

LECTURE - 8

LEARNING OBJECTIVE: TO KNOW ABOUT SELECTION OF TREE CROP SPECIES FOR AGROFORESTRY

Agroforestry is a deliberate integration of trees and crops in general, in same unit of land. These trees and crops compete with each other for nutrients, moisture and light. Therefore there are both +ve and –ve interaction among different components. In order to have a positive interaction among different components one must select a compatible component so that from a single unit of land a farmer/cultivator maximize his production. While selecting tree species for agroforestry three factors must taken into consideration such as...

- CLIMATE
- SOIL
- BIOTIC FACTOR

CLIMATE:- TREE SPECIES SELECTED FOR AGROFORESTRY TAKEN INTO ACCOUNT CLIMATE FACTOR

Hot desert: *Prosopis cineraria*, *P. chinensis*, *Acacia tortilis*, *Capparis spp*, *Tecomella undulate*

Cold desert: *Populus nigra*, *P. cilita*, *P. alba*, *P. tremula*, *P. euphratica*, *salix alba*, *S fragilis*, *Juniperus*

Tropical semi-arid: *Prosopis spp*, *Acacia tortilis*, *A. nilotica*, *A. senegal*, *Albizia lebbeck*, *Eucalyptus camaldulensis*, *Azadirachta indica*, *Salvadora persica*, *Tamarix spp*

Subtropical semi arid: *Pinus roxburghii*, *Acacia modesta*, *Albizia procera*, *Bauhinia variegata*, *Morus indica*, *Ficus spp*

Temperate semi arid: *Pinus gerardiana*, *Juniperus macropoda*, *Corylus colurna*

Humid tropical: *Terminalia myriocarpa*, *Tectona grandis*, *Terminalia alata*, *Schima wallichii*, *Gmelina arborea*, *Dipterocarpus macrocarpus*, *Cocos nucifera*, *areca catechu*, *Artocarpus*

heterophyllus, Pterocarpus santalinus, Chukrasia tubularis

Humid subtropical: *Eucalyptus globulus, Acer oblongum, Acrocarpus fraxinifolius, Aesculus indica, Pinus kesiya, Prunus spp, Quercus spp*

Humid temperate: *Acer campbellii, abies pindrow, Quercus spp, Robinia pseudacacia, Pinus alata, P. wallichiana, Alnus nitida, Populus ciliata, Cryptomeria japonica*

Subtropical semi-humid: *Albizia chinensis, Pinus roxburghii, P. kesiya, P. ellioti, Grewia optiva, Celtis australis, Eucalyptus grandis, E. globulus, Toona ciliata*

Tropical sub-humid: *Eucalyptus teriticornis, E. citridora, Casuarina equisetifolia, Dalbergia latifolia, Bombax ceiba, Morus alba, Leucaena leucocephala, Dalbergia sissoo, Anthocephalus chinensis, Adina cardifolia, populus deltoides, Moringa oleifera*

Subtropical semi-humid: *Albizia chinensis, Pinus roxburghii, Grewia optiva, Celtis australis, Morus indica, Toona ciliata, Eucalyptus grandis, Eucalyptus globules*

Temperate semi-humid: *Acacia mearnsii, Acer oblongum, Alnus nepalensis, Cedrus deodara, Celtis australis, Fraxinus spp, Quercus spp, Juglans regia*

SOIL:- TREE SPECIES SELECTED FOR AGROFORESTRY TAKING INTO ACCOUNT SOIL TYPE

Desert soil: *Prosopis cineraria, P. chilensis, Acacia tortilis, A. senegal, A. nilotica, Salvadora spp*

Recent alluvium: *Acacia catechu, Dalbergia sissoo, Bombax ceiba etc.*

Old alluvium:

Saline-alkali soils: *Prosopis spp, Acacia nilotica, Azadirachta indica, Ailanthus spp, Eucalyptus spp, Tamarix spp, Pongamia pinnata*

Coastal and deltaic alluvium: *Casuarina equisetifolia, Cocus nucifera, Areca catechu, Avicennia spp*

Red soils: *Tectona grandis*, *Madhuca indica*, *Mangifera indica*, *Dalbergia sissoo*, *Acacia nilotica*, *Leucaena leucocephala*, *Azadirachta indica*, *Eucalyptus hybrid*, *Pterocarpus marsupium*, *Adina cardifolia*, *Dendrocalamus strictus*

Black cotton soils: *Acacia nilotica*, *A leucophloea*, *Tectona grandis*, *Hardwickia binnata*, *Adina cardifolia*, *Tamarandius indica*, *Aegle marmelos*, *Bauhinia spp*, *Dalbergia latifolia*

Laterite and lateric soils: *Tectona grndis*, *Eucalyptus spp*, *Acacia auriculiformis*, *Azadirachta indica*, *Tamarindus indica*, *Embllica officinalis*

Peaty and organic soil: *Syzygium cuminii*, *Ficus glomerata*, *Bischofia javanica*, *Lagerstromia speciosa*, *Glircidia sepium*

Hill soils: *Juglans regia*, *Alnus nitida*, *Toona serrata*, *Cedrus deodra*, *Quercus spp*, *Grewia optiva*, *Celtis australis*

BIOTIC FACTORS:- Choice of species is also governed by biotic factors such as grazing, fire and incidence of Insect pest etc.

DESIRABLE CHARACTERISTICS FOR AGROFORESTRY

While selecting tree species for agroforestry systems, the following desirable characteristics should be taken into consideration. Though all desirable characters are not found in a single species, but their multiple uses are taken care of.

- **Tree species selected should not interfere with soil moisture**
 - ✓ Tree species selected for agroforestry should have very less water requirement
 - ✓ Should not compete with main agricultural crops for water.
 - ✓ Tree species should be deep tap rooted so that they can draw water from deep strata of the soil.
- **Tree species should not compete for plant nutrients**
 - ✓ Tree species should not utilize more plant nutrients
 - ✓ They should help in building soil fertility,
 - ✓ Leguminous tree species which fix atmospheric nitrogen in their roots should be prfer.
 - ✓ The root system and root growth characteristics should ideally result in to exploration of soil layers that are different to those being trapped by agricultural crops.
- **Tree species should not compete for sunlight**

- ✓ Tree species should not interrupt sunlight falling on the crops.
- ✓ Tree species should be light branching in their habit.
- ✓ Trees permit the penetration of light into the ground and promote better crop, pasture growth and yield.
- ✓ Tree species can withstand pruning operation if it posses dense canopy.
- **Tree species should have high survival rate and easy establishment**
 - ✓ Trees species should have high survival percentage,
 - ✓ Leave little or no gaps after transplanting.
 - ✓ Hardy tree species are easy to establish.
 - ✓ They have less mortality percentage because they can tolerate transplanting shocks easily.
 - ✓ Trees should have the ability to regenerate lateral roots within a short period of time after transplanting.
- **Tree species should have fast growing habit and easy management**
 - ✓ Tree species for agroforestry system should be essentially fast growing,
 - ✓ Rapid growth, especially in the early years,
 - ✓ Tree should have short rotation (the period between planting and final harvesting)
 - ✓ Fast growing species such as Poplar, *Casuriana*, *Leucaena leucocephala* etc. are important species which provide lot of opportunities to be planted in AFS
- **Tree species should have wider adaptability**
 - ✓ A tree species selected for agroforestry combinations must have a wider adaptability.
- **Tree species should have high palatability as a fodder**
 - ✓ Most of the Indian farmers rear livestock separately and cut and carry method of fodder production is quite prevalent.
 - ✓ Therefore, in agroforestry, farmer must select those tree species which are palatable to livestock and had a high digestibility.
- **Tree species should have shelter conferring and soil stabilization attributes**
 - ✓ Some tree species, because of their inherent growth habit and adaptability, are especially

helpful in providing protection for soils, crops and livestock. Poplars (*Populus* spp.), Willows (*Salix* spp.), *Casuarina equisetifolia*, etc. for example, have been extensively used in soil erosion control because of their extensive root system and ability to grow in water-logged soils.

- **Tree species should have capability to withstand management practices**
 - ✓ Many agroforestry systems demand extensive pruning and lopping of the trees in order to maximize production. In such cases, the trees must be able to withstand such treatment without drastically restricting growth rate.
- **Tree species should have nutrient cycling and nitrogen fixation attributes**
 - ✓ Within an agroforestry system, trees can play an important role in recycling nutrients, leached down through the soil profile and minerals released from weathering parent material such as rocks and sediments.
 - ✓ These nutrients are used in the growth and development of the tree, many returning to the top-soil in form of dead leaves, twigs, flowers and seeds which slowly decompose on the surface, or are eaten by animals.
 - ✓ Although all trees play some role in maintaining the nutrient status of the soil through recycling.
 - ✓ Deciduous trees drop most of their leaves in autumn leaving a thick mat of leaves on the ground, whereas most evergreen species maintain some level of litter fall throughout the year.
 - ✓ Another important factor is the ability of many tree species to convert atmospheric nitrogen into organic nitrogen for their own use through complex symbiotic relationship between Rhizobium bacteria and their fine roots.
 - ✓ The bacteria form nodules on the roots which can convert nitrogen gas, as it is in the atmosphere, into usable nitrogen for the plant.
 - ✓ Most leguminous trees and some non-leguminous ones, such as *Acacia*, *Leucaena* and *Prosopis* as well as *Casuarina* spp. fix the atmospheric nitrogen.
 - ✓ The litter of these nitrogen fixing trees is generally high in nitrogen, thus increasing the nitrogen status of the soil.

The following are a few tree species which help in fixing atmospheric nitrogen through their roots:

Table 8.1 Nitrogen fixing tree species

| | | | |
|-----|------------------------------|-----|--------------------------------|
| 1. | <i>Acacia albida</i> | 21. | <i>Bauhinia variegata</i> |
| 2. | <i>Acacia auriculiformis</i> | 22. | <i>Butea monosperma</i> |
| 3. | <i>Acacia catechu</i> | 23. | <i>Cassia fistula</i> |
| 4. | <i>Acacia aneura</i> | 24. | <i>Cassia siamea</i> |
| 5. | <i>Acacia dealbata</i> | 25. | <i>Casuarina equisetifolia</i> |
| 6. | <i>Acacia decurrens</i> | 26. | <i>Dalbergia latifolia</i> |
| 7. | <i>Acacia farnesiana</i> | 27. | <i>Dalbergia sissoo</i> |
| 8. | <i>Acacia implexa</i> | 28. | <i>Delonix regia</i> |
| 9. | <i>Acacia leucophloea</i> | 29. | <i>Gliricidia sepium</i> |
| 10. | <i>Acacia mearnsii</i> | 30. | <i>Hardwickia binata</i> |
| 11. | <i>Acacia melanoxylon</i> | 31. | <i>Leucaena leucocephala</i> |
| 12. | <i>Acacia mollissima</i> | 32. | <i>Moringa oleifera</i> |
| 13. | <i>Acacia nilotica</i> | 33. | <i>Oogetinia oogetinensis</i> |
| 14. | <i>Acacia planifrons</i> | 34. | <i>Parkinsonia aculeata</i> |
| 15. | <i>Acacia senegal</i> | 35. | <i>Peltophorum ferrugineum</i> |
| 16. | <i>Albizia chinensis</i> | 36. | <i>Pithecellobium dulce</i> |
| 17. | <i>Albizia lebbek</i> | 37. | <i>Prosopis alba</i> |
| 18. | <i>Albizia procera</i> | 38. | <i>Prosopis chilensis</i> |
| 19. | <i>Alnus nepalensis</i> | 39. | <i>Prosopis cineraria</i> |
| 20. | <i>Alnus nitida</i> | 40. | <i>Robinia pseudoacacia</i> |
| 41. | <i>Samanea saman</i> | 44. | <i>Sesbania bispinosa</i> |
| 42. | <i>Saraca indica</i> | 45. | <i>Sesbania grandiflora</i> |
| 43. | <i>Sesbania aegyptica</i> | 46. | <i>Tamarindus indica</i> |

- **Tree species should have thin bark**

- ✓ Species selected for agroforestry combinations should not shed its bark regularly but it should retain for longer period as bark shedding creates unhygienic conditions for under-ground crop.

- **Tree species should be free from chemical exudations**

- ✓ The species selected for agroforestry combination must be free from allelo-chemicals as these allelo-chemicals affect the growth of under-ground crops.

- **Tree species should have easily decomposable leaves**

- ✓ The suitable tree species for agroforestry will be that one in which fallen leaves decompose with fast rate.

- ✓ The leaves of most of the legume tree species are small in size, decompose quickly and easily, and add a large quantity of organic matter and nutrients to the soil.
 - ✓ Tree species having broad leaves such as teak, mango and banyan should not be preferred for agroforestry system.
 - ✓ They contain more fibre matter and also require longer time for decomposition. Further, broad leaves when fall on the tender crop plants, block their photosynthetic activities.
- **Tree species should have their multiple uses**
 - ✓ The selected tree species should have multiple uses.
 - ✓ The tree should yield more than one of the main produce like fuelwood, leaf fodder, edible fruit, edible flower and fibre.
 - **Tree species should have high yield potential**
 - ✓ High yield potential is the most important criterion of selection of tree species for agroforestry systems as the main aim is to obtain overall more output per unit area. Care should be taken before collection of seeds and seedlings that they are being procured from reliable source.

CHARACTERISTICS OF AGRICULTURAL CROPS FOR AGROFORESTRY

- a) Agricultural crops should be short duration and quick growing.
- b) They should be at least partially tolerant to shade.
- c) Most of them should belong to Leguminosae family.
- d) They should respond well to high density tree planting.
- e) They should bear some adverse conditions, like water stress and/or excess of watering;
- f) Crops should return adequate organic matter to soil through their fallen leaves, root system, stumps, etc.
- g) Crops should appropriately be fitted in intensive or multiple cropping system.