



FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

Shelterbelt

- 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.

Height and spacing:

- Height of shelterbelt is very important
- As it affects the distance to which protection will be afforded on the lee-ward side.
- Higher the trees forming the shelterbelt, the greater is the zone of influence on the leeward side.
- This affects the spacing of the shelterbelts also. If wind erosion has to be completely controlled, the second belt should be located a little before the place where the wind on the lee-ward side often first shelterbelt assumes damaging velocity.

- Taking 20% reduction in wind velocity as the basis of usefulness of a shelterbelt, effective protection zone extends up to 15 to 20 times the height of the belt.
- In Rajasthan, taking the height of shelterbelt to be about 7.5 m, spacing recommended is 10 times the height, i.e., 75 meters.

Length:

- The length of shelterbelt is an important consideration because at the ends of the shelterbelt eddies are produced resulting in increasing the wind velocity at these places.
- It is because of this that road is not ordinarily allowed to cross a shelterbelt.
- In some of the western countries, shelterbelts have been raised right across the country for the protection they afford
- For shorter shelterbelt, the minimum length of shelterbelt to be most effective is 24 times its height.

Soil Preparation:

- Soil preparation should be done at least a year in advance to build up sufficient reserve of soil moisture.
- It may be done either mechanically or by manual labour.
- Leguminous crops may be raised for the first few years in between the rows of trees and shrubs for improving the fertility of the soil.

Choice of species:

- The choice of species to be raised in shelterbelt is governed by the climate, soil and topography of the area.
- It is better to raise local species because of their easy establishment.
- Exotics may also be used to improve the efficiency of the shelterbelts.

Characteristics of tree spp. used for shelterbelt:

- The species selected should be non-exacting;
- Fast-growing;
- Wind-firm;
- Drought-resistant;
- Unpalatable to animals;
- It should have a dense crown and low branching habit;
- It should not be leafless at a time when protection is required;
- It should be economically a multipurpose species, i.e., fit for firewood, timber and fodder.

The following species are recommended for creation of shelter belt:

Grasses:- *Cenchrus barbatus*, *Saccharum spontaneum*, *Saccharum munja*, *Panicum turgidum*, *Panicum antidotale*.

Shrubs:- *Calotropis procera*, *Crotalaria burhia*, *Calligonum polygonoides*, *Clerodendron phlomoides*, *Cassia auriculata*, *Dodonaea viscosa*, *Jatropha curcas*, *Leptadenia spartivm*, *Agave spp.*, *Sesbania aculeata*.

Small trees:- *Acacia jacquemontii*, *Acacia leucophloea*, *Balanites aegyptiaca*, *Capparis aphylla*, *Salvadora oleoides*.

Trees:- *Acacia arabica*, *Acacia senegal*, *Acacia cyanophylla*, *Albizia lebbek*, *Azadirachta indica*, *Dalbergia sissoo*, *Lannea coromandelica*, *Parkinsonia*

aculeata, Prosopis cineraria, Prosopis juliflora, Pongamia pinnata, Tecoma undulata, Tamarix articulata, Eucalyptus spp., Acacia tortilis.

Method of raising the plants:-

- It is better to sow the seeds in polythene bags and plant out the plants so raised.
- For this purpose nurseries should be maintained at site.
- The plant should be regularly watered for one or two years.
- Properly fenced to protect them from browsing cattle.

Advantages of Shelterbelts:-

- Very little research work has been done in our country.
- To find out the benefits of the shelter-belts on yields of agricultural crops, horticultural crops and grasses.
- However, on the basis of research work done in CAZRI, TNAU and abroad, the following advantages of the shelterbelts may be mentioned:

Moderating effect on temperature:-

- Shelterbelt has a moderating effect on air and soil temperature by lowering the maximum and raising the minimum.
- Temperature during day time inside the forest is lower.
- Temperature during night is higher inside the forest than open.

Increase in humidity:-

- Shelterbelts increase relative humidity from 1 to 50%.
- There is distinctly perceptible increase in the average relative humidity in the agricultural land protected by shelterbelts

Reduction in evapo-transpiration:-

- Shelterbelts reduce evapo-transpiration sufficiently in the zone of their influence.

Increase in soil moisture:-

- Shelterbelts increase the moisture content of the soil on the leeward side and delay its drying up during summer.
- They also increase the underground water supplies by promoting infiltration in the soil.

Reduction in wind velocity and wind erosion:-

- Shelterbelts deflect the wind upwards
- Cause considerable reduction in the wind velocity on the leeward side upto a distance of 15 to 20 times the height of the trees forming the shelterbelt.
- As there is considerable reduction in the wind velocity on the leeward side of a shelterbelt, wind erosion is very much reduced.

Increase in agricultural and horticultural crops:-

- Shelterbelts increase production of agricultural and horticultural crops.
- Study made in 8 cotton fields in distinctly semi-arid areas of U.S.A. revealed an increase of 17.4% in cotton yield when protection against hot winds was provided by shelterbelts.
- Similar increase in crop yields has been reported from Russia where a shelterbelt of 5 rows increased the oat yield by 25% to 28%.

- Protection of orchards by shelterbelt reduces wind damage and increases fruit yield.
 - Studies revealed that even if 0.4 hectare out of 4 hectare orchard is devoted to creation of shelterbelt, the remaining protected 3.6 hectare of orchard yielded about 13.00% more than the unprotected 4 Hectare orchard.
 - Similarly, the increase in fodder yield is reported to be as high as 300 - 400%.
- Protection of damage to public and private property:-
- The shelterbelts hold up the movement of shifting sand
 - Save the roads and railway tracks from being covered and otherwise damaged by moving sand dunes.
 - They prevent deposition of silt in canals and agricultural fields.

i) Windbreaks:-

- Wind break is a protective planting around a garden, a farm or a field to protect it against strong winds.
- It usually consists of 2-3 rows of trees or shrubs, spaced at 0.5 m to 2.5 m apart, depending on the species.

j) Soil conservation hedges:-

- In this system, the major groups of components are: multipurpose and/or fruit trees and common agricultural species.
- The primary role of multipurpose fruit trees and agricultural species is soil conservation and provision of various tree products.
- The following tree species are used for soil conservation: *Grevillea robusta*, *Acacia catechu*, *Pinus roxburghii*, *Acacia modesta*, *Prosopis juliflora*, *Alnus nepalensis*, *Leucaena leucocephala*, etc.

Horticultural:-

- It is deliberately integration of horticultural trees with timber trees in order to harvest fruits and timber concurrently from single unit of land. Timber trees are planted on bunds of the orchards acts as windbreak thus protect orchard from high winds.

Hortisilvopastoral:-

- In this system various improved leguminous grasses are grown in orchard in order to provide forage to livestock. Trees are planted on the bunds of the orchards. These trees acts as windbreaks and protect horticulture plants from high wind; also provides multiple products.

Agrisilvopastoral/Agrosilvopastoral System

Agrisilvopastoral/Agrosilvopastoral System (Crops + Tree + Grasses/Animals)

This system has been grouped into two subgroups:

A. Home Gardens:-

- It is deliberate integration of trees, crop and animals in a same unit of land in some form of spatial and temporal sequence within the compounds of individual houses.
- This is one of the oldest agroforestry practices found in high rainfall area of South and South-East Asia.
- Home gardens are highly productive, extremely sustainable and very practicable.
- In India it is prevalent in Southern states like Kerala, Tamilnadu.
- Also common in North Eastern states like Tripura, Assam, West Bengal and part of Islands of Andaman and Nicobar.
- In India it is a common practice to plant trees around the habitation.
- It is also known as multilayered AFS
- Area of homestead varies from 0.2-0.5ha
- Tall tree/timber tree occupy the top most layer followed by fruit tree.
- Small shrubs also form the parts of home garden.
- Shade loving vegetables find their place in the ground layer.
- Trees provide timber, fruits and also support climber such as pepper, cucurbits, clove, yam, sweet potato, colocasia etc.
- Pineapple is a common fruit grown in home garden.
- In hills, the common spp. for home gardens is *Grewia optiva*, *Ficus glomerata*, *Juglans regia* and *Punica granatum*.

- In rural areas, fruit trees and commercial tree spp., such as Acacia and Neem are of common occurrence in most of the country.
- Cattle and poultry are the main component of homesteads.
- Forage spp. like Stylo, Guinea grass, Guatemala, Napier and *Setaria cephalis* variety *Kazungula* also find their place in home garden.

B. Woody Hedges for Browsing, Green Manuring, Mulching and Soil Conservation:-

In this system various woody hedges especially fast growing and coppicing fodder shrubs and trees are planted for the purpose of browse, mulch, green manure, soil conservation etc. The main aim of this system is the production of food/fodder/fuelwood and soil conservation. Species used are generally *Erythrina spp.*, *Leucaena leucocephala* and *Sesbania spp.* etc.

Agroforestry Systems Based Arrangement of Components

The arrangement of components gives first priority to the plants. even in AF systems involving animals, their management according to definite plan, say a rotational grazing scheme, gives precedence to the plants over the animals. Such plants arrangements in multispecies combinations involve the dimensions of space and time.

Spatial arrangement:-

- Spatial arrangement of plant in agroforestry mixture may result in
 - Dense mixed stands e.g., home gardens
 - Sparse mixed stands e.g., most systems of trees in pastures
 - The species (or species mixture may be laid out in zones or strips)
 - Zonal arrangement -microzonal, macrozonal
 - A common example of the zonal pattern is hedge intercropping

An extreme form of the zonal arrangement is the boundary planting of trees on edges of plots for fruits, fodder, fuel wood, fencing, soil protection and windbreak.

An extreme term of macrozonal arrangement can laid to sole cropping system but the interactions association of different components can be used criteria to decide like limits between zonal AF and sole crop (component) plots.

Temporal arrangement

- Temporal arrangement of plant in agroforestry systems can take various forms such as
 - Coincident:
 - When two components woody and non woody occupy the land together as coffee under shade tree and pasture under shade trees
 - Concomitant:
 - When two components woody or non woody stays together for some part of life as in taungya

– Intermittent (Space dominated):

When annual crops are grown with perennial crops such as paddy with coconut

– Interpolated (Space and time dominant):

When different components occupy space during different time as in home garden

– Overlapping Black pepper and rubber

– Separate (time-dominant):

When components occupy space during separate time such as improved fallow species in shifting cultivation

Functional basis:

- The functional basis refers to the major functions or roles of the system:

Productive functions:

- Food
- Fodder
- Fuel wood
- Other woods
- Other products

Protective functions:

- Wind break
- Shelterbelt
- Soil conservation
- Moisture conservation
- Soil improvement
- Shade (for crop, animal and man)

- *Socioeconomic basis*: refers to the level of inputs of management (low input, high input) or intensity or scale of management and commercial goals (subsistence, commercial, intermediate).

- Commercial agroforestry systems aim at the production of a saleable output (for example, commercial tree plantations with under planting of food crops)
 - Intermediate agroforestry systems fall between commercial and subsistence scales of production and management
 - Subsistence agroforestry systems are directed toward satisfying basic needs, and are managed mostly by the owner/occupant and his family. Cash crops, including sale of produce surplus are only supplementary
- *Ecological basis*: refers to the environmental condition and ecological suitability of systems, based on the assumption that certain types of systems can be more appropriate for certain ecological conditions; i.e., there can be separate sets of agroforestry systems for arid and semiarid lands, tropical highlands, lowland humid tropics, etc.