Lecture no-1

Introduction to Forest in India

Total geographical area of India is 32, 80,500 sq. km (328.8M ha)

Total forest area 7, 50,500.00 sq. km (75.06 M ha)

Agricultural area is about 46.4%

The second National Forest Policy was enunciated (decided) in 1952 as per which 33.33% of land should be under forest for proper ecological balance. In hills 60% area should be covered under tree cover. During last tow decades 2 million ha forest was diverted for non-forest purpose, Agro-industry, power and irrigation projects, housing etc.**Government has enacted the Forest Conservation Act. 1980** to ensure that no reserve forest can be diverted to any other type of forest and that no forest and that no forest land can be used for any non forest purpose.

Out of total area under forest, 45.6 million ha (60%) area is in use and another 14.8 million ha (20%) area potentially exploited and remaining unexploited area as on Himalayan states, North Eastern regions and Andaman Nicobar islands.

Sources of energy consumption in India are: Coal, 16.5% Oil 10.0% Electricity 15.7% wood 37.6% Cowdung 8.7% and Vegetation waste 11.5%

Forest:

The wood is derived from the Latin word "Eairs" means "outside' Therefore forests are areas covering practically all uncultivated or untended lands covered with rather tall and dense tree growth.

Defination and Terms used in Forestry

1. **Forestry:** Forestry has been defined as 'the theory and practice of all that constitutes the creation, conservation and scientific management of forests and the utilization of their resources.
2. **Silviculture:** The terms silviculture, commonly refers only to certain aspects of theory and practice of raising forests crops. **OR** Silviculture pertains to the establishment, development, are and reproduction of

forests crops.

3. **Pollarding:** This is a process in which the branch of a plant is cut off in order to produce a flush of new shoots. Pollarding is carried out at a height which is above the reach of browsing animals. It has been widely adopted on salix trees in Kashmir Valley. (Willow), *Hard-wickia binata* in A.P. (Anjan), *Grewia oppositifolia* in U.P. Hills (Silver oak type)
4. **Lopping:** It pertains to the cutting of branches or even young stems. This leads to the development of new shoots. It is carried out on Diospyros (Temburni) for bidi industry, also in number of broad leaved species for fuel and fodder and as *Quercus incana* (Indiana oak), morus etc, for rearing silkworm.
5. **Pruning:** Means the cutting of branches from the bole in order to maintain the quality of timber.
6. **Taungya system:** It was first evolved in Burma in 1850 as a mode of replanting vast teak areas. Taungya is a Burmas word. (Toung hill, ya - cultivation). This is a modified from of shifting cultivation of which the labour has permission to raise crop on the land, but, with this, they are responsible for planting, of the forest species, also for protection and well being of the plantation. After about five years or so, they are required to move to another patch of land.
7. **Coppice:** When certain plants or seedling are cut from near ground level, they produce a flush of fresh shoots. This is known as coppicing
8. **Seed orchards:** are plantations which may raised exclusively with the aim of producing seed.

    1. **Seed Production areas or seed stands:** Which are area set aside exclusively for the purpose (i) to produce seed of high quality from genetically superior trees available in the stand (ii) to concentrate seed collecting operation in a small sphere or area. The seed stands are established by removal of the inferior frees, seed orchards are plantation of genetically superior trees isolated to reduce pollination from genetically inferior once. Seeds orchards may be of two types: (i) Clonal: raised by grafting clones of superior trees on 2-3 year old seedlings (2) Seedling raised from obtained from seeds of superior trees.

9. **Pricking out:** When the seedlings have to be kept in

the nursery for more than a year, it must be transferred to beds, other than the seedling beds. This is known as pricking out or to transplant small seedlings individually in to nursery beds or boxes.

10. **Wind breaks:** Is a protective plantation in a certain area, against strong winds. It is usually comprised of a few rows of trees (or shrubs) spaces at 0.5 to 2.5 m apart.)

11. **Shelter belts:** is a wide zone of trees, shrubs and grasses, planted in rows, usually at right angles to the direction of the prevailing winds. Its aims are:
    a. To deflect the air current.
    b. To reduce the velocity of prevailing winds
    c. To provide general protection
    d. To protect the leeward area from the desiccating effects of hot winds.
12. **Tending:** Tending is a board terms given to operation which are carried out for the well being of forest crops, at any stage of it life, involving operation both on the crop itself and on its competing vegetation e.g. weeding, cleaning, thinning, improvement feeling etc. However, tending does not include operation concerning, regeneration such as regeneration feeling, soil working, control burning etc.
13. **Felling:** Felling comprise of removal of trees either singly or in small groups scattered all over the forest.
14. **Afforestation:** Establishing a forest by artificial means on an area on which not forest vegetation has existed for a long time in the past.
15. **Reforestation:** Re-establishing a forest, by artificial means on an area which previously bore forest vegetation, and which may have been felled or otherwise cleared in the recent past.
16. **Age crop:** The age of a regular crop corresponding to its crop diameters.
17. **Age classification:** The division of a crop according to difference in age **OR** the allotment of woods to age classes.
18. **Alpine:** Zone of vegetation where winter is server, slow fall heavy, the mean annual temperature is 450F and the mean January temperature below 300F. In India Himalayan at the altitude above 10,000 ft.
19. **Basal area:** The area of the cross section of a stem at breast height, when applied to a crop, the sum of basal areas of all the stems or the total basal areas per unit area.
20. **Bole:** The main stem of a tree.

21. **Breast height:** Almost universally adopted as the standard height for measuring the girth, diameter and a basal areas of standing trees. India 4’6” (1.37m). In U.K. and most commonwealth countries 4’.3” (1.30m)
22. **Coupe:** A felling area, usually one of an annual series unless otherwise stated. Preferable numbered with Roman numbers as, I, II, III etc.
23. **Crown:** The upper branchy part of the tree above the bole.
24. **Dendrology:** The identification and systematic classification of trees.
25. **Reserved forests:** an area so constituted under the Indian Forest Act or other Forests law.
26. **Protected forests:** A legal terms for an area subjected to limited degrees of protection under the provision of Chapter IV of the Indian Forest Act.
27. **Unclassed forest:** Forest land owned by Government but not constituted in to a reserved, village or protected forest.
28. **Log:** The stem of a tree or a length of stem or branch after felling and trimming.
29. **Logging:** Operation comprising felling of trees, limbing, bucking and transportation of the resulting product out of the forest timber harvesting (Bucking-Act of being)
30. **Pole:** A young tree from the time when the lower branches begin to fall off to the time when rate of height growth begins to slow down and crown expansion becomes marked.
31. **Raft:** An assemblage of logs, timbers or bamboos tied together or enclosed within a boom for transport by floating.
32. **Scrub:** Inferior growth consisting chiefly of small or stunted trees and shrubs.
33. **Stand:** An aggregation of trees or other growth possessing sufficient uniformity in composition, constitution, age arrangement or condition, to be distinguished from adjacent crops and forming a silvicultural unit.
34. **Succession:** The gradual replacement of one community by another in the development of vegetation towards a climax

Current Category » Silviculture and Agro Forestry

Current Category » Silv

Silviculture

Silviculture is an important subject of forestry. It is tie forestry as Agronomy in to agriculture, in that it is concerned with the technology of crop production. It has been defined in a number of ways. Following are the accepted definitions of silviculture.

1. Silviculture is that branch of forestry which deals with the establishment, development, care and reproduction of stands of timber. By Tourney and Karstien

2. Silviculture is the art and science of cultivating forest crops. By Indian Forest and forest products Teminology (1957)

3. Generally, The science and art of cultivating (e.g. growing and tending) of forest crops, based on a knowledge of silvios. More particularly, the theory and practice of establishment, composition, constitution and growth of forests. By Society of American Foresters (1983)

4. Silviculture refers to certain aspects of theory and practice of raising forest crops, methods of raising tree crops, their growth and after care up to the time of final harvesting. By Rao (1987)

In simple words, Silviculture is the growing and tending stands of trees. Silva is the Latin word for forest and culture for cultivation. Therefore, without exaggeration, Silviculture is the Real art of forest.

Silviculture is very important and essential when human beings wish to manage the forests.

a. To accelerate the wildlife, timber and forage production.
b. To increase the Recreation values and Watershed values.

Object of Silviculture

Silviculture is improved limitation of nature. In nature, we find a large number of species coming up at one place. Some individuals die out of competition, some attain top canopy while others remain at lower levels. Silvicultural factors are usually controlled by economic considerations. If there are a large number of species, perhaps a forester would select some of them which are economically more important. Also the forester may remove the trees which are likely to die out of suppression. Since our knowledge of economic and natural factor is not perfect, it is not always possible to determine how far to divert from purely natural course. In nature, succession is a process in which one species or group of species is replaced by another species or group of species and a stage comes when more stable species appears. The study of silviculture enables the foresters to know the whole course of natural succession on a given site and also the manner and the speed of existing crop being replaced or altered. This knowledge helps the foresters to determine where and how to control the succession. The important objectives of silviculture can be summarised as under:

1. Control of Crop Composition and Production of Species of More Economic

Value:

Under natural conditions, a large number of species form the crop inferior or less valuable species may flourish at the expense of the desirable species. The control is exercised by two ways:
i. By removing or cutting inferior species
ii. By creating more favourable conditions for the regeneration and growth of desirable species.

2. Control of Stand Density, for Production of Maximum Volume:

In the natural forests, trees are likely to grow either too dense or too open. If the trees are too dense-the wood production is distributed over large number individuals and none of them grow to the optimum size. If the trees are too less, the production would be less, though individual trees may grow sufficiently with higher dimensions. If the trees are too less, they will not be able to utilise the site, effectively and may be even inadequate to regenerate the area. Both these conditions are not good for maximum wood production. Silviculture helps to maintain or retain sufficient number of trees per unit area so that by optimum use of soil, maximum wood production is ensured. Substantial increase in production can be ensured by thinning dense prop through salvaging the trees otherwise these trees would have died.

3. Afforestation of Blank and Under Stocked Areas:

There is a large area of forests which is blank or under stocked due to fire, encroachments, illicit fillings, or some natural causes. These areas are however, suitable to bear tree growth. Silviculture helps us to afforest these areas with suitable trees by planting or by seedling. Silviculture guides to know the best period of seed collection, nursery technique, plantation details, etc. to complete afforestation.

4. Production of Quality Timber:

In unmanaged forests, because of intense competition or little competition, quality timber is not produced. A large number of trees are malformed, defective and sometimes diseased. Proper control of damaging agencies can increase the production. Insects,fungi,fire,wind, grazing,lopping, etc. which affect the quality of the timber are controlled by suitable Silvicultural techniques and methods.

5. Control on Rotation Period:

Rotation is counted period in years from regeneration to harvesting. In unmanaged forests, if there are more number of trees, the growth of individual tree is slow consequently, they take longer period to reach to harvestable size. The knowledge of silviculture helps to regulate the density of the crop at various sizes / ages which helps to reach exploitable size much faster. Thus, rotation of a crop can be reduced by regulating the density of the crop. It also helps in identifying short rotation crops.

6. Facilitate Management and Use of Forests:

In unmanaged forests, good forests exist in difficult areas, where it is difficult to manage and harvest the timber. In managed forests, it is easy to plant the growth and distribution of forests so that the produce is used efficiency and economically. It is possible to arrange the forest in different localities in such age classes and species composition that management becomes easy.

7. Creation of Man Made Forests and Introduction of Exotics:

Silvicultural techniques help us to replace wholly or partly, natural forests by man mad forests of the same species or by other species. If the existing, forest does not contain valuable and the desirable species. It can be planted with such important species. If the forest consists of desirable species but it is not regenerating properly, it can be harvested and regenerated artificially. Identification of suitable exotics depending upon geographical location, raising trail, plantations, selection of suitable exotics species, perfecting the nursery and plantation techniques of the exotics are some of the silvicultural techniques which help in introduction of exotic species on a large scale.

8. Protection of Site and Intangible Returns:

The main object of silviculture is to provide maximum protection to the site so that intangible returns from the forests are ensured. Important intangible returns include, moderating climate, increasing precipitation, reducing soil erosion and floods conserving soil and water increasing water yields providing shelter to a large number of wild animals, etc. Silviculture helps to understand the requirement of a tree and its effect on the site. The species, which are likely to deteriorate the site, are discarded. Only such species which afford complete protection to the site and ensure continuous flow of intangible benefits are preferred.

Functions & Types of Forest in India

Function of forests:

Sr.No.	Particulars	Functions
1	Productive	They provide timer, fuel, charcoal, beedi , leaves, was and resins, fruits, tanning, materials, manure leaves, grass, bamboo, gums, lac etc.
2.	Protective	Forests protect water sheds, catchments of rivers and streams against erosion.
3.	Aesthatic	Forests add good appearance, landscaping and a thrilling

		atmosphere to the locality.
4	Recreational	Forest provides picnic resorts and opportunities for sport like hiking, trekking, wild life watching, bird watching.
5	Scientific	Study of ecological process can be made
6	Ameliorative	Forests improve climate and reduce pollution
7	Hygienic	Forests improve the environment and help in reduction of noise, purify the air and give out oxygen to the atmosphere.
8	Industrial developments	Forest meet the need for raw material for industrial development such as Paper pups, rayon grade pulp, saw milk ply wood, hard board etc.

Forest types of Indian:

1. Tropical wt ever green forest
2. Tropical semi evergreen forest
3. Tropical moist deciduous forests (Southern and northern types)
4. Littoral and Swamp forests
5. Tropical dry deciduous forest
6. Tropical thorn forest
7. Tropical dry ever green forest
8. Sub tropical broad leaved hill forest
9. Sub tropical dry evergreen forest
10. Mountain wet temperate forest
11. Himalayan moist temperature forest
12. Sub alpine forest
13. Himalayan dry temperate forest
14. Sub alpine forest
15. Most alpine scrub
16. Dry alpine

The above types are called natural ecosystems. Ecosystems are the natural climax forests, resulting from a long process of ecological succession of plants and associated animals life, undisturbed by man.

Lecture no-2

No.3A/86-FP
Ministry of Environment and Forests
(Department of Environment, Forests & Wildlife)

Paryavaran Bhavan, CGO Complex,
Lodi Road, New Delhi - 110 003.
Dated the 7th December, 1988.

RESOLUTION

National Forest Policy, 1988

1. PREAMBLE

1.1. In Resolution No. 13/52-F, dated the 12th May 1952, the Government of India in the erstwhile Ministry of Food and Agriculture enunciated a Forest Policy to be followed in the management of State Forests in the country. However, over the years, forests in the country have suffered serious depletion. This is attributable to relentless pressures arising from ever-increasing demand for fuelwood, fodder and timber; inadequacy of protection measures; diversion of forest lands to non-forest uses without ensuring compensatory afforestation and essential environmental safeguards; and the tendency to look upon forests as revenue earning resource. The need to review the situation and to evolve, for the future, a new strategy of forest conservation has become imperative. Conservation includes preservation, maintenance, sustainable utilisation, restoration, and enhancement of the natural environment. It has thus become necessary to review and revise the National Forest Policy.

2. Salient feature of Indian Forest Policy

2.1 The basic objectives that should govern the National Forest Policy are the following

- Maintenance of environmental stability through preservation and, where necessary, restoration of the ecological balance that has been adversely disturbed by serious

depletion of the forests of the country.

- Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country.

- Checking soil erosion and denudation in the catchment areas of rivers, lakes, reservoirs in the interest of soil and water conservation, for mitigating floods and droughts and for the retardation of siltation of reservoirs.

- Checking the extension of sand-dunes in the desert areas of Rajasthan and along the coastal tracts.

- Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on all denuded, degraded and unproductive lands.

- Meeting the requirements of fuelwood, fodder, minor forest produce and small timber of the rural and tribal populations.

- Increasing the productivity of forests to meet essential national needs.

- Encouraging efficient utilisation of forest produce and maximising substitution of wood.

- Creating a massive people's movement with the involvement of women, for achieving these objectives and to minimise pressure on existing forests.

2.2 The principal aim of Forest Policy must be to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all lifeforms, human, animal and plant. The derivation of direct economic benefit must be subordinated to this principal aim.

3. ESSENTIALS OF FOREST MANAGEMENT

3.1 Existing forests and forest lands should be fully protected and their productivity improved. Forest and vegetal cover should be increased rapidly on hill slopes, in catchment areas of rivers, lakes and reservoirs and ocean shores and on semi-arid, and desert tracts.

3.2 Diversion of good and productive agricultural lands to forestry should be discouraged in view of the need for increased food production.

3.3 For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected areas should be strengthened and extended adequately.

3.4 Provision of sufficient fodder, fuel and pasture, specially in areas adjoining forest, is necessary in order to prevent depletion of forests beyond the sustainable limit. Since fuelwood continues to be the predominant source of energy in rural areas, the programme of afforestation should be intensified with special emphasis on augmenting fuelwood production to meet the requirement of the rural people.

3.5 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 dueregard to generation of employment and income.

4. STRATEGY

4.1 Area under forests

The national goal should be to have a minimum of one-third of the total land area of the country under forest or tree cover. In the hills and in mountainous regions, the aim should be to maintain two-third of the area under such cover in order to prevent erosion and land degradation and to ensure the stability of the fragile eco-system.

4.2 Afforestation, Social Forestry & Farm Forestry :

4.2.1 A massive need-based and timebound programme of afforestation and tree planting, with particular emphasis on fuelwood and fodder development, on all degraded and denuded lands in the country, whether forest or non-forest land, is a national imperative.

4.2.2 It is necessary to encourage the planting of trees alongside of roads, railway lines, rivers and streams and canals, and on other unutilised lands under State/corporate, institutional or private ownership. Green belts should be raised in urban/industrial areas as well as in and tracts. Such a programme will help to check erosion and desertification as well as improve the micro-climate.

4.2.3 Village and community lands, including those on foreshores and environs of tanks, not required for other productive uses, should be taken up for the development of tree crops and fodder resources. Technical assistance and other inputs necessary for initiating such programmes should be provided by the Government. The revenues generated through such programmes should belong to the panchayats where the lands are vested in them; in all other cases, such revenues should be shared with the local communities in order to provide an incentive to them. - The vesting, in individuals, particularly from the weaker sections (such as landless labour, small and marginal farmers, scheduled castes, tribals, women) of certain ownership rights over trees, could be considered, subject to appropriate regulations; beneficiaries would be entitled to usufruct and would in turn be responsible for their security and maintenance.

4.2.4 Land laws should be so modified whereever necessary so as to facilitate and motivate individuals and institutions to undertake tree-fanning and grow fodder plants, grasses and

legumes on their own land. Wherever possible, degraded lands should be made available for this purpose either on lease or on the basis of a tree-patta scheme. Such leasing of the land should be subject to the land grant rules and land ceiling laws. Steps necessary to encourage them to do so must be taken. Appropriate regulations should govern the felling of trees on private holding.

4.3 MANAGEMENT OF STATE FORESTS

4.3.1 Schemes and projects which interfere with forests that clothe steep slopes, catchments of rivers, lakes, and reservoirs, geologically unstable terrain and such other ecologically sensitive areas should be severely restricted. Tropical rain/moist forests, particularly in areas like Arunachal Pradesh, Kerala, Andaman & Nicobar Islands, should be totally safeguarded.

4.3.2 No forest should be permitted to be worked without the Government having approved the management plan, which should be in a prescribed format and in keeping with the National Forest Policy. The Central Government should issue necessary guidelines to the State Government in this regard and monitor compliance.

4.3.3 In order to meet the growing needs for essential goods and services which the forests provide, it is necessary to enhance forest cover and productivity of the forests through the application of scientific and technical inputs. Production forestry programmes, while aiming at enhancing the forest cover in the country, and meeting national needs, should also be oriented to narrowing, by the turn of the century, the increasing gap between demand and supply of fuelwood. No such programme, however, should entail clear-felling of adequately stocked natural forests. Nor should exotic species be introduced, through public or private sources, unless long-term scientific trials undertaken by specialists in ecology, forestry and agriculture have established that they are suitable and have no adverse impact on native vegetation and environment.

4.3.4 Rights and Concessions

4.3.4.1 The rights and concessions, including gazing, should always remain related to the carrying capacity of forests. The capacity itself should be optimised by increased investment, silvicultural research and development of the area. Stall-feeding of cattle should be encouraged. The requirements of the community, which cannot be met by the lights and concessions so determined, should be met by development of social forestry outside the reserved forests.

4.3.4.2 The holders of customary rights and concessions in forest areas should be motivated to identify themselves with the protection and development of forests from which they derive benefits. The rights and concessions from forests should primarily be for the bonafide use of the communities living within an around forest areas, specially the tribals.

4.3.4.3 The life of tribals and other poor living within and near forests revolves around forests. The rights and concessions enjoyed by them should be fully protected. Their domestic requirements of fuelwood, fodder, minor forest produce and construction timber should be the

first charge on forest produce. These and substitute materials should be made available through conveniently located depots at reasonable prices.

4.3.4.4 Similar consideration should be given to scheduled castes and other poor living near forests. However, the area, which such consideration should cover, would be determined by the carrying capacity of the forests.

4.3.5 Wood is in short supply. The long-term solution for meeting the existing gap lies in increasing the productivity of forests, but to relieve the existing pressure on forests for the demands of railway seleepers, construction industry (particularly in the public, sector), furniture and panelling, mine-pit props, paper and paperboard etc. substitution of wood needs to betaken recourse to. Similarly, on the front of domestic energy, fuelwood needs to be substituted as far as practicable with alternate sources like bio-gas, LPG and solar energy. Fuel-efficient "Chulhas" as a measure of conservation of fuelwood need to be popularised in rural areas.

4

4.4 Diversion of forest lands for non-forest purposes

4.4.1 Forest land or land with tree cover should not be treated merely as a resource readily available to be utilised for various projects and programmes, but as a national asset which requires to be properly safeguarded for providing sustained benefits to the entire community. Diversion of forest land for any-non-forest purpose should be subject to the most careful examinations by specialists from the standpoint of social and environmental costs and benefits. Construction of dams and reservoirs, mining and industrial development and expansion of agriculture should be consistent with the needs for conservation of trees and forests. Projects which involve such diversion should at least provide. in their investment budget, funds for regeneration/ compensatory afforestation.

4.4.2 Beneficiaries who are allowed mining and quarrying in forest land and in land covered by trees should be required to repair and re-vegetate the area in accordance with established forestry practices. No mining lease should be granted to any party, private or public, without a proper mine management plan appraised from the environmental angle and enforced by adequate machinery.

4.5 Wildlife Conservation

Forest Management should take special care of the needs of wildlife conservation, and forest management plans should include prescriptions for this purpose. It is specially essential to provide for "corridors" linking the protected areas in order to maintain genetic continuity between artificially separated sub-sections of migrant wildlife.

4.6 Tribal People and Forests

Having regard to the symbiotic relationship between the tribal people and forests, a primary task of all agencies responsible for forest management, including the forest development corporations should be to associate the tribal people closely in the protection, regeneration and development of forests as well as to provide gainful employment to people living in and around the forest. While special attention to the following :

- One of the major causes for degradation of forest is illegal cutting and removal by contractors and their labour. In order to put an end to this practice, contractors should be replaced by institutions such as tribal cooperatives, labour cooperatives, government corporations, etc. as early as possible.

- Protection, regeneration and optimum collection of minor forest produce along with institutional arrangements for the marketing of such produce;

- Development of forest villages on par with revenue villages;

- Family oriented schemes for improving the status of the tribal beneficiaries; and

- Undertaking integrated area development programmes to meet the needs of the tribal economy in and around the forest areas, including the provision of alternative sources of domestic energy on a subsidised basis, to reduce pressure on the existing forest areas.

4.7 Shifting Cultivation

Shifting cultivation is affecting the environment and productivity of land adversely. Alternative avenues of income, suitably harmonised with the right landuse practices, should be devised to discourage shifting cultivation. Efforts should be made to contain such cultivation within the area already affected, by propagating improved agricultural practices. Area already damaged by such cultivation should be rehabilitated through social forestry and energy plantations.

4.8 Damage to Forests from Encroachments, Fires and Grazing

4.8.1 Encroachment on forest lands has been on the increase. Ibis trend has to be arrested and effective action taken to prevent its continuance. There should be no regularisation of existing encroachments.

4.8.2 The incidence of forest fires in the country is high. Standing trees and fodder are destroyed on a large scale and natural regeneration annihilated by such fires. Special precautions should be taken during the fire season. Improved and modem management practices should be adopted to deal with forest fires.

4.8.3 Grazing in forest areas should be regulated with the involvement of the community. Special conservation areas, young plantations and regeneration areas should be fully protected. Grazing and browsing in forest areas need to be controlled. Adequate grazing fees should be levied to

discourage people in forest areas from maintaining large herds of non-essential livestock.

4.9 Forest based Industries

The main considerations governing the establishment of forest-based industries and supply of raw material to them should be as follows:

- As far as possible, a forest-based industry should raise the raw material needed for meeting its own requirements, preferably by establishment of a direct relationship between the factory and the individuals who can grow the raw material by supporting the individuals with inputs including credit, constant technical advice and finally harvesting and transport services.

- No forest-based enterprise, except that at the village or cottage level, should be permitted in the future unless it has been first cleared after a careful scrutiny with regard to assured availability of raw material. In any case, the fuel, fodder and timber requirements of the local population should not be sacrificed for this purpose.

- Forest based industries must not only provide employment to local people on priority but also involve them fully in raising trees and raw-material.

- Natural forests serve as a gene pool resource and help to maintain ecological balance. Such forests will not, therefore, be made available to industries for undertaking plantation and for any other activities.

- Farmers, particularly small and marginal farmers would be encouraged to grow, on marginal/degraded lands available with them, wood species required for industries. These may also be grown along with fuel and fodder species on community lands not required for pasture purposes, and by Forest department/corporations on degraded forests, not earmarked for natural regeneration.

- The practice of supply of forest produce to industry at concessional prices should cease. Industry should be encouraged to use alternative raw materials. Import of wood and wood products should be liberalised.

- The above considerations will however, be subject to the current policy relating to land ceiling and land-laws.

4.10 Forest Extension

Forest conservation programme cannot succeed without the willing support and cooperation of the people. It is essential, therefore, to inculcate in the people, a direct interest in forests, their development and conservation, and to make them conscious of the value of trees, wildlife and nature in general. Ibis can be achieved through the involvement of educational institutions, right

from the primary stage. Farmers and interested people should be provided opportunities through institutions like Krishi Vigyan Kendras, Trainers' Training Centres to learn agrisilvicultural and silvicultural techniques to ensure optimum use of their land and water resources. Short term extension courses and lectures should be organised in order to educate farmers. For this purpose, it is essential that suitable programmes are propagated through mass media, audio-visual aids and the extension machinery.

4.11 Forestry Education

Forestry should be recognised both as a scientific discipline as well as a profession. Agriculture universities and institutions dedicated to the development of forestry education should formulate curricula and courses for imparting academic education and promoting post-graduate research and professional excellence, keeping in view the manpower needs of the country. Academic and professional qualifications in forestry should be kept in view for recruitment to the Indian Forest Service and the State Forest Service. Specialised and orientation courses for developing better management skills by in service training need to be encouraged, taking into account the latest development in forestry and related disciplines.

4.12 Forestry Research

With the increasing recognition of the importance of forests for environmental health, energy and employment, emphasis must be laid on scientific forestry research, necessitating adequate strengthening of the research base as well as new priorities for action. Some broad priority areas of research and development needing special attention are:

i. Increasing the productivity of wood and other forest produce per unit of area per unit time by the application of modem scientific and technological methods.
ii. Revegetation of barren/marginal/waste/mined lands and watershed areas.
iii. Effective conservation and management of existing forest resources (mainly natural forest eco-systems).
iv. Research related to social forestry for rural/tribal development.
v. Development of substitutes to replace wood and wood products.
vi. Research related to wildlife and management of national parks and sanctuaries.

4.13 Personnel Management

Government policies in personnel management for professional foresters and forest scientists should aim at enhancing their professional competence and status and attracting and, retaining qualified and motivated personnel, keeping in view particularly the ardous nature of duties they have to perform, often in remote and inhospitable places.

4.14 Forest Survey and Data Base

Inadequacy of data regarding forest resources is a matter of concern because this creates a false

sense of complacency. Priority needs to be accorded to completing the survey of forest resources in the country on scientific lines and to updating information. For this purpose, periodical collection, collation and publication of reliable data on relevant aspects of forest management needs to be improved with recourse to modem technology and equipment.

4.15 Legal Support and Infrastructure Development

Appropriate legislation should be undertaken, supported by adequate infrastructure, at the Centre and State levels in order to implement the Policy effectively.

4.16 Financial Support for Forestry

The objectives of this revised Policy cannot be achieved without the investment of financial and other resources on a substantial scale. Such investment is indeed fully justified considering the contribution of forests in maintaining essential ecological processes and life-support systems and in preserving genetic diversity. Forests should not be looked upon as a source of revenue. Forests are a renewable natural resource. They are a national asset to be protected and enhanced for the well-being of the people and the Nation.

Lecture No-3

Natural Regeneration of Forest

Regeneration from seed or vegetative parts may observe in Natural Regeneration. Reforestation of a stand by Natural seedlings

1) Natural Regeneration from Seed: Successful natural regeneration from seed depends upon Seed production, Seed dissemination, Seed germination, Establishment and seedlings.

a) Seed Production: Seeds are cultured ovules, which contain the embryo. An embryo is a miniature plant consisting of seed leaves (cotyledons) attached to rudimentary stem (hypocotyl) with a growing tip (Plumule) and a root tip (radicle) at the other end. Seed production depends upon various factors such a species, age of tree, site, weather conditions, season of maturity, alternate bearing, attack of pests and diseases and birds.

b) Seed Dissemination: For the continued existence of a species, it is necessary that seeds are carried away from the parent plant, because seeds germinating immediately below the parent tree commonly do not get established. Seed dissemination gives young seedlings a better chance of survival for they are saved to a large extend from competition with the parent plant. The means of dispersal adopted by the seeds of different species vary

widely. The four important agencies by which seed dispersal is secured are i) Wind, ii) Water, iii) Animals, iv) Explosive mechanism or ejection mechanism in fruit itself.

c) Seed Germination: Germination of seed depends upon several internal and external factors such as Permeability of seed coat, Availability of moisture in seed, Oxygen, Nature of embryo (dormancy), Temperature, Moisture in soil, Oxygen and light. Besides this some factors,

1) Age of Tree,
2) Flowering Phase,
3) Sound or health of seed condition,
4) Coppice origin trees,
5) Size of seed,
6) Plant per cent,
7) Type of dissemination,
8) Soil type / nutrition,
9) Pest and disease,
10) Non insect pests.

d) Seedlings Establishment: Successful establishment of newly germinated seedlings in sufficient number as a member of forest crop is undoubtedly, the weakest link in the whole chain of process (a to c) which make up the regeneration of forest crops.

The Factors Responsible, for Seedlings Establishment are as:

1)Climate: Light / moisture rainfall / temperature / frost
2) Edaphic - Soil / nutrient / aeration / texture / structure.

II) Natural Regeneration by Coppice and Root Suckers: Coppice : Stool shoots generally arise from the adventitious buds formed between the wood and the bark of the stump and are comparatively short lived than those produced by dormant buds. These shoots are called coppice shoots.

Classification of Coppice Regeneration:

1) Seedlings Coppice
2) Stool Coppice and
3) Root collar Shoots
4) Pollard Shoots

Natural Regeneration by Root Suckers: Shoots arises from the roots, may occur naturally or artificially.

Lecture no -4

Regeneration by Artificial Method

The deforestation is still continuing and takes a heavy toll of forest wealth. This not only affects the forests but the wildlife and the whole ecosystem also. Deforestation is on alarmic rate (1.5 million hectare every year). For carrying out artificial regeneration, there are some preliminary considerations which are urgently needed.

Basic Steps in Artificial Regeneration:

1) Choice of Species:

i) The choice of species is very important in artificial regeneration. Therefore, before choosing the tree species, the purpose of growing the trees has to be specified.
ii) Climate and microclimate: The choice of species depends upon the prevailing climatic and micro-climatic conditions.
iii) Soil requirements: a) Wet soils - Salix species, Populus

species, etc. b) Water - logged soils, Eucalyptus robusta, E. saligna etc. c) Sandy loam - Albizia procera, Acacia nilotica, Dalbergia sissoo, etc. iv) Market faci ities :
v) Growth rate: Fast growing tree species - Acacia nilotica (Babul), Leucaena leucophala (Subabool), Melia azedarach (Bakain), P. deltoides (Poplar), Salix species (Willow)
vi) Availability of Exotics: In simple it meaning pertains to, not native to the area of question. The exotic can be described as "an organism in an area which is not native of the area but has its origin in some other region. For example, Eucalyptus species, Leucaena leucocephala, Robinia pseudacacia, Populus deltoides etc.
vii) Base of extablishment.
viii) Management objectives. The artificial regeneration depends upon the objectives of management.
ix) Site conditions: The site is the complex of physical and biological factors of an area that determine what forest of other vegetation may ^arry.
x) Succession: The succession is the gradual replacement of one community by another in the development of vegetation towards a climax.
xi) Cost of growing: This is also very important factor affecting the choice of species.
xii) Availability of seed /propagation material : The seed source should be sound.

2) Choice of Method: The success of artificial regeneration depends, to a great extent upon the choice of method. There are mainly two methods of this regeneration, viz. i) Sowing and, ii) Planting.

i) Sowing: Sowing, in the simplest words, is the process of scattering the seeds in a particular place e.g. nursery bed, field etc.

Advantages of Sowing:

a) It is the cheapest method and costs less,
b) Sowing is direct method and no other complications,
c) It takes less time and thus the work is completed soon,
d) In sowing method, there is no question of disturbances of roots.
e) Sometimes, sowing is done directly in the field (in forests),

and hence it does not require any nursery.
f) The sowing being the simple method, is supposed to be less cumbersome.

ii) Planting: Planting is another method of artificial regeneration. However, planting is described as the transferring nursery stock to the planting site as contrasted with transplanting in the nursery.

Advantages of Planting:

a) More Success, b) Less seed needed c) No damage, d) Cheaper weeding

Disadvantages of Planting:

a) Need of nursery
b) Disturbance of roots
c) Time consuming,
d) Need of skilled labour
e) Incurred high costs

3) Site Selection: The selection of site is also a crucial factor in artificial regeneration. There are several factors which affect the site preparation.

Following are the factors which are essential to carry out the preparation:

1) Ground Cover:
2) Physical Factors: a) Topography, b) Exposure, c) Soil type, d) Erosion hazards, e) Size of treatment area and f) Access
3) Preparation requirement: To create a suitable environment for establishment of desirable species.
4) Man Power and Equipment: The site selection and preparation methods require good skill and useful equipment.
5) External Constraints: a) Legal responsibilities, b) Smoke management guidelines, c) Proximity to sensitive areas and d) The attitude of adjacent farmers / land owners.
6) Spatial Arrangement: This is also called as Spacing.

Artificial Regeneration by Vegetative Method:

Planting material besides seeds for e.g. Bare root seedlings, containerized seedlings, cuttings, layering, rhizomes, suckers, offsets, bulbs, corms are also used for vegetative propagation material.

Propagation by Cuttings: Cuttings are of two types, 1. Stem cutting 2. Root cutting

1. Stem Cutting: Very few species response well for this method. The species, which easy to root are suitable for this method of planting. Particularly species of di-cotyledons group having active cambium layer e.g. Shisam, Nimbara Drumstick, Mulberry Inga dulsis, Dhaman, Pangara, Pimpal, and Banyan Tree etc.

Depending upon the maturity of stem cutting are grouped into:
i) Hard Wood Cutting: Mature woody branches are used.
ii) Soft Wood Cutting: Recently mature branches are used e.g. mulberry-Inga dulsis.
iii) Root-cutting: Roots are used for preparation of cutting e.g. Sandalwood, Pangara.

2. Stumps: In few species, stumps are used for planting e.g. Teak, Shivan, Shisam, Cassia spp. Stums are easy to transport, require less space and can be transported to long distance. These are prepared at the time of planting operation or just before planting operation. Fresh uprooted seedlings are used to transplant easily. 20% stem portion and 80% taproot is kept while preparing the stump. Fine edge knife or implement is to be used so as to avoid the damage, stem portion is cut 5 to 6 cm above the collar region is kept intact and remaining portion or roots are cut to prepare stump. The stumps are then packed in bundles, keeping stem portion on one side and roots on another side, the stumps should be transported immediately. For transportation stumps are covered with moist gunny bag cloth to avoid desiccation. They can be transported within 2-3 days without much loss.

These stumps are planted on start of monsoon after 3-4 rain showers when soil becomes sufficiently moist and soil temperatures are warm. Stumps are planted by preparing small holes in slating portion with the help of crowbar so that new shoot will rise straight. Then the stumps are inserted inside and

soil is pressed firmly so as to avid water stagnation in the hole. The cooler region is kept just near to the soil surface.

3. Root Suckers: Root suckers can also be used for planting purpose e.g. Pomegranate, Kokum, Salaim Anjan, Shisam, Nimbara, Pangara, Erythrona etc. The layers, grafted plants, budded plants can be used to prepare planting material. These all are only used in forestry for conservation of superior genotype. It is used for commercial plantation as they are short lived, spreading and not develop long straight (trunk), particularly suitable for timber purpose.

Planting by root cuttings in sandal wood, pangara. Planting by root suckers e.g. Pala, Anjan, Pomegranate, Kokum, Salai, Shisam, Nimbara, Erythrina Supersa.

Lecture no-7

Tending Operations in Silviculture

For establishment of the regeneration and subsequent development of the forest crop up to harvesting, several operations are carried out. These operations are carried out in the forest crop at different stages of growth in order to provide a healthy environment for their development. These operations are called tending operations includes:

i) Weeding
ii) Cleaning
iii) Thinning,
iv) Improvement Felling,
v) Pruning
vi) Climber Cutting

i) Weeding:

Weeds may be controlled by following methods:

a) Mechanical Methods
b) Biological Methods
c) Chemical Methods

ii) Cleaning:

Cleaning is carried out in a crop which has not crossed the sapling stage and is defined as the cutting made in order to face the best individuals from undesirable one of the same age which interfere or are likely to interfere with the growth of the desired individuals. The greatest advantage offered by cleaning is the-proper regulation of the composition of the crop, particularly in mixed crops.

Methods of cleaning may be mechanical, biological and chemical as described under weeding.

iii) Thinning:

Thinning is defined as a felling made in an immature stand for the purpose of improving the growth and form of the trees that remain, without permanently breaking the canopy. Thinning is a tending operation carried out in a crop beyond the sapling stage and up to the beginning of regeneration period. Thinning principles are so formulated that these are applicable only to pure even aged or relatively even, aged crop or even aged groups of the trees in a crop.

Thinning principles have been developed on the basis of natural development of the stand. Thus, thinning, takes place naturally in a density stocked forest under the law of Survival of the fittest.

Lecture No-12&13

Introduction to Agroforestry

Social forestry pertains to those areas and forest which are manmade. Agroforestry is conspicuously and important part of Social forestry and is it a dual system of production i.e. production of forest crops and food crops, fodders or medicinal plant becomes possible. It meets simultaneously at least two requirements of the participating persons. Agroforestry is defined as a sustainable land management system which increase the overall yield of land, combined with the production of crops (including tree crops) and forest plants and animal simultaneously or sequentially on the same unit of applies management practices that are compatible with the cultural practice of the local population. Thus in Agroforestry co-existence of farm and forestry is adopted on a scientific basis and consequently, the total yield of land is raised significantly. Present status of forest in India is as follows:

Total land area	329 m. ha.
Area under Agriculture	143 m. ha. (47%)
Area under Forest	75 m. ha. (22.7%)
Barren Land	21 m. ha.

Under non Agriculture	18 m. ha.
Illegally occupied	24 m.ha.
Population	1000 M.
Cattle production	400 m

• Half of the Forests in India are denuded, various degrees due to increased human activities.
• India's fast growing population stands at a count of more than 1000 in. and cattle population about 400 m, in which demands for huge amount of food, fodder, timber, fuel, Medicines, employment etc. It has been internationally acknowledged that 30 to 33% of the total geographical area must be under good forest cover.
• For balance environment and ecosystem
• All the above situation calls for massive programme of Afforestation and planting with people's participation. This programme should attempt is restore ecological balance and meet the various needs of rural people. This is feasible only if tree growing become a people's programme which brought to be combined with agriculture.
• The forest land area of 75 in ha under forest cover was not adequate to maintain good environment. It was therefore, rightly resolved through a National Policy Resolution in the year 1952 to add 35 m ha to the forest cover and to bring 33% of our land under forests. The decision though wise, timely and far-sighted, was never implemented with the same spirit.

Against this background Agroforestry should become an important land use system, conventionally which was duly recognized by planners while preparing the seventh plan document. At this stage a recommendation was also made that Agroforestry might be included as core subject in the curriculum by all the State Agricultural Universities.

Classification of Agro-forestry System

Different types of Agroforestry systems exist in different parts of the world. These systems are highly diverse and complex in character and functions. To evaluate understand and seek to improve them requires their classification into different categories. Several criteria can be used in classifying them, but the most common include the system's structure, functions, and socio-economic scale of management and ecological spread. According to Nair (1987), Agro-forestry systems can be classified according to following sets of criteria.

1. Structural Basis:

Consider the composition of the components; specially refer including spatial admixture of the woody component, vertical stratification or the component mix and temporal arrangement of different components.

2. Functional Basis:

This is based on the major function or role of the system; mainly of the woody components (This can be productive or protective).

3. Socio-economic Basis:

Consider the level of inputs or management (low input, high input) or intensity/scale or management and commercial goals.

4. Ecological Basis:

Take into account the environmental conditions on the assumption that certain types of systems can be more appropriate for certain ecological conditions.

Classification of Structural Basis Agro-forestry System:

In these systems the type of component and their arrangement are important. On the basis of structure, Agroforestry systems can be grouped into two categories

I. Nature of components
II. Arrangement of components.

I. Nature of Components:

(A) Agri-silvicultural Systems
(B) Silvipastoral Systems
(C) Agro Slivipastoral Systems
(D) Other Systems

II. Arrangement of Components:

(A) Spatial Arrangement
(B) Temporal Arrangement

Lecture no-14

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Lecture no-15

Shifting Cultivation

Fallow are cropland left without crops for a period ranging from one season to several years. The objective of improved fallow species in shifting cultivation is to recover depleted soil nutrients. Ones the soil has recovered crops are reintroduced for one more seasons.

Shifting cultivation as the term implies, is a pattern of land use and a system of production of crops under which plots of land are cleared, cultivated for a short period for raising crops, after which the land is allowed to rest longer than the period of cultivation. It is a system of production almost without capital inputs.

This system is practiced extensively the north-eastern hill region comprising the states of Assam, Meghlaya, Maniput, Nagaland and Tripura (Arunachal Pradesh and Mizoram). To some extent in Andra radesh, Bihar, Madya pradesh, Orissa and Kernataka. It is called as JHUM in the north eastern hill region and PODU, in A.P. and Orissa and considered most destructive for forest areas.

The main features of the improved fallow system of Agroforestry is that trees and shrubs.

Are not grown with crops on the same land, the best species for the fallow system should be include good N fixation in the soil.

The main function of the fallow is to maintain or restore soil fertility and reduce erosion some plants can be introduced primarily for their economic value.

Establishment:

Improved fallow can be established in a variety of ways and at various stages of the fallow methods. Direct seeding of clean filled harvest plots and Selective cutting of bush followed by enrichment planting with tall plants. Introducing tall seedlings and cutting into poor quality fallows.

Current Category » Silviculture and Agr

Taungya System

Taungya is Burmas ward meaning hill cultivation, it was introduced into-India by Dr. Brandis in 1890 and the first Taungya plantation was raised in 1896 in north Bengal. It is practiced in Kerala, West Bangal, U.P., and to lesser extent in Tamil Nadu, A. P. Orissa and the north eastern hill regions. In southern India the system is called KUMARI, it is practiced in a areas with an assured annual rainfall of over 1200-1500mm.

This is a modified term of shifting cultivation in which labour is permitted to raise crop in an area but only side by side with the forest species planted by them. The practices consist of land preparation, tree planting, growing agricultural crop for 1 to 3 years until shade becomes the dense and then moving on to repeat the cycle in a different area.

Traditional Taungya consist of land preparation for tree plantation, growing agricultural crops for 1 to 3 years after the tree plantation and moving on to another area to repeat the cycle. There are three types of Taungya .

a) Departmental Taungya:

Under this, agricultural crops and plantation are raised by the forest department. By employing daily paid labours the main aim of raising agril. crops along with the plantation is to keep along with the land free of unwanted vegetation.

b) Leased Taungya:

The forest land is given on lease to the person who affects the highest money for raising Agril. crop for a specialized number of years and ensure care of tree plantation.

c) Village Taungya:

This is the most successful of all the three Taungya systems. Under this the people who have settled down in a village inside the forest for this purpose raise crops. Usually each family has about 0.8 to1.7 ha of land has raise trees and cultivate crops for 3 to 5 years.

Advantages of Taungya System:

i) Artificially regeneration of the forest is done at cheaper rate
ii) Problem of unemployment is solved to some extent
iii) Better utilization of land
iv) Remunerative to forest department

Disadvantages of Taungya System:

i) Creates certain legal problems
ii) Exploitation of hum in labour
iii) Danger of epidemic
iv) Provision
v) Loss and soil fertility

Wind Breaks and Shelter Belts

The success of dry crops depends upon the available moisture in the soil and the period of its availability.

Generally in the first row Agave, Sitaphal, Phalsa (Grewia species) and small flowering shrubs are planted at 0.5 to 1 m distance. Average height of the row is 1 to 2 m. In the second row tree of 5 to 8 m height such as Sesbenia, Glyricidia, Subabulare planted. The Last row and middle row of some tall trees of Eucalyptus, Casuarina, are planted at 1.5 m.to 2 m spacing, whose height may reach 10 to 15 in. The rows are spaced at a 3 m distance. In the coastal belts cashew also can be introduced in the second row, in which some branches need to be pruned. Other fruit bearing species like Guava, Pomegranate and Ber also raised for their economic value. If space is available and can be spared, a row of bamboo clumps at 5 m spacing is introduced in the fourth row, as bamboo is of high utility.

The Benefits Accruing as a Result of Planting of Shelter Belts / Wind Breaks are:

1) They reduce the wind velocity blowing over the crops and this reduces the evaporation losses, which reduces number of irrigations.
2) The reduction of wind velocity helps in large exposure of the stomata apertures, thus extending the period of photosynthesis on the leaf surface.
3) It is recorded that the dew formation in sheltered areas increases by 200 per cent. This is an important factor for the crops which thrive well in winter such as Sorghum, Horse gram etc.
4) The shelter belts provide a place for the snakes to live and multiply, which in turn prey on the rats, the major cause of damage to grain. 5) The birds nesting on the shelter belts are agencies to prey on the insect-pests, which damage the crops, and live on the seeds of weeds, thus reducing the weed population in the fields.
6) The birds nesting on the trees of the shelter belts, add good manure through their droppings.
7) There is perceptible movement of soil practice when the wind velocity is high. The shelter belts by reducing the wind velocity prevent such movement of the fine soil particles and effectively prevent wind erosion.
8) The species planted as shelter belts yield, fruit, fodder, fuel,

small timber for the farmer and thus add to the agricultural income.
9) The belts regulate the weather by reducing high summer temperatures and increase the low temperatures of winter.
10) The continues and vast stretches of shelter belts add to the increased precipitation from cumulus clouds.

Biological methods to increase the yields will go a long way in improving the fertility of the land, creating a salubrious environment and make the country prosperous.

Planting of Wind Breaks:

Rows of trees along field margins, as far as possible perpendicular to the most high velocity wind of the locality constitute wind breaks. Roughly seven per cent of the total area should be planted for effective protection. The breaks are raised by planting two close rows of fast growing deciduous and one parallel rows of slow growing of longer living ever-greens (Tamarind). As far as possible dense crowned tree species are to be selected.

Species Suitable for Wind Breaks:

Dry and Arid Regions:

Casuariana. Pongamia, Azadirechta, Acacia planifrons, A. auriculiformis, Tamarin dus, Albizzia, Peltophorum, Dyal berja Melia azadirechta, Eugenia, Mangifera, Ailanthus, Sesbania, Morings, Eucalyptus sp., Artocarpus and Grevillea.

For Coastal Areas: Anacardium, Ailanthus, Acacia, Casuariana, Pongamia, Thespesia, Calophyllum, Mani, Gravillia, Cassia sp.

Shrubs and Grasses: Agave sp., Sesbania sp., Glyricidia, Cassia, Vitex, Dudonea, Euphorbia, Jatropha sp., Thevetia,

Grasses:

Saccharr species, Cynodon dectylon, Elusine coracana, Cenchrus ciliaris, Euleopsis binata

Suggested Pattern of Planting:

Shelter belts should be in three or more rows of trees, as the

sheltered area is 15 to 20 times the height growth, the protection afforded will many a time cross the fields of the farmer. Therefore, rising of these belts should be on a co-operative basis, as holdings are small. The practices of raising shelter belts and wind breaks can be adopted before planning agriculture on treeless tracts or large farms. For this effort, the leadership has to be strong.
The belts are triangular in cross section. Tall trees are planted in the centre and shorter ones along the sides. A mixture of species is advisable, as far as possible species should be selected on the basis of their coppicing power. Spacing should be 1 metre for shrub, 1.5 m for trees in rows each row being 1.5 to 4 m apart and there should be five rows for proper protection.

Objections of Raising Shelter Belts / Winds Break:

1) They act as harbour for cattle, browsing animals, rodents, etc. The objection is more theoretical and can be overcome by keeping a watch for the period when there is a crop.
2) Roots of trees compete with agricultural crops. This can be overcome by removing the roots to a distance at half the tree height. Digging a small trench of 22 cm depth will serve the purpose.
3) Shade affects the crops. This is insignificant when compared to loss of yield by patchy cultivation in dry land. The shade effect will not be there for the first six to eight years by which time yield from the crops.