A practical manual for the course

"*Introductory Agroforestry (NRM-313)*"

NRM 313 2(1+1)

For the B.Sc. Horticulture Vth Semester

Prepared by:

Dr. Sunil Kumar Chongtham
Assistant Professor
Multi Technology Testing Centre & Vocational Training Centre

College of Horticulture
Central Agricultural University, Imphal
Bermiok, South Sikkim

Publication No.:

Publication:

Copies:

Publisher:

College of Horticulture
Central Agricultural University, Imphal
Bermiok, South Sikkim

Preface

Agroforestry is an age-old practice in which trees/woody perennials along with crops and/or animals are raised together on the same piece of land. This practice is still prevalent in various parts of the world to meet diverse needs, including food, fodder, fruits, firewood, fibre, and other economically important products (like honey, gum, resin, etc.). It holds a strong potential to address food and nutritional security and mitigate climate change in the present scenario. Besides, providing food and other needs, the presence of tree components will render several environmental benefits like air purification, carbon sequestration, soil and water conservation, etc. Agroforestry is one of the unique farming practices that enable the retention of sufficient vegetative cover on the planet without affecting the cropping area. Due to all these advantages, it is gaining popularity in our country as well as in several parts of the globe.

This manual has been prepared for the fifth-semester students of B.Sc. (Hons.) Horticulture according to the recommendation of the Fifth Dean's Committee Report. The manual contains the identification of various multipurpose tree species (seed, flower, seedling) and their nursery management practices, surveying multipurpose tree species grown in various agroforestry fields, and social forestry (railway line, shelterbelt, roadside, and industrial plantations), and assessment of farmers needs for green manure, fodder, firewood, economic and marketing of agroforestry products, and their interpretations.

Date: **(Sunil Kumar Chongtham)**

Acknowledgement

It gives me immense pleasure to avail myself this opportunity to express my immense sense of gratitude to Dr. A.K. Pandey, Dean of the College of Horticulture, Central Agricultural University (Imphal), Bermiok, South Sikkim, for his kind support in bringing out of this practical manual.

I express my heartfelt thanks to the college library for providing the necessary information and books for preparing this manual.

I am highly grateful to the PME cell and Dean, College of Horticulture, CAU (Imphal), Bermiok, South Sikkim for overall support to produce the manual.

I shall consider my efforts successful and worthwhile if the practical manual serves the main objective for which it has been prepared. Also, I would be delighted to receive suggestions/feedback for further improvement of the manual.

Foreword

India is one of the most populous nations in the world accounting for about 17.7% of the total population of the globe. The rapidly burgeoning population promotes large-scale deforestation and reduction in cropping areas for meeting the land requirement for urbanization and industrialization. Indiscriminate cutting of trees severely affects the ecological balance and contributes to global warming. Agroforestry is a versatile farming practice that can mitigate these ill effects by retaining sufficient vegetative cover while producing multiple products such as food, forage, fibre, firewood, etc. Furthermore, trees also provide shelter to various wild species and contribute to maintaining an equilibrium in the ecosystem.

Agroforestry has been in practice since time immemorial in several parts of the world. It is an indispensable component of the integrated farming system in which multipurpose trees are raised along with crops and animals. This farming practice plays multiple roles, including assisting in food and nutritional security, employment generation for the rural populace, and conserving the environment. However, this practice is highly location-specific, and proper knowledge of locally-adapted multipurpose tree species and their meticulous integration in farming is highly essential to derive maximum benefit from this.

This manual has been prepared to assist students and other users to identify various economically important tree species, understanding nursery management practices of various multipurpose trees, economics, and marketing channels of various agroforestry products. I applaud the author for preparing such kind of manual for the advantage of students, teachers, readers, and all those involved in farming practices.

Date:

(Anupam Mishra)
Vice Chancellor
CAU, Imphal

College of Horticulture

CAU, Bermiok

South Sikkim 737134

CERTIFICATE

This is to certify that Mr./Ms ……..

Reg. No……has performed Practical for the semester……

B. Sc. (Hons) Horticulture in the Course No…… Title……

during the academic year……

He/She has performed…….practical out of ……

Registration No…….

Course teacher **Assistant Registrar (Academic)**

Examiner

CONTENT

Practical No. 1 : Identification of seeds and seedlings of multipurpose tree species

Objective : To study seeds and seedlings of different multipurpose tree species

1. **Botanical name** : *Morus alba*
   Common name : Mulberry
   Family : Moraceae
   Fruit : It is a succulent berry, white or dark purple or black with peduncle, sweet and edible
   Seed : It is very small and about 430-460 seeds weigh one gram


Seeds


Seedling


Ripened fruits

Plate 1.1 Seeds, seedling and ripened fruits of *Morus alba*

2. **Botanical name** : *Grewia optiva*
   Common name : Bhiul, Bhimal
   Family : Tiliaceae
   Fruit : It is a fleshy drupe, 2-4 lobed, olive green when immature and black when ripe
   Seed : The seed coat is hard. Each fruit contains 2-4 seeds. There are about 12000- 15000 seeds per kg.


Flower


Fruits

Plate 1.2 Flower and fruits of *Grewia optiva*

3. **Botanical name** : *Dalbergia sissoo*
   Common name : Shisam
   Family : Leguminosae
   Fruit : It is oblong-lanceolate, 4-9 cm by 1.3-2.0 cm, abruptly narrowed to a stipe, glabrous, flat, 1-3 seeded
   Seed : The seeds weigh 18500- 35000 per kg

Seeds

Fruits

Plate 1.3 Seeds, and fruits of *Dalbrgia sissoo*

4. **Botanical name** : *Albizia lebbek*
   Common name : Indian siris
   Family : Leguminosae
   Fruit : The pods are pale straw to light brown at maturity, narrow-oblong 12-35 cm x 3-6 cm, papery-leathery, swollen over the seeds and not constricted between them, indehiscent and borne in large numbers.
   Seed : Seeds are brown, flat, orbicular or elliptic, 8-10 mm x 6-7 mm, transversely placed with 3-12 in each pod.

Seeds

Flower

Ripened fruits

Plate 1.4 Seeds, flowers and fruits of *Albizia lebbek*

5. **Botanical name** : *Toona ciliata*
   Common name : Toon, Indian maghogany
   Family : Meliaceae
   Fruit : It is a dark brown oblong thin capsule (1.8-3 cm x 1.5 cm), 5-valved, liberating the seeds exposing a five-angled pith in the centre.
   Seed : Seeds are small, pale brown, winged at both ends, flat, and very light.

Ripened fruits

Plate 1.5 Ripened fruits of *Toona ciliata*

6. **Botanical name** : *Bauhinia variegata*
   Common name : Kachnar
   Family : Leguminosae
   Fruit : Pods 15-30 cm by 1.8-2.5 cm, papillose when young, hard when mature, flat, bursting when fully ripe.
   Seed : Seeds 10-15 per pod, nearly circular, 3.3 to 4.8 cm diameter, flat brown with coriaceous testa.

Seeds

Fruits

Plate 1.6 Seeds of *Bahunia variegata*

7. **Botanical name** : *Celtis australis*
   Common name : Neetle tree, *Khirk*
   Family : Ulmaceae
   Fruit : It is an ellipsoid drupe, about 1 cm long, purplish-black, sweet edible, and used as a remedy for amenorrhoea and colic disorders
   Seed : About 4600 seeds weigh one kg

Ripened Fruits

Plate 1.7 Ripened fruits of *Celtis australis*

8. **Botanical name** : *Sapindus mukorossi*
   Common name : Soapnut tree, Ritha
   Family : Sapindaceae
   Fruit : It is a globosely fleshy, single-seeded drupe, sometimes two drupes together 1.8-2.5 cm across.
   Seed : 0.8-1.3 cm in diameter, globose, smooth, black, loose in dry fruit

Ripened fruits

Plate 1.8 Fruits of *Sapindus mukorossi*

Practical No. 2 : Nursery practices for *Populus deltoides*

Objective : To study the practices for nursery management of *Populus deltoides*

Botanical name : *Populus deltoides*
Common name : Poplar, Pharipipal
Family : Salicaceae

Plate 2. Poplar tree

Phenology:

- Deciduous tree
- Flowering- April
- Fruit ripe- June
- Leaf fall- March – April
- Leaf renewal- October-March

Distribution: West Punjab in Pakistan, Middle East, New South Wales in South Australia, Parana Delta and north eastern continent part of the Argentina. In India, it has been successfully cultivated as a forest crop or agroforestry crop in the Punjab plains and in the *Tarai* region of Uttar Pradesh.

Soil: Sandy loam to fairly stiff clay, but it makes its best growth on moist, well-drained, deep, medium- textured, alluvial soils that are fertile and well-aerated.

General Description:

- Poplars are amongst the fastest growing tree species under appropriate agro-climatic conditions.
- Poplars can be harvested at short rotations of 8 to 10 years.

- ❖ Poplars with straight and cylindrical bole, moderate conical crowns mostly deciduous during winter months,
- ❖ Combine well with inter-cultivation of agriculture crops.
- ❖ Six indigenous species viz *Populus ciliata, P. laurifolia, P. gamblei, P. alba, P. glauca*, are found along water courses in Himalayan region

Artificial regeneration:

- ❖ By sexual reproduction
- ❖ By Vegetative propagation: Cuttings, Sets, Bag plants, Root-shoot cuttings, Entire transplants

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	
7.	**Irrigation**	**:**	

8.	**Fertilizer application**	**:**	
9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 3 : Nursery practices for *Grewia optiva*

Objective : To study the practices for nursery management of *Grewia optiva*

Botanical name : *Grewia optiva*
Common name : Beul, Dhaman
Family : Tiliaceae

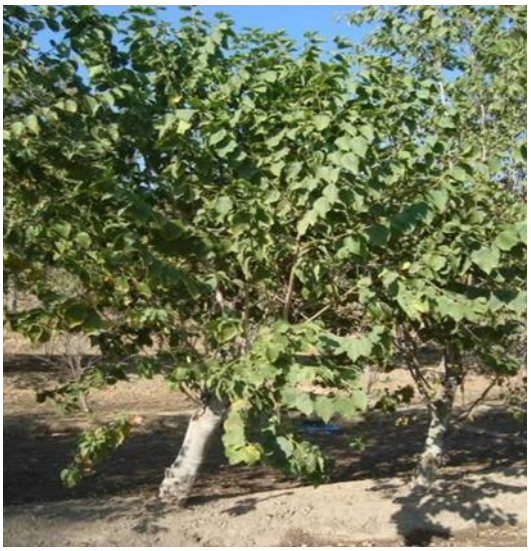

Plate 3. *Grewia optiva*

Phenology:

- Leaf-fall - March-April
- Leaf renewal - April-May
- Flowering - April-May
- Fruiting - June-July
- Fruit ripe - October-November

Distribution: It is a tree of sub-tropical climate. It is distributed from the foothills of the Western Himalayas from Jammu and Kashmir to Nepal up to 2000 m elevation.

Soil: Tree is hardy and grows on a variety of soils. Sandy loam soil with adequate moisture supply supports good growth.

General Description:

- It is a very popular tree of the farmers of the sub-Himalayan tract for its fodder and fibers.
- It is a strong light demander, require complete overhead light.
- It is frost hardy tree but young seedling dieback due to severe frost.
- It coppices very well, but susceptible to fire and browsing.

Artificial regeneration:

- By sexual reproduction
- By Vegetative propagation: By cutting or planting stumps, transplanting of nursery raised seedings

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	
7.	**Irrigation**	**:**	
8.	**Fertilizer application**	**:**	

9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 4 : Nursery practices for *Morus alba*

Objective : To study the practices for nursery management of *Morus alba*

Botanical name : *Morus alba*
Common name : Shahtut, tut, tutri, chinni
Family : Moraceae

Plate 4. *Morus alba*

Phenology:

- Leaf-fall – November-December
- Leaf renewal – March-April
- Flowering - March-April
- Fruit ripe – April-June

Distribution: Northern India from Jammu and Kashmir to Assam. In the Himalayas, it ascends up to an elevation of about 1200 m.

Soil: Tree grows on a variety of soils ranging from sandy loam to clayey loam, alluvial, deep, loamy soil with sufficient moisture supply supports its best growth. Grows best with soil pH ranging between 6.0 and 7.5.

General Description:

- A full-grown *M. alba* is a moderate sized tree with short clean bole and spreading crown
- *M. alba* is a shade bearing tree and it can with advantage be grown as an under-story with other light demanding species.
- It coppices and pollards very well. It can withstand light frost.
- Its water requirement is high. It suffers from droughts as may be expected from its being a surface feeder.
- It is susceptible to fire and browsing.

Artificial regeneration:

- By sexual reproduction

- By Vegetative propagation: By cutting or planting stumps, transplanting of nursery raised seedings

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	
7.	**Irrigation**	**:**	
8.	**Fertilizer application**	**:**	

9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 5 : Nursery practices for *Acacia catechu*

Objective : To study the practices for nursery management of *Acacia catechu*

Botanical name : *Acacia catechu*
Common name : Khair, kath tree, cutch tree
Family : Leguminoseae
Sub-family : Mimosoideae

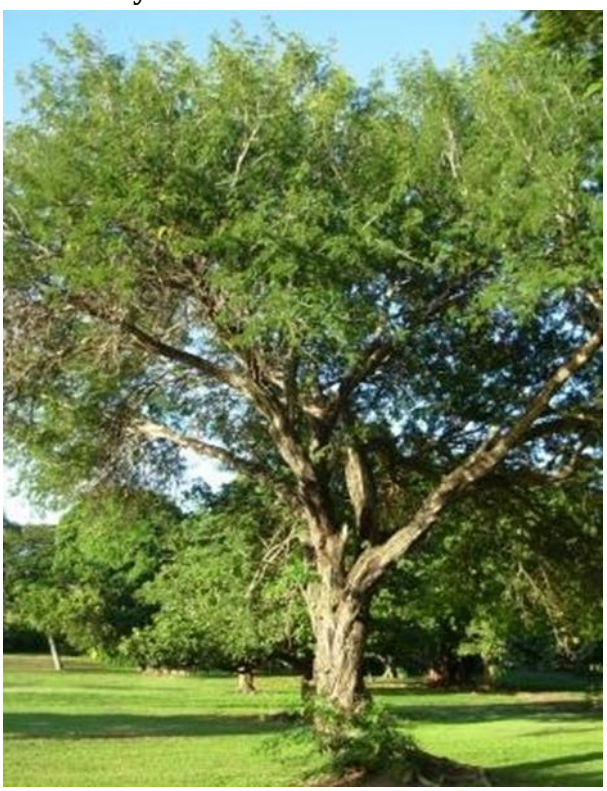

Plate 5. *Acacia catechu*

Phenology:

- Leaf-fall – January-February
- Leaf renewal – April-May
- Flowering – April-August
- Fruiting – September-October
- Seed collection – October-December

Distribution: It is found throughout India except in humid and temperate region. It is widely distributed between 900-1200 m from Jammu to Assam. Variety catechu is found in Sikkim, Tarai region, West Bengal, Assam.

Temperature: Maximum 40°C -50°C, Minimum 1°C**, Rainfall:** 500 mm to 2000 mm

Soil: *Acacia catechu* grows on wide variety of soils such as sandy, gravelly alluvial, loam with varying proportions of sand and clay and black cotton soils. It is capable of growing on shallow

soils with murram or kankar on which few other species can grow.

General Description:

- A moderate sized deciduous tree with light feathery crown with crooked brown bole, Bark dark brown and red inside. Branches are glabrous armed with recurved thorns.
- The species is distinguished into three distinct varieties viz. *Acacia catechu*, variety catechuoides, sundra and catechu.
- Strong light demander, frost and fire hardy, wind firm, browsed by animals

Artificial regeneration:

- By sexual reproduction
- By Vegetative propagation: By cutting or planting stumps, transplanting of nursery raised seedings

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	
7.	**Irrigation**	**:**	

8.	**Fertilizer application**	**:**	
9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 6 : Nursery practices for *Dalbergia sissoo*

Objective : To study the practices for nursery management of *Dalbergia sissoo*

Botanical name : *Dalbergia sissoo*
Common name : Shisham, Sissu
Family : Leguminoseae
Sub-family : Faboideae

Plate 6. *Dalbergia sissoo*

Phenology:

- Leaf-fall - November to December
- Leaf renewal - January-February
- Flowering - March/April
- Fruiting – May-July
- Fruit ripe - November-December
- Seed collection - November-December
- Seed viability - 12-18 months.
- Seed weight - 530 /g
- Germination - 80 per cent.

Distribution: The spp. occurs throughout the sub-Himalayan tract and outer Himalayan valleys from the Indus to Assam; usually up to 900 m, but occasionally ascending to 1500 m.

Temperature: Maximum 40°C -50°C, Minimum 1°C**, Rainfall:** 760 mm to 4600 mm

Soil: It grows gregariously on alluvial soil along stream banks, beds, and islands, and freshly exposed soil along roads and landscapes along with Khair.

General Description:

- ❖ It is a large deciduous tree with a light crown having thick, rough, grey bark with shallow broad longitudinal fissures exfoliating in irregular woody strips and scales.
- ❖ It attains a height up to 30 m and a girth of 2.4 m.

Artificial regeneration:

- ❖ By sexual reproduction
- ❖ By Vegetative propagation: By cutting or planting stumps, transplanting of nursery raised seedings

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	

7.	**Irrigation**	**:**	
8.	**Fertilizer application**	**:**	
9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 7 : Nursery practices for *Leucaena leucocephala*

Objective : To study the practices for nursery management of *Leucaena leucocephala*

Botanical name : *Leucaena leucocephala*
Common name : Subabul, Ipil-ipil
Family : Leguminoseae
Sub-family : Caesalpinoideae

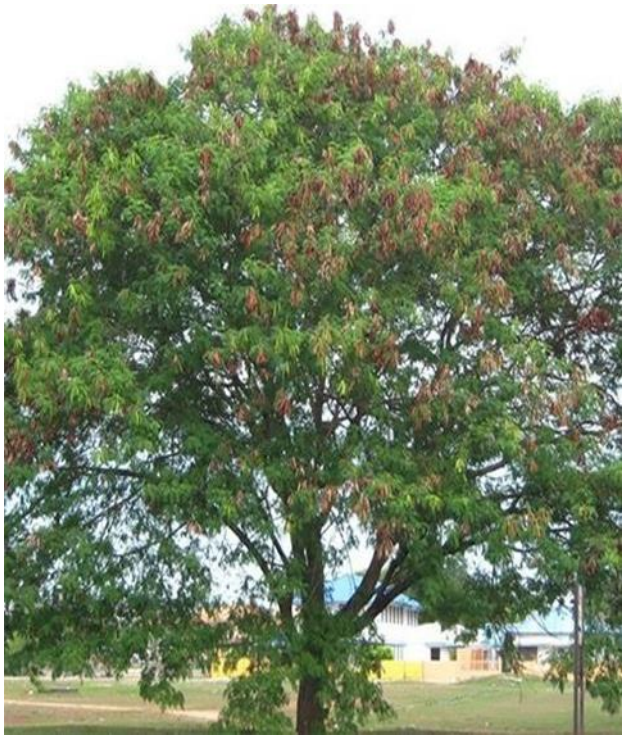

Plate 7. *Leucaena leucocephala*

Phenology:

- Evergreen plant
- Flowering – Round the year
- Fruiting – Round the year
- Seeding – Round the year

Distribution: It is native to Mexico, Gauntemala, Honduras and El Salvador. Grown in many Oceanic countries Philippines, India, Indonesia, Srilanka, Papua New Guinea, Malaysia, Hawaii, Fiji, Northern America, East and West Africa and the Caribbean Islands for various purpose soil conservation, fuel and fodder etc. In India, planted in Andhra Pradesh, Karnataka, Tamil Nadu, Himachal Pradesh etc.

Temperature: Maximum 45°C, **Rainfall: 60**0-1700 mm, Altitude: up to 1000 m

Soil: It is found to grow on diverse type of soils. It grows only on neutral to alkaline soils but low tolerance for acidic soils. Soils with low pH level give lower increments and yields. Exhibit good growth on coral and limestone outcroppings. Best growth is obtained on deep fertile soils

with adequate moisture and abundant supply of nutrients.

General Description:

- ❖ It is a large evergreen shrub or a small tree
- ❖ More than 800 species and these are broadly classified in four types: The Hawaiian type, The Salvador type, The peru type & Cunningham type.
- ❖ It produces a long tap-root and hence utilizes deep soil water and fairly drought resistant
- ❖ It is fire retardant and fire tolerant plant. It It is frost tender & good coppice ability.

Artificial regeneration:

- ❖ By sexual reproduction
- ❖ By Vegetative propagation: By cutting or planting stumps, transplanting of nursery raised seedings

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	

7.	**Irrigation**	**:**	
8.	**Fertilizer application**	**:**	
9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 8 : Nursery practices for *Robinia pseudoacacia*

Objective : To study the practices for nursery management of *Robinia pseudoacacia*

Botanical name : *Robinia pseudoacacia*
Common name : Black Locust
Family : Leguminoseae
Sub-family : Faboideae

Plate 8. *Robinia pseudoacacia*

Phenology:

- Leaf fall - September-November
- Leaf renewal - March-April
- Flowering - April-May
- Fruiting - June-July
- Fruit ripening - September-October

Distribution: It is native to North America, from where it has been introduced to France, Hungary, Belgium, Southern Russia, Italy and Balkan states. In India it was first introduced in Himachal Pradesh in 1890 and later to Jammu and Kashmir in 1919. It has performed well in outer Himalayas between 1800-3000m and in the inner Himalayas at elevations as low as 1050 m in Himachal Pradesh

Temperature: Maximum 29.4°C, **Minimum: 3.8**°C, **Rainfall: 70**0-1750 mm, Altitude: 1500-2000 m

Soil: It grows on wide variety of soils. Favours lime-derived soils having pH between 4.6 and 8.2. It is a versatile colonizer. For best growth it requires deep, rich gravelly, well drained loamy soils and avoids wet, heavy and stiff soils. Eexcessively dry soils and soils with slow drainage are not suitable for its growth.

General Description:

- ❖ It is a medium sized thorny, deciduous tree. Full grown trees have rough brown dark grey longitudinally furrowed bark.
- ❖ It is strong light demander. It is intolerant of competition. It is frost hardy, Mature trees are drought hardy.
- ❖ The tree is wind firm under ordinary wind velocity. It coppices freely

Artificial regeneration:

- ❖ By sexual reproduction
- ❖ By Vegetative propagation: By cutting or planting stumps, transplanting of nursery raised seedings

Nursery techniques:

1.	**Site selection**	**:**	
2.	**Site preparation**	**:**	
3.	**Selection of cuttings**	**:**	
4.	**Preparation of cuttings**	**:**	
5.	**Treatment of cuttings**	**:**	
6.	**Planting of cuttings**	**:**	
7.	**Irrigation**	**:**	

8.	**Fertilizer application**	**:**	
9.	**Plant protection measures**	**:**	
10.	**Utilisation**	**:**	

Practical No. 9 : Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops

Objective : To study the compatibility of MPTS with agricultural crops in agro-forestry fields

- Agroforestry is unique in many respects, both as a science and as a practice. One such aspect is its inseparable mixture of biophysical principles and social objectives.
- Amongst the inseparable components of agroforestry viz., land, tree, crop, animals and management, crop part is most important as it affects the owner's life most.
- Since the performance of the agroforestry, particularly the intercrop depends largely on the type and magnitude of tree crop interaction, management of tree and crop is very important aspect in agroforestry for its success.
- Management of tree crop interaction means enhancing the complementary effect and minimizing the competitive effect by selection of species, proper density, spacing and geometry, tree canopy management (training and pruning) and input management (water, nutrients, etc).

Exercise:

1 **Name of the visiting site: ……..**

2 **Date of the visit: ……..** **Day: …….**

3 **Locality: ……**

4 **Area (m^2): ……..**

5 **Geographical location: ……**

6 **Altitude: ……**

7 **Slope: ……**

8 **Presence of agroforestry tree species in the site**

S. No	Tree Species		No	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m^2)	Plants (m^2)	
i							
ii							
iii							
iv							
v							
vi							
vii							
viii							
ix							
x							
xi							

xii						
xiii						
xiv						
xv						
xvi						
xvii						

9 Criteria for selection of tree species: ……

……..

……

……

……

10 Identification of agroforestry systems (On the basis of structure and function):

S. No.	Name of agroforestry system	Components		
		Trees	Crops	Pasture
1.	Agri-silvi			
2.	Silvi-pasture			
3.	Agri-silvi-pasture			
4.	Others			

11 Significance of important agroforestry practices:

S. No.	Name of agroforestry practices	Components	Significance
1.	Alley cropping		

2.	**Fuel and fodder blocks**		

12 Schematic diagram :

13 Net amount of money gains by adapting particular agroforestry system: …….

…….

14 Suggestion: ……...

…….

…….

…….

…….

…….

15 Conclusion: ……

……..

……..

……..

Practical No. 10 : Visit to social forestry- Railway line plantations

Objective : To study various tree species grown in railway line platforms

- A trend toward rail-side planting for the provision of greenery, protection from dust and winds and creation of additional tree resources has developed in recent years in many countries.
- This trend is likely to spread to other countries due to the favorable results already achieved in certain countries.
- Three to six rows of trees on either side of the track are considered useful. The planting techniques are similar to those for roadside planting.
- Species vary and depend on the prevailing climatic conditions, mainly temperature, soil and rainfall.

Exercise:

1 **Name of the visiting site: ……..**
2 **Date of the visit: ……..** **Day: …….**
3 **Locality: ……**
4 **Area (m^2): ……..**
5 **Geographical location: ……**
6 **Altitude: ……**
7 **Slope: ……**
8 **Presence of agroforestry tree species in the site**

S. No	Tree Species		No	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m^2)	Plants (m^2)	
i							
ii							
iii							
iv							
v							
vi							
vii							
viii							
ix							
x							
xi							
xii							
xiii							

xiv						
xv						
xvi						
xvii						

9 Criteria for selection of tree species: ……

……..

……

……

……

10 Identification of agroforestry systems (On the basis of structure and function):

S. No.	Name of agroforestry system	Components		
		Trees	Crops	Pasture
1.	Agri-silvi			
2.	Silvi-pasture			
3.	Agri-silvi-pasture			
4.	Others			

11 Significance of important agroforestry practices:

S. No.	Name of agroforestry practices	Components	Significance
1.	Alley cropping		
2.	Fuel and fodder blocks		

12 Schematic diagram :

13 Net amount of money gains by adapting particular agroforestry system: …….

…….

14 Suggestion: ……...

…….

…….

…….

…….

…….

15 Conclusion: ……

……..

……..

……..

Practical No. 11 : Visit to social forestry- Roadside plantations

Objective : To study various tree species grown in roadside plantations

Transportation enhancement plantings along our state and federal highways and our country roads are critical elements of a complete road system.

Aims:

- Trees increase the comfort of travellers by providing shade and attractive surroundings.
- Trees may protect the road itself against moving dunes or act as a windbreak for adjacent fields.
- Trees may become an important factor by alleviating timber and fuelwood shortage. In fact, roadside trees are frequently considered a part of the national forest planting programme. Such trees may produce edible fruit, yield pods for feeding animals, furnish food and shelter for birds or, when in bloom, be valuable in beekeeping.
- Location of the trees in relation to road formation. First consideration should be given to the existing road formation so that trees ar not planted close to the inside of curves or near road junctions where they could obscure vision and so create a driving hazard. Secondly, consideration should be given to the possibility of the future widening of roads, including the development of double traffic lanes.

Exercise:

1 **Name of the visiting site: ……..**

2 **Date of the visit: ……..** **Day: …….**

3 **Locality: ……**

4 **Area (m^2): ……..**

5 **Geographical location: ……**

6 **Altitude: ……**

7 **Slope: ……**

8 **Presence of agroforestry tree species in the site**

S. No	Tree Species		No	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m^2)	Plants (m^2)	
i							
ii							
iii							
iv							
v							
vi							
vii							
viii							

ix						
x						
xi						
xii						
xiii						
xiv						
xv						
xvi						
xvii						

9 Criteria for selection of tree species: ……

……..

……

……

……

10 Identification of agroforestry systems (On the basis of structure and function):

S. No.	Name of agroforestry system	Components		
		Trees	Crops	Pasture
1.	Agri-silvi			
2.	Silvi-pasture			
3.	Agri-silvi-pasture			
4.	Others			

11 Significance of important agroforestry practices:

S. No.	Name of agroforestry practices	Components	Significance
1.	Alley cropping		

2.	**Fuel and fodder blocks**		

12 Schematic diagram :

13 Net amount of money gains by adapting particular agroforestry system: …….

…….

14 Suggestion: ……...

…….

…….

…….

…….

15 Conclusion: ……

……..

……..

……..

Practical No. 12 : Visit to social forestry- Industrial plantations

Objective : To study various tree species grown in industrial plantations

Transportation enhancement plantings along our state and federal highways and our country roads are critical elements of a complete road system.

Aims:

- Trees increase the comfort of travellers by providing shade and attractive surroundings.
- Trees may protect the road itself against moving dunes or act as a windbreak for adjacent fields.
- Trees may become an important factor by alleviating timber and fuelwood shortage. In fact, roadside trees are frequently considered a part of the national forest planting programme. Such trees may produce edible fruit, yield pods for feeding animals, furnish food and shelter for birds or, when in bloom, be valuable in beekeeping.
- Location of the trees in relation to road formation. Firstly consideration should be given to the existing road formation so that trees ar not planted close to the inside of curves or near road junctions where they could obscure vision and so create a driving hazard. Secondly, consideration should be given to the possibility of the future widening of roads, including the development of double traffic lanes.

Exercise:

1 Name of the visiting site: ……..

2 Date of the visit: …….. Day: …….

3 Locality: ……

4 Area (m^2): ……..

5 Geographical location: ……

6 Altitude: ……

7 Slope: ……

8 Presence of agroforestry tree species in the site

S. No	Tree Species		No	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m^2)	Plants (m^2)	
i							
ii							
iii							
iv							
v							
vi							

vii						
viii						
ix						
x						
xi						
xii						
xiii						
xiv						
xv						
xvi						
xvii						

9 Criteria for selection of tree species: ……

……..

……

……

……

10 Identification of agroforestry systems (On the basis of structure and function):

S. No.	Name of agroforestry system	Components		
		Trees	Crops	Pasture
1.	Agri-silvi			
2.	Silvi-pasture			
3.	Agri-silvi-pasture			
4.	Others			

11 Significance of important agroforestry practices:

S. No.	Name of agroforestry practices	Components	Significance

1.	**Alley cropping**		
2.	**Fuel and fodder blocks**		

12 Schematic diagram :

13 Net amount of money gains by adapting particular agroforestry system: …….

…….

14 Suggestion: ……...

…….

…….

…….

…….

15 Conclusion: ……

……..

……..

……..

Practical No. 13 : Visit to social forestry - Shelterbelt plantations

Objective : To study various tree species grown in shelterbelt plantations

- Shelterbelt is a wide belt of trees, shrubs and grasses, planted in rows which goes right across the land at right-angle to the direction of the prevailing winds to deflect air current, to reduce wind velocity and to give general protection to cultivated areas against wind erosion and desiccating effect of the hot winds in lee-ward side.
- A typical shelterbelt has a triangular cross-section which can be achieved by planting tall trees in the centre, flanked on both sides successively by shorter trees, tall shrubs and then low spreading shrubs and grasses.
- A certain amount of penetrability is desirable in shelterbelts as a result of which the zone of influence is very much greater and the velocity curve shows a smooth, slowly declining trend.
- The width of shelterbelt depends upon local climatic conditions, wind velocity, and the soil type.
- Shelterbelt should be oriented as nearly as possible, at right angles to the prevailing wind In case, where winds blow from different directions, shelterbelt should be raised in quadrangles

Exercise:

1 **Name of the visiting site: ……..**

2 **Date of the visit: ……..** **Day: …….**

3 **Locality: ……**

4 **Area (m^2): ……..**

5 **Geographical location: ……**

6 **Altitude: ……**

7 **Slope: ……**

8 **Presence of agroforestry tree species in the site**

S. No	Tree Species		No	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m^2)	Plants (m^2)	
i							
ii							
iii							
iv							
v							
vi							
vii							
viii							

ix						
x						
xi						
xii						
xiii						
xiv						
xv						
xvi						
xvii						

9 Criteria for selection of tree species: ……

……..

……

……

……

10 Identification of agroforestry systems (On the basis of structure and function):

S. No.	Name of agroforestry system	Components		
		Trees	Crops	Pasture
1.	Agri-silvi			
2.	Silvi-pasture			
3.	Agri-silvi-pasture			
4.	Others			

11 Significance of important agroforestry practices:

S. No.	Name of agroforestry practices	Components	Significance
1.	Alley cropping		

2.	**Fuel and fodder blocks**		

12 Schematic diagram :

13 Net amount of money gains by adapting particular agroforestry system: …….

…….

14 Suggestion: ……...

…….

…….

…….

…….

15 Conclusion: ……

……..

……..

……..

Practical No. 14 : Rapid assessment of farmers needs for green manure and fodder in selected village

Objective : To conduct rapid assessment of farmers needs for green manure and fodder in selected village

- The ensured availability of green manure and fodder as a source of sustainable livelihood and alternative source of income remained integral part of socio-economic fabric of farmers in India.
- Green manures, also referred to as fertility building crops, may be broadly defined as crops grown for the benefit of the soil. They have been used in traditional agriculture for thousands of years but conventional farming systems largely rejected them as the use of fertilizers and pesticides became more common. Although they have many roles they are still often under-utilized by today's organic farmers. However, recent emphasis on reducing the environmental impact of all farming systems (stimulated by new legislation) has led to a growing interest from the conventional sector.
- Adequate supply of quality feed, particularly fodder is essential for sustainable development of livestock as well as farming system.

Exercise:

1 Name of the selected village: ……

2 Date of the visit: …….. Day: …….

3 Locality: ……

4 Geographical location: ……..

5 Total no. of farmers to be sampled: ……

6 Estimates of fodders fed to the animals and mention their proportions to total seasonal fodder requirements (quantity per day in quintals/kgs)

S. No	Particulars	Winter season	Summer season	Rainy season
1	**Farmers own land**			
a)	Leaf fodder			
b)	Straw			
c)	Hay			
d)	Green fodder			
i)	From cultivated land			
ii)	From uncultivated land			
2	**Govt. forests**			
a)	Green grasses			
b)	Leaf fodder			
c)	Hay			
3	**Community lands**			
a)	Green grasses			
b)	Leafy fodder			
c)	Hay			

4	**Markets**			
a)	Green grasses			
b)	Leafy fodder			

7 Estimates of green manures their proportions to total seasonal requirements (quantity per day in quintals/kgs):

S. No.	**Particulars of green manures**	**Winter season**	**Summer season**	**Rainy season**
i.	**Farmers own land**			
a)				
b)				
c)				
d)				
e)				
f)				
g)				
ii.	**Community lands**			
a)				
b)				
c)				
d)				
e)				
f)				
g)				
iii.	**Markets**			
a)				
b)				
c)				
d)				
e)				
f)				
g)				

8 Conclusion: ……

……..

……..

……..

Practical No. 15 : Rapid assessment of farmers needs for fuel wood in selected village

Objective : To conduct rapid assessment of farmers needs for fuel wood in selected village

- ❖ Mastering the economic and social impact of fuel wood is of paramount importance in the bid to mitigate forest degradation and fight against poverty.
- ❖ In particular, due to continued fuel wood scarcity, rural households are developing strategies to cope with the added stress, such as increasing labor for fuel wood collection, collecting fuel wood from non-forest areas, or using crop residues.
- ❖ Adequate supply of fuel energy, particularly fuel wood is essential for farming community.

Exercise:

1 Name of the selected village: ……

2 Date of the visit: …….. Day: …….

3 Locality: ……

4 Geographical location: ……..

5 Total no. of farmers to be sampled: ……

6 Consumption of fuel energy (Per family per month)

Fuel	Winter		Summer		Rainy	
	Quantity	Value	Quantity	Value	Quantity	Value
LPG						
Coke/coal						
Agri. waste						
Firewood						
Dung cakes						
Kerosene						
Electricity						
Biogas						
Solar energy						
Others						

7 Presence of fuel wood tree species in selected village

S. No.	Tree Species		No.
	Common Name	Scientific Name	
i			
ii			

iii			
iv			
v			
vi			
vii			
viii			

11 Conclusion: ……

……..

……..

……..

Practical No. 16 : Economics and marketing of products raised in agro-forestry systems

Objective : To study on economics and marketing of products raised in agro-forestry systems in Sikkim

- Agroforestry trees play a key role in the economy of rural population and they add to diversification and contribute to nutrition and energy security of the people
- Agroforestry system have proven their financial viability and attractiveness as important land use alternatives in various setting throughout the world
- Economic analysis of agriculture and agroforestry developments is similar with a difference that agroforestry system has more than one component with complementary and supplementary roles.
- Agroforestry market is a place where buyers and sellers transact forest products, agricultural and livestock products at a particular place and time.
- The importance of marketing include optimization of resource use and output management in agroforestry, increase in farm income, widening of markets, growth of forest based industries, price signal to all stakeholders, adoption and spread of new technologies, generating employment and income at regional and national level, enhancing better living of the people and creating a form, place, time and possession utilities.

General costs of forestry enterprises

- Land value or rent
- Capital value or costs
- Costs of nursery
- Costs of raising plantation
- Costs of silvicultural practices

1. Simple rate of return (SRR) ……..
   ……..
2. Payback Period (PBP) ……..
   ……..
3. Benefit Cost Ratio (BCR) ……..
   ……..
4. Net present Value (NVP) or Net Present Worth (NPW) ……..
   ……..
5. Internal Rate of Return (IRR) ……..
   ……..

Exercise

1. Economic analysis of Agroforestry systems

S. No	Treatment	Components	Cost of cultivation	Gross return	Net return	BC ratio
1	Agri-silvi system					
2	Agri-horti system					
3	Agri-silvi-horti systems					

2. Major markets for forest, farm and agroforestry products in India

State	**Market**

3. Existing marketing channel of any fast-growing agroforestry tree in Sikkim

4. Conclusion: