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Non Timber Forest Products (NTFP)

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Department of Forestry and Environmental Science
School of Earth and Environmental Science

Uttarakhand Open University
Haldwani, Nainital (U.K.)

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# Unit 1: Non Timber Forest Products (NTFP)

**Unit Structure**



## 1.0 Learning Objectives

After studying this unit you are able to understand about:

- What are Non timber forest products (NTFPs)?
- Identify the concept of NTFPs.
- Various kinds of Non timber forest products (NTFPs)
- Management and importance of Non timber forest products (NTFP)

## 1.1. Introduction

The forest is a plant community composed of trees and other vegetation which contains not only a great quantity of timber reserves, but also abundant non-wood plant and animal resources. In China the development of non- wood forest products (NWFPs) resources has been given high priority over a decade. NWFPs constitute a large proportion of total exports of forest products in China and several other countries of the world and they have become essential means of livelihood for the people. It is estimated that 60 percent of the total production of NWFP is consumed locally. The contribution of some of the NWFP, through sales comes to nearly 50 percent of the total revenue from the forestry sector in India. Nearly 400 million people living in and around forests depend on non-wood forest products for their sustenance and supplemental income. NWFPs provide as much as 50 percent of the income to about 30 percent of rural people. The high potential of NWFPs in India should be rationally used through scientific approaches aided by research, acquisition of technology and people's participation. Intellectual property rights over knowledge about the uses and properties of NWFPs need to be suitably protected.

### 1.1.1. Non Timber Forest Product (NTFP)

**Definition:**The term "Non Timber Forest Products" (NTFPs) encompasses all biological materials other than timber, which are extracted from forests for human use De Beer and McDermott (1989).

By **Chandresekharan (1995)**Non-wood forest products include all goods of biological origin, as well as services, derived from forest or any land under similar use, and exclude wood in all its forms:

**Ros-Tonen et al. (1995, 1998)**"all tangible animal and plant products from the forest, other than industrial wood" In 1998, they slightly modified this definition to include "all tangible animal and plant forest products other than industrial wood, coming from natural forests, including managed secondary forests and enriched forests.

**Mathur and Shiva (1996)** All products obtained from plants of forest origin and host plant species yielding products in association with insects and animals or their parts and items of mineral origin except timber, may be defined as Minor Forest Products (MFP) or Non-Wood Forest Products (NWFP) or Non-Timber Forest Products (NTFP).

**M. P. Shiva (1998)**All usufructs/utility products of plant, animal and min eral origins except timber obtainable from forests or af forested / domesticated land areas are termed as Non Timber Forest Products (NTFP) or Non-Wood Forest Products (NWFP)/Minor Forest Products (MFP).

**FAO (1999)**defines Non wood forest products (NWFP) are as 'goods of biological origin other than wood derived from forests, other wooded lands and trees outside forests'.

**Wong(2000)**defines NTFP as'All products derived from biological resources found on forest land but not including timber and fuel.

## 1.2. Concept of NTFP

An extensive range of diverse forest products were initially referred to as "non-timber forest products" (NTFP), a term that is widely used internationally (Fig. 1). NTFP are now classified as plant or animal products that come from unmanaged or managed plant formations, excluding timber (for different purposes) or firewood. In a sense, it can be argued that the term "NTFP" was created to categorise this collection of resources that are purportedly underappreciated ecologically and to place a value on the environmental goods or services provided by tropical forest formations as an alternative to using wood or firewood (Vantomme 2001).

According to Neumman and Hirsh (2000), the NTFP's definition and high level of variability make them "inexact and disturbing, as they are determined not by what they are, but by what they are not." According to Walter (1998), the term chosen is based on the "question" that needs to be addressed. However, "its scope and range should be very clearly defined, regardless of the term used." in 2001 (Vantomme). According to Santos et al. (2003), NTFP are distinguished by their economic adaptability, the variety in their final uses, the differences among their production bases, and resource richness. Cashews, almonds, nuts, fruit, herbs, spices, dyes, oils, resins, fibres, bark, and aromatic, medicinal, and ornamental plants are a few examples of NTFP.

In addition to this practical problem, defining NTFP also has certain philosophical dead ends. The NTFP's collection from natural populations of forest formations, which excludes goods from highly altered landscapes like pastures and plantations, is noted as a key characteristic by Villalobos and Ocampo (1997). They contend that the latter circumstances already correspond to the processes of domestication.

According to Vantomme's (2001), "any biological material that can be extracted from natural ecosystems, managed plantations, etc., and that is used for subsistence or commercialization, or that has some type of social, cultural, or

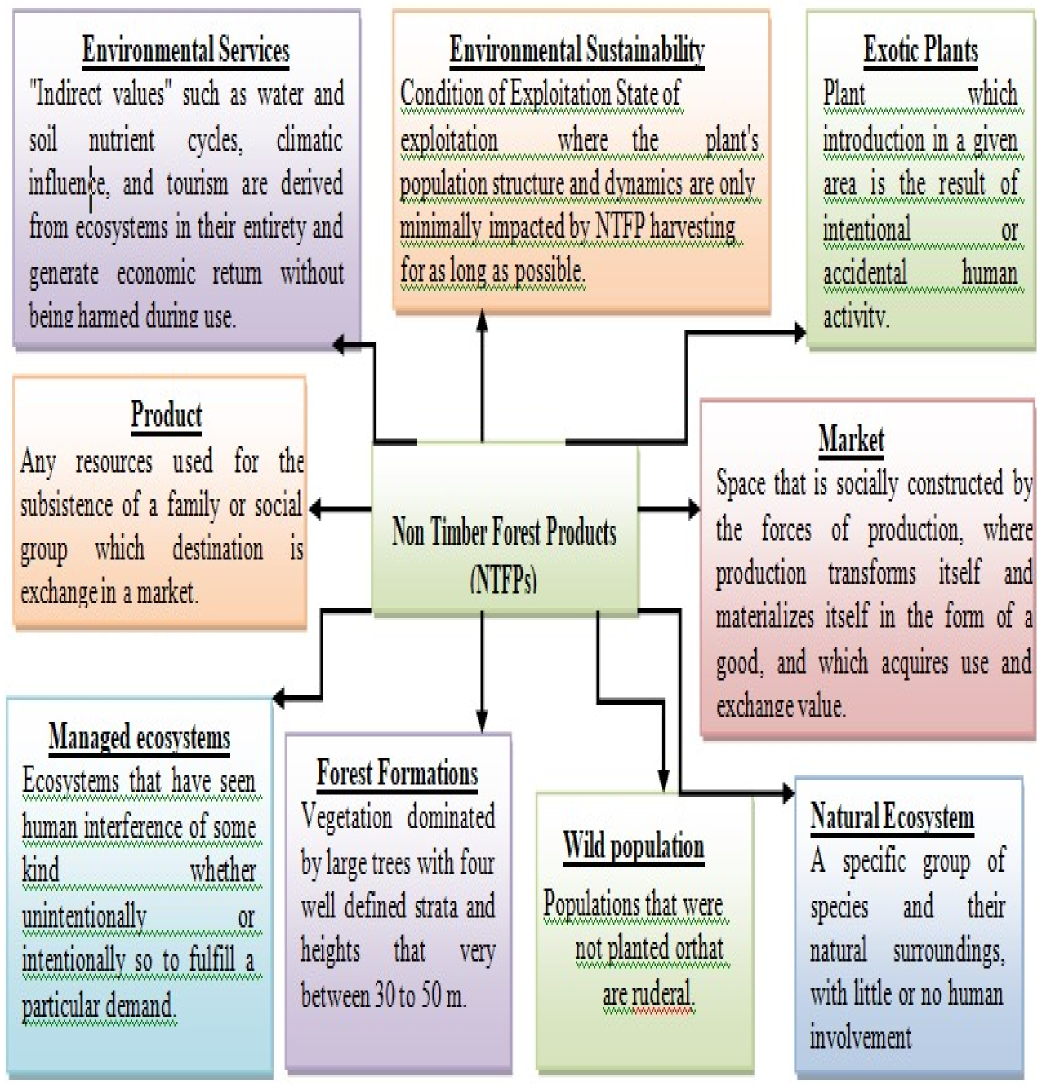


Fig. 1. Concept of Non Timber Forest Products (NTFPs)

religious value" excludes wood itself for industrial use and sawed wood by-products like signs and panels. Despite the fact that many studies do not classify environmental services as NTFP, we do (Walter 1998).

### 1.3 Status of Non-Wood Forest Products

Non-wood forest products (NWFPs) deserve special mention because of their grant potential to support an economic development consistent with the principles of Sustainable Forest Management (SFM). Non-wood forest products (NWFPs) cover a wide range of products (goods & services) from thatching materials to medicinal plants. These products are essential needs of local communities. Some NWFPs, such as latex, gums, resins, essential oils, flavours, fragrances and aroma chemicals help to promote value added processing, niche marketing and export trade. Non-wood forest products (NWFPs) can provide increased employment opportunities and income earning capabilities. Deriving the full benefits of some of the high value NWFPs, requires specialized/ sophisticated skills ranging from bio prospecting, at the resource end to quality control, storage and packaging at the market end. Management of NWFPs will decide the sustainability of forestry in future.

Nearly 400 million people living in and around forests depend on NWFPs for their sustenance and supplemental income. Non-wood forest products (NWFPs ) provide as much as 50 percent of the income to about 30 percent of rural people.

It is heartening to note that, in this context, there is a growing realization now that NWFP have a tremendous potential in meeting the subsistence needs of local people on the one hand while alleviating their abysmal poverty on the other. Another striking feature of minor forest products (MFPs) and non-wood forest products (NWFPSs) is that they can be used on a sustainable basis under scientific manner without adversely affecting the resource base. In this respect they differ considerably from 'Major Forest Produce'.

Non- Wood Forest Products (NWFPs) is an umbrella term used for a vast array of goods of biological origin other than timber derived from the forests. However, considering many conservations, cultural and ethical issues related to wild animals and their derivatives, these have been excluded from being considered as NWFPs. These are a wealth of useful goods with significant potential to ensure livelihood security at community level. Based on origin, NWFPs may be arranged in different classes viz., plant fruits, seeds and nuts; plant exudes-latex, resin, and nectar; plant parts-stem, leaf, roots, bark, apical buds, flowers, mushrooms and orchids and non plant products such as lac and silk. Commonly collected NWFPs in the Himalaya include a variety of medicinal and aromatic plants (MAPs), pine resin, lichens, moss, wild mushrooms, berries and honey. The values of NWFPs in poverty alleviation of marginalized forest-dependent communities has for long been acknowledged. The focus of interest is now on whether sustainable harvest from wild, cultivation on private farmland and commercialization of NWFPs can support local people to achieve sustainable livelihood in changed socio-economic scenario.

The contribution of non- wood forest products (NWFPs) to the forestry sector in most countries is significant, and studies are showing that they have been undervalued in the past. A recent valuation undertaken by the Ministry of Environment and Forests in India estimates that 220 million tonnes of fuelwood, 250 million tonnes of grass and green fodder and 12 million $m^3$ of timber are removed from India's forests annually. These products are estimated to be worth US$ 10 billion (Mukherjee, 1994).

In India, NWFPs provide about 40 percent of total official forest revenues and 55 percent of forest-based employment. Nearly 500 million people living in and around forests in India rely on NWFPs as a critical component for their sustenance (World Resources Institute, 1990). In Madhya Pradesh, the NWFPs which are primarily collected by tribal (i.e. members of local indigenous groups) women are worth more than Rs 21 billion (US$ 700 million) annually (Worldwatch Institute, 1991). Based on a study of ten forest protection committees under the Joint Forest Management programme, it was found that the income from NWFPs ranges from Rs 234 to Rs 5569 (US $8-$186) per hectare per year with a mean of Rs 2299 (US $79) (Malhotra et al., 1991).

Furthermore, revenues from NWFPs have been growing faster than revenues from timber in the past. For example, compound growth rates in revenue from NWFPs in India during the 1968/69 to 1976/77 period were 40 percent higher than those for timber. Export earnings from NWFPs on average account for about 60 to 70 percent of total export earnings from forest products, and this proportion has been rising. Moreover, there is considerable scope for increasing exports further by exploiting untapped resources as the current production of most NWFPs is estimated to be about 60 percent of the potential production. In the case of non-edible fibres and flowers, production is only 7 and 12 percent, respectively, of the potential production (Gupta, Banerji and Guleria, 1982).

It is now felt increasingly that management and development of NWFP resources is essential for various reasons. First, forest management focused on the production of NWFPs may be ecologically and economically sustainable provided that extraction rates do not exceed the maximum sustainable yield. Tribal communities have been involved in NWFP utilization for centuries without destroying the resource base. Managing forests for production of NWFPs also implies maintaining biological diversity of both plant and animal species. Second, non-timber forest products are a vital source of livelihood for a large proportion of the poor living in or close to the forest in most tropical countries. In West Midnapore district in West Bengal, many village communities derive as much as 17 percent of their annual household incomes from NWFPs (Malhotra et al., 1991). Other estimates suggest that up to 35 percent of the income of tribal households in India comes from the collection of unprocessed NWFPs. Also, since NWFPs involve a large variety of seasonal products, returns are frequent and relatively continuous. Moreover, local processing of NWFPs can increase off-farm rural employment opportunities. Small-scale forest-based enterprises, many of them based on NWFPs, provide up to 50 percent of income for 20 to 30 percent of the rural labour force in India (Campbell, 1988).Third, in addition to subsistence and income-generating potential, NWFPs also provide food security to large low-income populations, their cattle and other domestic animals, particularly during droughts or famines (FAO, 1989).

A major challenge related to the further development of NWFPs is the limited availability of documentation related to sustainable harvesting levels. In the past, studies on timber have dominated the scientific forestry literature. There are ethnobotanical studies which list a wide variety of forest products, descriptions of economically useful plants and scattered regional profiles of NWFP trade. The difficulty stems from a singular lack of hard scientific data on the economics of NWFP management, trade and marketing in different forest types; on biological production functions for most NWFP species; traditional harvesting and utilization patterns; and the impacts of commercialization and changing use patterns on the state of NWFPs and related activities.

Since 1921, when commercial exploitation of Medicinal and Aromatic plants(MAPs) in the hill areas of Uttarakhand, first began through auctions, collectors have been subjected to various government prescribed procedures and guidelines. In 1950, the Department of Cooperation (DOC) was awarded marketing rights. In 1962, this system was replaced by private contractors who paid a fixed amount in royalties. These contractors were appointed by the Forest Department. This system was scrapped after the complaints about exploitation of collectors and non remunerative wages and the DOC system was returned in 1979. In the mid 1980s, the Medicinal plants and Herbs Development Project (MPHDP) was initiated which entailed the establishment of gross roots level local cooperatives with a paid government employee from the Horticulture Department as secretary, affiliated to district level organization called Bhesaj Sanghs (Medicinal Plants Cooperative Unions).

In Uttarakhand and much of the Himalaya, the most profitable NWFPs are endangered and threatened medicinal plants whose extraction has been banned after India became a signatory to the Convention on International Trade in Endangered Species (CITES) on trafficking in endangered species of plants and animals. Hence for many of these NWFPs, there exist significant legal issues if any kind of collection is to be permitted. Yet, illegal extraction continues on a large scale with both local collectors and migrant labour (hired by traders) involved in this activity depending on the products and region. While much of the rural community is classified as agriculturists, the traditional lifestyle of the people living in Uttarakhand, like that of most highland communities across the World, had distinctive characteristics and cannot be as easily compartmentalized. Traditionally, the rural economy has consisted of a basket of activities, in which agriculture and animal husbandry provide the base to the subsistence economy.

Trading across borders, handicraft and extraction and processing of NWFPs, provided the base for the market economy.

Essential to the survival of the agro pastoral- economy, which is still the mainstay of the majority of the rural people is the dependence on forests for all elements of life, e.g., firewood, fodder, fibre, medicines, supplementary foods, water and soil conservation and fertility maintenance. Leaf fodder for cattle and leaf litter for cattle bedding provide energy and nutrient inputs that sustain agriculture in Uttarakhand.

Biomass products such as fuel wood, fodder and leaf litter while neglected in almost all accounting system need to be recognized as the most valuable NWFPs being extracted from the forests and a basis of the current rural economy of Uttarakhand. Theses biomass products are however often treated in a category of their own and for the purposes of the discussion below are not being included as NWFPs.

The SFD (State Forest Department) is responsible for production and sustenance of NWFPs. However, it does not trade in NWFPs with the exception of resin. It mainly acts as a regulator in the total process of procurement and collection. It allots coups to registered agencies, such as Uttarakhand Forests Development Cooperation (UFDC), Bhesaj Sanghs, Garhwal Mandal Vikas Nigam (GMVN) and Kumaun Mandal Vikas Nigam (KMVN) for procurement and collection od NWFPs and charges royalty on such collection.

Resin is procured and traded by the forest department through the three main depots in the state to different units inside and outside the state. At present the trade process of the NWFPs other than resin is controlled by UFDC. It is functions as a corporate body and is involved in the scientific management of forest resources. Until recently, it primarily deals with the trade of the timber and minor minerals from the forest area. Since 2004, it has also taken the responsibility of trade of MAPs.

Herbal Research and Development Institute (HRDI) set up as a research and development agency, HRDI has a good field establishment in Chamoli district of the state. The HRDI is helping in certification of farmers for MAP cultivation and training and developing of package of practices. The recent inclusion of the Bhesaj Sanghs as a partner to HRDI further strengthens the ability of this organization to deliver results in this sector.

Bhesaj Sangh is a cooperative mechanism for the regulation of medicinal plants collection and their trade in the state. They are district level collectors cooperatives, which were set up under the Horticulture Department. Bhesaj Sanghs were mandated with training on medicinal plants cultivation for growers. However, the functioning of the Bhesaj Sanghs is not very professional and the politicization of this body has been a major hindrance. Recently, there has been an attempt to professionalize this body through improving coordination and expertise provided through the HRDI. In theory, under the Bhesaj Sanghs, members of village- based cooperative societies were to be trained in sustainable harvesting/collection techniques and then issued with license at the start of collection season for rights to harvest specific species that are not under the endangered or threatened categories.

Thus, there was an excellent institutional mechanism in place which was supposed to assist in minimizing exploitation of local collectors by middle-men while at the same time conserving endangered MAPs. However, the profit earned by the Bhesaj Sangh is low and it is estimated that a small fraction, well less than 5% of the total trade in NWFPs occurs through these institutions. Typically, once a member obtains a license to harvest MAPs from the Sangh, it acts as a contractor, hiring a group of cheap migrant labour to do the actual MAP collection totally unsupervised. Some time not only harvesting is carried out unsustainably, but in order to increase profitability a range of MAPs many of them endangered are collected and sold to private traders.

G.B.Pant Institute of Himalayan Environment and Development (GBPIHED) an autonomous institute of Ministry of Environment and Forests, High Altitude Plant Physiology Research Centre (HAPPRC) of Garhwal University, Srinagar, and various NGOs are involved in research and development programme on medicinal plant conservation and cultivation. These organizations are also engaged in capacity building of local communities and extension activities.

It is heartening to know that some of the traditional farmers inhabiting the buffer zone of Nanda Devi Biosphere Reserve have successfully domesticated a number of medicinal plants including *Angelica glauca, Carum carvi, Megacarpea polyandra, Pleurospermum angelicoides, Saussurea costus* and *Allium* spp etc., at small scale.

The under mentioned provisions of National Forest Policy, 1988 are very important in the context of Minor Forest Produce (M.F.P.):

- Meeting the requirements of minor forest produce and small timber of the rural and tribal populations increasing the productivity of forests to meet essential national needs.
- Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income.
- The life of tribal and other poor people living within and near forest revolves around forests. The rights and concession enjoyed by them should be fully protected. Their domestic requirements of minor forest produce should be the first charge on forest produce.
- Having regards to the symbiotic relation between the tribal people and forests, a primary task of all agencies responsible for forest management, including forest development corporations should be to associate the tribal people closely in protection, regeneration and development of forests as well as to provide gainful employment to people living in and around the forests.

Non- wood Forest produce has been given an important place in the U.P. State Forest Policy of 1998. There is very close relationship between forests and tribal & rural people living inside and near forests. Success of any scheme of conservation of forests is not possible without their active co-operation. Non wood Forest Product viz. Tendu patta, resin, cane, herbs, and shrubs, mahua, chiraunji, anola, flowers and fruits etc. form an important part of the life of people living in and around forest and also provide profitable employment opportunities for them. All such non timber forest produce shall be identified and their protection, regeneration and optimum collection shall be done with their interest in view. With all this in mind people/ tribals living in and around forests shall be given facility of free collection of mahua, cheraunji, honey, wax, and fuel for self use without causing any damage to the forest wealth in any way. The governments of various states have given concessitions to various tribes for the collection of the some NWFPs without harming the forests in any manner- Aola, Gum, Honey, Wax etc.

These facilities will be admissible only to the residents of those villages who have been duly notified as right holders or concessionists or are proposed under the forest settlement operations and in case of hills for residents of village chalks situated within the reserved forest boundaries. Under the facilities mentioned above, free of cost collection will be allowed to benefited villagers only & not to any outsider.

**Summary**

All products obtained from plants of forest origin and host plant species yielding products in association with insects and animals or their parts and items of mineral origin except timber, may be defined as Minor Forest Products (MFP) or Non-Wood Forest Products (NWFP) or Non-Timber Forest Products (NTFP). According to Neumman and Hirsh (2000), the NTFP's definition and high level of variability make them "inexact and disturbing, as they are determined not by what they are, but by what they are not." According to Walter (1998), the term chosen is based on the "question" that needs to be addressed.

## Terminal Question:

1. What are Non wood forest products? Define concept of NWFPs.
2. Describe the status of NWFPs in India.
3. Evaluate the different forest products which maintain the status of NWFPs.

# Unit 2: Status and Classification of NTFPs

**Unit Structure**



## 2.0 Learning Objectives

After studying this unit, you are able to:

- Develop basic knowledge on the different types of NWFPs in India and their socio economic importance to the rural people
- Definition of NWFPs?
- Classification of NWFPs.

## 2.1 Introduction

Non- Wood Forest Products (NWFPs) is an umbrella term used for a vast array of goods of biological origin other than timber derived from the forests. However, considering many conservations, cultural and ethical issues related to wild animals and their derivatives, these have been excluded from being considered as NWFPs. These are a wealth of useful goods with significant potential to ensure livelihood security at community level. Based on origin, NWFPs may be arranged broadly in four classes viz., plant fruits, seeds and nuts; plant exudes-latex, resin, and nectar; plant parts-stem, leaf, roots, bark, apical buds, flowers, mushrooms and orchids and non-plant products such as lac and silk. Commonly collected NWFPs in the Himalaya include a variety of medicinal and aromatic plants (MAPs), pine resin, lichens, moss, wild mushrooms, berries and honey. The values of NWFPs in poverty alleviation of marginalized forest-dependent communities has for long been acknowledged. The focus of interest is now on whether sustainable harvest from wild, cultivation on private farmland and commercialization of NWFPs can support local people to achieve sustainable livelihood in changed socio-economic scenario.

The contribution of non-wood forest products (NWFPs) to the forestry sector in most countries is significant, and studies are showing that they have been undervalued in the past. A recent valuation undertaken by the Ministry of Environment and Forests in India estimated that 220 million tonnes of fuelwood, 250 million tonnes of grass and green fodder and 12 million $m^3$ of timber are removed from India's forests annually. These products are estimated to be worth US$ 10 billion (Mukherjee, 1994).

## 2.3 Classification of NWFPs

The various NWFPs found in India may be broadly classified on the basis of product type into the following categories

1. Edible plants (including fodder species)
2. Medicinal and Aromatic Plants
3. Spices
4. Fibre yielding plants.
5. Paper and pulp yielding plants.
6. Gums and resin yielding plants.
7. Dyes and tans yielding plants.

8. Bamboo species.

9. Insect byproducts (Honey, Silk etc.) promoting species.

10. Fatty and essential oil yielding plants.

11. Plants used for making soap.

12. Species of other importance.

### 2.3.1 Edible plants

Many plants species found in the region are suitable for human consumption. These are *Aegle marmelos,Agave Americana, Bauhinia vahli, Bauhinia variegate, Corylus jacquemontii, Cyperus rotundus, Dendrocalamusstrictus,Dioscoresbelophylla, Diploknemabutyraceae, Emblicaofficinalis,Ficusspp.,Fragaria indica,Juglans regia, Mangifera indica, Mentha spicata, Moringa oleifera, Morus alba, Myrica esculenta, Pyrus pashia, Rhododendron arboreum,Rubusspp.,Bombax ceiba, Shorea robusta, Syzygiumcumini, Utrica parviflora, Zizyphusmauritiana*etc. The important and most common edible plants of the Himalayan region along with the edible part have been given in table 1.

**Table1.The important edible plants of the Himalayan region**

(T= trees,S=shrubs,H =herbs and C= climbers)

| S.N. | Botanical name | Edible part | Distribution |
|---|---|---|---|
| 1. | *Actinidia callosa*(C ) | Fruit | In Himalayas, altitude between 1200-2400m elevation |
| 2. | *Actinidastrigosa* (C ) | Fruit (pulp) | In Himalayas between 1200-2400m elevation. |
| 3. | *Aesculus indica* (T) (Bankhor) | Embryo eaten by hill people | Western Himalayas between 1000-2500 m altitudes. |
| 4. | *Ampelocissus rugosa* (C) | Fruit | Himalayas between 1500-2000m |
| 5. | *Berberis asiatica* (s)(Kingora) | Fruit Pulp is edible | Himalayas up to 2500m. |
| 6. | *Berberis lycium* (S) | Fruit | Throughout Himalayas up |

| | | | |
|---|---|---|---|
| | (Chatroi) | | to 2750 m elevation |
| 7. | *Bischofiajavanica* (T) (Paniala) | Fruit | Sub- Himalayan forest from Kumaun to eastwards throughout eastern India. |
| 8. | *Buchananialanzan*(T) (Chironji) | Flesh of ripe fruit eaten raw as well as roasted seed used in sweet meats. | Dry deciduous forest in central India |
| 9. | *Buniumpersicum* (H) (Kala- Zirah) | Fruit are used as spices | Himalaya between 2000-3000m altitude. |
| 10. | *Bursera serrata* (T) | Pulp of fruit | Himalaya between 2000-3000m altitude |
| 11. | *Carissa carandas* (S) (Karaunda) | Half ripe fruit is used pickled and full ripe is edible | Dry deciduous forest also cultivated. |
| 12. | *Corylus colurna* (T) (Bhutia Badam) | Fruit | Himalaya between 1500-3200m |
| 13. | *Crataegus oxyacantha* (T) (Ban-sanjli) | Ripe fruits are eaten | Himalaya between 1500-2700m altitude. |
| 14. | *Debregeasia longifolia* (T) ( Sansaru) | Ripe fruits are eaten fresh | Sub- tropical Himalaya at an elevation of 600-2100m. |
| 15. | *Duabanga grandiflora* (T) | Ripe fruits are edible | Himalaya up to 1000m altitude. |
| 16. | *Ehretia acuminate* (S or T) (Pandayan) | Ripe fruit is eaten and unripe fruit is used for pickled | Himalaya up to 1800 m altitude |
| 17. | *Elaeagnus latifolia* (S) (Ghiwain) | Ripe fruit is eaten | Sub- Himalayan tract up to 1500-2400 m altitude. |
| 18. | *Ficus auriculata* (T) (Timla) | Fruits are eaten as vegetable and ripe eaten raw | Himalayas up to 1800 m altitude |
| 19. | *Ficus neriifolia* (T) (Parphuta) | Ripe fruits are edible | Himalayas up to 2400m. |
| 20. | *Fragaria vesca* (H) (Pahari rasbhari) | Fruits edible | Himalayas up to 1600-3200m elevation |

| | | | |
|---|---|---|---|
| 21. | *Grewia elastic* (T) (Bimla) | Ripe fruits are eaten | Outer Himalayas up to 1500m elevation. |
| 22. | *Juglans regia* (T) (Walnut) | Fruit | Himalayas between 1500-3500m elevation. |
| 23. | *Morus serrata* | Ripe fruits are eaten | Throughout Himalayas |
| 24. | *Prunus armeniaca*(T) (zardalu ) | The ripe fruits both fresh ane dried are eaten | North- Western Himalaya up to an altitude of 300m |
| 25. | *Prunus cerasoides* (T) (Paddam, Phaya) | Ripe fruits are eaten raw | Himalayas between 1200-3600 m altitude. |
| 26. | *Pyrus pashia* (T) (Mahal) | Pulp of ripe fruit is eaten. | Himalayas up to 600-2500 m |
| 27. | *Viburnum cotinifolium* (S) | Ripe fruits are eaten. | Himalayas up to 1200-3000 m altitude. |

### 2.3.2 Fodder species

There are about 350 species from 116 genera growing throughout the region between 500 and 4500 m amsl (Singh and Singh, 2006). The Himalayan region support about 84 trees and 40 shrubs of fodder value that the people use (Negi, 1977). Singh and Singh (2006) estimated that in the Uttarakhand fodder leaf production from forests, agricultural sector, orchards and bushes/ perennial herbs account for 77%, 12%, 2.7% and 19.2% respectively. Singh *et al.* (1988) computed contribution of different sources of fodder for the Uttarakhand Himalyan. A few case studies compiled from different parts of Uttarakhand reveal that the contribution of crop residue ranges from 13-41% and that of grazing from the surroundings forests and grazinglands from 35-40%. According to Nautiyal *et al.* (1998) 20% of annual fodder requirement is met from farm trees and 30% from crop by-products in a typical village located in sub-montane zone of Garhwal where traditional agroforestry is well developed. In many villages a sizable chunks of land (also referred to as Ghasnis) have been developed as grasslands to cater to the fodder need of the livestock that also serve as a source of income to the household that maintain Ghasnis. In general grazing in forests, unculturable wastelands and seasonal cropland follows are the mainstay for animals in Uttarakhand and fodder trees, shrubs and crop residue contribute significantly to the livestock dietary demands. A cost estimate of the fodder and leaves collected for cattle bedding from the surrounding forests and private support land revealed that each year a total of 5,748kg (equivalent to Rs. 6,380) fodder is extracted from the reserved forests 2,037 kg (equivalent to Rs. 2,260) from the private support system consisting of private grass lots and fodder trees, 3,471 kg bedding leaves (equivalent to Rs. 1,920) from reserves forests for cattle sheds per ha of croplands has been recorded (Singh *et al., 2002)*. Further analysis showed that on average 30 animal units have been found dependent on each hectare of cultivated land that in the state consume fodder costing Rs. 14,700 annually to produce an output of Rs. 3130 (milk, Rs. 585; animal labour utilized Rs. 1,340; and dung Rs. 1205), with the output; input ratio of 0.2 (Singh *et al.,*2002).

Some prominent fodder tree species of the region are *Bauhinia spp.,,Celtis australis, Carpinus viminea, Debregeasiavelutina, Desmodiumelegans,Diploknemabutyraceae, Ficus* spp.*,Grewia optiva, Melia azedarach ,Morus spp. ,Prunus cerasoides, Quercus spp.,Robinia pseudoacacia, Salix wallichiana* etc.

### 2.3.3 Medicinal and Aromatic Plants

Any discussion on NWFPs from the Himalaya would almost certainly focus on this very important group of plants for which the Himalaya is best known. While many of the important MAPs are herbs or small shrubs, a good example of a perennial form would be Yew tree (*Taxus baccata*) which gained great attention due to the anticarcenogenic properties of taxol mainly found in its bark.

**Himalayan Yew: *Taxus baccata*:** This tree occurs between 1800 and 3300m amsl in central Himalayan . It is one of the high value medicinal plants of Uttarakhand. The anti- cancer drug Taxol (paclitaxel; a diterpenoid) is isolated from the stem bark. Extracts of *T. baccata* is also known to be source of a drug called '*Zarnab'*, which is prescribe in the Unani system of Indian medicines and used as sedative and for the treatment of bronchitis, asthama, epilepsy, snake bites and scorpion stings, besides applications as an aphrodisiac (Beckstrom- Sternberg and Duke, 1993). The use of its bark as a substitute (or mixed with) tea is also known. Taxol is currently used in the treatment of several forms of breast, liver, lung, blood and gynecological cancers. Average taxol content in the bark of yew trees across an age series was found to range between 0.064 and 8.032 g/ tree, and a tree of about 100 yrs age can yield about 5.74 kg dry bark.

The other tree associates with it being *Cedrus deodar, Abies pindraw, Aesculus indica, R.arboreum, Lyonia ovalifolia, Quercus floribunda* etc. Due to its medicinal importance large-scale exploitation has been continuing until recently from this region. Consumption of seeds along with aril (a sweet, fleshy cup like structure surrounding the seed) by birds, monkeys and humans causes regeneration failure to this tree. Efforts for conservation and mass multiplication of this species using growth *hormones* are being made by G B Pant Institute of Himalayan Environment and Development(GBPIHED.

The most important medicinal and aromatic shrubs and herbs are *Acorus calamus, Adhatodavasica, Adiantum venustrum, Artemisia nilagarica, asparagus racemosus, Atropa acuminate, Berberis asiatica,Berginialigulata, Cannabis sativa, Centellaasiatica,Coptisteela, Datura stramonium,Dioscoreabulbifera, Euphorbia royleana, indigoferapulchella, Mentha sylvestris, Ocimumbasilicum, Potentilla fulgens, Selinumtenuifolium, Thalictrum foliolosum,*etc. The most important tree species are *Aesculus indica,Cassia fistula, Cinnamoumtamala,Diploknemabutyraceae, Emblica officinalis, Juglans regia, Lyonia ovalifolia, Mallotusphillippinensis,Myrica esculenta, Pinus roxburghii, Syzygiumcumini, Terminalia belerica, Terminalia chebula*etc.The exotic species included *Atropa belladonna, Digitalis lanata, Digitalis purpurea, Hyoscyamus nigar, Plantago ovate, Saussurialappa, Chrysanthemum cinerariaefolium, Mentha citrate, Ferula narthex, Glycyrrihizaglobra* etc.

### 2.3.4 Fiber yielding Plants

There are a number of natural fiber yielding plants present in the region. Most of these grow wild near villages and deforested areas as *Xerophytes* plants except for *Bhimal* which is being cultivated usually for subsistence use. Fibre is generally used for making ropes and mats. The region yield an immense quantity of material for ropes, cordage, mats and twines. The main fibreyielding species are- *Agave Americana, Calotropis gigantean, Cannabis sativa, Daphne papyraceae, Eulaliopsisbinata, Giraradiana heterophylla, Gerbera langinosa, Grewia optiva, Salix wallichiana, Utrica parviflora* etc.

### 2.3.5 Pulp and paper yielding plants

There are numerous varieties of trees and grasses in the region, which can yield material for paper and pulp. The *babar*grass found in sufficient quantities in the region and is a suitable material for making coarse cordage and paper. *Dendrocalamus spp.* can be utilized in the same manner. The pulp manufactured from *Daphne papyraceae* yields material for a paper that gives the engraver finer impressions than any English-made paper and nearly as good as the fine Chinese paper that is employed for what are called India-paper proofs. The paper made from this shrub in Kumaun is almost as strong and durable as leather and was largely used for village records and court proceedings. It is exported to Tibet in the north and to the plains in the South for manuscripts and account-books. Apart from this many other plants have paper value. Some important plants are *Daphne papyraceae*(Satpura), *Dendrocalamusstrictus* (Bans), *Dendrocalamus hamiltonii*(Bans), *Eulaliopsisbinata* (Babar), *Wikistroemia canescens* (Chameliya), *Desmodium tiliaefolium*(Chamara).

### 2.3.6 Gums and Resin Yielding Plants

Many important species found in the region produce gums and resins of high economic value. In fact resins is only next to timber in earning highest revenue amongst the various forest products. The species which produce gums and resins are-:

**Gums-***Bauhinia variegate* (kwairal), *Toona ciliate (*Tun), *Prunus cerasoides*(Padam), *Woodfordiafruticosa*(Dhaula).

**Resins-***Pinus roxburghii* (Chir), *Pinus wallichiana*(Kail): Resin is mostly extracted from *Pinus roxburghii* for the production of rosin and turpentine oil. However, *Pinus wallichiana* yields high-grade resin.

### 2.3.7 Dyes and Tanin Yielding Plants

In Kumaun region, the dyes of vegetative origin are extracted only from plants or tress growing wild or which are cultivated for some other use. Turmeric (*Curcuma longa)* and a great mass of dyes are exported from the hills as a portion of minor forest produce, but of little commercial value. The tanning materials produce by plants that grow wild afford a valuable assistance to the supply of similar materials found in the plains. Some popular dyes and tans are extracted from the following plants- *Acacia catechu* (Khair), *Alnus nepalensis*(Utis), *Bauhinia variegate* (Kwairal), *Berberis aristata* (Kilmora), *Toona ciliate* (Tun), *Cotinus coggygria*(Gardh tungs), *Curcuma longa* (Haldi), *Emblica officinalis* (Aonla), *Ficus glomerata* (Gular),*Flacourtia indica*(Bilongra), *Juglans regia* (Akhrot), *Prunus persica* (Aru), *Punica granatum* (Anar), *Quercus floribunda* (Moru), *Rubia cordifolia* (Majethi),*Sapiumsebiferum* (Pahari shisham),*Taxus baccata*(Thuner), *Terminalia chebula*(Harar), *Woodfordiafruiticosa*(Dhaula).

### 2.3.8 Bamboo Species

In Uttarakhand, some of the marginal communities such *Ruriya* and also other traditional communities inhabiting higher altitude areas of the state are dependent on bamboo resources for part of their livelihoods. The most common bamboos of the state are Ringal (*Arundinaria falcata)* and Tham abundantly occurring in temperate and subalpine forests. Local craftmen make a variety of household items such as baskets and mats from this resource. Ringal and Tham bamboos are also used as a thatch material for covering roofs. Of late, local craftmen have started making a number of fancy handicraft items from Ringal bamboo which are sold to a large number of tourists and pilgrims visiting the state.

Establishment of the Uttarakhand Bamboo and fibre Development Board (UBFDB) a few years ago has greatly increased the focus on bamboo planting and handicrafts made from bamboos. Bamboo planting has been included Training of bamboo artisan and products such as the 'Badrinath pooja basket' which has been used by thousands of pilgrams has greatly increased the value of this NWFP. Three main bamboo species- locally known as *Ningal or Ringal* are found in the Kumaun region are:

- *Arundinaria falcata-Gol-ningal*
- *Thamnocalamusfalconeri- Deo- ningal*
- *Thamnocalamusspathiflorus- Tham-ningal.*

### 2.3.9 Insects by-products (Honey, Silk etc.) promoting species

Silk and honey are the two most important insects by-products of the region. The region has a very high percentage of Oak species, which are suitable for tasar production. *Morus alba* can be increased sufficient to promote silk industry. Similarly, the potential of honey is also high as the region abound in suitable species for good quality honey production, for example- *Bombax ceiba* (Semul), *Citrus spp.Diploknemabutyraceae*(Cheura), *Prunus spp.*etc.

In the Himalaya, much of the honey production is dependent on the pollen of wild trees, bees are very important pollinator of cultivated crops. A decline in the yield of fruit trees in many parts of the Himalaya has been linked with depleted honey bee population. The principles species of bee which are kept in hives and managed for honey production and crop pollination are *Apis cerana* and *Apis mellifera*. *Apis cerana*, the native honey bee is not popular among commercial beekeepers in the Himalaya because of its low honey yield and undesirable behavioural traits such as frequent swarming and absconding.

*Apis florae, Apis dorsata* and *Apis laboriosa* are wild species of the honey bee and cannot be kept in hives. These species build single comb nests on tall trees and cliffs.

*Apis melifera*, the European bee was introduced to the region to promote beekeeping as a commercial enterprise and it has a high honey yield and a hive can yield 30-50 kg of honey per year. However, it is susceptible to disease and low temperature and cannot easily be maintained in the mountains unless beekeepers, which largely replace *Apis cerana,* the ecological implications of which are still not known.

In Uttarakhand, wall-hives with colonies of *Apis cerana* have been traditionally nurtured. The practice had declined somewhat for several reasons, such as a change in construction material (from stone walls to brick walls ) that make wall hives more difficult to keep and maintain, and also because of declining bee populations attributed to indiscriminate use of pesticides in fruit growing areas. However, bee- rearing is seeing a small resurgence in the region. A few NGOs and enterprenuers have aggressive programmes aimed at increasing bee colonies and the yield of honey per colony.

Honey yield can be increased from about 2-3 kg per hive annually to 5-7 kg per hive through use of better technologies such as removable combs. In newer wall hives frames are often inserted which allow for non-destructive removal of the hive and harvesting of honey rather than the old practice of cutting the hive out of the wall which resulted in its destruction and necessitated that bees build a fresh comb which in turn reduced honey yield.

### 2.3.10 Tasar silk

A niche activity is the production of tasar and other non- mulberry silks through use of leaves harvested from from the forest. *Quercus semecarpifolia* has been most commonly used. Eri and muga silks have also been produced in Uttarakhand in the limited quantities using species such as *Listea*and *Castor(Ricinus)*. However, the scope in terms of using forest resources vis-a vis productivity needs to be assessed for promotion of Tasar Silk in the in the state.

### 2.3.11 Pants used for making Soaps

The most important local species is *Sapindusmukoiossi* (Reetha) which has a tremendous commercial use in herbal –shampoos, woolen detergents etc. *Agave Americana* (Rambans) is also used for making soap-substitute.

### 2.3.12 Species of other importance

Other species of NWFPs importance are mentioned briefly under this category. The first and foremost species are grasses, the utilization of which is intimately connected with forest works. Grasses are used for a variety of purposes e.g. paper pulp, cordage, matting, thatching, essential oils, khuskhustatties, screens, chairs, stools and tables. Some important grasses of Kumaun are mentioned below:

*Apludemutica (Sachla), Arundinellanepalensis (Tutnalia), Arundo donax (Narkal), Arundinellasetosa (Murkiya/Pileri), Cenchrus ciliaris (Anjan), Chysopogongryllus (Kush/ Salama), Chyrsopogon fulvus (Gauriya), Cynodondactylon (doob), Cymbopogon martini (Babila), Dicanthiumannulatum (Nail), Dactylis glomerata (Orchards grass),Erianthusmunja (Munja), Eragrostisunioloides (Bansiya), Euragroshiscurvela (Luv grass),Eulaliopsisbinata(Babar grass), Heteropogoncontortus (Kumeriya), Imperata cylindrica (Siru), Neyrandiaarundinaceae (Nalsura), Pennisetum orientale (Vimalsa), Saccharum spontaneum (Kaus), Setarianandi (Nandi), Themedaanethera (Piriya), Themedaarundinaece (Ula), Vetiveriazizaniodes (Kush Kush).*

There are several species of other importance for example *Bauhinia vahlii* (Maljhan), *Shorea robusta* (Sal) and *Ficus auriculata (Timla)* the leaves of which are used for making platter; *Camellia sinensis* (Tea beverage), *Cinnamomum tamala*(*Dalchini)* used for spices and condiments; *Salix* (Bainsa) is used for handicrafts etc.

## 1.4 Regeneration Status and Production of Various Categories of NWFPs

*We have tried to very briefly discuss the regeneration status of the various plant and tree species under the categories of leaves, bamboos, flosses, tannins and dyes etc.The section includes the local name, brief distribution, uses and regeneration potential.*

### 1.4.1 Leaves

#### 1. Diospyros melanoxylon

Commonly known as “tendu”, but also called “abnus” in Andhra Pradesh, “kendu” in Orissa and West Bengal, “tembru” in Gujarat, “kari” in Kerala, “tembhurni” in Maharashtra and “balitupra” in Tamil Nadu.

**Uses:** Leaves are used as wrappers of tobacco to produce bidi. Off – cuts of leaves are burned and the ash is used in tooth powder.

**Distribution:** The species 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.

**Regeneration:**Under natural conditions, seed germinates in the rainy season and seedling production is plentiful. Seedlings tolerate considerable shade but for optional development more light is required. Seedling resists 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. About 40 percent of fresh seed germinates. Germination starts after 36 days and is complete in 80 days. It is the best raise seedling in long narrow baskets and transplant the seedlings with the second rains. Coppicing yields the best quality leaves and also facilitates easy collection.

**Annual production and value:** Around 300,000 tons of bidi leaves are produced annually in India, of which over 85 percent is collected from Madhya Pradesh, Orissa, Maharashtra and Andhra Pradesh. The values of these leaves is based on an average price of Rs. 15,000 per ton, but rates vary from state to state, according to demand, availability of leaves and location of bidi making industries.

**2 Bauhinia vahlii**

Local name of Bauhinia vahlii is “Mahul” in Uttar Pradesh and Madhya Pradesh, and “siali” in West Bengal and Orissa.

**Uses:** Leaves are used for making cups and plates and for wrapping foods.

**Distribution:** It is a giant climber and one of the most abundant Indian Bauhinia species. The species is distributed in the sub- Himalayan region up to 3,000 meters above sea level in Assam, Central India, Bihar, Eastern and Western Ghats.

Commercial collection of leaves is done in Madhya Pradesh, Orissa and Andhra Pradesh.

**Regeneration:** The species grows naturally in the forests. No efforts to regenerate it artificially are made. It is usually considered a weed because of the damage it does to healthy trees by climbing and spreading over them.

**Annual production and value:**In Madhya Pradesh, about 780 tons of leaves are collected, valued at approximately Rs. 2 million. In Orissa, over 160 tons of dried leaves and 86 million leaf plates are marketed annually. Collectors receive only about Rs. 1.50 per kg and earn only Rs. 8 to 10 per day. Therefore, collection of Bauhinia leaves is done only as a last resort during the low- income.

### 1.4.2. Bamboos

Over 100 species of bamboo occur naturally in India. Bambusa arundinacea, B. tulda, B. polymorpha, Dendrocalamus strictus, D. hamil-tonii, Melocanna baccifera and Ochlandra travancorica are the most important species because of their wide availability. Dendrocalamus strictus and Bambusa arundinacea are the two principal economic species.

**Uses:** Because of its fast growth, easy propagation, soil binding properties and early maturity, bamboo is an ideal species for afforestation, soil conservation and social forestry programs. Bamboo is strong, straight and light. It is hard and hollow and easy to work. It comes in many sizes and has long fibres. Such characteristics make bamboo highly versatile. Among bamboo’s medicinal properties is banslochan, a secretion found in the culums used as a cooling tonic, aphrodisiac and as a treatment for asthma and coughing.

**Distribution:** It is found almost everywhere. Its distribution is governed largely by rainfall, temperature, altitude and soil conditions. Most bamboo requires a temperature of $8^0$ to $36^0$C, a minimum of 1,000 mm of rainfall annually and high humidity for good growth. Bamboo is an important constituent of many deciduous and evergreen forests and extends from tropical to mild temperate regions. It grows on flat alluvial plains up to altitudes of 3,050 m above mean sea level.

**Regeneration:** Between seedling periods, reproduction of bamboo is by asexual means. In bamboo clumps, rhizomes grow under-ground and produce new culms as annual shoots. This process continues until the plant produces flowers and seeds, then dies. The most common method of vegetative reproduction is by rhizomes or offset planting. Bamboo flowers gregariously after long periods although sporadic flowering occurs almost every year. During the years of gregarious flowering, the forest floor is carpeted with seedlings and the areas are naturally regenerated.

**Annual production and value:** The price of bamboo varies with its end use. Most of the annual cut is used in making paper or rayon for which producers receive about Rs. 300 per ton. The value of the potential annual cut is Rs. 1,367 million.

### 1.4.3. Gums and Resins

Gums are translucent, amorphous substances which are degradation products of the cell wall of woody species. They exude spontaneously from trees and are soluble in water. Resins also are exudates but are soluble in alcohol not water. Resins often occur mixed with a high percentage of essential oils known as oleoresins. When oleoresins include some gum, as in the case of exudation from gums as in the case of exudation from Boswellia serrata, they are called oleoresins.

**Uses:** Commercial gums enter the market in the form of dried exudates. The varieties having the least color and highest adhesive power and viscosity are the most valuable. The finer grades are used in clarifying liquors, “finishing” silk, and in the preparation of quality water colors. In the cosmetics and pharmaceutical industry, gums serve to emulsify or bind mixtures in creams lotions and ointments. Resins are used in the manufacture of lacquers and varnishes. Resinous substances can be used for waterproof coatings. They are used in medicines for sizing paper, for incense and in the preparation of sealing wax and other products. Oleoresins are used in perfumery and medicines for making varnishes and lacquers as fixative and in scenting soaps.

**Annual production and value:** Madhya Pradesh has the potential to produce as much gum karaya as the rest of India combined. Approximately 1,400 tons of gum karaya are collected annually from other states valued at about Rs. 60 million. Production of other gums is about 1,900 tons fetching Rs. 12 million annually. About 46,000 tons of oleoresins are obtained from Pinus roxburghii each year, valued at approximately Rs. 2.8 million.

### 1.4.4. Oil seed

India has about 86 different oil seed is collected from Shorea robusta, Madhuca indica, Mangifera indica, Garcinia indica, Azardirachta indica, Pongamia globra, Schleichera trijuga, Salvadora oleoides,S.persica and Actinidaphne hookeri.

**Uses:** Sal (Shorea robusta) seed cotyledons yield the well known sal butter used for cooking and lighting. Mahua (Madhuca indica) seed is used in the production of washing soaps, refined oil can be utilized for cooking and also used in jute industry and in the manufacture of lubricating greases, candles, bathing oils, fatty alcohols and stearic acid. It is good laxative and is used in treating habitual constipations, piles and hemorrhoids. Karanj (Pongamia globra), both the seed and oils are poisonous but they possess remarkable medicinal properties. The seed is carminative, purifies and enriches the blood and is used for inflammation, earache, lumbago and chest ailments. The oil is styptic, anti-helminthic and good for rheumatism and cutaneous infections and as a remedy for scabies and herpes. Kusum (Schleichera trijuga) oil produced is utilized by the soap industry. It is used in hair dressing and in medicines used in treating skin diseases, rheumatism and headaches. Neem (Azardirachta indica) oil is used in soap and local medicines. Mango (Mangifera indica) seed oil is used as a cocoa butter substitute. Khakan (Salvadora oleoides) and pisa (Actinidaphne hookeri) oils are used in making soap. The fruit of khakan is edible and is fed to cattle to increase milk yield.

**Annual production and value:** Sal seed is collected and marketed on a commercial scale. The potential production is estimated at 5.5 million tons but current collection is only 100,000 tons, valued at Rs. 200 million. Mahua has a potential kernel production of 1.1 million tons but the annual collection is around 25,000 tons, valued at about Rs. 17 million.

### 1.4.5. Essential oils

It is also called volatile oils, are liquids which possess a pleasant taste and strong aromatic odor. They occur in about 60 plant families and are frequent or abundant in the Labiatae, Rutaceae, Geraniaceae, Umbellifereae, Asteraceae, Lauraceae, Graminae and Fabaceae families. Any part of the plant may be the source of essential oil. They are used in making perfumes, soap and other toiletries. Many have therapeutic and antiseptic properties. Several others are used as solvents in the paint and varnish industries, as insecticides and deodorants and in the manufacture of synthetic scents and flavors. The important essential oils produced in India are oils of sandalwood, Lemon grass, palmarosa, eucalyptus, khus and linaloe.

Estimated production of some of the important essential oils produced in India are about total 2,830 tons.

### 1.4.6 Fibers and Flosses

**A. Fibers:** Fiber fall into three categories, soft, hard and surface. Soft fibers are obtained from the bast or stem of plants; hard fibers from the leaf; and surface fibers are those which are borne on the surfaces of stem, leaves, seeds etc. based on their general use they are classified as textile fibers, brush fibers, plaiting and weaving fibers, filling fibers, natural fabrics and paper making fibres. The most important fibers coming from the forests of India are from the families of Bambacaceae, sterculiaceae, Tiliaceae, Fabaceae, Asclepiadaceae, Myrtaceae, Moraceae,Urticaceae, Palmaceae, Musaceae and Gramineae.

Various species are commonly used by cottage industries but only Agave sisalana and Sterculia villosa have commercial importance. Agave fibers are used in making ropes and mats. The fiber is also useful for cordage, twins and nets.

**Regeneration:** Agave plants usually grow in semi-arid tropical regions. They are propagated from rhizomes or bulbils. Sterculia villosa is mainly found in Uttar Pradesh, Tamil Nadu and Kerala, although it is scattered throughout most of India.

**Annual production and value:** It is estimated that around 2,500 tons per annum of agave fibers are produced in the country, with a present value of Rs. 45 million.

**B. Flosses:** Flosses are obtained from certain wild fruits. Important species are Bombax ceiba and Ceiba pentandra. Bombax ceiba grows throughout the Indian plains and Deccan plateau. Ceiba pentandra trees are found in Western and Southern states and the Andaman Islands.

**Uses:** The floss from Bombax ceiba is obtained from capsule and is known as "Indian kapok". The floss is soft and strong and used in life-saving devices for boats, stuffing for cushions, pillows and mattresses, thermal insulation and sound proof covers and walls. Flosses obtained from the fruit of Ceiba pentandra are elastic and are used in the manufacture of life belts and buoys.

**Annual production and value:** About 300 tons of kapok are produced annually in India with a value of Rs. 30 million.

### 1.4.7 Grasses

Grasses are used for paper making, cattle fodder, matting, ropes, thatching and in manufacturing furniture, baskets and screens.

**Regeneration:** Eulaliopsis binata, Saccharum munja, Cenchrus ciliaris, Vetiveria zizanioides, Thysanolaena maxima and some other fodder grasses are planted using cutting, slips or seeds.

**Annual production and value:** Some 0.3 to 0.4 million tons of grass could be harvested annually in India. Some 60,000 to 80,000 tons of sabai grass are purchased each year by paper mills. The price of sabai grass is around Rs. 300 per ton.

### 1.4.8 Tannin and dyes

**A. Tannin:** Tannins are polyphenolic compounds widely distributed among India's flora. They occur in varying concentrations in all plant material, but only certain plants contain concentrations permitting commercial exploitation. Tannins are classified as condensed or hydrolizable. Different parts of plants may contain different types of tannins.

**Uses:** Ninety (90) percent of the total vegetable tannins in the world are used by the leather industry. India has the largest livestock population in the world.

The important tannin yielding plants species are Terminalia chebul(Myrobalan), Acacia mollissima (Wattle), Acacia nilotica (Babul), Cassia auriculata (avaram) etc.

**Annual production and value:** Around 78,000 to 100,000 tons of myrobalan nuts are estimated to be produced annually, valued at 15 to 20 million. Over 23,000 tons of wattle bark are harvested every year, valued at Rs. 38 million. Annual production of avaram bark is estimated at 23,000 tons, valued at about Rs. 35 million.

**B. Dyes:** Over 2,000 plant pigments are known of which only a few are of a commercial importance. Various parts of plants like roots, stems, bark, leaves, fruits and seed may contain colouring material which can be exploited commercially. Some plants have more than one colour depending upon which parts of the plants are used. Dyes are substances that impart colour to a material and are generally soluble in water. The pigments are generally not soluble in water. To be applied to a staining material they are first ground into a fine powder and thoroughly mixed with some liquid (dispersing agent). Vegetable dyes have not been able to successfully compete with artificially dyes in recent years.

### 1.4.9 Drugs and Spices

India's medicinal plant wealth is comprised of about 1,500 species. Every region of India has contributed to its development. Drugs have been classified depending upon the plant organ from which they are derived: roots and other underground parts, bark, wood, leaves, flowers and fruit and seed. The important species are Dioscorea deltoidea,Salanum khasianum, Costus speciosus, Datura stramonium, Atropa acuminate, Rauwolfia serpentine and cassia angustifolia.

### 1.4.9 Spices

Spices are aromatic vegetable products characterized by pungency, strong flavors and sweet or bitter taste. They occur naturally in some forests and are also cultivated in some regions. The important spice–yielding plants are Alpinia glanga (greater galangal), Cinnamomum zeylancium (cinnamon or dalchini), Curcuma spp. (haldi), Elettaria cardamomum (cardamom) and Piper longum and P.nigrum (pepper).

### 1.4.10 Animal products

**A. Lac:** Commonly known as "shellac" in its refined flake form, lac is a resinous secretion from the insect Laccifer lacca, which feeds on the plant sap.

**Uses:** Lac is presently used for various purposes in plastics, electrical, adhesive, leather, wood finishing, printing, polish and varnish, ink and other industries. It is also the principal ingredients of sealing wax.

**Annual production and value:** About 14,500 to 20,000 tons of stick lac is produced annually in India. Its price varies from Rs. 4,500 to 16,000 per ton depending upon quality most of the produced sells around Rs. 14,000 per ton. Thus, the total value of the annual production in India is Rs. 203 million to Rs. 280 million.

**B. Honey and wax:** Honey forms a natural nutritious food for the rural people. It is also used widely for medicinal purposes. Two species of bees, Apis dorsata (rock bee) and Apis indica (Indian bee) produce honey. The former is wild in montane and sub-montane regions throughout India.

**Annual production and value:** About 250 tons of rock bee honey and 98 tons of Indian bee honey are produced annually. At a price of Rs. 40 per kg, the total value of honey produced is Rs. 139 million.

Bee's wax is used in the manufacture of furniture and floor polishes, dressing and water proofing of leather goods. About 28 tons of wax are produced annually, valued at approximately Rs. 1.6 million.

**C. Silk:** India produces four kinds of silk: mulberry, tassar, muga and eri. Silk is obtained from cocoons of silk worms. Its production has four components; 1) cultivation of host plants for silk worms, 2) rearing silk worms up to cocoon stage, 3) reeling of cocoons into continuous filaments called raw silk and 4) silk throwing and weaving by which filaments are twisted and woven into fabrics.The silk worm Bombyx mori is fed on mulberry leaves cultivated in plantations. There are other silk worms which are found wild on forest trees, the best known of these is Antheraea paphia, which produces the famous tassar silk of India. It feeds on several trees such as Anogeissus latifolia, Terminalia tomentosa, T. arjuna, Lagerstroemia parviflora and Madhuca indica.

**Annual production and value:** Estimated annual production of tassar silk is 130 tons. Production of other types of silk exceed 10,000 tons.

### 1.4.11 Edible plant products

Natural forests supplements the food supply for human beings. Several forest fruits and seeds, flowers, rhizomes, tubers, roots, barks etc. are consumed by people during periods of food scarcity and in normal times. A number of tree species provide such edible products. Important fruits are from Bachanania lanzan (Chironji), Anacordium occidentale (kaju), Pinus gerardiana (chilgoza), Emblica officinalis (aonla),Tamarindus indica (tamarind),Aegle marmelos (bel), Feronia elephantum (kaitha), Artocarpus lakoocha(Barhal), Syzygium cumini (jamun), Annona squamosa (custard apple), Carrisa opaca (karaunda), Juglans regia (akhrot), Moringa oleifera (drum stick)and Zizyphus jujube (ber).

The following forest species are particularly important in producing delicacies consumed by rural people: Buchanamia lanzan is commonly known as chironji, achaar or char. It is frequently found in dry, mixed deciduous forests of Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Maharashtra, West Bengal and Andhra Pradesh. The market price is about Rs.120 per kg.

Anacardium occidentale is a small tree, known as cashew nut or kaju. It is grown in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa and Western Maharashtra. The average yield of kernels per tree ranges from 9 to 18 kg. The price of raw kernel is Rs. 30 per kg and that of processed nut is from Rs. 80 to 120 per kg.

Pinus gerardiana is an evergreen pine known as “chilgoza” or “neoza”. The species is endemic to a part of Himachal Pradesh in the Himalayan dry temperate forests. A tree on an average yield about 7.4 kg of seeds.

Natural regeneration is limited because local inhabitants aggressively collect the cones to extract the chilgoza nuts. Attempts to raise chilgoza plantations by sowing have not succeeded because the seeds are readily eaten by various animals. Some success has been achieved, however, in planting seedlings and by heteroplastic grafting. About 140 tons of nuts are produced every year. They are priced at approximately Rs. 100 per kg.

### 1.4.12 Challenges associated with increased exploitation

As development of NWFPs increases, there is a danger of unsustainable exploitation. Unsustainable extraction practices may occur for many reasons. Increasing demand can lead people to disregard traditional harvesting techniques. For example, prices of chironji seeds (Buchanania lanzan, B. latifolia) or Cuddapah almond, used as a substitute for almond in various delicacies, have increased more than 150 times or so within a span of five years in India. Many tribal people prematurely harvest chironji fruits and overexploit them to the extent that natural regeneration is now being hampered, especially in Madhya Pradesh.

In West Bengal, faulty techniques of collecting mahua flowers (the collectors break the apical twigs which affects flowering in the following year) were found to do considerable damage to the natural stock (Rama Krishna Mission Lokashiksha Parishad, 1992). In Central India, mahua forests are burnt repeatedly to simplify collection of the yellow flowers from the forest floor, damaging regeneration. As a result, young mahua trees are becoming scarce and some experts suggest that the species will be extinct by AD 2200.

Similarly, the indiscriminate collection of raw materials from forests for the incense stick (agarbatti) industry in Karnataka State in southern India has created large environmental losses in some areas. Two examples out of many in the state are the extensive loss of gulmavu (Machilus macarantha) trees in Coorg and Malanad districts resulting from debarking of the trees, and of species such as Ailanthus malabarica (halmaddi) and Borewellia serrota owing to unsustainable exploitation (Parameswarappa, 1992). Similarly, the indiscriminate felling and collection of NWFPs from uppage (Garcinia cambogia) trees in Karnataka has resulted in widespread losses.

### 1.4.13 Policy and institutional challenges

Institutional and organizational processes need to be better understood in order to help communities manage NWFPs as part of a larger livelihood strategy, while maintaining an equitable distribution of responsibilities and benefits. It is possible for inappropriate, although well-meaning, policies to have an effect contrary to that desired.

A very good example of a policy and institutional response that proved inappropriate is governmental intervention in the NWFP industry in India. In an attempt to tap the potential more fully in terms of production and employment generation of the forestry sector in India, the Government of India set up the Forest Development Corporations (FDCs) in 1976, on the recommendation of the National Commission on Agriculture. One of the major objectives of the FDCs was to help tribal NWFP collectors by eliminating the large profit margins pocketed by local entrepreneurs and passing these benefits to tribal people in terms of better wages and working conditions.

An FDC was set up in each state; in addition, several government-supported cooperatives were also established. But the functioning of these cooperatives has often been detrimental to the interest of tribal people, and such organizations have not been cost-effective. As a result, tribal people sometimes receive as little as 10 to 40 percent of the sale price in the nearest NWFP market (Chambers, Saxena and Tushaar, 1990).

### 1.4.14 Tenure and ownership issues

Another challenge relates to tenure and ownership. Unless access and usufruct rights are given to users, there is little incentive to manage NWFPs sustainably. In an attempt to develop these resources, some Indian states nationalized many NWFPs. For example, Madhya Pradesh nationalized bamboo, khair, sal seeds, harra, gums and tendu leaves, among others. The tribal people were required to sell their produce exclusively to the Forest Department to the agent contractors appointed by them.

Production levels of some NWFPs declined sharply following nationalization (Chambers, Saxena and Tushaar, 1990). For example, production of tendu leaves in Madhya Pradesh declined from 5.1 million bags in 1981/82 to 3.9 million bags in 1985/86 - a decrease of 23.5 percent. In Orissa, the production of tendu leaves stagnated over a longer period. Similarly, after nationalization, the collection of sal seeds fell from 200000 tonnes in 1979 to only 60000 tonnes in 1987 -a decline of 70 percent. The average annual production of lac also declined from 32000 tonnes during 1961-70 to 16000 tonnes during 1981-86 - a decline of about 50 percent.

Nationalization can significantly reduce the remuneration to collectors of NWFPs. For example, the government of Madhya Pradesh, a central Indian state, paid only Rs 0.55 per kilogram of sal seeds collected as opposed to Rs 1.31 per kilogram, which a study (Chambers, Saxena and Tushaar, 1990) estimated could have been passed on to collectors after meeting all the expenses and margins of the Forest Department.

It can also result in delays in payment to gatherers, as government agencies often find it difficult to make prompt payments. This can stimulate the development of black market activities, with associated higher margins required to cover the costs of illegal activities. All these factors reduce tribal people's collection and incomes (Chambers, Saxena and Tushaar, 1990).

A number of experiments are under way to empower local communities in the protection and management of forest resources. India's Joint Forest Management programme in which local communities become partners with the State Forest Department, sharing responsibilities and benefits from forests, is an exciting step in this direction.

### 1.4.15 The size of enterprise development

Another challenge associated with the increased exploitation of NWFPs is a shift from small-scale to large-scale activities. If not carefully planned and managed, this shift can produce undesirable results, particularly in terms of benefits to local people.

Case-studies from India, Indonesia and Latin American and African countries on NWFP-based activities reveal that NWFP-based small-scale enterprises have some common characteristics. Obviously, these are small in size, are based in the household and are frequently seasonal in labour and employment generation. They are labour-intensive, are based on simple technologies, have low capital requirements and provide direct benefits to the local economy. Most important, they are accessible to low-income and socially disadvantaged groups and are most often managed by women (FAO, 1987; 1991a).

Large-scale enterprises typically incur higher collection and processing costs compared with small-scale enterprises because NWFP resources are scattered and hard to reach, making mass extraction and transfer costs high. Furthermore, for large-scale enterprises the minimum output required to break even may demand unsustainable exploitation and rapid moves in and out of the market. A very good example of the latter is the depletion of natural stands of edible palm species in southern Brazil during the 1960s by the palm-heart canning industry which has now moved to the states of Pará and Amapa. Further, unsustainable harvesting practices of palm hearts are stressing the resource base in these states too (Richards, 1993).

However, small-scale enterprises also face some common constraints, including limited access to institutional finance and a lack of tax incentives, highly risky market environments and income-sharing problems. Moreover, as NWFP markets expand and efforts are made to increase local processing capacity in order to capture the value-added benefits, traditional patterns of management, income distribution and the division of labour can become disrupted (FAO, 1991a; 1991b). In Karnataka, studies by the Indian Social

Studies Trust showed how increased commercialization of one product and improved technologies applied to another negatively affected the predominant user group as in each case women. As men saw greater value attachedof and felt attracted by new, more mechanized technology, women were marginalized (FAO, 1991b). A similar story can be heard from Raigarh village of West Bengal, India (Rama Krishna Mission Lokashiksha Parishad, 1992). About six or seven years ago, NWFP collection was a low-key activity, mainly done by women in Raigarh village. But, after the introduction of a Joint Forest Management programme under the Forest Department, as NWFP collection became a major activity for some families, men have taken over women's employment.

### 1.4.16 Requirements for sustainable management

Given the considerable potential of NWFPs to contribute to local livelihoods, there is a real need for field-level research; synthesis and collection of information on NWFPs from as many published sources as possible, and their dissemination in the form of practical guidelines for NWFP identification, regeneration, extraction management, collection, processing, storage and marketing; and training on technical issues, including silviculture, extraction management, processing and marketing issues.

The sustainable extraction levels of NWFPs are not easy to calculate, and yet they are a prerequisite for NWFP-based development. In order to ensure this, much more information is needed on current rates of extraction and on productivity rates for different products. Indiscriminate extraction practices have already resulted in the depletion of natural regeneration and local extermination of species in some cases.

Without good yield data and matching data on extraction rates (the flow) per unit of area, it is almost impossible to decide whether a given practice is sustainable in the long term or not. What is needed are systematic methodologies for rapidly assessing the distribution and yields of NWFPs and current and potential extraction levels.

More precise research is needed on the ecological requirements and functions of NWFP species, their regeneration rates and yields in different forest types and ecological zones and on innovative silvicultural techniques for managing multiple products.

Research is needed to clarify tenurial arrangements and understand the often conflicting layers of traditional rights, use pattern settlements, concessions and privileges and gender relationships.

Institutional processes and organizational arrangements need to be better understood in order to help communities manage NWFPs as part of a broader livelihood strategy, while maintaining an equitable distribution of responsibilities and benefits.

Research is needed on the values of selected commodities in village, district, national and international markets, on the marketing chain and the profits of collector/producers, processors and entrepreneurs.

The impact of product substitution and the possibility of creating new markets need to be examined, together with the impacts of changes in collection, processing and marketing patterns. Price supply and demand trends will need to be assessed to determine the medium- and long-term economic viability and market absorptive capacity of each NWFP.

## 1.5 SUMMARY

NWFPs cover a wide range of products (goods & services) from thatching materials to medicinal plants. These products are essential needs of local communities. Some NWFPs, such as latex, gums, resins, essential oils, flavours, fragrances and aroma chemicals help to promote value added processing, niche marketing and export trade. NWFPs can provide increased employment opportunities and income earning capabilities. It is estimated that 60 percent of the total production of NWFP is consumed locally. The contribution of some of the NWFP, through sales comes to nearly 50 percent of the total revenue from the forestry sector in India. Nearly 400 million people living in and around forests depend on NWFPs for their sustenance and supplemental income. NWFPs provide as much as 50 percent of the income to about 30 percent of rural people. The focus of interest is now on whether sustainable harvest from wild, cultivation on private farmland and commercialization of NWFPs can support local people to achieve sustainable livelihood in changed socio-economic scenario.

## 2.4 Summary

The values of NWFPs in poverty alleviation of marginalized forest-dependent communities has for long been acknowledged. The focus of interest is now on whether sustainable harvest from wild, cultivation on private farmland and commercialization of NWFPs can support local people to achieve sustainable livelihood in changed socio-economic scenario. The various plants of NWFPs importance found in India may be broadly classified on the basis of product types. They are edible plants (including fodder species), Medicinal and Aromatic Plants, Fibre yielding plants, Paper and pulp yielding plants, Gums and resin yielding plants, Dyes and tans yielding plants, Bamboo species, Insect byproducts (Honey, Silk etc.) promoting species, Fatty and essential oil yielding plants, Plants used for making soap, Species of other importance.

**Terminal Questions**

1. How will you classify NWFPs ?
2. What are aromatic and medicinal plants? Give five examples.
3. Enlist edible plants.
4. Write the name of plants that can yield gum and resin and fibre and flosses.
5. Give 10 examples of dyes and Tanin Yielding Plants.
6. Give the details of Regeneration status and production of various categories of Non- Wood Forest Products.

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# Unit 3. Livelihood Implications of NTFPs

**Unit Structure**



## 3.1 Learning Objectives

After you have studied this unit, you should be able:

- To develop a basic understanding of the importance of NWFPs in livelihood generation of the local community
- To learn about the various success stories relating to NWFPs and livelihood.
- to understand the role of important NWFPs in enhancing livelihood options of the people and to full fill the market demand also.

## 3.2 Introduction

NWFP species such as wild edible plants and medicinal plants have been regularly utilized in daily livelihood in the hill region of India, Nepal and Pakistan. Wild edible plants are mostly consumed with daily meals whereas medicinal plants are used for primary health care at household whenever necessary and also trading for economic development. The following sections provide a more detailed description of wild edible plants and medicinal plants than other NWFPs species. The wild edible plants are still being utilized in daily livelihood to mitigate the existing problem of food deficit, and nutritional demand or a supplement of food and nutrition.

In the hills, agriculture is the key source of livelihood. Aside from agriculture, trading of economically valuable NWFPs species including other off-farm income generating activities are other livelihood activities to support daily household needs. Annual agriculture production is not enough to support the livelihood throughout the year, and as a consequence, they have to engage in other off-farm activities. The off-farm activities are mainly collection of NWFPs and their marketing. We have tried to document a study from Nepal for bringing out the importance of wild edible plants in the livelihood of the people residing in the remote hill regions.

## 3.3 Consumption of Wild Edible Plants

In remote hill region of Nepal Roti*(Chapattis)* are mostly supplemented with wild edible plants such as the tender leaves of the stinging nettle Bicchu Ghass [*Urtica dioca*] throughout the year except during the period of mid-May to mid-June when the plant is usually found to be infected with insects, and between mid-December to mid-January when the plants are dry. Stinging nettle is consumed more between mid-March to mid-May when food deficit reaches its peak. In these months, every household has less stock of food grain. To cope with the situation, *local residents* mix stinging nettle with bitter buckwheat flour, and cook it in water and prepare soup. In this way, localscoped during food deficit months, and fulfilled their nutritional requirement from wild edible foods. Theyprefer stinging nettle more than vegetables such as cauliflower, cabbage, pumpkin, brinjal etc., because according to them it tastes better than other vegetables, particularly the vegetables grown from hybrid seeds distributed by the District Agricultural Office under the Government of Nepal and some other NGOs working in the agricultural sector/s. Additionally, stinging nettle is easily available in nearby settlements, farmlands and pasturelands. In this context, Chakra Bahadur Buda [40 years old] of *Syaandaa* village said, “We would be dying of starvation if God did not give us this stinging nettle. The combination of the curry of stinging nettle and *roti*is the best among all staple plants available in the region. Important NWFP’s which provide livelihood to hundreds of people in Uttarakhand have been discuss here under.

## 3.4 Resin from Chir Pine (*Pinus Roxburghii)*

Resin is an important NWFP and obtained from the genus*Pinus* which is best known as a source of this product. In Uttarakhand, resin is collected almost exclusively from *Pinus roxburghii*trees.Resin collection and managed by the State Forest Department. In areas dominated by *P. roxburghii* it is an important activity and contributes significant revenue as well as employment opportunity in Uttarakhand. In 2005-06, revenue generated from resin production in the state was Rs. 453 million ( Uttarakhand Forest Statistics 2005-06).Resin is collected from the forest according to working plans made by the State Forest Department(SFD). The State Forest Department employs registered labour for tapping and collection of resin. Till 1996, resin was collected largely by cup and lip method, which damaged the trees. Thereafter, the rill method is used which not only has much lower impact on trees but also increases resin production. Resin is collected and transported, in tin canisters, from jungle head and then road head depots. From these it is transported to the following three main head depots in the state:

- Rishikesh, Narendranagar Forest Division

- Sultannagri, Kathgodam, Nainital Forest Division. .
- Tanakpur, Champawat Forest Division.

Processing is done by the units after resin is sold by the State Forest Department. Resin is processed by simple distillation method to form two main products namely rosin and turpentine oil used in varnish, paints and polishes, paper manufacturing etc.

### 3.5 Lichens and Mosses

In terms of volume, lichens and mosses are the most common NWFPs that are collected from the state and have significant livelihood implications. While biologically very different, these two NWFPs are often grouped together due to their similarity of appearance.

Lichens or Jhula, are symbiotic associations of algae and fungi. They are most abundant in temperate forests at altitudes from about 1500m and above. Often associated with Oaks and rhododendrons, they are also commonly found on apple and other fruit trees. Lichens of the genus *Parmelia* are most commonly collected. In Ukhimath range (Rudraprayag district), over the past 8 years approx. 17.0 t of lichens were removed annually. This however would appear to be an under-estimate and reflects only Government records. Independent estimates from the region put the actual collection at closer to 200.0-250.0 t per year. As per estimates made by forest officials in Chamoli district, between July and March about 60-75 trucks of lichens are collected every year. Given an average of about 3.0 t per truck this would translate to about 180-200 t annually. Further a price of about Rs. 25 per kg to the collectors translates to value of Rs. 4,500,000-5,000,000 from the district. However, mandi prices are Rs.55-60 which translate to a value of Rs. 10 million for Chamoli district alone.

While the collection of lichens per day is not destructive to trees, due to the relatively low profitable and use of outside contract labour, the harvesting is done without any concern for the trees and branches are indiscriminately lopped off rather than scraping off the lichens from the branches. This causes severe damage to the trees. While there is considerable unrecorded trade, a significant proportion of the lichens harvested is sold through official channels as described below:

**3.5.1 Collection/ procurement**

The SFD allots land to UFDC, Kumaun Mandal Vikas Nigam and Bhesaj Sanghs for lichen collection. The registered collectors of these agencies, often assisted by local or migrant labour, collect and pack the produce in sacks. The field officer of the UFDC inspects the material and takes a permit from the concerned Range Officer of the SFD and after the verification; it is brought it to the above mentioned three main depots for sale.

Big traders purchase Jhula in bulk. A small amount is also bought by the local pharmacies within the state. After processing and gradation, dealers sell lichens in bulk amount to spice and ayurvedic manufacturers (such as Himalaya Drugs, Dabar, Jhandu) and to small traders.

**3.5.2 Products**

The products made out of Jhula are: Spices, Ayurvedic Medicines, Organic Dye and HawanSamgri.

**3.5.3 Market**

The market for Jhula is spread all over the country but has special demand in Gujarat, Mumbai and South India. A large part of lichens collected in the Himalaya goes to a place called 'Nander' in Gujarat where there is a hub of spice manufacturers. In the North India lichens are mainly used in Ayurvedic medicines and as Hawansamgri. The traders also sell it in the Khari Bawli market in Delhi.

**3.5.4 Mosses**

Mosses are easier to collect and used largely by florists and garden shops for moss-sticks. While lower in value than lichens and collected in smaller amounts, the market is nonetheless worth several hundred thousand rupees. Among mosses genus Sphagnum is collected most commonly. It is abundantly found in oak forests and grows well in cool and humid areas. Its main use is in plant nurseries where it is used as a medium of propagation by cutting and air layering. It is said to have a fungicidal effect and thus helps in protecting newly emerging seedlings and roots. It is used in making moss sticks, which gives support to trailing vine type ornamental plants. It can soak moisture 8 to 10 times its weight and thus is used to support indoor basket plants. It is also used as a base of small plants that have to be transported over long distances as it retains moisture for longer period of time.

Collection and trade is carried out in a manner similar to lichens and these two NWFPs are often grouped together in policy matters. Traders purchase it from Government operated mandis and then sell it to nurseries etc. At present the sale rate from the depot is Rs. 25 to Rs. 27 according to the quality of the product. The price of the moss after processing and cleaning ranges from Rs. 35 to Rs. 50 per kg. At present the collectors pay royality of 50 paisa per kg to the SFD.

## 3.6 Bamboo Resources

In Uttarakhand some of the marginal communities such Ruriya and also other traditional communities inhabiting higher altitude areas of the state are dependent on bamboo resources for part of their livelihood. The most common bamboos of the state are Ringal (*Arundinaria falcata)*and abundantly occurring in temperate and sub alpine forests. Local craftsmen make a variety of household items such as baskets and mats from this resource. Ringal and Tham bamboos are also used as a thatch material for covering roofs. Of late, local craftsmen have started making a number of fancy handicraft items from Ringal bamboo which are sold to a large number of tourists and pilgrims visiting the state.

Establishment of Uttarakhand Bamboo and Fibre Development Board (UBFDB) a few years ago has greatly increased the focus on bamboo planting and handicrafts made from bamboos. Bamboo planting has been included in forest working plans and several thousand hectares of bamboo have already been planted across the state. Training of bamboo artisans and products such as the 'Badrinath pooja basket' which has been used by thousands of pilgrims has greatly increased the value of this NWFP.

## 3.7 Medicinal and Aromatic Plants

Some of the important medicinal plants of the region are as follows:

### 3.7.1 Kira jari (*Codyceps sinensis*)

It is also known as Yarchagumbakira- jari. It is a rare species of parasitic fungus that grows on the bodies / head of insect larvae (*Hapialisvirescens )*. Studies from Nepal indicate that it takes 5 persons about a month tocollect 3500-4000 speices of kira-jari which weighs about 1 kg. Locals involved in collection said that the skill of the collector was very important and an unskilled collector would not even be able to collect 10g in a month while a proficient collector might collect over a Kg in less than a month. Prices of about Rs. 120,000 to 150,000 per kg were quoted by collector. While the quantum of collection is estimate of over 800 to 1000 kg are not uncommon from Uttarkhand which would have an approximate value of over Rs. 100 million. It is mostly used in Chinese system of medicine.

### 3.7.2Kutki (*Picrorhizakurrooa*)

Found between 3200-4500m, the roots of kutki are used to treat abdominal pains and fever. It is being cultivated at lower altitudes through support provided by Herbal Research and Development Institute (HRDI). Locals in Joshimath (Chamoli) estimated that approx. 100-120 quintals of Kutki were harvested from the forests. At a cost of Rs. 180 per kg., this would put the value of kutki harvested from the area at about Rs. 2,000,000. In Uttarakhand, the High Altitude Plant Physiology Research Centre's efforts to promote the cultivation of *Picrorhizakurrooa* (Kutki), a high value medicinal plant, differ significantly from similar attempts by other agencies. Farmers are given not only technical but comprehensive support, including assistance in marketing. Taking a farmer system approach, Centre provides planting material and training to farmers. More important is that they have arranged a buying contract with a commercial company that commits to purchase the complete production of Kutki at a guaranteed minimum price. This has been made possible through a tripartite agreement between the farmer, the company, and the Centre.

## 3.8 Wild Fruits

Several forest trees and shrubs bear fruits that are consumed locally and some items even marketed. Fruits such as Kaphal (*Myrica esculenta*) while valued and consumed locally, rarely made it to the market in the past can now be increasingly seen in markets during early summer. Similarly squash is prepared from *Rhododendron* flowers and sold in local market. Some of the important wild fruits found in (1000-2000 m msl) of Uttarakhand include:

- Kaphal (*Myrica esculenta)* stony berries rich in vitamin C.
- Hisalu (*Rubus ellipticus*), Kingori (*Barberis asiatica*) and related shrubs with tasty berries.
- Wild apricots (Chuli or Churu) (*Prunus armeniaca)*
- Mehal or wild pear (*Pyrus pashia)*

Other important fruits include the wild bel (*Aegle marmelos*), pangar or wild chestnut (*Aesculus indica*) Himalayan amla (*Emblica officinalis*), *Ficus roxburghii* (Wild Himalayan fig).

*Myrica esculenta* locally known as Kaphal, is small or moderate sized evergreen tree occurs in pine oak and mixed oak forest of middle altitudes of Uttarakhand. The genus *Myrica* isone of the non leguminous angiosperm nodulated by *Frankia spp.* and hence capable of fixing atmosphereic nitrogen like legumes. This tree yields delicious fruits during May-June and eaten as raw by the local people.

It is much cherished wild fruit of the region and particularly attracts children and women while they frequently visit the forest for daily needs of fodder and fuelwood. In the Kumaun region, Kaphal fruit is sold in local markets during summer for the last more than two decades. A detailed study conducted by Dhyani and Dhar (1992) reported that a number of villagers in Almora district are involved in collecting the raw fruits, which are sold directly and also through the middle-men in the nearby urban centre. They reported the yield of fruits ranging from 30-111 kg per tree and on average a person collected and sold about 20 kg fruits per day (@Rs. 12-20 per kg.) and about 567 kg fruits / month. Thus earning about Rs. 8364/ season. Another study conducted by Bhatt et al., (2000) reported that local people in Kumaun region can earn over Rs. 1.4 million per season from selling this fruits. They recorded the maximum fruit yield in chirpine forest (42.1 Kg./tree) and minimum in mixed oak forests (28.9 kg/ tree) and potential yields as 2-4 .3 tonne / hectare of forest area. Of the total fruit crop only 2.87 % was harvested across different forest sites. In some sampled villages as many as 60% of the total households were involved in collection / sale of these fruits. The observations during 2007 revealed that rates touched is as high as Rs. 80– 100 / Kg (Amar Ujala May 2007). However, the same day in the evening the rates dropped by Rs. 20-40/Kg as the fruit is perishable and its flavor and juice deteriorate rapidly. Also in the recent years the fruit selling trade has still grown up and Kaphal fruits are sold in bulk by local women to the traders early in morning at some locally fixed trading centres in townships of Almora and Ranikhet and immediately transported to Haldwani where they are sold at much higher rates.

## 3.9 Honey

In the Himalaya much of the Honey production is dependent on the pollen of wild trees,bees are very important pollinators of cultivated crops. A decline in the yields of fruit trees in many parts of the Himalaya has been linked with depleted honey bee population.

The principal species of the bee which are kept in hives and managed for honey production and crop pollination are *Apis cerana*, *A. mellifera*. *A. cerana,* the native honey bee is not popular among the commercial bee keepers in the Himalaya because of its low honey yields and undesirable behavioural traits such as frequent swarming and absconding.

*Apis florae, A. dorsata*and *A.laboriosa* are wild species of honey bee and can not be kept in hives. These species build a single comb nests on tall trees and cliffs. *A.mellifera* the Europen bee was introduced to the region to promote bee keeping as a commercial enterprise and it has a high honey yield and a hive can yield 30-50 kg of honey per year. However, it is susceptible to disease and low temperatures and cannot easily be maintained in the mountains unless bee keepers moved boxes to the lower altitudes during winters. Nevertheless it is very popular with commercial bee keepers which largely replace *A. cerana*, the ecological implications of which are still not known. In Uttarakhand wall hives with colonies of *A. cerana* have been traditionally nurtured . The practice had declined somewhat for several reasons such as a change in construction material (from stone walls to brick walls) the market wall hives more difficult to keep and maintain and also because of declining bee population attributed to indiscriminate use of pesticides in fruit growing areas. However, bee rearing is seeing a small resurgence in the region. A few NGOs and entrepreneurs have aggressive programmes aimed at increasing bee colonies and the yield of honey per colony.

Honey yields can be increased from 2 – 3 Kg per hive annually to 5-7 Kg per hive through use of better technologies such as removable combs. In newer wall hives farmers are often inserted which allow for non-destructive removal of hives and harvesting of the honey rather than the old practice of cutting the hive out of the wall which resulted in its destruction and necessitated that bees build a fresh comb which in turn reduced honey yield. There are no accurate estimates of honey production in Uttarakhand. Appropriate technology India (ATI) involved in large scale honey trade and sells approximately 70 tonnes annually much of it collected from Rudraprayag and Chamoli districts. Much of the honey in the districts is consumed locally or sold directly to tourists, as the prices for direct sell (Rs. 100-150 per litre) is typically much higher than prices when sold to institutions that brand and further market the honey (Rs. 30-70 per litre). The price of certified organic honey is however, significantly higher and can significantly increases the farmer incomes. Overall Himalayan honey can fetch higher prices than honey produced in the plains because a buyer is likely to pay a premium for honey produced in what is considered to be a relatively pristine and pure environment.

## 3.10 *Morchella esculenta:* A High Value NWFP of Higher Himalayan Forests

This is an edible mushroom and is found growing naturally in the humus rich forest floors of broadleaf-mixed conifer forests in Uttarakhnad. The fruiting body (Scientifically called ascoacarp) appears on soil surface soon after rains during march-april. People set surface fire every year during winter and believe that such a practice improves *Morchella*yield. The ascocarps collected during May-June, are cooked with rice and vegetables and considered nutritious. The decoction of ascocarp after boiling with water is used in medicine and health care system by the local communities. Out of the five species of *Morchella* found in India, *M. esculenta* is expensive because of its rich nutritional value and coupled with a unique flavor.

In the Niti valley of chamoli district approx. 40 villages inhabited by about 1600 families mostly involved in the collection of *Morchella*during summer. On average, a person may collect 2-3 kg. freshly weighing *Morchella* per day. The ascocarps are then hanged under roofs of the houses for 15-20 days for air drying. Every season a family (3-5 persons) collect a average 1.5 Kg air dry weight of *Morchella*that is sold by the local middlemen @ Rs. 5000 per kg. It has been realized that though the local people earn good amount of money from this wild resource, its indiscriminate extraction and traditional practice of setting fire on forest floor leads many fold negative impacts on forest biodiversity and ecosystem services and calls for more studies to find out an environment friendly technique to harvest this useful product of nature.

## 3.11 NWFPs: Success Stories on Livelihood

**Case study No:1**

**Bee Keeping: As a Tool for Poverty reduction in Chitral:** Mr. Mehoboob Ali of village Goldor Chitral in Pakistan, the sole supporterof eight family members, havingno cultivable landholding in hispossession always wanted toearn some extra money tosupport his extended family. Once the field staff of Non-wood forest produce came tohis area for providing training, he very receptively followed their trainings instructions in honey beekeeping. As honey bee keeping occupies only a small space was very ideal source of additional income for him. He joined the NWFP promotion Committee Gouldor Chitral along with others group and was trained by Directorate of Non-wood forest produce, NWFP Forest Department Chitral. They were also provided bee boxes to him on subsidy rate. He takes very good care of his bee boxes due to the training he received from the NWFP Department. In the first year he collected 12 kg of honey and out of which he sold 8 kg in a local market at Rs: 600/- per Kg and earned Rs.5000/-with which he paid off his daughter school fees which was due on him. Now his young daughter also helps him in the management of honey bees. Mr. Ali is planning to buy 10 more bee boxes this year and wants to establish a farm near his house**. As, Mr. Ali said, "beekeeping is a good business and brings in good profit as bee flora is abundant in the surrounding area".**

**Case study No: 2**

**Medicinal plants as a source of livelihood promotion:** Dilshad Bibi a poor widow of 60 years of age with four daughters and two sons lives in a small house in the remote village of Bomburat kalasha valley Chitral. Dilshad was trained by Non-wood forest produce, department Chitral in medicinal plants collection and its storage during valley training program in kalash valley. After receiving the training Dilshad was motivated enough to such an extent that in July 2008 Dilshad borrowed an amount ofRs. 2000/- as loan from a local shopkeeper in Bomburate to open a small store inher house. With the amount she purchased all the medicinal plants that the villagers collected. She repaid back the whole amount well before the repay mentdate and borrowed another amount worth Rs.5000/-. **"I have earned a profit of Rs.5000/- from the sale of the medical plants in Drosh market", as she said**. Apart from her this source of income she also sells basketry products in the local shopes. Now she is not an active member of NWFP promotion Committee Bomburat but also motivates other women of the area to adopt NWFP activities to earn income. Now she is very well established in her life and is really thankful to NWFP Department for extending help in such a way that taught her to catch the fish and made her independent and not dependent on any one else to supporter family.

**Case study No 3**

**A shift from timber to Non-wood products:** Gingerate village is situated about 16 Km from the Main Drosh Bazaar. The soil of the area is very fertile and agriculture is the main source of livelihood of the area. The area being rich in forest resources also has become vulnerable to timber trade where people are involved in illegal cutting of the forest for sale purposes to earn for his living. Once a NWFP Field staff visited the area and arranged a meeting with the community on the non-timber forest produce as an alternate source of income to forest logging. The people accepted the fact of the forest of the area being under immense pressure due to over harvesting and the reason they cited were lack of employment opportunities. The forest protection member pointed out the names of those involved in timber trade and was causing great damage to the forest. Mr. Subaddar was one of them, being involved in timber trade, had also established a mini timber depot at his home and was selling timber in Drosh market at a very high price. When the Staff of Non-timber forest produce Directorate, NWFP Forest Department, Chitral contacted him and tried to motivate him that forest being a very important source of survival of people and the removal of vegetation could cause high flood and erosion and can cause great damage to his area. **Then he said, "I have no other source of income and therefore had to getinvolved in timber trade".** At this the NWFP staff briefed him about different NWFP and its market value. After an extensive meeting with him he agreed to leave this profession and start the cultivation of medicinal plants in his farm land, and also demanded for bee boxes. The said person has a huge number of wild olive that can be utilized as source of income. Now Mr. Subaddar is an active member of NWFP promotion committee. The local communities are very much happy at this achievement of NWFP department and also requesting for the engagement of the other similar people in NWFP activities and involve them in income generating activities and thus save the valuable forest resources.

**Cases study No 4**

**Tasar culture as a source of livelihood in Ukhimath region of Uttarakhand:** Appropriate Technology India (ATI), a local NGO with the help of Appropriate Technology International has been promoting silk culture by providing silk worms to the local formers for developing silk cocoons with a buy back facility. The silk worms are fed on leaves of *Quercus semecarpifolia* (Kharsu oak). Locals have been trained in weaving a silk cloths. The activity has been a success providing livelihood to several families in the area.

**Case study 5**

**Chilgohza (*Pinus girardiana*) seed as a livelihood option in Himachal Pradesh:** In Kinnaur,HP, Chilgohza pine is a valuable non-timber forest product of the area and is serving as a good source of income for the local community. But due to the lack of proper knowledge and awareness the local community is unsustainably using these resources; the local community removes100% cones from the Chilgohza tree during collection, and cut its branches in order to collect the pine nut. Due to this the natural generation of this valuable species is badly affected. According to an estimate about 10-15 tones of pine nut is collected from the area by the local community..

**Case study 6**

**Cultivation of Medical Plan (An extra source of income):** Mr. Rasheed, Belongs to Gingerate, Drosh in southern Chitral. He completely dependent on his land to earn living and support of his extended huge family. But due to old methods of farmer and non availability of certified seeds his production was less. When the Directorate of NWFP Forest department Chitral Field staff visited the area and arranged a meeting with the local community for the promotion of livelihood. Mr. Rasheed showed his willingness for the cultivation of medicinal plants but has no idea about their cultivation and seeds of the plants. Then, the

NWFP Staff trained him in the cultivation and propagation of medicinal plants and also provided him seeds of medicinal plants to cultivate on his farm land. Now 6 species of medicinal plants sp grows in his farm land, like Saffron, Banafsha, Alsietc and he has also gained a lot of knowledge and experience in the cultivation of the medicinal plants. He has also placed a request for the grafting of his wild olive tree surrounding by his house in order to get more income from it too.

## 3.11 Potential of NWFPs in solving livelihood problems

NWFPs species offer opportunity to alleviate the existing livelihood problems of the rural people. The studies conducted so far in Nepal and India has found several NWFPs that can be instrumental in solving livelihood problems. Out of these three different tradable NWFP medicinal plant species have been dealt in detail. They are: "atis" [*Delphinium himalayai*], "jatamansi" [*Nardostachysjatamansi*], and "kutki" [*Picrorhizascrophulariiflora*]. All these tradable NWFPs species are sold for their medicinal properties. In addition, people also collect one mushroom species called "guchchi " [*Morchellaconica*]. "Guchchi", which has a high economic value, is used to make mushroom soup and vegetable, and has been exported to Germany, Switzerland, Canada etc [Roy *et al.*, 2009]. Presently, these tradable NWFPs species and fungi are being collected from public lands such as government forests and pasture lands. Hence, availability of these resources is scattered. As a result, the amount of time and labor that people invest in collecting these valuable resources are greater than the monetary value they can derive from the species collected. In addition, competition among the primary collectors worsens the situation, resulting in people collecting pre-mature NWFPs species in order to maximize the economic gain in the face of such competition. This situation puts more threat on the natural regeneration of the NWFPs species, and as a consequence, there is a possibility of extinction of the over harvested NWFPs species. To solve this problems cultivation of these species along with several others can help in the conservation of the species and provide good monetary benefits to the local growers. NWFPs can be sold at a good price. In order to ensure supply, cultivation of economically valuable NWFPs species on private lands was found to be the most prevailing livelihood opportunity.

## 3.13 Summary

NWFP's provide livelihood to marginalized hill communities in the entire Himalayan region. Several wild edible plants have become a major part of the daily livelihood and several other are a source of earning. However, unsustainable collection of several NWFP's has resulted in their overexploitation. There is a need to educate the locals about sustainable collection and techniques of raising NWFP's for developing livelihood opportunities as well as elevation of their economy.

**Terminal Questions**

1. How NTFPs are useful in enhancing livelihood generation for rural people?
2. Explain some important NWFPs having potential of income enhancement?
3. Medicinal and aromatic plants (MAPs) are useful in livelihood improvement?
4. Explain the importance of NWFPs in livelihood improvement by giving case studies?

# Unit 4: Industrial uses of NTFPs

**Unit Structure**



## 4.0 Learning Objectives

After studying this unit, you are able to understand about:

- Non wood forest products based industries
- You know about Resin tapping
- You will know about Silk, Lac, Honey and bees wax

## 4.1. Introduction

Non-wood forest products are used as raw materials in forest basis industries. Small and medium-sized businesses make up the majority of these industries. Moreover, NTFPs are used as raw materials by a wide range of sectors, from big suppliers of floral greens and pharmaceutical firms to small businesses focused on a broad range of pursuits (such weaving baskets, carving wood, and gathering and preparing different medicinal plants).

India has one of the world's most significant forest-based industries. The need for furniture, building materials, paper products, and other forest-based products is rising, which is driving growth in these industries. Agro-based industries are those that get their raw materials from agricultural items. The textile industry, which includes the following varieties: cotton, woolen, silk, synthetic, and jute textiles, is India's biggest agro-based sector. Mineral-based industries are those that rely on minerals as their primary raw resource. The iron and steel sector is the main mineral-based industry and the foundation of a nation's industrial growth. The chemical, fertilizer, and cement industries are some more sectors that rely on minerals.

Forest-based industries are those that rely on forest resources as their primary input. The primary forest-based industries are those that produce paper and pulp, matchwood, lumber and sandalwood, plywood, oil and biodiesel, among others.

- Paper and pulp industry
- Match wood industry
- Timber and Sandalwood industry
- Plywood industries
- Oil
- Biodiesel industry

## 4.2. Paper and pulp industry

Our daily lives depend heavily on paper, which has been around for a long time. The wood pulp used to make paper is an environmentally favorable product.

To make paper, the following procedures are used:

1) The fibers will be separated and cleaned using a pulping method.

2) The refining process will come following the pulping procedures.

3) Diluting the mixture to create a thin layer of fibers

4) Fiber formation on a narrow screen

5) Pressurization to increase the density of the substance

6) Drying to remove the materials' density

7) Final steps to provide an appropriate surface for usage in.

Cellulosic fibers and additional plant components are used to make pulp and paper. Certain synthetic materials can be added to the final product to give it unique properties. Although wood fibers are the primary ingredient in paper, certain papers also contain rags, flax, cotton linters, and bagasse, or sugar cane leftovers. Recycled used paper is also frequently mixed with virgin fibers and reformed into new paper after being purified and occasionally dickered. Products manufactured from cellulose, such as cellulose acetate, rayon, and cellulose esters, are used to make explosives and packaging films. The goal of pulping is to remove lignin without weakening the fibers, releasing the fibers and getting rid of contaminants that discolor the paper and could cause it to break down in the future.

Hemicellulose is crucial for the gluing of fibers together while manufacturing paper. In terms of structure and purpose, it is comparable to cellulose. Although wood contains a number of extractives, including waxes and oleoresins, these do not add to its strength; they are also removed during the pulping process.

Paper can be made from any plant's fiber that has been harvested. However, the pulping process is complicated by the fiber's strength and quality as well as other considerations. Softwoods, such as pines, firs, and spruces, typically provide long, strong fibers that are used to make boxes and packaging and add strength to paper. Hardwoods have shorter fibers, which results in a weaker paper. Softwoods are more transparent, smoother, and more printing friendly. Both hardwoods and softwoods are utilized for paper making and are sometimes mixed to provide both strength and print ability to the final product.

**Steps in the pulp and paper-making process:** Steps in the pulp and paper-making process are as follows:

**(a) Preparation of Raw material**

There are various forms that wood in a pulp mill might take. It is dependent upon the origin of the raw material and the pulping procedure. It may be obtained as half-dollar-sized chips that were made at a sawmill from round wood that had been debarked somewhere, or as bolts, or short logs, of round wood with the bark still on it. If round wood is to be utilized, it must first be debarked, usually by letting it tumble in big steel drums that can be filled with wash water. If further chemical digestion is required for the pulping process, those debarked wood bolts are subsequently chipped in a chipper. After being cleaned and size-screened, the chips are briefly stored for further processing.

**(b) Separation of Fiber**

Many pulping technologies will diverge during the fibre separation step. The chips are stored in a sizable pressure cooker, also known as a digester, to which the necessary kraft chemical pulping chemicals are added. After that, the chips are partially dissolved in lignin and other extractives and the fibres are separated using steam digestion at a set temperature. Certain digesters run constantly, treating a batch at a time while receiving a steady stream of chips (furnish) and alcohol that is charged sporadically.

Following the process of digestion, the pulp that has been cooked is released into a pressure vessel. The volatile compounds and steam are tubed off at this point. This heated pulp is then added back into the cycle of chemical recovery. In mechanical pulping, fiber separation is less pronounced.

Stone ground-wood involves pushing debarked logs up against revolving stone grinding wheels. Chips are used to make thermo-mechanical pulp and refiner pulp. In both procedures, these chips are pulverized by being passed through a rapidly rotating device. Following refining, the pulp is cleaned, screened, and the majority of the process water is eliminated in the second stage so that paper may be made.

**( c) Method of Bleaching**

In order to generate the light colored or white papers that are sought for many items, raw pulp must be bleached because it includes a significant quantity of lignin and other discolorations. By solubilizing extra lignin from the cellulose through oxidation and chlorination, the fibers are further delignified. These consist of oxygen, hydrogen perioxide, sodium hypochlorite, chlorine dioxide, and chlorine gas.

In the fiber separation stage, several pulping technologies will be diverged. The chips are kept into a large pressure cooker (digester), into which is added the appropriate chemicals in kraft chemical pulping.

The chips are then digested with steam at specific temperatures to separate the fibers and partially dissolve the lignin and other extractives. Some digesters operate continuously with a constant feed of chips (furnish) and liquor are charged intermittently and treat a batch at a time.

After the digestion process, the cooked pulp is discharged into a pressure vessel. Here the steam and volatile materials are tubed off. After that, this cooked pulp is returned to the chemical recovery cycle. Fiber separation in mechanical pulping is less dramatic.

Debarked logs are forced against rotating stone grinding wheels in the stone ground-wood procedure. Refiner pulp and thermo-mechanical pulp are produced by chips. These chips are ground by passing them through rapidly rotating in both processes.

In the second stage after refining, the pulp is screened, cleaned, and most of the process water is removed in preparation for paper making.

**( c) Bleaching Process**

Raw pulp contains an appreciable amount of lignin and other discoloration, it must be bleached to produce light colored or white papers preferred for many products. The fibers are further delignified by solubilizing additional lignin from the cellulose through chlorination and oxidation. These include chlorine dioxide, chlorine gas, sodium hypochlorite, hydrogen peroxides, and oxygen.

A powerful alkali called sodium hydroxide is used to remove the dissolved lignin from the surface of fibers. Numerous variables, including the kind and condition of the pulp and the relative cost of the bleaching chemicals, affect the choice of bleaching agents and the order in which they are applied.

Chemical and mechanical pulp bleaching are not the same. The purpose of mechanical pulp bleaching is to minimize lignin removal, which lowers fiber yields.

Chemicals such as sodium bisulfite, sodium or zinc hydrosulfite (which is no longer used in the United States), calcium or sodium hypochlorite, hydrogen or sodium peroxide, and the Sulphur Dioxide-Borol Process (a variation of the sodium hydrosulfite) are used to bleach mechanical pulps - these chemicals selectively destroy coloring impurities while leaving the lignin and cellulosic materials intact.

**(d) Papermaking Procedure**

To improve the formation and bonding of the fibres as they enter the paper machine, bleached or unbleached pulp can be further refined by cutting and roughening the fibre surface. To create a thin combination with less than 1% fibre, water is added to the pulp slurry. The diluted slurry is then fed into the paper-forming machine's "wet end" after being cleaned in cyclone cleaners and screened in centrifugal screens. A head-box is used to evenly distribute the diluted stock's fibre slurry across the breadth of the paper sheet that is going to be manufactured.

## 4.3. Resin, Rosin and Turpentine

### 4.3.1. Resin Tapping

The resin of Chir pine trees found in the Himalayan region is trapped in parts of Jammu, Himanchal Pradesh and Uttarakhand for the manufacture of rosin and turpentine. The oleoresin is secreted from two types of resin canals: - large longitudinal ducts in the wood and smaller ducts in the rays are occurring as right angles to the former. Besides chir pine, the other trees, which yield resin in significant quantities, are khasi pine, blue pine and tropical pines. However, tapping them is not commercially viable.

### 4.3.2. Methods of resin tapping

Different methods have been evolved for tapping chir pine trees in order to obtain the oleoresin on a commercial scale. These have been described below.

**a) Box method:** This is the oldest method of resin tapping in which a cavity is cut at the base of the tree. The resin that exudes from this cavity is collected in a box. However, this method was considered to be wasteful and the trees began to die after a few years.

**b) Cup and lip method:** In this method of resin tapping, a blaze is made on the stem of the tree after scrapping the outer bark. Below this a lip is placed so as to guide the resin that begins to flow. The blaze has a width of about 15 cms and length of about 25 cms. In trees with a larger girth, a number of blazes may be made simultaneously. The blaze is freshened from time to time. About 5 freshening may be required fr every month. An acid paste is also applied to induce the flow of resin. The resin is collected in a container.

However, this method too resulted in over tapping and thetrees began to be heavily damaged during windstorms.

**c) Rill method**

The rill method of resin tapping has been recently developed and is now being adopted on a large scale A part of the outer bark is removed and a series of rill like channels excavated in the stem. These rills are not very deep and in this way, the bole is protected from being weakened, as was the case in the cup and lip method.

This method of resin tapping has proved to be more costeffective and results very little damage to the bole of the trees being tapped.

### 4.3.3. Factors affecting resin yield

The yield of resin is affected by the factors listed below:

a) Genetic characters of the trees being tapped
b) Size and growth vigor of the trees.
c) Anatomy and structure.
d) Temperature and other climatic conditions.
e) Elevation, aspect and slope.
f) Method of tapping and timing of freshening

### 4.3.4. Processing of Resin

Rosin and turpentine factories process the resin obtainedfrom Chir-pine trees for the production of rosin and turpentine. Cruderesin is in a very impure state when it reaches the resin factory. Itmay contain major impurities in the form of water, bark, needles, dirtand even the remains of insects. The first step is to remove theseimpurities which usually float on the resin. The resin is then emptiedinto large melters or vats made of mild steel.

The melters or vats have arrangements for steam heating, ahelical mixer and a V-shaped bottom. A small quantity of impureturpentine is added to the crude resin placed in the melter and steamheating is started. The helical mixer mixes the resin as it is heated,after which it is allowed to settle down. The heavy impurities settledown at the bottom, while the lighter ones float at the top and maybe removed by hand.The resin is then led into a sludge tank with the heavyimpurities remaining in the melter. Some of the diluted resin ispumped into a still with a steam jacket for distillation 'The lighter oils are recovered first followed by the heavier ones After recovery of all the turpentine, rosin is left behind, It is drawn off and packed in special wooden casks prepared for this purpose The turpentine oil, which is distilled after the first stage of distillation, is subjected to further-distillation in order to obtain pure turpentine oil.

## 4.4. Grades of turpentine oil

Commercial grading of turpentine oil may be done in the following manner (after Negi 1992)

| **Property** | **Grade I** | **Grade II** |
|---|---|---|
| Colour | Water white | Not darker than freshly prepared solution of 0.000gm of potassium dichromate made upto 100 ml with distilled water acidulated with sulphuric acid |
| Specific gravity | 0.8520 to 0.8620 | 0.8520 'to 0.8720 |
| Refractive index at 30 degrees C | 1.4680 to 1.4730 ` | 1.4680 to 1.4750 |
| Acid value (maximum) | 0.5 | 1.0 |
| Evaporation residue | 1.0 | 2.0 |

## 4.5. Grades of rosin

The commercial grades of rosin have been listed in the following table (after Negi 1992).

| **Type** | **Grade** | **Lovibond Color Value-Red** | **Lovibond Color Value-Yellow** | **Lovibond Color Value- Blue** |
|---|---|---|---|---|
| Pale | X<br>WW<br>WG | 1.35<br>1.85<br>2.6 | 13.0<br>19.5<br>30.0 | -<br>-<br>- |

| | | | | |
|---|---|---|---|---|
| | N | 3.6 | 41.0 | - |
| Medium | M | 4.9 | 51.0 | - |
| | K | 6.2 | 60.0 | - |
| | I | 8.8 | 80.0 | - |
| | H | 12.0 | 100.0 | - |
| Dark | G | 17.0 | 100.0 | - |
| | F | 27.0 | 120.0 | 0.1 |
| | E | 47.0 | 130.0 | 1.2 |
| | D | 75.0 | 160.0 | 3.2 |

## 4.6. Properties and uses of Resin, Rosin and Turpentine oil

The main properties and uses of turpentine oil have been listed in the following points (after Negi 1992):

1) Turpentine oil is a mixture of terpenes.
2) Turpentine oil is a colorless and viscous liquid having a characteristic odor and an unpleasant taste.
3) Its specific gravity varies from 0.85 to 0.88, while the boiling point is about 155 degrees C.
4) It is more or less insoluble in water, miscible with absolute alcohol and ether and dissolves sulphur, phosphorous, resins and caoutchouc.
5) On exposure to air, turpentine oil has the tendency to become dry after absorbing oxygen and giving off ozone.
6) It is used in the manufacture of paints, varnishes, shoe and other polishes.
7) Used in the manufacture of chemicals, drugs and pharmaceuticals.
8) This oil also finds use in dissolving fats, resins, caoutchouc and related uses.
9) Products based on turpentine oil are used in the manufacture of synthetic rubber, waxes, camphor, insecticides and germicides.

The main properties and uses of rosin have been listed in the following points:

1. It is a colorless, red, brown, blue or black.

2. Its specific gravity is about 1.08. The melting point ranges from 100 to 140 degrees C.
3. Rosin is used in the manufacture of soaps and also for sizing of paper. It is used for providing a stiff coat to certain types of paper for writing and printing.
4. Also used is the manufacture of linoleum, sealing wax, oilcloth, special floring compounds and coverings, lubricating compounds, inks, disinfectants, paints and varnishes.
5. It is used for soldering and as a dressing for machine belts and bows of violins and cellos.

## 4.7. Ply wood Industry

Strong adhesives are used to assemble thin layers of wood veneer to create plywood, a building material. It consists of wood from maple, mahogany, oak, pine, cedar, spruce, and teak, or a mix of both softwoods and hardwoods. Tropical, aircraft, ornamental, flexible, and marine plywood are all commercially available varieties. It is an adaptable material that fits in beautifully with any interior design. It is a reasonably priced, precisely sized sheet of wood that is manufactured in a factory and is resistant to warping and deterioration from variations in air moisture content. Furniture like tables, chairs, shelves, cabinets, sofa frames, beds, and stools are made with it.

## 4.8. Lac

Lac is a resinous substance secreted as a protective, covering by the Lac insect *Lacciferlacca* which live as a parasite s on many host plants, found in and around forest areas. The small red larvae of this insect live on the young succulent shoots of the host plants and draw nutrients from their sap. They secrete a thick resinous fluid that covers their bodies. This secretion forms a hard and almost continuous encrustation on the twigs and branches of the host plant. These encrustations are collected from the host plants and processed to obtain the Lac of commercial use.

**Host**

The character of the sap is the single most important factor, which determines if a particular plant can act as host plant for the Lac insect. The characteristics of its sap should be:

- Neutral to slightly reaction.
- Relatively lower density.

**Major hosts**

There are three major hosts for the Lac insect in India. They are:

a) *Butea monosperma*- Palas.

b) *Schleicheraoleosa*- Kusum.

c) *Zizyphusmauritiana*- Ber.

**Local hosts**

The hosts of local and specific importance are: Acacia catechu, *Acacia farnesiana, Acacia leucocephala, Acacia nilotica, Alhiziaamara, Albizia chinensis, Albizia lebbeck, Albizia lucida,*

**4.8.1. Properties and uses of Lac**

The main properties and uses of Lac been listed in the points below:

a) It is soluble in alcohol and weak alkalis.

b) It is elastic and adhesive in nature.

c) Lac has many uses, mainly due to its properties as a valuable molding material.

d) It was widely used in the manufacture of musical records.

e) It is used for decorative and insulating varnishes and lacquers of various kinds.

f) Lac is also used as a coat for metal ware in order to prevent them from tarnishing.

g) Various products like playing cards; oilcloth and linoleum are provided with a finishing coating of Lac.

h) Lac also finds use as an insulator.

i) The other uses of Lac are in the manufacture of adhesives and cements, glazing paper, nail polishes, dental plates, jewelry fittings, bangles and grinding wheels.

j) Lac is also used in some types of confectionery.

## 4.9. Silk

Silk is obtained from the cocoons of the silk worm which are widely reared in India, mainly on the mulberry tree but on other trees as well. There is a thriving silk industry in India which produces silk of various qualities, a part of which is also exported to other countries.

### 4.9.1. Common Silk Worm

The common silk worm (*Bombyx mori*) produces silk in considerable quantities in various parts of India. It feeds on the leaves of mulberry tree, which is specifically reared for this purpose. The species of mulberry on which this worm feeds are *Morus Alba, Morus australis* and *Morus indica*.

### 4.9.2. Tussar silk worm

The tussar silk worm or Antheraea paphia feeds on many wild plants and produces the famous tussar silk. It is semi domesticated and is reared in forest areas and their periphery.The main plant species on the leaves of which this Worm feeds are *Anogerssuslatifolia, Madhuca indica, Lagerstromia parviflora and Terminalia tomentosa.*Tussar silk is collected from two sources:

a. From cocoons in the wild.
b. From cocoons on plantations and orchards.

In the latter case, the eggs are collected from trees and other plants in the forest and placed on trees in plantations and orchards, where it is easier to manage them and collect the cocoons. These are protected against damage by birds. Two or three crops of cocoons are obtained each year with the silk yield of 15 to 20 cocoons being about 10 to 12 grams.

#### 4.9.3. Muga silk worm

The muga silk worm is known as *Antheraea assamensis* and is either found in the wild or reared n small plantations and orchards in parts of northeast India and West Bengal. It thrives on species like *Cinnarnornumobtusifolium, Litsaeasp, Machilusodoratissima*and*Michelia oblonga*.

#### 4.9.4. Eri silk worm

This silk worm is known as *Philosamiacynthiaricini.* It is reared from the production of silk in parts of Assam, West Bengal, Bihar and Orissa.

### 4.10. Honey and Bees Wax

Honey and wax have developed as a cottage industry in many parts of the country. It is obtained from the rock bee, *Apis dorsata* and the Indian bee, *Apis indica*. They feed on the nectar of plants occurring in the forests, using it as a food and also storing it in the form of honey after partial digestion. The Indian bee has also been domesticated and is reared for honey in special boxes. Honey and beeswax may be collected two times each year. It is separated from the combs by cutting the tops of the cells with .a sharp knife. The honey is collected after sieving through a fine muslin cloth. The beeswax remains during this process and is used for various purposes.

The uses of the honey are:

a) It is eaten as a delicacy or as a part of food preparations and confectionery.
b) Honey also has medicinal Properties.
c) Bee wax used in making the comb foundation of artificial hives.
d) Bee wax used for making polishes, varnishes and providing a waterproof coating to leather goods.

## Summary

India has one of the world's most significant forest-based industries. The need for furniture, building materials, paper products, and other forest-based products is rising, which is driving growth in these industries. Agro-based industries are those that get their raw materials from agricultural items. The textile industry, which includes the following varieties: cotton, woolen, silk, synthetic, and jute textiles, is India's biggest agro-based sector. Mineral-based industries are those that rely on minerals as their primary raw resource. The iron and steel sector is the main mineral-based industry and the foundation of a nation's industrial growth. The chemical, fertilizer, and cement industries are some more sectors that rely on minerals.

Forest-based industries are those that rely on forest resources as their primary input. The primary forest-based industries are those that produce paper and pulp, matchwood, lumber and sandalwood, plywood, oil and biodiesel, among others.

**Terminal Questions:**

1. Discuss about pulp and paper industry.
2. Discuss about Silk industry
3. Discuss Properties and uses of Resin, Rosin and turpentine.
4. What is Honey and Bee wax?

# Unit 5. Valuation, Value Addition and Enterprise Development

**Unit Structure**



## 5.0. Learning Objectives

After you have studied this unit, you should be able:

- To have basic understanding of valuation and value addition
- To understand how value may be added by the local scientific technology to Bamboo and Rattan.
- To understand how the value of several oil yielding species has been enhanced.

## 5.1 Introduction

It simply means adding economic value to a particular raw material by any process like simply drying the plant material, grinding it, or extracting a compound from it by any process of distillation or boiling etc. We can understand it better with an example of *Rhododendron arboreum*(burans) flowers which are plucked from the tree and the collectors sell them at a meagre price varying from 10-20 Rs/kg. However, when the burans juice is extracted the bottled juice is sold at rates varying between 50-70 Rs/litre.

Similarly there are various medicinal and aromatic plants herbage of which (leaves and shoot parts) if sent to a distillation unit can cost several thousand rupees in transportation but if a small distillation unit is available with the grower, he can extract the important compound in a small bottle which he can take to any market, get a high net return without any transport charges. There are several such examples which can be quoted for value addition to NWFP's. In this chapter we have discussed the problems of low returns to the marginalized communities if the product is un processed, market information is not available, value chains and women empowerment and several case studies to provide an indepth knowledge on what is being done locally for value addition to NWFP's.

NWFPs offer great promise for producers in the informal economy. Although official production and trade statistics and research have somewhat neglected the sector, there is a sizeable and growing international market for NWFPs. These include essential oils, medicinal plants, gum arabic, rattan, bamboo, natural honey, edible nuts, mushrooms, various types of fibres, and other types of wild nuts and seeds used in cooking, skin care and for other purposes. While exports include some without value added, there is an increasing trend towards local processing of a range of more sophisticated products (Belcher and Schreckenberg 2003). Together these NWFPs involve millions of workers and producers, including many indigenous women and men in the most remote areas of developing countries. Several agencies, including IFAD (International Fund Agriculture Development), have increased their support – in the form of loans, grants and technical assistance – to enable indigenous populations to take advantage of these new economic opportunities and to share equally in the increased gains from globalization. Although new economic opportunities exist in this sector, it is not easy for people to take advantage of them.

- If NWFPs are not processed locally, they yield low returns.
- Forest dwellers do not have access to market information.
- Expansion of the NWFP sector can result in overexploitation or the loss of access to the natural resource base

**Low returns:** Resource-poor people find NWFP activities attractive because of the low technical and financial entry requirements, freely available resource base and instant cash in times of need. However, if they do not process NWFPs locally, the raw materials tend to yield low returns and offer little prospect for accumulation of the capital needed to escape poverty.

Remote areas are among the poorest and least informed, with little formal education. Without access to market information, forest dwellers have little knowledge of how much a consumer in the city or in developed countries will pay for the final product, and they have little or no means of bargaining for an increased stake in growing profits. As mentioned, they typicallyreceive less than 10 per cent of the final selling price. Without organizing into producers' or marketing groups and without access to information and technological and economic resources, women have very little chance of increasing their control over returns from the productive process. Membership in a group would enable them to gain a more powerful position in the value chain, and access to resources would enable them to add value at the source. Only when forest dwellers receive resources to address these constraints directly they will be able to adopt strategies that help them use forest resources as a means of escaping poverty.

## 5.2. Value Chains and Women's Empowerment

Women and men living in poverty in rural communities are trapped at the production end of global value chains. Most profits go to traders, distributors and retailers, who tend to be men from less remote and richer communities. But even at the production level, women are likely to work in the lowest skilled and lowest paid jobs. Given their major role in lifting themselves and their families out of poverty, any poverty reduction programme should ensure that women can position themselves more favourably within these large and complex chains. Several recent publications offer suggestions on how value chain analysis can examine the integration of poor rural women into NWFP global value chains, as well as on how to improve their position (Marshall, Schreckenberg and Newton 2006; Royal Tropical Institute (KIT) 2006; Kaplinsky and Morris 2001). These publications present variations on four ways in which the upgrading or improvement of value chains can benefit poor rural women producers and, in particular, indigenous women from remote communities:

**Process upgrading:** Process upgrading is carried out in order to increase the efficiency of production within or between stages of the value chain. Typically, forest dwellers accumulate larger quantities of the product or use a new technology, supported by access to credit and training. An example of this is the introduction of improved beehives or oil expellers. To the extent that women have less time than men to increase output and less access to credit, technology and training, they are at a disadvantage at this level of upgrading.

**Product upgrading:** In order to improve the quality or introduce new products using the same raw materials product upgrading . This is particularly common in NWFP value chains and can enable producers to gain access to a more specialized 'niche' market and protect themselves against product substitution. Examples include diversifying from honey into organic honey or other bee products, such as royal jelly and propolis, which have very high value in niche markets.

A**ctors:** Women who simply gather and handle NWFPs, with no involvement in processing the product or in managing the value chain

**Integrators:** Women who do some processing of their product, but still have no say in management of the chain and rely on intermediaries to reach markets

**Partners**: Women who do no processing of their product, but do have a say in management of the chain

**Co-owners:** Women who both add value and have a say in management – thus increasing both returns and power. This is an important form of analysis, as far too many projects and interventions concentrate only on raising income, without concern for increasing ownership and empowerment.

In the section given hereunder we have tried to quote several examples of the methods used for value addition:

## 5.3. Bamboo and Rattan

Bamboo is the world's largest plant in the grass family. Drawing on a long history of use, it has been integrated into the modern technological world, with many types of goods produced – from high-quality paper to chopsticks, woven baskets, *agarbatti*(incense sticks), crafts, furniture, plywood and floorboard. Some of the newer bamboobased products include soaps, water purifiers, pain relievers, lotions and textile products. Over one billion people live in bamboo houses, and in Tokyo and Hong Kong, the scaffolding of high-rise structures employs bamboo. China is the richest bamboo-producing country in the world, with over 500 bamboo species and sales of some US$2.4 billion in bamboo products annually. The value of one culm is US$1, while the value of a final bamboo product, even if made at the villagelevel, can be significantly higher, thus adding much-needed income at the local level. Bamboo shoots are another major export product, with exports from Taiwan alone reaching US$50 million per year.

Rattan provides sustainable income to some of the most disadvantaged people living in and on the fringes of forests. In the 1970s, Indonesia became the major supplier of rattan, accounting for nearly 70 per cent of global trade. The value of rattan exports in Indonesia has increased a stupendous 250-fold in just 17 years, with lesser but still very large increases in other countries in South-East Asia. Overall global trade is worth US$4 billion annually, and domestic trade is worth US$2.5 million. Markets for rattan consumption in Europe, North America and Japan are growing steadily.

Both bamboo and rattan are environmentally friendly. A 60-foot bamboo grows in only 59 days, versus 60 years for a tree. Rattan 'hugs' trees and saves them from the logger's axe by providing equal or more benefit than the companion tree, without disturbing the natural habitat.

In Uttarakhand, non-Government organization like appropriate technology in India and the Bamboo and Fibre development board have taken initiative to add value to raw bamboo material by training the local people in weaving baskets, mats, and other decorative items which fitches a much higher value than the raw material.

## 5.4. Wild Mushrooms

Traditionally, peoples in all parts of the world have collected wild mushrooms such as oyster, chanterelle, morel and shitake/matsutake from the forest floor. Recently, there has been a loss of skill in identifying safely edible mushrooms, and local populations are reluctant to consume them. Export markets for higher-value mushrooms such as shitake/matsutake have grown considerably, in part because of the high demand of large consumers such as Japan. This is resulting in a shift in the division of labour in supplying countries. Men and women participate increasingly in all parts of the global value chains for high-value mushrooms. Mushrooms provide a major source of nutrition for local populations. They are high in protein and essential minerals, and remote poor populations often use them as a substitute for meat. They also have great medicinal value: people use them widely in parts of the world as they believe them to boost the immune system. However, as they degrade quickly they need to the transported to cities.

Simple processes like drying of mushrooms and preserving them with local preservatives can add value to this important NWFP. However, it is important that the wild edible mushrooms are identified by an expert before consumption.

## 5.5. Bee Products

In the hills value has been added to the honey by getting it certified by relevant agencies as organic honey. This has also resulted in the price going up several fold. Raw honey, either on its own or in combination with other products, is well known for its healing qualities. These include disinfecting wounds, killing bacteria that cause stomach ulcers and diarrhea, alleviating symptoms of arthritis and colds, lowering cholesterol levels and boosting immune systems (Krell 1996). Honey-hunting has traditionally been a male activity, partly because it involves climbing trees, which is not culturally suitable for most people.

## 5.6. Medicinal and Aromatic Plants

Globally, Gibb (2007) estimates sales of herbal medicines alone to have exceeded US$12.5 billion in 1994 and US$30 billion in 2000. Annual growth rates range from 5 to 15 per cent. In 2000, the Secretariat of the Convention on Biological Diversity reported the world market for herbal medicines, including herbal products and raw materials, at US$60 billion and forecast it to reach US$5 trillion by 2050. Hundreds of thousands of medicinal plant species around the world constitute:

- the basis of health care systems throughout much of the developing world
- a source of compounds on which to base new pharmaceutical products
- a major component of the burgeoning markets for herbal health care remedies and natural products
- a source of income for growers, traders, collectors and manufacturers of plant based medicines

Unfortunately, some medicinal plants are already in short supply. In Europe, the trade structure is complex and dominated by a few wholesalers. In producer countries, diverse types of traders, including local dealers, village cooperatives and district traders, buy plant material from collectors and cultivators. They then pass it on to wholesalers, manufacturers or directly to retailers. The wide range of manufacturers includes production of pharmaceuticals, extracts, cosmetics, foods and colouring agents. The length of the trade chains and a perceived need to protect information lead to a lack of transparency.

A direct consequence is that people at the start of the chain have little idea of the market valueof the medicinal and aromatic plants they are supplying and are unaware of the value added from source to end-use World Wide Fund for Nature (WWF) 2002. Medicinal plants are an important source of livelihood for millions of people in developing countries, particularly women, indigenous peoples and very poor people. Traditional knowledge associated with medicinal herbs is a highly gender-specific activity in most countries. While women tend to be the repositories of indigenous knowledge relating to the uses of medicinal plants, both women and men collect them (Gibb 2007). Women collect plants from forests closer to home and combine this activity with others, such as collecting firewood and fodder. The plants they collect tend to be of lower value and destined for local markets. Men make special trips to more distantlocations, including the highest altitudes where higher-value plants are found. These often endup in the more complex value chains related to export markets, and men tend to dominate the trading and exporting functions in these chains. While demand for medicinal herbs has risen in global markets, inequitable trade practices have meant that only a small portion of the profits trickle down to collectors. Concerns include recognition of the intellectual property rights of traditional users and biopiracy. Increasingly, scientists and industry are appropriating, adapting and patenting the knowledge of traditional medicine with little or no compensation to its original custodians and without their informed consent. There are two crucial, related concerns:

- People who depend on traditional medicine may lose access to medicinal plants if pharmaceutical companies patent them.
- Over-harvesting of commercially valuable medicinal plants in the wild could result in their extinction, with both health care and livelihood impacts for indigenous and traditional peoples(Gibb 2007). Although companies and entrepreneurs specialized in the commercializing of NWFPs

## 5.7. Hills Leasehold Forestry and Forage Development Project (HLFFDP):

In 1990, the Government of Nepal and IFAD signed a loan agreement for HLFFDP, with the twin objectives of raising the incomes of hill families living below the poverty line and contributing to improvements in the ecological condition of the hills. A decade later, the development community of Nepal recognized HLFFDP as an innovative, unique project that had a significant impact on the lives of its group members, especially women, as well as on the environment. In particular, HLFFDP contributed to an enhanced sense of self-confidence and bargaining power among women participants. It achieved this through the incorporation of gender issues and the targeting of poor women in the strategy and implementation of the project. To overcome the problem of the scarcity of women staff in the Department of Forestry and the line agencies implementing the project, HLFFDP hired women group promoters to organize women’s and mixed groups and to train men and women in gender awareness at the grass-roots level. In addition, a team of three women Nepalese technical assistants joined the project coordination unit to develop mechanisms for mainstreaming gender considerations. The team identified gender focal points (mostly men) within the implementing line agencies and developed their gender skills through training, coaching and guidance. These focal points worked closely with the women group promoters. According to one male focal point, "these group promoters are like our own family. If we had not given them this support, the project would not have been successful. They are our messengers to leasehold communities and help us conduct meetings. Since they have come, the participation of women has increased. Through gender training, we have become aware of women's knowledge and roles in natural resource management." (Gurung and Lama 2002). Continue to exploit local communities, there are some examples of methods that can protect their rights. In 1997, the South African Council for Scientific and Industrial Research (CSIR) licensed a United Kingdom-based company to develop and commercialize an appetite-suppressant drug that CSIR had isolated from hoodia, which has long been used by the San people to ward off hunger. In 2001, media reports led to increased interest in the drug and alerted the San to the potential use and value of their traditional knowledge. This resulted in the South African San Council signing a memorandum of understanding with CSIR, which acknowledged the San as the custodians of their traditional knowledge. CSIR also agreed to share the benefits of commercialization of the new drug. The potential income for the San could exceed US$7 million annually for the 15-20 years before the CSIR patent expires. It will be deposited in a San hoodia trust for development of the San community (Schreckenberg 2003).

Overexploitation of several valuable medicinal and aromatic plants has resulted in some governments banning exports of raw materials. In addition to conserving the natural resource base, such policy changes have also promoted local processing and increased employment levels and foreign exchange earnings. In Nepal, forest dwellers used to export over 90 percent *Jatamansi* (an aromatic plant of the valerian family) as raw material. Following a change in trade policy, they now process over 75 per cent into oil before export. Of course, a corresponding increase in financial and technical support for local processing should accompany policy changes. Ideally, it should enable most of the value added to stay within local communities. Transfer of forest resource management to community forest user groups (CFUGs) and investment in local, community-owned distillation units in Nepal has led to substantial increases in income for indigenous collectors – both women and men. CFUGs also help put collectors on a more equal basis with traders and thus increase their control over the market chain. Nepal has affected major policy shifts on exports and on the transfer of ownership of forest resources.

## 5.8. Fruits, Nuts and Seeds

Indigenous trees are yielding valuable raw materials, primarily for the cosmetics industry. These trees have been harvested sustainably for generations by indigenous and marginalized rural women. The creation of viable, ethical domestic and export markets for these products can add local value and preserve the traditional culture associated with their use. This, in turn, enhances rural women's livelihoods and food security and protects the trees (see the website of PhytoTrade Africa, www.phytotradeafrica.com, the Southern African Natural Products Trade Association headquartered in Harare). Tree types include shea, marula, baobab and mongongo. Producers process the fruits in a variety of ways: traditional processing by women using simple technologies; by women's groups using improved technologies; or in more-sophisticated factories using capital-intensive technologies. The end product is an oil or butter that has widespread use locally as a cooking oil, in soap-making and in skin and health care. Users brew some fruits for local consumption and sale, and eat others as a nutritious snack food. They feed the cake left over after pressing to livestock. Few indigenous communities could survive without these multipurpose trees. Cosmetics industries in Europe, North America and Japan have a high and growing demand for these oils and butters, often met through fair-trade markets. However, they often do final processing in the consumer country to ensure the meeting of proper standards (Bekure et al. 1997). Shea is increasingly being used in chocolate manufacture in northern countries. Demand has increased, in particular after August 2003, when a new European 'norm' went into effect that allows for the use of up to 5 per cent non-cocoa fats. Women's associations in West Africa that produce shea butter report an increase in orders following the change in regulations (Gordon 2004). Women who collect the fruits and depend on them for their livelihoods are failing to benefit equitably from these growing markets. As can be seen in figure 5, the production chains are long and complex.

They involve a range of processors, traders, exporters, importers, wholesalers, manufacturers and retailers, who rake off much of the profit, leaving women collectors with little or no increase in income. Governments and development agencies should assist women in increasing their control over the marketing chain and in sharing more widely in the gains of globalization (Carr et al. 2000).

**Interventions:** Given the high visibility of these products in the global marketplace, interventions have been well documented. There are several good examples of how a variety of actors can come together to enable women collectors to take advantage of expanding export markets. In Namibia, 3,000 women who collect marula seeds have formed a cooperative that is a member of PhytoTrade Africa. The cooperative exports both seed and processed oil to the Body Shop International, which advertises the use of 'community-traded' marula oil in its whole cosmetics range. The Centre for Research-Information-Action in Africa/Southern African Development & Consulting (CRIAA SA-DC), a local NGO, has enabled the cooperative to enter into direct negotiations with The Body Shop. It has also linked cooperative members with local artisans, who have developed appropriate processing equipment in response to members' needs (Schreckenberg 2003). PhytoTrade Africa, which is an IFAD grant holder, has had a number of other success stories in southern Africa. In 2006, almost 30,000 primary producers (93 per cent women) sold raw or value added NWFPs worth US$340,000 to PhytoTrade Africa members located in seven countries in the region. The network has built robust supply chains, which make possible the delivery of high-quality products to global markets on time and to specification. Its exports are 19 per cent fair-trade certified (PhytoTrade Africa, 2007). In West Africa, development agencies andthe private sector have combined resources to respond to requests from governments for help in developing the shea sector. In Burkina Faso, 400,000 rural women participate in the harvesting and processing of shea nuts. A joint project of the United Nations Development Fund for Women (UNIFEM) and CECI has introduced improved technologies and international marketing assistance. These activities have led a major cosmetics company (l'Occitane) to purchase shea butter directly from a network of 100 shea groups. The company also provides training and pays for the butter in advance, thus promoting greater economic security.

## 5.9. Value Addition in Cheura (*Diploknema Butryacea*)

Cheura (*Diploknemabutryacea*) belongs to the family sapotaceae and popularly known as Indian butter tree which is mainly found in Uttarakhand state. It is a multipurpose tree and its untapped vast potentials need to be harnessed. It is also known as Phulwara, Fulwa, Pahari Mahua, Gophat or Indian Bitter Tree in Kumaun region of Uttarakhand state. Commercially, the Cheura oil extracted from the seeds, is marketed as PhulwaraGhee.Cheura is a native of Nepal and distributed from India through Nepal to Philippines and from Garhwal, Kumaun eastwards to Sikkim and Bhutan (Sub-Himalayan tracts and outer Himalayan ranges). It also occurs sporadically in tropical moist deciduous, semi-deciduous and evergreen forests of Andaman Islands. It is a fast growing tree borne oilseed and found in the elevation ranges between 400-1400 meters mainly along the sides of ravines and in shady valleys.

Cheura starts flowering in the months of October- November at the age of 8-10 years. Its flowers are either white or yellow colour with a special fragrance. Generally, an alternate bearing has been observed in this tree. The fruits start ripening in June-July months. Fruits are oval in shape and initially with green colour which turns light yellow after ripening during June-July. Fruits are harvested during second week of June till July end.

The weight of seed is 20% weight of the fruit whereas the kernel weighs 76-80%. Seed and kernel contain 42-47% and 60-66% oil, respectively. The market price of raw fruits of cheura is 20-30 Rs/kg but it dried price is 80-100 Rs/kg, but the extraction of oil with seed on commercial scale the value price increased several times more than raw fruit value. In Gurna, after the establishment of an oil expeller the value of cheura oil has gone up significantly as more oil is extracted per kg dried kernels and the outer fleshy portion of the fruit is being used by the local cottage industries of preparation of juggery, chutney etc. Cheura oil is used as Ghee and butter which is known as 'Phulwara Ghee' for cooking and frying of vegetables and food. Cheura butter is used for preparing medicines, ointment, candles, cream and other user-friendly products.

## 5.10. Value Addition of Wild Apricot (*Prunus Armeniaca*)

The wild apricot (*Prunus armeniaca*Linn.) is an important tree borne oilseed crop of mid hills and dry temperate regions of the country. Wild apricot belongs to the family *Rosaceae* and sub-family *Prunoideae*. In the Himalayan region of the country, local communities known it by different vernacular names viz. ”Chulli”, “Shara”, “Khurmani”,”Chulu” etc.

The cultivated apricot has its origin in North-Eastern China, whereas, wild apricot appears to be indigenous to India. Wild apricot locally called Chullu is found in the dry temperate region of North-Weastern Himalayas. In Kumaun region, wild apricot is found in all the three districts of Nainital, Almora and Pithoragarh. Pithoragarh district has maximum density of wild apricot tree in the Kumaun region.

Wild apricot fruits generally start maturing during from last week of May and continue upto August end depending upon altitude and location. They are harvested manually by shaking the tree branches and no mechanical harvesting is practiced. Change of surface colour, from full bloom to harvesting and fruit total sugar solids (TSS) are considered as the best indices of maturity. For fresh marketing, fruits should be plucked when they change their surface colour from green to yellow. Fully ripened fruits are harvested for freezing, canning and drying. The fruits should be harvested in morning hours and direct exposure of fruits to sun should be avoided during grading and packaging tree. It starts bearing fruits at the age of 4-5 years and continues to bear well for 50-60 years. The full bearing occurs at about 10-15 years when it yields about 85-100 kg. fruits per tree. The stone yield varies from 12-17 percent of fruits and the kernel yield ranges 3.14-4.81 kg/tree. The yield of a full-bearing well maintained plant tree varies from 120-150 kg.

Kernel oil closely resembles expressed almond oil thus it is employed as an adulterant or a substitute for almond oil. An essential oil that is identical with bitter almond oil is distilled from the cake. Apricot kernels are cheaper and give higher yield of oil (0.8-1.6 percent) than bitter almond oil. The oil of the seed is also edible and is used mixed with other edible oil like mustard oil. The fetches very high in the cosmetic industry. It is also medicinal and used for joint pain. The strained baby foods from pulp are nutritious and a good source of calcium, phosphorus and iron.

## 5.11. Gums

Gums are a type of resin exuded from a variety of trees, partly as the result of natural phenomena and partly from injury to the bark or stem of a tree. They exude in liquid form and, on exposure to air, dry into translucent tears that remain stuck to the bark of the stem or branch, from which collectors can then pluck them. People use gums for a variety of purposes: as adhesives; for clarification of liqueurs; finishing of silk; preparation of quality water colours; in pharmaceuticals, printing inks and the sizing and finishing of textile fabrics and dyeing; in the paint industry; in cosmetics – to bind creams, lotions and ointments; in preparing ice cream, chewing gum and other confectionary items; and in soft drink manufacture (Grams 1998). There are two major types of gum: Arabic and karaya. Both types are primarily for the export market, where a wide range of industries use the semi-processed product to produce finished retail goods. Sudan is the largest supplier of gum arabic and had more than 90 per cent of the world market until the 1970s. The country's leading position has declined in recent years, owing to internal political factors and the development of artificial substitutes. India is the world's largest exporter of gum karaya. Exports have declined in volume (although not in value) in recent years, due in large part to a loss of trees because of the widespread use of non-scientific and harmful tapping methods. The value chains and gender division of labour involved in these two types of gum are quite different. In the Sudan, men are totally responsible for collection of gum arabic, which they then transport over long distances to one of 13 central auction markets, where approved merchants buy it at an agreed price. They deliver the gum to their cleaning sheds, where teams of local girls select and hand grade it. The merchants then sell the graded gum to the Gum Arabic Company, which is 30 per cent government owned. The company is the sole permitted exporter (Grams 1998). In India, the system is more decentralized and women participate more in the collection, transport and sale of gum karaya. However, the methods of tapping are very primitive, resulting in injuries to both the pickers and the trees. Gum pickers live in some of the most remote parts of the country. Until recently, they worked in isolation, without advice on improved production methods and without information on markets, prices or local legislation on the use of forest products. As a result, while gum karaya is a valuable productand a major source of export earnings for the country as a whole, the tribal women and men involved in collection earn a pittance for long, unpleasant hours of work (Mehta 1998). The value chains vary from state tostate.

**Interventions:** In India, state governments control the collection, sale and marketing of gum, issue collection licenses and buy the gum from licensed collectors. In Gujarat, thousands of the State's poorest women rely on gum collection for their incomes. Most do not have a collection license and are thus forced to sell to local licensed contractors at a very low price. The Gujarat State Forest Development Corporation Ltd. has allowed prices to vary according to changes in conditions (such as an influx of cheap imports from the Sudan) and has no market linkages or plans. An intervention by the Self- Employed Women's Association (SEWA), a women's union, helped collectors organize into groups. These groups secured collection licenses for their members and were able to negotiate higher selling prices with the forest corporation. Eventually, the women also won the right to sell on the open market, where prices are higher. The women's union is developing more direct market linkages on behalf of the gum collectors.

**GCC and the Andhra Pradesh Tribal Development Project (APTDP):** The Girijan Cooperative Corporation Ltd.(GCC) undertook research on the processing and marketing of forest products collected by tribal peoples. Its initiative on gum *karaya* was a good example of the benefits of combining a concern for tribal people with dissemination of scientific knowledge and professional marketing techniques. Gum *karaya* is the most important NWFP procured by GCC, accounting for about one half of total procurement, and it is a major source of income for almost 12,000 tribal people.

GCC's employing of a pharmaceutical specialist led to the development of scientific tapping and post-harvest practices, modernization of storage and quality control. It engaged nearly 80 consultants and 400-500 liaison workers to train and supervise the collection of gum. Within two years, the price of grade 1 gum tripled and tribal income rose proportionally. The improved tapping techniques also extended tree life. GCC organizational expansion, facilitated by APTDP, led to the creation of the Commercialization, Research and Development Division, illustrating the importance that

GCC assigns to issues related to market linkages. (Government of the Republic of India 2002).

In Andhra Pradesh, on the contrary, thousands of tribal women and men gum collectors have been assisted directly through the Girijan Cooperative Corporation Ltd. (GCC). The State Government set up GCC to procure and market NWFPs, with the assistance of the IFAD-supported Andhra Pradesh Tribal Development Project. GCC's managing director was reluctant to lower prices when the corporation was unable to sell stocks of gum owing to the poor quality of the product. Instead, he looked for scientific solutions to resolve marketing problems throughimproving quality. GCC employed young, tribal volunteer workers to liaise with gum collectors and scientists to develop and disseminate solutions. As a result, the quality of gum has improved, prices paid by traders and the incomes earned by collectors have increased, and the life span of gum trees has been extended. Because scientists worked with gum collectors on technology development, there has been a beneficial blending of modern and traditional technologies.

**Karaya value chain (Andhra Pradesh, India): An Analysis:** Global value chains for most NWFPs are highly skewed in the direction of distributors and retailers. Forest dwellers at the collection end of the chain typically receive much less than 10 per cent of the total selling price. As is the case with many other products originating in developing countries, NWFP chains are highly gender specific. Women mostly deal with lower-value products and lower-value activities than men, and do not have the same access to the technology, credit and training needed to redress the balance. However, there are many ways to alter the distribution of returns and power in favour of indigenous communities and the women within them. To return to the terminology of chapter I, a major of objective of gender-sensitive NWFP projects is to increase the income of indigenous women by adding value to their forest resource base. Projects should also enable women to control the subsequent marketing process to benefit on a sustainable basis. In other words, projects need to move women from being 'actors', where they are mere price-takers, to 'co-owners', where they have an equal say in price-setting and marketing with those further down the value chain. Implicit in this approach is the need for women to have control over the use of the resource base. The following examples demonstrate various ways to achieve this:

- In Nepal, the producers of wintergreen target mainstream European markets. A change in government policy banned the export of raw wintergreen plants, so there is now more processing at the local level. There has also been investment in local, community-owned distilleries and a gender-sensitive programme to transfer forest resources to user groups. These measures have resulted in significant increases in income and control for the women who have traditionally collected this aromatic plant.
- In Namibia, the producers of marula oil target 'niche' fair-trade markets. Innovations in the supply chain have resulted in a women's cooperative being able to capture 47 per cent of value added, where the norm for primary producers would be less than 10 per cent.
- In Andhra Pradesh, the producers of gum karaya target mass industrial markets. Gum collectors and scientists employed by their associations have developed improved collection and processing technologies that have doubled the incomes of tribal communities and extended the life of the gum trees.

**Major Interventions:** Assisting local population in capturing a greater proportion of value added in globally marketed NWFPs – and doing so in an institutionally and environmentally sustainable way – will require finding innovative approaches to:

- dealing with resource scarcity
- increasing competitiveness and improving market linkages/access While these tasks are important within the context of local/domestic markets, they become crucial in supplying global markets and require a mix of skills and resources from a range of actors. The range and mix vary from product to product and from place to place:

  **Bamboo and rattan:** there are examples of NGOs supporting women's self-help groups in collaboration with national and international research institutions.

  **Mushrooms/bee products:** there are examples of social entrepreneurs, private companies, socially-owned businesses, community enterprises and internationally supported research-anddevelopmentprogrammes linking women gatherers and producers with national and global markets.

**Medicinal and aromatic plants:** community forest user groups, community enterprises and local and international research-and-development institutions have enabled women to share in the benefits of growing global markets.

**Fruit, nuts and seeds:** women gatherers and processors of marula, shea and other indigenous fruits have been supported by women's unions and associations, the private sector and local and international NGOs.

**Gums:** women gum collectors have been assisted directly by state government institutions as well as by collector associations, women's unions and local research-and-development resources.

In addition, national governments and private traders deal with all product groups. Governments have played a major role in formulating policies and programmes in support of women's participation in and benefits from NWFP expansion. These policies and programmes range from bans on the export of raw medicinal plants in Nepal, to prioritization of the shea nut sector in Burkina Faso, and the implementation of an apiculture export strategy in Uganda. Private traders are key links in the value chains of most NWFPs and especially those destined for export markets.

To better understand the role of these different players in the NWFP commercialization process, it is useful to examine them in the light of resource scarcity and competitiveness/market access. The process of supplying local markets has continued in much the same way for generations. However, moving to the supply of sophisticated national and international markets requires major changes. Some type of process upgrading is usually necessary to improve quality and meet international standards. It may also be necessary to take on new functions such as marketing, with the associated need to establish a brand name or achieve certification. The opening up of global markets offers new economic opportunities that demand new skills in identifying and diversifying into new products. Government policy has a major role in ensuring an economic environment conducive to investment and innovation. Governments also have an important role in providing institutions and infrastructure to support such investment and innovation. For example, they can offer business development services, national monitoring services, training resources, public-sector research and export promotion boards. One good example of a package of government services to promote growth in output and exports of a specific NWFP is that of bee-keeping in Uganda: the national strategy promotes public/private partnerships and development of the industry through the private sector. Entrepreneurship, which drives the innovation process, comes largely from the private/civil society sector, with backing from international research-and-development institutions and development agencies. Private entrepreneurs, private traders, social entrepreneurs, leaders of producer associations, and, less often, NGO staff tend to be the social vehicles of technological innovation. On occasion, entrepreneurship is also found in more surprising places as, for example, the managing director of the state NWFP agency in Andhra Pradesh. Clearly, there is an amazing amount of innovation taking place in linking indigenous women with domestic supermarkets and global markets. In the case of technology, while the private sector tends to buy commercial equipment (often imported), community based organizations and social enterprises have innovated at the local level. They have come up with technologies that are low cost, use local materials and do not depend on imported spare parts or need sophisticated skills to maintain and repair them. Sometimes they build on indigenous technical knowledge, and they always draw on local technical skills and incorporate a mutually beneficial dialogue between artisan and user. Several of the bee-keeper associations in Uganda have adapted improved beehives to lower the cost of production and incorporate features such as pest control. Others have developed technologies that enable the poorest bee-keepers to diversify into higher-value products. Although bee-keepers can draw on research and development undertaken by regional research institutions such as ICIPE, they are also very capable of innovating on their own behalf and their efforts in this respect deserve recognition and support. In the case of credit, private companies and social entrepreneurs have introduced innovative and successful user-friendly schemes. These work in situations in which microfinance options exist but fail to meet producers' needs and circumstances. In Uganda, the private company Bee Natural Products gives credit to every registered farmer/supplier. This is repayable over a four year period from honey harvests. Unlike many microcredit schemes, the company recognizes that it takes some time before a hive can be harvested, and it schedules repayments accordingly. In Kenya, the social enterprise Honey care has introduced microleasing schemes as opposed to microfinance. Incorporation of such financing options in NWFP projects is crucial to their success. Also important is the concept of payment of guaranteed prices on (or before) delivery. In Burkina Faso, advance payment from l'Occitane to women shea groups has promoted economic security, whereas in Namibia, lengthy delays in payment from The Body Shop to women marula oil producers have had the opposite effect. There have also been innovations in market accessthrough collaboration with international networks and research centres such as INBAR, ICIPE and PhytoTrade Africa. INBAR's programme of development and diffusion of technologies for smallholder producers emphasizes improved product and market development. Its work with incense sticks and cane baskets in India incorporates innovative ideas, such as selling under a brand name to obtain and maintain market visibility. ICIPE's programme of bee-keeping technologies in East Africa incorporates research on market linkages in collaboration with private traders. The programmeisexamining the possibility of creating a common brand for the products developed (preferably fair-trade certified), as well as providing quality assurance (ISO certified) and organic certification for beekeeping enterprises. PhytoTrade Africa is a member of the International Fair Trade Association (IFAT) and assists its members in linking with global markets by requiring that they sign on to a collective Fair Trade Charter. Such assistance is obviously crucial in situations where the aim is to provide rural women with access to speciality niche markets – which is so often the case with NWFPs – and where costly and complicated certification schemes exist.

## 5.12. Conclusions

Spreading the gains of globalization to those communities that depend on forest products for their livelihoods and well-being is a major challenge for policymakers and development practitioners. Isolation and the usually low educational level of forest dwellers, and especially women, creates an uneven balance of returns and power within the global value chains into which they are increasingly integrated. However, significant new economic opportunities are opening up for these communities. And a range of strategies can help communities take advantage of these opportunities. There is no one recipe for success. Different strategies work in different locations and cultures and for different products within locations. Thus designers will need to plan interventions that help women increase their incomes from their forest resource base on a site- and product-specific basis – and in consultation with the women themselves. There are, however, some general guidelines that apply to most interventions. First, no one agency or individual can improve the position of local marginalized communities within global value chains. Because of the complex nature of these chains, one agency may take the lead in implementation, but it will need to draw on the resources and expertise of many other agencies and individuals to bring about positive change. A significant trend is that of public/private partnerships in which governments provide training and capacity building, while the private sector provides marketing and business development. Combining social issues with profitability and competition in global markets is not something that has been undertaken successfully by government agencies or NGOs working in isolation. Success is more likely if each agency takes responsibility for what it does best and then unites its resources with others.

Value addition to NWFP's results in increasing the monitory benefits to the local collectors. By applying simple techniques for which the scientific knowledge and the microfinance are available the cost of the products can be increased several times over. In the current chapter we have tried to highlight the various processes for the most important NWFP's that can add value to them. Certification of the fact that the honey collected by the local collectors is organic has increased the cost of the honey. Similarly, grinding of Ritha seeds to powdered form can doubled its cost.

**Terminal Questions**

1. What do you understand by valuation and value addition?
2. How value addition and women empowerment are related?
3. What are the different steps in value addition? Please explain in brief.
4. Please explain briefly the valu addition of Bamboo and rattan.

5. How wild mushrooms can be useful for income enhancement of rural poor through value addition?
6. Explain some important value additions which can be usefull in uplifting rural economy.
7. How medicinal aromatic plants can enhance rural household incomes?
8. How value may be added to fruits, nuts and seeds?

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# Unit 6: NTFPs: Fodder and Fuel

**Unit Structure**



## 6.0. Learning Objectives

After studying this unit, you should be able to:

- To know about important fodder and fuel species?
- To develop an understanding about the problems faced by the fodder growers.
- To know how supply of green fodder increases?

## 6.1. Fodder Trees, Shrubs and Climbers

India holds the largest livestock population in the world. During l982, the total livestock population in the country was 415.94 million. The population of livestock has been increasing rapidly during the last 30-40 years. The increase in livestock population in the last 40 years is indicated in the table 1.

**Table 1. Livestock population for the year 1951-1982 in India**

| **Category** | **Livestock population (in million)** | | | |
|---|---|---|---|---|
| | **1951** | **1961** | **1972** | **1982** |
| Cattle | 155.30 | 175.56 | 178.34 | 190.79 |
| Buffaloes | 45.35 | 54.21 | 57.34 | 69.00 |
| Sheep | 38.43 | 40.02 | 39399 | 48.07 |
| Goats | 47.08 | 60.86 | 67.52 | 94.72 |
| Horses and ponies | 1.51 | 1.33 | 0.94 | 0.93 |
| Pigs | 4.42 | 5.18 | 6.90 | 9.58 |
| Camels | 0.63 | 0.90 | 1.11 | 1.03 |
| Others | 1.30 | 1.15 | 1.11 | 1.82 |
| **Total** | **292.02** | **336.21** | **353.34** | **415.94** |

Due to large livestock population and less availability or fodder, most of the livestock in the country are grossly underfed. The available fodder resources can provide only about one-third of the maintenance ration per day. The total availability of green and dry fodder in the country is grossly inadequate and meets only one-third of its requirement. The main sources of fodder for the livestock in India are the residues of agricultural crop, cultivated fodder, weeds and India is given in table 2. It appears that the leaf fodder available from trees and shrubs roughly constitutes 10 percent of the total green fodder available in the country. The fodder obtained from the trees and shrubs is of great value particularly in hills.

**Table 2: Estimated Fodder Production in India (Annon, 1987)**

| **Type of Fodder** | **Estimated Production (million tonnes)** | |
|---|---|---|
| | **Dry Fodder** | **Green Fodder** |
| (a) Agricultural crop residues | 263 | - |
| (b) Grass | 205 | - |
| (c) Green fodder | | |
| i) Cultivated green fodder | | 208 |
| ii) Top feeds including sugarcane tops | | 4 |
| iii) Weeds | | 14 |
| iv) Leaf fodder from trees | | 24 |
| **Total** | **468** | **250** |

The green leaf fodder obtained from trees, shrubs, herbs or climbers is of great value in certain areas and during specific period of time. There is vast scope for increasing the production of green fodder. The leaf fodder harvested from trees can be given in green form. It can also be converted into hay or silage. However, the general practice is to give tree fodder in green form.

A large proportion of green fodder needs is fulfilled either from the cultivating forage crops or from the tree leaf fodder obtainable from the forest. The fodder obtained from forest trees odd and shrubs is almost as nutritive and valuable as cultivated fodder. The fer from forest trees helps to increase the total fodder production and iglus helps in meeting the local fodder requirement. The total fodder yield from trees, shrubs, herbs and climbers from forests is of great significance particularly during scarcity and famine period, when fodder yield from agriculture sector is low. The fodder yield from forests is sufficient to meet the demand of local livestock population. Fodder can be obtained from forests without causing any significant adverse effect on trees, as most of the trees are of deciduous nature and shed their leaves. Therefore, the leaves from these trees can be harvested for feeding the livestock before these are shed.

## 6.2. Important Fodder Species

A large variety of trees, shrubs herbs and climbers in forests, yield nutritive leaf fodder. These plants are traditionally lopped for the production of fodder. Most of the trees, shrubs, herbs and climbers which are traditionally lopped for fodder are classified as follows:

A. Tree fodder whose nutrient value is known
B. Fodder trees which are locally lopped but fodder value is not yet determined
C. Fodder yielding shrubs, herbs and climbers.

### 6.2.1. Tree Fodder of Known Nutrient Value

**1. *Acacia catechu* (Khair)**

Khair is regarded as a good fodder tree and occurs all over the tropical dry deciduous forests of the country. The tree is extensively lopped to feed goats and at times it is fed to cattle also. The leaves contain (in per cent): crude protein 13.03, crude fiber 21.88_ 2155, nitrogen free extract 46.9-50.96, ether extract 3.05-4.55, total ash 9.66-9.80, calcium 2.46-2.74 and phosphorus 0.14-0.17 (Sen and Ray, 1971; Pal et. al., 1979). Leaves contain 1.54 percent of tannin. The average digestibility coefficients are: crude protein 24 per cent, ether extract 60 per cent, crude fiber 31 percent and nitro-gen free extract 60 per cent. The total digestible nutrients are 46.33 kg/100 kg of dry matter. The yield of fodder per tree is about 10-15 kg. Heavy lopping causes damage to trees. The digestibility value of fodder is moderately high which shows that leaves are a good fodder for goats and cattle.

**2. *Acacia leucophloea* (Safed kikar)**:

This tree is lopped for fodder especially for goats and sheep. It occurs in dry deciduous forest, dry deciduous scrub, southern thorn forest, desert thorn forest and ravine thorn forest types. Its fodder is classed between medium to good quality. It is extensively lopped for fodder in Rajasthan, Madhya Pradesh and Uttar Pradesh.

The leaves contain crude protein 15.2 %, nitrogen free extract 55.80 percent, ash 7.28 percent, phosphorus 0.11 per. 18.81 per cent, ether extract 53 percent and calcium 1.12 percent (sen and Ray 1971). In south India, pods are fed to high grade cattle.

**3. *Acacia nilotica* (Babul)**

This tree is distributed all over the iota rails of the country. Leaves of *Acacia nilotica* are considered as an excellent fodder and the tree is extensively lopped for this purpose. The palatability rating of the leaves is good. The chemical composition varies with locality and age growth of leaf. The variation in the chemical contents is crude protein 18.72-19.75 per cent, crude fibre 6.49- QS1 per cent, ether extract 2.16-4.20 per cent, total ash 4.79-11.23 per cent, calcium 1.11-so percent and phosphorus 0.25-0.52 percent (Majumdar et al, 1967). Yield of fodder per tree per year is about 20-45 kg and about 5 tonnes of fodder yield is expected per ha.

The pods are also used for fodder. Ripe pods contain (on dry weight basis): crude protein 11-15 percent, crude fibre 8-21%, nitrogen free extract 51-71 percent, ether extract 0.42- 3.26 percent, total ash 5-7% (Sen and Ray 1971). Generally, an average tree yields about 18 kg of pods in a year. Well stocked plantations are expected to yield about 8-10 tonnes of pods per ha per year.

**4. Other Acacia**

Several other Acacias Several other Acacia are consumed as fodder to a smaller extent in certain areas. *Acacia farnesiana*, which is thorny shrub, lopped for fodder in Punjab and Orissa. Thepods of this species are also used as fodder. The leaves of *Acacia feruginea*, which is a large tree are lopped for fodder in Tamil Nadu. *A. lenticularis* is a prickly tree which grows in sub-Himalayan tract is lopped for fodder in Uttar Pradesh, the pods of this species are also fed to cattle. *A. modesta* another species which grows in sub-Himalayan tract up to 1200 m elevation is lopped for fodder in its zone of distribution. Kumat (*A. senegal*), a smaller tree which grows in arid regions of Rajasthan, Haryana and Gujarat produces useful fodder especially for goats and camels. *A. suma* a medium sized tree occurs in Maharashtra and Madhya Pradesh. It is lopped for fodder for sheep and goats. The pods are used as fodder.

**5. *Adina cordifolia* (Haldu)**

*Adina cordifolia* (Haldu)is a tree of dry and moist deciduous forests of the country. The leaf fodder of this species is of medium quality and the tree is generally lopped for fodder. The chemical composition of leaf varies with the locality and the season of lopping. The chemical composition of leaf shows crude protein 8.68 to 12.50 %, ether extract 3.14-5.62%, crude fibre 121.10-13.84%, ash 7.72-8.22%. (Majumdar et. Al. 1967)

Average digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen free extract are 28, 20, 23 and 67 percent respectively. Total digestible nutrients per quintal of dry matter are 0 90 kg. The tender leaves are preferred for fodder by animal than the mature leaves.

**6. *Aegle marmelos* (Bel)** is tree of tropical dry deciduous forests of the country. It occurs naturally in forests and is also planted. It is considered as a good fodder tree. The chemical composition of the leaves varies with locality. The leaves contain crude protein 15.13-15.33 per cent, crude fiber 16.45-18.14 per cent, nitrogen free extract 48.37-52.83 per cent, ether extract 1.36-1.54 per cent, total ash 14.05-16.80 per cent, calcium 4.24-4.79 percent and phosphorus 0.14-0.30 per cent. Digestibility coefficients are fairly high. The value for crude protein is 71 per cent, ether extract 62 per cent, crude fibre 30 percent and nitrogen free extract 73 per cent.

***7. Ailanthus excelsa (Mahrukh)***

*Ailanthus excelsa* is indigenous to India and occurs in the southern tropical thorn forest and in moist and dry tropical mixed deciduous forest types. The leaves are considered to be highly palatable and nutritious fodder for sheep and goats. An average tree yields about 5-7 quintals of green leaves twice a year (Bhandari and Gupta, 1972). The leaves are rich in crude protein. The chemical composition on dry matter basis shows (per cent) moisture 72.56, crude protein 19.83, ether extract 3.96, crude fibre 14.26, nitrogen free extract 41.99, total ash 19.96, calcium 2.00 and phosphorus 0.26, Trees are generally lopped to feed green leaves to animals. However, some-times the leaves are dried and stored for during scarcity. Animals relish green leaves better than the dry leaves. The digestibility coefficients of nutrients are dry matter 66.33 per cent, crud protein 81,7; per cent, ether extract 35.31 %.The digestibility coefficientsare fairly high for all the nutrients. The young green leaves can be served as a maintenance ration for livestock. The leaves are marketed in Rajasthan and Gujarat where they fetch a fairly good price.

***8. Albizia chinensis***

It is a tree of tropical and sub-tropical climate, common in moist localities throughout sub-Himalayan region. The leaves of this tree are harvested for fodder. However, feeding of young leaves and continuous feeding of mature leaves as sole feed are reported to be toxic. The leaves contain 15.08 percent crude protein, 4.39 percent ether extract, 13.64 percent crude fibre, 43.61 percent nitrogen free extract, 1.15 percent calcium and 0.14 percent phosphorus. The digestibility coefficients for dry matter, crude protein, ether extract, crude fibre and nitrogen free extract are 37.8, 32.3, 40.4, 2.0 and 69.6 percent respectively. From the above figures it appears that digestibility of nitrogen free extract is high and that of crude fibre is very low. Continuous feeding gives rise to toxic manifestations such as grunting, spasmodic, bleeds, etc. The leaves should be fed mixed with other fodders.

***9. Albizia lebbeek (Siris)***

It is a tree of mixed deciduous forests both dry and moist types. The leaves of A. lebbeck are classed as good quality fodder for cattle. The chemical composition of leaves varies with locality and climate. The range of variation in chemical composition shows: crude protein 16.81-26.50%, crude fibre 26.47-37.52%, nitrogen free extract35.99-42.76%., ether extract 2.85-4.68%, total ash 7.11-11.54% calcium 1.10-2.71 percent and phosphorus 0.14-0.25 per cent.

Average digestibility coefficients are: crude protein 67 percent, ether extract 9 percent, crude fiber 41 percent and nitrogen free extract 68 percent. The tree is lopped for fodder during scarcity period. The leaves are generally given mixed with other feeds.

**10. *Albizia procera* (Safed siris)**

It is a characteristic tree of moist mixed deciduous forest and low alluvial savannah wood land. The leaves are rated as good fodder for cattle. Young saplings are also browsed by deer. The tree is lopped for fodder in almost throughout its range of distribution. Leaves contain 5.54 percent ash, 1.55 percent calcium, 3.21 percent nitrogen and 46.79 percent carbon.

**11. Other *Albizias***

*Albizia amara* a medium sized tree, found in the peninsular region of India, yields fodder especially for goats. In Tamil Nadu, the leaves are also fed to cattle. *A. lucida* a large deciduous tree, found in east-ern Himalayas is lopped for fodder especially for elephants.

**12. *Anogeissus latifolia* (Bakli)**

*A. latifolia* trees are reported to be a good fodder for cattle. The tree is mostly lopped to feed buffaloes. It occurs as an associate in the moist and dry sal forests,

southern dry mixed deciduous forests and northern dry mixed deciduous forests. The chemical contents observed in the leaves are: crude protein 7.45- 11.48 %, crude fibre 16.38-24.15 percent, nitrogen free extract 55.36 percent, ether extract 2.68- 4.41 percent, ash 8.67-10.93 percent, calcium 2.66-3.68 percent and phosphorus 0.16-0.58 percent. The chemical composition of leaves varies with locality and season. Average digestibility coefficient for crude protein is 8 per cent, ether extract 53 percent, crude fibre 32 percent and nitrogen free extract 64 percent.

***13. Anogeissus pendula (*Kardahai)**

It is a characteristic species of southern thorn forests and ravine thorn forests and occurs in Rajasthan, Madhya Pradesh and other adjoining areas. The leaves of this species are said to be moderately palatable. The tree is extensively lopped for fodder purposes. The chemical composition of the leaves shows crude protein 7.60 per cent, crude fibre 19.00 per cent, nitrogen free extract 65.30 per cent, ash 8.10 per cent, phosphorus 0.10 per cent, calcium 3.50 percent and magnesium 0.3() per cent. Mostly, the tender leaves are preferred for fodder. 14. Artocarpus heterophyllus (Kathal) It is a common tree of the moist ever-green forests of western ghats and also the tropical wet evergreen forests of the country. In greater part of the country, the tree of A. heterophyllus is lopped for fodder. Chemical composition of leaves varies with climate of the area and season of lopping. The range of variation is crude protein 11.18-14.19 percent, total ash 8.33-14.22 per cent, crude fibre 18.72-22.83 per cent, 0.52-2.15 percent calcium, nitrogen tree e\tract 46,33 57.66 lure cent and 0.11-0.30 percent phosphorus. Crude protein content decreases with the maturity of leaves; leaves lopped during the month of October have higher crude protein content than those lopped in the month of November.

**15. *Azadimchta indica* (Neem)**

It is a medium sized, dense foliage tree which occurs widely throughout India in tropical dry deciduous and thorn forests of country. It is regarded as a good fodder for cattle. The leaves are highly nutritious and arc mostly used as a substitute of green fodder. The chemical composition of leaves varies with place and season. Average chemical composition is: crude protein 12.40-18.27 per cent, crude fibre 11.40-23.08 per cent, nitrogen free extract 43.32-66.60 per cent, ether extract 2.27-6.24 per cent, total ash 7.73-18.87 per cent, calcium 0.89-3.96 percent and phosphorus 0.10-0.30 percent (Patel et. al., 1962; Ganguli et. al., 1964; Majumdar et. al., 1967; Sen and Ray, 1971). Digestibility coefficients for organic matter is 53.20 per cent, crude protein 49.00 per cent, crude fibre 65.00 per cent, nitrogen free extract 51.70 percent and carbohydrates 53.90 per cent. These values indicate good digestibility. Calcium utilization from these leaves is good due to negligible quantities of phyton and absence of anhydrous oxalic acid. Seed cake is also fed to cattle in smaller quantity.

***16. Bauhinia malabarica (*Amli)**

*Bauhinia malabarica* is a good fodder tree and is lopped heavily for leaf fodder in Madhya Pradesh, Uttar Pradesh and Orissa It occurs as a common species in sal forest, and in northern dry mixed deciduous for. Leaves contain 8.83 percent ash, 352 percent calcium, 4.56 percent carbon and 2.18 percent nitrogen,

***17. Bauhinia purpurea (*****Khairwal*****)***

It is a characteristic tree of eastern sub. montane semi-evergreen forests. It yields medium quality fodder. The tree is lopped for fodder in Assam, West Bengal, Himachal Pradesh, Madhya Pradesh, Orissa and Pun-jab. Young leaves are rich in chemical nutrients than mature leaves. Mature leaves contain 14.55 percent ash, 4.03 percent calcium, 42.30 percent carbon and 2.94 percent nitrogen.

***18. Bauhinia semla (Kandla***)

The leaf fodder of this tree is considered to be medium to good quality and the tree is generally lopped for this purpose during winters in Madhya Pradesh, Uttar Pradesh and Orissa. Chemical analysis of mature leaves shows 7.85 percent ash, 3.73 percent calcium, 46.20 percent carbon and 2.03 percent nitrogen.

***19. Bauhinia variegata (Kachnar)***

The leaves of this tree are regarded as a good fodder and the cultivation of species is advocated for leaf fodder production (Sagreiya, 1940). Average fodder yield obtained from the tree is reported to be 15-20 kg /tree (Negi et. al., 1979). Leaves contain 41.4-49.8 percent dry matter, 10.73-15.91 percent crude protein, 1.33-3.93 percent ether extract, 25.28-32.97 percent crude fibre, 40.87-51.83 percent nitrogen free extract, 6.27-12.37 percent total ash, 1.76-4.13 percent calcium and 0.20-0.38 percent phosphorus (Negi et al, 1979).The digestibility coefficient values differ with the animal fed. The crude protein and crude fibre content increases as the leaves mature.

***20. Bombax ceiba*****(Semul)**

It occurs in southern moist mixed deciduous forest, west Gangetic moist mixed deciduous forest and low alluvial savannah woodland forest types. The tree is lopped for fodder in many states of the country. The fodder yield obtained from the tree is of medium quality (Sen Gupta, 1942; Laurie, 1945; I.A.B., 1947). The leaves collected in the month of November from Dehra Dun forests contained 10.40 percent ash and 2.80 percent nitrogen. The tree is lopped for fodder particularly in Uttar Pradesh.

***21. Bridelia retusa (Kaj)***

It is a common species of northern dry mixed deciduous forest type and is also found in sal forests. Chemical analysis of mature leaves indicates the presence of 10.14-10.75 percent ash, 1.30 percent calcium, 44.20 percent carbon and 2.32-3.01 percent nitrogen. The tree is lopped in greater parts of country for fodder specially fed to buffaloes. The leaf fodder is considered to be of medium to good quality (Laurie, 1945, I.A.B., 1947). Chemical composition of mature leaves shows 10.14-10.75 percent ash, 1.30 percent calcium, 44.20 percent carbon and 2.32-3.01 percent nitrogen.

***22.. Buchanania lanzan (Chironji)***

It is a common tree of deciduous forests in India. The fodder quality of leaves is classed as medium to good. The tree is mostly lopped for buffaloes. Chemical analysis shows ash 11.990 %, calcium 2.42%, carbon 44.30% and nitrogen 1.62%.

***23. Butea monosperma (Dhak)***

It is a tree of edaphic climax types in dry deciduous forests namely Butea forests and babul savannah. The tree is lopped almost throughout its range of distribution. The leaves of the tree are rich in nutrients and are regarded as good fodder. Leaves contain 11.50 percent crude protein, 71.40 percent neutral detergent fibre, 28.60 percent cell content, 45.60 percent acid detergent, 25.80 percent hemicellulose, 11.90 percent lignin, 30.30 percent cellulose, 9.25 percent minerals, 3.30 percent calcium, 0.24 percent phosphorus and 3.20 percent silica. The digestibility values of leaves are low as compared to the total nutrients. The fodder is consumed generally during scarcity period.

***24. Careya arborea (Kumbhi)***

It is a characteristic tree of sal forests, particularly found in Kamrupsal forest type. In its natural zone of distribution, it is typical of savannah lands and grassy blanks in sal forests. It is lopped for fodder in greater part of India, its fruits are also eaten by cattle. Leaves contain crude protein 10.37 per cent, crude fibre

25.92 per cent, nitrogen free extract 42.56 per cent, ether extract 7.68 per cent, ash 7.48 per cent, calcium 1.59 percent and phosphorus 0.26 per cent.The digestibility coefficients are: crude protein per cent, ether extract 18 per cent, crude fibre MI per cent, nitrogen free extract 53 per cent. The total digestible nutrients per quintal of dry matter is 43.08 kg.

***25. Celtis australis (Khark)***

It is a tree of sub-tropical and temper-ate forests. It grows mixed with maple, chestnut and oaks in moist areas of blue pine and deodar forests. It is common tree in farmers field all over Himalayas between 1500-2500 in altitude. The chemical composition of leaves varies with season and the stage of development. Leaves contain crude protein 14.47-15.33 per cent, ether extract 2.54-5.62 per cent, crude fibre 19.45-21.45 per cent, nitro-gen free extract 42.65-49.02 per cent, total ash 11.66-17.81 per cent, calcium 3.47-4.87 percent and phosphorus 0.18 percent (Pal et al, 1979). The palatability decreases with the maturity of leaves and so the dry matter intake by the animals also decreases. The low total digestible nutrient value is due to low palatability to some extent. The digestibility coefficients observed during the month of May and October are 59.3 and 39.5 percent for dry matter, 62.7 and 42.8 percent for crude protein, 45.9 and 20.9 percent for ether extract, 43.5 and 29.8 percent for crude fibre, 74.0 and 57.6 percent for nitro-gen free extract and 59.42 and 41.22 percent for digestible nutrients respectively. Leaves lopped during summers have better nutritive value than the leaves lopped in autumn season.

***26. Cordia dichotoma (Lasora)***

It is a medium sized tree and occurs in a variety of forests ranging from dry deciduous to moist deciduous forests of Western ghats. The leaves of the tree yield a good quality fodder and are extensively lopped (or 1111 purpose. sr"::. contain crude protein 12.37-15.13 per cent, crude fibre 16.45-26.76 per cent, nitrogen free extract 41.93-52.83 per cent, ether extract 1.53-2.87 per cent, total ash 12.56-17.41 per cent, calcium 2.37-4.24 percent and phosphorus 0.24-0.30 per cent. Tannin content in leaves is 0.84 per cent. The digestibility coefficients are 71 percent for crude protein, 30 percent for ether extract, 58 percent for crude fibre and 76 percent for nitrogen free extract. The digestible nutrients reported per 100 kg dry leaves are: crude protein 5.14 kg, carbohydrate 19.00 kg and ether extract 1.12 kg.

***27. Dalbergia sissoo (Shisham)***

It is a good fodder tree and occurs in khair-sissoo primary serial type forest. The leaves of this tree are fed to cattle in greater part of the country. It is classed as medium to good quality fodder. Leaves contain 32.46 percent dry matter, 15.00 percent crude protein, 34.10 percent neutral detergent fibre, 65.90 percent cell content, 23.50 percent acid detergent fibre, 10.60 percent hemicellulose, 7.80 percent lignin, 14.90 percent cellulose, 9.80 percent total minerals, 2.00 percent calcium, 0.17 percent phosphorus and 0.80 percent silica. Green leaves contain a mucilaginous substance which causes digestive disorders. Siloed leaves show no digestive disorders. Animals take some time to develop the taste, leaves are made into silage and eaten by animals. Pods are also used as fodder during scarcity period. The chemical composition of pods shows crude protein 11.94 percent.

## 6.2.2. Fodder trees which are locally lopped but fodder value is not yet determined

**1. Acer spp. (Maples)**

Acer spp. is generally found in temperate forests in Himalayas. Several species are lopped for fodder purposes. *Acer campbellii*, a moderate sized tree, common in eastern Himalayas between 2000-3000 m elevations is lopped for fodder in Sikkim and West Bengal. *Acer campanulatum* is a moderate sized tree, which grows in Himachal Pradesh and Jammu and Kashmir between 2300-3000 m elevations is lopped locally, *Acer oblongum* growing in outer Himalayas is lopped for fodder in Jammu and Kashmir. The fodder is of medium quality. *Acer pictum* grows in north-west Himalayas above 2000 m elevation and is lopped for fodder during scarcity period. The fodder is of medium quality. *Acer villosum* is also found in Himalayas between 2000-2800 m elevations. It yields leaf fodder of medium quality and it is generally lopped locally for this purpose.

**2. *Balanites aegyptica* (Hingu)**

A shrub or small thorny tree, generally found in dry areas of Rajasthan, Gujarat and Madhya Pradesh is lopped for fodder locally. Leaves are generally fed to cattle, sheep and goats.

**3. Betula spp.**

*Betula alnoides* is a moderate sized deciduous tree, generally found in Himalayas between 1500-3000 m altitudes. The tree is lopped for fodder. Leaves are a good fodder for goats. *Betula utilis* another species is a moderate sized deciduous tree found in the inner Himalayas between 3000 to 4200 m altitude. The leaves are used as fodder during the time of scarcity.

**4. *Bischofia javanica* (Kot semla)**

It is a large sized deciduous or ever- green tree. It is found throughout the sub-Himalayan tract. The tree is lopped for fodder during scarcity period.

**5. *Boehmeria macrophylla* (Bara siaru)**

It is a shrub or small tree found in the sub-Himalayan tract upto 1200 m altitude it a considered as a good fodder tree in its range of distribution.

**6. *Boehmeria regulosa* (Genti)**

It is a small to moderate sized tree. It is mostly found in the sub-Himalayan tract and outer Himalayas upto 1200 m altitude. The leaves are lopped for fodder and are considered to be of medium quality.

**7. Brassaiopsis spp.**

***B. hispida:*** It is a small sized prickly tree. It s generally found in Sikkim and West Bengal hills upto 2100 m altitude. The tree is lopped for fodder at the time of scarcity period.

***B. mitis:*** It is a small deciduous tree. It is found in Sikkim and West Bengal hills up to 2100 m altitude. The tree is lopped for fodder at the time of scarcity.

**8. *Buchanania angustifolia***

It is a medium sized tree found mostly in the western peninsula. The tree is lopped for leaf fodder. The leaves are fed to cattle as fodder.

***9. Buxus wallichiana***

It is a small sized evergreen tree, commonly found in western Himalayas from 1,200 to 2,700 m elevation. The tree is lopped for fodder during scarcity period. Goats feed on the leaves of the tree, but the leaves are reported to have poisonous effect when fed to cattle.

**10. *Carallia brachiata* (Thekeramahi)**

It is a moderate sized evergreen tree found in evergreen and swamp forests along streams in sub-Himalayan tract and Western Ghats, The tree is lopped for fodder in Assam. The leaf fodder is considered to be of medium quality.

**11. *Carpinus faginea***

It is a moderate sized deciduous tree found in western Himalayas between 1,500 to 2,100 m elevations. The tree is lopped for fodder in Himachal Pradesh. The leaves are classed under medium to poor quality fodder.

***12. C. vimminea (Lolti)***

It is a moderate sized deciduous tree found in Himalayas between 1,500 to 2,200 m altitudes. The tree is generally lopped for fodder in Himachal Pradesh and Uttar Pradesh. Leaves are especially fed to goats. The leaf fodder is classed as medium quality.

***13. Caryota urens (Mari)***

It is an erect and tall palm. It grows in moist and shady valleys and in sub-Himalayan tract upto 1,500 altitude. The leaves are used as fodder mostly in Orissa. The chemical composition of leaves shows: 2.0 per cent crude protein, 9.3 per cent crude fibre, 22.9 per cent nitrogen free extract, 1.1 per cent ether extract, 0.35 per cent calcium and 0.23 per cent phosphorus.

***14. Casearia tomentosa (Bheri)***

It is a small deciduous tree found in plains and the sub-Himalayan tract upto 1000 m altitude. The tree is lopped for fodder in Orissa, Punjab and Uttar Pradesh during scarcity periods. The leaf fodder is considered to be of poor quality.

***15. Cassia fistula (Amaltas)***

It is a deciduous tree found almost throughout the greater parts of the country. It occurs upto 1200 m altitude in outer Himalayas. The tree is lopped for fodder only during the time of scarcity.

***16. Castanopsis tribuloides (Tumari)***

It is a moderate sized evergreen tree found in the sub-Himalayan tract upto 1800 m altitude. The tree is lopped for fodder during the scarcity period in Uttar Pradesh.

***17. Ceiba pentandra (Safed simal)***

It is a moderate sized deciduous tree commonly found in Andamans. It is also cultivated in different parts of country. Seeds are fed to cattle in Tamil Nadu.

***18. Choroxylon swietenia (Bhirra)***

It is a moderate sized deciduous tree. The tree is lopped to feed goats during scarcity in Madhya Pradesh.

***19. Cipadessa fruticosa***

It is a small tree or a shrub found in Orissa and Chhota Nagpur. The tree is lopped for fodder in Orissa during scarcity period.

***20. Cochlospermum religiosum (Kumbi)*** It is a small deciduous tree found in the plains and sub-Himalayan tract upto 1000 m altitude and occasionally in central parts of India. The tree is lopped for fodder in Maharashtra. The leaves are especially fed to buffaloes.

***21. Cordia macleodii (Dhaiman)***

It is a small tree occurring in Central India, Rajasthan, Bihar and Orissa. The tree is lopped for fodder in Maharashtra and Uttar Pradesh. The leaves are especially fed to buffaloes.

***22. C. rothi (Gundi)***

It is a tree commonly found in the dry areas of the country. The tree is lopped for fodder in areas of its natural occurrence during scarcity period.

***23. C. vestita (Kumbi, Kum)***

It is a small sized deciduous tree. It generally found in the sub-Himalayan tract upto 1200 m altitude. The tree is lopped for fodder in Uttar Pradesh. The leaf fodder classed under medium quality.

***24. Cornus capitata***

It is a small deciduous tree common in outer Himalayas. In Himachal Pradesh an Uttar Pradesh, the tree is lopped for fodder at the time of scarcity. The leaf fodder considered to be of poor quality.

***25. C. macrophylla (Kagshi).*** It is a moderate sized deciduous tree occurring in western Himalayas between 1,200-2,500 m altitudes. In Himachal Pradesh and Uttar Pradesh, the leaves are fed animals only during scarcity. The leaf fodder is of poor to medium quality.

**26. *C. oblonga* (Bonnvi)**

It is a small deciduous tree found outer Himalayas between 1000-2000 m altitudes. The tree is lopped for fodder in Himanchal Pradesh and Uttar Pradesh and is considered to be of medium quality fodder.

**27. *Corylus colurna* (Thangoli)**

It is a moderate sized tree found western Himalayas between 1,500-3,000 elevation. The tree is lopped for fodder in Himachal Pradesh. The leaves are fed specially to goats.

**28.** ***Cotoneaster bacillaris*** **(Reus)**

It is a shrub or a small tree occurring in North-west Himalayas between 1.500 to 3,000 m altitudes. The tree is lopped for fodder in Himachal Pradesh. The leaves are fed to goats and sheep.

**28.** ***Crataeva nurtula*** **(Biliana)**

It is a moderate sized tree. It is found throughout the sub-Himalayan tract and central parts of the country. The tree is lopped for fodder in Uttar Pradesh and is dassed under medium quality fodder.

**30.** ***Cyclostemon assamicus*** **(Chipla)**

It is a small sized tree found throughout the sub-Himalayan tract and Andamans. The tree is lopped for fodder in Assam. The leaves are considered to be poor quality fodder and generally fed during the time of scarcity.

**31.** ***Dalbergia lanceolaria*** **(Tantosi)**

It is a large sized deciduous tree found in Bihar, Sikkim and Maharashtra. It is lopped for leaf fodder in Maharashtra. The leaves are specially fed to buffaloes.

***32. D. latifolia (*****Sissoo)**

It is a moderate sized tree, found in greater part of the country. The tree is lopped for leaf fodder in Madhya Pradesh, Tamil Nadu and Orissa.

**33.** ***D. sissoldes***

It is a large sized deciduous tree, generally found in southern parts of country. The leaves are browsed by cattle in Tamil Nadu.

**34.** ***Delonix elata***

It is a small sized tree, mostly found in western peninsular region and is cultivated throughout the country. The tree is lopped for fodder at the time of scarcity in its range of distribution.

***35. Dichrostachys cinerea (Kumlai)***

It is a small thorny shrub or a small tree. It is mainly found in central parts of India and Rajasthan. The tree is sparingly lopped for fodder. The pods are fed to cattle.

***36. Diospyros chloroxylon***

It is a large shrub or a small tree found in central and southern parts of India. It is common in Maharashtra and Orissa. The tree is lopped for fodder in areas of its natural occurrence. The leaf fodder is rated as good quality fodder.

***37. D. montana (*****Birtendu*****)***

It is a moderate sized deciduous tree. It is found almost throughout India in deciduous forests. In Maharashtra, the tender leaves are used as fodder.

Other species of *Diospyros viz., D. pere grine and D. sylvatica* are lopped for fodder in Maharashtra and Orissa in the scarcity period.

38. ***Diploknema butyracea (*****Phalwara**)

It is a large deciduous tree occurring in the sub-Himalayan tract upto 1500 m altitude. The tree is lopped for fodder in Uttar Pradesh and West Bengal. The leaf fodder is rated as good quality fodder.

***39. Dolichandrone atrovirens***

It is a moderate sized tree and is com monly found in deciduous forests. The tree is lopped for leaf fodder in Tamil Nadu.

***40. Dolichandrone falcata (Dudga)***

It is a moderate sized tree found in Madhya Pradesh, Maharashtra and Tamil Nadu. The tree is lopped for fodder in its range of distribution. The leaf fodder is rated as medium quality fodder.

***41. Dracaena angustifolia (Bakripatti)***

It is a shrub to a small sized tree gen- erally found in the plains and Himalayas upto 1000 m altitude and Andamans. The tree is lopped for fodder in Andamans. The leaves are fed to goats as fodder.

***42. Engelhardtia colebrookiana***

It is a moderate sized tree found in the sub-Himalayan tract upto 1800 m elevation. The leaves of the tree are used as a cattle feed throughout its range of distribution.

***43. Eriobotrya bengalensis***

It is a large sized evergreen tree found in Khasi hills, Manipur, Sikkim and West Bengal. The tree is lopped for fodder in its range of distribution during scarcity period.

***44. Erythrina suberosa (Pangra)***

It is a moderate sized tree, found in the deciduous forests throughout the country. The tree is lopped for leaf fodder in Assam, Madhya Pradesh, Uttar Pradesh and Maha- rashtra. The composition of leaf varies with place and hence the quality of fodder is reported to be variable.

***45. E. variegata (Pangra)***

It is a moderate sized tree found in the coastal region of the country. The tree is lopped for fodder in the coastal region of the country. The tree is lopped for fodder in Maharashtra. It is rated to be a medium quality fodder.

***46. Euonymus lacerus (Pichhoi)***

It is a small deciduous tree. It occurs in Himalayas between 1,800-3,300 m altitude. The leaves are lopped for fodder during scarcity throughout the range of distribution.

***47. Evodia fraxinifolia***

It is a medium sized aromatic tree found in outer Himalayas between 1,200-2,100 m elevation. The tree is lopped for fodder in West Bengal. At places the tree is cultivated for fulfilling fodder needs.

***48. Ficus clavata (Khanoi)*** It is a small tree or shrub, found in outer Himalaya's upto 1800 m elevation. The tree is lopped for fodder in Uttar

Pradesh and the leaf fodder is rated to be a good quality fodder. When fed to calves it shows adverse effects.

***49. F.elastica***

It is a large evergreen tree found in outer Himalaya's upto 1500 m altitude. The tree is lopped for fodder in West Bengal. The tree provides good quality of leaf fodder.

***50. F. gibbosa (Chirwal)***

It is a medium to large sized tree found throughout the sub-Himalayan tract and western peninsula. The tree is lopped for fodder in its region of distribution.

***51. E nemoralis (Dudhla)***

It is a small tree found in Himalayas between 800 to 2,400 m altitudes. The tree is planted and lopped for cattle fodder in West Bengal.

***52. F. tomentosa***

It is a large tree found in Maharashtra, Madhya Pradesh and Western Peninsula. The tree is lopped for leaf fodder in Uttar Pradesh. The leaves are rated as medium quality fodder.

***53. Fraxinus xanthoxyloides (Sanjal)***

It is a shrub or a small tree found in western Himalayas between 900-2700 m elevation. The leaf fodder is considered as a good quality fodder. The tree is lopped for this purpose in its range of distribution.

***54. G. glabra (Kath bewal)***

It is a small sized tree found in moist and shady places along ravines throughout India. It occurs upto 800 m altitude in outer Himalayas. The tree is lopped for fodder in Tamil Nadu and adjoining states. The leaves are classed as medium quality fodder.

***55. Hibiscus tiliaceus (Bola)*** It is a small sized tree found in the tropical forests commonly in Sunderbans and Andamans. The tree is lopped for fodder in its range of distribution. The chemical composition of the leaves is 11.8 per cent protein, 48 per cent fat, 52.1 per cent starchy material, 21.5 per cent crude fibre and 99 per cent ash

***56. Juglans regia (Walnut)***

It is a large deciduous tree commonly occurs throughout the Himalayas upto 3000 m elevation. The tree is lopped for leaf fod- der in its range of distribution. The chemical composition of leaves shows 3.22 per cent nitrogen and 11.57 per cent ash. Oil cakes are also fed to cattle.

***57. Litsea monopetala (Singran)***

It is a moderate sized evergreen tree found in Assam, West Bengal and Uttar Pradesh. The tree is lopped in these regions for fodder. The leaves are reported to be of medium quality.

***58. L umbrosa (Sharur)***

It is a middle sized tree, found in Himalayas between 1,200-2,500 m elevation. The leaves yield medium quality leaf fod- der.

***59. Machilus bombycina***

It is a moderate sized tree. It commonly occurs in Assam and West Bengal. The tree is lopped for fodder in Assam. The leaf fodder is rated as medium quality.

***60. M. duthiei (Kewla)***

It is a moderate sized evergreen tree growing along ravines and streams in col shady places. In Himalayas, it occurs up to 2000 m altitude. The leaves are classed as medium quality fodder and the tree is lopped for this purpose in Assam and Uttar Pradesh

***61. M. odoratissima (Kaula)***

It is a moderate sized tree of outer Himalayas and extends upto 2000 m altitude. The tree is lopped for fodder in Punjab, Himachal Pradesh, Uttar Pradesh and West Bengal. The tree yields leaf fodder of medium quality.

***62. Mallotus tetracoccus***

It is a medium sized tree found in Western ghats, West Bengal and Assam. The tree is lopped for fodder in West Bengal. The leaves are rated as medium quality fodder.

***63. Meliosma dilleniaefolia (Shapra)***

It is a small sized deciduous tree, found in Himalayas between 1200-3200 m altitudes. The tree is lopped for fodder in Himachal Pradesh and West Bengal. The tree yields medium quality leaf fodder.

**64.** ***M. wallichii***

It is a moderate sized deciduous tree found in Sikkim, West Bengal and Khasi hills. The tree is lopped for fodder in West Bengal. It is reported to yield medium quality leaf fodder.

**65.** ***Miliusa velutina (Domsal)***

It is moderate sized deciduous tree found throughout the sub-Himalayan tract upto 500 m elevations. The tree is lopped for fodder during scarcity period in Uttar Pradesh.

**66.** ***Mimusops elengi (*****Mulsari)**

It is a large evergreen tree found throughout the Western Ghats and Andamans. The tree is lopped for leaf fodder in Maharashtra. It yields fodder of medium quality.

**67.** ***Myrsine semiserrata (*****Chupra)**

It is a large shrub or a small tree. The species is found in outer Himalayas between 800-2500 m elevations. The leaves are rated as medium quality fodder and the tree is lopped for fodder in Uttar Pradesh.

**68.** ***Nyctanthes arbortristis (*****Harsingar)**

It is a large shrub to a small tree. The tree is found in sub-Himalayan tract and outer Himalayas. The tree is lopped for leaf fodder in Madhya Pradesh, Himachal Pradesh and Uttar Pradesh. It yields leaf fodder of medium to poor quality.

**69. *Ochna Jabotapita***

It is a small tree or large shrub growing in Assam, Bihar, Orissa and Western Peninsula. The tree is lopped for leaf fodder in Maharashtra and Orissa. The leaves are generally fed to buffaloes.

**70. *Phoenix acaulis (*Wild*)***

It is a short palm found in the sub- Himalayan tract upto 1200 m altitude. The tree is lopped for leaf fodder in Orissa. The leaves are classed as medium quality fodder.

**71. *Pistacia integrrima* (Kakra)**

It is a medium sized deciduous tree, found in the outer Himalayas between 400- 1800 m altitude. The tree is lopped for leaf fodder in Himachal Pradesh and Uttar Pradesh. The leaf fodder is regarded to be of medium quality.

**72. *Premna Latifolia* (Bakar)**

It is a moderate sized deciduous tree, found in mixed forests in sub-Himalayan tract upto 600 m also common in Uttar Pradesh, Bihar, Orissa and West Bengal. The tree is lopped for fodder in its range of distribution. The leaves are rated as good fodder.

**73. *Prosopis chilensis* (Vilayati kikar)**

It is a moderate sized tree, often found in the dry region of the country. The fresh foliage is fed to livestock. The pods are considered to be a good feed to livestock,

**74. *Prunus cornuta (Jamana)***

It is a medium sized deciduous tree, often found between 1,200-3,000 m altitude in Himalayas. In Himachal Pradesh and Uttar Pradesh, the leaves are lopped for fodder. The leaves are fed to goats and buffaloes and are considered to be good fodder.

***75. Rhododendron arboreum (*Chiu, Burans*)***

It is a small sized evergreen tree, often found in outer Himalayas between 1,500 and 2,500 m altitude. The tree is lopped for fodder in Uttar Pradesh. The leaves are specially fed to sheep and goats.

***76. Salix wallichiana (*Bhains)**

It is a small deciduous tree often found Himalayas between 800-2,400 m elesation. The tree is lopped for fodder in Uttar Pradesh. The leaves are specially fed goats and sheep.

**77. *Santalum album (*Chandan)**

It is a small evergreen tree found scat tered in central to south India. The tree is

***78. Trewia nudiflora (*Tumri*)***

It is moderate sized deciduous tree, found in the plains and sub-Himalayan tract upto 800 m altitudes and in moist and swampy places. The tree is lopped for fodder in Maharashtra, Tamil Nadu and Uttar Pradesh. The chemical composition of mature leaves is 2.01 per cent nitrogen and 3.05 per cent calcium.

## 6.2.3. Fodder Yielding Shrubs, Herbs and Climbers.

There are number of shrubs, herbs and climbers which yield valuable fodder and are generally lopped or cut for this purpose. The fodder yielding shrubs and climbers are given in table 3.

**Table 3: Important Shrubs and Climbers yielding fodder**

| **Species** | **Part Used as fodder** |
|---|---|
| *Bauhinia vahlii* (Malu) | Leaves |
| *Berbaris asiatica* (Darhaldi) | Fruit |
| *Berberis chitria* (Kingora) | Leaves |
| *Cotoneaster microphylla* (Bhedda) | Leaves and Branches |
| *Daphane papyracea (*Chamua*)* | Leaf |
| *Debregeasia longifolia* (Tusari) | Leaves and Young shoots |

| | |
|---|---|
| *Ficus arnottiama* (Paras Peepal) | Leaves |
| *Ficus tinctoria* (Chanchri) | Leaves |
| *Indigofera cassioides* (Sakena) | Leaves and Young branches |
| *Phonix acaulis* (Khajur) | Young leaves |
| *Rhammus Purpurea* | Leaves |
| *Rosa sericea* (Jangli gulab) | Leaves |
| *Rubus ellipticus* (Hishalu) | Leaves and young twigs |
| *Salvadora oleoides* (Jhal) | Seed cake |
| *Viburnum cotnifolium* | Leaves and Young branches |
| *Ziziphus nummularia* (Ber) | Leaves and Young Fruits |

## 6.3. Present status of fodder production in India

Fodder production in India varies greatly across the country, and its use is determined by cropping pattern, climate, socioeconomic conditions, and the type of cattle. Cattle and buffaloes are often fed fodder from cultivated regions, with collected grasses and top feeds supplementing it to a small extent (Shashikala et al., 2017). Fodder crops are cultivated or harvested for feeding the animals in the form of forage (cut green and fed fresh), silage (preserved under anaerobic conditions) and hay (dehydrated/dried green). Sorghum (2.6 M ha) and Egyptian clover (1.9 M ha) account for roughly 54% of the total cultivated fodder area in the kharif and rabi seasons, respectively (Dagar, 2017). Farmers are growing grasses and legumes including hybrid Napier, guinea grass, para grass, velvet bean, stylo, etc. in many areas. Farmers with small ruminants, in particular, pick

tree-top fodders in times of scarcity. The area covered by permanent pastures and other grazing land is 10.34 M ha (Directorate of Economics & Statistics, DAC&FW, 2020) and has been decreasing over time, with the tendency likely to continue. The productivity of pastures has also been falling due to overgrazing (Pathak & Dagar, 2015). Crop residues are expected to provide 54% of total fodder, while rangelands provide 18% and only 28% is met from cultivated fodder crops (Hegde, 2010).

There is currently a net deficiency of 35.6% green fodder, 10.95% dry fodder and 44% concentrate feed materials in the country (IGFRI Vision, 2050). By 2050, the demand for green and dry feed will be 1012 and 631 million tones, respectively (Figure 1). In the year 2050, with the current rate of expansion in forage supplies, there will be an 18.4% deficit in green fodder and a 13.2% shortfall in dry fodder (Figure 2). Green forage supply must rise at a rate of 1.69% per annum to satisfy the deficit; however, the area under cultivated fodder accounts for only 4% of the total cultivated land (8.4 million ha) in the country, and has remained unchanged over last few decades. (Dagar, 2017; Halli et al., 2018; Meena et al., 2018).

Different states are affected by the shortfall in different ways. While the shortage is minor in Punjab and Haryana, where fodder accounts roughly 8% of total cultivable land, it is severe in arid areas such as Bundelkhand, where fodder is grown on less than 2% of cultivable land. Despite the fact that various government agencies have implemented several plans to alleviate the fodder production, there is no reputable survey or study that evaluates the situation of fodder production on ground, and central/state governments dismiss the scarcity of fodder on the thin premise that no comprehensive data on fodder production exists. Whatever researches are available in the public domain are merely speculation (Jitendra, 2017).

Crop residues, cultivated fodder, and fodder from community re- sources like permanent pastures and grazing lands are the three main sources of fodder in India. There is a big gap in fodder availability anddemand due to multiplicity of forage crops grown in different seasons and regions, non-commercial nature of crops, and production of forage with minimal inputs from degraded and marginal land (Ghosh et al., 2016). Further, since it is not cost-effective to transport forages across long distances, regional and seasonal deficits are more critical than national deficiencies. Also, because the available forages are of poor quality and lack adequate energy, protein and minerals, farmers main- tain huge herds of animals to compensate for low productivity, put- ting further pressure on fodder and other natural resources (Palsaniya et al., 2008, 2009, 2010). Feed and fodder accounts for over two-third of total animal production costs (Ginwal et al., 2019), hence, any effort to increase feed and fodder availability and economizing the feed cost will result in better remuneration to livestock farmers.

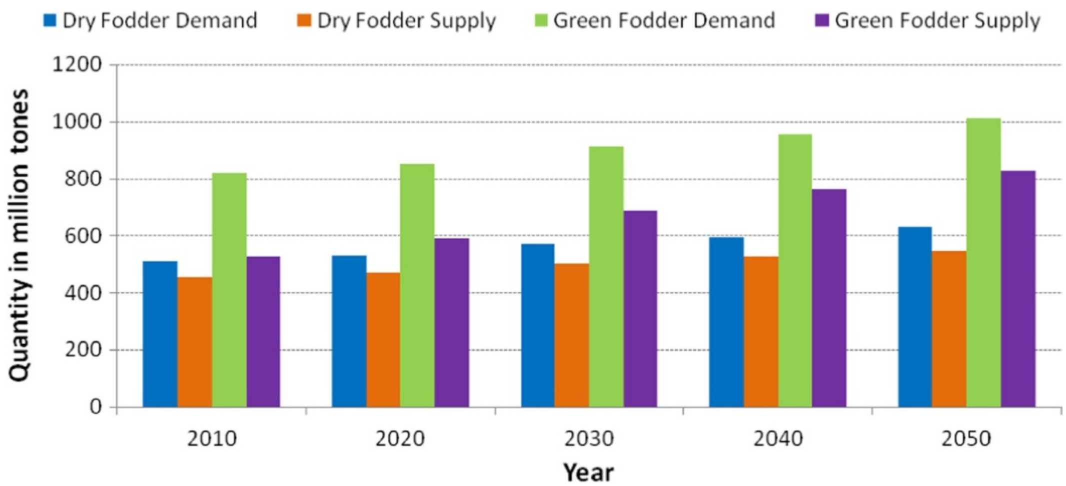


Fig. 1: Year wise Demand and supply of green and dry fodder in India (source: IGFRI Vision, 2050)

## 6.4. Opportunities in Fodder Production

At current prices, the livestock sector contributes about 28.63% of the total value of output in the Indian agriculture and allied sector. During the fiscal year 2018–19, the livestock sector contributed about 4.19% of total GDP (Anonymous, 2021). Milk production has expanded dramatically over the previous few decades, and India has surpassed the United States to become the world's largest milk producer (187.7 million tonnes in 2018–19) (Economy Survey 2020–21, 2021). This increase

in milk production has primarily been attributed to an increase in the cattle population, as the productivity of our livestock has remained extremely low among major milk producing countries. While the average milk yields of cattle around the world and in Europe in about 2238 and 4250 kg per lactation, respectively; the average yield of Indian cattle is only about 1538 kg per lactation (IGFRI Vision, 2050; Vijay et al., 2018).

The main reason for our livestock's low productivity is malnutrition or under-nutrition caused by a wide disparity in demand and supply of feed and fodder in the country (Prajapati et al., 2019). Due to shortage of green fodder, particularly during the summer months, dairy farmers have been feeding a disproportionate amount of concentrates to their animals in order to maintain milk production. According to a study published in the Archives of Animal Nutrition in 2018, 'Feeding of concentrates is required during the early lactation period to meet the nutritional requirement of milch animals. The concentrate feeding indeed increases milk production, but it also leads to rumen acidosis and causes severe health problems in dairy cows'. This practice disrupts the balance in the gut microbiota, causing more toxins to be released and resulting in liver damage. Therefore, careful balancing of livestock ration is necessary to mitigate these risks. Forages are thought to be most nutritious and cost- effective feed for dairy animals (Iqbal et al., 2015; Rehman & Raja, 2020). Thus, the availability of green fodder is critical for animal health and productivity, particularly in case of dairy enterprises where a consistent sup- ply of green fodder is imperative for sustainable milk production. Green fodder provides vitamins and minerals along with energy, and improves digestion. It has been found that by upgrading the feeding system based on green fodder, the cost of milk production may greatly be reduced (Jha & Tiwari, 2018). Forages are 5–14 times cheaper source of important feed ingredients like digestible crude protein and total digestible nutrients than concentrates (Agrawal et al., 2008). Growing fodder crops in combination with legumes has the potential to improve fodder palatability and digestibility (Kumar et al., 2016; Kumar, Kumar, et al., 2018).

Although the green revolution has advanced Indian agriculture, the livestock sector has been unable to expand beyond artificial insemination (AI) and veterinary services, and it continues to be a subsidiary activity. The development of forage resources is more complicated issue than that of food and commercial crops. Farmers are also not very interested in fodder production due to the non-commercial nature of fodder crops; most often degraded and marginal lands are used for forage production with minimal fertilizer, water and human resources inputs. Therefore, considering the low productivity of farm animals and huge gap in demand and supply of green fodders, there is a great opportunity for improvement in live- stock sector by increasing fodder production in India.

## 6.5. The Way Forward to Supply Green Fodder

Approaches to increase supply of green fodder include: (1) increasing area under cultivated fodder crops, (2) increasing productivity of existing cultivated fodder crops through adoption of improved and innovative cultivation technologies, and by enhancing the availability of quality seeds/planting material of fodders crops, (3) inclusionof fodder crops in cropping systems on rotational basis, (4) fodder production from marginal land, (5) hydroponic fodder production and (6) exploring alternative sources of fodder like azolla, and (7) overcoming the dry fodder shortage by efficient utilization of crop residues like rice and wheat straw. However, due to demographic pressure for food crops, the scope for further expansion of area under cultivated fodders appears to be quite limited.

### 6.5.1. Increasing fodder productivity

Increasing the production of fodder crops per unit land area is one of the potential options for meeting livestock fodder needs. Forage cultivation, being a soil-based production system that extracts nutrients from the soil, requires efficient approaches for replenishing mined nutrients in the soil for sustaining the productivity (Palsaniya and Ahlawat, 2009). The majority of fodder crops belongs to Poaceae family and have high nutrient requirement, therefore, proper nutrient management measures should be prioritized to boost forage production and sustain the livestock production and productivity. So the nutrient management in fodder-based cropping sequence is a key to the higher production and maintenance of soil fertility. In recent years it has been realized that integrated nutrient management (INM) is the best way of achieving higher system productivity and maintaining soil health on sustainable basis (Antil & Raj, 2020;

Babu et al., 2020; Yadav et al., 2007). Under crop + livestock integrated farming system, avail- ability of organic manure is not a problem for INM. Therefore, it can be adopted as a successful strategy to improve the fodder productivity.

## 6.5.2. Enhance availability of good quality seed

Non-availability of quality seeds of forage crops is also limiting fodder productivity in India. Only 25%–30% of the required quantity of quality seeds is available in cultivated fodders and less than 10% in rangeland grasses and legumes. So, there is need to evolve superior varieties of forage crops with high yield and quality, and also development of new technologies for multiplication (Thomas & Thomas, 2019).

The fodder seed shortage can be addressed by intensifying the planning and strategy for uplifting the production of forage seeds. This includes creating awareness about the importance of using high quality seed of improved varieties, increasing the seed replacement rate from the present 2%–3% to at least 10%, establishing an appropriate seed chain to produce sufficient quantity of certified seed for farmers, improving the seed chain network, seed production through farmer participatory approach, improving proper marketing facilities, con- ducting research to increase the ovule to seed ratio in forages, channelizing the existing demand towards entrepreneurship development, improving crop management, village seed banks development, utilizing forest waste lands for the seed production, and application of new research innovations such as in vitro maturation, exogenous chemical application, high density nursery for rooted slip production, harvesting based on morphological indicators, hormonal spray for enhancing seed setting, seed pelleting in range grasses etc. (Palsaniya et al., 2010; Vijay et al., 2018).

Seed production is quite difficult in forage crops as compared to other crops. There are mainly two systems of forage seed production viz., opportunist system, an informal system in which forage particularly range species' seed harvesting is done from existing grasslands/ rangelands and specialist system, in which seed production forage crop is planted for seed production. This system requires technical guidance to grow the crop. For successful working of this system it requires an assured market and reasonable prices for the seed (Malviya et al., 2013). The seed production in a specialist system re- quires a certain package of practices (Table 2) to follow for enhanced seed yield. To achieve standard seed quality, proper isolation has to be followed along with regular roguing off-types/volunteer plants.

## 6.6. Problems faced by fodder growers

Fodder production does not require the intensive use of inputs. On the marketing front, the price in the market fluctuates vigorously with the supply in market.

In Karnataka, the highest percentage of problems is reported with respect to access to credit, labour availability, high expenditure on production, seed quality and access to technical knowledge.

In Punjab, supply of poor quality and un-recommended varieties of seed, shortage of labour especially during harvesting of the crop, lack of technical knowledge, acquisition of credit were the major problems faced by the fodder growers during production of these crops in the study area. One of the major problems faced by the dairy farmers and commercial fodder production farmers in India is, the lack of availability of high yielding varieties of fodder seeds. In India, the National Policy for release of high yielding variety of fodder seeds, the way it is done for the high yielding and better quality grain varieties, is badly lacking. This is a major bottle neck in enhancing good quality fodder production in this country. Policy planners need to pay special attention towards this burning problem, and thus, ease out the problem regarding fodder shortage in the country.

### 6.6.1. Marketing problems

Problems in respect of non-availability of market information in time and transport facility at reasonable rate. As fodder being high volume low value crop, transportation of fodder has become a very costly affair. Hence, demand of fodder is not coming from the distant places. Across different seasons, problems relating to marketing of fodder do not vary much.

**Low price in the market.**

The sharp fluctuations in prices in wake of even small changes in production/supply are another serious concern impacting the cultivation of these crop choices as prices are dependent upon the demand of fodder by dairy owners on the particular day.

**Terminal Questions:**

1. Discuss present status of fodder production in India
2. What problems are faced by the fodder growers?
3. Give any 10 species used as a good fodder.

# Unit 7. Wild fruits/ Edible plants

**Unit Structure**



## 7.1 Learning Objectives

After studying this unit, you should be able to:

- Understand the wild edible plants of Himalayan region
- Know the indigenous uses of wild edible plants

## 7.2 Introduction

Non wood forest products (NWFPs) have emerged as a vital income-generating and source of employment for rural poor in all parts of the world. There are about 600 species of wild edible fruit plants found in India. In the Indian Himalaya alone 675 wild edible plant species are found, out of them 344 occur in the west Himalaya. Despite this diversity of wild edibles, limited attempt have been made to assess the status of their occurrence and availability, harvesting trends, and the potential of wild edibles to generate income. In the present section we have tried to document in detail the most promising edible plants that occur in the Himalayan region. A brief description of the other important wild edible plants has also been discussed in brief.

## 7.3 Important Wild Edible Plants

### 7.3.1 *Myrica esculenta* (Kaphal)

*Myrica esculenta* (local name Kaphal), known for edible fruit is a potential income-generating species in the sub-Himalayan region. *M esculenta* is a medium-sized, dioecious, evergreen tree widely distributed between 900–2100 m asl in the Indian Himalaya from Ravi eastward to Assam, Khasi, Jantia, Naga, and the Lushi Hills and extending to Malaya, Singapore, China, and Japan (Osmaston 1927). This species is well known for its edible fruit and other by products, and has emerged as a potential income generating species in Uttarakhand. The popularity of the species can be judged from the fact that local people of the region can earn over Rs. 14.00 lakh/ season from selling the fruits of the species. The bark of *M. esculenta* yields tannin, which is used commercially as tanning and dyeing material. The bark of the plant is astringent carminative and antiseptic. In Khasi hills the bark of this species is used as a fish poison. The species is known for its unique medicinal and industrial uses. Myriconol has been isolated from stem bark, which has lesser toxicity than related rotenone. The bark also contains yellow colouring substances in the form of glycoside, quercitin, βsitosterol taraxerol and trirterpindiol. Glutamine and aspargine are reported to the principle amino acids in *Myrica* species.

The species of *Myrica* are recognized for their nitrogen fixing capacity (Becking 1977; Benson and Silverster, 1993; Muckun*et al.* 1993). The ecological importance of genus *Myrica* is of being non-leguminous angiosperm, nodulated by *Frankia* spp. Nodulation of *Myrica gale* has been studied well. This species is used as fodder in some parts of Uttarakhand and Himachal Pradesh. The species is extensively used as a fuel throughout the hilly region. The wood has high density with the highest biomass/ ash ratio amongst some of its associated woody species like *Alnus nepalensis*, *Aesculus indica* and *Juglans regia* etc. the species competes well with other species in its fuel wood value index equaling almost with *Quercus semecarpifolia*.

### 7.3.2 *Diploknemabutyracea* (Cheura)

Cheura (*Diploknemabutyracea*) belongs to the family Sapotaceae and popularly known as Indian Butter Tree which is mainly found in Uttarakhand state. This multipurpose tree is also known as Phulwara, Fulwa, Pahari Mahua, Gophat or Indian Butter Tree in Kumaun region of Uttarakhand state. It is a medium size deciduous tree with straight trunk attaining a height of 15-22 m and girth 1.5-1.8m, but in Andaman Islands, it reaches a height of 21-36 m and the girth of 1.5-2.4 m. Commercially, the Cheura oil extracted from the seeds is marketed as Phulwara Ghee. Cheura is a native of Nepal and distributed from India through Nepal to Philippines and from Uttarakhand eastwards to Sikkim and Bhutan (Sub-Himalayan tracts and outer Himalayan ranges). It also occurs sporadically in tropical moist deciduous, semi-deciduous and evergreen forests of Andaman Islands. It is a fast growing tree borne oilseed and found in the elevation ranges between 400-1400 meters mainly along the sides of ravines and in shady valleys.

Cheura starts flowering in the months of October- November at the age of 8-10 years. Its flowers are either white or yellow colour with a special fragrance. Generally, an alternate bearing has been observed in this tree. The fruits start ripening in June-July. Fruits are oval in shape and initially with green colour which turns light yellow after ripening during June-July. Fruits are harvested during second week of June till July end. Ripened Cheura fruits with grey and light blackish in colour are harvested manually either by hand or locally made bamboo stick. Average fruit yield per annum is about 100-250 kg/tree. The fruits are eaten and are sweet. Cheura is used as food, fodder and medicines in Kumaun hills and called Kalp- Vriksha. Its flowers are rich source of sugar and utilized for preparation of Gur (juggery) like products and for fermentation (alcohol). Cheura products are usually handled by the local farming community in Kumaun and are used mostly for household consumption. The price of the fruit is determined by the dryness of the fruit. Dried fruit fetches a higher price to a raw fruit. Large and fleshy Cheura fruits are considered of good quality. Some of the consumers of the Kumaun region of Uttarakhand have been using Cheura ghee since decades are habituated in the consumption of ghee(NOVOD Report 2002).

### 7.3.3 *Prunus armeniaca*(Wild Apricot)

The wild apricot (*Prunus armeniaca*) is an important tree borne oilseed crop of mid hills and dry temperate regions of the country. In the Himalayan region, local communities known it by different vernacular names viz. ”Chulli”, “Shara”, “Khurmani”,”Chulu” etc.

The cultivated apricot has its origin in North-Eastern China, whereas, wild apricot appears to be indigenous to India. Wild apricot locally called Chullu is found in the dry temperate region of Uttarakhand. The Chullu tree is about 10-15 m tall with a reddish brown bark. Leaves are ovate to round, approximately 5-9 cm long. Flowers are solitary, white or pinkish about 2.5 cm across, borne singly and appearing much in advance of the foliage. Fruits are around 1.5-4.0 cm across or more and hairy when young but nearly smooth skinned at maturity. The appearances of the ripened fruits are yellowish with light red cheek and nearly glabrous. The flesh is yellow or yellowish orange to firm and sweet. Stone is smooth with a thickened furrowed edge. It starts bearing fruits at the age of 4-5 years and continues to bear well for 50-60 years. The full bearing occurs at about 10-15 years when it yields about 85-100 kg. fruits per tree. The stone yield varies from 12-17 percent of fruits and the kernel yield ranges 3.14 - 4.81 kg/tree. The yield of a full- bearing well maintained plant tree varies from 120-150 kg(NOVOD report, 2006).

Wild apricot fruits generally start maturing during from last week of May and continue up to August end depending upon altitude and location. They are harvested manually by shaking the tree branches and no mechanical harvesting is practiced. Change of surface colour, from full bloom to harvesting and fruit total sugar solids are considered as the best indices of maturity. Fully ripened fruits are harvested for freezing, canning and drying. The fruits should be harvested in morning hours and direct exposure of fruits to sun should be avoided during grading and packaging tree. Apricot is a good source of sugars and vitamin A and contains appreciable amounts of thiamine and iron. Fresh Indian wild apricots yield 86% of edible matter. The wild apricot fruits yield 22-38% percent kernels, which may be sweet or bitter depending on the type. Sweet kernels resemble almonds in taste and are used as its substitute in pastes and confectionery and can be added to apricot jams.

The wild apricot is unfit for table purpose due to high acids and low sugars. It is not processed for any commercial product at present although studies for preparation of sauces and chutney from this fruit have given quite encouraging results. The major portion of the crop pulp is utilized by the tribals in Himachal Pradesh and Uttarakhand for the preparation of distilled alcoholic liquor. The fruits are highly perishable and can be preserved in a number of ways. They are frozen, candied or made into a paste. In some countries, fruit pulp is cooked and thinly spread on cloth and then rolled and dried and it constitutes an important food. A number of products are prepared from fruits of apricot. Its fruits mixed with those of cultivated types are utilized in Himachal Pradesh in production of number of products like apricot jam, apricot nectar and apricot papad. The strained baby food from pulp is nutritious and a good source of calcium, phosphorus and iron. The oil of seed is edible and oil cake can be used as organic manure.

### 7.3.4 *Embilica officinalis* (Aola)

Aola (*Embilica officinalis)* belongs to family *Euphobiaceae.* It is native to India and also known as Indian gooseberry. This is a small to medium sized deciduous tree, 8-18 meters high with thin light grey bark, leaves are light green having the appearance of pinnate leaves; flowers are greenish yellow, in axillary fascicles, unisexual, males numerous on short slender pedicels, females few, subsessile, ovary 3-celled; fruits globose, fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds in 2-seeded 3 crustaceous cocci. The tree is found throughout India, the sea-coast districts and on hill slopes up to 200 meters, also cultivated in plains. The fruits are sour, astringent, bitter, acrid, sweet, cooling, anodyne, ophthalmic, carminative, digestive, stomachic, laxative, alterant, aphrodisiac, rejuvenative, diuretic, antipyretic and tonic. They are useful in vitiated conditions of tridosha, diabetes, cough, asthma, bronchitis, cephalalgia, ophthalmopathy, dyspepsia, colic, flatulence, hyperacidity, peptic ulcer, erysipelas, skin diseases, leprosy, haematogenesis, inflammations, anemia, emaciation, hepatopathy, jaundice, strangury, diarrhoea, dysentery, hemorrhages, leucorrhoea, menorrhagia, cardiac disorders, intermittent fevers and greyness of hair.

Aola fruit has been used as valuable ingredient of various medicines in India and abroad. Aola is highly nutritious and is an important dietary source of vitamin C, minerals and amino acids which is resistant to storage and heat damage due to cooking. The edible fruit tissue contains protein concentration 3-fold and ascorbic acid concentration 160-fold compared to that of the apple. The fruit also contains considerably higher concentration of most minerals and amino acids than apples. Glutamic acid, proline, aspartic acid, alanine, and lysine are 29.6%, 14.6%, 8.1%, 5.4% and 5.3%, respectively of the total amino acids. The pulpy portion of fruit, dried and freed from the nuts contains gallic acid 1.32%, tannin, sugar 36.10%;

gum 13.75%; albumin 13.08%; crude cellulose 17.08%; mineral matter 4.12% and moisture 3.83%. Aola fruit ash contains chromium, 2.5 ppm; zinc 4 ppm; and copper, 3 ppm.

A small to medium sized deciduous tree, 8-18 meters height with thin light grey bark exfoliating in small thin irregular flakes, leaves are simple, subsessile, closely set along the branchlets, light green having the appearance of pinnate leaves; flowers are greenish yellow, in axillary fascicles, unisexual, males numerous on short slender pedicels, females few, subsessile, ovary 3-celled; fruits globose, fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds in 2-seeded 3 crustaceous cocci. Found throughout India, the sea-coast districts and on hill slopes upto 200 meters, also cultivated in plains.The fruits are sour, astringent, bitter, acrid, sweet, cooling, anodyne, ophthalmic,carminative,digestive, stomachic, laxative, alterant, aphrodisiac, rejuvenative, diuretic,antipyretic and tonic. They are useful in vitiated conditions of tridosha, diabetes, cough, asthma, bronchitis, cephalalgia, ophthalmopathy, dyspepsia, colic, flatulence, hyperacidity, peptic ulcer,erysipelas, skin diseases, leprosy, haematogenesis, inflammations, anemia, emaciation, hepatopathy, jaundice, strangury, diarrhoea, dysentery, hemorrhages, leucorrhoea, menorrhagia, cardiac disorders, intermittent fevers and greyness of hair1-6. Amla is becoming increasingly well known for its unusually high levels of Vitamin C, which is resistant to storage and heat damage due to cooking.

*Emblicaofficinalis*is effective in the treatment of amlapitta (peptic ulcer) and in dyspepsia. The fruits exhibit hypolipiadaemic and antiatherosclerotic effects in rabbits and rats. The fruit extract has antimutagenic activity on certain directly acting mutagens in some strains of *Salmonella typhimurium*. The extract of Aola also has antimicrobial properties. Amlaki is an antioxidant with free radical scavenging properties which may be due to the presence of high levels of super oxide dismutase.

### 7.3.5 *Pyrus pashia*(Indian wild Pear)

Indian wild Pear (*Pyrus pashia)* belongs to family Rosaceae. The cultivation of the pear in cool temperate climates extends to the remotest antiquity, and there is evidence of its use as a food since prehistoric times. Many traces of it have been found in the Swiss lake-dwellings. Pears are native to coastal and mildly temperate regions of the Old World, from Western Europe and North Africa east right across Asia. They are medium sized trees, reaching 10–17 m tall, often with a tall, narrow crown; a few species are shrubby. The leaves are 2–12 cm long, glossy green to densely silvery-hairy, broad oval to narrow lanceolate in shape. Most pears are deciduous, but one or two species in southeast Asia are evergreen. Most are cold-hardy, withstanding temperatures between −25 °C and −40 °C in winter, except for the evergreen species, which only tolerate temperatures down to about −15 °C. The flowers are white, rarely tinted yellow or pink, 2–4 cm diameter, and have five petals. Flowering takes place in March–April and fruiting in August–September. Like that of the related apple, the pear fruit is a pome, in most wild species 1–4 cm diameter, but in some cultivated forms up to 18 cm long and 8 cm broad; the shape varies in most species from oblate or globose, to the classic pyriform 'pear-shape' of the European Pear with an elongated basal portion and a bulbous end. The pear is very similar to the apple in cultivation, propagation and pollination.Pears and apples cannot always be distinguished by the form of the fruit; some pears look very much like some apples. One major difference is that the flesh of pear fruit contains stone cells (also called "grit"). Another interesting difference is that apples, when placed carefully in water, will float; pears will sink. Fruits are eaten raw. The fruit is usually bletted, but even then it is not sweet. Tasty when fully ripe, even when dried. The fully ripe fruit has a reasonable flavour and, when bletted, is sweet and very pleasant. A mature tree yields about 45kg of fruit per year. The fruit contains about 6.8% sugars, 3.7% protein, 1% ash, 0.4% pectin. Vitamin C is very low, about 1.2 mg per 100g. The juice of the ripe fruit is used in the treatment of diarrhea. Wood -

compact fine grained, hard, durable, liable to split and warp during seasoning. Used for small implements, walking sticks and fuel.

### 7.3.6 *Pinus gerardiana*(Chilgoza Pine)

*Pinus gerardiana*, known as the Chilgoza Pine**,** is a pine native to the northwestern Himalaya in eastern Afghanistan, Pakistan, and northwest India, growing at elevations between 1800-3350 m. It often occurs in association with Blue Pine (*Pinus wallichiana*) and Deodar Cedar (*Cedrus deodara*). It belongs to family Pinaceae. The trees are 10-20 m tall with usually deep, wide and open crowns with long, erect branches. Trees with a girth of up to 4 meters (approx. 127 cm dbh) are reported. The branchlets are smooth and olive-green. The leaves are needle-like, in fascicles of 3, 6-10 cm long, spreading stiffly. The cones are 10-18 cm long, 9-11 cm wide when open, with wrinkled, reflexed apophyses and an umbo curved inward at the base. The seeds (pine nuts) are 17-23 mm long and 5-7 mm broad, with a thin shell and a rudimentary wing. Chilgoza Pine is well known for its edible seeds, rich in carbohydrates and proteins. The seeds are sold as dry-fruits by the name "Chilghoza". The seed is eaten as dry fruit chilgoza. The seed is also anodyne and stimulant. The oil obtained from the seeds is used as a dressing on wounds and ulcers; it is also used externally in the treatment of head diseases. The turpentine obtained from the resin of all pine trees is antiseptic, diuretic, rubefacient and vermifuge. It is a valuable remedy used internally in the treatment of kidney and bladder complaints and is used both internally and as a rub and steam bath in the treatment of rheumatic affections. It is also very beneficial to the respiratory system and so is useful in treating diseases of the mucous membranes and respiratory complaints such as coughs, colds, influenza and TB. Externally it is a very beneficial treatment for a variety of skin complaints, wounds, sores, burns, boils etc. and is used in the form of liniment plasters, poultices, herbal steam baths and inhalers.

In Afghanistan, this species is cultivated for its edible seed, and efforts are underway to expand its economic utilization in India. Elsewhere, native populations are ruthlessly exploited, with typically 100% of cones harvested. This harvest pressure is driven by subsistence and for the economic benefits that it provides. As a consequence, there is virtually no natural regeneration of this species except in that very small fraction of its range (about 5%) where the species is inaccessible to significant human exploitation. Besides, Chilgoza pine is also a good soil binder, which ultimately checks the soil erosion in dry temperate zones, where it grows. Though it has not been exploited commercially for oleoresin, owing to its limited distribution and to avoid destruction of the trees in order to get more valuable nuts, yet there is plenty of scope for resin extraction once large areas will be under this species. Reckless cone extraction and almost complete lack of natural regeneration have led Chilgoza pine to brink of extinction, which deserves immediate attention for genetic conservation and improvement. This species is listed as lower risk, near threatened. Overcutting, and intensive grazing causing poor regeneration, may result in the extinction of this pine species. The Himachal Pradesh State Forest Department has tried artificial regeneration of Chilgoza Pine at many places. However, performance of seedlings was found to be very poor.

## 7.3.7 *Rubus ellipticus*

*Rubus* is a large genus of flowering plants in the rose family, Rosaceae, subfamily Rosoideae. Raspberries, blackberries, and dewberries are common, widely distributed members of the genus. Most of these plants have woody stems with prickles like roses; spines, bristles, and gland-tipped hairs. The blackberries, as well as various other *Rubus* species with mounding or rambling growth habits, are often called brambles. It is a prickly bramble with long arching stems, 13 ft long. Leaf compound with 3 leaflets,thick, hairy, terminal leaflet 3 inches long by 2.5 inches wide. Flowers white in terminal clusters. Fruit yellow, 0.3 inches long. Among the different Himalayan species of *Rubus*, *R. ellipticus*(Yellow Himalayan Raspberry) is a native to India and South Asia. This shrub, growing up to 2 m tall is clothed with prickles and reddish hairs. The alternate leaves are compound with three round to blunt leaflets 5-10 cm long. The flowers are small, white with five petals. The fruit is a round yellow cluster of druplets easily detaching from the receptacle. Flowering occurs in February-April followed by fruiting. The prickly shrub invades native forests principally in pig-disturbed habitats. The plant has underground shoots that contribute to its spread and allow it to rapidly regenerate following a fire. The fruits are edible and frugivorous birds spread the seeds. A purple to dull blue dye is obtained from the fruit.

The plant is astringent and febrifuge. A decoction of the root, combined with *Girardiniadiversifolia* root and the bark of *Lagerstroemia parviflora*, is used in the treatment of fever. The juice of the root is used in the treatment of fever, gastric troubles, diarrhoea and dysentery. A paste of the roots is applied externally to wounds. Both the roots and the young shoots are considered to be a good treatment for colic. The leaf buds, combined with *Centella asiatica* and *Cynodondactylon*, are pounded to a juice and used in the treatment of peptic ulcers. The juice of the fruit is used in the treatment of fever, colic, coughs and sore throat. The inner bark is used in Tibetan medicine, it is said to have a sweet and sour flavour plus a heating potency. A renal tonic and antidiuretic, it is used in the treatment of weakening of the senses, vaginal/seminal discharge, polyuria and micturation during sleep.

The plant is grown to deter soil erosion and is good for soil conservation. It is easily grown in a good well-drained loamy soil in sun or semi-shade. This plant is cultivated for its edible fruit in southern U.S.A. The fruit is sometime sold in local markets in the Himalayas. Another species of *Rubus (Rubus lasciocarpus)* is a large, rambling, throny shrub upto 3 m high and 2.5 cm in diameter, met within the temperate Himalayas from Kashmir to Sikkim at 1,200- 3,000m. It also occurs in the Western Ghat at higher elevations from Kanara southwards. The fruit is dark purple or blackish, round, 0.8-1.3 cm in diameter. It resembles blackberry and is very palatable (Mehta, 1981).

### 7.3.8 *Aegle marmelos* (Bael)

This is a small to medium sized thorny tree. It is wild in the sub-Himalayan tract, and central and south India; it is often planted all over the plains and foot hills. The fruit is woody, grey or yellowish, round, 5 - 17.5 cm in diameter, containing numerous seeds embedded in a mass of sweet, orange coloured aromatic pulp. The ripe fruit is sweet and cooling. It is used in the form of *sherbet* or for making jams and preserves(Dwivedi, 1993)..

### 7.3.9 *Agave Americana* (Century plant)

This plant is a native of America, found in India only as an ornamental plant in gardens. On cutting of the young flower head, a large quantity of juice is obtained. This, when fermented yields *pulque*, the national drink of Mexico; the distilled spirit is known as *mescal*. In times of scarcity, the flowering stalk and the pulp of the lower part of the leaf are used as food.

### 7.3.10 *Anthocephalus cadamba* (Kadam)

This is large tree occurs in the sub- Himalayan tract from Nepal eastwards to Assam and in the south in the Northern Circars and Western Ghats. A spirit is distilled from the flowers. The ripe fruits are edible.

### 7.3.11 *Artocarpus heterphyllus* (Kathal)

This is a large evergreen tree found wild in the forests of the Western Ghats, but is cultivated more or less throughout India. The fruit is large, oval, tubercled, 0.3-0.6 m long by 0.2-0.4 m broad, hanging by stalk from the trunk and larger branches. It is actually an aggregation of the fruit produced by a number of flowers. The individual fruits are often called flakes, which consists of a seed surrounded by a pulpy mass of luscious tissue. Unripe jack fruit is used as a vegetable or made into pickles. The ripe fruit is eaten or made into preserves. The seed is eaten as a vegetable or roasted and eaten as such(Dwivedi, 1993).

### 7.3.12 *Artocarpus lakoocha* (Lakooch)

This is a large deciduous tree, found in the outer hills of Kumaun and in Sikkim, Assam, Bihar, Orissa, Madhya Pradesh, The Western Ghats and The Andamans. The unripe fruits are made into pickles. The ripe fruit, which has a sweetish taste, is eaten.

### 7.3.13 *Bauhinia vahlii*

This is a gigantic climber abundantly distributed in the sub-Himalayan region upto 900 m and also found in Assam, Madhya Pradesh and Bihar. The seeds are eaten raw or fried. When ripe they taste like cashew-nuts. The roots are boiled and eaten like potato in times of scarcity.

### 7.3.14 *Bauhinia variegata*

This is a moderate- sized deciduous tree, found in the sub-Himalayan tract from Jhelum eastward, as also in dry deciduous forests of eastern, central and southern India. It ascends to 1,200 m, preferring low hills. It is also cultivated as an ornamental tree. The flower buds and leaf buds are edible as vegetable.

### 7.3.15 *Diospyros melanoxylon* (Coromandel ebony)

This is a medium sized to large tree, up to 1.8m in girth and 15m high, occurring in the IndianPeninsula, extending northwards to parts of Madhya Pradesh, Orissa and Bihar. The fruit is globose, 2.5- 4.0 cm in diameter. The fruit contains a sweetish- astringent pulp which is much relished by the local population.

### 7.3.16 *Juglans regia* (Walnut)

This is a large deciduous tree, found in the temperate Himalayas from Kashmir to Bhutan at 900-3000 m and extensively cultivated in the region. The fruit is ellipsoidal about 5 cm long with a green leathery aromatic fruit-coat enclosing a 2- valved woody nut inside which is the edible kernel. The wild variety has a very small kernel and is rarely eaten. The fruits of cultivated varieties contain large kernels which from an important article of diet of the local people. A sweet oil expressed form the kernels is used for culinary purpose in the hills.

### 7.3.17 *Madhuca indica* (Mahua)

This is a large deciduous tree. It is found all over India in deciduous forests and is often planted in Central and Northern India. The oil extracted from the kernels of the fruit is largely used in Central and Southern India for culinary purposes and as a cheap substitute for ghee. The fruit is sometimes eaten. The succulent flowers are eaten raw or cooked and are also made into sweetmeats. Average annual yield of flowers per tree is about 100 kilograms. It is estimated that some 25,000 tonnes are gathered in India every year. A spirit distilled from the flowers is consumed by the local people. Alcohol is also made from the flowers on a large scale.

### 7.3.18 *Madhuca longifolia*

This is a large tree found in the forests of peninsular India from the Konkan southwards to Kerala and in the Anamalais and the Circars at low elevations. The uses of flowers, fruits and seeds are the same as for *M. indica*. The tree is often cultivated in parts of Tamil Nadu.

### 7.3.19 *Mangifera indica* (Mango)

This is a large evergreen tree found in moist forests of southern India and elsewhere. It is also extensively cultivated as an avenue tree and in gardens and near villages up to 1,200 m elevation. The fruits are ovoid, 5-15 cm long, fleshy, compressed, containing a hard and fibrous stone. The mango is one of the most important and popular fruits of India and is consumed both ripe and unripe in many different ways not only as a delicacy but also as a food. It is extensively cultivated in orchards, with numerous named varieties. The mango kernel is also used as a food in times of scarcity. Ripe fruits of the wild mango, found in the forests of southern India, are not edible; tender fruits are, however, much in demand for pickling.

### 7.3.20 Morchella esculenta (Morel)

This is fleshy fungus is abundantly found in Kashmir, as also in Chamba, Kangra and elsewhere in Himachal Pradesh and parts of Uttarakhand. This is most important among the Indian edible fungi. It is eaten in curries and pulaos, fresh or dried.

### 7.3.21 *Syzygiumcumini*(Black plum)

This is a large evergreen tree, found all over India and is often planted as an avenue tree or in gardens. The fruit, which is sub acid and rather astringent, is largely eaten by all classes of people. It improves in taste when shaken with a little salt. A wine resembling port in taste and colour is prepared from the fruits. Vinegar is also manufactured.

### 7.3.22 *Tamarindus indica* (Imli)

This is a large tree cultivated throughout tropical India. It is self-sown in waste places and in forest lands all over the Peninsula. The acid pulp of the ripe fruit is used extensively as an ingredient in food preparation throughout India. It can also be used for making jams and syrups. The seeds with the outer coat removed, contain starch and can be eaten after boiling or roasting. Commercial starch is made from the seeds. The flowers and tender leaves are made into curries and chutneys.

### 7.3.23 *Zizyphusnummularia*

This is a gregarious, tomentose, throny shrub, occasionally growing into a small tree 4.5 m high and 15 cm in girth. It is found in the arid and dry regions of Punjab, Rajasthan and the Peninsula. The ripe fruits are eaten. The seeds are soaked in water and the decoction strained and drunk as a cooling beverage and as a great thirst-quencher.

### 7.3.24 *Ziziphus oenoplia*

This is a straggling or climbing thorny shrub, found very commonly throughout the hotter parts of India from the Punjab and N.W. Himalayas to Assam and South India. The fruits are small, black, round, about 0.6 cm in diameter, with a stone inside. The sweet, somewhat acid, fruits are eaten locally.

## 7.4 Summary

There are several wild edible plant species found world wide. In India 600 species of wild edibles are found and still more are discovered gradually. Of the 675 wild edible plant species in the Indian Himalaya, 344 occur in the west Himalaya. The important wild edible fruit plants are *Myrica esculenta*, *Prunus armeniaca, Diploknemabutyracea, Embilica officinalis*, *Pinus gerardiana*, *Pyrus pashia, Rubus ellipticus* etc. All species have their own food and medicinal value. These species can be instrumental in enhancing the livelihood options in the Himalayan region. However, most of these species are facing the danger of their over-exploitation from the nature. Attempts are therefore required to increase their population in wild and also cultivating them in wasteland.

**Terminal Question**

1. Give a brief description of wild edible fruit plants found in India.
2. Describe in detail the characteristics and importance of any five of the wild edible fruit plants found in Uttarakhand.
3. How can the wild fruit plants useful for poverty alleviation of rural people?
4. Describe the nutritious and medicinal value of some important wild fruit plants of India.

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# Unit 8: NTFPs: Bamboos and canes

**Unit Structure**



## 8.0. Learning Objectives

After you have studied this unit you should be able to understand about:

- What are Bamboo and Canes?
- How Bamboos are regenerated?
- Bamboo stocking and some important Bamboo species.
- Propagation and Harvesting of Bamboos.
- Important species of Canes.

## 8.1. Introduction

Often described as the poor man’s timber, bamboos are very important in the everyday lives of the people of South and Southeast Asia. It finds many uses such as for fodder, fuel, food, fiber, medicine for making baskets, mats, scaffoldings, bridges and also as a raw material for the manufacture of pulp and paper. Canes are also close associates of bamboos and find multiple uses.

Bamboos and canes are one of the most important groups of forest produce utilized for a variety of purposes. They resemble the woody timber trees in their form and strength and therefore, they are largely used as a substitute for timber.

Once considered as weed in forests, these species are now regarded as the most versatile and useful forest plant species. When uses of bamboos were restricted, they were cheap and used by poor people in place of timber. That is why perhaps bamboos are known as poor man's timber. These are however, no more poor man's timber but much sought after material for several purposes.

Bamboos belong to the tribe of Bambuseae of the family Gramineae. There are about 30 genera and 550 species of bamboos in the world. Asia accounts for more than 300 species of bamboos. Out of these, about 130 species occur in India; of them 100 species are indigenous (Gaur, 1987). The most important genera of bamboos found in India are *Arundinaria, Bambusa, Chimonobambusa, Dendrocalamus, Dinochloa, Gigantochloa, Indocalamus, Oxytenanthera, Phyllostachys, Melocanna, Pseudoxytenanthera, Ochlandra*, etc.

India is one of the leading countries in the world as far as bamboo resources are concerned. Bamboo constitutes a rich flora of varied species, composition and density in the country. It occurs almost throughout the country but is widely distributed in Assam, Bihar, Meghalaya, Manipur, Tripura, Mizoram, Arunachal Pradesh, Western Ghats, Andaman and Nicobar Islands, Madhya Pradesh, Maharashtra, Orissa, Andhra Pradesh.

## 8.2. Morphology

Bamboos are perennial grasses of extremely gregarious habit. The stems of these species are called culms, which arise from woody rhizomes. The culms generally grow in a group which is termed as a clump. The point on a stem from which a leaf grows are said to be nodes. The stem looks jointed and these joints are nodes. Nodes are spaced along stem with internode between them. The portion between the two nodes is called internode. Important parts of a bamboo plant are shown in figure 1. A bamboo plant consists of three distinct morphological components: (i) the leafy aerial part called culm, (ii) the underground rhizome and (iii) underground roots.

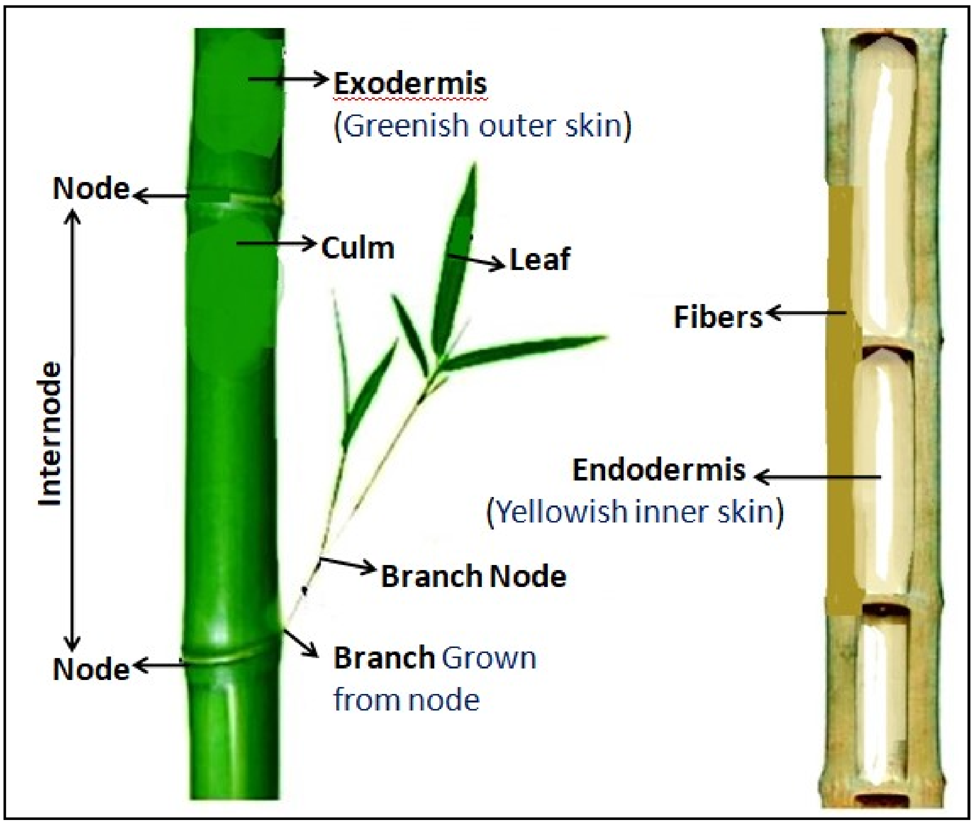


**Fig 1: Important parts of a bamboo plant**

**1) Culm**

Bamboos can be classified into three broad groups: (i) sympodial or clump forming bamboos as in Dendrocalamus and Bambusa, (ii) monopodial i.e. erect and non- clump forming bamboos as in Melocanna and Phyllostachys and (iii) climbing as in Dinochloa. The sympodial forms are found in tropical zone, the monopodial forms are found in sub tropical zone and climbing forms are generally found in temperate zone. Bamboos vary in size from lofty forms to small thin sticks. Sometimes the stems are as high as 30 m in height and as thick as 30 cm in diameter as in *Dendrocalamus giganteus* and *D. brandisii*. Some of the bamboo species are shrubs and climbers e.g. Arundinaria and Dinochloa respectively.

Buds on rhizome nodes develop within the soil before the tender shoots emerge as pointed cones completely covered with sheath. Rhizomes sprout in the beginning of the monsoon generally during the month of May-July. Shoots elongate rapidly and in a period of about 3-4 months, before branching they attain the maximum height. The rate of growth is very fast. Some species grow about one meter in 24 hours. At this stage, culm sheath covers the lower part of each internode and disappears when culms grow old. Most of the bamboos have hollow culms. Only some species such as *Dinochloa* spp. and *Bambusa pygmaea* have solid culms.

The culm sheaths are modified leaves arranged alternatively in two opposite ranks, which protect tiers of new culms. The sheath is attached at the nodes, clasp the clump and fall when culms become old. These sheaths are of vital importance to culms during and before the growth. Each internode is carefully wrapped in a single sheath, but basal nodes are always with more than one sheath.

The sheath works as a nurse to the culm. It protects the culm against injury and desiccation. The outer surface of the sheath is covered with a cluster of stiff hairs, which gets detached easily by a light touch. They cause irritation to touched part of the human body.

The culm above the ground is a complete aerial shoot irrespective of the size. There is no terminal bud in the culm and consequently no terminal growth. The height growth in a culm takes place due to the successive elongation of the internodes. The lowest internode which is near the ground grows first and the top most at the last.

**ii) Rhizome**

The basal portion of the culm usually swollen with shoot internodes, grows horizontally and remains at the soil surface or slightly below is called rhizome. Bamboo rhizome is an underground modification of stem. Rhizome bears several buds, flat in shape usually less than 2.5 cm in diameter and is covered with scales. The scales are the underdeveloped sheaths. Each bud contains a complete bamboo in its embryo. A bud has about 35 or more telescopic inter- nodes. Sympodial rhizomes are solid, short and thick. Only their lateral buds produce new rhizomes each of which eventually produce a solitary culm. The sympodial form ensures that each new culm will have its own new roots to meet its needs. The constricted proximal portion of the rhizome which develops first is known as 'neck'. The short necked rhizome develops dense clumps. Long necked rhizomes develop loose clumps in which culms are not tightly packed. When the rhizome neck is longer, it has a capacity to invade larger area. Monopodial rhizomes continue horizontal growth until constrained by branches bearing lateral buds, most of which give rise to culms directly. They are long, slender and hollow. The slender roots coming out of the rhizomes are the feeding organs. They grow from a few centimeter to about a meter in length.

**iii) Root**

The roots of the bamboos form the underground portion of the plant and remain within 1 m depth of the soil surface. Some of the roots coming out from rhizomes generally help in nutrition.

## 8.3. Habitat and distribution

Bamboos are widely distributed almost throughout the country, almost in every state. The distribution of this species is governed by the climatic and edaphic factors. Bamboo species mostly require high rainfall, but few species thrive even in areas having rainfall range even less than 750 mm. *Dendrocalamus strictus*, a species of bamboo found in high rainfall areas (more than 1000 mm) is also found in Banswara, Udaipur, Chittorgarh and Sirohi (Rajasthan) having rainfall of about 500 mm. The important species found in high rainfall areas *include bambusa arundinacea, B. tulda, B. polymorpha, Dendro calamus strictus, D. hamiltonii*, etc..

Bamboo species thrive in almost all types of soil except in very dry soils. Most of the bamboo species form a luxuriant crop on deep and fertile soils. Best growth is found on loamy soils, sandy loams and clayey loams. Only a few species grow on hill tops and depleted soil. *Dendrocalamus strictus* grows well in well-drained soils while *Bambusa bambos* prefers valley bottoms and stream banks. *Schizostachyum longispathus* is capable of growing in ravineous areas. *Schizostachyum helferi* grows in moist humid valleys in evergreen forests. A large number of species are tropical in nature and are distributed in tropical moist deciduous and evergreen forests of the country. *Dendrocalamus hamiltonii* is gregarious on cooler aspects of lower hills of terai belt and *Melocanna baccifera* on southern aspects. *Bambusa tulda, B. balcooa* and *B. bambos* occur on the plain areas. *Bambusa nutans, Dendrocalamus sikkimensis* and *Arundinaria intermedia* occur up to 1200 m altitude, while *Schizostachyum polymorphum* is found between 1200-2000 m altitude and *Arundinaria racemosa* above 2000 m elevation. They require a temperature range of 10° to 30°C, however, sub-tropical and temperate areas also contain some species of bamboos.

In tropical dry deciduous and tropical moist deciduous forests, bamboos form an important component of forest biomass. Bamboos are also significant in tropical evergreen forests. They do not form a pure crop and are usually found associated with tree canopy where they form understory crop. In case of secondary brakes, they form almost a pure crop.

## 8.4. Silvicultural characters

Generally, in forests bamboos occupy the place where tree canopy is broken. The gaps or clear space which exists in the canopy are occupied by different species of bamboos. Most of the bamboos are light demander. Wherever, bamboo is found as an under- storey crop, the growth is poor. Most of the species of bamboos are susceptible to fire and grazing. Rapid decline in the area of *Dendrocalamus strictus* in several states is primarily due to heavy incidence of grazing and fire. These factors are inimical to the establishment of regeneration. Repeated cuttings and fire also cause adverse effect on the growth of many bamboo species.

**Phenology**

Bamboos are monocarps therefore, most of the species after a long earth bound existence, suddenly produce flowers, set seeds and die. Mostly, bamboo species have two types of flowering 6) sporadic flowering and (ii) gregarious flowering. In sporadic flowering, only a few culms in a clump flower and flowered culms die and not the entire clump. In gregarious flowering, usually the whole crop of the area flowers at a same time. In this type of flowering, almost all clumps involving all culms flower and subsequently die. It may take a few years to complete the gregarious flowering. It occurs like a wave beginning at one end of the area and culminating at the other end. The period between two gregarious flowerings over the same area is observed to be constant for a species and is usually called physiological cycle.

## 8.5. Uses of Bamboos

The available data given in table 26 indicate the physiological cycle for various bamboo species (Suri and Chauhan, 1984). The physiology of bamboo flowering is not fully understood. There is a widespread belief that bamboo flowering synchronizes with famine years. It is also observed that prior to the gregarious flowering; the formation of new culms in clumps almost stops.

Bamboos have multiple uses. The stems are used for structural purposes for different constructional purposes and as a raw material for paper and pulp industries. More recently, other uses of stem such as laminated bamboo, bamboo parquet, etc. have also gained commercial importance. Tender shoots of several species of bamboo are edible. Seeds of a few bamboo species are edible. Leaves of most of the species are a good fodder for livestock. Leaves and tender shoots are also used for medicinal purposes. In India, bamboos are used for various purposes.

Mechanical strength properties of bamboos depend upon the species, locality factors of growth, age and moisture content. Mechanical strength increases up to 3-4 years. It also increases with decrease in moisture content. The drier bamboo is much structural component for low cost house construction.

Bamboos are extensively used in rural housing. They are used in the construction of houses and huts. They are used as rafters, posts, trusses, purlins, roof ridges, coverings, walls, floorings, doors and windows, scaffoldings, etc. The outer surface of bamboo is smooth, clean and hard enabling its easy use for specific purpose. There is no wastage as there is no bark. Most of the bamboo species possess high tensile strength and elasticity.

As compared to other constructional timbers, bamboos possess better strength to weight ratio and can suitably be used for structural purposes. Due to its physical form with nodes and cross partition walls, bamboo results in light weight but stronger

**(i) Construction purposes**

Bamboos are largely used as a substitute for timber. Due to the good strength properties, straightness and lightness combined with hardness, bamboos are extensively used for construction purposes.

**(ii) Traditional and handicraft items**

Bamboo is largely used by handicraft industries due to its strength properties, light weight, straightness (erectness) combined with hardness. Almost all the species of bamboo are easy to work and take a good polish and finish. There are a large number of traditional and fancy items which can be easily made out of bamboo. These items include agricultural implements, anchors, arrows, back scratches, baskets, beds, binds, boats, bottles, bows, bridges, brooms, brushes, buildings, caps, cart-yokes, caulking material, chairs, chicks, chopsticks, coffin, combs, containers, cooking utensils, cordages, dust-pans, fans, fences, fish-traps, fishing-nets, fishing rods, flag-poles, floats for timber, flutes, flower-pots, food baskets, fuel, furniture, hats, handicrafts, haystack stabilizer, hedges, hookah-pipes, joss-sticks, kites, ladders, ladles, lamps, lance staves, lanterns, lining of hats and sandals, loading vessels, masts, match-sticks, mats, milk vessels, musical instruments, nails, net- floats, ornaments, support for pan (betel) vines, pens, polo-mallets, rafters, roofing ropes, sails, scaffolding, scoops, seed-drills, shoes, shuttles, slats, sports goods, sprayers, stools, sticks, tallies, tables, tobacco pipes, umbrella-handles, walking sticks, walls, water vessels and wrappers. toys, tool-handles, traps, trays, tubs,

**(iii) Paper and pulp**

Most of the bamboo species yield high grade chemical pulp suitable for making writing, printing and different kinds of quality paper. It is known that bamboo is com- posed of two main types of tissues, namely; fibres and vessels (parenchyma tissues). The fiber filaments constitute about 60-70 per cent (on weight basis). The parenchyma tissue plays a negative role in the pulping process. More recently, a process has been developed through which parenchyma can also be pulped to increase the total yield of pulp. Most of the bamboo species provide, long fiber material commonly used in India for paper and pulp industries. The paper and pulp industries depend on bamboo species for the supply of long fiber material.

**(iv) Bamboo parquet (Block flooring):** The term parquet is applied to the flooring, in which strips, 3.81 cm x 6.71 cm, are cut and laid out in geometric pattern.

**(v) Laminated bamboo**

The bamboo culms are cracked or split, spread out and flattened into sheets with suitable binding and filling material. These sheets are then combined, lapped, arranged, glued, treated and pressed to the desired form. These are then cut and trimmed to different size and shape.

**(vi) Bamboo strip for aircraft**

The bamboo-woven mat glued to wood or laminated to other bamboo mat is used in light aircraft has been studied. The material has been found to be relatively stronger and its fatigue strength and under bending stress is much higher than that of wood. The bond strength of bamboo to bamboo is fairly comparable to the bond strength between bamboo and wood.

**(vii ) Bamboo-reinforced concrete**

Bamboo reinforced concrete was first used in China in the year 1919 in concrete (x) piles in railways. Since then, the possibility of bamboo reinforcement is being thoroughly investigated and used in many countries.

**(viii) Artificially shaped bamboo**

Bamboo can be made to grow into different shapes. It can be shaped into square, rectangular and triangular shapes for low cost housing, handicrafts, decoration items and cottage industries. Japan has successfully grown artificially-shaped bamboos Production of such bamboos is simple like molding hollow blocks, but needs practice. The artificially shaped bamboos are expected to be stronger than the round ones.

**(ix) Medicinal uses**

White silicious secretion known as Banslochan is exuded from the hollow internodes of some of the bamboo species, which carries high medicinal properties. It is mainly composed of silicic acid. The residue obtained on ignition, contains 99 per cent of silica. It is valued as stimulant and febrifuge and is useful as a cooling tonic and an aphrodisiac. It is also used in the treatment of asthma, cough, paralytic complaints and other debilitating diseases. Some of the species of bamboo produce abundant white powder on the surface of young culms. This powder is used for making sex hormones. Bamboo leaves also possess medicinal properties. Decoction of leaves is fermented and used in the treatment of fevers and for blood purification. Leaves of *Bambusa bambos* are emmenagogue in Ayurveda, for blood purification, leucoderma and for the treatment of inflammatory conditions. Leaves are also used in the treatment of bronchitis, gonorrhea and fever.

**(x) Edible shoots and gum**

Tender shoots of several bamboo species are used in curries and pickles. They are considered delicacy by local population. The tender shoots are soaked in water, boiled and made into curries. Important species yielding edible shoots are *Bambusa tulda, B. bambos, B. multiplex, B. polymorpha, B. vulgaris, Dendrocalamus hamiltonii, D. strictus, D. giganteus, D. longispathus, Dinochloa andamanica, Gigantochloa rostrata, G. pseudoa- rundinacea, Melocanna baccifera, Schizosta chyum* spp., etc. These shoots are sometimes marketed also. Flowering culms in dry localities exude a sweet brittle gum, which is edible and contains saccharine.

Bamboo shoots contain cyanogenic or glucosides which on hydrolysis yield hydrochloric acid. Tips of immature shoots con- tain hydrochloric acid to the extent of 0.05 to 0.50 per cent. Cooking destroys the enzymes responsible for hydrolysis. While cooking, if water is changed several times, the toxicity is removed. In several countries, bamboo is cultivated for edible shoots and about 10 tons of edible shoots per ha can be obtained. Bamboo shoots are not highly nutritious, but are a good source of thiamine and niacin, which are the members of vitamin B- complex. Tender shoots of *Bambusa bambos* contain 88.8 per cent water, 3.9 per cent protein, 0.5 per cent fat, 5.7 per cent carbohydrate and 1.1 per cent minerals. They also contain thiamine, riboflavin, niacin and vitamin C.

Bamboo seeds are consumed by poor's during famine. Seeds of *Bambusa bambos* contain protein content comparable with wheat in quality and with rice comparable in quantity. Seeds of several species of bamboo can be eaten without any adverse effect on human health. In rats, a complete replacement of rice by bamboo seeds in diet enhanced the rate of growth in rats by 50 per cent.

**(xi) As fodder**

Leaves of several bamboo species are used as fodder. Young leaves and twigs are relished by elephants. Leaves of *Dendrocalamus strictus,* the most common bamboo are widely used as fodder. Leaves of this species on dry matter basis contain crude protein 15.09 per cent, crude fiber 23.15 per cent, ether extract 1.43 percent and ash 18.33 per cent. The digestible crude protein and digestible nutrient content are 93.34 and 48.91 per cent respectively indicating very high digestibility.

## 8.6. Regeneration of Bamboo

Natural regeneration Bamboo forests are regenerated naturally as well as artificially. Profuse natural regeneration of bamboo occurs after gregarious flowering. Under favorable conditions of moisture and temperature, sufficient number of seeds germinates during the rainy season. After rainy season, regeneration starts, and the entire field appears like a mat of grass. Regeneration is better in areas where mineral soils are exposed. These seedlings need replacement or thinning out after one or two years. The thinned out seedlings are properly tended and protected. In due course of time, they form clump and future crop. However, when grazing and fire are frequent, natural regeneration of bamboo does not get established. The seed- lings, which germinate during the monsoon are grazed by livestock or killed during fire. Therefore, in natural forests of bamboos, it is important that after gregarious flowering is over, the area must be completely protected against fire and grazing (Dwivedi, 1988). Experience in certain areas of Madhya Pradesh, Maharashtra and Uttar Pradesh indicates that the seedlings of gregarious flowering which are grazed by livestock keep living for many years as underground rhizome and root system remains intact. The seedlings of bamboo get established after they are protected from biotic factors. These rhizomes send out shoots when biotic pres- sure is removed. This is particularly true in case of *Dendrocalamus strictus.*

### 8.6.1. Artificial regeneration

Artificial regeneration of bamboo has been taken up on large scale in bamboo areas and also for afforestation of degraded forest areas due to their importance in eco- logical restoration and adaptability to the wide range of climatic and edaphic situations. Most of the species of bamboos can be regenerated artificially by following means:

(i)) By seed
(ii) By seedlings
(iii) By rhizomes
(iv) By offset cuttings
(v) By cuttings of stem/rhizomes

**(i) By Seed:** Bamboo species can be raised by seeds. If the seeds are sown within 1-2 months of seed collection, most of the bamboo seeds germinate within 5-10 days. The viability of seeds depends upon species. Generally seeds of most of the species lose their viability gradually after 2-3 months. The viability period can be increased by providing proper storage conditions. The seeds are light in weight and small in size. Seeds of bamboo species resemble in shape and size with rice or wheat seeds except in case of *Melocanna baccifera* where seeds are very large in size. If plantation is raised by direct sowing, the seeds are sown in lines 3- 5 meters apart. These lines are then properly tended for the formation of future crop.

**(ii) By seedlings:** In case of direct seeding, seedlings are exposed to various kinds of biotic damages. Therefore, the usual procedure of artificial regeneration in case of bamboos is to plant nursery raised seedlings. Generally 6-10 months old seedlings are planted in the field. But in case of *Dendrocalamus strictus* planting one year old seedlings have been found to give better results. In some cases, to develop rhizomes the seedlings are allowed to remain in the nursery for 1-1½ years. Once rhizomes are developed, these are separated and planted in the polythene bags. Plants in the poly. thene bags are then transferred in the field. This method has been found to give better results.

**(iii) By offset cuttings:** Several species of bamboo are propagated by rhizomes. The new rhizomes are dug from the clumps and planted in the new areas. This is a common practice adopted in villages for the plantation of *Bambusa bambos* and *B. vulgaris*. The method is also used in case of *Dendrocalamus strictus* and some other bamboos. Rhizomes are taken out before the beginning of the monsoon as the buds are the most active during this period. This method is not suit- able for large scale plantations because the availability of rhizomes is very much restricted. The method is good for small scale village plantation.

**(iv) Rhizome cuttings:** Species with monopodial rhizomes which are mostly confined to temperate regions are propagated by rhizome cuttings.

**(v) Stem cutting:** This method of plantation has not yet been tried at a large scale. However, the method has been tried successfully for small scale trial plantations. Cuttings of the culm (2-3 years old) having 1 to 2 nodes are taken and planted horizontally in the month of April-May, when humidity is high. Stem cuttings of some of the species which do not root easily, requires pretreatment with Indole Acetic Acid (IAA) and Indole Butyric Acid (IBA) for successful rooting

## 8.7. Growth and yield in bamboo plantations

In plantation, growth in height is fairly fast. In the first year of plantation, the height attained is 0.50 to 0.75 m and in the second year the height reaches from 0.75 to 1.5 m. Growth of naturally regenerated bamboos after gregarious flowering, the seed- lings develop singly and it takes 5-6 years the average height of culms is about 6 to 8 for the formation of clumps. At this stage, m and culm girth is 7.5 cm. At the age of 10 years, the best clump has culms of average height of about 12 m and average girth at breast height of 10 cm. After 12 years, the dumps have sufficient number of normal commercial sized culms. A comparative study on the method of sowing, transplants and rhizome offsets of *D. strictus* indicates that rhizome offset gives better clump numbers among all the methods of propagation. A bamboo plantation raised in Shahdol (Madhya Pradesh) at a spacing of 5 x5 m in pits of 30 cm' indicates the following rate of growth.

### 8.8. Bamboo stocking

The stocking of bamboo in natural forests is variable. On the basis of number of clumps/ha, the bamboo area can roughly be classified into four categories. a. Dense or pure: Where more than 125 mature and well developed clumps occur. b. Predominant: Areas having 50-125 mature clumps c. Sparse: Areas having 25-50 clumps d. Poor and scattered: Areas having less than 25 clumps.

In plantations raised by seedlings at a spacemen of 4m x 4m or 5m x 5m, the clump formation generally takes place in the following 3 year or 4th year depending upon the soil, rainfall and its distribution. By about the sixth year, exploitable full grown culms are produced. On an average, five new culms are produced per year per clump and there are about 275 to 300 productive clumps per hectare. The size of the biggest culm does not exceed 5 cm in diameter at the second internode from the base and 6-8 meter in length, weighing about 2 to 2½ kg (green). It is observed that systematic and commercial working of the plantation may be started from the 8th year onwards. It is expected that on a 3 years cycle, a good plantation may yield about 3-4 tonnes of bamboos per hectare at the first cut, 5 to 6 tonnes at the second cut and 8 tonnes from the third cut onwards.

## 8.9. Some Important Bamboo Species

### 1. *Arundinaria racemosa* (Maling)

It is a shrubby, erect and gregarious bamboo with long rhizomes. Culms are 3-4 m high, 3-5 cm in diameter, yellow with prominent nodes, Culm-sheath is 6 x 2.5 cm. leaves 10 x 1.0 cm linear lanceolate. It is found in north Bengal, Sikkim and Arunachal Pradesh at an elevation of 3000- 3660 m. The species forms a dense under- growth in temperate forests. It is used for roof construction and matting for houses, fencing, garden support. Its leaves are used for fodder.

**2. *Bambusa balcooa* (Balku bans)**

It is a tall caespitose bamboo with culms 16-23 m high and 10-15 cm in diameter. The culms are green, thick walled, branched from the base, nodes thickened with whitish ring above and hairy below. Branches from the lower nodes are leafless, hard and some- times thorn like. Culm sheaths are deciduous, leaves lanceolate 15-30 cm x 2.5 cm in size. It occurs in Bihar, West Bengal, Nagaland, Meghalaya, Tripura and Assam. It is cultivated in foot hills of Arunachal Pradesh and has been introduced in Kerala and Uttar Pradesh. The species is reported to flower gregariously. Sporadic flowering also takes place. The species can be planted by seed- ling and rhizome planting. Culm and branch cuttings are also reported to root when treated with 100 ppm IAA.

It is probably the best and the strongest bamboo species for building purposes and is mostly used for scaffoldings. In Tripura, it is used for making incense sticks (agarbatti). It is also used in making huts and houses in rural areas.

**3. *Bambusa bambos* Syn. B. arundinacea (Katany bans)**

The species prefers rich and moist soils and grows along the perennial rivers and moist valleys. It attains best growth in moist deciduous forests receiving rainfall of nearly 2000 mm. It is a thorny bamboo, bearing bright green shining culms, 20-30 cm high and 10-18 cm in diameter. The nodes are swollen, lower nodes produce aerial roots; internodes 20-40 cm long. Branches develop from the nodes from the base upwards, lower branches are with curved spines. Calm sheath 20-35 x 20-30 cm coriaceous with dark brown hairs. Leaves variable in size usually linear or lanceolate. The species flowers sporadically and also gregariously. The cycle of gregarious flowering is reported to be 30-50 years. After gregarious flowering sufficient quantity of seeds can be collected. A single clump may yield about 50-100 kg of seeds. The seeds have short viability. However, seeds stored properly may show viability even upto 6 months. The species can be propagated by seed- ling, rhizome and culm cutting. Seedlings are raised in the nursery and one year old seedlings are planted in the field. Rhizome planting is common in villages. Culm cut things treated with IAA 100 ppm in the month of January and July produce sufficient roots.

Young shoots of the species are made into various marketable produce such as curry, candy, chutney and pickle. In Manipur, young shoots are used as vegetables. Fermented preparation of young shoots known as 'Soibum' is delicacy in Manipur. Protein content in seeds is comparable to that in wheat and quality is comparable to rice and can be eaten. The species produces strong culms which are used for making various handicraft and constructional items.

**4. *Bambusa nutans* (Mala bans)**

It is a medium sized graceful bamboo. Culms 7-14 m high, 5-7 cm in diameter, loosely clumped, much branched above and unbranched below. Culms are straight, green, smooth, internodes 25-45 cm long. Leaves 15-25 cm long, 2 to 3.5 cm broad, linear lanceolate, acuminate at the apex. Young shoots yellowish green at the apex.

This bamboo occurs naturally in sub- Himalayan tract from Yamuna to eastwards to Arunachal Pradesh between 600-1500 m altitudes. It is commonly cultivated in northern Uttar Pradesh, Orissa and north Bengal. The species grows well in the moist hill slopes and flat uplands in well drained loamy to clayey loam soils. Apart from sporadic flowering, this bamboo seems to flower gregariously at 35 to 40 years cycle. The species can be raised by planting nursery raised seedlings. In several areas, villagers raise it mostly by planting offsets sometimes rooting of culm cutting is also done. It is a graceful bamboo and is largely grown for ornamental purposes. The culm is hard, strong, straight and mainly used by local people for poles and other purposes.

**5. *Bambusa pallida***

It is a graceful bamboo growing in thick clumps. The culms are 13-20 m high, 5-8 cm in diameter, smooth, olive green, nodes not prominent, internodes 40-70 cm long. Leaves 10-20 cm long, 1-2 cm broad, linear lanceolate, rounded at the base with scattered long bristles, petiole very short. Young shoots are spear shaped. The species occur in north-east India in Arunachal Pradesh, Assam, northern Bengal, Meghalaya, Mizoram, Sikkim and Tripura. It occurs in hills mainly between 700-2000 m altitude. It is also cultivated in plains. The species is generally used in building construction, making baskets and mats. It is extensively used for manufacture of toys, wall plates, screens, wall hangers, etc.

**6. *Bambusa polymorpha* (Narangi bans**) It is a large evergreen densely tufted, erect or drooping bamboo with tall clean culms, attaining a height of 24 to 27 m and diameter of 15-20 cm. Internodes are 40 to 60 cm long. Culm-sheath 20-25 cm long, 20- 30 cm broad and usually persistent. Leaves 7-18 cm long 1-2 cm broad linear lancecolate, base rounded, petiole 2-3 mm long. Young shoots brownish green. This handsome bamboo is a native of Arunachal Pradesh, Manipur, Meghalaya and Tripura. It is also found in Madhya Pradesh, Kerala and is cultivated in North Ben- gal, Karnataka and Tamil Nadu. It grows well in low hill slopes along the valleys in deep fertile well drained riverain alluvium.

It has been reported to flower gregariously and sporadically. Gregarious flowering takes place usually in a cycle of 40 to 60 years. It is propagated by seed and also by planting of nursery raised seedling and rhizome. The species has outstanding mechanical properties, durability and is popular for building houses. It is used for making paper and pulp, agarbati sticks, fibreboards, toys, mats, etc. It is considered to be the best for wall, flooring and roofing. Young shoots are used for edible purposes. Young shoots are sweet in taste and eaten raw as well as widely used for curry, pickles, chutney, etc. It is a graceful species for landscaping.

**7. *Bambusa striata* Syn. *B. vulgaris* (Basini bans)**

It is a moderate sized bamboo not densely tufted. Culms are 10-20 m high, 5-10 cm in diameter, bright green, erect, yellowish with thick walls. Nodes prominent lower ones often with a narrow ring of roots, internodes up to 45 cm long. Culm-sheath 15-25 x 20-35 cm rounded and truncate at the top. Leaves narrowly or broadly lanceolate, 15-25 x 2-4 cm. Origin of this species of bamboo is not known. It is cultivated extensively in many parts of the country particularly in north- east Madhya Pradesh, Bihar, Uttar Pradesh and other states of the country mainly for ornamental purposes. It flowers both gregariously and sporadically. It is raised by seedling or rhizome planting. It is used for making paper, scaffolding, poles and other structures. Culms are durable and fairly compare with timber. Rings prepared from the split culms are put into ear perforations by the Tunkul Naga tribes of Manipur.

**B. vulgaris var. striata** is a graceful, tufted bamboo, culms 4-8 m high, 5-8 cm in diameter, glabrous, yellow with light green stripes, shining, internodes 10-15 cm long. It is generally cultivated for ornamental pur- poses. Culms are used as poles for construction purposes. It can be used for pulp,

**8. *Bambusa tulda* (Peka)**

It is an evergreen to deciduous tufted and gregarious bamboo with culms usually 15-23 m high and 7-10 cm in diameter. Culms are glabrous green when young and grey-green on maturity. Nodes slightly thickened and internodes 40-70 cm long.. Culm-sheaths 15-25 cm long and 10-20 cm broad and usually deciduous. Leaves 15-25 cm long, 2-4 cm broad, lanceolate, apex acuminate and yellow stripes on green sur- face. The species is naturally distributed in Bihar, Assam, Meghalaya, Mizoram, Nagaland and Tripura. It is cultivated in Arunachal Pradesh, Uttar Pradesh, north Bengal and Karnataka.

It flowers gregariously and sporadically. Partly uprooted culms often produce flowers without any general flowering. Life span of seeds of this species is not much, the viability decreases after one month period. Freshly collected seeds show better germination percentage, germination starts within 7 days and completes within 20 days.

The species is used for house construction and scaffolding. It is considered to be inferior in strength properties to *B. balcon*. Tender shoots of 0.6 m high are frequently used for making pickles. It is used by pulp and paper industries. It is used for making toys, mats, screens, wall plates, wall hangings, hats, baskets, food grain containers, etc. In Arunachal Pradesh, flute used by the priests is made from this species with a belief that it keeps the evil spirit away. Fish- ing rods are also made from this species of bamboo.

***9. Dendrocalamus giganteus***

This is the tallest bamboo with close culms and slender branches. Culms are 25-30 m tall, 20-30 cm diameter, usually 2-5 cm thick walled and dull green in colour. Culm- sheath is 30-50 cm long and 15-20 cm broad. Leaves are variable in size, in main culm upto 50 cm long and 10 cm broad. It is a native of Burma and introduced successfully in India sometimes in 1930. Presently, it is cultivated in Arunachal Pradesh, Assam, Manipur, Nagaland, West Bengal and occasionally in other parts of the country. It is good for moist hill slopes and flat lands with rich loam soils. It flowers both gregariously and sporadically. Gregarious flowering in some clumps has been observed in certain parts of the country. It is propagated by seeds and rhizomes. Rooting of culm cutting is also reported to be successful.

This bamboo is primarily used for hut and house construction, mast of boats, flower vases, buckets and other decorative items. In Arunachal Pradesh, it is used as water pitcher particularly by Abore and Mishmi tribes. Young shoots are considered to be a good vegetable. It is a good material for paper and pulp. It is also used for mak- ing various handicraft items.

***10. Dendrocalamus hamiltonii***

It is a large caespitose bamboo often culms at an angle or curved downwards. Culms 15-20 m tall, naked below, much branched above. Culm sheaths long and stiff variable in size. Leaves variable in size, larger leaves (35.0 x 3.7 cm) on new shoots.

It is distributed in north-west Himalayas, Sikkim, Bhutan, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. It is generally used for walling of native huts, other constructions, basket making, mats, water and milk vessels, fuel, floats, etc.

**11. *Dendrocalamus hookeri***

It is a large tufted bamboo with culms 15-20 m high and 10-15 cm in diameter. The culms are dark green, internodes 40-50 cm long, rough, hairy with long curving branches. Culm sheath is 40 cm broad at the base and 20-30 cm long. Leaves are large, oblong lanceolate with a long acuminate tip. Young shoots are covered with black tomentum. It is distributed throughout in Arunachal Pradesh, Nagaland, Mizoram, Meghalaya, North Bengal, Sikkim and Manipur in the hills between 600-1500 m altitude. The seeds are obtained in gregarious flowering, clumps die soon after flowering. It can be propagated by seed, rhizome and culm cutting. The species is generally used for building purposes. It is also used for making baskets and water buckets. The species is quite similar to *Dendrocalamus hamiltonii* in qualities and is generally confused with it.

**12. *Dendrocalamus longispathus***

It is a large handsome tufted bamboo with culms usually 15-18 m high. The culms are glaucous green when young and turns grayish green when old; nodes slightly swollen, often rooting; internodes 25-60 cm long. Culm-sheaths 35-50 cm long and 10-20 cm broad. Leaves 10-30 cm long, 2.5-4.5 cm broad, oblong lanceolate. Young shoots spear shaped; sheath green. The species is found mainly in Manipur and Tripura. It has also been introduced in West Bengal, Bihar, Assam and Orissa. The species grows in moist localities and is found mainly along streams. The species often flowers sporadically and gregariously after long intervals. Seeds have short viability. Freshly collected seeds have the highest viability. The species can be propagated by nursery raised seedlings and by rhizomes. Culms are not very strong and there- fore, are considered inferior to other species for building purposes. In Tripura, it is large- ly used for making baskets and food grain containers. It is a handsome species and generally planted for ornamental purposes.

**13. *Dendrocalamus membranaceous***

It is a moderate sized strong bamboo which forms loose clump. The culms are straight, 20-25 m high and 8-10 cm in diameter. It is a native of Burma, Thailand and China and has been introduced successfully in Kerala and West Bengal. It occurs in moist forests but is capable to tolerate dry conditions. Since it is a strong bamboo, it is highly preferred for construction purposes. Its raw shoots are eaten. It is also used for making chopsticks, shreds and paper.

**14. *Dendrocalamus strictus (Bans or Lathi bans)***

It is a deciduous and densely tufted bamboo with culms 8-15 m high and 4-8 cm in diameter. They are blue green when young and dull green or yellowish when old. The nodes are swollen and basal nodes often rooting. Internodes 30-50 cm thick walled. Culm-sheaths are variable in size, lower ones are usually shorter than the upper. Leaves are shorter in dry localities and larger in moist localities. It is widely distributed in semidry and dry areas upto an altitude of 1000 m. In India, it is a predominant species in Madhya Pradesh, Uttar Pradesh, Maharashtra and Orissa usually associated with tropical dry deciduous forests.

It flowers both sporadically and also gregariously (40-60 years cycles). The clumps die soon after gregarious flowering. The seeds can be stored for about one year. Their viability can be retained for a longer period if kept under optimum (low) temperature. The species is propagated by seed, seedlings and rhizomes. Culm-cutting has also been reported successful under con- trolled conditions. This is one of the most important bam- boo species and is widely used for construction purposes in rural housing. It is the most common bamboo used for paper and pulp. Its young shoots are pickled and made into delicious curry, tribals love to eat them. The thin solid culms are used as lathis (walking sticks) in rural areas. It is also used for making baskets and handicraft items. Leaves are a good fodder. The decoction of leaves is used as medicine; silicious matter is used as tonic and astringent. The species is largely used in afforestation of wastelands.

**15. *Drepanostachyum falcatum* Syn. *Arundinaria falcata* (Ringal)**

It is a low level bamboo of the western Himalayas distributed from Ravi to Nepal at an elevation of 1200-2230 m. This species grows gregariously forming an undergrowth in the forests of deodar, oak, etc., usually in moist shady locations. It forms a large number of culms, sometimes more than a hun- dred culms in a clump. The culms are 4 m high, 1-2 cm in diameter, smooth and cylindrical. Culm branches numerous. Culm sheath 17-30 x 3-7 cm, papery straw coloured. Leaves 8 x 0.5 cm, linear lanceolate, much larger in young shoots. Flowering is both sporadic and gregarious. It is used for basket work, fishing rods, arrows, hookah pipes, etc. It is especially prized for fishing rods. Leaves are used for thatching, roofing, etc. Young shoots are edible.

***16. Gigantochloa albociliata* Syn. *Oxytenanthera albociliata***

It is a densely tufted bamboo almost evergreen, with culms 6-9 m high and 1.5. 2.5 cm in diameter. The culms are grayish green with white strips. The young shoots are purplish-green. The species is distributed in Burma and widely cultivated in West Bengal, Assam, Arunachal Pradesh, Meghalaya and elsewhere in the country. It flowers sporadically. However, the seeds from the sporadic flowering are reported to be not fertile. The species is not of much use, locally used by villagers for household purposes.

***17. Gigantochloa rostrata* Syn. *Oxytenan***

It is a tufted dark green bamboo with culms 5-8 m tall and 2.5-5 cm in diameter. Culms are thick walled, basal portion with yellowish strips. The species is distributed in Assam, Meghalaya, Orissa, Bihar, Madhya Pradesh, Maharashtra and Karnataka. It prefers growing in moist localities along streams. It is used for building huts, making baskets and also as a raw material for paper and pulp industries.

***18. Indocalamus wightianus*** **Syn.** ***A. wightiana***

It is a shrubby and erect bamboo. Culms 3 m in height with bulbous base and golden hairs. Internodes are flat on one side, nodes swollen with a hairy ring below. Culm-sheath papery and straw coloured. Leaves 13.5 x 2 cm; ovate lanceolate. It occurs in Nilgiris, Palaghat and Tirnelvelly in South India between an elevation of 1800-2600 m. It forms gregarious under- growth in the evergreen solas. Culms are 2 to 3 m high. It flowers annually and is used for matting.

***19. Melocana baccifera*** **Syn.** ***M. bambusoides (*****Muli bans*****)***

It is an evergreen bamboo. Avoids formation of clump. The culms are 10-20 m high and 4 to 7 cm in diameter, green when 21 young and straw coloured when old. Culm sheath 10-15 cm long yellowish green when young and yellowish brown when old. Leaves 15-30 cm long, 2.5-5 cm broad oblong lanceolate with acuminate apex. The species is distributed in Assam, Manipur, Meghalaya, Mizoram, Tripura and West Bengal mostly in lower hill slopes and plains. In Mizoram and Manipur, this species occupies a large area of abandoned shifting cultivation. It is propagated mainly by rhizome as they are vigorous and highly productive. This is due to a large rhizome neck (up to 1 m length). Sporadic and gregarious flowerings have been observed in this species. The species produces the largest fruit amongst bamboos. The size of fruit is generally 10 cm x 7.5 cm excluding the beak, which is about 2.5 cm long. The species is employed in various uses, it is a principal material used for building houses, for making woven

**20.** ***Pseudoxytenanthera ritcheyi*** **wares**

Important source of superior paper and pulp. Culms are strong and durable and fruits are edible. The species is also used for making toys, mats, wall plates, screens, wall hangings, hats, umbrella sticks, baskets, food grain containers, etc. The species is useful from ecological point of view as it comes up very well in shifting cultivation areas and prevents soil erosion, landslide, etc.

***21. Ochlandra scriptoria Syn. O. Theedii***

It is a shrubby bamboo with culms up to 5 m in height and 2. 5 cm in diameter, found gregarious at low elevations in Kerala. It is also cultivated along the skirts of ponds and paddy fields as a soil binder. This species is mostly used for making mats, baskets and paper pulp.

***22. Ochlandra travancorica***

It is a shrubby bamboo found in Mysore, Travancore, Annamalai and Tiru. nelvelli hills up to 1550 m elevation. Culms are 6 m in length and 5 cm in diameter, with rough, thin-walled, solid internodes up to 1.5 m in length. It is grown along paddy fields as a soil binder. It is used for making agricultural implements and tool handles." The mature culms are used in the manufacture of paper pulp. It is also used for making temporary huts and thatching.

It is a thin-walled, shrubby bamboo found along river banks and valleys in Sikkim, extending eastwards to Assam. It is in considerable demand among tea planters, as it gives the best material for making baskets. It is also suitable for making umbrella handles and walking-sticks.

***23. Syn. Oxytenanthera ritcheyi***

It is an erect, thick-walled bamboo occurring from the Konkan to Annamalai hills on the Western ghats. It is often cultivated. The culms are 6 m in height and 2.5 cm in diameter. They are strong and used for tent-poles, walking sticks, baskets and umbrella handles.

**24. *Schizostachyum pergracile***

It is widely distributed in Bihar, Assam, Naga hills, Madhya Pradesh, Orissa and Andhra Pradesh. It is a graceful deciduous tufted bamboo with thin walled glaucous green culms, attaining a height of 9 to 12 m or more and a diameter of 5-7.5 cm under favourable conditions. It is a characteristic of low hilly country. It thrives best in well drained fresh loam soils and is remarkably gregarious. This species often flowers sporadically, and occasionally flowers gregariously over extensive areas. It is used in buildings, mats, fishing rods, hat and other handicraft items. It is an important source of paper pulp. In Manipur, it is also used in ceremonial functions. Young shoots are known for high cyanogen content and hence are not edible.

***25. Thamnocalamus spathiflora (Arundinaria spathiflora)***

It is a densely tufted shrubby bamboo. Culms 6 m in height 2 cm in diameter, smooth, glaucous green when young and turns shining yellow with age. Nodes much raised dark coloured, internodes 20-25 cm long. Culm sheath 13 x 15 cm, loose, light yellow in colour. Leaves clustered in groups, 10 x 1.0 cm, linear-lanceolate. It is a small sized bamboo, growing gregariously in the undergrowth of fir, spruce and deodar forests of western Himalayas at 2100-2700 m elevation. The culms are used for making pipes, mats, baskets, etc. It occurs in western Himalayas from Sutlej throughout Nepal to Arunachal Pradesh between 2100-3050 metres elevation above mean sea level.

## 8.10. Species and Usage

According to uses bamboo species can be grouped into the following groups:

- Afforestation of river banks and soil conservation areas, shelter belts and wind belts: all bamboos.
- **Agricultural implements:** *Bambusa balcooa, B. striata, Dendrocalamus strictus, Ochlandra travancorica.*
- **Bamboo hats:** *Bambusa blumeana, B. striata, B. vulgaris, Var. striata.*
- **Basket making:** *Arundinaria intermedia, Bam- busa bambos, B. nutans, B. pallida, B. khasiana, B. tulda, B. striata, B. polymorpha, Chimno-bambusa falcata, Dendrocalamus giganteus, D. longispathus, D. hamiltonii, D. strictus, Gigan- tochloa nigrociliata, Indocalamus wightianus, Neohouzeaua helferi, Oxytenanthera ritcheyi, Thamnocalamus spathiflora.*
- **Boat plying rod:** *Bambusa glaucescens* and *B. polymorpha.*

- **Bows and arrows:** *Bambusa bambos, Cephalostachyum capitatum, C. pergracile, Dendrocalamus strictus.*
- **Cart containers and roof:** All bamboos.
- **Cart yokes:** All large sized hard and solid bamboos.
- **Chicks for doors and windows:** *Bambusa bambos, Dendrocalamus strictus*.
- **Combs:** *Oxytenanthera bourdillonii*.
- **Containers for cleaning grains:** All bamboo species.
- **Containers to carry maps:** *Oxytenanthera bourdillonii.*
- **Construction:** *Bambusa polymorpha, B. balcona, B. tulda, B. bambos, B. nutans, Bambusa khasiana, Bambusa striata, B. blumeana, Cephalostachyum capitatum, C. pergracile, Dendro- calamus membranaceus, D. hamiltonii, D. gigan- teus, D. longispathus, D. strictus, Gigantochloa nigrociliata, Melocanna baccifera, Neohouzeaua dullooa, Oxytenanthera stocksii, Teinostachyum beddomei, Thyrosostachys oliverii.*
- **Containers to administer medicine to Bulls and animals:** *Bambusa bambos.*
- **Country tiles:** *Bambusa bambos.*
- **Cooking utensils:** *Bambusa bambos, Cephalostachyum pergracile. Cradles: Bambusa bambos, Dendrocalamus strictus.*
- **Lattle shats:** *Dendrocalamus strictus, Ochlandra* species.
- **Loading vessels:** Neohouzeaua dulloca
- **Cremation and coffins:** *Bambusa bambos, Dendrocalamus strictus* and all bamboos
- **Fencing:** *Indoculamus wightianus, Oxytenanthera monodelpha, O. ritcheyi* and all other species.

- **Fishing rods**: *Arundinaria amabilis, Chimono- bambusa falcata, C. khasiana, C. intermedia, Dendrocalamus strictus.*

- **Floating timber and rafting:** Bambusa bambos, Dendrocalamus hamiltonii, Ochlandra scriptoria.

- **Mats:** *Arundinacia intermedia, A. racemos, Bambusa bambos, B. blumeona, B. nutans, B. pallida, B. teres, B. tulda, Cephalostachyum pergracile, Dendrocalamus hamiltonii, D. stric tus, Indocalamus wightianus, Neohouzeaua dul looa, Ochlandra scriptoria, O. travancorica, Oxytenanthera nigrociliata, Teinostachyum dullooa.*

- **Match boxes and splints:** Ochlandra travan corica.

- **Flooring:** Bambusa polymorpha.

- **Fodder:** *Arundinaria racemosa, Chimnobambusa densifolia, Cephalostachyum capitatum, C. pergracile, Dendrocalamus sikkimensis, D. strictus, Ochlandra travancorica, Bambusa bambos* and leaves of all bamboos.

- **For jaundice:** *Bambusa striata*.
- **Fuel:** All bamboos and rhizomes of bamboos.

- **Musical instruments** (Flutes, mariba, horns, clarionets, flagerlets, saxophones, piccoles, drums, etc.): *Arundinaria* spp.*, Dendrocalamus strictus*, all small sized bamboos,

- **Ornamental purposes:** *Bambusa vulgaris, Cephalostachyum pergracile, Dendrocalamus giganteus, Phyllostachys aurea, Oxytenanthera monadelpha, Thyrsostachys siamensis*.

- **Pandals for shade:** All bamboos.

- **Pan trays:** *Neohouzeaua dullooa.*

- **Furniture:** *Bambusa bambos, B. glaucescens, B. tulda, B. striata*, all thick walled species.

- **General utility:** *Bambusa bambos, B. tulda, Cephalostachyum burmanicum, C. pergracile, Dendrocalamus hamiltonii, D. hookeri, D. strictus* and all bamboos which are strong.

- **Handicrafts**: Bambusa nana, Dendrocalamus giganteus.

- **Hookah pipes:** *Chimonobambusa falcata, Thamnocalamus aristatus, Teinostachyum griffit- hii, Thamnocalamus spathiflora.*

- **Horticultural pursuits:** *Bambusa bambos, Dendrocalamus strictus,* all strong bamboo species.

- **Ladder:** *Bambusa bambos* and *Dendrocalamus strictus.*

- **Lance staves:** *Dendrocalamus strictus, Ochlandra scriptoria, O. travancorica*.

- **Paper and pulp:** There have been wide changes in the utilisation pattern of bamboo in the production of paper and paper board. During 1950-70 bamboo constituted about 70 per cent of the total raw material requirement for paper and pulp. However, presently the share of bamboo raw material is only 30 per cent. The country's paper industry mainly depends upon *Dendrocalamus strictus* and *Bambusa bambos*. The mills in the north mainly use the former species while those in the east and the south use both. *Bambusa nutans, B. tulda, Dendrocalamus hamiltonii and Melocanna baccifera* are some of the other bamboo species with limited uses in the industry. Presently, nearly 20 million tons of bamboos are used annually by the paper industry with possibilities of a substantial rise in the intake if economically available.

- **Pea sticks:** Thamnocalamus spathiflora.

- **Pipes:** *Bambusa arundinacea, Dendrocalamus hamiltonii* and *Teinostachyum griffithii. Polomallets: Bambusa blumeana* (Basal portion of culm).

- **Protection while pounding grain:** *Bambusa bambos* and all big sized bamboos.

- **Punting poles:** Oxytenanthera stocksii, O. ritcheyi, solid varieties.

- **Rickshaw hoods:** *Bambusa striata, Dendrocalamus* species.

- **Roofing of boats:** *Bambusa bambos, B. tulda. Scaffolding: Bambusa bambos, B. striata, Dendrocalamus strictus*.

- **Seed food:** *Bambusa bambos, Cephalostachyum pergracile and Dendrocalamus strictus.*

- **Seed drills:** *Dendrocalamus strictus*.

**Sericultural industry**

- **Trays for rearing silk worms:** *Bambusa bambos, Dendrocalamus strictus, Thyrsostachys siamensis.*

- **Shoots as vegetables and food:** *Bambusa bambos, B. nana, B. tulda, B. striata, Dendro- calamus giganteus, D. hamiltonii, D. longi- spathus, Sinobambusa elegans* and several others.

- **Stablishing haystocks:** *Bambusa blumeana, B. tulda, B. striata, Dendrocalamus strictus.*

- **Stakes in forestry practices:** All bamboos.

- **Tea estates:** *Pseudostachyum polymorphum*.

- **Thatching and roofing:** *Bambusa bambos, B. polymorpha, B. tulda, B. striata, Chimonobam- busa falcata, Dendrocalamus brandisii, D. hamil- tonii, D. longispathus, D. membranaceus, Gigantochloa atter, Oxytenanthera monodelpha, Dendrocalamus strictus.*

- **Tool handles:** *Dendrocalamus merrillianus, D. strictus, Ochlandra travancorica* and all solid varieties.

- **Trellis work:** *Bambusa bambos, B. blumeana* and all big sized bamboos.

- **Umbrella handles:** *Melocanna baccifera, Neohouzeaua dullooa, Oxytenanthera ritcheyi, O. stocksii, Teinostachyum griffithii.*

- **Walking sticks:** *Arundinaria armata, Dendro- calamus strictus, Ochlandra travancorica, Oxytenanthera nigrociliata, O. ritcheyi, Phyllostachys mannii*.

- **Walling of native huts:** *Arundinaria racemosa, Bambusa atra, B. polymorpha, B. tulda, Gigantochloa nigrociliata, Neohouzeaua dullooa, Oxytenanthera nigrociliata, Sinobambusa elegans.*

- **Water and milk vessels (Thunga), water buckets, cups and containers:** *Bambusa pallida, B. tulda, Dendrocalamus asper, D. giganteus, D. hamiltonii, D. hookeri, D. sikkimensis, Gigantochloa aspera, G. levis, Melo- canna baccifera.*

### 8.11. Canes

Canes (Rattans) are referred to as plants belonging to genus Calamus. Calamus is a genus consisting of about 390 species. The genus belong to the family Palmae and is generally found distributed in the virgin forests of tropical and sub-tropical regions. Most of the species are climbers and twining shrubs which climb over forest trees with the help of hooked spines or by the flagellum like prolongations of the leaf rachis. These spines are located either on leaves or on leaf-sheaths. The stem of many species of Calamus form the common canes commercially called as rattans. Few other related genera like *Daemonorops, Certolobus, Plectomia* and *Korthalsia* also yield canes but of minor importance.

### 8.12. Uses of Canes

Canes are used for variety of purposes. On account of their remarkable strength, elasticity and length, they are used for various purposes. Most of the canes are very strong and can be used as a substitute for ropes as cables for suspension bridges and other purposes. Canes are also used for wickerwork's, making baskets and different types of containers. Cane industry is developed in Bengal, Bihar, Karnataka and Kerala.

The most extensive use of canes is in furniture industry. Furniture made from canes is in great demand. Chairs, tables, sofa sets, etc., made out of canes are novelty. For making furniture, canes are generally split and the outer shining layer is removed and cut into thin flat pieces then woven into sheets or backs. Splitting of canes is done usually by hand, machines are also some- times used for this purpose. Stems of *Calamus rotang* and *C. tunius* are generally used for furniture making. The thinner canes generally obtained from *Calamus ochentospathus, C. latifolius* and *C. viminalis* are used for making furniture frames, polowicket, umbrella handles, etc. The refuse from the splitting of the canes is generally used for making rough cordage, fibremat and variety of other articles.

The fruits of some species of Calamus such as *Calamus rotang* are fleshy, mucilaginous, sweet-bitter and edible. The seeds of *Calamus extensus* and *C. erectus* are used as a substitute for betel nut (areca nut). The young and tender shoots of some species are eaten boiled or made into curries and also pickled.
The roots and leaves are used for medicinal purpose. The seeds of Calamus rhele are powdered and applied in ulcer. The roots of *Calamus rotang* are remedy for dysentery, biliousness and febrifuge and also used as tonic. It is used in veterinary as aperients. The tender leaves of *Calamus travancoricus* are used in dyspepsia, biliousness and as anthelmintic.

## 8.13. Important Species of Canes

Many Calamus species are climbing species; their stems are long usually cylindrical having uniform thickness. They are solid, yellow in colour and covered by spiny leaf-sheaths. They are flexible, elastic and strong. The outer surface is hard and shiny. The shining appearance of outer surface of the stem is due to the deposition of silica on the surface. The core of the stem is spongy. Nodes are less dominant and inter-nodes vary in length from species to species and sometimes even in different plants of the same species. Leaves alternate; leaflets are acuminate usually parallel and the rachis modified to armed flagellum. The culm sheath is armed into spines. Flowers are small and solitary. Fruits are clips and elipt. Seeds are sub-glubose and oblong. The important species of Calamus along with their uses are discussed in the following lines:

1. **C. acanthospathus:** It is distributed in eastern Nepal, Sikkim and Bhutan Himalaya, ascending to 2000 m altitude. Stem slender, scandent, as thick as a swan's quill.

Leaves 60-90 cm; leaflets 25-40 cm by 5.0-7.5 cm, margins naked or spinulose, both sur faces naked or very rarely with a few small spines on the costae of the upper surface with erect, armed short recurved spines. It is used for making handicraft items.

2. **C. andamanicus:** It is found in Andaman and Nicobar islands. Stem is lofty, scandent, as thick as an arm (with the sheaths on). Leaflets 60-75 cm by 2.5 cm broad. It is used in making furniture, handicraft items, wicker-work, basket, etc.

**3. C. erectus.** It is distributed in Sikkim, Himalayas, Assam, Khasi hills and Manipur, ascending upto 1200 m altitude. Stem dense- ly tufted, 4-6 m high, internodes 5.5-7.5 cm long, 2.5-3.0 cm diameter. Leaves 4-6 m; leaflets few, 40-60 by 3.0-5.0 cm, 1-nerved. Spadices 30-60 cm, spikes 15-25 cm x 1.0 cm across the imbricating coriaceous spathels. Calyx acutely 3-toothed; corolla thrice as long. Stamen free, filaments broad and erect. Fruit about 2.5 cm long, ovoid-oblong, sub- tended by the spreading perianth; scales trapezoid, dark brown with a yellow base. The seeds of this species are used as a substitute for betel nut (Areca nut). The young and tender shoots of this species are also eaten, boiled and made into curries and pickled.

**4. C. flagellum:** It is distributed in Sikkim Himalayas, Assam and Khasi hills, ascend- ing upto 1200 m elevation. Stem 2.5-4.0 cm in diameter. Leaves 2.0-2.5 m; leaflets 60-75 cm by 2.5-4.0 cm broad, con-colorous; petiole 30-45 cm. Spathes tubular, lowest 45-60 cm, compressed, upper lacerate. Spadix 2.5-3.0 m; spikes 20-25 cm, pendulous, unarmed; spathels like C. erectus. Flowers 1 cm long, decurved. The species is used for making furniture and other handicraft items.

**5. C. floribundus:** It is found in Assam, Khasi (Meghalaya) and Mishmi hills. Stem is as thick as the middle finger. Leaflets bright green, 20-50 x 25-40 cm; spines on rachis 1.0-2.5 cm long, rather flattened and deflexed. Lower spathe 45 cm, coriaceous, terete, mouth very oblique. It is used for furniture and other handicraft items.

**6. C. gracilis.** It is distributed in the Khasi hills, ascending upto 1200 m altitude; upper Assam and Cachar. Stem slender, scandent; naked stem not thick. Leaves

60-90 cm; leaf- lets 12-20 cm, margins obscurely bristly except at the tip where the bristles are long; petiole very short and rachis fugaciously scurfy. It is used widely in making furniture and handicraft items.

**7. C. guruba:** It is distributed in Bengal, Assam, Khasi hills, Silhet, Chittagong and Burma. Stems are tall, scandent, without sheaths very slender. Leaves 1.75-2.0 m; leaflets 30-40 x 1.0-2.0 cm, upper smaller free, sometimes quite naked on both surfaces; sheath with a long membranous lacer- ate ligule. It is used for making furniture, handicraft items, umbrella handles, etc.

**8. C. latifolius:** It is distributed through- out the Sikkim Himalaya and Assam ascending upto 600 m altitude in Himalayas. Stem stout, 30-60 cm, as thick as thumb. Leaves with the flagellum 3-5 m; leaflets 30- 60 cm by 2.5-5.0 cm, upper sometimes flabellate clustered or connate at the base; cross nervules many and close; petiole short, sometimes bearing the leaflets only far up the flagellum; base sometimes 2.0 cm broad, smooth, biconvex, spines various always scattered. It is used for making furniture, handicraft items, umbrella handles, etc.

**9. C leptospadix.** It is distributed in Sikkim Himalaya, Khasi hills and Naga hills. Stem is slender and scandent. Leaves 1.0-1.5 cm; leaflets 20-25 x 0.70-1.0 cm, thin, pale green; rachis armed with simple recur- ved spines. Spathes slender, tubular. Spadices several feet long, branched, below and armed with hooked short spines, branches very long and slender, with 20-40 recurved spikelets 1.0-2.5 cm long and 0.3 cm in diameter.

**10. C. pseudotenuis:** It is distributed in Deccan peninsula; on the Western ghats; from Canara southwards. Stem slender, leaflets 25-45 x 1.0-2.0 cm, upper free; rachis rather stout petiole short; sheath 2.0 cm in diameter. Stem is used for various purposes e.g. furniture items, handicrafts, etc. It is also used for making walking sticks, polo- sticks and umbrella handles.

**11. C. rotang:** This species grows in the Deccan peninsula and Ceylon. Stem scandent and slender. Leaves 60-90 cm; leaflets 20-30 x 1.0-2.0 cm, unarmed on both surfaces or armed beneath only, lateral unarmed on both surfaces. Spadix and its slender tubular spathes unarmed or nearly flattened spines. It is used for making baskets, mats, etc. Fleshy, mucilaginous, sweet bitter pulp of the fruits is edible. Decoction of the root is used as a remedy for dysentery.

**12 C. tenuis:** It is distributed in tropical Himalaya from Kumaon eastwards, Bengal, Assam, Mizoram, Manipur and Tripura. It is also distributed in Kerala. Stems are very long, scandent; internodes not thicker than a goose-quill. Leaves 40-60 cm; leaflets, lower 20-30 x 0.7-1.0 cm, margins minutely setulose or spinulose, bristles; petiole pale, stout; spines with broad laterally compressed coni- cal bases. It is used for making mats, baskets, screens, furniture, chair seats, etc.

**13. C. thwaitesi:** It is distributed through- out the central India along streams. The rachis of the petiole bears stout recurved claws with black tips, the upper spathes bearing scattered spinescent tubercles and in the smaller fruits with few pale scalesrose or the margin channelled down the centre and with a narrow brown marginal band.

**14. C. travancoricus:** It is distributed in Deccan peninsula; from Malabar to Travan- core. Stem is slender and scandent. Leaves 45-60 cm; leaflets 10-15 x 1.0-2.0 cm, broadest about or above the middle and tapering to a capillary point, shining above; rachis scurfy when young; petiole 10-15 cm, dorsally rounded, margins acute much com- pressed towards the base and are chiefly spiny. The species is used for making furni- ture, handicraft items, umbrella handles, etc.

**15. C. viminalis:** It is found in lower Bengal, Orissa, Karnataka and Andaman Islands. It is a stout scrambling and climb- ing species. Leaves 60-90 cm, leaflets 10-25 x 2-3 cm, pale green, young and rachis and sheath white-floccose, petiole short and rachis very stout, spines slender 2.0-3.0 cm long, pale hardy flattened. Spathes coriaceous, mouth obliquely truncate; flagelli with hooked 2-3-fid claws. Spadix and its spreading branches rather stout, internodes (and truncate spathels) 1.0-2.0 cm. The species is used for making furni- ture, frames, polo-wicket and umbrella handles. It is also used for making rough cordage, fibre mat and a variety of other articles.

## 8.14. Propagation of canes

### 8.14.1. Propagation by seeds and seedlings

Seed is the best source for propagation, but its availability on a large scale is dependent on several factors. Calamus spp are dioecious and flower annually. Extraction of canes before flowering and the destruction of the natural habitat of canes also directly affect the seed source. Seeds generally mature in the rainy season. The best period for collection of ripe fruits is April to June. Fruits should be collected from a mature plant of height over 12 m. It is advisable to collect fruits directly from the plants when the colour is turning from green to yellow. Only ripe fruits should be collected since they give a good germination.

The fleshy mucilaginous sweet-bitter pulp of the fruit of some species (e.g. C rotang) are edible. This pulp attracts ants and birds (e.g. C. tenues). Fruits are produced in abundance; fruits in any one inflorecense generally ripes simultaneously. The size and shape of fruit vary depending on the species. Fruits are covered with vertical rows of reflexed overlapping scales.

The ripe fruits are thoroughly washed and mucilaginous protective coat is removed. Removal of outer scaly cover and inner fleshy layer from seed ensures good germination. After this, soak the seeds in water for about 48 hours to induce fermentation of the fleshy layer. Remove the fleshy part of the seed by rubbing with the hands and collect clean seeds settled at the bottom of the vessel. These seeds can be stored for a week but proper care should be taken to keep the seeds moist as dry seeds fail to germinate. Otherwise gunny bags containing fruits should be immersed in running water for 24 hours till the fruit becomes soft enough for removing the mucilaginous covering of the seed coat, then they have to be gently washed by hand till the seeds are completely separated from the pulp.

On an average 1000 seeds weigh about 1 kg. Generally cane seeds are known to be viable only for short periods i.e. about 1 to 2 months. The moisture content of the seeds ranging between 40-60 per cent appears to be very critical for seed viability as above 60 per cent the seeds tend to germinate and below 40 per cent they become non-viable. It may be rather difficult to provide suitable storage conditions for maintaining the proper moisture content. Earlier attempts were made to introduce Malayan canes such as *Calamus caesius, C. seipanum and C. ornatus* to India, but these seeds lost viability during air transport itself. With proper stor- age conditions the viability can be extended to about 6 months.

Germination starts in 30 to 40 days after sowing. Seedlings grow very slowly and it takes 2 years to reach plantable size of about 70 cm. Some species e.g. *C. hookerians, C. pseudotenius, C. ornatus* take 1-7 months for completing the germination process. The rattan seeds cannot withstand drying out.

The whole fruit gives the highest percentage of germination than those of cleaned seeds in *C. tenuis.* But in case of *C. hookerians and C. pseudotenius* seeds sown in polythene containers filled with a mixture of forest soil and sand, kept in partial shade and watered daily gives better results of germination.

**8.14.2. Nursery techniques**

Cleaned seeds should be kept in moist sawdust in polythene bag for about 2 weeks till the seeds start germinating. Sprinkle water over the sawdust when the upper layer gets dry. The process helps to fasten the germination rate. For establishing seedling, nursery site should be selected near a perennial water source. Nursery should be partially shaded with a thatch of palm leaves or coir mat as cane seedlings need shade for their initial growth. It is better to sow the germinated seeds separately in polythene containers of 15x20 cm size filled with a mixture of forest topsoil and sand in the ratio of 3:1. Arrange the polythene containers in the nursery over a black polythene sheet spread over the soil, so that growing roots do not penetrate the ground. Transfer the sawdust with the seeds from the polythene bags to shallow trays. Plant just germinated with seeds in the polythene containers are transferred in the nursery bed and later pricked out into containers. Maintain the seedlings and plant till the following rainy season i.e. June-July.

Alternately, the seeds are sown in seed bed with a layer of 2 inch thick sand and farm yard manure mixture. After sowing the seed beds should be covered with grass and watered regularly twice a day. Normally it take 15-35 days for germination, by the end of 35 days, about 85 per cent of seeds germinates. After 45-50 days, the small seed- lings are carefully pricked out and trans- planted in the polythene bags filled with 1:1:1 proportion of red earth sand and farm manure. It has been found that 12-14 month old seedlings are ideal for planting. At this age the seedlings attain height of 40-60 cm.

For raising plantation of *C. tenuis,* sowing the whole fruits within 10 days of collection in the nursery beds gives better results. The seedlings are kept in the nursery for about a year and then planted at a spacing of 5 x 5m.

### 8.14.3. Vegetative propagation

Usually seed is the best source of propagation. However, in rattans, due to uncertainty of viable seeds, vegetative propagation by suckers, rhizomes, auxiliary shoots and stem cutting are the alternative method for regeneration.
Canes are multiplied by suckers and rhizomes. Suckers and rhizomes of 20-25 cm in height can be planted before the onset of monsoon in June/July. Auxiliary shoots developed on aerial stem can be separated and raised as individual plants. The inflorescence tip of *Calamus pygmaeus* when comes in contact with the soil strikes roots and produces new shoots.

## 8.15. Harvesting

Canes are harvested by cutting mature stems at the base. The soft terminal portions are discarded. The sheaths are removed and then dried in sun or over fire soon after cutting. Canes are extracted between December and May (summer months) in South India. During rainy season, they are susceptible to fungal infection which affects the quality and appearance of canes. Undried canes deteriorate rapidly. In south Indian states, the extraction of cane is being done through departmental agencies or through tribal co-operative societies and the harvested produce is brought to the depots. From the depots, it is marketed to different furniture manufacturing units depending on their production capacity and availability of the stock.

One major complaint in the cane trade is that the quality of Indian cane products is inferior to that of the canes from the South east Asian countries. This is mainly due to lack of appropriate processing techniques. Canes are generally treated with hot kerosene oil which not only maintains properties like density and strength of natural cane but also improves its colour (ivory white), appearance and durability.

## Terminal Questions

- What are Bamboos? Define its structure in detail.
- Discuss regeneration in Bamboos?
- Discuss in detail uses of Bamboo.
- What are canes? Discuss propagation of canes.

# Unit 9: Gums, Resins and Oleo-Resins

**Unit Structure**



## 9.0 Learning Objectives

After studying this unit, you should be able to:

- To differentiate between gums, resins and oleoresins.
- To classify the resins and gums depending upon their purity or mixture with essential oils gums etc.
- To develop an understanding about the major plants that yield resins and gums.
- To develop an understanding about the significance of the gum and resin yielding plants in the industrial and economic development.

## 9.1. Introduction

Among the forest products of India gums and resins occupy an important place. These natural products have been known to man from time immemorial. Gum Arabic was used by the Egyptians as early as 2000 B.C. Balsams, myrrh and frankincense are frequently referred to in the old Testament and these have been in use in India and China for religious purposes from ancient times. They were in great demand in ancient Egypt for embalming the dead and for use in cosmetics. There are several species in India that yields resins and gums. Generally gums and resins are plant exudations which may occur naturally or due to some injury in the plant parts. Although mostly of plant origin an important resin lac is obtained by secretions of minute insects *Laccifer lacca* (Indian Forest Utilization, 1972). . Gums are supposed to be the result of disintegration of internal tissues in which cellulose is decomposed into more or less viscous substance through a process called gummosis, which exudes from cracks and wounds of the stems. The species of genus pine are the most common resin yielding species. In small hill state like Uttarakhand where resin is collected from Pine trees (*Pinus roxburghii*), the revenue to the state forest department was Rs. 453 million in 2005-06.

The secretion of toxic resinous compounds is regarded as a defense against a wide range of herbivores, insects, and pathogens; while the volatile phenolic compounds may attract benefactors such as parasitoids or predators of the herbivores that attack the plant.

## 9.2 Resins

A resin is a hydrocarbon secretion of many plants particularly coniferous trees. It is valued for its chemical constituents and uses, such as varnishes and adhesives, as an important source of raw materials for organic synthesis. Resins consist primarily of secondary metabolites or compounds that apparently play no role in the primary physiology of a plant. While some scientists view resins only as waste products, their protective benefits to the plant are widely documented. The toxic resinous compounds may confound a wide range of herbivores, insects, and pathogens; while the volatile phenolic compounds may attract benefactors such as parasitoids or predators of the herbivores that attack the plant.

The resin produced by most plants is a viscous liquid, composed mainly of volatile fluid terpenes, with lesser components of dissolved non-volatile solids which make resin thick and sticky. Some resins also contain a high proportion of resin acids. Resinous secretion occurs in special cavities or passages in a wide variety of plants. The mode of resin formation or its utility to the plants is little understood. Presumably resins originate through reduction and polymerization of carbohydrates. They may also represent exudation products of various essential oils. They normally ooze out through the bark, hardening on exposure. Commercial resins are collected from artificial wounds or fossils material. Unlike gums, resins are insoluble in water but are more or less soluble in ordinary reagents such as ether, alcohol and turpentine. They are brittle, amorphous and more or less transparent and burn with a smoky flame when ignited. Though widespread in nature, only a few families of plants are commercially important as source of resin; these include Anacardiaceae, Burseraceae, Dipterocarpus, Guttiferae, Hamamelidaceae, Leguminosae, Liliaceae, Pinaceae, Styraceae and Umbelliferae.

The classification of resins is in a chaotic condition. The resins occur both in the pure or nearly pure state, and in mixture with essential oils, gums and the like. Resins are mainly distinguished into three types: (i) hard resins, (ii) oleo-resins and (iii) gum-resins. The classification of the resins has been given following Indian Forest Utilization, 1972, Dwivedi, 1993 and Mehta, 1981.

## 9.2.1 Hard resins

These contain only a little, if any, essential oil. They are usually solid, more or less transparent, brittle substances with no particular odour or taste. They constitute the best sources of varnishes. The most important commercial resins, such as copals and dammars, belong to this class.

**(a) Copals:** It comprise a considerable group of resins of recent, semi-fossil and fossil origin, found in many tropical and subtropical countries. They contain almost no oil and yield a hard and elastic varnish, much used for outdoor work.

**(b) Dammar:** This is the Malay term for all gums and resins that exude from cracks or cuts and solidify upon exposure to the air, but used commercially as it designates a group of varnish resin obtained from Indian or East Indian trees belonging to the families Dipterocarpaceae and Burseraceae (Mehta, 1981).

**(c) Amber:** This is a fossil resin found principally on the shores of the Baltic Sea. The principal source was now extinct Pinus succinifera. Amber is an exceedingly hard and brittle substance. The larger and finer pieces are used for jewellery, beads, trinkets, cigar holders, etc., and the smaller pieces and waste form carving for varnish (Mehta, 1981).

**(d) Lacquer:** This is a natural varnish exuded by Rhus verniciflua, a native of China. When applied, the varnish rapidly hardens in a moist atmosphere owing, in part, to oxidation.

**(e) Sandarac:** This is a soft, pale- yellow resin obtained from Callitris quadrivalvis, a small tree of Northern Africa. Some Australian species of Callitris also yield sandarac. It is hard, white, spirit varnish, useful for coating labels, negatives, leather and metals.

**(f) Mastic:** This is derived from Pistacia lentiscus, a small tree of the Mediterranean region. Mastic yields a pale varnish used for coating metals and pictures, both oils and water colours. It is one of the most expensive and high- grade resins with many other uses (Mehta, 1981).

## 9.2.2 Oleo-resin

It contains a considerable amount of essential oils in addition to resinous materials and consequently they are more or less liquid in form. They have a distinct aroma or flavor. Among the oleo-resins are included the turpentine, the balsams and elemis. The distinction between these groups is very slight and often confusing (Indian Forest Utilization, 1972). Different oleo-resins are mentioned below:

**(a) Turpentine:** Turpentine are oleo-resins obtained almost exclusively from coniferous trees. For commercial purposes crude turpentine is obtained by tapping the trees. On distillation turpentine yield the essential oil or spirits of turpentine and rosin. The turpentine industry is one of the major industries based on forest products in India. Turpentine and rosin are produced in many European countries and in the United States, Indo-China etc (Mehta, 1981).

**(b) Balsams:** Balsams are oleo-resins that contain benzoic or cinnamic acid and so are highly aromatic. The name is usually applied to same substances like Canada balsam which is true turpentine. True balsam contains much less oil than the turpentine. They yield essential oils on distillation. Balsam of Peru is obtained from *Myroxylon pereirae,* a tree of Central America. It is used in perfumes as a fixative for heavier odours. It is also used in medicine.

There are several other oleo-resins which do not belong to either the turpentine or balsams. Among these may be Copaiba and elemi.

### 9.2.3 Gum-Resins

Gum- resins are mixture of both gums and resins and combine the characteristics of both groups. They also contain small amount of essential oils. They are usually produced by plants of dry arid regions, specially species of Umbelliferae and Burseraceae. These plants are abundant in Iran and Afganistan. Important gum-resins include gambage, asafoetida, galbanum, myrrh and frankincense (Indian Forest Utilization, 1972) and detailed as follows:

**(a) Gambage:** This is a hard, brittle, yellow gum-resin produced by several species of *Garcinia,* especially *G. hanburyi* of Siam and Indo-China and *G. morella* of India. It is used to colour golden lacquers, as a water colour pigments, and in medicine (Mehta, 1981).

**(b) Asafoetida:** The sources of asafetida are *Ferula asafoetida* and allied species found in Iran and Afganistan. The gum-resin exude from the roots when the stem is cut off. It has a powerful odour and a bitter acrid taste due to sulphur compounds present in the essential oil. It is used throughout the East for flavoring curries, sauces and other food products and as a drug (Mehta, 1981).

**(c) Galbanum:**A gum- resin excreted from the lower part of stems of *Ferula galbaniflua.* It has a tenacious and powerful aromatic odour. It is used in medicine.

**(d) Myrrh:** One of the oldest and most valuable of the gum-resins derived from *Commiphora myrrh,* a large shrub or small tree of Ethiopia, Somaliland and Arabia (Mehta, 1981).

**(e) Frankincense:** A fragrant gum-resin obtained from the stems of species of *Boswellia,* especially *B. carterii,* native to north-eastern Africa and Southern coast of Arabia. Its principal use is as incense in Roman Catholic and Greek churches.

One more category, which constitutes 75% of resins used, is unsaturated polyester resin. Ion exchange resin is another important class with application in water purification and catalysis of organic reactions.

Synthetic resins are materials with similar properties to natural resins—viscous liquids capable of hardening. They are typically manufactured by esterification or soaping of organic compounds. The classic variety is epoxy resin, manufactured through polymerization-polyaddition or polycondensation reactions, used as a thermo set polymer for adhesives and composites. Epoxy resin is two times stronger than concrete, seamless and waterproof. Accordingly, it has been mainly in use for industrial flooring purposes since the 1960s. Since 2000, however, epoxy and polyurethane resins are used in interiors as well, mainly in Western Europe. Use of natural resins in paints, varnishes and lacquers, in particular, has suffered as cheaper, synthetic chemicals have become available. Others, especially the soft resins and balsams, are used as sources of fragrances and pharmaceuticals, usually after preparation of a suitable solvent extract or distillation of a volatile oil.

The hard transparent resins, such as the copals, dammars, mastic and sandarac, are principally used for varnishes and cement, while the softer odoriferous oleo-resins (frankincense, elemi, turpentine, copaiba) and gum resins containing essential oils (ammoniacum, asafoetida, gamboge, myrrh, and scammony) are more largely used for therapeutic purposes and incense.Resin in the form of rosin is applied to the bows of stringed instruments (e.g. violin, rebec, erhu, sarangi, etc), because of its quality for adding friction to the hair. Ballet dancers may apply crushed rosin to their shoes to increase grip on a slippery floor.

Resin has also been used as a medium for sculpture by artists such as Eva Hesse, and in other types of artwork.In the early 1990s, most bowling ball manufacturers started adding resin particles to the covers of bowling balls. Resin makes a bowling ball tackier than it would otherwise be, increasing its ability to hook into the pins at an angle and (with correct technique) making strikes easier to achieve.Resins used to be much more commonly utilized in industry, e.g. in the production of oil paints and varnishes or to waterproof ships. These days their industrial uses have largely been diminished in favour of synthetic substitutes. Some resins have powerful medicinal properties that have long been utilized in herbal medicine, but others can be toxic. For example resins derived from certain plants of the *Artemisia* family or from the *Cypress* contain thujone, which is a known neurotoxin.

*Agathis* is the most tropical of all conifers. The copal-yielding species are very tall trees, up to 60 m high, often with a near-cylindrical bole. However, there can be some variation in the characters of the living tree, as well as the ecological conditions under which it occurs. It is grown widely as a timber tree on Java (over 100 000 ha) and other parts of Indonesia. Recent research in Indonesia and the Philippines has shown that thick-barked *Agathis* yields significantly more resin than thin-barked trees (in one study in Indonesia, almost nine times as much), and that tapping in the morning and at the side of the tree which maximizes the length of time that sunlight falls on it is beneficial to resin yields

Important resin yielding plants in India are as follows:

**Salai (*Boswellia serrata*):** It is a large sized tree, generally found in dry deciduous forests. For taking out the resin, the bark is shaved off from the trunk in fully grown trees at a height of generally 0.75 meters above the ground. The phloem which contains resins canal and ducts are exposed for exudation of resin. The blaze so made is freshened after every fourth and fifth day to facilitate resin exudation. The first collection is made after one or two weeks of making the blaze. Freshening of the blaze is done from time to time and the original blaze is gradually widen to tap the resin in larger quantities. It hardens in four days and it is golden in colour and transparent in nature. The tapping is done during December to June every year. It closes on the onset of monsoon (Dwivedi, 1993).

**Black dammer (*Canarium strictum*):** This tree is a large deciduous tree, generally occurs as an associate of moist deciduous forests in Karnataka. It is found up to an elevation of about 1500 meters in the Western Ghats. The resin is tapped from these trees and vertical incisions are made in strips at about 1.8 meters from the ground. Generally, a fire is lit in the ground near the base of the tree to damage the outer layer of the bark. The resin begins to flow from this portion of the stem and lasts for about six months each year usually from November to April up to about 10 years. The resin is generally translucent and bright shining in colour. It is used in caulking boats, making varnishes and bottling wax. It is also used as a substitute for Burgundy pitch in plasters (Dwivedi, 1993).

**Guggal(*Commiphora mukul*):** It is a large sized shrub or small tree generally found in dry and rocky areas of Rajasthan, Gujarat, Maharashtra, Karnataka and adjoining states. The resin obtained from this tree is known as guggal gum or Indian myrrh in the trade. For harvesting the resin oblique incisions 7 to 10 cm apart are made with sharp instrument into the bark of the stem. The milky liquid exudes from the incisions. The colour become darker as it thickens. Each tree yields about one kg of resin each year. The resin is aromatic in taste and balsamic in colour. It is used as an incense and as a mixture in the preparation of perfumes. It is also used in the preparation of certain medicines. Other species, *C. berryi, C. caudata* and *C. roxburghii* also exude resins.

**Gurjan (*Dipterocarpus turbinatus*):** It is large sized tree found in the moist tropical forests of Assam and the Andaman Islands. The trunk exude an oleoresin commercially known as the gurjan oil. About 1 m from the ground, a cone shaped cavity is made on the trunk of the tree and fire is lighted to char the cut surface. After sometime, the oleoresin starts flowing out which is removed periodically. An average tree yields about 10 kg of oleoresin in one season i.e., from November to May. This oleoresin is used in lithographic inks, providing an anticorrosive coating to iron, for the preservation of timber and bamboo, for caulking boats, in preparation of varnishes. It also finds use as a medicine (Dwivedi, 1993)..

**Chir Pine (*Pinus roxburghii*):**The Chir Pine (*Pinus roxburghii*) named after William Roxburgh, is a pine native to the Himalaya. It is a large evergreen tree reaching 30-50 m with a trunk diameter of up to 2 m, exceptionally 3 m. The range extends from northern Pakistan, Jammu and Kashmir, Punjab, Himachal Pradesh, Uttarakhand, Sikkim and Nepal to Bhutan. It generally occurs at lower altitudes than other pines in the Himalaya, from 500-2000 m, occasionally up to 2,300 metres (7,500 ft). The other Himalayan pines are Blue Pine, Bhutan White Pine, Chinese White Pine, Chilgoza Pine and Sikang Pine. Chir pine is widely planted for timber in its native area, being one of the most important trees in forestry in northern Pakistan, India and Nepal. It is also occasionally used as an ornamental tree, planted in parks and gardens in hot dry areas. In Uttarakhand this tree is tapped intensively for resin. On distillation, the resin yieds an essential oil, commonly known as turpentine, and non-volatile rosin. The proportion of rosin and turpentine oil in Chir Pine is 75% and 22%, respectively with 3% losses, etc. The turpentine is chiefly used as a solvent in pharmaceutical preparations, perfume industry, in manufacture of synthetic pine oil, disinfectants, insecticides and denaturants. It is one of the most important basic raw materials for the synthesis of terpene chemicals which are used in a wide variety of industries such as adhesives, paper and rubber, etc. Chir Pine rosin is principally used in paper, soap, cosmetics, paint, varnish, rubber and polish industries. Besides these, other uses include, manufacture of linoleum, explosives, insecticides and disinfectants, as a flux in soldering, in brewing and in mineral beneficiation as a frothing agent. Presently, India imports resin which is far superior in quality as well as cheaper than the indigenous one. Quality of resin depends on the pinene content. Imported resin contains 75-95% pinene, whereas Chir Pine resin contains only about 25% pinene.

Old Chir Pine trees which die from fire or drying out undergo some metamorphosis in their wood due to the crystallization of the resin inside the heart wood. This makes the wood become brightly colored (various shades from translucent yellow to dark red) and very aromatic with a brittle, glassy feel. This form of wood known as *Jhukti/Chhilka* by the locals is very easy to ignite (it never gets wet or waterlogged) fires and even used for lighting, as a small piece of this burn for a long time (owing to the high resin content). Of all the conifer species in Uttarakhand, only this one seems to be ideal for that purpose. Another use of this tree is made extensively for its dried needles those are collected from the forest floor to form a dense carpet underneath the cattle beds mostly during winter to provide warmth to the cattle. This material when mixed with animal dung and urine is allowed to decompose in compost pits and applied to the criopfileds to replenish soil fertility. The green needles are also used to make tiny hand brooms. For local building purposes, the wood of this tree is the least preferred, as it is the weakest and most prone to decay when compared with other conifers. However, in most low altitude regions, there is no other choice, except for Chir Pine the clear boles of which are used for making rafters and furniture as the wood is soft and easily worked out.

**Chilgoza Pine (*Pinus gerardiana*):** *Pinus gerardiana*, known as the Chilgoza Pine**,** is a pine native to the northwestern Himalaya in eastern Afghanistan, Pakistan, and northwest India, growing at elevations between 1800-3350 m. It often occurs in association with Blue Pine (*Pinus wallichiana*) and Deodar (*Cedrus deodara*). The trees are 10-25 m tall and approx. 127 cm dbh with usually deep, wide and open crowns with long, erect branches. The seeds (pine nuts) are 17-23 mm long and 5-7 mm broad, with a thin shell and a rudimentary wing. Chilgoza Pine is well known for its edible seeds, rich in carbohydrates and proteins. The seeds are sold as dry-fruits by the name "Chilghoza". In Afghanistan, this species is cultivated for its edible seed, and efforts are underway to expand its economic utilization in India. Elsewhere, native populations are ruthlessly exploited, with typically 100% of cones harvested. As a consequence, there is virtually no natural regeneration of this species except in that very small fraction of its range (about 5%) where the species is inaccessible to significant human exploitation. Besides, Chilgoza pine is also a good soil binder, which ultimately checks the soil erosion. Though it has not been exploited commercially for oleoresin, owing to its limited distribution and to avoid destruction of the trees in order to get more valuable nuts, yet there is plenty of scope for resin extraction once large areas will be under this species. Reckless cone extraction and almost complete lack of natural regeneration have led Chilgoza pine to brink of extinction, which deserves immediate attention for genetic conservation and improvement. The Himachal Pradesh State Forest Department has tried artificial regeneration of Chilgoza Pine at many places. However, performance of seedlings was found to be very poor.

The seed is eaten as dry fruit chilgoza. The seed is also anodyne and stimulant. The oil obtained from the seeds is used as a dressing on wounds and ulcers; it is also used externally in the treatment of head diseases. The turpentine obtained from the resin of all pine trees is antiseptic, diuretic, rubefacient and vermifuge. It is a valuable remedy used internally in the treatment of kidney and bladder complaints and is used both internally and as a rub and steam bath in the treatment of rheumatic affections. It is also very beneficial to the respiratory system and so is useful in treating diseases of the mucous membranes and respiratory complaints such as coughs, colds, influenza and TB. Externally it is a very beneficial treatment for a variety of skin complaints, wounds, sores, burns, boils etc and is used in the form of liniment plasters, poultices, herbal steam baths and inhalers.

Oleo-resins are present in the tissues of all species of pines, but these are often not present in sufficient quantity to make their extraction economically worthwhile. The resins are obtained by tapping the trunk, or by destructive distillation of the wood. In general, trees from warmer areas of distribution give the higher yields. Turpentine consists of an average of 20% of the oleo-resin and is separated by distillation. Turpentine has a wide range of uses including as a solvent for waxes etc, for making varnish, medicinal etc.

Rosin is the substance left after turpentine is removed. This is used by violinists on their bows and also in making sealing wax, varnish etc. Pitch can also be obtained from the resin and is used for waterproofing, as a wood preservative etc.

**Blue pine (*Pinus wallichiana*):** Blue pine forests occur in moist valleys at elevations above 2000m in the middle Himalayas. These trees are generally found mixed with deodar.

**Khasi pine (*Pinus kesiya*):** It grows in Garo, Khasi and Naga hills in North-eastern states between the elevations of 1000-2000 m.

**Tropical pines:** Some of the tropical Pines introduced in the country viz. *Pinus caribaea, Pinus illiottii, Pinuspetula*, etc., also yield oleoresin similar to that yielded by Chir pine.

## 9.3 Gums

Gums are substances that are either water soluble or can absorb water - they are not soluble in oil. Chemically they are complex polysaccharides (Carbohydrates). True gums are formed as a result of disintegration of internal plant tissues, chiefly decomposition of cellulose, through a process known as gummosis. Gums are soluble in water or can at least imbibe quantities of water and swell in the process, but are usually insoluble in common organic solvents such as alcohol and ether and in various oils. On heating they decompose completely without melting usually showing charring.

Gums either derive from the resinous sap or from the endosperm of certain seeds, e.g., Guar Gum, which is derived from the seeds of *Cyamopsis tetragonolubus*, an African herbaceous plant of the pea family. Gums are widely used as emulsifying and thickening agents in the food industry, but they also find uses in other industries, from pharmacy to cosmetics and skin care products, to the manufacture of inks, paper, watercolours and even the adhesive on the back of stamps. Water soluble gums also play an important role in a healthy diet as they are able to bind endotoxins and help to excrete them by adding bulk to the stool. *Psyllium* seed - a well known dietary supplement often used for minor constipation is a prime example of this action. Some sea weeds also yield gums, e.g., agar agar is well known and widely used in cooking as a thickener.

In India, there are a large number of species, mostly trees, which exude gums. Some of these are of local or limited interest, while a few are used extensively all over India and also enter the export trade of the country. The most important are;

## 9.3.1 *Acacia* gums

The acacia gums, largely known as gum arabic are derived from several species of genus *Acacia*. The bulk of the gum from indigenous sources is utilized locally. The gum Arabic available in the market is often a mixture largely of the gums of *Acacia* species and small quantities of the gums of *Anogeissus latifolia, Feronia limonia,* etc. This mixture is used as such for various purposes. The following are important Indian species of *Acacia* yielding gum:

***Acacia catechu* (khair):**This tree is well known as the source of katha and cutch and occurs in many places in India. The gum from this tree, though darker in colour, is of good quality and is regarded as a better substitute for true gum Arabic than babul gum. The tears may be as large as 3 cm in diameter and pale yellow to dark amber in colour. It is not collected separately and is generally mixed up with other Acacia gums. No gum is formed during the rainy season when the trees are in flower and fruit. With the onset of the dry season as indicated by the withering and falling of the leaves, the gums oozes out freely from injured areas in the trunk and branches.

***Acacia modesta*:** This tree yields a fair quantity of a gum which is highly valued in indigenous medicine and also in calico-printing.

***Acacia nilotica*:** This tree is widely distributed throughout India, especially in the drier localities. It forms the main source of the Indian "gum Arabic", rightly called the babul gum. This gum is commercially important in the internal trade. Babul gum is generally considered inferior to true gum arabic obtained from *A. senegal,* especially for medicinal purposes. Gum arabic from *A. senegal* is a pale to orange-brown coloured solid, which breaks with a glassy fracture. The best grades are in the form of whole, round tears, orange-brown in colour and with a matt surface texture; in the broken, kibbled state the pieces are much paler and have a glassy appearance. Gum from *A. seyal* (gum talha) is more friable than the hard tears produced by *A. senegal* and is rarely found as whole lumps in export consignments.

Gum arabic is a complex, slightly acidic polysaccharide. The precise chemical and molecular structure differs according to the botanical origin of the gum, and these differences are reflected in some of the analytical properties of the gum. As a result, the functional properties and uses to which gum arabic can be put (and its commercial value) are also very dependent on its origin. Unlike some other gums such as tragacanth, locust bean and the seaweed gums, gum arabic is very soluble in water and forms solutions over a wide range of concentrations without becoming highly viscous. The combination of high solubility in water and low viscosity confers on gum arabic its highly valued emulsifying, stabilizing, thickening and suspending properties. Despite some substitution of gum arabic by cheaper alternatives, brought about in the past by shortages of supply and high prices, it has remained the most important of the exudate gums and in some applications it has technical advantages which make it difficult to substitute completely. Its uses fall into three main areas: food, pharmaceutical and technical. Gum arabic's use in pharmaceuticals has been displaced in many of its applications by modified starches and celluloses. However, it still finds some use in tablet manufacture, where it functions as a binding agent or as a coating prior to sugar coating, and it is also used as a suspending and emulsifying agent, sometimes in combination with other gums.Other technical uses include ceramics, where gum arabic helps to strengthen the clay, certain types of inks, and pyrotechnics. Use in textiles, paints and adhesives (including the traditional office glue and postage stamps) has decreased to very low levels in recent years, at least in Western markets.

***Acacia Senegal*:** This tree yields the true gum arabic. It is small throny tree, 3-4.5 m in height and 30-60 cm in girth, found in Punjab, Himachal Pradesh and the northern Aravalli hills and other parts of Rajasthan. It is abundant in the arid tracts of North Africa, particularly in Sudan, from where world supplies are drawn. It has been an article of commerce since the first century of the Christian era.

### 9.3.2 *Anogeissus latifolia* (dhaura)

This is a large tree found in the dry deciduous forests, almost throughout India. It is the source of the so-called ghatti gum. The tears are round or vermicular, opaque externally and transparent internally, and almost free from cracks. The colour varies from whitish yellow to amber. It is sometimes brown because of impurities. Factors which affect the colour are the proximity of the tear to the bark and the length of time it has remained on the tree before collection, since tannins in the bark darken the gum tears. This gum is said to be superior to babul gum in colour. It is partly soluble in water, forming a colourless mucilage. The gum is a substitute for gum arabic and is used for calico-printing, pharmaceutical purposes and sizing paper. In recent years, it has been used in the petroleum industry as a drilling mud conditioner and in the explosive industries as a preferential water-absorbent or desiccant. It is also used in ceramics and foods.

### 9.3.3 *Bauhinia retusa* (semal)

This is a tree found in many parts of India and is often tapped for the gum known as semal gond, in parts of Himalayan foothills (Siwaliks) and elsewhere. There is always a good local demand for this gum which resembles gum arabic. It is eaten by the poor people and is also used for sizing cloth and paper and for water proofing terraced roofs. It can also be used as an efficient binder in the manufacture of charcoal briquettes, either alone or in conjunction with other binders of starchy nature.

### 9.3.4 *Cochlospermum religiosum*

This tree, which is found in many parts of the country, yields a gum by exudation from the fibrous, deeply- furrowed bark. The gum is similar to gum karaya in appearance and properties. It is known as katira gum or hog gum and is used as a substitute for gum tragacanth. Katira gum and gum karaya are in great demand for export for use in cigar paste and in ice-cream industry. Katira gum is used as a substitute for gum tragacanth in calico-printing and leather-dressing. The gum is sweetish, cooling and sedative and is useful in coughs.

### 9.3.5 *Lannea coromandelica* (jhingan)

This is a moderate to large- sized deciduous tree, found throughout the greater part of India up to 1,500 m in the sub-Himalayan tracts. A mucilaginous gum, called jhingan gum, exudes from wounds and cracks in the bark. The gum is tapped in North India from March till the onset of rains, by making shallow cuts in the bark. The yield is about 5kg per tree in the first year, decreasing to 1 kg after 5 years, when the tree is given rest. The gum occurs in round tears or colourless angular fragments like gum arabic. Fresh gum is soluble in water, forming thin mucilage with good adhesive properties. It is used in calico- printing, paper and cloth sizing and inferior varnishes and for preserving fishing nets. It is also used in confectionary. Small quantities are exported.

### 9.3.6 *Pterocarpus marsupium* (bijasal)

This is a large tree, distributed in central and southern India. It is source of an important gum, the kino of the Indian Pharmacopoeia and the officinal kino of the British Pharmacopoeia. The blood red or ruby-coloured, astringent gum exudes from the bark. It is valuable medicine in cases of diarrhea and dysentery. There is a considerable demand for the kino gum for export much of it going to Europe.

### 9.3.7 *Sterculia urens*

This tree is common in India in the tropical deciduous forests, mostly in dry and rocky areas. It is the source of an important gum known in the trade as “gum karaya” or “katira gum”. It belongs to the tragacanth group of gums that swell to jelly like masses in water, but are not actually soluble in it. Gum karaya is commonly used as substitute for gum tragacanth; in some properties e.g., viscosity, the former is even superior to the latter and has the added attraction of being lower in cost.

In world trade two kinds of gums play an important role, viz. gum arabic and gum tragacanth. The term gum arabic is used with varying degrees of precision by different groups of people. In the context of its use as a food additive the most recent international specification, published by FAO (FAO, 1990), defines gum arabic as the "dried exudation obtained from the stems and branches of *Acacia senegal* (L) Willdenow or closely related species". The specification then proceeds to give limits for certain parameters which have been selected to try and ensure that only gum from *A. senegal* (and closely related species) satisfies the specification. The need for such legislation arises from the need to assure the public on safety grounds that there are no hazards associated with ingestion of gum arabic; gum arabic which complies with the definition and specifications has been tested and shown to be safe to consume.

## 9.4 Summary

A resin is a hydrocarbon secretion of many plants particularly coniferous trees. It is valued for its chemical constituents and uses, such as varnishes and adhesives, as an important source of raw materials for organic synthesis.The resins occur both in the pure or nearly pure state, and in mixture with essential oils, gums and the like. Resins are mainly distinguished into three types, hard resins, oleo-resins and gum-resins. The important resin yielding plant species are *Boswellia serrata*, *Canarium strictum, Commiphora mukul, Dipterocarpus turbinatus, Pinus roxburghii,Pinus gerardiana*etc. Gums are substances that are either water soluble or can absorb water - they are not soluble in oil. Chemically they are complex polysaccharides (Carbohydrates).Gums either derived from the resinous sap or from the endosperm of certain seeds, e.g. like Guar Gum, which is derived from the seeds of *Cyamopsis tetragonolubus*, an African herbaceous plant of the pea family. The two important types of gum found in India i.e., Gum arabic and gum tragacanth. The important gum yielding plant species are *Acacia spp.,Anogeissus latifolia, Bauhinia retusa, Cochlospermum religiosum, Lannea coromandelica, Pterocarpus marsupium,Sterculia urens* etc.

### Terminal Questions

1. Differentiate between gum and resins and oleoresins.
2. Describe the various uses of gum, resin and oleoresins.
3. Describe various gum yielding major plant species.
4. Write in detail about Chir Pine, a resin yielding plant of Uttarakhand.
5. Differentiate between gum arabic and gum trgacanth.
6. Describe some common method of extraction of gums and resins with some examples.

7. Describe the industrial, medicinal and other uses of resin.

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# Unit 10. NTFPs: Tans and dyes

**Unit Structure**



## 10.0 Learning Objectives

After studying this unit, you should be able to:

- To differentiate between tannins and dyes.
- To understand the importance and uses of tannins and dyes.
- To develop an understanding of major plant species including herbs and shrubs and their parts that yield tannin and dyes.

## 10.1. Introduction

In this section we will try to understand what are Tannins and Dyes and their importance in our daily life along with the name of plants and parts that produce them. There are several plant parts like bark, root, leaf, stem that produce dyes and have tannin properties. Tannin and dyes are secretion products found almost universally in plant tissues in small or large amounts. Tannins and dyes are comparatively simple chemical compounds of carbon, hydrogen and oxygen along with some nitrogen in case of dyes. However, economically important and commercially exploited plants are those that yield these natural products in large quantities. For the sake of convenience in this unit we will deal with tannins and dyes separately.

## 10.2 Tannins

As mentioned above tannin are simple chemical compounds of carbon, hydrogen and oxygen secreted almost universally by plant tissues in small or large amounts. Tannin is a generic name applied to large classes of organic substances which often differ widely in chemical composition and reaction but have one common property that reacts with animal hides and skins and make them resistant to decomposition and at the same time leave them flexible and stronger. It is only after the skins and hides of animals have been treated with tans that they are called tanned leather.

The name ‘tannin’ is derived from the French ‘tannin’ (tanning substance) and is used for a range of natural polyphenols. Since ancient times it is known that certain organic substances have tanning properties and are able to tan animal skins to form leather. Prehistoric tribes already knew about the tanning of animal hides with brain material and the fat of the killed animals. However, precisely what happens to the skin during the tanning process was only elucidated during the twentieth century with the help of modern analytical techniques. Real tanning is understood as the cross linking of the skin’s collagen chains, while false tanning entails the filling of hollow spaces between the skin’s collagen chains. High tannin concentrations are found in nearly every part of the plant, such as in the bark, wood, leaves, fruits, roots and seeds. Frequently an increased tannin production can be associated with some sickness of the plant. Therefore, it is assumed that the biological role many tannins in the plants is related to protection against infection, insects or animal herbivory. The tannins appear as light yellow or white amorphous powders or shiny, nearly colourless, loose masses with characteristic strong smell and astringent taste.

The tannins are known over millennia (Mediterranean since 1500 BC), through medicinal uses to uses in the food industry. In medicines, especially in Asian (Japanese and Chinese) natural healing, the tannin- containing plant extracts are used as astringents, against diarrhea as diuretics, against stomach and duodenal tumors and as anti-inflammatory, antiseptic and haemostatic pharmaceuticals. Tannins are used in the dyestuff industry as caustics for cationic dyes (tannin dyes) and also in the production of inks (iron gallate ink). In the food industry tannins are used to clarify wine, beer and fruit juices. Other industrial uses of tannins include textile dyes, as antioxidants in the fruit juice, beer and wine industries and as coagulants in rubber production.

Recently the tannins have attracted scientific interest especially due to the increased incidence of deadly illnesses such as AIDS and various cancers. The search for new lead compounds for the development of novel pharmaceuticals has become increasingly important, especially as the biological action of tannin containing plant extracts has been well documented. During the last twenty years many representatives of this class of compounds have been isolated and characterized. Currently known tannins with unambiguously determined structures already number far more than 1000 natural products. In extensive biological tests many representatives of tannins were found to have antiviral, antibacterial and especially antitumor activity.

Besides natural tannins (plant material) mineral and synthetic substances called 'syntans' are also used in tanning. But they are not very widely used as they lack certain properties necessary to produce heavy leathers and therefore cannot the regarded as true replacement materials for plant based tannins (Dwivedi,1993). Approximately 90 percent of the plant based tanning materials is used for tanning leather. In India it is a flourishing industry earning large foreign exchange. With a large livestock populations in India, annual production of ran hides is relatively large requiring a sizable quantity of tanning material. There are more than 1000 tanneries in India (big and small) utilizing fifty thousand tons of wattle extracts, four lac tones of barks and more than fifty thousand tons of myrobalans as material for tanning. Some tanning material is still being imported (Dwivedi,1993).

Tanning materials are obtained from different parts of the plant. On the basis of their presence in plant parts, these are classified into the following four groups:

- Wood tans
- Bark tans
- Fruit tans

- Leaf tans

### 10.2.1 Wood tans

Forest trees with wood yielding tanning material are termed as wood tans. Among the most important wood tans is Quebracho (*Quebracho colorado*) tree which is widely distributed in South America. The heart wood contains 20-27 percent tannin, which is obtained by cutting the wood into small chips and extracting the tannin with water. India imports sizable quantity of this extract from South America. Another important example of wood tans is *Acacia catechu (Khair).* In India, the cutch obtained from khair heart wood is used for tanning purpose. This tree grows in khair-sissoo forests, southern thorn forests and very dry teak forests. In India, it is found growing in Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Jammu and Kashmir, Maharashtra, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand. The estimated availability of the cutch extract from an organized sector is about 4000-5000 tonnes. Cutch is used as blend along with wattle, it is used for producing heavy leather. It is also used for dyeing leather.

### 10.2.2 Bark tans

Barks of several tree species yield tannins, which are commercially exploited. The species known to yield bark tans are *Acacia mearnsii, Acacia nilotica, Cassia auriculata, Shorea robusta, Terminalia arjuna, Cassia fistula, Ceriops roxburghiana* etc. Some other trees such as *Acacia leucocephala,Bridelia retusa, Lagerstroemia spp., Tamarix aphylla, Terminalia alata, Quercus spp. and Castanopsis spp*. also yield bark tans and are locally important. Most of these trees are found naturally in the forests and some of them are also being planted under several plantations programmes. The bark is chipped off from the stem by debarking axes or debarking spade as a byproduct when the tree is harvested for timber or firewood. Only *Cassia auriculata*, which is a small shrub, is harvested solely for the production of bark. Trees with faster rate of growth contain more bark tan than slow growing trees. Generally, the beginning of the growing season (mostly spring through summer) is considered to be the most optimum period for harvesting bark for collecting tans, as tannin content is the highest during this period. The bark is collected, dried, stored and marketed. Some important plants those yield bark tans are mentioned below:

***Acacia mearansii*(Wattle, mimosa, black wattle):** The species is a native of South Australia and has been planted successfully in India. It is cultivated in many parts of the country for its bark. In India, it has been found to grow in Tamil Nadu, Nagaland, Kerala; hilly region in Jammu and Kashmir and Meghalaya. The bark yields an excellent quality of tannin. In India, the estimated availability of tannin extracted from the species is about 5000 tonnes per year. The tree is largely cultivated for tanning material. It is astringent, catechol type of tannin. The important characteristic property of the tannin obtained from this tree is that the liquor has a good shelf life, i.e., on standing; the liquor does not loose its stability. It penetrates into the dried hide of animals easily and rapidly. The leather produced with the liquid plant extract when exposed to light, becomes reddish in colour. The liquor provides very little acid on fermentation. The leather obtained by the tanning extract is firm and possesses an average degree of tanning, which can be further improved by retreating after acidifying the liquor. It is used in blends. It is also used in plywood industries in adhesive formulations.

***Cassia auriculata* (Avaram):**Avaram bark is obtained from Cassia auriculata. In India the species grows wild in the Deccan plateau and South India. It thrives best on dry stony hills and black soils. Its bark is mostly used as a tanning material in Tamil Nadu and South India. It also occurs in Andhra Pradesh, Maharashtra, Karnataka and Rajasthan. The estimated yield of bark is 2.00 lakh tonnes per year. The bark has 23% tannin material. The method of collection of bark consists of cutting of shoots from the base and striping off the bark from shoots and drying it. The bark of the species is regarded as one of the best tanning material in India. Avaram tannin obtained from the bark produces lightly tanned, pale coloured leather with good strength. The tan liquor obtained from this species is stable and has low tannin loss on standing. An important feature of this bark is that it is easy to use and yields uniformly successful results. It was used in the production of famous East Indian leather. The method of collection of bark consists of cutting of shoots from the base and striping off the bark from shoots and drying it. The bark of the species is regarded as one of the best known tanning material in India. Avaram tannin obtained from the bark penetrates the hide very quickly and produces lightly tanned, pale coloured leather with good strength. The tan liquor obtained from this species is stable and has low tannin loss on standing. In past, the half tanned leather was exported, where its tannage and preparation for a variety of uses were carried out. It was used in the production of famous East Indian leather. It is also used in medicines and as a green manure (Mehta,1981).

***Acacia nilotica*** **(Babul):** Both bark and fruits of babul (*Acacia nilotica*) is used as a tanning material on a large scale. Babul is a common species of northern and southern tropical thorn forests and southern tropical dry mixed deciduous forests. It is a native of India and widely occurs all over the country. It is found in almost all states of the country viz., Rajasthan, Gujarat, Andhra Pradesh, Madhya Pradesh, Karnataka, Maharashtra, Tamil Nadu, Bihar, Orissa, West Bengal, Uttar Pradesh, Haryana, Punjab etc. (Mehta,1981). The tree is largely grown in homestead and field bund plantations in rural India. The wood has several uses as a building material and firewood. The bark is generally removed when the tree is felled for timber or fuel. In India, the estimated yield of tannin from the bark of this species is about 1 lakh tonnes. The bark is largely consumed by tanneries in Kanpur. The tannin content is comparatively higher in older tress than younger trees. The tannin content in the bark of branches is about 7-12 percent only. The deep colour and high non-tannin content are the two main drawbacks of this tree bark tan. It is considered to be good for heavy leather. It gives a dark coloured, firm and durable leather. It is not considered good for kips and half tanned hides.

***Cassia fistula*** **(Indian laburnum) (Amaltash):**Konnai (Cassia fistula) bark is also used in India for tanning purposes. The tree is widely distributed throughout the tropical India. It is found scattered in the tropical moist and dry deciduous forests and occasionally in the sal forests of the country. The total bark production obtained from this tree per annum is not precisely known. The minimum tannin and the maximum non-tannin content calculated on moisture free basis is 12 and 13 per cent, respectively. This tree is commonly used among the tanners in southern part of Tamil Nadu. It produces smooth grained, pale leather. Instead of the bole bark, the twig branches are used for improved leather colour. It is used in the tannage of kips and light weight hides. Bark is sometimes used as a substitute for avaram bark in blends. It cannot be used alone. Tannin obtained from the bark of this tree possesses low penetrating power.

***Ceriops roxburghiana* (Mangrove, goran):** It is evergreen mangrove tree, found in the coastal forests. In India, this species is predominant in Sunderbans (West Bengal), Tamil Nadu, Gujarat, Maharashtra, Andaman and Nicobar islands. The species produces valuable tannin material and leaves are also considered to be an important tan stuff. The bark contains 20-37 per cent tannin, while the leaves contain 9-15 per cent tannin. The bark is suitable of preparing extracts, the minimum tannin content in the solid extract and sprayed dried extract calculated on moisture free basis is 70 percent and 72 percent, respectively, and the maximum non-tannin content in the solid extract and spray dried extract calculated on moisture free basis is 35 percent and 34 percent, respectively. The minimum tannin content in the bark calculated on moisture free basis is 22 percent. The bark tannin of this tree imparts red colour to leather, which can be avoided by blending the bark with myrobalans and Babul bark. It can also be improved by decolorizing and bleaching. The bark is an astringent material. When used, it imparts red colour to the leather and is mostly used for manufacturing heavy leathers. The penetration power of the tannin is slow. The important characteristic of the mangrove liquor is its stability and low loss of tannin on standing.

*Ceriops tagal* and *Rhizophora mucronata* are also mangrove trees similar to C. roxburghiana, which find use in tanning industries. The bark is rich in tannin content and contains an excessive quantity of colouring material. The extract prepared from the bark of these species is also known as cutch and is used in local tanneries (Dwivedi, 1993).

***Terminalia arjuna* (Arjun):**It is a common tree of India and widely occurs in Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh, Bihar, Andhra Pradesh and Tamil Nadu. The tree grows in waterlogged areas. The tannin content in the bark varies considerably. Tannin content in dry bark of the main stem is about 20-24 per cent, while that in the lower branches is 18 percent. On an average, the tannin content and the non-tannin content are 15.8 percent and 8.2 percent, respectively. Tannin of this bark is widely used in large tanneries. It produces upper leather and very good quality sole leather. The bark of the tree is generally cut repeatedly to get fresh crop of bark. It is also used in medicines.

***Emblica officinalis*(Aonla):** It is a popular forest fruit tree distributed all over India in dry and moist deciduous forests. Aonla fruits are also used as tanning agents and also consumed for a variety of medicinal purposes. Aonla pickle is the most popular product consumed by people. The stem bark yields 8-9 percent tannin. The twig bark is richer in tannin content and contains about 20 percent tannin. The tannin extracted from the bark of this tree is used locally.

***Terminalia alata*** **(Laurel):**The tree is a common associate of sal and teak trees in tropical semi-evergreen and moist and dry deciduous forests. It is gregarious in Uttar Pradesh, Madhya Pradesh, Orissa, Maharashtra, Gujarat, Bihar and other parts of country. The tannin content and the non-tannin content in the bark is about 18.7 percent and 5-7 percent, respectively. It produces red leather which is somewhat similar in appearance to mangrove tanned leather. The bark of the species is generally harvested for oxalic acid (Diwedi, 1993; Mehta, 1981; Forest Utilization vol II).

***Shorea robusta*** **(Sal):**It is a large evergreen tree. The species occurs in the northern and the central region of India. It ascends to 1000m elevation in the hills. It is found in the forests of Uttar Pradesh, Uttarakhand, Madhya Pradesh, Bihar, Orissa, West Bengal and Assam. The minimum tannin and the maximum non-tannin content calculated on moisture free basis in the tree bark is 8 percent. Shorea robusta bark is widely used in local tanneries. It furnishes very tough leather with reddish tinge. The tannin is of condensed (catechol) type.

## 10.2.3 Fruit tans

Fruits of some of the forest trees are used in tanning industries for the extraction of different tannins. The various important species yielding fruit tans are as follows:

***Acacia nilotica*****(Babul)**: The pods of Acacia nilotica produce tannin of good quality. The tannin and the non-tannin content in the pods is found 17.5 and 28.08 percent, respectively. The tannin content is about 18-27 percent in the pods after the seeds have been removed from the pods. Large quantities of pods of babul are used locally for tanning purposes in Maharashtra, Madhya Pradesh and Uttar Pradesh. In tanning industries, pods are used not only for tanning but also to soften and impart a good colour to the leather. An estimated yield of pods from an average tree is about 10-15 kg.

***Caesalpinia coriaria*( Divi-divi):** It is a small tree, native of South America and has been successfully cultivated in India. In India, it has been planted in parts of Tamil Nadu and Maharashtra. The parts of this tree yield divi-divi of commerce. Central and South American countries export a large quantity of this tanning material to different countries. On moisture free basis, the tannin and soluble non-tan content in the pods ranges between 28-41 percent and 21-29 percent, respectively. The important feature of pods is high tannin content and the easy extraction process. The leather is soon affected with climatic conditions. In moist conditions, the leather becomes soft and spongy and in dry weather, it looses its pliability. Therefore, it is blended with other tans to overcome this drawback. It is also used as moderating agent in textile industries.

***Zizyphus xylopyrus*(Kath bor):** The species is a common shrub and generally occurs in the scrub forests and occasionally with sal forests. In India, it is found in the sub- Himalaya tract, north-western India, Uttar Pradesh, Bihar, Rajasthan, central and southern parts of India. The tannin and the non-tannin contents of the nuts are 9.3 and 16.7 percent, respectively. The penetrating power of the tannin to animal hide is slow. The tan imparts black colour to the leather, and is mostly used for tanning bags and purses (Diwedi, 1993; Mehta, 1981; Forest Utilization vol II)

***Emblica officinalis*(Aonla):** Aonla occurs in tropical dry deciduous forests generally, mixed with teak and sal forests. This tree is also found in rocky habitats of dry and warm valleys in Uttarakhand. The fruits of this species are used for tanning along with other tan stuffs. The tannin content in the fruits is about 28 percent (Diwedi, 1993).

***Shorea robusta*(Sal)**: As mentioned above bark of the tree is also used for tanning. The tannin obtained from the fruits of sal tree is of ellagitannin class of the hydrolysable type. The tannin content in the original and the deoiled seeds is 7.2 and 9.6 percent, respectively. The phenolic constituents present in the seeds are corilagin, chebulinic acid, gallic acid and ellagic acid. The seeds can be used as blend with Babul. These cannot be used as a self- tanning material.

***Tamirandus indica*(Tamarind):** It is a large tree and occurs in moist deciduous and tropical dry evergreen forests. It is commonly found throughout the warmer parts of India. It is extensively planted in Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. The estimated yield of tamarind fruits is about 30,000 tonnes per annum. The maximum non-tan and the minimum tannin content present in the testa calculated on the basis of moisture free basis are 15 and 20 percent, respectively. The seed testa yields dark colour leather. It is used with myrobalans and other hydrolysable tannins in the processing of heavy leather (Diwedi, 1993; Mehta, 1981).

***Terminalia chebula* (Myrobalan):** This tree occurs throughout the greater parts of India particularly in sal and mixed deciduous forests. It is found in Madhya Pradesh, Orissa, Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh, Himanchal Pradesh and Bihar and warm valleys of Uttarakhand. Fruits of the tree are one of the important sources of medicinal value besides tannin. The fruits are collected during the months of December-February. The total estimated yield of fruits is nearly 50,000 tonnes per annum. The minimum tannin content worked out on dry weight basis for fresh picked selected, leftover and crushed nuts is 35, 27 and 40 percent, respectively by the total weight. The minimum tannin content worked out on moisture free basis for solid extract is 58 and 60 percent by weight, respectively. In the trade, myrobalans are usually known by the place of origin. For example, Bimilies (Bis) exported from Bimlipatam (Andhra Pradesh), etc. The myrobalans of Salem district (Tamil Nadu) are regarded as the best in India for colour and tannin content (Dwivedi,1993).

## 10.2.4. Leaf tanning material

Leaves of some of the plants provide tanning material for local use. They are not used extensively for tanning purpose by large tanneries. Generally, village artisans and shoe makers use leaves for tanning leather on a small scale. Important leaf tanning material is obtained from leaves of *Anogeissus latifolia, Carissa spinarum, Emblica officinalis, Lawsonia inermis* and *Rhus cotinus*. Leaf galls found on several trees such as Tamarix spp., Garuga pinnata, Prosopis cineraria, Terminalia spp. etc. are used locally for tanning purposes.

***Anogeissus latifolia* (Axle wood; Dhawa):** The tree occurs almost throughout the sub-Himalayan tract, Bihar, Chhota Nagpur, Central and southern parts of India upto 1000 m altitude. The leaves are locally used for tanning purposes. The tannin and non-tannin content in the dry mature leaves is about 32.5 percent and 10.5 percent, respectively. A mixture of green leaves, red leaves and petiole contain about 38.5 percent tannin. Maximum tannin content up to 55 percent is found in young leaves. The tannin is hydrolysable type and finds limited use in the leather industry. It produces pale coloured leather. The leather prepared is highly sensitive to light. The tannin is used as mordant.

***Carissa spinarum*** **(Karunda):** The species is extremely common and gregarious in scrub jungles along the foot hills of the Siwaliks (the outermost hilly tract of Himalaya). This thorny shrub is also found in the warm and dry valleys of Uttarakhand. Fruits are also eaten raw and used for making pickle. It is also common in central India. The tannin content in the leaves is about 9-15 percent. The tannage is slow and causes swelling in the hide.

## 10.3 Tanning Material, Problems and Solutions

Even though India has a high floral diversity in its forests and several plants and trees produce tannins, there are just a few that have high percentage of tans in their parts which can be commercially exploited. Some of them which are more easily available like myrobalan, kath bor, cutch etc. have some inherent problems. For example, hydrolysis of tannins results in the formation of sludge fermentation, mould growth and loss of tannin. Similarly progressive polymerization leads to the formation of tannin reds resulting in an increase of insolubles and decrease in tannin content. Several studies have been carried out to reduce and overcome these defects in India and abroad. These have been divided into physical methods and chemical methods. Physical methods which include blending with other tanning material or treatment with synthetic or chemical tans. Chemical methods include sulphilation, sulphomethylation, aminomethylation etc.

Due to the commercial importance of the above mentioned plants for tanneries they are felled illegally for extraction of commercial plant parts ignoring its other important uses. For example, *Terminalia chebula* (harar) and *Acacia catechu* (Khair) trees has several other important medicinal values. But at times they are cut for tannin production. We need to increase the production of tannin through large scale plantation of tannin yielding plants as per altitudinal and climatic requirements of the species and also promoting their natural regeneration.  Grafting techniques which are being practiced in some of the fruit bearing plants have to be evaluated for tanninferrous plants to gain the advantage of different tannin materials having both condensed and hydrolysable.

## 10.4 Dyes (Natural)

Nature expresses itself in a wide spectrum of colour all around us. Dyes are the name given to substances which are used for imparting colour and staining purposes. The alchemy or colour started from an early time. The earliest record of the use of natural dyes is from China, way back in 2600 B.C. Indians have been forerunners in the art of natural dying. The advent of synthetic dyes caused rapid decline in the use of natural dyes. Various parts of plants like roots, stems, bark, leaves, fruits and seed may contain colouring material which can be exploited commercially. Some plants have more than one colour depending upon which parts of the plants are used. Dyes are substances that impart colour to a material and are generally soluble in water. The pigments are generally not soluble in water. To be applied to a staining material they are first ground into a fine powder and thoroughly mixed with some liquid (dispersing agent).

## 10.5 Classification of Dyes

- On the basis of their origin dyes can be classified into the following classes:
- Wood dyes
- Bark dyes
- Flower dyes
- Fruit dyes
- Root dyes
- Leaf dyes
- Animal dyes

### 10.5.1 Wood dyes

**Cutch dye:** Cutch dye is obtained from the wood of Acacia catechu (Khair). The tree is widely distributed in India. It is characteristic species of Khair- sissoo forests, southern thorn forests, ravine thorn forests and very dry teak forests. It is used for dyeing fishing nets, sail cloth, mail bags, leather, canvas, etc. the cutch extract is considered as the most valuable dye among all the wood dyes. It is used as tan and also commonly as dyeing agent for silk and woolen fabrics.

***Artocarpus* dye:** Artocarpus dye is obtained from the wood of Artocarpus heterophyllus and of A. lakoocha. The mixture of the wood gives a bright yellow dye. For obtaining the dye, the wood is cut into small pieces or chipped and boiled in water. The dye obtained from these species is used in dying industries for dyeing robes of monks and saints. It gives fast colour on silk cloth.

**Brazilian dye:**It is the trade name given to the dye obtained from the wood of Caesalpinia sappan commonly called as sappan. It yields a valuable red dye commercially known as Brazilian. It is cultivated as a hedge plant in many parts of South India. The dye is used for dyeing silk, cotton and woolen fabrics. The dye is mostly used for producing red and pink colours in calico printing. When dissolved with indigo colour, it produces purple colour.

**Santaline dye:** It is obtained from the heart wood of Pterocarpus santalinus. The tree is commonly known as the Red Sanders. It occurs mostly in Andhra Pradesh. It is a tree of southern tropical dry deciduous forest type, constituting a sub-type of forest called the Red sanders forest. The dye obtained is known as bright red Santaline dye. It is extracted from the heart wood of the tree. The dye obtained is used for dyeing leather and staining wood. It is also used as a colouring agent in pharmacy. A cloth dyed in a solution containing santaline dye mixed with alcohol or ether results in a beautiful pink colour cloth. The dye is used for dyeing silk and cotton clothes, when mixed with the Brazilian dye. A variety of colours can be obtained on woolen, cotton and linen cloth by the use of different mordant.

## 10.5.2 Bark dyes

The dyeing property in bark is meager. The maximum number of barks contain the tanning material. The bark mostly yield brown and black coloured dye. The plant species used for dyeing purposes are:

***Acacias:*** The bark of few of acacia tree species viz., Acacia concinna, A. farnesiana and A. leucophloea yield a black dye (Mehta, 1981; Forest Utilization vol II).

***Alnus species:*** The bark of Alnus nepalensis and Alnus nitida trees are used in dyeing to fasten the colour of the fabric previously dyed with brown dye of Himalayan madder (Rubia cordifolia). The tree is found in isolated patches along the cool and moist streams in Uttarakhand and other localities of Himalayan region.

***Casuarina equisetifolia:***The bark of this tree is used in dyeing and gives a light reddish colour. It is also used for toughening fisher men's net.

***Manilkara littoralis*:** The bark of this species yield a red colour dye.

***Myrica esculenta*:** The bark of this tree is rich in tannin content and it yields a yellow colour dye. This is an important tree that also yields delicious edible fruits and found in the temperate forests of Uttarakhand.

***Terminalia alata*:** It is used as a tanning as well as dyeing material. The bark of this tree gives black colour dye. Bark of the root of Ventilago patina is considered to be a valuable dye in the Decan and the Carnatic region of the country.

## 10.5.3 Flower dyes

***Butea monosperma (Dhak):*** It is considered as the most popular tree to yield flower dye. The flowers on drying, yield an unstable yellow colouring matter. The colour is made less fugitive and dark with the addition of alum, lime or/ and alkali. In past, the dye was extensively used for dyeing sarees and other cotton and silk clothes.

***Toona ciliata* (Toon):**The flowers of this tree yield a red colouring matter. These are considered as an important source of natural dye stuff. It easily gives light yellow colour to the cotton and woolen fabrics, when immersed in boiling extract of flowers. The colour can be fasten by using suitable mordents.

***Nyctanthes arbortristis* (Harsingar):** The tube of the flower of this plant is rich in colouring material. It gives a beautiful orange or golden yellow colour, which is fugitive and is commonly used as an auxiliary to other dyes. The dye is often used to colour liquors.

***Mammea longifolia*:** The flower in the bud stage of this plant is used for dyeing silk fabric.

***Crocus sativus***: The stigma and the style of lavender flowers are used for the preparation of dye extraction having a deep yellow coloured dye, saffron crocus. Soon after the opening, the flowers are clipped and allowed to dry naturally or artificially. The colouring material is easily soluble in water and is used for colouring food and medicines (Mehta, 1981).

### 10.5.4 Fruit dyes

***Mallotus philippensis***: Commercially known as Kamela dye, it is common fruit dye almost throughout India. It is regarded as one of the best known fruit dyes. The dye is obtained from the red glands on the surface of the capsule of the tree species. The fruits are collected in large cloth bags or sacks and are lightly beaten for obtaining the dye. The dye is generally used for dyeing silk. It gives a bright orange or flame colour. When mixed with other mordants, the colour can be changed from pale yellow to dark red. It is also used for colouring oils, soaps, ice creams and soft drinks. The moderate size tree also grows in the sal forests of Shivalik foothills of Uttarakhand (Mehta, 1981; Forest Utilization vol II).

***Bixa Orellana***: The seeds of bixa orellana yield a well known dye, commercially known as Annatto. The tree is mostly cultivated in South India. The major colouring matter in the seeds is bixin. The arils around the seed are used for extraction of dye. A bright yellow coloured dye is obtained from the seeds. The dye is used for calico printing, woollen and silk fabrics (Mehta, 1981; Forest Utilization vol II)

***Wrightia tinctoria***: The seeds of the plant species yield an indigo dye.

### 10.5.5 Root dye

***Berberis aristata***: The species is reported to yield one of the best yellow dyes in the country. The dye is readily soluble in water and alcohol. The colour changes from yellow to brown on addition of alkali. The dye is used for the manufacture of Morocco leather (Mehta, 1981) . The shrub grows extensively in Uttarakhand and has been exploited recklessly for the medicinal properties of its roots.

***Datisca cannabina***: The root of the plant is commercially known as alkabir and yields a yellow dye. It is used for dyeing silk, wool and cotton. It is commonly used in Kashmir and throughout the Himalayas.

***Morinda coreia***:The root bark yields a red colouring dye. The dye obtained from the root of the species is generally used for dyeing handkerchiefs, turbans etc.

***Punica granatum:*** The root of the species yield dyes of yellow and red shades.

***Rubia cordifolia:*** The roots and the stem of the plant yield a red dye. The plant is common in the Himalaya.

## 10.5.6 Leaf dyes

***Indigofera tinctoria*:**Earlier, the shrub was extensively cultivated for the remarkable dye extracted from the leaves of the species. It was known as the king of dye stuff. The dye gives deep blue colour. It is widely used for its stability and strength of the colour (Mehta, 1981; Forest Utilization vol II).

***Lawsonia inermis*:**Commonly called as henna herb, it yields an orange coloured dye called as the henna dye. It gives a fast dye and is used for fabrics and leather. It is also used for dyeing hairs, nails and eyebrows (Mehta, 1981; Forest Utilization vol II).

## 10.5.7. Animal dyes

Animal dye is obtained from the lac insect (*Laccifer lacca*). It produces crimson red coloured dye. It once enjoyed wide commercial importance.

### 10.6 Summary

Tannins are polyphenolic compounds, made up of carbon, hydrogen and oxgen. Tannins brings about the following changes by their action on animals hides and skins- (a) they render the hides and skins resistant to decomposition; (b) they make them strong and flexible; and (c) they improve the wearing qualities of animal hides and skins. The process in which animal hides and skins are treated by tannins is known as tanning. It turns these raw products into leather. In India a large number of tanning materials are found which can be classified into wood tans, bark tans, fruit tans and leaf tans. Dyes are the name given to substances which are used to imparting colour and staining purposes. On the basis of origin dyes are classified into wood dyes, bark dyes, flower dyes, fruit dyes, root dyes, leaf dyes and animal dyes. The cutch obtained from khair (*Acacia catechu*) tree heart wood is the main wood tans in India. Bark tans include *Acacia mearansii, Cassia auriculata, Acacia nilotica, Cassia fistula, Terminalis arjuna, Termenalia alata, Shorea robusta, Emblica officinalis* etc. Fruit tans include: *Acacia nilotica, Caesalpinia coriaria, Zizyphus xylopyrus, Embllica officinalis, Shorea robusta* etc. Leaf tannin includes *Anogeissus latifolia, Carissa*

*spinarum* etc. But leaf tans are not of any importance from commercial point of view. Many of these species are of medicinal importance also thus facing the pressure of extraction from nature and need to be planted and regenerated to meet the industrial demand.

**Terminal Questions**

1. Differentiate between tannins and dyes and briefly write about their uses in different industries.
2. Provide a brief description of various plants and plant parts which yield tannins and dyes.
3. Give some examples of plants which yield tannin from fruits.
4. Give brief description of plants which yield tannin from wood bark.
5. What are the uses of tannins and dyes?
6. Give brief description about various dye yielding plant parts.
7. List some of the plants which yield both tannins and dye and also important for medicinal purposes.

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# Unit 11. NTFPs: Fibers and Flosses

**Unit Structure**



## 11.0 Learning Objectives

After you have studied this unit, you should be able:

- To understand the importance and uses of fiber and flosses
- To develop an understanding of the major plant species (tree, shrubs and herbs) and their parts that yield fibres
- To identify the major plant species (tree, shrubs and herbs) and their parts that yield fibres
- To differentiate between fibre and flosses

## 11.1 Introduction

Forests have been traditional source for supply of fibres and flosses. The most common examples are ropes, cordages, mattresses made by the rural people for several domestic purposes traditionally. Fibres of both vegetable and animal origin have been used long before the dawn of history, for the spinning of the thread and cordage and weaving of coarse fabrics. Among the earliest of such fibres wax flax; cotton, the greatest of modern textile fibre came later. Fibres generally occur as sclerenchyma cells and serve to provide rigidity to the plant. They are as a rule long cell with thick walls and small cavities. They are found in various parts of the plant such as stems, leaves, roots, fruits and even seeds. Fibres of economic importance are furnished by many different families. Forests have been the traditional source for supply of fibres and flosses for the rural population. Fibres obtained from the forests are used for making ropes, cordages,mattresses and for several other domestic purposes.

Natural fibres are susceptible to microbial decomposition. They have an affinity for water, both in liquid and vapour form. This property of absorbing moisture makes them suitable for clothing. These fibre are non-thermoplastic i.e. they soften when heat is applied.

## 11.2 Classification of Fibres

Classification of the fibres is done on the basis of their origin, texture, morphology and uses. On the basis of origin, fibres can be classified into: (i) fibres from roots, (ii) fibres from stems, and (iii) fibres from leaves. On the basis of texture, fibres can be classified into the following three types:

**Soft fibres:** Fibres obtained from the innermost bark of the stem are called soft fibres, e.g. jute, hemp, flax, etc.

**Hard fibres:** Fibres obtained from leaves of plants are hard fibres, e.g., Manila hemp, etc.

**Surface fibres:** Fibre obtained from the surface of plant parts (stem, leaf, seed etc.) are generally called surface fibres.

On the basis of morphology, fibres can be further classified into the following categories on the basis of their morphology (Mehta, 1981; Dwivedi, 1993):

(i) Hair borne on the seeds or the inner wall of the fruits: Among the commercially important fibres in this group are Cotton, Kapok and Akund floss.

(ii) Fibres occurring in the innermost tissue or bark of the stem: Some of the commercially most important fibres are found in this group such as flax, hemp and jute. These are generally known as bast fibres or soft fibres to distinguish them from the hard fibres obtained from the leaves of several species.

(iii) Fibres obtained from the leaves of the plant and which are a part of the fibres of vascular system of the leaves. The most important fibres of this group are cordage fibres, abaca or Manila hemp and Sisal. (iv) Woody fibres of trees and plants consist of various elements which constitute the fibre vascular tissues of wood. These are used in paper making.

### Table1. Important fibre and floss yielding tree species in Uttarakhand

| Name of the species | Fibre/Floss yielding part | Uses |
|---|---|---|
| *Butea monosperma* | Roots/ bark fibre | Making ropes |
| *Grewia optiva* | Stem fibre | Ropes and clothing |
| *Utrica dioca* | Stem fibre | Cloth making |
| *Cannabis sativa* | Stem fibre | Ropes and fabrics |
| *Ougenia oojeinensis* | Branch fibre | Making coarse ropes |
| *Ficus bengalensis* | Bark and aerial roots | Coarse ropes |
| *Careya arborea* | Bark fibre | Cordages and ropes |
| *Agave americana* | Leaf fibre | Bags, ropes |
| *Populus ciliata* | Pods yields floss | Filling pillows and mattresses |
| *Bombax ceiba* | Pods yields floss | Filling pillows and mattresses |
| *Kydia calycina* | Bark fibre | Drag ropes |
| *Erythrina suberosa* | Bark fibre | Cordages |
| *Bauhinia vahlii* | Bark fibre | Ropes |

## 11.2.1 Fibre from roots

The fibres are extracted from the young roots of *Butea monosperma* (a small deciduous tree commonly known as the flame of forests). Young roots of the plants yield fibre, which is used in making ropes and cordage. For obtaining the fibres, the young roots are dug, taken out and cut into 0.5 m long pieces. When these are green, the end portion of the root is crushed against stones, which forces the fibres to release from the root. These fibres are then caught and torn from the remaining portion of the root and removed by beating them lightly. The fibres are generally used for making ropes and cordages. The ropes are generally coarser and better for use under wet conditions. During dry period, the rope becomes brittle and breaks easily (Mehta,1981; Dwivedi, 1993).

*Pandanus odoratissimus* is another plant which is exploited for fibre from its roots.It is a densely branched shrub, found along the coastal regions and in Andaman islands. The roots of the plant are fibrous and are used by basket makers for binding purposes. The fiber obtained is used in making paint brushes and brushes for white wash. It is used as a substitute of bristles in brushes.

## 11.2.2 Fibres from stems

In some plants, the stem yields fibre. In such plants fibres are extracted from the bast tissue of the stem of woody species. The type of the fibre varies from plant to plant. Some plants yield long and strong fibres, while some plants yield silky fibres, which are used in textiles. Retting is the commonly used process of extracting plant fibre in which the stems are submerged in ponds or streams for 10-15 days. It is the process of separating the fibres after loosening them from the woody plant tissue. This process depends on the age of plant, type of species, type of fibre required and the temperature of water used during processing. Over retting is harmful for the plant tissues, as they lose the luster on over treatment. The common best fibre yielding species are as follows:

***Calotropis spp.:***Two species of Calotropis (C. *gigantea* and C. *procera)* yield stem fibres. These are moderate sized shrubs commonly found in the dry tracts of the country on the wasteland or as an associate in dry mixed deciduous forests. The barks of the stem yield a white, silky, strong and durable fibre. Which is superior to cotton in tensile strength. It is extensively used for making fishing nets and lines, bow strings, twines, etc. Extraction of the fibre from the plant is done by steaming of the stem followed by pressing it in between wooden rollers and water retting followed with mallet beating. It can also be extracted by soaking the bark in water for 24-48 hours followed by autoclaving to avoid encrustations. The separated fibres can be bleached to yield white flexible, cylindrical fibres. These fibres can be spun alone as well as mixed with cotton.

***Marsdenia tenacissima* (Marsdenia):** It is large twinning shrub commonly found in the sub-Himalayan tracts of the country. It is occasionally found in the Khair forests and less frequently in sal forests. The fibre extracted is used in making fishing nets and lines, bow strings, netting and cordage.

***Acacia leucopholea* (Hiwar):** It is a small to moderate sized tree, found in the tropical dry deciduous forests in arid and semi-arid regions of the country. The bark of the plant yields a strong fibre when soaked in water and beaten. The fibre obtained is commonly used for making fishing nets and coarse cordage.

***Bauhinia vahlii* (Malu):** It is a large evergreen climber, generally found in the moist localities and shady hill slopes with rock outcrops. It is common in almost all forest types in India. It causes great damage to the forest trees. The fibre obtained from the inner bark of the plant is strong and is used for making rough ropes. The bark of *Bauhinia racemosa* also yield fibre (Mehta,1981; Dwivedi, 1993).

***Butea monosperma* (Palas):** The bark of the plant also yields fibre (beside the roots) which is used in making ropes and cordage. The fibre obtained from the bark is inferior than the fibre obtained from roots. *Butea parviflora* (Butea bel) is another species which is a woody climber, found in most parts of the country which also yields fibre from the inner part of the bark is used for making ropes. The fibre obtained is strong and durable.

***Hardwickia binata* (Anjan):** It is a moderate sized deciduous tree very common in Madhya Pradesh. It is characteristic of dry teak and degraded dry deciduous forests of central and southern India. The young shoots and branches of the plant yield a strong, reddish brown coloured fibre. The fibre is widely used in making well ropes and also for other agricultural purposes(Dwivedi, 1993).

***Ougenia oojeinensis* (Sandan):** It is a medium sized deciduous tree generally found in tropical deciduous forests. In Uttarakhand this tree is found on rocky habitats in warm valleys. The new branches yield fibre, which is used for making ropes and cordage.

***Ficus bengalensis* (Bargad):** It is a large sized evergreen tree, found almost throughout the country in the plains upto 600m and in the hills. The bark and the aerial roots of the tree yield fibre, which is used as coarse rope. The other species of the same family which yield stem fibre generally used for making ropes include *Ficus cunia* and *Ficus religiosa*.

***Helicteres isora* (Marorphal):** This moderate sized tree is commonly found in the dry and moist mixed deciduous forests of India. The fibre is extracted from the inner bark of the plant by retting it in water, pool, ponds and rivers. Rotted branches are then taken out from the water and beaten lightly to separate the fibre. The fibre obtained is light brown to grayish green in colour, soft, silky and lustrous. It is durable, but is inferior to jute fibre in strength. The fibre is mostly used as cordage for sewing sacks, gunny bags and cattle harness. The quality of the fibre which can be spun into good yarn and woven into canvas and better quality of durable fabrics by selecting the equal aged stalks and retting them properly and scratching the dried fibre on appropriate modern machines. In Southern India, Kerela, tamil Nadu and Karnataka, the shrub is collected from the forest for extracting fibre (Dwivedi, 1993). Its fibres are twice durable than Jute (Corchorus capsularis) which is cultivated extensively in Kerala, West Bengal, etc.

***Grewia elastica* (Dhaman, Bhimal):** It is a tree with grey bark that grows in sal and mixed forests in outer Himalayas. This moderate size tree is mostly cultivated in the lower hills of Uttarakhand by the farmers around their farmlands. This is multipurpose tree which yields quality fodder, fuelwood and fibre. The bark of the stem yields strong white fibre which is used for cordages and rope making. *Grewia tiliaefolis* (Daman), *Grewia optiva* (Bhimal) and *Grewia vestita* are other species which yields a coarse, strong and yellow brown coloured fibre useful for rope making and for domestic purposes. It is a small medium sized deciduous tree, 8-10 m in height of Family Tiliaceae. The species is found abundantly in the entire Himalayan region upto 1800m. The bark of the species yields fiber. The fiber is used for making ropes and clothing.

***Utrica dioca* (Stinging nettle) Bichhu:** It is herbaceous perennial plant (Genus Utrea). They grown like weeds and are generally eradicated. The fiber is removed nettle plants have long from stem, stingy fiber that can be separated by retting. Nettle fibers are better than those of hemp and can even be used for cloth making. Nettle may also be used as a dye, producing yellow colour from roots or yellowish green from leaves.

***Cannabis sativa*:** It is a plant native to Asia. The term 'hemp' may refer to the tall, coarse plant itself or to the coarse tough fiber the plant which can be used to make rope, fabrics etc. the fiber is one of the valuable parts of the plant. It is commonly called bast hemp fiber can be between 2.5 to 3.5 m long depending in the height of the plant.

***Ceiba pentandra* (Kapok tree):**It is a large tropical tree species which can attain height upto 50-60m on certain localities. The pods contain the floss along with the seeds. The fiber is light very buoyant. It is used for filling mattresses, stuffing toys etc.

***Sterculia villosa* (Udal):** It is a small to moderate sized tree, found in the tropical deciduous forests throughout the greater part of India. A coarse and strong fibre is obtained from the inner layers of the bark. The fibre strips off in broad flakes having a net like appearance. The fibre is commonly used for making bands for elephants used for dragging timber. The fibres are made into ropes for tying cattle and sheep and for making cordages. The cordage made, if frequently wetted in the initial stages becomes stronger. The other species of the same family which yield rope fibres but are not so common for this purpose are *Sterculia urens, S. foetida* and *Firmiana colorata*(Dwivedi, 1993).

***Trema orientalis* (Jiban):** It is a large shrub or a small sized tree found in tropical deciduous forests. The tree yields a long light brown fibre. The fibre can be easily stripped off from the bark of the tree in thin narrow bands. The fibres, on drying, can be easily separated. The fibre obtained is mostly used for making ropes, twine and coarse cloth.

***Girardinia hetrophylla* (Nilgiri nettle):** It is a medium sized shrub commonly known as stringing nettle and commercially as Nilgiri nettle. It is found in the Himalayas and in the peninsular region of India. It yields a fine, soft and silky fibre, which is used for making ropes, twine and coarse cloth. The plant is not given high priority for fibre because of the difficulties like high cost of collecting and clearing the fibre.

***Kydia calycina* (Pola):** It is a large sized tree generally found in tropical moist deciduous forests. It yields a strong fibre which is used from making ropes and cordage generally put to several uses in forestry. It is also used for making drag ropes. This tree is also found in Bhabar area of the Uttarakhand.

***Careya arborea* (Kumbhi):** It is a moderate sized tree, found as a common associate of moist mixed deciduous forests. The inner bark of the tree yields fibre which is used for making coarse cordage and ropes for tying carts and rafters. The fibre is also used in paper industries. *Careya arborea* is a deciduous tree that grows up to 15m. Its leaves turn red in the cold season. Flowers are yellow or white in colour that become large green berries. The tree is a common associate of sal forest and grows throughout India. In Uttarakhand it is commonly found in Bhabhar and Tarai regions.

***Cerbera manghas* (Cerbera):** It is an evergreen tree or large shrub with milky latex. It is found in the tidal forests of India commonly in the Andamans. The bark of the tree yields a fibre of minor importance(Dwivedi, 1993).

***Cordia dichotoma* (Lasora):** It is a small or medium sized tree with crooked trunk. It is found in the warmer regions of the country. The bark of the tree yields fibre which is used for caulking of boats. Another species, *Cordia rothii* (Lasora), *Cordia myxa* and *C. oblique,* which isfound in the drier parts of the country also yields a fibre used for caulking boats and making ropes. It is a small sized tree with twisted trunk. It is found in the warm regions of the country. The bark of the tree yields fibre which is used for sealing joints of boats.

***Erythrina suberosa* (Daul dhak):** It is a medium sized tree, found scattered throughout the dry forests of India. The bark of the tree yields a fibre used for making cordages. A medium size tree with very attractive maroon reddish coloured flower clusters. Young stems are prickly. The fibre is removed from bark and used for cordages. It is found grown extensively in Bhabhar amd Tarai regions of Uttarakahnd.

***Erythrina variegata:*** It is found in Andaman and eastern coastal states of India. The fibre is removed from bark and used for cordages.

***Lannea coromandelica* (Jhinhan):** It is a moderate to large sized deciduous tree, distributed throughout the greater part of India up to 100 m elevation. The bark of the tree yields a strong fibre used for ropes and cordages (Dwivedi, 1993).

***Miliusa velutina* (Dam sal):** It is a middle sized tree, found in the moist deciduous forests. The bark of the stem is locally used for extracting fibre which is used for making ropes and cordages (Dwivedi, 1993).

***Thespesia populnea* (Ban kapasi):** It is a compact quick growing evergreen tree, found in the coastal regions of India, commonly in the Andamans. The bark of the tree yields a strong white fibre used for cordage, fishing lines and coffee bags. It is also used for caulking boats (Dwivedi, 1993).

***Urena lobata* (Unga):** It is an under shrub occurring throughout the hotter parts of India. The plant is often cultivated as a fibre crop. To obtain good quality fibre, the harvesting is suggested when the plant is full in flowers. If harvesting is done before the time recommended, the fibre obtained is less in quantity and fine in texture. If the harvesting is done after the time of flowering, the fibre obtained is less shiny and coarse in texture. Its fibre closely resembles with jute in chemical composition. It is mostly used for making ropes, sacks, cordages and carpets. Mixed with other fibres, it can be worked on machinery and can be utilised for making artificial silks, upholstery and sail cloth. *Urena repanda* is another species (a deciduous under shrub), which yields fibre of the same quality as of *U. lobata.*

## 11.2.3 Fibres from leaves

***Agave spp.* (Sisal):**Sisal (*Agave* spp.) is perhaps the most important and valuable among the fibre yielding plants. *Agave* consists of about 300 species. These species are native of tropical and sub-tropical North and South America. They have been introduced to a large number of countries in East Africa, West Indies, Indonesia, Israel, South Africa, Philippines, etc. Agaves have been introduced in India as hedge plants. These are generally planted in gardens, fields and along the road and rail sides. In India, *Agave sisalana* was first introduced in Orissa by Christian missionaries in the late of 19th century. Since then a large scale plantations of these species have been taken up in different parts of India particularly in Orissa, Madhya Pradesh, Maharashtra, Tamil Nadu and some part of Uttar Pradesh. The common species planted in India are *Agave sisalana, A. fourcroydes, A. cantala, A. wightii* and *A. americana.* In Uttarakhand efforts were made to cultivate this plant on wastelands on a large scale. The planting of *Agave* species is done in the forest and the modern practice is the use of bulbils for plantation. These bubils are placed in nursery about 12-19 cm apart before transplanted in the field. The plants, which are ready for planting out should be generally 50-70 cm in height. It is recommended that plants less than 35 cm in height and 1 kg in weight should not be out planted. Planting is done generally at a spacing of 2.5 m x 1.5 m. The leaves of this plant yield a valuable fibre and the fibre is considered to be one of the important hard fibres. It is mostly used for making ropes, cordage and twine. Some time the short fibres of the genus are used for making mops and brushes. The fibre compares favourably in durability with Manila hemp for marine cordage. Recently, the fibre is used for manufacturing coarse fabrics. It is extensively used for binders, twine, fishing nets, hammocks, door mats, rugs, carpets, etc. The remains left after extracting the fibre from the leaves, are used for making paper and paper boards.

In areas with sufficient moisture, the plant produces 6-8 new leaves per month but during dry period, no new leaves sprout. This adversely affects the yield of the fibres. A single green leaf weighs about 600-1000 gms and contains about 2 to 5 per cent of fibres. The yield is determined by the number of leaves produced on the plant and by the amount of fibre collected. From the available data under Indian conditions, weight of a single leaf from the plant is generally found 900 gms and total number of leaves produced during the life time is about 240. The harvesting of leaves can be done after 36-40 months of planting. Generally the mature leaves are harvested twice a year, first in the month of January and secondly in the month of September. About 10-15 tonnes per ha leaves are generally available in the plantation areas. The fibre is extracted from leaves by decorticating them. After decortication, fibres are sun dried. The moisture content in dry fibres should not be more than 8-15 percent. After drying they are boiled and packed for transport.

There are several species of *Agave* which are mainly grown for fibre production. *Agave americana* is grown as an ornamental garden tree and also grown as a hedge plant on the boundaries of the field. The leaves of this plant yield about 5 percent of fibres used for making ropes and cordage. *Agave angustifolia*is commonly found in the sub Himalayan tract and outer Himalayas. The leaves of the species yield some what shorter fibres. *Agave sisalana* has been planted on a large scale in several states of India. The species grows well in areas with an annual rainfall of about 700-1300 mm. It succumbs to water-logging and can not tolerate very low temperatures. The species has been planted in Deccan plateau and adjacent areas of Sambhalpur, Sundargarh, Ranchi, Hazaribag, Palamau, Bankura, Purulia and Birbhum. The length varies from 1 to 2 m. The fibres are strong, medium, fine and recovery is about 4.2 to 4.8 per cent of the leaf weight. *Agave veracruz* is native of Mexico and is also found throughout the greater part of India. It is found commonly in Assam, Bengal, Bihar and southern parts of India. The leaves yield about 1.5-2.5 per cent fibre. The fibre is coarser and stronger then the *Cantala* fibre and is used for making ropes, mats and cordage.

***Caryota urens* (Indian sago-palm):** Indian sago-palm is one of the most important leaf fibre producing plant. This palm is found in the moist regions of western and eastern coasts in cool and shady places. The leaves of this plant yield strong fibres. The fibres are obtainable from the base of leaf sheath, petiole and flowering stock. The fibres are straight, strong and smooth and very elastic. The fibres are like horse-hair type in appearance and used in making rope of great strength. The fibres are used by fishermen for preparing fishing nets and fishing lines. They are also used for making soft brooms.

***Musa paradisiaca* (Plantain tree):** It is also commonly known as the red plantain. It is found along the west coastal region. The plant yields strong fibre but the collection of fibre is not profitable profitable as these species are not plentiful and are found sporadically distributed in the depressions of the low hills that lie along the coast.

***Musa textiles* (Banana tree):** It is a tall stout stoloniferous plant. It is native of Philippines and successfully cultivated in India for its fibre. The fibre is extracted from the leaf sheaths of the mature plant. The leaves yield a strong and durable fibre known as Manila hemp.

The leaves of the plant consists of three layers. The outer fibrous layer is strong and brown or dark brown in colour. The middle layer contains some quantity of soft-white fibre. The third layer is without fibre. The fibre is stronger than the fibre obtained from hemp and sun hemp. It is mostly used in making twines, ropes and cable. The fibre is spun into thread and is used in coarse weaving, upholstering and preparing fine fabrics.

***Pandanus odoratissimus* (Pandanus):** It is a densely branched shrub, found along the coastal region of India and in Andaman Islands. The leaves of the plant yield fibre used for making sacks for coffee, grains, sugar etc. The fibre is also used for making ropes, mats, cordage, hats, baskets and other fancy articles. To get the superior quality of mats, young and freshly harvested leaves are used.

## 11.2.4 Fibre from grasses

Important grasses which yield fibres for making mats, ropes, cordage, fishing nets include *Eulaliopsis binata, Desmostachya bipinnata, Sacharum bengalense, S. spontaneous, Themeda arundinacea, Phragmites* spp, *Arundo donax, Typha elephantine,* etc. *Eulaliopsis binata, Saccharum spontaneum, S. Bengalense* and *Desmostachys bipinnata* are used for making ropes, cots and fishing nets. These are also used for making cordage and mats. Some of these grasses are highly suitable for making paper.

*Eulaliopsis binata* is cultivated on a large scale in Shiwalik region of Himalayas. It also grows in Madhya Pradesh and Orissa. The grass is used for making ropes. It is also used for making paper.

## 11.3 Flosses

The outer loose pieces of silk of a cocoon or other waste fibres which do not easily spun are termed as flosses. Many forest trees and shrubs in India produce silky flosses within their fruit. Flosses are generally used for stuffing mattresses, pillows, cushions, upholstery and packing. They are also used for the manufacture of life belts.

Some of the important floss yielding species found in the forests of India are as follows:

***Populus ciliate:*** A large deciduous tree with a straight bole growing extensively in the Himalayan region between 1500-2600m. However, it is not a forest forming species and has restricted distribution. It grows on early successional condition especially along watercourses in the Central Himalaya. The ratio of male and female tree varies from site to site. The new leaves appear towards the end of March or early April. The catkins appear immediately before the young leaves. The female trees have new flush of leaves simultaneous with the flowering while male trees do not unfold leaves untill the dehiscence of pollen is over. The seed dispersal takes place from the end of May to June depending upon the climate of the locality. The species yields abundant floss which is enclosed around the seeds in the pods. The floss is put to several uses in the villages for filling pillows and mattresses.

***Bombax ceiba*** **(Semal):**It is medium to large sized deciduous tree, typical of alluvial savannah type of forests. The species is found growing sporadically in mixed deciduous forest of sub-Himalayan region, and moist deciduous forests of west coast. Fibres are obtained from the inner side of the capsule. It is slightly brownish yellow in colour. The floss from this tree is known as Indian kapok. The green capsule of this tree yields soft and strong floss about 4.5-6.0 kg per tree in full bearing. Kapok is similar to the true Java kapok and is used in life saving appliances and other general flotation purposes. The floss is used for stuffing quilts, mattresses, cushions and pillows. Articles stuffed with kapok are said to be vermin proof. It is also used as an insulating material for refrigerators, sound proof covers and walls. It is considered to be the best for making padded surgical dressings. In the recent years, with the help of the modern modified carding machines, the floss can now be easily spun in to yarn.

## 11.3.1 *Calotropis gigantea* (Aak, Akund floss)

It is a common shrub found in the Sub-Himalayan regions Central part of India and in the South zone. The seeds bear fine, soft, glossy and resilient floss. Through inferior to Indian kapok in strength and resilient properties, it has a good buoyancy. The floss from this species is used in stuffing mattresses, pillows, etc. It can be spunned either after chemical treatment or mixed with cotton but it can not be bleached.

## 11.3.2 *Ceiba pentandra* (Kapok)

It is a medium sized deciduous tree found widely distributed in the hotter parts of western and southern India and in Andaman Islands. The tree is commonly called as silk cotton or kapok tree. The floss is obtained from the pods of the plant. Unopened pods are collected from the tree with hand and are allowed to dry in the sun. After drying, on beating with mallet, the pods are split open. The floss is taken out along with the seeds and dried in sun. On beating lightly, the seeds yield a white or pale yellow coloured floss. The floss is light brittle, elastic and lustrous. The yield of the floss varies with the age of the plant. As the age advances, the yield per tree also increases. It finds use in bedding and upholstery industries. It is used in stuffing pillows, cushions and mattresses. It is also used for making padded surgical dressing. Due to water qualities, it is used for manufacturing life jackets and belts, waistcoats, fishing and aviation suits and other naval life saving devices. Recently, with the help of modern machines, the floss of this species has been spun either alone or in admixture with cotton into yarn. This yarn can be dyed or bleached like cotton. It is used for insulation of refrigerators, cold storage plants, offices, theatres, motor cars and aeroplane for sound insulation. It is used in aeroplane cabins, studios, hospitals, auditorium and theatres. It is useful for packing water pipes exposed to forest.

### 11.3.3 *Cochlospermum religiosum* (Silk cotton tree)

It is a small or medium sized deciduous tree, commonly called as the yellow cotton tree. It is common in hot dry and stony regions. It is found almost throughout India. The seeds of this species are covered with soft and resilient floss which can be used as substitute for kapok. It is mostly used for stuffing mattresses, pillows, cushions and life belts.

## 11.4 Coir

The fibre obtained from the drupe of the coconut tree is termed as coir. Coconut (*Cocos nucifera)* is a tall, straight palm. In India, it is found in the coastal and the deltaic regions of south India. This species yields a variety of products viz., ripe coconuts, copra, coconut oil, coir, etc. Coir is extracted from the thick fibrous husk of the fruit. Retting is the process implied for the extraction of coir. It is usually carried out in the saline back waters. The retted husks are washed with water then the fibres are separated by beating the husks with wooden mallets. The separated fibre is dried, beaten and finally passed through the cleaner. The coir fibre is light, elastic and highly resistant to water and mechanical wear. It is considered to be the best material for the manufacturing shock proof packing material and hard boards for panels, doors and battery containers.

## 11.5 Summary

Fibre and flosses are useful for human beings. The main source of supply of fibre and flosses are forests. Fibres are of plant and animal origin. Fibres are used in spinning of thread and cordage and weaving of coarse fabrics. Fibres occurs generally as schlerenchyma cells of the plants. They are found in various parts of plants such as stems, leaves, roots, fruits and seeds. Important fibres are obtained from roots of *Butea monosperma* (Palas), *Pandanus odoratissimus*, from stems of *Calotropis spp., Bauhinia vahlii*, *Grewia optiva* etc. from leaves of *Agava americaana, Caryota urens, Musa textiles* etc. Flosses are the outer piece of silk of cocoon or other waste fibres which do not easily spun as they are short. These are generally used for stuffing mattresses, pillows, cushions etc. The main species which yield flosses are *Bombax ceiba, Calotropis gigantean, Cochlospermum religiosum* etc. Fibres are more important than flosses particularly for spinning purposes. These plant products are not only important to human beings but also provide livelihoods to a section of our society.

## Terminal Questions

1. Give a brief description of important fibre yielding plants of India.
2. Differentiate between fibre and flosses.
3. Describe various plant parts which yield fibre with some important examples.
4. Give a brief description of various plants yielding flosses.
5. Describe different methods of extraction of fibre from plants.

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# Unit 12: NTFPs: Miscellaneous Products

**Unit Structure**



## 12.0 Learning Objectives

After studying this unit you are able to understand about:

- Cutch and Katha
- Cultivation and processing of Lac in India
- Bee products

## 12.1. Introduction

Various non-wood forest products have already been discussed in the previous chapters. Still, there are a number of useful products yielded by forests which could not be included in groups already discussed. These products are grouped under useful miscellaneous products. The important forest products classified under miscellaneous products are as follows:

- Katha and cutch
- Latex
- Insecticides
- Chemicals
- Nuts
- Bead seeds
- Minerals

## 12.2. Katha and Cutch

Katha is obtained from the heartwood of khair (*Acacia catechu*). On boiling with water, the heartwood of the tree yields catechu. The two common varieties of Catechu marketed in India are the pale catechu and the dark catechu commonly called as Katha and cutch respectively. In some of the older trees, a third substance called as Kheersal is also obtained. It is a white powder or crystalline solid material found in the cavities of the wood and occurs in small irregular fragments. It can be readily purified by the crystallization with hot water. It is valued for its medicinal properties and is used for the treatment of cough and sore throat.

In the market, katha is sold in irregular pieces or small square blocks grey in colour. On breaking, these pieces show crystalline fracture. Katha is extensively used in pan preparations and medicines. It is an essential ingredient of pan preparation. It is applied in combination with lime. It gives a red colour resulting from the chewing of pan. Katha is considered to be an astringent, cooling and digestive, useful in relaxed conditions of throat and gums. It is used for the treatment in cough and diarrhea. It is also used as cooling application to ulcers, boils and skin eruptions.

Cutch or dark catechu is used for dyeing cotton and silk fabrics and in calico printing. Cutch brocun is obtained by steeping the material in a boiling solution of cutch and cusoy. The dark catechu or the cutch is marketed in the form of small cubes or blocks. It is rusty brown or dull orange in colour and has conchoidal fracture. It possesses high tannin content and was earlier used as a tanning material. It is used as dyeing and preserving agent. Cutch is widely used in printing than in dyeing. In printing it is used for two main classes one for producing very fast steam brown and drabs, and other for producing brown in combination with red and chocolate. Cutch can be printed on with a starch tragacanth. On mixing cutch with diazo salts, a wide range of bright and attractive shades with moderate fastness to most of the agencies and poor fastness can be produced. It is used for dyeing the ship sails based on its excellent fastness and for its preservative action, which prevents the rotting of cotton from sea water. It is also used in Indian pharmacopoeia. It can be used for dyeing paper and pulp.

The chief components of khair heart- wood include catechin and catechu tannic acid. The proportion of cutch in heartwood is nearly upto 17 per cent. The highest annual production of Katha from a factory is about 350-450 tonnes and the annual production of cutch is about 750-800 tonnes. In many parts of the country, such as in Gujarat and Orissa, there are communities traditionally engaged in the extraction of cutch and katha. The important centres of production include Madhya Pradesh, Maharashtra and Gujarat. Cutch is exported mainly to United Kingdom. It is considered to be a good source for forest revenue.

## 12.3 Latex

Latex of several species is used but rubber plant yields the most useful latex and it is cultivated for the latex production.

**(1) Rubber (*Hevea brasiliensis*)** is a large sized deciduous tree distributed chiefly in the Amazon region of South America. It has been largely cultivated in forest lands as a plantation crop in Kerala, Tamil Nadu, Karnataka and Andaman and Nicobar islands. It is valued for the latex obtained from the trunk by tapping. Latex, when fresh is milky white in colour, sometimes may be grey, yellow or slightly pink depending upon the season and local conditions of exudation from the trunk of the plant.

Rubber is produced in India in large estates, small holdings and in forest plantations. Rubber is obtained from the latex vessels present in the bark by making a sharp cut on the main trunk. The latex vessels are arranged in concentric cylindrical rings which run in counter clockwise spirals throughout the trunk. On giving a sharp Encision on the stem or trunk of the plant, he latex oozes out quickly at first, then the speed of the flow slows down and finally coagulates on the cut. During the first taping, a small amount of latex exudes. The quantity of the latex increases with each successive tapping. With the gradual increase in the yield of latex, the viscosity decreases. Tapping is generally done in the morning when the flow of latex is vigorous. The flow slows down with the increase in temperature. An average yield of rubber in India from the plantations is about 700-800 kg/ha.

Rubber is used for making a wide variety of products. It is largely used for making tyres and tubes for automobiles and cycles, footwear, wire and cable insulation. Elastic fabrics are made from latex threads Rubber is used in making washers and gaskets, water bags, ice bags, surgeons gloves, toys, erasers and rubber bands, fountain pen barrels, tobacco pipe stems, telephones, combs and dentures. Raw rubber is used for making insulation tapes, shoe soles, adhesives and erasers. Natural rubber in concentrated form is used for the manufacture of balloons, gloves, contraceptives, appliances, finger stalls and teats. It is also used for making foam rubber and for dipped goods, fabric coatings, impregnation and molded goods.

Reclaimed rubber is prepared from discarded rubber products and rubber scrap, which includes automobile tyre and tubes. It is low in cost and easy to process. It is used for manufacture of heels, soles, rubber goods, tyres, adhesives used in flooring, carpet backing, fabric dipping, etc. The hard rubber is used for manufacturing battery containers, tubes and rods.

## 12.4. Insecticides

The term insecticide includes substances designed for the destruction of insects and other related pests. When used for the protection of plant, it is generally applied in the form of sprays, aerosols or dusts. It is used in such a way so that it does not harm the living plant, which is its host. The toxic material should be suitable to the application in the form of either a solution, a suspension or emulsion or a fine powder enough to be used in a spraying machine.

Several tree species possess pesticide properties. Extract obtained from different parts of plant may be the leaves, flowers, fruits, roots and stem shows pesticidal properties against different insects. The trees commonly employed for this purpose are *Azadirachta indica, Annona reguamore, Derris indica, Melia azaderach, Chrysanthemum cinera- riaefolium*, etc. Many plant species belonging to the genera Derris, *Longhocarpus, Millettia* and *Mundulea* also possess insecticidal properties.

**1. Neem (*Azadirachta indica*):** A large sized tree, found almost throughout India. Extract obtained from the seeds of the neem tree when mixed with organic solvents such as acetone, ethanol and methanol has been successfully tried against larvae of some forestry pests viz.,poplar defoliator- Clostera cupreata (Lepidoptera: Notodontidae) and teak skeletonizer- Eutectona machaeralis (Lepidoptera: pyralidae) for their gustatory phagodeterrent (antifeedant) effects. Neem seed extract has been found effective against about 200 insect pest causing damage to various types of crops. In neem seed kernel, an important chemical constitu- ent said to be effective against insect pest is azadirachtine. It works as an antifeedant. The azadirachtine content in the neem ker- nel varies considerably. The African neem is said to contain as much as 4 per cent azadirachtine. Whereas, Indian neem is poor in azadirachtine content, it contains about 0.5- 1.5 per cent of azadirachtine. The efficacy of neem seed extract depends primarily on the azadirachtine content in the seed kernel.

**2. *Dalbergia stipulacea*:** The bark and roots of Dalbergia stipulacea are also used as bio- pesticide. The acetone and alcohol extract of this species work as food poison against the moth, which infests rice, wheat and sor ghum crop.

**3. *Adina cardifolia*:** The alcohol extract of the leaves of Adina cardifolia works as a food poison against the moth Corcyra cephalonica which infests several cereal crops. It is also found effective against poplar defoliator.

**4. *Princepia utilis*:** The methanol extract of the defatted seeds of *Princepia utilis* also exhibits antifeedant activity against poplar defoliator *Clostera cupreata*.

**5. *Hopea parviflora:*** The ethanol extract of Hopea parviflora has been found to impart resistance to the timber of Mangifera indica and Hevea brasiliensis against termite and fungal attack.

**6. *Acorus calamus*:** The ethanol and acetone extract of *Acorus calamus* has been found affective against Ailanthus web worm, *Ateva fabriciella*. The other species reported to have insecticidal and antifungal properties include *lantana camera, Adhatoda vasica, Melia azaderac*h. The species have been effective against several insect pest and diseases.

***7. Pyrethrum (Chrysanthemum cinerariae folium):*** This insecticide is obtained from the flowers of the species of Chrysanthemum. The chiefly used species for this purpose is *C. cinerariaefolium*. It is a perennial herb with small daisy like flowers. The flowers of this species form the source of commercial pyre- thrum. The yield of flowers from about one hectare of land is 450-560 kg. Flowers are dried to yield about 3 percent of crude pyrethrum.

This insecticide is a contact poison, which is used either as a powder or as a spray. Pyrethrum preparation are used as anti-malarial measures and protection coat against a number of agricultural and horti cultural pests. It is also used as livestock spray against parasitic insects. Pyrethrum is widely used in agricultural crops as it does not leave toxic residues in crops.

**8. Rotenone**: Another valuable insecticide next to pyrethrum is rotenone, which is non poisonous to man and domestic animals. Rotenone is obtained from the roots of Lon- chocarpus nicou var. utilis.

***9. Derris spp.:*** Species belonging to genera Derris are climbing shrubs, found wild in the evergreen forests of eastern Himalayas and Assam. The roots of *D. ferruginea* yield rotenone and a resin. The rotenone content in the roots varies from place to place. For making dusting preparations, the roots of the species are ground and diluted with clay, talc or other diluents to give a product. The rotenone concentration in it is about 0.75 per cent, it can be utilized as a spray. It kills serious pests on fruit and vegetable crops, without leaving toxic residues in crops. It is also used as livestock spray for killing ticks, lice, fleas. *Derris elliptica* has been cultivated largely in many parts of the country.

## 12.5. Chemicals

Various parts of the plant such as leaves, roots, barks, etc. are rich in chemicals and some of these are used as a raw material for large scale production of these chemicals. Chemical investigations on the bark of Acacia catechu are in progress. It has been established that coxalic acid, an important commercial chemical, can be isolated in 10- 12 per cent yield from the bark which is available in large quantities in katha factories. Agarbatti industry uses powdered bark of *Machilus macarantha* (popularly known as jigat') as a binding material. There is an acute shortage of this material and about 1500 tonnes is being imported every year. Research carried out at IWST, Bangalore, has shown that a mixture of the barks of *Lannea coromandelica and Machilus macarantha* in 1:1 ratio can be used as a good substitute for bark of *Machilus macarantha.*

### (1) Oxalic acid

Several units in Maharashtra and Madhya Pradesh are working for the production of oxalic acid using the bark of saja (*Terminalia tomentosa* syn. *T. alata*). This tree occurs as an associate in sal and teak forests of the country. It is large and gregarious tree and valued for its timber. When the tree is harvested, the bark is separated with debarking spade or axe. The bark so obtained is collected and taken to the factory for utilizing it as a raw material for oxalic acid. The bark of T. *alata* contains about 11.0 per cent oxalic acid. The mature trees contain more acid than the younger trees. Ursolic acid, isolated from the leaves of Eucalyptus hybrid was evaluated for its choleretic, anticholestatic and hepatoprotoctive activities in rats in collaboration with Central Drug Research Institute, Lucknow. Significant anticholestatic activity (27.9-100 per cent) was observed against paracetamol (2g/kg) induced cholestasis. The compound also showed marked hepatoprotective activity against paracetamol and galactosamine (800 mg/kg) induced hepatotoxicity by reversing the altered value in viability of the isolated hepatocytes and the altered bio- chemical liver and serus parameters. The activity of the ursolic acid compared well with the known hepatoprotective drug silymarin.

A new prenylated chalcone, which is named as stipulin, was isolated from the root of *Dalbergia stipulacea*. From the leaves of the same species a new luteolin glycoside and luteolin have been isolated. A flavonol glycoside was isolated from the leaves of *Adina cordifolia*. Betulinic acid and beta- sitosterol were isolated from the bark of Eucalyptus hybrid. Acetone extract of the leaves of *Eucalyptus camaldulensis* contain eucalyptin, ursolic acid, betulinic acid and beta-sitosterol.

Polysaccharides have been isolated from the seeds of *Prosopis cineraria and Prosopis juliflora*. Mucilage isolated from the leaves of *Dalbergia sissoo* and preliminary studies indicate that it can be used as a very good wet-end additive in paper industry. *Prosopis cinerarium grows* in dry and arid regions of India, and is being planted on a large scale under social forestry programmes. It is estimated that about 200 kg of seeds can be expected from one hectare plantation with 100 unlopped trees (10-30 years old). A gum in 20 per cent yield can be isolated from these seeds. When used as wet-end additive, this gum was found to increase the tensile and burst strength of the paper. Starch has been isolated (54.75 per cent) from the seeds of *Quercus leucotrichophora*. Starch has been isolated from tubers of *Costus speciosus* and *Alocasia macrorhiza*.

## 12.6. Nuts

### (1) Soap nuts

Many plants yield products that contain saponins, which are a group of water soluble glucosides. The plant products which contain saponin yield soap froth in water and so are used as a substitute of soap. Sapindus is a genus of tree or shrubs, found chiefly in the Indo-Malaysian region. The fruits of species belonging to this genus are saponaceous. Soapnuts are exported to many countries of the world.

**(2) *Sapindus trifoliatus:*** It is a medium to large sized deciduous tree, found commonly on the coasts and in the open, dry deciduous forests at low elevations in south India. It is found in the dry evergreen forests in Nellore (Andhra Pradesh). It is planted as an avenue tree in many parts of the country. The tree is commonly known as the soapnut tree of south India. The fruits of this tree are known as ritha or soapnut. Soap nuts are widely used as a detergent for washing clothes before dyeing and for washing hair. It contains 10-15 per cent saponin. In India, it is used by jewellers for furnishing plates and ornaments tarnished by exposure. They are said to improve the colour and the flavour of spices so they are also used for bleaching cardamom. These are used to wash delicate fabrics like silk, woollen and nylon.

**(3)** ***Sapindus mukorossi:*** It is a deciduous tree found in the Himalayas up to an altitude of 1500 m. The fruit of the plant is valued for the saponin content (10.1 per cent) present in the pericarp, which constitutes 56.5 per cent of the drupe. It is used as a detergent for washing cloth before dyeing and for washing hair. It is considered to be the best soap for washing woollen and silk cloth and shawls Saponin is used in the preparation of soaps and toothpastes. It is used as an emulsifier in the preparation of insecticides, for vegetable and essential oils. It is also used as foam stabilizer in soapless sham- poos.

**(4)** ***Acacia concinna:*** It is a prickly scandent bush, found in the tropical forests through- out India. The fruits of this bush are commercially called as shikakai. The pods are extensively used as a detergent. The dry pods are powdered, perfumed and marketed. Shikakal is preferred to soap, when taking an oil bath. The saponin content in the pods is about 5 per cent. The pods are used for washing hairs and delicate woollen and silken cloths. It is also used for cleaning old, tarnished brassware. It adds fine gloss to silk when used powdered and boiled.

**(2) Marking nuts**

***Semicarpus anacardium:*** It is a moderate sized deciduous tree found common in the forests with sal. The fruits are slightly astringent and eaten when ripe. The species yield a dark vesicant, resinous juice from the pericarp of the drupes, which has been traditionally used for marking linen. It is sold in the market as a dry black drupe. The other species belonging to this genus used for marking linen is *S. travancorica*.

**(3) Sola pith**

***Aeschynomene aspera:*** It is a little, branched stout herb with spongy floating stem found in the marshy places, waterlogged situations and on the margins of lakes or tanks. In India, it is found in the West Bengal, Assam and south India. The stem of the plant consists of a mass of very light soft pith, which possesses very good insulating properties. It is used for making sun hats. The pith is also employed for making toys, artificial flowers, models, swimming jackets and life belts. It can also be used as a substitute for bottle corks.

***Aeschynomene indica:*** It is a slender annual herb, found commonly in the wet grass- lands. In India, it is found in Assam, Bengal and south India. The pith obtained from the stem of the plant is of inferior quality and cannot be split into thin sheets. It is used for making hats.

**(4) Bead Seeds**

**(1)** ***Abrus precatorius:*** It is a beautiful climbing shrub found throughout India upto 1500 m elevation. The seeds are shiny and small nearly of the size of small peas. The seeds are usually bright scarlet with a black eye. Sometimes the seeds are white and may be with or without eyes. The seeds are extensively used as beads for necklaces and for other jewellery items. In India, the beads are used by goldsmiths for weighing ornaments.

**(2)** ***Adenanthera pavonina:*** It is a moderate sized deciduous tree, found in the eastern sub-Himalayan tract in the Western ghats and in the Andamans. The pods of the tree carries the hard, shining scarlet seeds used for beads and necklaces. The seeds are larger in size than the seeds of *Abrus precatorius*.

**(3)** ***Coix lacryma:*** It is a tall erect grass, found in the plains and warm slopes of hills upto 1,500 m elevation. The tree produces shining pear shaped fruits used for ornamental pur- poses. The fruits are valued for the use in necklaces, rosaries, bead curtains, etc.

**(4)** ***Corypha umbraculifera (fan palm):*** It is an erect palm found in the moist coastal regions. The seeds of the palm are hard and white in colour and can be used as a substitute for ivory in the manufacture of buttons, beads and other ornamental and jewellery articles. These are generally coloured to stimulate coral and used in ornamental ware.

**(5)** ***Elaeocarpus sphaericus*** **Syn.** ***Elaeocarpus ganitrus (*****Rudraksha*****):*** It is a moderate sized tree, found in Nepal, Bihar, Bengal, Assam, Madhya Pradesh and Maharashtra. It is also cultivated as an ornamental tree. The tree flowers in the cold season and fruits ripen in autumn. The fruit is drupe which encloses a hard longitudinally, grooved tubercle stone. The stones are cleaned, polished and stained and are used for ornamental ware, these are used as beads in rosaries, bracelets and generally worn by Brahmins, saints and fakirs. These fetch high prices and are frequently set in gold.

**(6)** ***Putranjiva roxburghii:*** It is an evergreen tree found wild or cultivated in all parts of India. It is a widespread belief that the stones of the fruits ward off evil spirits. It is said to protect the lives of children, and is frequently worn by the children strung together into amulets as a protective charm.

**(Vii) Minerals**

The mineral products found in forests of the country are building stones, road metal, mica, coal, gold, silver, aluminium, lime- stone, etc. The areas rich in forests usually possess these minerals in large quantity. The forest revenue obtained from minerals is small.

**Terminal Question:**

- Write a short note on

(i) Kutch and Katha
(ii) Nuts
(iii) Latex

# Unit 13: Non wood Forest Products and Tribals

Unit Structure



## 13.0 Learning Objectives

After studying this unit you are able to understand about:

- Tribals and their distribution throughout India
- Nature and dependance of tribals on forests.
- How NWFPs improving the livelihood of the tribes?

## 13.1. Introduction

Forests are an important gift of nature for the well being of mankind. They are of a great importance to almost all living being on the earth. In India, a large population still depends on forest for their existence. Most of these people belong to schedule caste and schedule tribe category and live below the poverty-line and almost entirely depend on forests for their existence. They generally reside inside or in the vicinity of forests. Tribals are the most dominant group of communities who live inside the forest area and depend on the forests for meeting their maximum needs.

Tribe is a social group, the members of which are tribals, who collectively live in common territory, have a common dialect, uniform social organization and possess culture homogeneity having a common political pattern. A large number of tribal communities are identified in India. Anthropological Survey of India during 1967 has recorded 314 tribal communities. According to Census Report 2011, tribes constitute 8.6% of India's population or about 104 million tribal individuals. These groups of tribes are the inhabitants of the Khargone, Dhar, Jhabua, and Ratlam communities of Madhya Pradesh. The state wise population of tribals is given in table 1. The largest percentage of ST people, 94.8 percent, is found in Lakshadweep, followed by 94.4 percent in Mizoram and 86.5 percent in Nagaland, according to the 2011 Census. Goa has the lowest percentage of Scheduled Tribes in any state (0.04%). It is clear from the table that tribal communities are distributed in almost all of the states of India. There are certain regions where tribal population is dense.

**Table 1: States with population of Scheduled Castes as per 2011 census (Government of India, 2021)**

| State | Total population | Scheduled Caste population | Scheduled Tribe population |
|---|---|---|---|
| Andhra Pradesh | 84,580,777 | 13,878,078 | 5,920,654 |
| Arunachal Pradesh | 1,383,727 | 0 | 951,865 |
| Assam | 31,205,576 | 2,231,321 | 3,885,094 |
| Bihar | 104,099,452 | 16,567,325 | 1,332,472 |
| Chhattisgarh | 25,545,198 | 3,274,269 | 7,821,939 |
| Goa | 1,458,545 | 25,449 | 148,917 |
| Gujarat | 60,439,692 | 4,074,447 | 8,914,854 |
| Haryana | 25,351,462 | 5,113,615 | 0 |
| Himachal Pradesh | 6,864,602 | 1,729,252 | 391,968 |
| Jammu & Kashmir | 12,541,302 | 924,991 | 1,492,414 |
| Jharkhand | 32,988,134 | 3,985,644 | 8,646,189 |
| Karnataka | 61,095,297 | 10,474,992 | 4,246,123 |
| Kerala | 33,406,061 | 3,039,573 | 484,387 |
| Madhya Pradesh | 72,626,809 | 11,342,320 | 15,316,994 |
| Maharashtra | 112,374,333 | 13,275,898 | 10,507,000 |

| State | Total population | Scheduled Caste population | Scheduled Tribe population |
|---|---|---|---|
| Manipur | 2,570,390 | 97,042 | 903,235 |
| Meghalaya | 2,966,889 | 17,355 | 2,555,974 |
| Mizoram | 1,097,206 | 1,218 | 1,036,201 |
| Nagaland | 1,978,502 | 0 | 1,710,612 |
| Odisha | 41,974,218 | 7,190,184 | 9,591,108 |
| Punjab | 27,743,338 | 8,860,179 | 0 |
| Rajasthan | 68,548,437 | 12,221,593 | 9,240,329 |
| Sikkim | 610,577 | 28,275 | 205,886 |
| Tamil Nadu | 72,147,030 | 14,438,445 | 793,617 |
| Tripura | 3,673,917 | 654,918 | 1,166,836 |
| Uttar Pradesh | 199,812,341 | 41,357,608 | 1,138,930 |
| Uttarakhand | 10,086,292 | 1,892,516 | 292,502 |
| West Bengal | 91,276,115 | 21,463,270 | 5,294,014 |
| India | 1,210,854,977 | 201,378,086 | 104,254,613 |

## 13.2. Distribution of Tribals

Broadly, the tribals are concentrated in the following regions of India:

**1. North-eastern region**

The north-eastern region of India covering the state of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura have the concentration of Mongolian racial stock of tribals. This region is occupied by tribes such as Abor, Garo, Khasi, Kuki, Mishmi, Naga, Boro, Chakma, etc.

**2. Himalayan region**

The sub-Himalayan region covering parts of north Bengal, Uttar Pradesh and Himachal Pradesh also have concentrated tribal population in certain areas which belongs to communities eg. Lepcha, Rabha, etc.

**3. Central Indian region**

The central Indian region covering Bihar, Orissa, Madhya Pradesh and West Bengal have a dense population of tribes belonging to Proto-Australoid racial stock. Important tribal communities of this region are Gond, Oaran, Munda, Santhal and Bhil.

### 4. Western India region

This region includes Rajasthan, Maharashtra, Gujarat, Goa and Dadra Nagar Haveli where a maximum number of tribal com- munities belong to Bhil, Meena, Halba, Korku, etc. These tribal groups also belong to Proto-Australoid race.

### 5. Southern region

This region includes Kamataka, Andhra Pradesh. Tamil Nadu, Kerala. Important tribal communities of this region are Chenchu, Irula, Kota, Kurmba and Toda.

### 6. Island region

This region includes Andaman Nicobar and Lakshadweep group of islands. A number of small tribal communities such as Andamanese, Onges, Sentinelese, etc. live in this region. India has a wide distribution of tribals. In almost all states and union territories of the country some scheduled tribes population exists. Madhya Pradesh, Orissa, Bihar and Rajasthan account for more than 50 per cent tribal population of the country (Fig. 1).

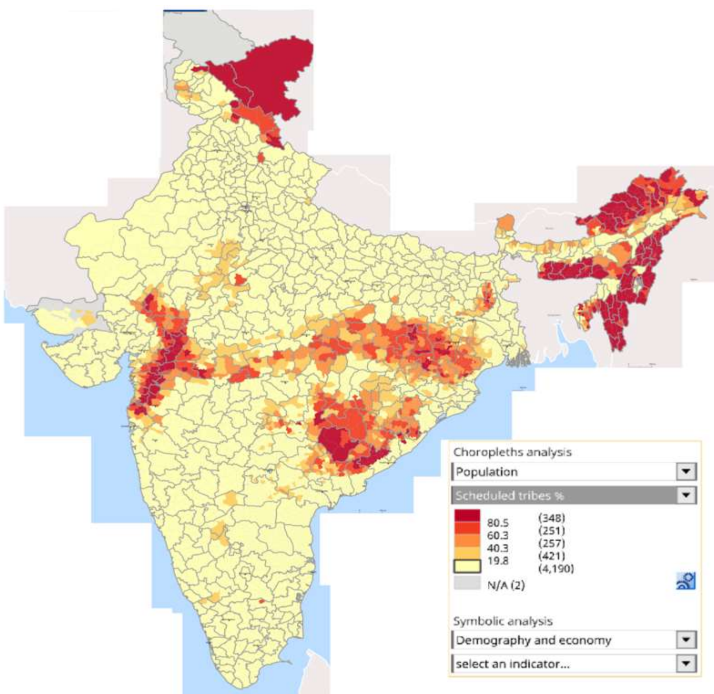


Fig.1. Percent of scheduled tribes in India by tehsils by census 2011
Source: https://upload.wikimedia.org/wikipedia/commons/f/fc/Percent_of_scheduled_tribes_in_India_by_tehsils_by_census_2011.png

## 13.2. Important tribes of India

The important tribes whose population is large are as follows:

1. The Bhils of Madhya Pradesh, Rajas- than, Maharashtra.

2. The Gond of Madhya Pradesh, Andhra Pradesh, Gujarat and Orissa.

3. The Santhals of Bihar, Orissa and West Bengal.

4. The Oran of Bihar, Orissa, West Bengal and Madhya Pradesh.

5. The Meena of Rajasthan and Madhya Pradesh.

6. The Munda in Bihar, Madhya Pradesh, Orissa and West Bengal.

7. The Khond in Bihar, Orissa, Madhya. Pradesh, West Bengal and Maharashtra.

8. The Ho in Bihar, Orissa and West Bengal.

9. The Naga in Nagaland.

a. Tribes of Ghotkulb. Halam Tribe c. Meghwar tribe d. Chang naga man

Source: https://www.google.com/url?sa=i&url=https%3A%2F%2Fthefolktales.com%2Fblog%2Findian-tribes-celebrate-live-in-

The tribes whose population is very small include great Andamanese, Onge, Jarwa, Shompen, Sentanalese, etc. State wise detail of tribal communities is as follows:

**Arunachal Pradesh:**Abore, Akka, Apatani, Barmas, Dafla, Galong, Gomba, Khampti, Khova, Mishmi, Singhpo, Sheerdukpain.

**Assam:** Boro-Boro Kachari, Chakma, Dimsa, Devari, Hozai, Hazong, Kachari, Lalung, Maich, Mikir.

**Meghalaya:** Garo, Hamar, Khasi.

**Nagaland:** Naga, Siteng.

**Manipur:** Kuki.

**Tripura:** Bhutia, Bhil, Chakma, Chaimal, Garo, Halam, Jamatia, Kuki, Klasia, Lushai, Lepcha, Mog, Munda, Noatia, Orang, Reang, Santhal, Tripura or Tripuri Tippera, Uechai.

**Mizoram:**Lakher, Mizo, Maat, Paki.

**West Bengal:** Asur, Baiga, Banjara, Badia, Bighia, Birhor, Bhutia, Chero, Chakma, Garo, Gond, Gorait, Ho, Kota, Kharwar, Khond, Kisan, Korwa, Lodha or Kheria, Lepcha, Lohra, Munda, Magh, Mahali, Mech, Mahli, Nagesia, Oraon, Santal, Sauria Paharia, Savar.

**Bihar:** Asur, Bhumji, Baiga, Banjara, Bathudi, Bedia, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Kharia, Kherwar, Khond, Kisan, Kora, Korwa, Lohra or Lohar, Mahli, Mal Paharia, Munda, Oraon, Parhaiya, Santhal, Sauria, Paharia, Savar.

**Uttar Pradesh:**Bhoksa, Bhotia, Jounsari, Raji, Tharu.

**Orissa:**Bagatta, Baiga, Banjara or Banjar, Bathudi, Bhotada, Bhuiyan, Bhumij, Binjhal, Birhor, Bharua, Chenchu, Dal, Desua Bhu mil Gondia, Gond, Ghara, Holwa, Ho, Juang, Kisan, Kol, Lohar, Kolha, Koli, Kora, Ganda, Kawar, Kharia, Khond, Kuli, Kond, Kolha, Madia, Mahali, Mankeedi, Mankirdia, Matya, Mirdha, Munda, Oraon, Parenga, Paroja, Rajor, Santhal, Saora, Shabar, Sonti, Tharua.

**Madhya Pradesh:**Agariya, Birhor, Biar, Bhaina, Bhumiya, Bhil Meena, Bharia, Baiga, Bhilala, Bhils, Dhanwar, Gond, Cadba, Garasia, Gajhwar, Halba, Kol, Korku, Kamar, Korwa, Keer, Karku, Khairwar, Kha- ria, Khond, Munda, Meena, Mogia, Mawasi Majhi, Nihal, Nat, Nagesia, Oraon, Pardhan, Pardhi, Parja, Patika, Pao, Panika, Saharia, Saur, Sawar, Saonta.

**Himachal Pradesh:** Gaddi, Gujjar, Jad, Kanaura, Lahula, Pangwala, Sawangla.

**Punjab:** Bodh, Gaddi, Swangwala.

**Rajasthan:** Bhil, Bhil Meena, Chodhara, Damor, Dubla, Dhodia, Dhanka, Garasia, Gamit, Gond, Kathodi, Kokna, Kolidhor, Korku, Pomla, Patelia, Pardhi, Rathawa, Sethria, Varli, Vitolia.

**Maharashtra:**Andh, Bhil, Barda, Bamcha, Bijhwar, Birhul, Bhaina, Bharwad, Bhunjiya, Bhattra, Chodhara, Charan, Dubla, Dhodia, Dhanwar, Gond, Gadaba, Halba, Kathodi, Kokna, Kandh, Kol, Korku, Korwa, Kharia, Kharwar, Kamar, Kunbi, Koli Mahadeve, Koya, Naikda, Nagesia, Nihal, Oraon, Pomla, Patelia, Pardhi, Mahal, Parja, Par- dhan, Rathawa, Rawri, Siddi, Sawar, Saonto, Thoti.

**Andhra Pradesh:**Andh, Bagata, Bhil, Bal- mike, Chenchu, Gadaba, Gond, Hill Reddis, Jatapu, Kammara, Kolam, Koya, Konda Dona, Konda Reddis, Khonds, Kotias, Kulia, Kattunayakan, Kotiya Bindhu, Malis, Manne, Dora, Nayaks, Porja, Pardhan, Rona, Sabra, Sugalis, ThotiValmike, Yanadia, Yerukula Karnataka: Arnadan, Barda, Bamcha, Bhil, Chodhara, Chenchu, Dhanka, Dhodia, Dubla, Godalu, Gamta, Hasadaru, Hakki Pikki, Kathodi, Kokna, Kolidhor, Koya, Koruba, Kaniyan, Kuruman, Kota, Konda Reddi, Kadar, Malaikudi, Maleru, Maratha, Meda, Marti, Madian, Naikda, Pardhi, Pate- lia, Pomla, Pumyan, Rathawa, Rajgond, Thoti, Toda, Varli, Yerawa.

**Tamil Nadu:**Audian, Erulaj, Eravalan, Kammard, Kahunayakan, Kondo Kakush Konda, Kota, Kudia, Kuruman, Kulayan, Kurumba, Kaniyan, Malaikindi, Mudugaar, Mannan, Malyan, Malaipandram, Mala, Malakurravan, Paniyan, Sholga, Urali.

**Kerala:** Andaman, Erulaj, Eravallan, Kanni- kar, Kochuvelan, Kaminara, Kondakakus, Koraga, Kota, Kudia, Kuruman, Kurumba, Mathuwan, Malai Aryan, Malayaam, Man- nar, Malai Kundi, Marti, Pulayan, Urali, Ulladan, Vishvan.

**Lakshadweep, Minicoy and Amindivi Is- lands:** Inhabitants of the Laccadive, Minicoy and Amindivi Islands who or both of whose parents were born in those Islands.

**Andaman and Nicobar Islands:** Andamanese, Jarwa, Nicobarese, Onges, Shom Pens, Sentinelese.

## 13.3. Forests and tribal concentration

The areas rich in forests are rich in tribals. The areas without forests have usually low tribal population. For example, Punjab, Haryana, Delhi, Chandigarh, etc. where forest area is negligible, there is no tribal population.

Similarly, the areas rich in forests such as Andaman and Nicobar Islands, Arunachal Pradesh, Mizoram, Nagaland, Orissa, Madhya Pradesh, etc. are also rich in tribal population. This is also true in the context of smaller areas.

**PRIMITIVE TRIBES**

There are a number of tribal communities which are almost completely dependent on forest as they reside inside the forest area and are away from the civilized world. The list of such tribes is given in table 2.

**Table 2: State wise population of tribals**.

| S.No. | State/ UT | Primitive Tribal Group |
|---|---|---|
| 1. | Andhra Pradesh4 | Bodo-Gadaba, Bondo Poroja, Gurob Gadaba, Khond Poroja, ParengiPoroja, Thot, DongariaKhonda, Konda Sabaras, Kulia Khond, Chenchu, Kolam, Konda Reddi |
| 2. | Bihar | Asur, Birhor, Birjia, Savar, Hill Kharia, Korwa, Malpharia, Parhaiyas, Sauria Paharia |
| 3. | Gujarat | Kathodi, Siddis, Kolgha, Kotwalia, Padhar |
| 4. | Madhya Pradesh | Abujhmarias, Baigas, Bharias, Hill Korbas, Saharias, Kamar |
| 5. | Maharastra | Maria Gond, Karkaria, Kolam |
| 6. | Orissa | Birhor, Didayi, Mankidias, Lodha, Bondo, Dongaria Kondh, Kutia Kandh, Lunjia, Souras, Paudi Bhuyan, Soura, Kharias, Juangs |
| 7. | Rajasthan | Seharia |
| 8. | Tripura | Reangs |
| 9. | West Bengal | Birhor, Toto, Lodha |
| 10. | Uttar Pradesh | Rajis, Busa |

| | | |
|---|---|---|
| 11. | Karnataka | Jenu Kuruba, Koraga |
| 12. | Kerala | Cholanaichans, Kadar, Kurumbas, Kattunaickans |
| 13. | Manipur | Marram Nagas |
| 14. | Tamil Nadu | Kaltunaickans, Kotas, Irulas, Kurumbas, Panivans |
| 15. | Andaman and Nicobar Islands | Great Andamanese, Jarawas (Estimated), Onges, Sentenelese, Shompens |

## 13.5. Nature of dependence of tribals on forests

Tribals depend upon forests for their existence in several ways. The degree of dependence of tribals on forests depends upon various factors. These factors include their socio-economic conditions, distribution, cultural and religious norms, literacy, etc. The primitive tribes, who lived inside the dense forests are very poor and depend entirely on forests for meeting most of their needs. However, the tribal communities, which have gained access to the modern world have gradually started adopting to the modern ways of life.

The dwindling of forest resources have also forced them to look for alternative ways of meeting their needs. The following are the ways of the dependence of tribals for forests:

i. Collection and consumption
ii. Dependence for income
iii. Dependence for employment
iv. Dependence for shifting cultivation
v. Dependence for pastoralism activity
vi. Satisfying cultural, religious and festival needs

### 13.5.1. Collection and Consumption

Tribals have been dependent on forests since ages. Tribals collect both wood and non-wood forest products in large quantities for meeting their day to day needs. The non-wood products include food, medicines, bamboos and canes, fibre, tans and dyes, oilseeds, etc. Among the important daily required food items collected from the forests include flowers, fruits, seeds and other plant parts.

One of the important flowers largely used by the tribals largely is mahua flower. These flowers are rich in carbohydrates, proteins and minerals and are collected in large quantities by the tribals. These flowers are consumed by them in different ways. These are eaten boiled, raw, powdered, roasted or made into chapatti. These are also used for making liquor and are considered to be a good as maize seeds.

Tribals depend on forests for their health care and treatment of various dis eases. Modern facilities of medicine Le the allopathic system has not yet become accessible to them. Many drugs for modern medicines are obtained from the plant parts traditionally used by the tribals. The information about medicinal plants used by them has been passing from one generation to the another.

Several kinds of oilseeds are collected and crushed locally for the extraction of oil. Seeds of sal, mahua, kusum, etc are collected and oil is extracted which is used for domestic purposes. The oil is used for edible purposes and also for lighting. These oils are generally used for all those purposes for which mustard or linseed oil is used. Other oils like neem oil and karanj oil are gene- rally used for medicinal purposes.

Similarly, other non-wood products, e.g. gums and resins, tans and dyes, leaves, bamboos and canes, spices, fibre and flosses, animal products, etc. are collected by the tribals for their own consumption.

Studies carried out indicate that Chenchu and Kolam tribes of Andhra Pradesh, Abhujmarias and Baigas of Madhya pradesh, Jungas and Kharias of Orissa depend on forests for meeting about 50 per cent of food requirement, 90 per cent of health care and 100 per cent for meeting other needs eg. oil seed, fibre, bamboo, canes, firewood, grasses and grazing, tanning and dyes, soaps, etc. Several tribes who have taken to settled agriculture and situated near the means of communication, eg. roads and rails, etc. have reduced their dependence on forests considerably.

Most of the tribals belonging to the poorest group collect non-wood products in large quantities. A major part of the collected produce is retained by them for meeting their own needs and only a smaller part of the produce collected is sold in the market. On the other hand tribal families which are economically better, collect non-wood produce for sale.

**13.5.2. Collection for Income**

Most of the non wood forests products collected by tribes are consumed by them. Certain proportion of the collected non wood forest products are sold in the market to earn some income from the sale of these forest products. The quantity of non-wood forest products collected by the tribals depends upon several factors. The economic status remains one of the important criteria. The poor people collect non-wood products from the forest in large quantity and they sell large quantity of the produce in the market. The persons belonging to higher income group retain larger part of the produce for their own use and sell the remaining part in the market. The sale also depends upon the type of produce. Certain non-wood forest products such as leaves (tendu leaves) are sold whatever quantity is collected by the people, as there is a good network for collection and sale of tendu leaves in several states. There is also no local consumption of leaves.

In case of edible fruits, flowers, seeds etc. such as Mahua flowers, chironji, etc. are collected by the tribal people and other weaker sections for their own consumption and sale. Relatively economically better people can afford to keep more produce for their own consumption than the lower income group people. Ownership on the land also affects collection and sale of non- wood produce. If a person has enough land and he is able to produce enough food grains, his dependence on forests is limited. If a person has trees producing non-wood forest products, then the children collect all items from them and the adult persons collect from the forests. In all the cases, non- wood products sold by the tribals give them an additional income to meet day to day needs. In some cases, the non-wood forest products from the main source of income.

The non-wood products are sold in the market or local bazaars. The traders and the middle men generally purchase these produce from the tribals. The income generated by the sale of non-wood products is utilized by tribals for buying clothes, salt and other necessary items.

### a) Deforestation

Forest dwellers face various kinds of hardships in the collection of non-wood products from the forest owing to deforestation. Study made in Orissa indicates that for collecting the same quantity of non- wood produce, today tribals have to cover an average of 7 km as against 1.7 km distance about twenty years ago. Most of these non wood forest products are collected by the women and therefore, they have to undergo maximum hardships because of the deforestation. For collecting the same quantity of non-wood forest products, they have to walk long distance for about 3-4 hours a day to collect various non-wood forest products. The study in Madhya Pradesh and Orissa indicates that deforestation has reduced to availability of non wood forest products and consequently led to additional work load. In spite of the problems in collection of non-wood produce tribals still collect various non-wood produce in large quantity indicating that there is no alternative available for them.

### b) Exploitation by middle men

The commercialization of various non wood forest products has added to the depends of forest dwellers on forests. The weaker sections of society collect consume and sell various forest produce in order to survive. They are generally exploited by the middle men, who play an important role in the trade of non-wood forest products. The tribals who collect the non-wood products from the forests usually get low price per unit of the produce, while the traders and the middlemen get much higher income from the same unit of the produce. The traders generally lend money to the tribals during lean months in order to get non- wood forest products at low price during the harvest season.

Several middlemen resort to cheating in the measurements. In the remote areas, these middlemen resort to the barter system. They exchange the costly forest produce with things like salt, some cheap cloths, etc. resulting in the disadvantage of the tribals. In Madhya Pradesh, 3 kg mahua flowers are purchased by the middlemen in place of 1 kg common salt. While one kg of salt costs about Rs. 1.25, the cost of 3 kg of mahua is Rs. 4.50, this indicates that how tribals are exploited and cheated. These middlemen do not carry physical balance in the interior and generally make purchases through volume measurement, which is advantageous to them. Some times tribals are forced to sell the produce in wet or semi dry conditions, middle men reduce very heavy dry percentage from the weight of the produce. Sometimes reduction is taken out even from the dry forest produce, these results in loss of income to the tribals. Most of the tribal realize that they are being cheated by the local money lenders and traders but they are helpless and generally do not have any alternative.

It has been realized that the tribals and other forest dwellers are exploited by the local traders. The government decided to form tribal cooperative societies during early sixties, to resist the exploitation of tribals by the middle men. These cooperative societies met with several problems due to lack of working capital, imperfect organization, poor management' and low representation of tribals. Various types of tribal cooperative societies have been formed to help the cause of tribals and collection of non-wood forest products in different states. In case of tendu leaves and sal seed, in Madhya Pradesh, collection is being done by tribal cooperative societies and each collector is enrolled as a member of the society. The collector is being paid the wages for collection and also the share of profit which results due to the trade of these products. In the year 1991-92 in Madhya Pradesh about Rs. 120 crores rupees were distributed among 10 million collectors of tendu leaves as a profit of the trade.

**13.5.3. Dependence for Employment**

There is an acute problem of unemployment in the country particularly in the rural and remote areas, where concentration of schedule tribes and schedule castes is comparatively high. There are no avenues for providing employment in forest areas as there is less developmental works by other sectors. The various operations in the forestry sector remain the only source for creating job opportunities for the people located inside the forest areas. There are variety of operations such as plantation, tending, wee- ding, pruning, harvesting, processing and marketing, etc which create sufficient job opportunities for the schedule castes and tribes population. Most of these operations are labour intensive and generate sufficient labour opportunities for these people.

Three different kinds of employment are generated to the rural population. These are as follows:

i) Direct employment,

ii) Self employment and

iii) Secondary employment based on forest industries

**i) Direct employment**

Direct employment is provided by management, protection, research, planning and executive activities. The direct employment generated by the forestry sector gene- rally involves hard and arduous work. These manual activities concern with the growth, development and maintenance of forest, survey of forest resources, forest protection, survey of flora and fauna, harvesting of forest products, etc. Collection, tending and harvesting of non-wood forest pro- ducts like lac, resin, katha and essential oils, plantation activity, soil working, fencing, planting, development of infrastructures like roads, buildings, etc. create sufficient labour opportunities. These activities provide the backbone of the tribal economy since there are no such activities relating to employment from other departments. Forest activities remain the only source for providing the employment in remote areas. The villagers which are away from the forest or when the tribals have land they engage themselves in agricultural activities and therefore, the benefits of labour generation by the non-wood forest products is generally utilized by the poor sections of the society.

**ii) Self employment**

Self employment is resources based activities employing the person in the production of output of benefit, which is wholly or partially consumed by the person employed. The output generated may or may not be sold in the market. Such self-employment activities include removal of head load of firewood and fodder from the forest, grazing and lopping, availing of rights and concessions, collection of honey and other food items from the forests, raising food crops, vegetables and fruits through agri-silviculture, etc.

**iii) Secondary employment**

Secondary employment is generated through activities which process the forest products and bring out the suitable output for human consumption. These can be related to primary forest industries or secondary forest industries. These industries process the goods and sell them in the market in utilizable form.

**Estimation of employment generation through non-wood products:** The non-wood forest products provide far greater employment to the people than the wood. They have much greater potentialfor providing employment in future. This is particularly true in respect of unskilled labour force. Most of the activities pertaining to non-wood forest products like collection, plucking, processing, transport, marketing, etc are labour intensive and they provide substantial employment. It has been estimated that non-wood forest products generate employment to the tune of about 1.2 million person year, which is 55 percent of the total employment generated in the forestry sector.

It has also been estimated that potential for employment generation in the non-wood sector is 3.8 million person years (Table 2). These estimates are based on recorded production of various non-wood forest products. Now the interest of the forest management is generally shifting from wood to non wood products. The non-wood forest products hold the key for providing employment to a large scheduled caste and schedule tribal population.

Table 2. Current and potential production and employment in collection of non-wood forest products in India (Gupta and Guleria, 1984)

| Description | Collection period | Production | | Employment | |
|---|---|---|---|---|---|
| | | Current | Potential | Current | Potential |
| **1** | **2** | **3** | **4** | **5** | **6** |
| **Fibers and Flosses** | | | | | |
| Fibres | March-May | 2500 | 45000 | 4400 | 79000 |
| Grasses | October-March | 350000 | 525000 | 1200000 | 1800000 |
| **Bamboo and Canes** | | | | | |
| Bamboo | All year round | 1932000 | 4309000 | 48300 | 110000 |
| Canes | All year round | 14000 | 21000 | 700 | 1050 |
| **Essential oils** | | | | | |
| Lemon grass | May-June | 1300 | 1950 | 21700 | 32550 |
| Eucalyptus | All year round | 140 | 210 | 2320 | 3480 |
| Cinnamon | All year round | 3 | 4 | 50 | 70 |
| Deodar | All year round | 15 | 23 | 150 | 230 |
| Pine | All year round | N.A. | 100000 | N.A. | 100000 |
| **Non-edible oil seeds** | | | | | |
| Mahua | April-June | 85000 | 490000 | 28600 | 163000 |
| Neem | May-June | 6000 | 418000 | 1000 | 70000 |
| Kusum | June-July | 30000 | 90000 | 6700 | 30000 |
| Sal | April-June | 240000 | 5504000 | 53000 | 1123000 |
| **Tans and dyes** | | | | | |
| Babul bark | All year round | 27400 | 50000 | 4570 | 8300 |
| Avaram bark | All year round | 30000 | 45000 | 5000 | 7500 |
| Wattle bark | All year round | 30000 | 45000 | 5000 | 7500 |
| **Gums and resins** | | | | | |
| Karaya gum | April-June | 15000 | 22500 | 50000 | 75000 |
| Resins | March-June | 74200 | 150000 | 30000 | 60200 |
| **Lac and tasar silk** | | | | | |
| Lac and Lac products | October-January | 22000 | 30000 | 7300 | 10950 |
| Tasar silk | August-December | 300 | 1900 | 1500 | 9500 |
| Tendu leaves | April-June | 210000 | 300000 | 74900 | 107000 |
| **Drugs, Spices and Insecticide** | | | | | |
| Sarpagandha | - | 600 | 1600 | 16000 | 42670 |

**13.5.4. Dependence for Shifting Cultivation**

Shifting cultivation is a transition between the food gathering and food production. The practice is known as jhuming in the north east, Kurva in Bihar, dahiya or podo in Orissa, Madhya Pradesh and Andhra Pradesh. The system consists of cutting back the forest, drying the wood and other vegetable material, burning it and cultivating the area for one or two years and moving to another place for the same purpose. Shifting cultivation is an age old practice of cultivation. It is primitive in nature and causes damage to forests of the area. The practice aims at utilizing the productivity of the forest for cultivating the food grains.

**13.5.5. Dependence for Pastoral Activity**

A number of scheduled castes and schedule tribe communities depend upon forests for grazing their cattle. Most of the tribals in India rear cattle for variety of purposes. Among the Indian tribes, who depend entirely on pastoral activities include Toda, Gaddies, Gujjars, Bhotia, etc. The Todas of Nilgiris in Tamil Nadu earn their living by selling milk and milk products. Usually they exchange milk and milk products for other commodities. Gujjars of Uttar Pradesh and Himachal Pradesh generally keep cows, buffaloes and sheep for commercial purposes. Similarly, Bhotias are also engaged in pastoral activities. The Gad- dies of Himachal Pradesh rear buffaloes, sheep and goats. These tribes depend on forest grazing and leaf fodder provided by trees for maintaining their animals.

**13.5.6. Religious and Cultural Activities**

Trees and animals have been associated with forest dwellers in their social, religious and cultural life. They worship a large number of trees. Trees are considered to the abode of a number of gods and goddesses whom they worship in several ways on special occasions. The trees worshipped depend on *the area and the tribe.* Bhils of Rajasthan and Madhya Pradesh worship the following trees*:*

***Adansonia digitata*** **(Kalpa Dev):** The tree is worshipped by tribals for fulfilment of wishes; it is believed to fulfil wishes per training to marriage, children, etc. It is very commonly worshipped in Banswara.

***Ficus benghalensis*** **(Vadlo):** It is worshipped on different occasions believing that some deity lives there.

***Ficus religiosa*** **(Pipal):** The tree is considered to be the female goddess. Destroying of this tree is considered to be ungodliness.

***Mangifera indica*** **(Amba):** It is believed to have been planted by Bhim during the period of exile to please Indra (lord of rains). In the month of March a two days fair is held when the tribals assemble at this spot, bathe the trunks of the ancient amba trees, apply turmeric and offer coconuts.

***Musa paradisiaca*** **(keli, kera, jhar):** The plant is worshipped throughout; it is associated with Aryans rituals also. The plant prospers only if unpolluted person are in its proximity,

***Emblica officinalis*** **(Amla):** Bhils worship it after Valia Bhil.

***Tamarindus indica*** **(Imli):** Worshipped mainly on amliegyaras.

***Vetiverazizanoides*****(Kator):** The plant is worshipped with, a belief that kator goddess will be responsible for safety and welfare of children. In the month of October this weed is worshipped. Similarly other tribes worship different trees found in their localities.

## 13.6. Forests and trees are associated with rituals and cultural traditions

Forests supply everything from food and drink to clothing and musical instruments for customary rituals. Even while some of these items aren't always used on a daily basis, they are nonetheless integral parts of many different cultural traditions.

All across the region, forest materials are employed in traditional medicine. The first section's discussion of medicines and medicinal practices heavily relies on the mystical values connected to various forest species. Thus, when examining a plant's efficacy, it is impossible to distinguish between its psychological and medicinal effects.

In various traditional rituals, such as marriages, burials, initiations, chief installation, and birth celebrations, forest foods are also served. In humid West Africa, palm wine and cola nuts are significant symbolic foods. For instance, palm wine is highly valued at the majority of social gatherings in Nigeria (Okafor 1979). It is employed for libation pouring, prayer offering, and event proclaiming. Cola nuts are recognized as significant emblems of friendliness and welcome. Cola nuts are revered by the Muslims in the area since the prophet gave them to them. They appear on all joyous events and are a representation of friendship. All conversations, prayers, and rituals among the Igbo people of southern Nigeria start with the breaking of cola nuts. These aren't considered special occasions without cola.

*Pentaclethra macrophylla* seeds are yet another example of a food item of symbolic significance found in forests. They are a part of girl initiation rituals and child naming ceremonies in southwest Nigeria, where they signify adulthood. Women's burial traditions feature the serving of bread fruit, or *Treculia africana*. Additionally, it is offered at a celebration meant to signal a girl's approaching departure for her husband's house (Okafor 1979). Additionally, forests supply the raw materials for a large number of the items utilized in customary rites. Forest products are used to make most musical instruments.

**Neem dak mandi** (ceremonial eating of rice cooked with neem leaves) Use of vessel made of sal leaves Shade is made using sal and jamun leaves and posts. Deity and gods are installed by using posts of Ficus spp. On fifth day of death telnahn purifies the family members in which mahua seed, sal stick are used.

## 13.7. Non-wood forest products improving the livelihood of the tribes

Minority people in Vietnam, Myanmar, and Laos live away from mainstream settlements. The hill tribes and many other minority groups are closely associated with forests for centuries. Much of their household subsistence and part of the income is generated from the sale of a variety of NTFP products. In the highlands of Vietnam, NTFPs production is spread almost throughout the year, so provides a sustained income for the ethnic minority people. From June to August is the wild berry called uoi (Scaphiumma cropodium) collection that provides the bulk of household income. Every

family sends several people into the forest on a regular basis during this period where they stay for 2–3 days during which 5–6 kg of berries are collected. A kilogram of dried berries (2–3 days of sun-dry) is sold for $1.50. The next comes bamboo shoots, mushrooms, and vegetable collection that goes through to February. The minority people in Sa Pa area depends mainly on a variety of NTFPs for their livelihoods. Among the products collected are fruits, berries, leaves, mushrooms, fish, bees honey, bamboo shoots, wild orchids and the list goes on. The Friday market is full of orchids and other wild plants put forward by these people for the tourists, both domestic and international, that flock there. Between 10-15% of the total household income is derived from the sale of NTFPs. The harvesting of leaves in the diet of family goes round the year where different species are readily available in specific months. Water from forest areas is yet another service that is useful in the livelihoods of these people. They have micro-hydro plants installed in streams

Figure 1 Batwa Pygmies tribe, Mgahinga Gorilla National Park, Uganda, September 2017.

Figure 2. African tribe selling handicraft products, Mgahinga Gorilla National Park, Uganda, September 2017.

that generate the much needed power for pounding (grain and seeds) and lighting too.

In the drier areas of Sri Lanka, the harvesting of curry leaves to be sold to traders is an important income. The harvesting` of velvet tamarind (Dialiumo voideum) is an important income source to the rural people. This tree which is endemic to the country provides a fruit that has a high-popularity during certain months of the year. The returns from the sale of these two products is an important addition to the household incomes of rural people.

Figure 3. Agroforestry in Lubuk Beringin village
Source: https://www.flickr.com/photos/cifor/35820564770

A Lubuk Beringin villager, Rahimah, loads cinnamon in the forest near Lubuk Beringin village, Bungo district, Jambi province, Indonesia. Forests have become an integral part of Lubuk Beringin, Jambi province, as the villagers have carried out forest management and exploitation in a sustainable manner by implementing traditional values.


<img.src="https://c.pxhere.com/photos/09/62/tobacco_leaves_dried_dry_tobacco_leaves _smoking_cigar_narcotic_product-1241700.jpg!d"srcset="https://c.pxhere.com/photos/09/62/ tobacco _leaves _dried_ dry_tobacco_leaves_smoking_cigar_narcotic_product-1241700.jpg!d" alt="wood, smoking, food, dried, baking, product, leaves, art, cigar, tobacco, burma, nicotine,

narcotic, dry tobacco leaves, Free Images InPxHere">

*Linking conservation and use of forest resources with the economic interests of local people can still foster sustainable use.*

Soligas harvesting NTFP, BR Hills

Source: https://www.conservationindia.org/wp-content/files_mf/1307624097Soligassml.jpg

## Conclusion

The effects of shifting cultural values on the utilisation of forest resources have not been studied. Nevertheless, it is indisputable that values have evolved and will continue to evolve. People's views of the surrounding forest environment will surely change as a result of this transformation. However, some experts contend that, in part because they represent cultural coherence, trees and the products they produce are and will always be valued.

## References:

1. *"Government of India, Ministry of Social Justice website". Archived from the original on 5 March 2021. Retrieved 6 March 2021.*
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# Unit 14: NTFPs- Medicinal Plants and Their Uses

**Unit Structure**



## 14.0 Learning Objectives

After studying this unit, you should be able to:

- define medicinal plants
- enlist important medicinal plants of Uttarakhand
- Describe some important medicinal plants,
- Discuss the medicinal uses of some important medicinal plants

## 14.1 Introduction

Humans have always been dependent on plant resources for a variety of their requirements from food items, fibers, timber and many more. When humans suffered from some ailment, he found herbs useful in curing it. It has been confirmed by now that plants have many compound and chemicals which have defined role in curing many diseases. Such plants having some or other kind of healing property in them are known as medicinal plants.

According to an estimate, there are about 2,50,000 higher plant species on earth with about 80,000 species with some or other medicinal values. Our country is one of the world's 12 mega biodiversity centers with the presence of over 45000 different plant species. The high diversity of plants in our country is mainly attributed to the presence of 16 different agro-climatic zones, 10 vegetation zones, 25 biotic provinces and 426 biomes. It has been recorded that about 7000-7500 plant species have been in use for its indigenous medicinal uses by the traditional communities. There are many traditional systems of medicine prevailing in India since time immemorial such as Unani, Ayurveda and Amchisince ancient times. These all systems were based on herbal based medicines by using the whole plant or different part of the plants such as leaves, stem, bark, root, flower, seed, etc.

In this unit, we will be learn about medicinal plants, their local names, scientific names and families they belong to. Further, we will also discuss the various classifications of medicinal plants and also the various uses of medicinal plants found in India.

## 14.2 Medicinal Plants and their classification

According to World Health Organization (WHO), 2008, medicinal plants are defined as, "plants that contain properties or compounds that can be used for therapeutic purposes or those that synthesize metabolites to produce useful drugs".

Medicinal Plant are classified according to the part used, habit, habitat, therapeutic value etc, besides the usual botanical classification. The various ways medicinal plants are classified have been described as follows (Based on PP Joy et al 1998):

**1. Classification Based on part used**

i) **Whole plant:** *Boerhaavia diffusa*, *Phyllanthus neruri*

**ii) Root:** *Dasamula*

**iii) Stem:** *Tinospora cordifolia*, *Acorus calamus*

**iv) Bark:** *Saraca asoca*

**v) Leaf:** *Indigofera tinctoria*, *Lawsonia inermis*, *Aloe vera*

**vi) Flower:** *Biophytum sensityvum*, *Mimuso pselenji*

**vii) Fruit:** *Solanum species*

**viii) Seed:** *Datura stramonium*

**2. Based on habit**

**i) Grasses:** *Cynodon dactylon*

**ii) Sedges:** *Cyperus rotundus*

**iii) Herbs :** *Vernonia cineria*

**iv) Shrubs:** *Solanum species*

**v) Climbers:** *Asparagus racemosus*

**vi) Trees:** *Azadirachta indica*

**3. Based on habitat**

**i) Tropical:** *Andrographis paniculata*

**ii) Sub-tropical:** *Mentha arvensis*

**iii) Temperate:** *Atropa belladona*

**4. Based on therapeutic value**

**i) Antimalarial:** *Cinchona officinalis, Artemisia annua*

ii) **Anticancer:** *Catharanthus roseus*, *Taxus baccata*

iii) **Antiulcer**: *Azadirachta indica, Glycyrrhi zaglabra*

**iv) Antidiabetic:** *Catharanthus roseus, Momordica charantia*

v) **Anticholesterol**: *Allium sativum*

**vi) Anti-inflammatory**: *Curcuma domestica, Desmodium gangeticum*

**vii) Antiviral:** *Acacia catechu*

viii) **Antibacterial:** *Plumbagoindica*

ix) **Antifungal:** *Allium sativum*

x) **Antiprotozoal:** *Ailanthus sp*., *Cephaelis ipecacuanha*

**xi) Antidiarrhoeal:** *Psidium gujava, Curcuma domestica*

xii) **Hypotensive:** *Coleus forskohlii, Alium sativum*

xiii) **Tranquilizing:** *Rauvolfia serpentina*

xiv) **Anaesthetic:** *Erythroxylum coca*

**xv) Spasmolytic:** *Atropa belladona, Hyoscyamus niger*

**xvi) Diuretic:** *Phyllanthus niruri, Centella asiatica*

**xvii) Astringent:** *Piper betle, Abrus precatorius*

**xviii) Anthelmentic:** *Quisqualis indica, Punica granatum*

**xix) Cardiotonic:** *Digitalis sp., Thevetia sp.*

**xx) Antiallergic:** *Nandina domestica, Scutellaria baicalensis*

**xxi) Hepatoprotective:** *Silybum marianum, Andrographis paniculata*

**5. Based on Ayurvedic formulations in which used**

**a) The ten roots of the Dasamoola (Dasamoolam)**

i) *Desmodium gangeticum* (Orila)

ii) *Urariala gopoides* (Cheriaorila)

iii) *Solanum jacquinii* (Kantakari)

iv) *Solanum indicum* (Cheruchunda)

v) *Tribulus terrestris* (Njerinjil)

vi) *Aegle marmelos* (Koovalam)

vii) *Oroxylum indicum* (Palakapayyani)

viii) *Gmelina arborea* (Kumizhu)

ix) *Steriospermum suaveolens* (Pathiri)

x) *Premnas pinosus* (Munja)

b) The ten flowers of the Dasapushpa (Dasapushpam)

i) *Biophytum sensitivum* (Mukkutti)

ii) *Ipomea maxima* (Thiruthali)

iii) *Eclipta prostrata* (Kayyuniam)

iv) *Vernonia cineria* (Poovamkurunnil)

v) *Evolvulus alsinoides* (Vishnukranthi)

vi) *Cynodon dactylon* (Karuka)

vii) *Emelia sonchifolia* (Muyalcheviyan)

viii) *Curculigo orchioides* (Nilappana)

ix) *Cardiospermum halicacabum* (Uzhinja)

x) *Aerva lanata* (Cherula)

c) The four trees of the Nalpamara (Nalpamaram)

i) *Ficus racemosa* (Athi)

ii) *Ficus microcarpa* (Ithi)

iii) *Ficus relegiosa* (Arayal)

iv) *Ficus benghalensis* (Peral)

d) The three fruits of the Triphala (Thriphalam)

i) *Phyllanthus emblica* (Nellikka)

ii) *Terminalia bellerica* (Thannikka)

iii) *Terminalia chebula* (Kadukka)

## 14.3 Important Himalayan Medicinal Plants

Indian Himalayan Region (IHR) is a treasure house of medicinal plants. As many as 1648 medicinal plants have been reported from IHR (Samant et al.,1998). Some of the important medicinal plants are described in details:

### 14.3.1. Black Pepper

**Botanical Name:** *Piper nigrum* Linn.
**Family:** Piperaceae
**English:** Black Pepper
**Ayurvedic names:** Maricha, Vellaja, Uushna, Suvrrita, Krishnaa

**Origin and Distribution:** Black pepper is grown in many tropical regions of the world viz., Brazil, Indonesia and India. It is native to India and Indo-Malaysian region. Now, due to its commercial value, it has been under cultivation in Western Ghats, Karnataka, Maharashtra, Assam and Kerala.

**General Description**: *Piper nigrum* is one of the popular plant used in almost all families as spices as well as for its medicinal values. On account of its most common use as spices, it is known as "**The King of spices**". It is a woody perennial climbing vine growing up to 9 m (30 ft) or more in length. The rootlets arise at the nodes of the stem. The upper side of the leaves is dark green whereas lower side is pale green. The leaves are glossy, ovate and acutely tipped. Leaf size ranges from 12–24 cm. Inflorescence type is spikes or catkins and bear minute white coloured flowers. Each flower spike produces approximately 50–60 single-seeded dark red berries, approximately 4-6 millimeters in diameter, always appear on stems opposite the leaves. Fruits are spherical and lustrous red when ripen. The fruits are categorized as drupe. Seeds are almost spherical. It has been recorded that India is the largest producer (average 191,000 tonnes per annum) whereas Thailand has the highest productivity in terms of kg per ha is (3595 kg per ha).

**Medicinal Uses**: The plants has many medicinal uses as listed below:

- The fruit is stimulant, carminative, diuretic, anti-asthmatic

- It is used in fevers, dyspepsia, flatulence, indigestion and as mucous membrane and gastro-intestinal stimulant.
- Externally, it is stimulant to the skin
- Used as a gargle for sore throat
- Used with ginger and *Piper longum*for viral hepatitis
- The fruit yields piperine, piperatine and piperidine; amides, piperyline, piperoleins A &B, and N-isobutyl-cicosa-trans-2-trans-4-dienamide

**14.3.2. Pippali**

**Botanical Name:** *Piper longum* Linn.

**Family:** Piperaceae

**English:** Indian Long Pepper, Joborandi

**Ayurvedic names:** Pippali, Maagadhi, Maagadha, Maagadhaa, Maagadhikaa, Magadhodbhavaa, Vaidehi

**Origin and Distribution**: It is native of Indo-Malaya. It is now widely distributed in India, Nepal, Indonesia, Malaysia, Sri Lanka, Rhio, Timor and Philippines (Farooqui and Sreeramu 2001). In India it is found in Asom, Khasi Hills, lower hill of West Bengal, eastern Uttar Pradesh, Madhya Pradesh, Maharashtra and evergreen forests of Western Ghats in Kerala, Karnataka and Tamil Nadu. It is widely grown in Andhra Pradesh and Andaman and Nicobar islands.

**General Description:** Long pepper is a semi-erect or climber shrub. It is glabrous with slender branches. The branches are often of creeping type or trailing type. Leaves are simple, alternate, stipulate and petiolate or sessile at the upper end of the stem. The leaf lamina varies in shape over the same plant. The leaf is ovate or ovate oblong, acute, most often unequal sided or unequally cordate at base while the lower ones are usually cordate. All the leaves are entire, glabrous, membranous or slightly succulent and five to seven ribbed from the base. Inflorescence is spike with unisexual (dioecious), small, densely packed flowers and form very close clusters of small grayish green or darker grey berries. The female stalk is shorter than that of male stalk, which elongates during maturation. The stalk of female spike is thick in contrast to the male spike, which is slender.

**Chemical Composition:** Alkaloids piperine (4-5%) and piplartin have been reported in long pepper. Other alkaloids also have been reported which are designated as piperolactam a, piperolactam b and pellitorine. These have been isolated from the cold ethanol extract of long pepper (Desai et al. 1988). Piper longumine (0.2 - 0.25%) is also reported in fruits. Further purification yielded six other alkaloids which are cepharadione b, cepharadione a, cepharanone b aristolactum, all- norcepharadione b, 2 hydroxy 1 methoxy 4 and h dibenzoquinoline -4, 5 (6 h) dione.

**Medicinal Uses**: The main plant parts which are used for medicinal purposes are fruits, roots, stem, female spike (dried spikes) and leaves. The various medicinal used described in literature are as follows:

- The root is used for stomachic, laxative, anthelmintic, carminative, improves the appetite, useful in bronchitis, abdominal pains, diseases of spleen and tumours.
- The ripe fruit is sweetish, pungent, heals stomach, aphrodisiac, laxative, diarrhoeic and antidysentric.
- In ayurveda, it is used for treating ‘vata’ and ‘kapha’ asthma, abdominal complaints, bronchitis, leucoderma, fevers, tumours, urinary discharges, piles, diseases of the spleen, pains, inflammations, leprosy, insomnia, hiccoughs, jaundice, and tuberculous glands.
- The root and fruit both are used in lumbago and gout.
- In unani system, the fruit is used as the tonic of liver, for stomachic, emmenagougue, abortifacient, aphrodisiac, diuretic, digestive, general tonic, useful in inflammations of the liver, pains in the joint, lumbago, and night blindness.
- It is prescribed after parturition to induce the expulsion of the placenta. ® The dried immature spike and the matured root in the

form of decoction are extensively used in acute and chronic bronchitis and cough for getting gradual relief.

- Long pepper with ginger, mustard oil, butter milk and curds make an ointment for sciatica and paralysis.
- The roasted spikes are beaten up with honey and are given for treating rheumatism in Konkan (Maharashtra).
- Long pepper is a useful remedy in veterinary medication.

### 14.3.3. Cardamom (Small cardamom)

**Botanical Name:** *Elettaria cardamomu*m Maton. (Small cardamom)

**Family:** Zingiberaceae

**English:** Lesser Cardamom

**Ayurvedic Name:** Elaa, Sukshmailaa, Kshudrailaa, Bhrngaparnikaa, Tutthaa, Draavidi

**Distribution:** Cultivated either as pure plantation crop, or as subsidiary to coffee and arecanut in hilly forests regions of Western Ghats in Karnataka and Kerala, and in parts of Madurai, the Nilgiris and Tirunelveliin Tamil Nadu

**General Description:**Cardamom is a valuable spice that is obtained from the seeds of a perennial plant (*Elettaria cardamomum*). Cardamom originates from the coastal area of India. Cardamom is known as the "**Queen of Spices**". It is one of the highly priced spices in the world. It is a perennial tropical herb plant belonging to the ginger family (Zingibaraceae) and grows up to 6-10 feet.

There are two main types of cardamom, the small green cardamom (*Eletteria cardamomum*) and large red/black cardamom (*Amomum subulatum*Roxb). However, the most common type is the small green cardamom which is generally produced in the tropical regions of the world. Largest cardamom producer of the world is Guatemala followed by India.

**Medicinal Uses:** Cardamom possesses the following medicinal properties:

- It is antispasmodic (neuromuscular), aphrodisiac, expectorant, anthelminthic, antibacterial (variable), cephalic, cardio tonic, diuretic, emmenagogue, stomachic, carminative, anti-emetic, stomachic, anti-asthmatic
- Oil is antispasmodic, antiseptic, used for flatulence, loss of appetite, colic, bronchitis, asthma.
- Paste used as balm for headache and husk for rheumatism

**Note:** The large cardamom also belongs the same family but is different to the small cardamom. The botanical name of large cardamom is *Amomum subulatum* Roxb. It is mainly grown in India, Nepal and Bhutan. India is the largest producer with more than 85% of the production of India comes from Sikkim. It is also called greater Indian or Nepal cardamom, which is a native of the Eastern Himalayan region. Large cardamom is the most important perennial cash crop of the region and is widely cultivated with Himalayan alder (*Alnus nepalensis*) as a shade tree. Large cardamom is also known as **'black cardamom'**. The pods are used as a spice, in a manner similar to the green Indian cardamom pods, but it has a drastically different flavour, so it cannot be substituted in the same recipes, unless a different flavor is acceptable. Unlike green cardamom, this spice is used rarely in sweet dishes. Its strong, smoky flavour and aroma are derived from the traditional drying procedure, which involves drying over open flames.

### 14.3.4. Clove (Laung)

**Botanical Name:** *Syzygium aromaticum* (Linn.) Merr.&Perry. Syn. *Eugenia aromatic* Kuntze

**Family:** Myrtaceae

**English:** Clove

**Ayurvedic Name:** Lavanga, Devakusum, Devapushpa, Shrisangya, Shriprasuunaka

**Distribution:** The clove tree is frequently cultivated in coastal areas up to an altitude of 200 m amsl.

**General Description:** The "Clove" literally means the symbol of dignity. It is a precious and valuable spice of the world. It is an unopened flower bud growing on a tree belonging to the guava family. It is an evergreen tree, which grows to a height ranging from 8-12m, having large square leaves and sanguine flowers in numerous groups of terminal clusters. The flower buds are at first of a pale color and gradually become green, after which they develop into a bright red, when they are ready for collecting. The production of flower buds, which is the commercialized part of this tree, starts after 4 years of plantation. Flower buds are collected in the maturation phase before flowering. The flower buds are at first of a pale color and gradually become green, after which they develop into a bright red, when they are ready for collecting. Cloves are harvested when 1.5–2 cm long, and consist of a long calyx, terminating in four spreading sepals, and four unopened petals, which form a small ball in the center.

Cloves are the aromatic dried flower buds, which are commonly used in various Indian food preparations (cuisines) such as biryanis, pickles, salads and is an important ingredient of Garam masala. Clove buds possess intense fragrance and burning taste. They have deep brown color, powerful fragrant odour which is warm, pungent, strongly sweet and slightly astringent.

**Medicinal Uses:** It has many medicinal properties. It is carminative, anti-inflammatory, antibacterial, anti-emetic and stimulant. It is also used in dyspepsia and gastric irritations. The oil is obtained from the flower bud which is employed as a local analgesic for hypersensitive dental lines and carious cavities.

#### 14.3.5. Ginger

**Botanical Name:** *Zingiber officinale* Rosc.

**Family:** Zingiberaceae

**English:** Ginger

**Ayurveda Name:** Aardraka, Aadrikaa, Shrngibera, shrngavera, Katubhadra

**Distribution:** Native to Southeast Asia and now in cultivation mainly in Andhra Pradesh, Kerala, Maharashtra, Uttarakhand, Uttar Pradesh and WestBengal

**General Description:**

**Medicinal Uses:** The rhizome of the plant is used as anti-emetic, anti-flatulent, hypocholes terolaemic, anti-inflammatory, anti-spasmodic, expectorant, circulatory stimulant and diaphoretic. It is also used in irritable bowel, diarrhoea, cold and influenza. Showed encouraging results in migraine and cluster headache.

The Ayurvedic Pharmacopoeia of India recommends dried rhizomes in dyspepsia, loss of appetite, tympanitis, anaemia, rheumatism, cough and dyspnoea; fresh rhizomes in constipation, colic, oedema and throat infections.

### 14.3.6. Turmeric (Haldi)

**Botanical Name:** *Curcuma longa* Linn. Syn. *C. domestica* Valeton.

**Family**: Zingiberaceae

**English**: Turmeric

**Ayurvedic Name:** Haridraa, Priyaka, Haridruma, Kshanda, Gauri,

**Distribution:** Cultivated all over India, particularly in Maharashtra, Tamil Nadu and West Bengal. It is a native of the Indo-Malayan region, distributed throughout tropical and subtropical regions of the world, being widely cultivated in Asiatic countries, mainly in India and China.

**General Description:** In India is popularly known as “Haldi” It is a perennial herbaceous plant, mostly cultivated in the tropical parts of the India. It grows up to a height of 1 m but has a short stem. The leaves are large which may attain a size up to 1 m long. Leaves are petiolate, oblong, and lanceolate, with blade up to 52 cm long and 8.5 cm wide. Flowers are yellow white in colour and originate during June to November on a spike. It can be propagated by vegetative means by rhizomes. Its rhizomes are oblong, ovate, pyriform, and often short-branched.

**Medicinal Uses**

- It is a household remedy and may be used as Anti-inflammatory, cholagogue, hepato-protective, blood-purifier, antioxidant, detoxifier and regenerator of liver tissue, anti-asthmatic, anti-tumour, anti-cutaneous, antiprotozoal, stomachic and carminative.
- It also reduces high plasma cholesterol.
- Its antiplatelet activity offers protection to heart and vessels. Also offers protection against DNA damage in lymphocytes.

### 14.3.7. Betel vine

**Botanical Name:** *Piper betle* Linn.

**Family:** Piperacee

**Ayurvedic Name:** Taambula, Naagvallari, Naagini, Taambulvalli, Saptashiraa, Bhujangalataa.

**English:** Betelpepper

**Distribution:** The plant is under cultivation in warmer and damper parts of India such as Assam, Bihar, Karnataka, Kerala, Uttar Pradesh and West Bengal.

**General Description:** The betelvine is known as ‘pan’. Betelvine is a perennial, dioecious, evergreen climber that is grown in tropics and subtropics for its leaves that are used as a chewing stimulant. The vine spreads readily on account of rooting from the stems where it touches the ground. It has glossy and heart-shaped leaves. The leaves are alternate, entire, 5 to 10 cm long and 3 to 6 cm broad. The small flowers are produced on pendulous spikes at the leaf nodes. Betelvine leaves and stem have pungent aromatic flavour. Betel leaves chewing is considered as source of dietary calcium. Betel oil has several medicinal uses.

**Medicinal Uses:**

- Leaves of the plant are stimulant, carminative, astringent, antiseptic
- Essential oil from leaves is antispasmodic, antiseptic and used in respiratory catarrhs
- The leaves contains beta and gamma-sitosterol, hentriacontane, pentatriacontane, n-triacontanol, stearic acid and chavicol.
- The essential oil from leaves contained carvacrol, eugenol, chavicol, allyl catechol, cineole, estragol, caryophyllene, cardinene, pcymeneandeugenol methyl ether.

### 14.3.8. Periwinkle (Sadabahaar)

**Botanical Name:** *Catharanthus roseus* (L.)G.Don. Syn. *Vinca rosea* L.

**Family:** Apocynaceae

**English:** Madagascar Periwinkle

**Origin and Geographical Distribution**: It is a native to Wes Indies and Island of Madagascar in Indian Ocean region. It is now common in many tropical and subtropical regions of the world mainly in India, China, Indonesia, Israel, Madagascar, Philippines, South Africa, and USA. In India, it is extensively cultivated in the states of Tamil Nadu, Karnataka, Gujarat, Madhya Pradesh and Assam.

**General Characteristics:** It is an erect, perennial and evergreen herb. It is highly branched and attains the height of up to 1 m. The leaves are oblong or obviate, opposite, short petiolated, smooth with entire margin. The lower surface of leaf is light green coloured with prominent veins. Leaves are arranged in the opposite pairs. Flowers are white to dark pink with a dark red center known as eye. Flowers are borne on axils in pair. The calyx is linear-subulate. The corolla tube is cylindrical measuring about 30 mm in length. Anthers are epipetalous present on a short filament. The bicarpellate ovary is basally distinct with fused common style and stigma, which is ascribed to post genital carpel fusion (Walken 1975). The fruit is dehiscent, it consists of a pair of follicles containing up to 30 linearly arranged seeds with a thin black tegument.

**Chemical constitution:** This plant has largest number of alkaloids in the plant kingdom (Hui-Lin Li and Willaman 1972). Constable et al (1981) and Balsevich et al (1988) detected 60 alkaloids from leaves by means of supercritical fluid chromatography and mass spectrometry. Most important are Vincristine and Vinblastin. Root is found to have ajmalcine and serpentine. Four alkaloids possessing antibacterial activities are extracted from leaves. Moreover there are also two glycosidal principles, urosolic acid, leurosine, isoleurosine, previne, mitaphylline, lochnevin and perosine (Chatterjee, 2000).

**Medicinal Uses:** Alkaloids are the most potentially active chemical constituents of the plant. More than 400 kinds of alkaloids are present in the plant, which are used in pharmaceuticals, agrochemicals, flavor and fragrance, ingredients, food additives and pesticides. Whole plant is used for medicinal purposes. Some of the important uses are as follows:

- Root alkaloids **Ajmalcine** and Serpentine are used for allopathic medicines for cure of hypertension and other diseases.
- Leaf alkaloids **Vincristine and Vinblastin** are used in allopathic medicine to treat blood cancer.
- Leaves are used for curing diabetes, menorrhagia and wasp stings.
- Roots are used as tonic, for stomach ache, sedative and tranquilizer.
- There was a discovery of anti-neoplastic activities of a leaf alkaloid by Nobel etal (1958).
- The cytotoxic dimeric alkaloids are used for the treatment of certain type of cancer.

### 14.3.9. Rauvolfia

**Botanical Name:** *Rauvolfia serpentine* Benth.exKurz.

**Family:** Apocynaceae

**English:** Rauvolfia root, Serpentina Root, Indian Snake root

**Origin and Geographical Distribution:** It is indigenous to the moist, deciduous forests of south-east Asia which includes Bangladesh, Burma, Malaysia, Sri Lanka, Indonesia and the Andaman Islands. It is distributed in India, Nepal, Burma, Thailand, Bangladesh, Indonesia, Cambodia, Philippines and Sri Lanka. In India it occurs naturally in the foothills of Himalayan range. From Himalayan foothills it is distributed from Sal forest in north-west near Yamuna river, to the lower ravines of Asom and Meghalaya to the elevation of 1300-1400 m, via Shiwalik ranges of Shimla and Dehradun, eastern U.P, Bihar, Nepal, eastward of Sikkim, foothills of Darjeeling and Jalpaiguri reserves forests of north Bengal. It is also available in Andaman Island, Western Ghats tract in Konkan, slopes of Annamalai hills of Tamil Nadu and south- west coast in Kerala state. The plant is also distributed sporadically in Andhra Pradesh, Bastar forests of Madhya Pradesh, Odisha and Chota Nagpur of Bihar (Dutta and Virmani, 1964; Sulochna, 1959). At present it is being cultivated in U.P., Bihar, T.N., Odisha, Kerala, Assam, West Bengal and Madhya Pradesh. Thailand is now the chief exporter of Rouvolfia alkaloids. Zaire, Bangladesh, Sri Lanka, Indonesia and Nepal are also small exporters (Guniyal et al. 1988 and Sarin, 1982). *Rauwolfia serpentina* or Sarpaghandha is also distributed in the foot -hill of Himalayan, up to the elevation of 1300–1400 m.

**General Characteristics:** Rauwolfia is an evergreen and perennial shrub. It can attain the maximum height of 60 cm. The roots are tuberous with pale brown cork. The leaves are in three whorls. They are elliptic to lanceolate or obvate. Lower leaf surface is pale green whereas upper surface is bright green in colour. It bears white flowers often tinged with violet colour. Flowers are irregular corymbose cymes. In Indian conditions, it flowers during March to May. The fruits are drupe, single or didymous.

It is an erect evergreen perennial under shrub with a cluster of branches (2 - 6) arising from the root. Leaves are simple having short petiole, it is glandular at the base, glabrous and bright green when young but becomes pale yellow before shedding. Leaf shape is elliptic-lanceolate and occur in whorl of 3 - 5 but may be opposite, particularly at the base of the stem. Leaf apex is acute to acuminate. Inflorescence is terminal or sometimes axillary. The flowers are abundant and form an inflorescence in compact cymes, forming a hemispheric head at the end of a long peduncle. Flowers are small, pedicellate and hermaphrodite. Calyx is glabrous, five-lobed and deep red. Petals are five in number, gamopetalous and white. Corollas are tubular and swollen in the middle. Stamens are 5, epipetalous, enclosed within the dialated portion of corolla tube. Carpels are 2, connate, style filiform and stigma large. Fruits are drupe, obliquely ovoid and purplish black in colour when gets matured. Seeds are ovoid and wrinkled. The main root grows upto 40-60 cm deep into the soil. Root is prominent, tuberous, usually branched. Outer bark of the root is corky with irregular longitudinal fissures and posseses high alkaloid concentration. Thin branches have more alkaloid content.

**Chemical constituents:** The roots of *Rovwolfia* are reported to have more than 20 alkaloids, of these reserpine, rescinnamine, deserpidine, ajmaline, alstonine, neoajamaline, serpentine and alpha- yohimbine are pharmacologically important alkaloids. The extraction of alkaloid depends on the age of plant, the time of harvest, ecological condition of growth and also on the handling of material, ie. drying and storage.

**Medicinal Uses:** Roots, leaves and seeds are the main plant parts employed for the treatment of various ailments. Some important medicinal uses of the plant are as follows:

- The roots of this plant is used as sedative, to control high blood pressure and certain form of insanity.
- In ayurvedic system of medicine, roots of the plant are used for the treatment of insomnia, epilepsy, asthma, acute stomachache and painful delivery of child and also high blood pressure and insanity.
- It is an antidote for snakebites
- It is often employed to treat anxiety, insomnia, and insanity. In fact, in parts of India, *R. serpentina* is known as "**pagal-ka-dawa**" which translates to "the insanity cure."
- Other local cultures are the plant used as a relaxant and as a tranquilizer to put children to sleep for the night.
- The alkaloid reserpine isolated from the root is considered a sympathomimetic agent, one that targets the sympathetic nervous system.
- Reserpine has been found to lower blood pressure in remarkably low oral doses. CIBA, a pharmaceutical company based in Switzerland, marketed reserpine under the trade name Serpasil as the first major drug to treat hypertension. (In 1996, CIB A combined with Sandoz Pharmaceuticals, another Swiss company, and now exists under the new name Novartis.)
- Extracts from the root are used for the treatment of intestinal disorders, like diarrhea and dysentery
- It is used in common treatment for hypertension by generalized vasodilatation and thus, lowering of blood pressure on the vasomotor centre,
- It soothes the general nervous system by depressant action on the cerebral canters and therefore, used in insomnia and also in various central nervous system disorders, both physical and motor, including anxiety states, excitement

- It stimulates the bronchial musculature

### 14.3.10. Dioscorea

**Botanical Name:** *Dioscorea deltoidea* Wall. Ex Griseb

**Family:** Dioscoreaceae

**English Name:** Wild yam, Elephant's foot

**Geographical Distribution**: It is distributed throughout the tropical and subtropical regions in the world, mainly in West Africa, parts of Central America and the Caribbean, Pacific islands and South East Asia (Anand, 2011). In Asia, the plant is found mainly in Cambodia, Bhutan, Afghanistan, China, Pakistan, India (Western Himalaya), Nepal, Vietnam and Thailand.

Its habitat is found ranging from 450 to 3100 m altitude. In Himalayas it is found at altitude of 29000 feet (Gopichand et al., 2013). It is found in forest clearings, shrubberies, slopes and rocky substrates.

**General Description:** *Dioscorea deltoidea* is a perennial climber. Mostly it is found growing upto 3m (10 ft) in height. It is a hairless vine that is twinning clockwise. Rhizomes are ligneous (resembling wood), irregular, horizontal and alternately arranged. They may resemble ginger like shape. Stem is also twining, drying and have a purplish brown to brown groove. Leaves are alternate, simple, 5-11.5cm long and 4-10.5cm broad (Saikia et al., 2011). Morphology of leaves show that they are triangular ovate, long pointed, often heart-shaped, 7- 9 nerved, hairless on upper side and velvety on the nerves beneath. Leaf stalks are slender, 5- 10cm long. Flowers usually are small, distant in clusters with 6 stamens and inferior anthers. Male flower spikes are solitary in leaves axils. They may be simple or sometimes branched slender, 7.5-25cm long. Female flowers are stalked, solitary and slender up to 15cm long. Capsule usually may be reflexed brown at maturity and purplish brown spots are observed.

**Medicinal Uses:**

- It acts as a vermifuge (worm repellent) for children specially. Its roots are found being active against uterine sedative.
- It is also used as bio-poison for fishes
- Its tubers are employed to treat bilious colic and to kill lice
- Its roots contain good amount of diosgenin used as starting material for hormone preparation.
- It is also used in soap making due to its saponin content. Studies indicate that it was used to wash clothes as detergent because of saponins present in this species.
- Traditionally *D. deltoidea* is found to be anti-rheumatic and treat ophthalmic conditions
- Jain (1975) and Kumari et al. (2012) has reported that the rhizome powder is taken orally to cure dysentery, abdominal pain and piles

**14.3.11.Isabgol**

**Botanical Name:** *Plantago major* Linn.

**Family:** Plantaginaceae

**English Name:** Broadleaf Plantain

**Origin and Geographical Distribution**: It has its origin from Eurasia (Persia)but is now naturalized almost throughout the world. It has its distribution in west Asia, westwards to Sind, Baluchistan, Spain and the Canary Islands. (Kirtikar and Basu, 1953). In its wild form, it grows from sea level to 3500 m altitude (Sagar& Harper, 1964). It is also found in southern Spain and north Africa, Canary islands, Tasmania, Australia, Mexico and Turkmenistan. Commercial cultivation in India is done in north Gujarat, southern Rajasthan, in some places of Madhya Pradesh, Punjab and Haryana. The species is a common weed in most of the agricultural areas of the world including the places where tropical crops are grown (Anderson, 1999)

**General Description**: It is a small annual plant having a short, stout and erect herbaceous stem of about 30 cm tall. Tillers arise from the base of the plant. There is a rosette of leaves on each tiller. The leaves are narrow, finely acuminate, entire or distantly toothed, attenuated at base, usually 3 nerved. Inflorescence are either shorter or longer than leaves arising in the leaf axils and bear ovoid or cylindrical terminal spikes with sessile flowers subtended by a bract and arranged in a dense spiral. The bracts are 4 mm long and broadly ovate, concave, membranous and glabrous. The sepals have herbaceous midrib bordered by wide, membranous wings similar to that of bracts. Corolla is colourless, but midveins are often coloured brownish or red. The lobes are narrow to broadly oval. Style and filament are colourless or pink to dark red. The style is lengthier than stamens and protogynous. Ovary is superior, 2 celled with a single ovule in each cell. Seeds are albuminous with oily endosperm and straight embryo. They are deeply concave and are broadly elliptical to ovate or boat shaped. Length varies from 2-3.5 mm and width of 1-1.5 mm. It is pale brown to moderate brown with a dull surface. The convex surfaces have a small and elongated glossy brown spot. This spot is surrounded by a white portion extending to the concave surface and is called husk. The concave surface has a deep cavity in the centre of the base on which is present a hilum covered with a thin membrane (Osol and Ferrar, 1960). Root is a tap root which is 20-30 cm deep with many lateral roots which are almost perpendicular to tap root.

**Chemical constituents:** Seeds contain protein, a fixed oil, mucilage, some cellulose and traces of starch (Anon., 1968). A glycoside named aucubin was isolated from the plant and reported to be pharmacologically inactive (Chopra et al. 1958). A sugar called plantiose was also isolated. Seeds contain pale yellow oil (11.42%), large amount of mucilaginous matter, inorganic ash and reducing sugar. The oil contains both saturated and unsaturated fatty acids. Saturated acids are composed of 32.77% palmitic, 60.37% stearic 6.80% lignoceric acid (Pendse, 1973). The seed during extraction with water yield mucilage, its constituents are d-xylose, 1-arabinose, d-galacturonic acid and 1-rhamnose (Smith and Montagomery, 1959). The husk is found to have a polysaccharide with a polyxylose backbone and pectin like compound containing galactouronate and rhamnose. The composition of these basic components may vary from species to species (Salyers et al. 1978). Isabgol oil is the by-product of isabgol husk and is found to have high protein with good amount of limiting essential amino acids. The content of oil is not much (8.6%), but its oleic or linoleic acid ratio (1: 27) ensures that it is good grade edible oil (Anon. 1989).

**Medicinal Uses:** Seeds and husk obtained from the seed. The various uses are as follows:

- The seeds are used as the demulcent, for cooling, for inflammatory and bilious derangements of the digestive organs.
- Seeds are also used as poultice to rheumatic and gonuty swelling.
- Decoction is used for curing cough and chronic diarrhoea.
- It is used for curing dysentery and irritation of intestinal tract.
- It stimulates the intestinal peristalsis mechanically by swelling up, on coming into the contact of water and this way it relieves the chronic constipation.
- The husk acts as an anti-diarrhoeal drug. It is good in chronic dysenteries of amoebic and bacillary origin. It is also beneficial in treating constipation and intestinal disorders.
- Leaves— cooling, astringent, diuretic, vulnerary, febrifuge. Used for diarrhoea, bacillary dysentery, hepatitis, urinary diseases, piles, ulcers and skin diseases. Leaves are used for cystitis with blood, haematuria and other bladder disorders

**14.3.12.Honey Plant**

**Botanical name:** *Ammi majus* Linn.

**Family:** Apiaceae (Umbelliferae)

**English Name:** Biship's Weed-Amee, Greater Ammi

**Origin and Geographical Distribution:** It originated in Egypt and grew in the Nile Valley especially Behira and Fayoom. It is found distributed in the basin of Mediterranean sea in Syria and Palestine. It is also found in some regions of Iran and the mountains of Kohaz (Ramadan, 1982). It is found wildly in Abbottabad, Mianwali, Mahran, Lahore and also in Europe, West Africa and Abyssinia. In India it is cultivated on an experimental scale in the places like Uttar Pradesh, Gujarat and Tamil Nadu. In India with the courtesy of UNESCO in 1955, 2 species, i.e. Ammi majus and Ammi visnaga were introduced in the Forest Research Institute, Dehradun, Uttarakhand.

**General Description:** It is an annual herb of 0.80 to 1.2 m height. The plant stem is erect and solid. The leaves are compound, light green, alternate, pinnately divided having lanceolate to oval segments. The plant has axillary and terminal compound umbels of white flowers. The fruits are ribbed, ellipsoid, green or greenish brown when immature, but turn to reddish brown at maturity. The seed tastes bitter and extremely pungent. Its odour is characteristically terebinthinate, which becomes strong on crushing. The plant has a long tap root. Two varieties are found, ie Ammi majus L. var. Sutton's Monica and Ammi majus L var. Horticulture.

**Chemical constitution:** Fahmy and Abu-shady in 1947 isolated ammoidin. It was reported to have xanthotoxin, bergaptenis opimpinellin, isoimperatorin, oxypeucedanin, heraclenin, oxypeucedanin hydrate, This species is one of the richest known sources of linear furocoumarins. This furocoumarins when activated by sunlight acts as bactericidal, fungicidal, mollscicidal, larvicidal, nematicidal, insecticidal, ovicidal and viricidal, so it is considered as a natural pesticide. The fruit contains 1% of amorphous glucosidal principle, 0.45% tannin, 4.76% oleo resinous products, 3.2% of an acrid oily liquid, 12.92% fixed oil, 0.2% glucose, 13.83% proteins and 22.43% cellulose (Fahmy and Abu-Shady, 1947).

**Medicinal Uses:** The Flowers and fruits are the plant parts used for medical purposes. The important uses are as follows:

- The yellowish brown powder of fruit is prepared for use in the treatment of leukoderma (vetilago) since Atharva Veda (1400 BC).
- US (FDA) in 1982, approved it as a treatment for severe cutaneous psoriasis.

**14.3.13.Belladonna**

**Botanical Name:** *Atropaacuminata* Royle ex Lindl. Syn. *A. belladonna* auct. non L.

**Family:** Solanaceae

**English:** Indian Belladonna, Indian Atropa

**Geographical Distribution**: The plant is native to Europe, North Africa and Western Asia. In India, it is distributed in Kashmir and Himachal Pradesh up to 2500 m.

**General Description**: It is a branched herbaceous perennial herb attining a height of 6.0 ft. It has purplish stem, stout, undivided at the base but dividing a little above the ground into three to more, rarely 2 to 4 branches each of which branched freely. Roots are thick, fleshy, whitish, branched, about 6 inches long or more. Leaves 3 to 10 inches long, ovate, dull, darkish green, the lower solitary, the upper ones in pairs alternately from opposite sides of the stem, one leaf of each pair much larger than other, acute at apex, entire with short petiole, veins prominent in undersurface and depressed on upper surface. Plant is glabrous though soft downy hairs may occur in stems and leaves when they are young. Flowers solitary in the axil of leaves, dark and dingy purlish colour, tinged with green, about an inch long, pendent, bell shaped, furrowed, the corolla with 5 large teeth or lobes, slightly reflexed, flowering time from June to early September. Fruits berry and five-cleft calyx spreads round the base, shining black colour, full of dark inky juice, sweet and consumed by animals that disperse seeds, even though the seeds contain toxic alkaloids.

**Medicinal Uses**:

- Highly poisonous; sedative, narcotic, anodyne, nervine, antispasmodic (used in paralysis); parkinsonism; encephalitis; carcinoma; spastic dysmenorrhoea; whooping cough, spasmodic asthma; colic of intestines, gall bladder or kidney, spasm of bladder and ureters; contraindicated in enlarged prostate.
- Drops prepared from the plant are used to dilate the pupils of the eye.
- Traditionally used in the treatment of headache, menstrual symptoms, peptic ulcer, histamininc reactions, inflamations and motion sickness.
- Also used as sedative, stopping brochial spasm in asthama, whooping cough, also in cold and hey fever

### 14.3.14.Cinchona (Lojabark)

**Botanical Name:** *Cinchona officinalis* Linn. Syn. *C. robusta* How.

**Family:** Rubiaceae

**English:** CrownorLoxa Bark

**Ayurvedic**: Quinine

**Habitat:** Cultivated in West Bengal and Tamil Nadu.

**Geographical Distribution:**

**General Description:** It is an evergreen tree with an erect trunk rising up to a height of 15–25 m. Its bark is yellow in colour and the leaves are broad and smooth. The flowers are red, flowering takes place between May to August, and it bears fruit in autumn. The bark is grayish brown, thin, with many shallow fissures; branches flattened to sub-quadrangular, puberulentto hirtellous or glabrescent. Petiole 3– 20(–30) mm, glabrous or hirtellous or puberulent; leaf blade drying papery or thinly leathery, oblong-lanceolate, elliptic-oblong, or lanceolate, 7–16(–21.5) × 2.5–6(–11) cm, both surfaces glabrous or sparsely puberulent to hirtellous abaxially, base acute to cuneate, apex obtuse to rounded or rarely acute; secondary veins 7–11 pairs, usually with crypt domatia, these best developed in proximal part of blade; stipules 10–20 mm, glabrous to puberulent or hirtellous, obtuse to rounded. Inflorescences 5–23 × 5–18 cm, densely hirtellous to puberulent; bracts triangular, 0.5–3 mm; pedicels 1–8 mm. Calyx densely sericeous; ovary portion ellipsoid, 1.5–2 mm; limb 1–2 mm, sparsely puberulent, partially lobed; lobes ovate-triangular, 0.5– 1 mm. Corolla white, pale yellow, or pale pink, glabrous to puberulent outside; tube cylindrical, 5–9 mm, glabrous inside; lobes lanceolate, 3–4(–6) mm, acute. Capsules 8–30 × 3–8 mm, stiffly papery to woody, puberulent or pilosulous to glabrescent; seeds 3–10 × 1.6–3.7 mm (including wing). Fl. Jun–Feb

**Medicinal Uses:** Anti malarial, febrifuge, astringent, orexigenic, sapasmolytic. Also prescribed in amoebic dysentery, jaundice, atonic dyspepsia, night cramps. Sometimes causes gastric and intestinalirritation.

### 14.3.15. Indian Wild Liquorice

**Botanical Name:** *Abrus precatorius* Linn.

**Family:** Papilionaceae/Fabaceae

**English**: Indian Wild Liquorice, Jequirity, Crab's Eye, Precatory Bean

**Ayurvedic:** Gunjaa, Gunjaka, Chirihintikaa, Raktikaa, Chirmiti, Kakanti, Kabjaka, Tiktikaa, Kaakananti, Kaakchinchi

**Habitat:** Throughout the country, ascending to an altitude of about 1050 m in the outer Himalayas.

**General Description:** *Abrus precatorius* is a woody twinning plant with characteristic toxic red seeds with black mark at the base (5). It is native to India, at altitudes up to 1200 m on the outer Himalayas. It is now naturalized in all tropical countries (6). It is a beautiful, much-branched, slender, perennial, deciduous, woody, prickly twining or climbing herb. Stem cylindrical, wrinkled, bark smooth-textured, brown. Leaves stipulate, pinnately compound; leaflets 7-24 pairs, 0.6-2.5 x 0.4-1.2 cm, turgid, oblong, obtuse, truncate at both ends, appressed hairy. They are alternate and glabrous with many paripinnate leaflets arranged in pairs. Flowers in axillary racemes, shorter than leaves, fascicled on the swollen nodes, pink or pinkish-white; calyx-lobes short, appressed hairy. Pods 1.55.0 x 0.8-1.5 cm, turgid, oblong, appressed hairy, with a sharp deflexed beak, silky-textured, 3 to 5-seeded. Seeds elliptic to sub-globose, 0.5 cm in diam., smooth, glossy, shining red with black blotch around the hilum.

**Importance:**

- Uterine stimulant, abortifacient, toxic.
- Seeds—teratogenic. A paste of seeds is applied on vitiligo patches. Along with other therapeutic applications, The Ayurvedic Pharmacopoeia of India has indicated the use of seeds in baldness.
- Seeds contain abrin, a toxalbumin, indole derivatives, anthocyanins, sterols, terpenes. Abrin causes agglutination of erythrocytes, haemolysis and enlargement of lymph glands.

### 14.3.16. Vasaca

**Botanical Name:** *Adhatoda vasica* Nees. Synonym *A. zeylanica* M

**English Name:** Malabar Nut

**Family:** Acanthaceae

**Ayurvedic Name:** Vaasaa, Vaasaka, Vaasikaa, Simhaasya, Simhaparni, Simhavadanaa, Vaajidanta, Vrisha, Aataruushaka

**General description:** *Adhatoda vasica* Nees belongs to the medicinal family Acanthaceae. It is an evergreen shrub of 1-3 feet in height with many long opposite branches. Leaves are large and lance-shaped. Stem herbaceous above and woody below. Leaves opposite and exstipulate. Flower spikes or panicles, small irregular zygomorphic, bisexual, and hypogynous (Shinwari et al., 1995). It has capsular four seeded fruits. The flowers are either white or purple in colour. Its trade name Vasaka is based on Sanskrit name (Kumar et al., 2010). Inflorescences in axillary spicate cymes, densely flowered; peduncles short; bracts broadly ovate, foliaceous. The leaves, flowers, fruit and roots are extensively used for treating cold cough, whooping cough, chronic bronchitis and asthma, as sedative, expectorant and antispasmodic (Pandita et al., 1983).

**Medicinal Uses**

i) Expectorant (used in bronchial, asthmatic and pulmonary affections), antispasmodic, febrifuge.

ii) As bronchodilator, expectorant (Indian Herbal Pharmacopoeia.)

iii) The Ayurvedic Pharmacopoeia of India indicates its use in dyspnoea. The chief quinazoline alkaloid vasicine is reported in all parts of the plant, the highest being in inflorescence. It is a bitter bronchodilator, respiratory stimulant, hypotensive, cardiac depressant, uterotonic and abortifacient.

**14.3.17. Haldu**

**Botanical Name:** *Adina cordifolia* Hook.f.ex Brandis Syn. *Haldina cardifololia* Ridsdale

**Family:** Rubiaceae

**Habitat:** Indigenous in deciduous forests all over India

**English:** Yellow Teak, Saffron Teak

**Ayurvedic name:** Haridru, Haraduaakadamba, Gaur-kadamba

**General description:** It is a South East Asian species. It is distributed throughout India, Burma, Sri Lanka, Bangladesh, Nepal, Thailand, South China, Bhutan, Vietnam, Myanmar and Malaysia. It is found scattered in deciduous forests throughout the greater part of India, (except in arid regions of Rajasthan) ascending to an altitude of 900 m in the sub-Himalayan tract. It is also common in the forests of South India (Iqbal et al. 2009). It grows well under 300-1000m altitude and prefers well-drained soil. Suitable soil pH range is 5.5 to 6.5. The annual temperature requirement is within the range of $25^0$C-$35^0$C and prefers a mean annual rainfall between 1000-2000 mm (Tntreepedia, 2018). It is not frost tolerant. The tree grows in various geological formations such as granite, gneiss, schist, quartzite, trap and laterite up to an elevation of 1000 MSL (Kundu, 2018).

It is a large deciduous tree up to 40 m tall and 2.2m in diameter. Bark pale brown, horizontally wrinkled and cracked. Leaves opposite which are broadly oval in shape with heart shaped base and pointed tip (Kulkarni et al. 2015). Flowers are bisexual yellow in color in round heads, seeds many with tail at one end and bifid wings on other end. Generally flowering occurs during June–July and fruits ripen during December-March (Talbot,1976). The seeds are very small and light 0.06 to 0.12 in. long brown with numerous minute longitudinal wrinkles, one end tapering to a point, and the other terminating in a pair of pointed appendages. One gram of seeds contains as many as 11000 seeds (Troup 1921)

**Medicinal uses:** Antibacterial, antiseptic, antidysenteric, ant bilious (used in biliary colic), febrifuge. Root is astringent.

### 14.3.18. Bael

**Botanical name:** *Aegle marmelos* (L.) Correaex Roxb.

**Family:** Rutaceae

**English**: Bael tree

**Ayurvedic name**: Bilva, Shriphala,

**Habitat**: The plains and sub mountain regions of India, ascending to an altitude of 1200 m in the western Himalayas; cultivated all over India.

**General Description:** It is a small to medium sized thorny tree about 10-12 m in height. It is recorded growing in wild habitats in foot hills of Himalaya, Chattishgarh, Bihar, West Bengal, Central as well as South India. The fruit is woody, grey or yellowish, round, 5 - 17.5 cm in diameter, containing numerous seeds embedded in a mass of sweet, orange coloured aromatic pulp. The ripe fruit is sweet and cooling. It is used in the form of sherbet or for making jams and preserves.

**Medicinal uses:** Stomachic, antimicrobial (specific for diarrhoea, colitis, dysentery and enteric infections), digestive, astringent, spasmolytic, hypoglycaemic. Key application As antidiarrhoeal. (Indian Herbal Pharmacopoeia.) Along with other therapeutic applications, The Ayurvedic Pharmacopoeia of India indicates the use of root in dysuria; stembark in diabetes and lipiddis orders. A number of coumarins (including xanthotoxol and alloimperatorin methyl ether), flavonoids (including rutin and marmesin), alkaloids (including alpha-fagarine), sterols and essential oils have been isolated from plant parts. Pectin is an important constituent of the fruit. Alkaloid aegeline, present in the leaves, is efficacious in asthma. The active principle in aqueous extract of leaf shows hypo glycemic activity similar to insulin. Leaves are also given in jaundice. Alcoholic extract of seeds shows antiallergic activity. Marmin, a coumarin isolated from the roots, shows anti-inflammatory effects experimentally. Marmin also inhibited gastric haemorrhagic lesions in rats and exhibited antiulcer effects. Seed oil showed beneficial effects in regeneration of tumour cells. Aurapten is found to be the most potent inhibitor of heart rate. Root bark is used for palpitation of the heart.

**14. 3.19. Akarkara**

**Botanical name:** *Anacyclus pyrethrum* DC. syn. *A. officinarum* Hayne

**Family:** Asteraceae

**English**: Pellitory

**Ayurvedic name**: Aakaarakarabha, Aakallaka, Aakulakrit, Agragraahi

**Habitat**: Native to the Mediterranean region; cultivated in Algeria

**General Description:** A perennial procumbent herb bearing alternate and pinnate leaves; segments linear; ray florets white, purplish beneath, 3 much like chamomile in habitat and appearance, the root is brown, rough, shriveled surface, with the root bark closely adhering to the wood. They have a slight aromatic smell and persistent pungent test. The plant is native to North Africa, distributed in Mediterranean region, 3 it has been grown on an experimental scale at elevations of 900 m at Katra (Jammu and Kashmir), and Himalayan region from seeds imported from Algeria. The roots of the plant have long been imported into India for medicinal use.

It is a perennial herb with numerous spreading, prostrate or ascending branched stems, 19 more or less hairy in their upper portion, nearly smooth below, and coming from the crown from a long, tapering, vertical, brown, slightly branched root. Leaves alternate, the ones at the root crown long stalked, ovate or oblong in outline, deep bipinnatisect, segments linear, acute often again 2 or 3 fid, more or less hairy or nearly glabrous. Heads terminal, large, 1-1½ inch or more wide, with a wide disk; involucral scales in several rows, imbricated , ovate- lanceolate, varying in width, blunt or sub acute, smooth, pale green, bordered with an edge of brown; receptacle slightly convex, with large obovate rounded transparent scales beneath the flowers.

Disk flowers bisexual, corolla tubular, contracted below, with 5 equal triangular spreading teeth, yellow; style exerted, stigma bifid, with 2 linear branches. Ray flowers female in a single row, corolla ligulae, the limb broadly oval, trifid at the apex, white above, tinged with bright pink below. 5 The root as found in shops is simple, 3-4 inches long by 3/8 to 4/8 of an inch thick, cylindrical or tapering, some time terminated at the top by bristly remains of leaves and having only a few hair like rootlets, externally it has a brown, rough, shriveled surface, is compact and brittle, the fractured surface being radiate and destitute of pith which is almost obliterated, and internally radiating secondary wood occupying about 2/3 of total thickness particularly in older roots. The root is characterized with an aromatic odor and a persistence pungent test.

**Medicinal uses**: Stimulant, cordial, rub efficient. A gargle of infusion is prescribed for relaxed vulva. Root— used for toothache, rheumatic and neuralgic affections and rhinitis. Roots, along with the root of *Withania somnifera* and *Vitis vinifera, areusedin epilepsy.* Along with other therapeutic applications, Ayurvedic Pharmacopoeia of India indicates the use of the root in sciatica, paralysis, hemiplegic and amenorrhea. The root contains anacycline, isobutylamide, inulin and *atraceo fessential* oil.

The local anaesthetic activity of the alcoholic extract of the root was found to be comparable to that of xylocaine hydrochloride in dental patients. Use of the drug in patients with insulin-dependent diabetes mellitus reduces the dose of insulin. It decreased the plasma glucose and serum cholesterol levels after oral administration for3-6 weeks. (The plant is mixed with *Helleborus nigar* in a ratio of 1:3).

**14.3.20.Kalmegha**

**Botanical name:** *Andrographis panicultata* Wall.exNees

**Family:** Acanthaceae

**Ayurvedic name**: Kaalmegha, Bhuunimba, Bhuuminimbaka, Vishwambharaa, Yavtikta, Kalpanaatha, Kiraata-tikta

**Habitat:** The herb is found in a variety of habitat viz. plains, hill slopes, waste lands, farms, dry or wet lands, and sea shore and even in the road side.

**Distribution**: Widely found and cultivated in tropical and subtropical Asia, south-east Asia and India. The species is also reported from different phyto-geographical zones throughout India, from Himachal Pradesh to Assam and Mizoram, and all over southern India.

**General Description:** It is an annual profusely branched, erect herb extremely bitter in taste. It grows to a height of 30-110 cm in moist shady places with glabrous leaves and white flowers with rose purple spots on the petal. The stem dark green, 0.4-1.0 m in height, 2-6 mm in diameter, quadrangular with longitudinal furrows and wings on the angles of the younger parts, slightly enlarged at the nodes; leaves glabrous, up to 8.0 cm long and 2.6 cm broad, lanceolate, pinnate; flowers small and solitary, corolla whitish or light pink in color with hairs, in lax spreading axillary and terminal racemes or icles; capsules linear-oblong, acute at both ends, 1.90.3 cm; seeds numerous, sub quadrate, yellowish brown. It is an annual herb found in Sri Lanka, Pakistan, Java, Malyasia, Indonesia and throughout India, specifically in Maharashtra, Karnataka, Uttar Pradesh, Tamilnadu, Andhra Pradesh and Madhya Pradesh. It is cultivated to some extent in Assam and West Bangal.

**Medicinal uses:** Hepato-protective, cholinergic, antispasmodic, stomachic, anthelmintic, alterative, blood purifier, febrifuge. It acts well on the liver, promoting secretion of bile. Used in jaundice and torpid liver, flatulence and diarrhoea of children, colic, strangulation of intestines and splenomegaly; also for cold and upperrespiratory tract infections.

**Table 1. List of some Important Himalayan Medicinal Plants**

| Botanical names | Local names | Botanical names | Local names |
|---|---|---|---|
| 1. *Acacia catechu* | Khair | 2. *Brassica rapa subsp.* | Sarson |
| 3. *Achyranthes aspera* | Latjeera | 4. *Calotropis procera* | Ak |
| 5. *Aconitum heterophyllum* | Atis | 6. *Cassia fistula* | Amaltas |
| 7. *Acorus calamus* | Bach | 8. *Crocus sativus* | Kesar |
| 9. *Aegle marmelos* | Bel | 10. *Dactylorhiza hatagirea* | Salam-panja |
| 11. *Aesculus indica* | Pangar | 12. *Datura stramonium* | Dhatura |
| 13. *Agave Americana* | Ram-bansh | 14. *Dioscorea bulbifera* | Gethi |
| 15. *Ajuga bracteosa* | Ratpatti,Ratpatia | 16. *Eclipta prostrate* | Bhangru,Bhangri |
| 17. *Albizia lebbeck* | Siris | 18. *Evolvulus alsinoides* | Sankha-pushpi |
| 19. *Allium cepa* | Pyaj,Pyaz | 20. *Ficus palmate* | Beru |
| 21. *Allium sativum* | lehsan | 22. *Ficus religiosa* | Pipal |
| 23. *Angelica glauca* | Gandhrayan | 24. *Glycyrrhiza glabra* | Muleti |
| 25. *Artemisia indica* | Pati | 26. *Grewia optiva* | Bheemal |
| 27. *Artemisia nilagirica* | Ghari-pati | 28. *Juglans regia* | Akhrot |
| 29. *Asparagus racemosus* | Satavari,Kairua | 30. *Mangifera indica* | Aam |
| 31. *Azadirachta indica* | Neem | 32. *Mentha arvensis* | Pudina |
| 33. *Bacopa monnieri* | Mandookparni, Brahmi | 34. *Ocimum canum* | Tulsi |
| 35. *Bauhinia vahlii* | Malu,Maljhan | 36. *Oxalis acetosella* | Chalmori |
| 37. *Bauhinia variegata* | Kachnar | 38. *Phyllanthus emblica* | Amla |
| 39. *Berberis aristata* | Kilmora,Rasut | 40. *Potentilla flugens* | Bajradanti |
| 41. *Berginia ciliate* | Pashan-bhed | 42. *Solanum nigrum* | Makoi |
| 43. *Berginia ligulata* | Pathar-chatta | 44. *Swertia nervosa* | Chirayata |
| 45. *Betula utilis* | Bhoj-patra | 46. *Taxus baccata* | Thuner |
| 47. *Boerhavia diffusa* | Punernava | 48. *Terminalia bellirica* | Behera |
| 49. *Bombax ceiba* | Semal | 50. *Tinospora cordifolia* | Giloy |

# Unit 15: Management of Non- Wood Products

**Unit Structure**



## 15.0 Learning Objectives

After studying this unit, you should be able to understand about:

- Management of the non-wood forest products
- Various Management Problems?
- Steps for proper management of NWFPs

## 15.1. Introduction

### Present Production

There is no accurate data regarding the present production of various non-wood products. A large number of non-wood forest products are collected and utilized by the forest dwellers in large quantities. These quantities do not find record in production and thus a large part of production goes unrecorded. The available recorded data pertaining to production of some of the non-wood forest products is given in table 1.

Table 1. Current and potential production of some non-wood forest produce.

| S.No. | Description | Current production ('000 t) | Potential production ('000 t) |
|---|---|---|---|
| 1 | Fibres and flosses | 6 | 50 |
| 2 | Grasses (other than fodder) | 350 | 525 |

| | | | |
|---|---|---|---|
| 3 | Bamboo | 1932 | 4309 |
| 4 | Canes | 14 | 21 |
| 5 | Essential oils | 2 | 3 |
| 6 | Non-edible oil seeds | 430 | 6671 |
| 7 | Tans and dyes | 187 | 290 |
| 8 | Gums and resins | 91 | 175 |
| 9 | Lac and tassar silk | 22 | 35 |
| 10 | Tendu leaves | 210 | 300 |
| 11 | Drugs and spices | 3 | 5 |

## 15.2. Management Problems

Forest products play a significant role in the life style of mankind. Primitive man depended on forests for meeting almost all of his day to day needs. He derived food, clothing shelter and other necessities from the forest. Gradually, as time passed, he made new inventions and his dependence on forest for non-wood products gradually reduced. A large section of population particularly those belonging to tribal and other rural communities still depend entirely on forests for satisfying various needs. Besides timber and firewood, man is gifted with various essential items such as fibres, medicines, fruits, vegetables, grasses, nuts, fruit, honey, lac, silk, etc. from forests. Most of the forests in India are pre-dominantly managed for the production of timber and fire wood as these commodities are obtained in bulk from forests. The non-wood forest products do not significantly affect the management of forests. Leaving aside a few specific localities and recent plantations, management of forests for the production of non-wood products did not receive much attention of the foresters and forest managers. There are several reasons for such negligence on the part of forest managers. The important reasons are as follows:

(i) Scattered distribution of important plant species
(ii) Over-exploitation
(iii) Method of collection and harvesting

(iv) Lacks proper management strategy
(v) Poor yield
(vi) Poor transport and storage facilities
(vii) Poor marketing infrastructure
(viii) Inadequate organization

**1. Scattered Distribution**

Most of the non wood forest products are not restricted or confined to a single place in forests. These are found scattered an r in the forests. Only some of the non wood products such as bamboo, canes, tendu leaves, pine-resin, etc. have concentrated distribution. Most of the forest areas are primarily managed for the production of timber and firewood, non-wood products do not receive much attention. Scattered distribution of trees and shrubs yielding non-wood products lead to various management problems. These problems includes problem of collection, harvesting and transportation of non-wood products, which further creates problem in marketing. Forests are generally managed for increasing the production of timber and firewood. The timber and firewood yielding trees and shrubs are generally encouraged. In this process, trees and shrubs yielding non-wood produce get suppressed or eliminated. Such trees and shrubs are removed during thinning and cleaning. With the result, most of the trees, shrubs, climbers and herbs yielding non-wood products are eliminated gradually from the forest areas. The specific requirements of trees and shrubs yielding non-wood products also pose problems in growing them over a large part of the forest area.

Most of the trees and shrubs which are timber yielding generally remain localized either in the top canopy or in the middle canopy. The trees, shrubs, climbers, herbs, grasses, etc. yielding non-wood products usually occupy lower storeys. The management system for the production of timber and non-wood products often gets complicated. Many shrubs, herbs and climbers having immense value get smothered or to their scattered distribution. Many plants yielding i planets its yielding valuable non-wood products often go unnoticed. Some plants arc not identified by the lower functionaries of the forest department. This is particularly true in case of medicinal plants. The plants get inadvertently destroyed.

### 2. Over-Exploitation

Most of the plants yielding non-wood products have been traditionally exploited by the tribals and other rural population living in and around forest areas. Continu-ous exploitation without bothering for the regeneration has led to extinction of some plants yielding non-wood products. A large number of medicinal plants and other plants yielding valuable non-wood products have already become endangered. The biotic pressure on forest due to fire, grazing and uncontrolled removal of trees for firewood purposes has led to the disappearance of the trees and shrubs yielding non-wood products. Several times a tribal or forest dweller is not aware of the value of the plant and he cuts it with ignorance. Such situation leads to serious adverse con-sequences resulting in the loss of plants yielding non-wood products. There are several examples showing how over-exploitation has led to the disappearance of some of the non-wood products. In Madhya Pradesh, Maharashtra and some other parts of the country, bamboo forests were leased to paper mill owners. These paper mills carried out heavy exploitation from the forest areas without bothering for the regeneration. Due to unrestricted grazing and fire along with heavy exploitation, bamboo forests from a large part of the area have disappeared. Forest areas which were once rich in bamboo resources do not sup-port bamboo growth any longer.

Heavy exploitation of the medicinal plants by contractors have caused disappearance of these valuable species. *Dioscoria* species whose roots and rhizomes are used in the treatment of various diseases have virtually become extinct from the hill forests of Himanchal Pradesh and Uttar Pradesh. Collection of sal seeds in a large quantity by the tribals and other rural people has adversely affected the regeneration of sal in these forests. Heavy resin tapping from the trees of Films spp. causes serious mortality in trees. Similarly, there are a number of examples of heavy exploitation of non-wood products which has led to the disappearance of these valuable species.

Some of the valuable species like Chironji, Chilgoja pine and others yielding several non-wood products are harvested by the villagers for meeting timber and fuel wood needs. Once these trees are cut, the regular yield of seeds and fruits reduces considerably. Several times, the villagers cut these trees and shrubs to facilitate the harvesting of non-wood products. The purpose of the villagers to harvest the non-wood products easily without bothering for the future yields and the regeneration of the plant. Therefore, trees yielding minor forest products are usually damaged by them. These trees remain scattered in forests, reduce gradually in numbers and finally become extinct from the area.

In most of the states, non-wood forest products are generally removed by villagers free of cost. There is no restriction or preference to any person on collection of non-wood forest product among forest dwellers or people living near the forest. There is a virtual competition among the villagers to remove the produce. The villagers like to collect the non-wood products as early as possible. This competition leads to over-exploitation of trees and shrubs yielding non-wood products. Some of the non-wood products sup-port various industries In urban areas. The harvesting of these non -wood products is generally supported by the industries. For example, aonla is harvested by the support of industries manufacturing products like trifla, chyavanprash and other Ayurvedic medicines. Such industrial supported harvesting operations usually leads to over-exploitation of the trees and shrubs yielding non-wood forest products.

## 3. COLLECTION AND HARVESTING

Collection of non-wood products from the forest is difficult and the collector face several problems. The way of collection of utilisable products differs depending upon the part of the tree which is used. For example, the rhizomes of bamboo (*Dendrocalamusstrictus*) are generally eaten by the tribals and other local villagers of Madhya Pradesh, Maharashtra and other areas. The new plants arising from the rhizomes are harvested as early as they come out over the ground. This in turn adversely affects the regeneration and growth of bamboo forest. Several forest plants yield seeds and fruits which are of great use. For harvesting seeds, fruits and flowers from the trees, the tree is either climbed or the tree or branches are shaken and sometime even cut. Climbing the tree is a risky operation, villagers in most of the areas prefer cutting the branches or sometimes cutting down the whole tree in order to harvest the fruits. Such harvesting operation often leads to destruction of species and reduction in future yields of non-wood products.

Heavy damage to the plants have been recorded in harvesting of several kinds of non-wood products. Pine resin is obtained from the trees of *Pinus roxburghii*. The method used for collecting resin includes tapping and sometimes other crude methods which causes serious damage to the trees. Over exploitation of these trees for resin led to departmental collection of pine resin in the forest area. Similarly, collection of sal seeds and fruits of harra and bahera have also been taken up by the forest department in order to ensure proper collection of these products. Collection of fodder from the fodder trees, by lopping the branches often leads to overlopping which causes serious damage to trees. The lopping procedure prescribes that it should be restricted to lower 1/3rd of the crown but villagers generally lop the whole crown of the tree resulting in serious damage to growth of these trees.

### 4. LACKS PROPER MANAGEMENT STRATEGY

As it has been explained that the forest management in government forests generally aims at the production of timber or firewood. It rarely takes into account the yield of non-wood products. Working plans or the management plans which provide prescriptions for the management of forests hardly provide any prescription for the management of non-wood products. Only in the exceptional cases, such as chir pine for resin-tapping, tendu trees for leaf production and in some other cases, it is subjected to considerations by forest departments.

The trees, shrubs and other species yielding non-wood products are innumerable and these species generally occur associated with different plant species in the forests. There is no inventory of these trees, shrubs, climbers and herbs. There is also no study made relating to growth, productivity, etc. Therefore, suitable strategy has not yet been formulated for the management of these non-wood species in most of the states. Tendu leaf, which provides sizable revenue to several states like Madhya Pradesh, Maharashtra, Uttar Pradesh and Andhra Pradesh, management aspect of these trees has not been given desired attention. There have been no worthwhile research relating to factors which contribute to the growth and development of these non-wood species. There has been little efforts to ensure natural regeneration or taking up of artificial regeneration and plantations of these species. There are several species yielding non-wood products which have a great promise relating to yield of forest products. For example, Mahua tree produces about a quintal edible flower every year per tree. In raising plantations, it has been suggested that if this tree is given preference in plantation, it will also contribute significantly in solving the food scarcity problem of the region.

There is no worth-while information regarding the growth and yield of different non-wood species. The main reason for such state of affair is that the non-wood products are basically managed by unorganized sectors. The villagers/ tribals are almost free to collect the forest produce. There is no investment either by the government or by the villagers for the regeneration and development of deforested new species. Immediate steps should be taken for taking up conservative and development actions for propagation and development of these non- wood products.

## 5. POOR YIELD

Most of the trees, shrubs, herbs and climbers yielding non-wood products are scantly distributed in our forests. The management prescriptions for the forests do not support the growth and development of such vegetation. Management policies are so formulated that these generally benefit only the timber yielding trees. The trees, shrubs, herbs and climbers yielding non-wood products are often neglected. The well-known plants yielding non-wood products are over- exploited by the villagers and the tribals. Biotic pressure on forests caused by grazing, fire, headload removal of firewood, illicit fellings and encroachments etc. lead to dwindling of non-wood forest resources in the forests. The yield of non-wood products per unit area is low. Therefore, commercial harvesting of such products is generally uneconomical. Even at places where the non-wood produces yielding plants exist in sufficient numbers, they are not provided with proper conditions of growth and development. These plants remain suppressed under woody trees resulting in poor growth and low yield.

### 6. POOR TRANSPORT AND STORAGE FACILITIES

The non-wood products are very large in numbers and require different ways of collection, processing, storage and utilization. The yield of these products obtained from forest areas is poor, this works as dis- incentive for collection of non-wood pro- ducts. Collection is generally limited to the quantity which is consumed locally. Due to unavailability of transport facilities, these are not transported to other places for marketing.

Several non-wood products cannot be stored for longer period. They are to be consumed soon after they are harvested. Such conditions create problems in the utilization of the produce. In absence of proper transport facilities, these products cannot be harvested in large quantities as these cannot be transported outside the area. Those non-wood products which can be dried, processed and stored also becomes problem as sufficient storage facilities do not exist. Many non-wood products which are harvested get destroyed during rains due to poor transport and storage facilities.

### 7. POOR MARKETING INFRASTRUCTURE

The marketing infrastructure for non- wood products is more complicated and less developed than wood products. Several non-wood products such as medicinal herbs, dyes, gums, resins, essential oils and many other non-wood products require some sort of processing before they are used. The local villagers and the tribals who collect these products from the forests are generally not trained in processing techniques. Therefore, the intermediaries purchase these materials from the villagers and the tribals at very cheap rate. The prices paid are so little that there is hardly any incentive for collection of valuable forest products. The local villagers and the tribals are not aware of the market and the exact prices of the commodities, which they sell to the intermediaries.

**8. INADEQUATE ORGANISATION**

Most of the non-wood products are collected by the tribals or the nearby villagers. There is complete absence of any organization entering into collection of these products. The tribals are poor, they collect and use the edible plant parts for satisfying their own needs. For example, mahua flowers are eaten, they are also used for preparing alcoholic drinks, mahua seed and sal seed are used for oil extraction which is used her cooking, lighting., etc, medicinal plants are used for treating various ailments, tanning and dyeing materials are used locally and abroad by tanneries and dyeing industries. Since their is a complete absence of market in the tribal areas, these tribals have no incentive for collecting more non-wood products other than their requirement. Therefore, the non-wood products which are in excess of requirement are generally left as such and are not collected. In some of the states, collection of non-wood products has been taken by the tribal co-operative societies. However, these societies have poor organizational infrastructure and are not functioning effectively.

## 15.3. Management of Non-Wood Forest Products

Harvesting of timber and firewood is generally subject to environmental considerations. Felling of trees on steep slopes, along rivers and on fragile eco-systems is restricted due to environmental considerations. Maintenance of green cover leads to control-ling green house gases and checking environmental pollution. Environmental enthusiasts therefore, advocate to restricting the felling of trees for timber and firewood purposes. Government of India has already put monotorium on felling of green trees above 1000 m elevation. Similarly, harvesting of timber and firewood has received back seat in several other areas. Clear felling of forest has been totally banned by the government in almost all forest areas. Selection fellings are only practiced in valuable forests. Non-wood forest products therefore have become significant when trees are not harvested for timber and firewood purposes.

Management of forest therefore, for increasing the yield of non-wood products is environment friendly and does not call for any concern from the environmentalists. Steps necessary for ensuring proper management of forests for obtaining increased yield of non-wood products from our forests are as follows:

(i) Inventory of non-wood resources
(ii) Preparation of management plans
(iii) Plantation of species yielding valuable non-wood products
(iv) Germplasm protection, collection, storage and improvement
(v) Development of improved technologies
(vi) Improving storage and transport conditions
(vii) Improvement in processing
(viii) Effective organization
(ix) Establishment of markets and marketing facilities

**(1) INVENTORY OF NON-WOOD RESOURCES** It has already been mentioned in previous chapters that there are a large number of species of plants yielding various kinds of non-wood products. These species occur in forest in varying density and the resources in terms of number of plants and in terms of yield is not known. It is therefore, necessary to carry out inventory of species yielding of non-wood forest products and also the approximate yield of the specific produce which these trees are able to provide.

Such inventory in respect of all categories of non-wood products will be difficult to plan and execute. However, inventory pertaining to valuable non-wood resources can be obtained to assess the existing growing stock, existing rate of growth and expected yields. It is necessary that first survey of the forest area should enlist the existence of various plant species yielding non-wood forest products. Depending upon the concentration of the species and expected yield, it is necessary to delineate areas which may be managed for specific kind of non-wood forest products. Presently, certain plant species such as bamboo, khair (for katha manufacture), chir (resin tapping), etc. are identified and managed taking into con-sideration the yield of non-wood products. It is however, necessary that more areas need to be identified on the basis of other products for increasing the yield.

**(ii) PREPARATION OF MANAGEMENT PLANS**

Forests are managed on the basis of written document generally called management plan or working plan. Management plans are being prepared for managing forest areas for harvesting timber and fire-wood. Management plans have yet not been framed for the management of non-wood forest products. This is because of two rea-sons, primarily because the number of non-wood products is very large and secondly the quantity of produce obtainable from the specific areas is not significant to justify preparation of separate management plan. Harvesting of non-wood products is environmentally safe because the trees and shrubs yielding non-wood products are not cut but only the produce such as flowers, fruits, seeds, leaves, barks, roots, rhizomes, etc. are harvested. There are a number of plant species which yield non-wood products, these need to he managed primarily with a view to enhancing the yield of the products.

Similarly, there are several areas yielding bamboos, mahua flower and fruit, chironji and several other products, which need to be identified and the management plan need to be pre-pared for enhancing production of the non-wood products existing there. Some of the present management plans prescribe the management of non-wood pro-ducts in constituting over-lapping working circles. There are khair over-lapping working circles, bamboo over-lapping working circles, resin tapping over-lapping working circles, etc. To enhance the productivity of such products, it is required to identify more products and proper management of forests.

**(iii) PLANTATION OF SPECIES YIELDING VALUABLE NON-WOOD PRODUCTS** Out of 75 million ha total forest area of the country, approximately 50 per cent of the area has become degraded. There is a sizable area under wastelands. Both of these categories of lands i.e. the degraded forest areas and wastelands are being afforested regularly with various plant species. The present annual target of plantation of Government of India is more than 2 million ha per annum. In order to increase the production of non-wood products in the country, it is necessary to raise plantations of trees and shrubs which are capable of yielding valuable non-wood forest products.

Some of such plantations have already been started in India. Bamboo plantation have started long ago in degraded forest areas. Similarly, wattle plantation have been taken up in Tamil Nadu for the production of tannin material. Chir pine plantations are being done to boost resin production. Simi- larly, plantation of large number of species yielding fodder have also been taken up in different states. Government of India has launched a scheme for the plantation of medicinal plants.

Present need is to select species for plantation which are important from the point of view of non-wood forest products. Selection of such species is environmentally safe and generally provides benefits to the local population to a large extent. If the timber yielding species are planted, the local population is generally not benefited as the harvested timber is sold to contractors or timber merchants. However, if non-wood products yielding species are planted the local people get benefitted.

In many areas, the plantation of timber species has been opposed by the local population. In Madhya Pradesh, teak plantations were opposed by the tribals, however when mahua was planted, the local people protected the plantation very well, because the tribals like flowers and seeds of mahua and is largely used by them. Therefore, on the general policy, there must be emphasis on selecting multipurpose tree species for plantation which yield products which can be utilized by the local population.

## (iv) GERMPLASM COLLECTION, STOR AGE AND IMPROVEMENT

It has been pointed out that there has been loss in genetic diversity due to various reasons. There are a number of species which are gradually becoming extinct from our forests. Red Data book published by the Botanical Survey of India indicates that more than 800 plant species from our forests have reached at the verge of extinction. These species include valuable medicinal plants and several other non-wood forest products yielding plants.

There is an urgent need to preserve the biological diversity pertaining to non-wood forest resources. Efforts are already on way to preserve the genetic diversity by preserving the ecosystem consisting of biosphere reserves, national parks, sanctuaries, etc. It is necessary that the species which have become endangered, their habitat should be identified and efforts should be made to protect that habitat. Species diversity is being also preserved by establishing botanical gardens, arboretum, etc. Preservation of genetic material e.g. seed or clone should be taken up in case of several species whose specimens are limited.

Preservation of genetic material is not enough. There should be concerted efforts for the improvement and the genetic mate- rial of non-wood forest produce species. Selection of high yielding provenances and varieties need to be taken up on the priority basis. Once identification of superior genotype is done, further propagation can be taken up by the method of vegetative propagation or through tissue culture.

**(v) Development of Improved Technologies**

There are a number of species yielding non-wood forest produce. The details about the plant and other related technologies such as propagation, tending, thinning, growth and yield, processing etc. arc not precisely known in case of several species. It is therefore, necessary to carry out studies relating to these aspects of plants. Phenology and details about seed and planting material is not known in case of several species. It is therefore, necessary to investigate the details about seed, seeding behaviour and other aspects pertaining to seed, which may help in propagation of non-wood species. Several important species belonging to the group of medicinal plants, tans and dyes, gums and resins, fodder trees, bamboo and canes and several other valuable species do not regenerate naturally. Their method of artificially regenerating these species is to be perfected. Other details e.g. proper time and method of harvesting, frequency, etc. have to be worked out. In case of medicinal species, it is necessary to assess the proper stage of harvesting when the chemical constituent which is medically important is in its highest concentration.

**(vi) IMPROVING STORAGE AND TRANSPORT CONDITIONS** Several non-wood products find use in various industrial products. For example, tree borne oil seeds such as sal, neem, mahua, kusum, etc. are collected, stored and transported to refineries or ghanis for extraction of oil from oil seeds. If storage and transport facilities are not developed, these oil seeds cannot be transported to the extraction plants for extracting oil. Similarly, tendu leaves and other leaves which are used for making bidis are required to be stored for some time in godowns. They are then transported to various bidi manufacturing centres to various parts of the country and exported out of the country. These leaves require proper storage and transport infrastructure. Similarly, all other products which are not essentially consumed locally and have high market value require proper storage facility for some time. Proper trans- port facilities are required for transfer of material from one place to another. Most of the industries are located in urban areas, therefore to deliver goods in respective industries for processing proper transport facilities are required.

**(vii) PROCESSING**

Several non-wood products require processing for their proper storage and utilization. Oil seeds require decortication, drying, winnowing, etc. Tanning material whether it is a fruit or bark requires drying, storing, etc. Gums and resin require purification and drying. Similarly, medicinal plants, edible plants and all other various non-wood forest products require processing before they are utilized.

Mostly, non-wood products harvested from forests are taken to industries in raw state. This necessitates heavy expenditure on transport. If processing could be carried out in the forest by the collectors themselves, there will be some saving on the transport and also the collectors will get better price for their labour. It is therefore, necessary to train the local tribals and other people in the rural areas to carry out processing involving various non-wood products.

## (viii) ORGANISATION

There is no effective organization for the management, collection, harvesting, processing and marketing of non-wood products in India. In most of the states, non-wood forest products are collected by the villagers free of cost. Only a limited number of non-wood products have been brought under the con- trol of state government. For some non- wood products, there are some organizations in the State Forest Department. These include tendu leaves, sal seed, harra seed, etc. For other non-wood products, there is no organization for effective propagation, development, collection, harvesting and utilization.

Details of organization for collection and marketing differ from state to state. The position in respect of some major states is as under:

**(i) Madhya Pradesh:** Tendu leaves, sal seed, myrobalans (Harra), gums (five types), khair wood and bamboos are nationalised items specified by monopoly state trading. Collection of tendu leaves, sal seed, myro- balans (Harra) are arranged and through purchaser-agent system departmentally by engaging LAMPS and MARKFED. Other non-wood products viz. Mahuline leaves, chironji seeds, kusum seeds, baheda, rosha (Palmrosa), grassbrooms (phool), etc. are transacted through contractor agency.

**(ii) Bihar:** Tendu leaves (Kendu) and sal seeds are the two nationalised non-wood products in Bihar. Tendu leaves are col- lected by Bihar State Forest Department whereas, sal seed collection is in the hand of Forest Development Corporation. Biscolamf is an apex co-operative commodity body engaged in procurement, processing and marketing of lac and lac products. Other non-wood products viz. tamarind, karanj, kusum and nigar seeds, chironji, sabai grass, tassar cocoon and barbath, etc. are transacted through the T.C.D.C. and private traders.

**(iii) Orissa:** Tendu leaves (Kendu) are collected by Forest Department but its marketing is handled by Orissa Forest Corporation. Sal seed collection is done by private parties (having their sal seed solvent plant) Forest Development Co-operative Corporation. Other Development Corporation and Tribal Devel- non-wood items viz. gums, kusum, karanj, neem seeds, Tamarind, Sunari bark, Siali leaves and fibre, Annato seeds, Rouvolfia serpentina root, etc. are collected either through T.C.D.C. or private traders.

**(iv) Andhra Pradesh:** All items of non- wood produce are, monopoly items of Procurement. Non-wood produce collected by people are sold at Mand where Girijan Development Corporation purchases them at a fair price.

**(v) Gujarat:** Forest Development Corporation organizes collection and marketing of all non-wood produce, LAMPS and FLCs act as its collection agents.

**(vi) Maharashtra:** As per provisions of Maharashtra Tribal Economic Conditions (Improvement) Act, 1976, no person can purchase any agricultural produce in the tribal area except the state government or Tribal Authority or an authorized agent of government, Agriculture produce include all non-wood produce items.

**(vii) Rajasthan:** Tendu leaves are nationalized item and their collection is done departmentally. Non-wood produce are collected by Tribal Development Corporation.

**(viii) Uttar Pradesh:** Tendu leaves and chironji collection is attempted departmentally following a special system. Sal seed collection is still on lease. Other non- wood produce are transacted through private traders.

**(ix) West Bengal:** Major area of the forest having non-wood produce is allocated to West Bengal Development Cooperative Corporations. In the remaining area non- wood produce is transacted through traders.

Recent forest policy of India recognizes the role of tribals in the management of non-wood forest products in the country. The policy has recommended that tribal communities should participate in manage- ment, collection, processing, marketing and utilization of various non-wood products for the betterment their life style. Therefore, in some of the states tribal co-operative societies have been formed with view to managing, collecting and marketing various non-wood products. However, such co-operative societies are not functioning in all the states. The societies have been successful in Gujarat, Madhya Pradesh, Maharashtra and Orissa. It is therefore, necessary to have a separate organization for non-wood products which can properly manage the forest and improve the non-wood forest product yield.

### (ix) MARKET AND MARKETING

One of the major problem for management of non-wood products in the country is the absence of suitable marketing infrastructure for these products. Most of these products are either utilized locally by the tribals or sold in the markets for which no suitable marketing infrastructure is avail- able. The tribals and other villages are compelled to sell the non-wood produce to local traders at very cheap rates. The tribals do not know the exact value of the non-wood products and lack the knowledge of physical measurement. Hence the development of marketing facilities will help in getting the remunerative price to the tribals which will help in larger collection and greater outturn of various non-wood products found in the forests. A large number of non-wood products are marketed every year. Some of them are also exported outside the country. These products hold an important place not only in the home but also in international markets.