the grain is called cross-graining and has several important benefits: it reduces the tendency of wood to split when nailed at the edges; it reduces expansion and shrinkage, providing improved dimensional stability; and it makes the strength of the panel consistent across all directions. A typical plywood panel has **face veneers** of a higher grade than the **core veneers**. The principal function of the core layers is to increase the separation between the outer layers where the bending stresses are highest, thus increasing the panel's resistance to bending.

**4.1.1** There are **two types** of plywood: **softwood plywood** and **hardwood plywood**. Softwoods generally correspond to coniferous species. Hardwoods generally correspond to deciduous species. Softwood plywood is manufactured by gluing several layers of dry softwood veneers together with an adhesive. Softwood plywood is used for wall siding, sheathing, roof decking, floors, and containers. Hardwood plywood is made of hardwood veneers bonded with an adhesive. The outer layers (face and back) surround a core which is usually timber, veneer, particleboard, or medium density fibreboard. Hardwood plywood is used for interior applications such as furniture, cabinets, architectural millwork, panelling, flooring, store fixtures, and doors.

**4.1.2** The **manufacture** of softwood or hardwood plywood consists of the following main processes: log storage, log debarking, heating the logs, peeling the logs into veneers, drying the veneers, gluing the veneers together, pressing the veneers in a hot press, plywood cutting, and other finishing processes such as sanding.

## 4.2 Laminated wood

Laminated wood is layers of wood glued or otherwise united with the grains parallel to form boards or timbers. (<http://www.merriam-webster.com/dictionary/laminated%20wood>). The wood layers called laminae may be thin veneers or boards. They are seasoned in kiln, cut to uniform width and length, arranged in proper order and then fed into a glue spreader. The glued laminae are then placed on a form and pressure applied by means of clamps fitted at regular intervals. Laminated wood is used for furniture parts, cores of veneered panels, sports goods, flooring etc.

## 4.3 Fibre Boards

(Source: <http://www.wisegeek.com/what-is-fibreboard.htm>)

Fibreboard is a composite wood product sold in large, thin sheets. It is similar to other composite wood products like plywood and particleboard, but offers a higher level of density and strength. This material is made from a variety of different wood products and recycled materials. These materials are shredded or chipped to form small, workable pieces,





and then are placed into a piece of equipment known as a **defibrator**. The defibrator produces a high level of heat and pressure to turn the wood scraps into fine fibres. The fibres are then mixed with wax and resin and pressed into sheets to make fibreboard. Fibreboard is often used to make furniture or cabinets, but not recommended for use in exterior applications because it is vulnerable to moisture and humidity. This product is available in low, medium, or high density varieties, though medium-density fibreboard (MDF) is the most widely used.

#### **4.4 Particle Boards**

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

A particle board is a board or sheet constituted from fragments of wood and other lignocellulosic material, bonded with organic binders with the help of one or more agents like heat, pressure, humidity, catalyst etc. Particles of waste wood – flakes, shavings, splinters etc. – or chips obtained by converting the raw material in a chipper, are usually screened to get particles of more or less uniform size. The screened particles are run through drier and then mixed thoroughly in a mechanical mixer with a resin adhesive. The mix is then formed into particle boards by flat pressing in a hot press at a suitable temperature and pressure. Particle boards are used in the interior of house and furniture.

#### **Reference material**

- (1) Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun
- (2) Websites cited in the lesson





## Lesson 5

1 Hour

### Lesson Plan

#### To Study

#### Non-wood Forest produce

- **Vegetable products**

- 📖 **Bamboos**

- 📖 **Canes**

- 📖 **Fibres and Flosses**

- ❖ Fibres from stems

- ❖ Fibres from leaves

- ❖ Flosses

- 📖 **Tannins and Dyes**

- ❖ Bark tans, Fruit tans, Leaf tans

- ❖ Wood dyes, Bark dyes, Flower and Fruit dyes

- 📖 **Oil Seeds**

**Backward Linkage:** Nil

**Forward Linkage:** Observation and study, during tour, of the plants that yield vegetable products. .

**Training Materials Required:** Copy of Lesson 5 to be circulated beforehand

#### Allocation of Time:

- **Non-wood Forest produce – Introduction** 3 mts
- **Vegetable products**
  - 📖 **Bamboos** 8 mts
  - 📖 **Canes** 10 mts
  - 📖 **Fibres and Flosses** 12 mts
    - ❖ Fibres from stems
    - ❖ Fibres from leaves
    - ❖ Flosses
  - 📖 **Tannins and Dyes** 15 mts
    - ❖ Bark tans, Fruit tans, Leaf tans
    - ❖ Wood dyes, Bark dyes, Flower and Fruit dyes,
  - 📖 **Oil Seeds** 7 mts
- **Discussion/Miscellaneous** 5 mts



## Non wood Forest produce (NWFP)

### 1. Introduction

FAO defines Non-wood forest produce/products (NWFP) as being “goods of biological origin other than wood derived from forests, other wooded land and trees outside forests”. Different terms like secondary, minor or non-timber forest products (NTFP) are also being used by governments, institutions and academics.

(<http://www.fao.org/forestry/nwfp/6388/en/>).

NWFPs may be gathered from the wild or grown in forests, agro-forestry schemes and trees outside forests. Examples of NWFPs include

- **Vegetable Products** – bamboos and canes, fibres and flosses, tannins and dyes, gums and resins, oil seeds, herbal medicines etc.
- **Animal Products** – honey and wax, silk, , lac etc
- **Mineral products.**

### 2. Vegetable Products

#### 2.1 Bamboos

Bamboos are tall arborescent (tree like) woody grasses; belong to the family Graminae. Most of the bamboos are hollow, often gregarious in habit. Growth of bamboos is very fast. Some common characteristics of bamboos – straightness, being light though hard, easy to split, availability in various sizes, easy propagation – have added to their utility. Common uses are in house construction, masts, cart shafts, basket making, furniture etc. Propagation and management practices of bamboo may be seen in Lesson 4 of “Silviculture of Trees and Silviculture Systems”.

#### List of bamboo species recommended by NBM & raised in West Bengal:

(Source: National Bamboo Mission in Forest Areas of West Bengal, Monitoring Report 2007-08; [http://www.westbengalforest.gov.in/publication\\_pdf/NBM\\_Report\\_07-08.pdf](http://www.westbengalforest.gov.in/publication_pdf/NBM_Report_07-08.pdf))

SL. No.	Species	Local name
1	<i>B. balcooa</i>	<i>Bhalki bans / Boro bans</i>
2	<i>B. bambos</i>	<i>Kanta bans</i>
3	<i>B. nutans</i>	<i>Makla bans</i>
4	<i>B. vulgaris</i>	<i>Basin/ basni / kalai makla</i>
5	<i>Dendrocalamus asper</i>	
6	<i>D. giganteus</i>	<i>Koko / Bhalu bans</i>
7	<i>D. hamiltonii</i>	<i>Chawa bans</i>
8	<i>D. strictus</i>	<i>Jaw bans</i>
9	<i>Melocanna baccifera</i>	<i>Muli bans</i>

## 2.2 Canes

Canes (“rattans” of commerce) are the stems of climbing palms of the genus *Calamus* principally and of a few other related genera. The genus *Calamus* has about 30 species occurring in India and chiefly distributed in Himalayas, Assam, West Bengal, Kerala, Karnataka, Tamilnadu and Andaman. The stems of canes are long, usually cylindrical, solid, straw-yellow in colour. They are strong, tough and elastic. The canes reach maturity in about 5 years. Mature canes after harvest are dried in sun. The silica layer is removed by rubbing the canes over a knife or a sharp piece of bamboo, and then the canes are bleached by fumigation with burning sulphur. In order to restore the natural lustre, they are polished with woolen rag or soap-stone. Canes are used as furniture frames, walking sticks, umbrella handles, baskets, etc. (Tribhawan Mehta 1981 A Handbook of Forest Utilization).

**2.2.1** A few species of canes of North Bengal are described below.  
(Source: <http://www.ntfpwestbengal.in/project-cane-nursery.html>)

### (1). *Calamus erectus* (FEKRE BET)

HABIT: erect, non deciduous, perennial, maximum 3m in height, leaflet wide.

FLOWERING: October to November

OCCURRENCE: 100-1000m altitude , foothill to lower middle hill area, slopes, river banks, swampy , shady area

REGENERATION STATUS: Scattered

USES: Garden fencing, basket making, furniture

### (2). *Calamus guruba* (MURGI BET)

HABIT: erect, non deciduous, perennial, maximum 17m in height.

FLOWERING: December to March

OCCURRENCE: 33-500m altitude, plain to foothill area, near river banks, ditch-pond area, shady area.

REGENERATION STATUS: Abundant, common

USES: Basket- furniture making; Rava, Mech, Garo, tribes use the flagellum for capturing cricket insect for food.

### (3). *Calamus latifolius* (PUTULI BET)

HABIT: At a glance resembling like Palm sp, erect, only sub – deciduous species, perennial, 40 m in height, spine falls on maturity.

FLOWERING: December to February

OCCURRENCE: 33-850m altitude, plain to foothill area, slopes, river banks, swampy, shady area

REGENERATION STATUS: Scattered

USES: Making furniture, walking stick



(4). ***Calamus tenuis*** (PANI BET)

HABIT: erect, non deciduous, perennial, Stem at base not clavate or arise singly.

FLOWERING: January to March

OCCURRENCE: 33-500m altitude, plain to foothill slopes, river banks, wet, damp, shady area

REGENERATION STATUS: Uncommon. One of the threatened species.

USES: basket, furniture making; Forest villagers use tender top of stem as vegetables, medicine

(5). ***Daemonorops jenkinsianus*** (GARAL ,DUDHIA BET)

HABIT: erect, non deciduous, perennial, Upto 17m in height mammoth rattans.

FLOWERING: Sept to Nov

OCCURRENCE: 33-1000m altitude , foothill to middle hill area, near river , occasionally on dry grounds of plantation

REGENERATION STATUS: Abundant in scattered, common species.

USES: Making of furniture, walking stick Tender top is used as vegetable by Rava, Mech, Garo, Toto tribes.

### 3. Fibres

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization)

Fibres generally occur as sclerenchyma cells and impart rigidity to the plant. The fibres of forest origin generally fall under two groups – (1) fibres from stems, and (2) fibres from leaves.

#### 3.1 Fibres from stems

Fibres obtained from the bast tissue of some woody plants are long and strong enough to make ropes. There are also species which yield silky fibres which are fine enough for textile purposes.

**3.1.1** Some important forest plants yielding fibres from stems are mentioned below.

(1) Family **STERCULIACEAE**

- ***Sterculia villosa*** (Odal) – it yields a coarse, strong, whitish-pink fibre, used in making elephant harness, drag ropes, tying rafts etc.
- ***Helicteres isora*** (Atmora) – A common shrub of dry forests, yields light-brown or greyish fibre which is soft and silky; used for sacking, tying, cattle harness etc.

(2) Family **TILIACEAE**

- ***Grewia tiliaefolia*, *G. Vestita*, *G. Laevigata*, *G. Oppositifolia*** - all yield coarse, strong yellow fibres used for rope making.

(3) Family **LEGUMINOSAE**

- ***Hardwickia binata*** (Anjan) – yields red colour, fairly strong fibre, used in rope making.
- ***Bauhinia vahlii*** – yields strong fibre, used for tying etc.

(4) Family **MORACEAE**

- ***Ficus religiosa*** (Aswattha), ***F. Bengalensis*** (Bat) – yield short strong fibre, suitable for ropes.

### 3.2 Fibres from leaves

Some important species whose leaves yield fibres are mentioned below.

- ***Caryota urens*** (Fishtail palm)- fibre is dusky brown or black and fairly strong; used in fishing nets and fishing line, rope making etc.
- ***Agave species (A. Americana, A. Cantala, A. Sisalana)*** - *A. Americana* yields durable fibre for ropes and cordage. *A. Sisalana* yields sisal fibre of commerce. It is strong, coarse and flexible.

### 4. Flosses

Some important forest trees and plants which produce silky flosses in their fruits are mentioned below.

- ***Ceiba pentandra*** (kapok) – The floss is known as silk cotton or kapok. It is extensively used for stuffing.
- ***Bombax ceiba*** (Shimul) – The floss is known as Indian kapok. The capsule of the tree yields silky cotton, soft and strong, used in stuffing pillows and mattresses.
- ***Cochlospermum religiosum*** – known as yellow silk cotton tree or buttercup tree, the floss can be used for stuffing pillows, mattresses etc.

### 5. Tannins and dyes

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization; H Trotter 1925, Special Lecture Notes on the Minor Forest Products of India)

Tannins and dyes are products of secretion found in plant tissues. Tannins make the animal hides and skins resistant to decomposition, make them flexible and strong, and improve their quality. Dyes are the substances used for imparting colour and staining purposes. There is currently very little commercial use of natural dyes - used mostly as food dyes and histological stains.

#### 5.1 Bark tans

Some of the important species whose bark yields tannin are described below.

- ***Acacia nilotica*** (Babul) – tannin content is about 18%, and widely used.
- ***Cassia fistula*** (Amaltas, Bandorlathi) – tannin content is about 10-12%.
- ***Shorea robusta*** (Sal) – bark contains about 3-9% tannin
- ***Acacia mollissima*** (Wattle) – Cultivated in south India, the most important among vegetable tan stuff.
- ***Terminalia arjuna*** (Arjun) – tannin content is 20-24%.
- ***Ceriops roxburghiana*** – A small evergreen mangrove tree; tannin content in bark is 20-37%.
- ***Rhizophora mucronata*** – A mangrove tree; bark is rich in tannin but contains excessive colouring matter.



## 5.2 Fruit tans

Some examples of fruit tans of forest origin are given below.

- ***Terminalia chebula*** (Haritaki) – The tannin content is about 32% and is of high quality.
- ***Acacia nilotica*** (Babul) – pods contain about 12-19% tannin.
- ***Emblica officinalis*** (Amlaki) – Immature fruits are used in combination with other tan stuff.

## 5.3 Leaf tans

Leaves are not much used for tanning purpose, but used by local tanners as colouring agents. Some examples are –

- ***Anogeissus latifolia*** (Dhaw) – A mixture of green leaves, red leaves and petioles, when dried and ground, yields a product containing about 30% tannin.
- ***Carissa spinarum*** (Karaunda, Karamcha) – A thorny shrub; leaves have 9-11% tannin.

## 5.4. Wood dyes

- **Santaline** – Santaline dye is probably the best known of wood dyes. The wood of ***Pterocarpus santalinus*** (Red sanders) yields a bright red dye. When dissolved in alcohol, it dyes cloth a beautiful salmon pink colour.
- ***Artocarpus* spp.** – The wood of the jack tree, ***Artocarpus integrifolia***, as also that of ***A. lakoocha***, if ground to powder and boiled in water, yields a bright yellow dye.
- **Cutch dye** – The cutch extract from ***Acacia catechu*** is an important dyeing agent.

## 5.5 Bark dyes

Many barks yield brown and black dyes. However, as these barks are often used for tanning purpose, the dye contained in them is considered a defect. Following are of local interest – ***Terminalia tomentosa***, ***Acacia* spp**, ***Alnus* spp** etc.

## 5.6 Flower and Fruit Dyes

The dyes obtained from flowers and fruits are, generally speaking, more important than the wood and bark dyes. A few important dyes under this category are described below.

- **Kamela** – One of the best known fruit dyes is that obtained from the red fruit glands of ***Mallotus philippinensis***, and commercially known as “kamela powder”. The ripe fruits are placed in a cloth or sack which is then beaten and shaken until the red powder is all removed from the glands. The powder is then sifted free from the broken refuse and is ready for market. The dye is extensively used for dyeing silk a bright orange or flame colour.





- **Arnotto** – Well known as “arnotto dye” of commerce, it is obtained from the pulp surrounding the seeds of *Bixa orellana* (Please see Lesson 15 of Forest Botany). The dye is obtained by boiling the fruit pulp and pressing the residue into cakes.
- **Dhak** – A popular flower dye which is obtained from *Butea monosperma* (Dhak, Palash). The dried flowers yield a bright yellow dye. It was extensively used in colouring saris, but has been largely replaced by more permanent aniline dyes.

## 6. Oil Seeds

(Source: Tribhawan Mehta 1981 A Handbook of Forest Utilization; H Trotter 1925, Special Lecture Notes on the Minor Forest Products of India)

A large number of forest trees bear seeds yielding oils of varying commercial importance. However, owing to the scattered occurrence of the forest trees and high cost of collection of seeds, these oils or “butter” as they are often called, cannot compete in the market with those obtained as field crops. Some common species producing oil seeds are described below.

- ***Azadirachta indica*** (Neem) – The oil is used in medicine, as an illuminant, and for manufacture of soap.
- ***Madhuca butyracea*** – The Indian butter tree produces seeds that yield an oil known as “Phulwara butter”. It is used as an adulterant of ghee, in manufacture of soap, as an ingredient of chocolate.
- ***Madhuca indica*** (Mahua) – The seed oil is known as “Mahua butter”. Very important among tree seed oils, it is used for cooking purpose, hair oil, soap making and as illuminant.
- ***Mesua ferrea*** (Nageswar) – The oil has a fine red-brown colour and is slightly scented. It is used for burning, lubricating, soap making, and applying on sores.
- ***Pongamia pinnata*** (Karanj) – The seeds yield a yellow-brown oil. It is used in medicine, soap making and for lighting purpose.
- ***Schleichera oleosa*** (Kusum) – It yields “Kusum oil” of commerce. It is a bright yellow oil and used for cooking, lighting and soap making.
- ***Shorea robusta*** (Sal) - It yields the well known “Sal butter” from the cotyledons of its seeds. It is used for cooking and lighting and adulteration of ghee.

## Reference material

- (1) Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun
- (2) H Trotter 1925, Special Lecture Notes on the Minor Forest Products of India for Indian Forest Students, Government of India Central Publication Branch, Calcutta
- (3) Websites cited in the lesson





## Lesson 6

1 Hour

### Lesson Plan

#### To Study

#### Non-wood Forest produce

- **Vegetable products (continued)**

- ✚ **Medicinal Plant Species**

- ❖ Some important species of WB

- ✚ **Edible Products**

- ✚ **Tendu (bidi) leaf**

- ❖ The species - occurrence/habitat
  - ❖ Regeneration
  - ❖ Quality , Production
  - ❖ Collection of leaf, drying, packaging
  - ❖ Annual production
  - ❖ Marketing- means of income

- ✚ **Cutch and Katha**

**Backward Linkage:** Lesson 5

**Forward Linkage:** Observation and study, during tour, of medicinal plants and tendu leaf collection.

**Training Materials Required:** Copy of Lesson 6 to be circulated beforehand

#### Allocation of Time:

✚ <b>Medicinal Plant Species</b> – some important species of WB	30mts
✚ <b>Tendu (bidi) leaf</b> –	15mts
✚ <b>Cutch and Katha</b>	10mts
✚ <b>Discussion/Miscellaneous</b>	5mts



## Non-wood Forest produce

### 1. Medicinal plant species

A large number of plants of forests are known for their medicinal value. In fact, the traditional knowledge of therapeutic use of forest-plants has remained largely unexplored and undocumented. According to WHO, 80% of the people in developing countries rely on traditional natural medicines. Currently more than 75% of herbal products are obtained through wild collection. It shows the importance of forests as source of drugs which come from trees, shrubs and herbs. Description or even listing of all medicinal plants is beyond the scope of this lesson. So we discuss some important drug plants of West Bengal under the following categories – (1) Root drugs, (2) Bark drugs, (3) Flower, fruit and seed drugs, and (4) Leaf drugs. It may be noted, however, that the categories the following plants have been classified into only indicate the part of plant body known to yield the major drugs. In most cases, other parts of the plants also yield drugs which have been excluded from description for the sake of brevity.

### 2. Root Drugs

- (1) ***Asparagus racemosus*** Willd.(Satamuli)- An undershrub of climbing habit. It is infrequent in the wild, often cultivated. The tuber roots are used in blood dysentery, bloody urine, epilepsy, haematemesis (vomiting of blood) and many other diseases.



(Source: Medicinal Plant Resources of south West Bengal 2005 Research Wing Directorate of Forests, WB)

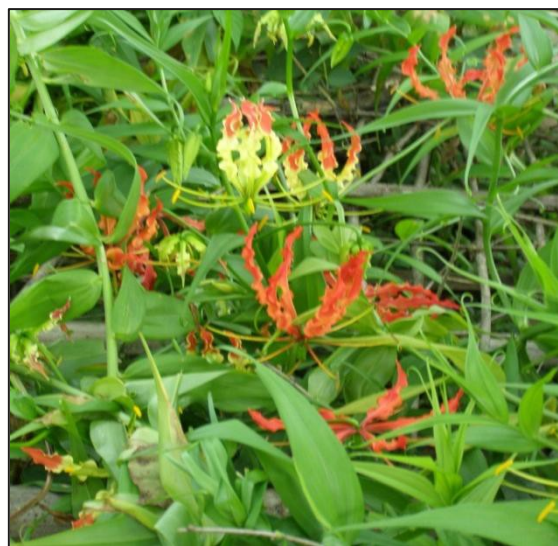
**Fig. 6.1 *Asparagus racemosus*** (Photo: courtesy Shri T K Das WBFS)

- (2) ***Berberis aristata*** Dc (Chitra, daru haridra, kashmal) - A small shiny shrub, bright shining, slightly drooping. It is a native of the Himalayas at a height of 2000-3000 metres and found in forests of Darjeeling hills. A product called “rasaunt” is a brown extract obtained from the roots and the lower parts of the stem; when added to water, it is supposed to make the water cool. Its active principle is berberine. Its roots are used for ophthalmia and bronchial diseases. (Source: *J. F. Dastur. Useful Plants of India and Pakistan*, H Trotter 1925, Special Lecture Notes on the Minor Forest Products of India)



**Fig.6.2** *Berberis aristata* (Source:<http://www.101herbs.com/berberis-aristata>)

- (3) ***Gloriosa superba*** Linn. (Bishalanguli, Ulatchandal) - Rambling herb. Root-stock a chain of cylindric fleshy tubers with fibrous roots. Found in the wild, though infrequent. Tubers used as anticancer, antimalarial, febrifuge, purgative, stomachic; used in skin diseases, chronic ulcers etc. Roots used as diuretic; beneficial in gout and rheumatism. (Source: Medicinal Plant Resources of south West Bengal 2005 Research Wing Directorate of Forests, WB)



**Fig.6.3** *Gloriosa superba* (photo: courtesy Shri T K Das WBFS)

### 3. Bark Drugs

- (1) ***Holarrhena pubescens*** (Buch-Ham) wall.ex G.Don; Syn. ***H. Antidysenterica*** (Kurchi, Indrajab) – A small or medium sized tree found in the wild and also cultivated. The stem bark is used in diarrhoea, blood dysentery, fever, piles, haematemesis, acute rheumatism and many other diseases. (Source: Medicinal Plant Resources of south West Bengal 2005 Research Wing Directorate of Forests, WB)
- (2) ***Alstonia scholaris*** R.Br. (Chhatim, Chhatiyani) – An evergreen tree with whorled leaves; found in the wild and also planted. The bark is used as tonic, febrifuge (reducing, removing fever); the bark-extract used in chronic diarrhoea, asthma, cardiac troubles, sores, ulcers, etc. (Source: Medicinal Plant Resources of south West Bengal 2005 Research Wing Directorate of Forests, WB).





Fig.4.4 *Alstonia scholaris*

(Source: <http://www.evaidyaji.com/Ayurvedic/Ayurvedic%20Herbs/Saptaparna>)

- (3) ***Terminalia arjuna*** (Roxb.) Wight. & Am. - A large deciduous tree, trunk thick and often buttressed. Bark silvery grey, flaky. It occurs in the wild along the banks of rivers and streams. It is planted throughout south-west and central part of West Bengal, and also in plains (preferably in low-lying areas) of north Bengal forests.

The bark is used as styptic (check bleeding), antidiarrhetic, cardiostimulant, febrifuge; used in haematemesis, leucorrhoea, and many other ailments. (Source: Medicinal Plant Resources of south West Bengal 2005 Research Wing Directorate of Forests, WB).

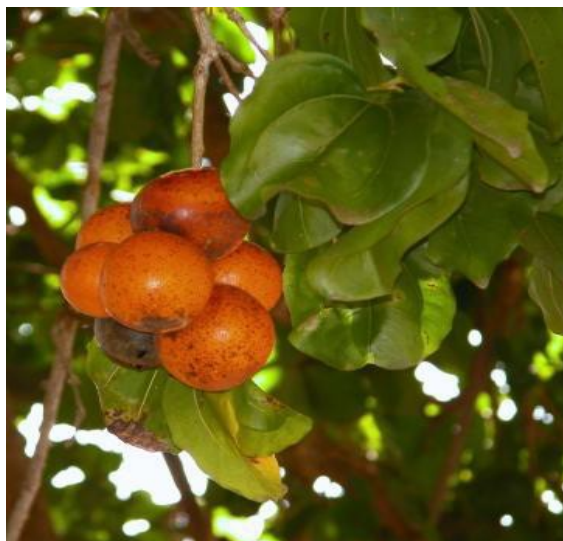


Fig.4.5 *Terminalia arjuna*

(Source: <http://davesgarden.com/guides/pf>)

#### 4. Flower, fruit and seed drugs

- (1) ***Strychnos nux-vomica*** Linn. (Kuchila) - A medium-sized or large deciduous tree. Throughout south West Bengal. It is now infrequent in the wild. All parts of the plant except the pulp of the fruit are poisonous. The seed contains valuable alkaloids Strychnine and brucine. Seed is used to treat nervous breakdown, blood dysentery, paralysis, dyspepsia, cold and cough, intermittent fever, low blood pressure and many other ailments. (Source: J. F. Dastur. Useful Plants of India and Pakistan; Research Wing, Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal)



**Fig.4.6 *Strychnos nux-vomica***

(Source: <http://biogeodb.stri.si.edu/herbarium/species>)

- (2) ***Aegle marmelos* Corr.** (Bel) - A moderate sized deciduous tree, armed with axillary, straight, strong spines, Occurs throughout the plains of West Bengal. The sweet aromatic fruit pulp is very nutritious. The ripe fruit is used as tonic, restorative and laxative, and is good for heart and brain.

(Source: Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal)

- (3) ***Embllica officinalis* Gaertn.** (Amlaki) - A small or medium-sized deciduous tree. Foliage feathery, light green. Found and planted in deciduous forests of south West Bengal, and in mixed plains forest and lower hill forests of north Bengal. The fruit is edible and has many medicinal uses. Dried fruits with fruits of bahera and haritaki, soaked in water overnight, taken in the morning to cure dyspepsia. Ripe fruit with common salt is given to children to treat diarrhea. The fruit is also used to treat vomiting, leprosy, constipation, inflammation, piles and many other ailments.

(Source: Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal)

## 5. Leaf drugs

- (1) ***Andrographis paniculata* (Burm.f.) Wall.ex Nees** (Kalmegh) - Erect Annual bitter herb; Occurs throughout south west Bengal. The **leaves** are used to improve digestion and liver function.

(Source: Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal)



(2) ***Azadirachta indica* A. Juss** (Neem) - A large evergreen tree; leaves pinnate, crowded near the end of the branchlet. Found throughout south West Bengal, wild and cultivated. Leaves are used to treat ophthalmia, leprosy; consumed as preventive medicine to pox; paste applied to cure skin diseases; decoction used to wash septic wounds; leaf extract used as febrifuge, blood purifier and to treat diabetes.

(Source: Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal)

(3) ***Gymnema sylvestre* (Retz) R.Br. ex Schult.** (Gurmar) – A climber, leaves elliptic or ovate, follicles (pods) lanceolate, tapering into a beak. Occurs in the wild in south West Bengal, though infrequent. Leaves are used as diuretic, cardiac stimulant, and in treating diabetes, enlargement of liver and spleen, malarial fever, eye diseases; pounded leaves with hot water taken to treat dyspepsia.

(Source: Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal)



**Fig. 4.7 *Gymnema sylvestre***

(Photo: Courtesy Shri T.K.Das WBFS)

(4) ***Swertia chirata* Chirata** – It is a herb of temperate Himalayas at elevations between 1200 m and 3000 m. The dried plants (stems, leaves, flowers and roots) are used as tonic, febrifuge, laxative and anthelmintic.

## 6. Edible products

Edible products available from forests are many. Most of these edible products do not earn much revenue. However, they are of local importance, as these products are extensively used by the local villagers as supplementary to their daily diet. The more common and best known forest fruits are mango (*Mangifera indica*), the jack fruit (*Artocarpus integrifolia*), Jam/ Jamun (*Syzygium cumini*), walnuts (*Juglans regia*), Kul/baer (*Zizyphus mauritiana*), and the wild cherries, pears and figs. Young shoots of bamboo are considered as a delicacy in curries, and the palms provide many edible such as coconuts, dates etc.



## 7. Tendu (bidi) leaf

(Source: <http://www.fao.org/docrep/x5334e/x5334e04.htm>)

Tendu leaf or bidi patta comes from the tree *Diospyros melanoxylon* (Kend). Leaves of the tree are used as wrappers of tobacco to produce bidi.

### 7.1 The species

The species *D. melanoxylon* is abundant in Madhya Pradesh, Orissa, Maharashtra, Andhra Pradesh, Bihar, Rajasthan, Uttar Pradesh, Gujarat, Tamil Nadu, and West Bengal. It generally grows in dry mixed deciduous forests, occurring alongside *Shorea robusta* and *Tectona grandis*. In West Bengal (South west) it is a Sal associate species.

### 7.2 Regeneration

Under natural conditions, seed germinates in the rainy season and seedling production is plentiful. Seedlings tolerate considerable shade, but for optimal development more light is required. Seedlings resist frost and drought, but are vulnerable to excessive dampness. The profusion and tenacity of root suckers ensure the survival and spread of the species without planting.

### 7.3 Tendu leaves – quality and production

There is wide variation in the quality of leaves from different locations. Superior-quality leaves of large size, papery texture, and inconspicuous veins fetch up to 5 times the price of inferior-quality leaves. Coppicing yields the best quality leaves and also facilitates easy collection. The best coppicing results are attained when stems are cut 15 centimeters above the ground, but cutting at such height is difficult. Therefore, the common practice is to cut small trees flush with the ground. Cutting occurs between January and March. There is a bumper production of leaves once in four years.

### 7.4 Collection of leaves

Leaves are plucked just after the new flush (coming after coppicing) have turned from crimson to bright green and have a leathery texture. Generally, collection starts from the second fortnight of April and continues until the onset of the monsoon. Bundles of 50, 70, or 100 leaves (depending on drying conditions) are assembled and tied with strings or fibers from bark. These bundles are brought by laborers to collection centers where they are sold.

### 7.5 Drying and curing of leaves

Proper drying of leaves is important. Too much moisture makes the leaves black and mouldy with foul odor. Too much drying makes the leaves brittle, resulting in loss during handling. To dry, leaf bundles are spread on the ground, keeping the dorsal sides up for three to four days. The bundles are then turned upside down. Drying is complete in about 8 to 10 days.



## 7.6 Packing and storage

Dried leaves are packed in gunny sacks for storage in godowns until sold or used for making bidis. Before filling the bags, water is sprinkled on bundles to soften the leaves for easier packing.

## 7.7 Annual production and value

Around 300,000 tons of bidi leaves are produced annually in India. In West Bengal, the annual production is about 500 tons, the value of which is about Rs 7.5 million (calculated at a price of Rs.15000 per ton).

## 7.8 Means of income and marketing

A large number of fringe villagers, mainly tribal people, become engaged in gathering tendu leaves. Being JFMC members they are allowed to collect tendu leaves from forests free of cost. In West Bengal, all tendu leaves collected from forests are to be sold to LAMPS (LARGE SIZED MULTIPURPOSE CO-OPERATIVE SOCIETIES) which have the exclusive right to buy the forest product from the collectors, and are obliged to offer fair price to the collectors for the same. Tendu leaf collection is a major source of income for the forest fringe dwellers in the lean months when they have hardly any other occupation to pursue.

## 8. Cutch and Katha

Cutch and katha are obtained by boiling in water the heartwood of Khair (*Acacia catechu*), a common tree in the riverine tracts of tropical deciduous forests. The principal constituents of Khair heartwood are catechin (Katha) and catechutannic acid (cutch). The basic principle of extracting katha and cutch and separating one from the other is that while cutch is soluble in both hot and cold water, katha is soluble in hot water and very sparingly so in cold water.

### 8.1 Method of extraction

The basic steps are as follows.

- Khair heartwood is cut into chips; the chips are placed in a vessel (preferably copper, in no case iron) and boiled with water.
- The boiled liquid is transferred to another vessel while hot, straining through a piece of muslin to remove all impurities. Fresh water is added to chips and boiling continued.
- The liquid on straining is concentrated on fire till the required density is obtained. It is then set aside to cool. As soon as the liquid cools sufficiently, katha crystallizes out, and soon a mass of katha gets deposited at the bottom of the vessel.
- Crystals of katha are separated from the mother liquor by filtering the whole liquid mass through a fine muslin. The cutch in mother liquor passes through muslin, leaving katha crystals on the muslin.
- Katha arrested in muslin is washed, dried between sheets of cotton and cut into cubes to be marketed.

- The mother liquor containing mainly cutch is further concentrated by heating followed by cooling so that further crop of katha may be removed as before.
- Finally the mother liquor will be practically devoid of katha and can be concentrated to a consistency at which it solidifies on cooling, yielding cutch.

### Reference material

- (1) Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun
- (2) H Trotter 1925, Special Lecture Notes on the Minor Forest Products of India for Indian Forest Students, Government of India Central Publication Branch, Calcutta
- (3) Directorate of Forests, Govt of West Bengal, 2005. Medicinal Plant Resources of South West Bengal
- (4) J. F. Dastur. Useful Plants of India and Pakistan
- (5) Websites cited in the lesson





## Lesson 7

1 Hour

### Lesson Plan

#### To Study

#### Non-wood Forest produce

- **Animal products**

-  **Honey and Wax**

- ❖ Wild bees
    - ❖ Collection and marketing

-  **Silk**

- ❖ Silkworms
    - ❖ Vanya silk
    - ❖ Tropical tasar – plantation and rearing

-  **Lac**

- ❖ Lac producing states
    - ❖ Lac hosts
    - ❖ Lac crops
    - ❖ Lac cultivation
    - ❖ Lac processing
      - Shellac-properties and uses

- **Mineral Products**

**Backward Linkage:** Nil

**Forward Linkage:** Observation and study, during tour, of mode of collection of honey, tasar cultivation and Lac cultivation


**Training Materials Required:** Copy of Lesson 7 to be circulated beforehand

#### Allocation of Time:

##### Animal products

-  **Honey and Wax** 12 mts

-  **Silk** 18 mts

-  **Lac** 20 mts

**Mineral Products** 5 mts

**Discussion/Miscellaneous** 5mts



## Non-wood Forest produce

### Animal products

#### 1. Honey and Wax

The two commonest of wild honey bees are *Apis dorsata* and *Apis indica*. Collection of honey is a major forest activity in Sundarbans. Giant honey bee, *Apis dorsata*, makes hives in the mangrove species of deep forest. Khalsi, Baen, Sada Baen (*Avicennia alba*), Kankra, Goran, Gewa, Jhana Garjan, Keora, Chaila, Passur, Singra and Hargoza are considered good honey and nectar producing plants for *Apis dorsata*. Honey flow in the Sundarbans continues for a period of 4 month from the month of March into the month of June. Among the nectar yielding plants some are early honey and nectar producing plants and others are late honey and nectar producing species. Khalsi (*Aegiceras corniculatum*) is the first most and best nectar and pollen producing plant.

(Source:<http://www.apimondia.com/congresses/2001/Papers/335.pdf>)

#### 1.1 Collection and marketing

In West Bengal, the two territorial forest divisions/units - South 24 Parganas Division and Sundarban Tiger Reserve (STR) – undertake collection of sundarban honey. They allow and engage the local villagers, called mowallis or moulis, to collect honey from the forest. The moulis, the honey collectors, deliver the crude honey to the forest divisions and earn the collection charge which at present is Rs.100 per kg.

**1.1.1** Collection of honey is done during the period from April-May to the onset of monsoon. The Moulis, after entering the forest and locating a giant honeybee colony, make torches from green goalpata leaves and some dry materials for smoking to drive the bees from the comb. Smoking removes most of the honeybees. After the removal of bees from the hive, the Moulis cut the portion of honey from the hive with the help of a knife. The comb honey is placed in woven baskets which are then brought to boat where the honey is squeezed by hand to separate the honey from the wax. The liquid honey is then stored in barrel for transportation. (Source:<http://www.apimondia.com/congresses/2001/Papers/335.pdf>)

**1.1.2** About 100 tonnes of crude honey is collected annually by the South 24 Parganas Division and STR. The job of filtering and processing the crude honey and marketing the product is done by West Bengal Forest Development Corporation Ltd. The Corporation bears the collection cost of crude honey as well as the incidental cost, the latter being the cost incurred by the forest divisions to facilitate collection of honey by the moulis.

**1.1.3** The wax is melted and used in making candles and sealing wax.



## 2. Silk

The whole world of silk is mainly constituted by two distinct sectors; the Mulberry and Non-Mulberry or wild, now called 'Vanya Silk'. In Mulberry sector, the silkworm *Bombyx mori* that feeds on mulberry leaves and reared indoor, produces mulberry silk. Normally sericulture is referred to this mulberry culture and silkworm rearing that largely contributes to the total raw silk production in the country. The Non-mulberry or **Vanya silk** sector consist of **Indian tasar or Tropical tasar** (*Antheraea mylitta* Durr), **Oak tasar** (*Antheraea proylei* J), **Muga** (*Antheraea assamensis* Ww.) and **Eri** (*Philosamia ricini* Hutt.). Owing to immense diversity in climatic conditions coupled with wide-ranging ecological habitats, India is the only country that produces all five varieties of the silk. ([http://www.academia.edu/4138029/TROPICAL\\_TASAR](http://www.academia.edu/4138029/TROPICAL_TASAR))

### 2.1 Tropical Tasar (*Antheraea mylitta*)

Mulberry is not considered a forest crop and is not cultivated in forest land. Among the Vanya silk, Tropical tasar is produced in West Bengal and the major cocoon-producing districts are Purulia and Bankura. Tasar silkworm is polyphagous, that is, subsist on different kinds of food. Besides more than two dozens of secondary food plants, the primary food plants are eight types -

1. *Terminalia tomentosa*, W & A.
2. *T. arjuna*, W&A.
3. *Shorea robusta*, Roxb
4. *Lagerstroemia parviflora*, Roxb.
5. *L. Speciosa*, Pers.
6. *L. indica*, Linn.
7. *Zizyphus mauritiana*, Lam.
8. *Hardwickia binata* Roxb

(Source: [bieap.gov.in/pdf/nonmulberrysilkworms.pdf](http://bieap.gov.in/pdf/nonmulberrysilkworms.pdf))

In the districts of south West Bengal, *Terminalia tomentosa* (Asan) and *T. arjuna* (Arjun) are the popular Tasar host plants.

### 2.2 Plantation and rearing

Healthy seedlings of the host plants are raised in the nursery. During the normal planting season the seedlings are planted in the field. **According to guidelines issued by the Govt of India under the Forest Conservation Act, plantation of tasar host plants, in order to be reckoned as forestry activity, (1) should not involve felling of existing trees, and (2) should contain at least three species, of which no single species should cover more than 50% of planted area.** (Please see Lesson 10 of Forest Law)

**2.2.1** The host plants are planted at a close spacing (1.2 m x 1.2 m or 1.5 m x 1.5 m), which is closer than the normal spacing (2.5 m x 2.5 m) of usual forest plantations in the region. The plantation is maintained and nourished well by regular weeding-cleaning and manuring. After the host plants like Arjun and Asan are about 5 years old and have established well, they become ready to feed the insects. The young plants which are dedicated to serve as



tasar host are pollarded every year in order to (a) induce flush of new leaves and (b) have subsequent rearing and management within heights of easyreach.

**2.3 Disease Free Layings (DFLs)**, that is, disease free eggs of tasar silkworm are normally obtained from the Sericulture Department. Eggs hatch in 3-5 days. Hatched larvae are placed on the host plant leaves. Since the larvae are exposed to natural conditions, the fate of the crop largely depends on choice of rearing site and food plants, supervision and maintenance of larval population and other rearing operations. A large number of larvae are lost due to diseases and pests. The cocoons, as they form at a stage of the life cycle of the silk worms, are collected from the branches of food plants and marketed.

### **3. Lac**

Lac is a complex resinous substance excreted by a minute insect called *Lacifer lacca* which belongs to the group of “scale” insects. The lac insect feeds on the sap of certain plants and continuously secretes the resin as a protective covering throughout its life. The scale of the insect consisting of this resinous amber-coloured substance is lac. India is a major producer and exporting country in respect of this product.

#### **3.1 Lac producing states**

The leading producer of Lac is Jharkhand, followed by the Chhattisgarh, West Bengal, and Maharashtra states of India.

In West Bengal, about 99,000 cultivators are engaged in Lac cultivation. People of the rural areas of backward district like Purulia, Bankura, Midnapur, Murshidabad and Malda have been traditionally cultivating Lac as a subsidiary source of income.

(Source: [http://msmewb.org/htm/lac\\_industries.html](http://msmewb.org/htm/lac_industries.html))

#### **3.2 Lac hosts**

The lac insect has been reported over 100 species of plants. However, the important and common hosts are –

- (1) *Butea monosperma* (Palas)
- (2) *Zizyphus mauritiana* (Ber, Kul)
- (3) *Schleichera oleosa* (Kusum)
- (4) *Cajanus cajan*
- (5) *Grewia* species
- (6) *Ficus* species

The first three are the major commercial plants. Kusum produces the best quality lac.

#### **3.3 Lac Crops**

There are two distinct strains of lac insects in India, called **Kusmi** and **Rangeeni**. Kusmi is raised on Kusum tree and Rangeeni on all other lac host plants. Both the strains have 2 generations and consequently 2 crops a year.



### 3.4 Lac Cultivation

The host trees are pruned in season. When shoots come out, two or three sticks of brood LAC (small lengths of lac covered branches) with living insects are tied on to the branches near them. The larvae swarm out, settle on the shoots and go on producing resin. The crop is cut, scraped and sold as stick LAC. Yield of stick LAC is generally three to four times the weight of brood LAC.

(Source: [http://msmewb.org/htm/lac\\_industries.html](http://msmewb.org/htm/lac_industries.html))

#### 3.4.1 Pruning and Cropping:

(Source: <http://www.agriinfo.in/default.aspx?page=topic&superid=6&topicid=1524>)

The lac hosts should have plenty of new growth with tender branches for feeding of the lac insect. Hence the trees need be pruned to get sufficient tender growth. Before initial inoculation, pruning is done as a separate process, but in subsequent years pruning is identical and one and the same as the cropping. All the host trees should not be cultivated continuously with lac as this will have adverse effect on the vigour of the trees.

#### 3.4.2 Inoculation and harvesting time

(Source: <http://www.agriinfo.in/default.aspx?page=topic&superid=6&topicid=1524>)

The time of inoculation and harvesting of different lac are:

Strain	Crop	Time of inoculation	With brood lac from	Time of harvesting
Rangeeni	Baisakhi	October November	Katki crop	June – July
	Katki	June – July	Baisakhi	October November
Kusumi	Jathwi Aghani	Jan – Feb June - July	Aghani Jathwi	June – July Jan - Feb

Inoculation of various crops is done in the months as shown in the cropping calendar with the brood lac obtained from the previous crop of the particular strain. The brood lac should be thick and it should have continuous encrustation. The crop is harvested earlier than the swarming is due but in the case of crop required for brood it is harvested later just before swarming is due to occur.

### 3.5 Lac Processing

(Source: Lac Culture by Ramesh Singh Department of Zoology Udai Pratap Autonomous College Varanasi-221002;

<http://nsdl.niscair.res.in/jspui/bitstream/123456789/219/1/LAC%20CULTURE.pdf>)

#### 3.5.1 Stick lac

Following harvest, lac encrustations are removed from the twigs of host plant by scraping. The raw lac thus obtained is known as raw or crude lac or scraped lac or **stick lac**. This crude lac consists of resin, encrusted insect body, lac dye, and sand and twig debris. The freshly



scraped lac contains a lot of moisture and usually left to dry. The quality and value of stick lac depend very much upon variety of factors, viz. host tree, climate, whether the crop is harvested before or after emergence of larvae, and the method of drying and storage. The stick lac cannot be stored for longer duration, as the lac has tendency to form lump, and there is loss in quality of lac. High moisture content is responsible for lump formation. It is recommended to store the stick lac on floor in layers less than 30 cm. in height and raked frequently.

### 3.5.2. Seed lac

The primary processing to seed lac soon after harvesting is necessary, because the storage of stick lac is more congenial for lump formation and breeding of storage pests, and thereby causing substantial losses and deterioration in quality of desired industrial parameters. The stick lac is crushed and sieved to remove sand and dust. It is then washed in large vats again and again to break open the encrusted insect bodies, to wash out the lac dye and twig debris. Decaying bug bodies turn the water a deep red that is processed further to get the by-product **lac dye**. The remaining resin is dried, winnowed and sieved to get the semi refined commercial variety product called **seed lac**. The seed lac is in form of grain of 10 mesh or smaller and yellow or reddish brown in colour in general appearance.

### 3.5.3 Shellac

The shellac is the name of finished product and is commonly used across the world. Seed lac is processed into shellac by any of the three methods: hand made country Process or heat process or solvent process. The hand made country process is described below.

#### 3.5.3.1 Hand made Process

Traditionally seed lac is processed by hand. The seed lac is filled into long sausage shaped cloth bag of about 2 inch diameter and 30 feet long. The long bag is passed gradually in front of a charcoal-fired hearth hot enough to melt the lac. By twisting the bag, molten lac is squeezed out through cloth. The residue left inside cloth bag is another variety of refuse lac known as **kirilac**. The molten filtered mass is stretched into sheets approximately 0.5 cm thick and thinner by skilled workman with the help of glazed ceramic cylinder. Alternatively, the molten mass is allowed to solidify in form of discs, and then it is called as 'button lac'.

#### 3.5.3.2 Properties and Uses of Shellac

Shellac is a natural gum resin, a nature's gift to the mankind and is used in over 100 industries. It is natural, non toxic, physiologically harmless and edible resin. Shellac is a hard, tough, amorphous, and brittle resin containing small amount of wax and a substance responsible for its characteristic pleasant odour. Shellac is slightly heavier than water. Its natural colour varies from dark red to light yellow. Shellac is insoluble in water, but dissolves readily in alcohols and organic acids.



- ❖ It is used in fruit coatings, e.g. for citrus fruits and apples, parting and glazing agents for sweets, marzipan, chocolate etc.
- ❖ It is used as binder for mascara, nail varnish additive conditioning shampoo, film forming agent for hair spray, micro-encapsulation for perfumes.
- ❖ It is used for enteric (i.e. digestive juice-resistant) coatings for tablets
- ❖ It is used in manufacturing of photographic material, lithographic ink and for stiffening felt and hat material.
- ❖ It is utilized in preparation of gramophone records.
- ❖ Jewellers and goldsmiths use lac as a filling material in the hollows in ornaments.
- ❖ It is also used in preparation of toys, buttons, pottery and artificial leather.
- ❖ It is also used commonly as sealing wax.

#### **4. Mineral Products**

Among the mineral products found in the forests are building stones, road metal, mica, lime stone, gravel, slates and other similar products. The collection and sale of these products is regulated by Forest Department. Collection of mineral products is done either by mining, quarrying or surface collection. According to the Forest Conservation Act, all these activities amount to use of forest land for non-forestry purpose and would require prior permission of the Central Government.

#### **Reference material**

- (1) Tribhawan Mehta 1981 A Handbook of Forest Utilization, International Book Distributors Dehra Dun
- (2) H Trotter 1925, Special Lecture Notes on the Minor Forest Products of India for Indian Forest Students, Government of India Central Publication Branch, Calcutta
- (3) Websites cited in the lesson



