

**PRACTICAL MANUAL**  
**ON**  
**Agroforestry Systems and Management**

**FSA 402 3(2+1)**

**For B.Sc. Forestry VIII Semester students**



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**2020**

**RANI LAKSHMI BAI CENTRAL AGRICULTURAL  
UNIVERSITY, JHANSI**

**Agroforestry Systems and Management FSA 402 3(2+1)**

**Practical:** Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programmes. Assessment of standing stock of tree species in various agroforestry systems such as homegardens. Survey of agroforestry practices in local/adjoining areas. Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices- agro-silvi-culture systems, silvo-pastoral systems, pastoral silviculture systems, agro-silvo-pastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks. Exercise on Diagnosis and Design of agroforestry systems and practices. Assessment of productivity of tree crop combinations. Studying resource partitioning in agroforestry systems - water, light and nutrients. Analysis of soil and plant samples for organic carbon N, P and K.

**Name of Students** .....

**Roll No.** .....

**Batch** .....

**Session** .....

**Semester** .....

**Course Name :** .....

**Course No. :** ..... **Credit** .....

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## Exercise No. 2

### Objective: Assessment of standing stock of tree species in various agroforestry systems-Homegardens

- Homegardens agroforestry system is one of the most prevalent types of land use systems suitable to high rainfall areas in tropical conditions.
- Homegardens represent intimate, multistory combinations of various perennial and annual crops, sometimes in association with domestic animals, around the homestead which serves as a permanent or temporary.
- Traditional resource management adaptations such as homegardens in agroforestry systems may potentially provide options for improvement in livelihoods through simultaneous food production (either directly food grains, fruits, vegetables and root crops or indirectly improving soil conditions and there by promoting understory crop productivity especially on degraded sites), fodder and firewood, high biodiversity, low use of external inputs, soil conservation potential, nutritional security, ecological benefits, socio-cultural as well as mitigation of the impact of climate change.
- By providing supportive and complementary roles with a flexible approach, homegardens offers specific social and environmental benefits across a range of landscapes and economies.
- Assessment of standing stock of tree species in homegarden having a huge importance in terms of biomass calculation and estimation of carbon

#### Field Exercise:

1. Name of visiting homegarden:.....
2. Location:.....
3. Area: .....
4. Locality:.....
5. Area (m<sup>2</sup>): .....
6. Presence of tree species in homegarden:

S. No.	Tree Species		No.	Uses
	Common Name	Scientific Name		
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				



## Exercise No. 3

### Objective: To conduct survey of agroforestry practices in local/ adjoining areas

- **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**.
- Agroforestry is the management and integration of trees, crops and/or livestock on the same plot of land and can be an integral component of productive agriculture. It may include existing native forests and forests established by landholders. It is a flexible concept, involving both small and large-sized land holdings.
- In agroforestry, the ecological function of trees, crops, and animals can increase food production while at the same time reducing the impact of agriculture on the environment.
- In other words, the rural poor are commonly considered as the primary beneficiaries of agroforestry; consequently, agroforestry technologies are expected to be especially relevant and applicable to small-scale land-users with low capital- and energy-requirements, and to yield products and benefits directed to immediate human needs rather than commercial advantages.

#### Field Exercise:

1. Name of the visiting agroforestry sites: .....
2. Date of visit: ..... Day: .....
3. Locality: .....
4. Area (m<sup>2</sup>): .....
5. Geographical location: .....
6. Altitude: .....
7. Slope: .....
8. Presence of agroforestry tree species in the sites

S. No	Tree Species		No.	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m <sup>2</sup> )	Plants (m <sup>2</sup> )	
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							



14.							
15.							

9. Criteria for selection of tree species: .....

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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. Agroforestry practices and their importance:

S. No.	Name of agroforestry Practices	Importance
1.		
2.		
3.		
4.		
5.		
6.		
7.		

**12. Diagrammatic representation:**



**13. Benefits of agroforestry practices to socio-economic status of the family: .....**

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**14. Suggestion: .....**

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**15. Conclusion:**

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**Exercise No. 4**

**Objective: Field observations to characterize the structural, functional and economic attributes of the agri-silviculture system**

- Agri-silviculture is a production technique which combines the growing of agricultural crops with simultaneously raised and protected forest crops. This practice, called agri-forestry, has been in existence in various primitive forms since man learned to clear forests and cultivate land, and has different names in different parts of the world.
- In various ways agri-silviculture seeks to create harmony between crop farming and tree farming. Decidedly, the system is not an easy one and at times the plans may not fully materialize. indeed, those patient, flexible and intelligent administrators who understand and sympathize with the forest farmers, their traditions and their human needs are among the most important elements of success of any system of agri-silviculture.

**Advantages:**

- Produce multiple products such as food/vegetables/fruits, fodder and forage needed for livestock, fuel wood, timber, and leaf litter needed for organic manure production.
- Improve and sustain the crop productivity which increases the level of income of the farmers.
- Improve the nutritive value of animal feed due to the supply of green fodder.
- This is also the best practice for soil nutrient recycling, which also helps to reduce chemical fertilizer purchase.
- Improve the farm site ecology by reducing surface run off, soil erosion and nutrient loss, gully formation and landslides.
- Improve the local micro-climate and enhance the productive capacity of the farm.
- Reduce pressure of community forests and other natural forests for fodder, fuel wood and timber.
- This practices helps for the beautification of the surrounding areas

**Field Exercise:**

1. **Name of the visiting agri-silviculture system sites:**.....
2. **Date of visit:** ..... **Day:** .....
3. **Locality:** .....
4. **Area (m<sup>2</sup>):** .....
5. **Geographical location:** .....
6. **Altitude:** .....
7. **Slope:** .....
8. **Presence of tree and crop species in agri-silviculture system**

S. No	Tree Species		No.	Uses	Distance		Crop Component	
	Common Name	Scientific Name			Rows (m <sup>2</sup> )	Plants (m <sup>2</sup> )	Common Name	Scientific Name
1.								
2.								
3.								



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**11. Diagrammatic representation:**



**12. Net amount of money gains by adapting agri-silviculture system: .....**

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**13. Suggestions: .....**

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**14. Conclusion: .....**

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**Exercise No. 6**

**Objective: Field observations to characterize the structural, functional and economic attributes of the pastoral- silviculture system**

- The pasture combined with production of woody plants is referred to as a **pastoral- silviculture**. The trees and shrubs may be used primarily to produce fodder for livestock or they may be grown for timber, fuel wood, and fruit or to improve the soil.
- Based on the commodity involved agroforestry can be classified into pastoral-silviculture system that include grasses, ground legumes and livestock in the shrubs and tree integration.
- This development is largely contributing to meet the growing demand for food of plants and animal origin subsequently is enhancing the socio-economic condition of rural population and maintaining, if not increasing, sustainability of land utilization.

**Field Exercise:**

1. **Name of the visiting silvo-pastoral system sites:**.....
2. **Date of visit:** ..... **Day:** .....
3. **Locality:** .....
4. **Area (m<sup>2</sup>):** .....
5. **Geographical location:** .....
6. **Altitude:** .....
7. **Slope:** .....
8. **Presence of pastures and trees species and in pastoral- silviculture system**

S. No	Tree Species		No.	Uses	Distance		Pastures	
	Common Name	Scientific Name			Rows (m <sup>2</sup> )	Plants (m <sup>2</sup> )	Common Name	Scientific Name
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

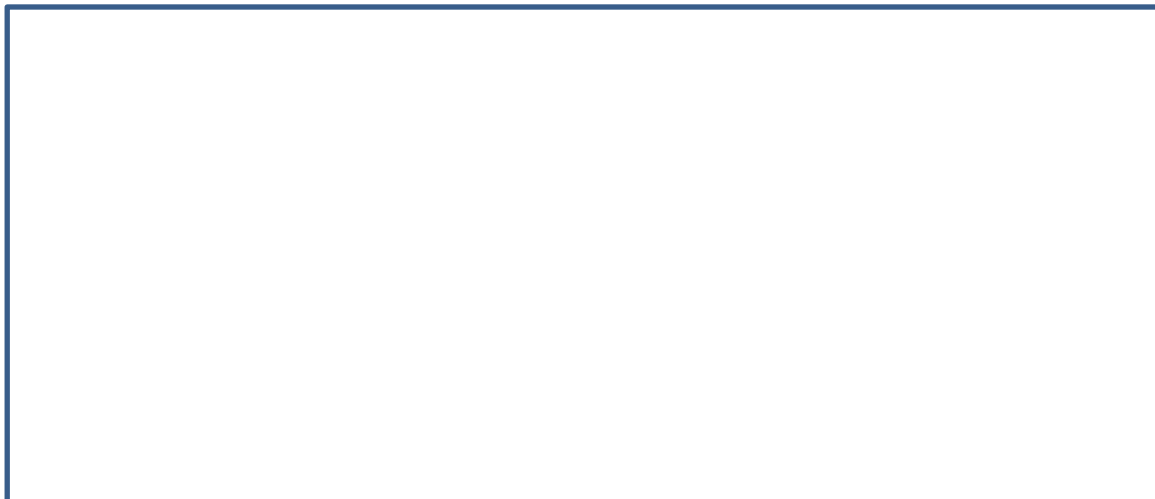
9. **Criteria for selection of pasture and tree species:** .....
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**11. Function of visited pastoral- silviculture system** .....

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**11. Diagrammatic representation:**



**12. Net amount of money gains by adapting pastoral- silviculture system:** .....

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**13. Suggestions:** .....

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**14. Conclusion:** .....



9. **Criteria for selection of tree, crop and pasture species:** .....

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12. **Function of visited agri-silvi-pastoral system:**.....

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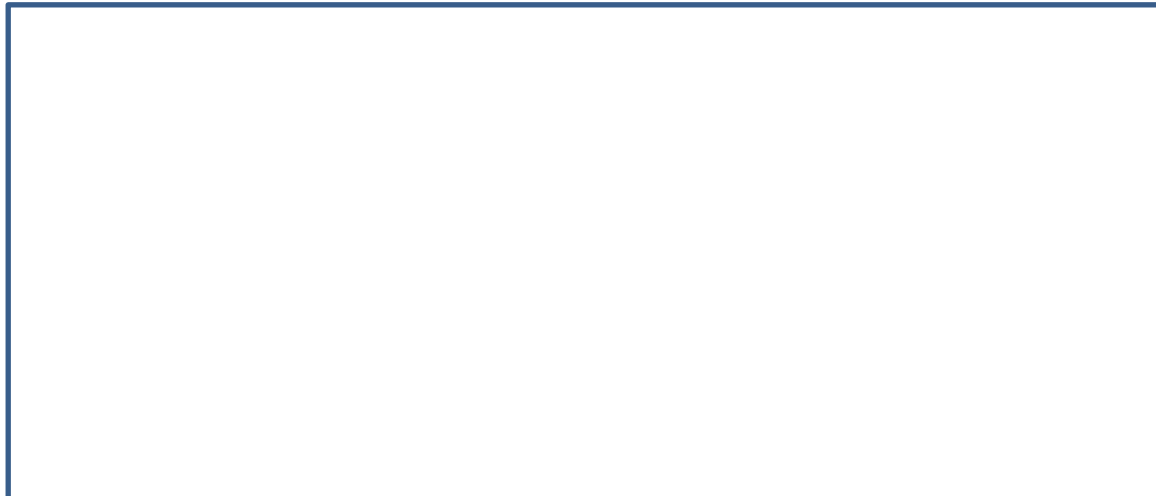
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11. **Diagrammatic representation:**



12. **Net amount of money gains by adapting agri-silvi-pastoral system:** .....

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13. **Suggestions:** .....

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14. **Conclusion:** .....

### Exercise No. 8

**Objective: Field observations to characterize the structural, functional and economic attributes of the shelterbelts and windbreaks**

- Windbreaks are rows of trees or shrubs that reduce the force of the wind. They can reduce soil erosion, increase crop yields and protect livestock from heat and cold. Windbreaks can shield buildings and roads from drifting snow. They beautify the landscape and provide travel routes and habitat for wildlife. Windbreaks can also be sources of wood and food.
- 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.

#### Advantages:

- Mitigating soil loss from wind erosion
- Providing higher yield and product quality over parts of cropped fields
- Mitigating the effects of pesticide spray drift
- Permitting better crop pollination by reducing wind speeds
- Reducing irrigation needs and assist with disease control
- Protecting crops from early frost damage by circulating air
- Reducing energy consumption and odour control around livestock barns

#### Field Exercise:

1. **Name of the visiting shelterbelts and windbreaks sites:** .....
2. **Date of visit:** ..... **Day:** .....
3. **Locality:**  
.....
4. **Area (m<sup>2</sup>):** .....
5. **Geographical location:** .....
6. **Altitude:** .....
7. **Slope:** .....
8. **Presence of multipurpose tree species in the sites**

S. No	Tree Species		No.	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m <sup>2</sup> )	Plants (m <sup>2</sup> )	
1.							
2.							
3.							
4.							

5.							
6.							
7.							
8.							
9.							
10.							

9. **Criteria for selection of tree species for shelterbelts and windbreak:**.....  
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13. **Function of visited shelterbelts and windbreak** .....  
 .....  
 .....  
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11. **Diagrammatic representation:**

12. **Net amount of money gains by adapting shelterbelts and windbreak:** .....  
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13. **Suggestions:** .....  
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**14. Conclusion:** .....  
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**Exercise No. 9**

**Objective: Field observations to characterize the structural, functional and economic attributes of the live fences**

- Living fences are lines of trees or shrubs planted on farm boundaries or on the borders of home compounds, pastures, fields or animal enclosures.
- Their main purpose is to control the movement of animals or people.
- This purpose is what differentiates them from other agroforestry technologies based on trees planted in lines, such as boundary plantings, contour strips or hedgerow intercropping.
- Besides their main function to control human and animal movement living fences may provide fuel wood, fodder and food, act as windbreaks or enrich the soil, depending on the species used

**Field Exercise:**

- 1. Name of the visiting live fence sites:** .....
- 2. Date of visit:** ..... **Day:** .....
- 3. Locality:**  
.....
- 4. Area (m<sup>2</sup>):** .....
- 5. Geographical location:** .....
- 6. Altitude:** .....
- 7. Slope:** .....
- 8. Name of potential tree species to be used in live fence**

S. No.	Tree Species		Other Information
	Common Name	Scientific Name	
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

9. **Criteria for selection of tree species for live fence:**.....  
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10. **Function of visited live fence** .....  
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11. **Diagrammatic representation:**



12. **Net amount of money gains by adapting live fence:** .....  
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13. **Suggestions:** .....  
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14. **Conclusion:** .....

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### Exercise No. 10

#### **Objective: Field observations to characterize the structural, functional and economic attributes of the fodder trees and protein banks**

- Fodder trees are important feed sources for livestock in a wide range of agroforestry systems throughout the world. Researchers, extension services and farmers have developed and promoted fodder tree practices in many different countries and contexts
- Protein banks are fodder banks where trees, shrubs and pasture legumes with high protein-containing leaf biomass are combined. Trees are planted as close as 1 m x 1m and cut regularly to induce maximum herbage production
- In this system of agroforestry, various multipurpose trees (protein rich trees) are planted on wasteland and rangelands for cut and carry fodder production to meet the feed requirements of livestock during the fodder deficit period in winter.
- In this category, the system components are multipurpose trees that are usually protein-rich trees planted in or around the farmlands for providing animal feeds. The common components in this system are *Acacia nilotica*, *Azadirachta indica*, *Albizia lebbeck*, *Gliricidia sepium*, *Leucaena leucocephala*, and *Sesbania grandiflora*

#### **Field Exercise:**

1. **Name of the visiting protein bank sites:** .....

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

3. **Locality:**  
.....

4. **Area (m<sup>2</sup>):** .....

5. **Geographical location:** .....

6. **Altitude:** .....

7. **Slope:** .....

8. **Presence of potential trees in protein bank sites**

S. No.	Tree Species		Other Information
	Common Name	Scientific Name	
1.			
2.			
3.			
4.			
5.			

6.			
7.			
8.			
9.			
10.			
11.			

9. **Criteria for selection of fodder trees in protein bank sites:**.....  
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11. **Function of visited protein bank sites** .....  
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11. **Diagrammatic representation:**

12. **Net amount of money gains by adapting protein bank:**  
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13. **Suggestions:** .....  
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14. **Conclusion:** .....

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**Exercise No. 11**

**Objective: Studies on Design & Diagnostics (D&D) exercise in agroforestry**

- D&D is a methodology for the diagnosis of land-management problems and the design of agroforestry solutions.
- It was developed by ICRAF to assist agroforestry researchers and development fieldworkers to plan and implement effective research and development projects.
- D&D is simply a systematic approach to the application of this principle in agroforestry.

**Key features of D&D:**

- **Flexibility:** D&D is a discovery procedure which can be adapted to fit the needs and resources of a wide variety of land users.
- **Speed:** D&D has been designed to allow for a "rapid appraisal" application at the planning stage of a project with in-depth analysis occurring during project implementation.
- **Repetition:** D&D is an open-ended learning process. Since initial designs can almost always be improved, the D&D process need not end until further improvements are no longer necessary

**Basic procedures of the Diagnosis and Design (D&D) methodology:**

D&D Stages	Basic questions to answer	Key factors to consider	Mode of inquiry
Pre-diagnostic			
Diagnostic			
Design & Evaluation			
Planning			
Implementation			

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Studies on **Pre-diagnostic & Diagnostic** stage under **D&D** exercise in agroforestry

**Pre-diagnostic stage:**

1. **Planning the study:** .....

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2. **Regional reconnaissance:** .....

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3. **Land-use system:** .....

.....

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**4. Site Selection**

- **On the basis of severity of problems:** .....
- .....
- **Agroforestry potential:** .....
- .....
- **Regional representativeness:** .....
- .....
- **Priority by land use systems:** .....
- .....
- **Priority by region:** .....
- .....
- **Selected land-use systems:** .....
- .....

**Diagnostic stage:**

5. **Diagnostic survey:** .....

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6. **Diagnostic analysis:** .....

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7. System specifications: .....

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**Exercise No. 12**

**Objective: Studies on Design & Evaluation stage under D&D exercise in agroforestry**

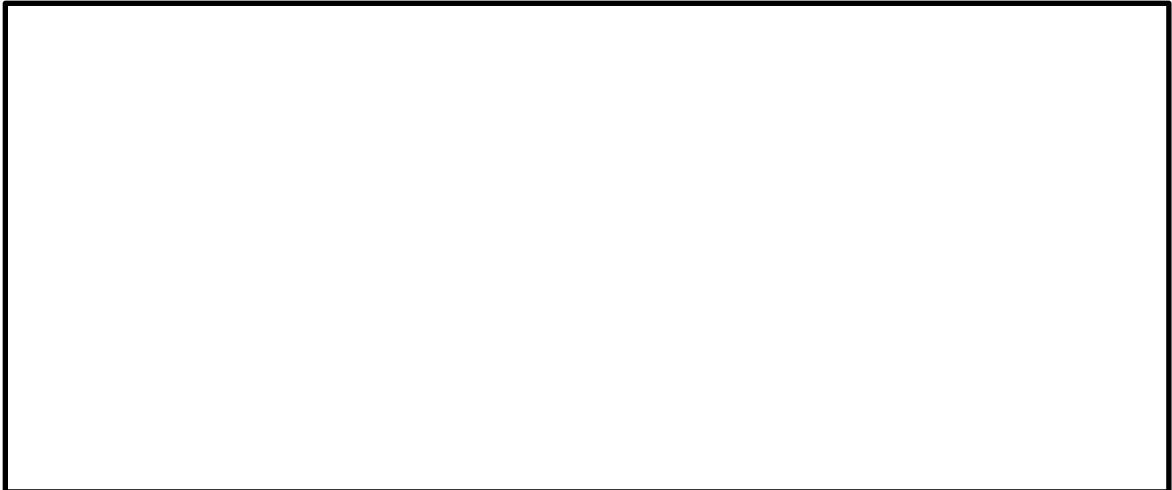
**Technology design:**

1. Candidate technologies:

2. Technology specifications:



**3. Technology Design:**

A large, empty rectangular box with a black border, intended for the user to provide details about the technology design.

**Evaluation & redesign:**

**4. Ex-ante evaluation & redesign:**

A large, empty rectangular box with a black border, intended for the user to provide details about the ex-ante evaluation and redesign process.

**Suitability Classification:**

A large, empty rectangular box with a black border, intended for the user to provide details about the suitability classification.

**Exercise No. 13**

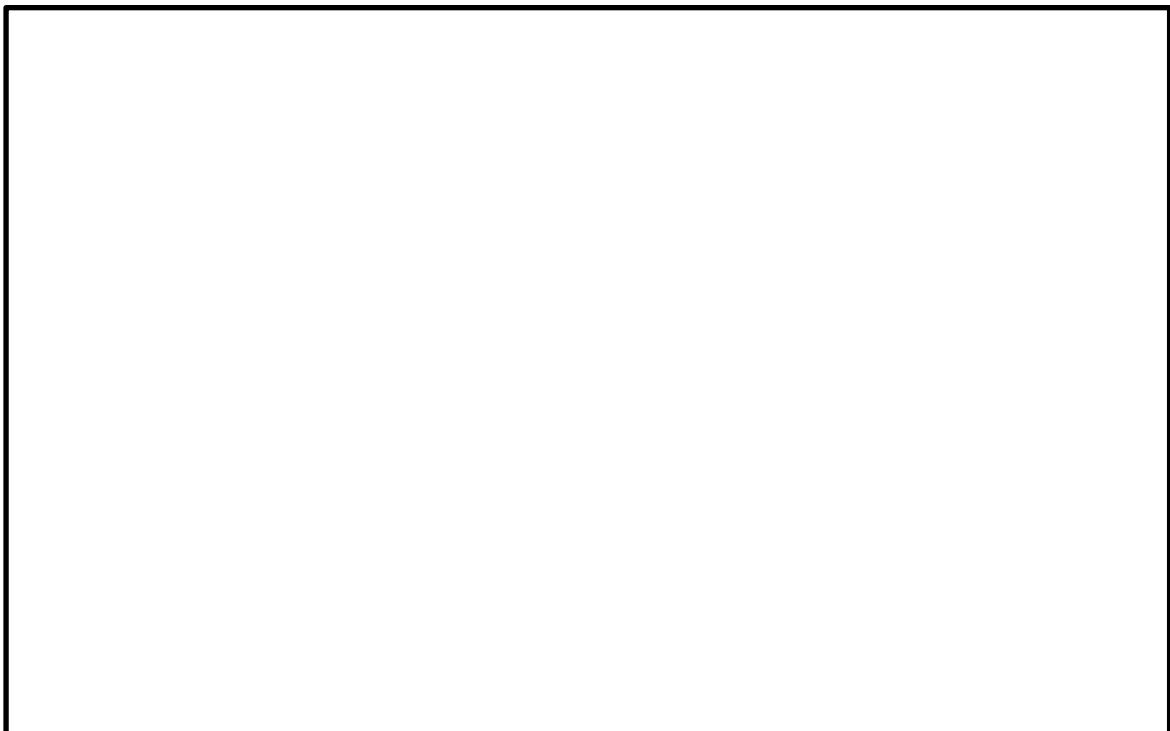
**Objective: Studies on Planning & Implementation stage under D&D exercise in agroforestry**

**Planning stage:**

**1. Research needs:**

A large, empty rectangular box with a black border, intended for the student to write their research needs.

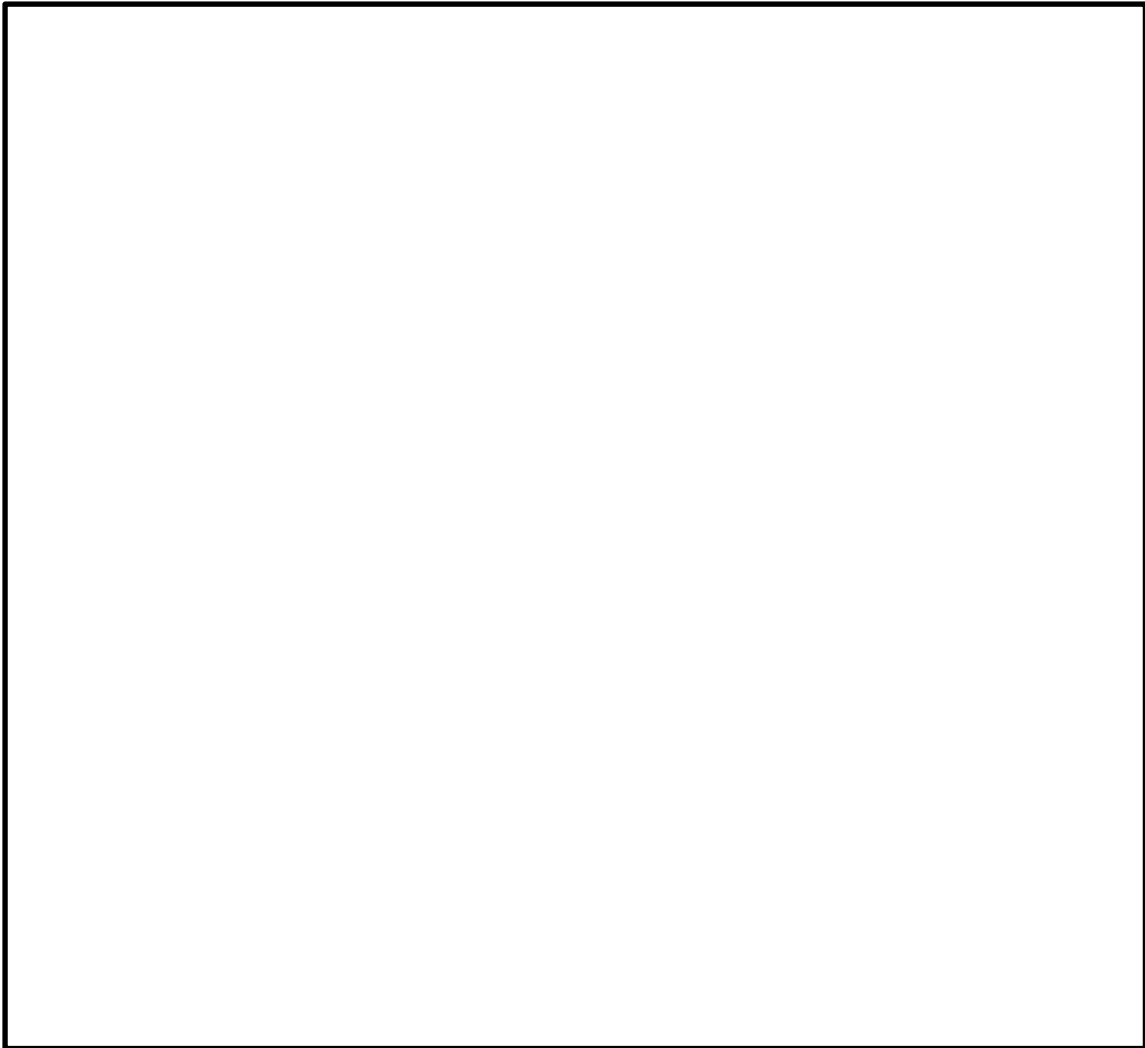
**2. Research and extension plans:**

A large, empty rectangular box with a black border, intended for the student to write their research and extension plans.



**Implementation stage:**

**3. Programme implementation:**



**Conclusion:** .....

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## Exercise No. 14

### Objective: Assessment of productivity of tree crop combinations

- Agroforestry has attracted considerable attention in recent years because of its potential to reduce poverty, improve food security, reduce land degradation and mitigate climate change. However, progress in promoting agroforestry is held back because decision-makers lack reliable tools to accurately predict yields from tree-crop mixtures.
- Agroforestry systems, containing mixtures of trees and crops, are often promoted because the net effect of interactions between woody and herbaceous components is thought to be positive if evaluated over the long term. From a modeling perspective, agroforestry has received much less attention than monocultures. However, for the potential of agroforestry to impact food security in country to be fully evaluated, models are required that accurately predict crop yields in the presence of trees.

#### Field Exercise:

##### 1. Presence of agroforestry tree species in the sites

S. No	Tree Species		No.	Uses	Distance		Other Information
	Common Name	Scientific Name			Rows (m <sup>2</sup> )	Plants (m <sup>2</sup> )	
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

##### 2. Criteria for selection of tree species: .....

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3. 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			

4. Productivity of agroforestry systems:

S. No.	Name of agroforestry system	Components yield (Yield/ year)			Total income
		Trees	Crops	Pasture	
1.	Agri-silvi				
2.	Silvi-pasture				
3.	Agri-silvi-pasture				
4.	Others				























**Reagents and Apparatus:** .....

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**Procedure:**.....

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**Calculations:**

**Interpretation:**.....

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