FRM507: ADVANCED SILVICULTURE

LECTURE NOTE

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PLANTATION TECHNOLOGY

Definition of forest plantation

Forest plantation is defined as forest crops raised artificially either by sowing or direct plantation or seedling, they are usually refers to as artificial or man-made. They are established to satisfy specific objective. The objective could be to establish a good ground cover to enhance the productivity of a land for specific economic objectives, plantation of exotics are usually man-made and can not occur naturally, in most cases such exotics becomes adapted to their newest and with tome are easily regenerated, when this occur they are said to be naturalized. However, even though naturally regenerated, such forests are still defined as being man-made until after 200 years after the original introduction.

Development of plantation in the tropics

Interest in plantation in the tropics continue to be increase reason for these are many although several factors could be identified between 1965-1980, the area of forest, plantation in the tropics more than triple, most countries in the they represent 2.5% of the total land area under forest reserve. Plantation programme are similarly consider in large during these period in Tanzania, Malawi and several other countries in the tropics. Most of the expansion have seen attested for individual purpose, pulpwood, sawn timber and to a small extend plywood and veneers more recently plantations has also increased to meet material, fodder for grazing animals and for entail protection.

Peruse forgives are very rare to come by however nearly every tropical countries have expanded their supply of seedling for plantation purposes and most of these are frees of charge to the village farmer. The expansion of plantation combine with excessive use of exotics spp has lead to increase international cooperation particularly in seed collection, distribution and tree breeding.

Although plantation forestry has appeared to be the beyonony of the optimate for example in 1980, the total land area of plantation in its tropics was estimated ads 18 millions ha

Plantation life history

Variation	Usual	Major decision	Crop description	Time of plantation
	Obtain seed	Specie		-3 to 1
Cutting	Raise plant in nursery	Bore rooted or containerized pt	Seedlings	1.5 or c
Direct sowing	Prepare garden	Intensity of site preparation		
Intercropping	Planting	Spacing/fertilizer	Forest crop	0 year
	Tending	Weeding/manual chemical	Saplings	0-3 years
	Low pruning	Partial	Small pole	4 – 10 years
Re spacing	Thinning	Time?	Large poles	5 – 15 years
Heavy thing	Clear felling	When?	Mature trees	6 – 30 years
Coppicing	Replanting	New species	Second rotation	

Plantation organization and structure

The business planting trees although a straight forward involves a lot of organization and planning. Plantation establishment involves series of operation which range from seedling production to tree planting and maintenance and the eventual exploitation or harvesting. Hence, it must be well placed to avoid failure, planning is often described as a linear process, it involves identifying needs to project objectives and designing a programme to meet the objective of the project, in reality, the process is more complex. In general, planning embrace 3 closely related activities.

1. Collection and Assembling of Data
2. Examination and testing against correct characteristic
3. Formulation of plane.

The major reason of planning is to maximize profit such that the planning must represent the most efficient course of action in plantation programmes; the 1st operation is to carry out feasibility study of the project. This involves formulation of objectives, review of available resources, and assessment of future requirement, identification of possible alternatives and analyses of the implication of these alternatives. These 4 processes help us to arrive at the choice of suitable project. Organization is an important aspect of plantation forestry, if distinguishes the plantation from I the natural forest.

Plantations are characterized by orderliness, regularity and relative ecological simplicity. The economic advantages of these qualities are as follows:

1. There is greater efficiency in many operations. It is early to apply all silvicultural composition since it is monoculture. E.g if you known the light cooperation plantation of teak, you can effectively apply the operation but not in natural. Since you known teak will require nitrogen in nitrate form, you can easily apply it.
2. There are more uniform product all at which have demand in the market.
3. The choice of spp usually suite the object of management.

4. Growth rate is higher (CAI) with high out put perhaps often characteristic of plantation are spp. Composition, eye class distribution, stuccoing rate and silvicultural system employed. Species composition plantation mostly monoculture over a large area such as a compartment, although individual stand and particularly old compartment, on compose at one spp. In reality, it is very rare for the entire forest to be at one spp. The risk associated with monoculture are as follows:

1. Successptability to diseases and pests particularly where a pest or pathogen becomes adapted, the uniformity and extend limit of plantation provides enormous food reserve for the pest.
2. The uniformity of spp and closeness of spp allows for rapid colonization infection among trees.
3. Since the plantation grows for a particular site for many year, it makes it possible for pests a diseases to build up over a period of time.
4. The nutrient demand or the soil is specific and the 4 exhaustive.

Age class distribution

Plantation usually contains even age a the trees are planted almost at the same time, a few months may be introduced for beating-up purposes, however this usually does not change the structure.

Stocking

This refers to the number of utilizable trees per ha the stocking does not remain constant in the life of a plantation, some trees die naturally, others are removed through thinning.

Plantation design

Conventionally, plantation are orderly and regular in appears which natural truest. This is belongs the trees are planted in lines, in plantation design, 3 aspects must be considered which are:

1. The shape of the plantation
2. Layout and subdivision
3. Line of communication.

The shape

The outer boundary of any plantation would be determined by its legal position with respect to neighboring land, it is usually not essential to plant to the boundary if it is awkwardly shape. Usually, a strip is left as an extent fire-break.

Layout and subdivision

In large plantation projects for convenience of management and organization, the forest do not expand from one centre but usually develops around several centres each forming a self contained units.

Lines of communication

The regular layout of plantation in convenient shaped blocks is not early in practice bellows forest land are often rough, rugged and in broken terrain where access is limited to 4 wheel drive vehicle will enable plantation to be established but will be inadequate during time of exploitation land with poor access shouldn't be planted if trees are grown for industrial purposes particularly for large scale consequently, it is important to access an area not only in farm, it suitability for growth but also in terms of accessibility for exploitation.

Socio and economic factors in plantation development

These factors embrace economic development, social input and impact and are interrelated in determining the success of plantation programme particularly in the tropics. 3 aspects of the socio-economic factors of interest are as follows:

1. The size scale and rate of plantation development
2. The impact of plantation project on local community particularly on their socio and cultural lives
3. The contribution of plantation forestry on economy of rural development in developing nations.

Factors which affect the scale and rate of plant development

The scale of plantation could be measured in terms of land area, amount of fund invested, the number of people employed. The purpose (objective of management) of growing trees is the overriding consideration which determine the size or the overriding consideration which determine the size or the scale of the plantation. For instance, while individual plant or raise plantation for fire wood or shelter, usually government or companies especially musts national can afford integrated pulpwood project.

The factors that determine rate are:

1. Finance: - In developing countries finance for plantation project usually comes from World Bank and co. The rate is essentially a function of fund to date local banks are usually not involved, this is belongs to longer time frame required for investment to mature greater risk and occasionally political instability. The rate at which a plantation programme proceeds in evitable and primitive depends on the initial availability and continuity of fund. The heavy reliance on external funding makes orderly development and steady expansion uncertain.

2. Land Availability: - The needs to acquire or lease land for plantation to allow the legal title and survey to be done is important for regular plantation operation to produce unhindered. Functionally where land is under the control of federal government or the afforestation agencies, availability is usually not a problem. On the other hand obtaining the use of the costuming owned land can be problem in maintaining a steady plantation programme.
3. Labour: - Remoteness of forest plantation operates makes it unattractive such that most employees live in the forest for few months locos of inductivity to adapt to job discipline.
4. Infrastructural provision: - Provision of infrastructure takes time and money and could be a major constraint to plantation progress.

SOCIO AGRICULTURAL EFFECTS IN PLANTATION DEVELOPMENT

Essentially there are 2 major effect which are as follows:

1. Socio changes in villages are the first major effect of plantation programme. The first not able impact is that at the traditional division of labour e.g. the men in rural start to earn wages and even the woman in the villages earn some income by selling foods.
2. the second changes has to do with problem of ownerships of planted trees in some part of the world, the person who planted the tree may not necessary be the land owner but become the owner at the tree so planted.

Solutions

1. Consultation and involving the local populations by first identify the local problems.
2. Employ those that have been displayed from acquiring that particular land.
3. Adapt practices that will suit the local skill and ability which is by 2 way either by bringing them to your level or you come to their level.

4. Where necessary phase out or your programme/operation (may be in phase 1 or 2 e.t.c.)
5. Use intermediate technology that does not require highly socialized skills.

Responsibility toward employees

1. Provision of minimum level at employment and on the job Iranian.
2. Provision infrastructures and amenities e.g. roads, schools e.t.c.
3. The employer must be sensitive to their local customs and allow their local tradition.

Contribution of plantation forest to rural development

The main benefit of plantation forestry particularly in the third world can be:

1. Resources creation rather than site exploitation: - This is to meet increasing demand for wood and wood products.
2. Development of flexible resources able to yield various sizes at product both for internal consumption and for export. This range from village wood pant, fuel wood plot, for large scale industrial for sawn wood, veneer, logs.
3. It determines land that were otherwise considered are marginal for agricultural production
4. Creation of employment in the rural areas.
5. High level of employment per unit of investments particularly because plantation establishment is labours intensive.
6. Plantation develop bring other development such as roads, schools, maternity a clinic.
7. There are also important secondary benefit or integrated of trees plantation and other land uses.

8. Use of many skills already common in agriculture and most additional training can be done on the job.

Technical details of plantation forestry

1. **Choice of species: -** The success of plantation forestry depends in the first place in the judicious selection of tree species to be grown under a given set of conditions. This is important because no amount of attention given to nursery operation and tendering operation can overcome the mistake of wrong choice of spp. Furthermore, this mistake does not shown up until a considerable tome has elapsed because of expenses involved in artificial regeneration and length of time to discover such mistake. The forester can not afford to speculate as to which spp would survive in a given environment.

Factors to be considered in which choice of species

1. Closeness of correlation between site factor and silvicultural requirement of that particular spp. The spp chosen must adapt to site, it must have high potential for producing on the site.

   Every effort must be made to correlate various environmental factors existing in an area with the various requirement of the spp bee such a spp could be selected for extensive use (some spp are light demander while others are not).

2. **Suitability of that spp for the object at right**: The choice of spp must be suitable to the object at management e.g. if it is for industrial uses little sawn timber the object will be for fuel wood, panel product it can be for environmental protection. The tree planting is usually the integral part of the land use such as shelter belt, agroforestry. The most suitable spp will differ grown object of management e.g. early plant calm made utensils for fuel wood if the object is to control wind erosion, you can choose tree with

evergreen or persistence foliage, if the object is to protect land slide on a sloppy area you can use deep rooting system.

Where the object is to control flood or stream flow plant tree that take water more than evaporate.

e.g. Anatosephalus cadamba

For desertification control deep rooted which have low leaves potential (Faldebia indica

3. **Adaptability of the spp is dependence upon the silvicultural system**: Choice of spp is dependence upon the silvicultural system to be adopted e.g. while all spp could be managed as high forest, few could be managed as coppicw forest e.g the conifera pinus family in particular seldom coppice i.e they do not coppice while eucalyptus, teak and gimbelona do coppice.
4. **Effect of particular spp upon site**: foresters must select spp which must not only suit the locality but improve the soil with the knowledge of the site, spp which tends to improve nutrient status must be selected provided they meet all other equipment (ecologically there is a problem with neem tree, so plant other tree with it to supply nutrient because it is very aggressive in taking water and other substances without replacing).
5. **Cost of regeneration:** Rapidity of growth and resistance to injury are factors related to cost consequence the choice of spp must aim at maximizes profit .e. use and utilized spp that will warrants less cost in management to achieve this consider.
    i. spp which require less disease and fungi control
    ii. choice spp that prevents weed growth
    iii. choose spp that produces straight bole and that have smelt pruning ability
6. **Market demand:** A good local demand for a particular spp must be guarantee e.g in Ibadan cassia seamen for fuel wood in Kano Dalbe gialis

Introduction of exotic plantation species

It must be started that native or indigenous spp in a given locality is the safety choice. As a result every effort must be made to utilize the beet adapted indigenous spp suitable to the object at management. However, the age factors which necessitated the introduction of exotic spp.

Factors leading to introduction of exotic spp

(1) When the supply of indigenous timber and other are inadequate to meet local demand

(2) When the original spp in a given environment are unsuitable for the object at management

(3) Where an inferior vegetation is to be replaced by more valuable forest e.g. the conversion of guinea savanna is to a plantation.

(4) When the objective of management is to extend the growth of a particular spp uniform over a large area.

(5) When the fertility of the soil are so deteriorated such that the original or the indigenous spp could no longer do well in the soil and must give way to or less demanding spp.

Species Trial

The 1st step in introducing exotic spp is to carryout spp trial. This is necessary to determine the suitability or otherwise to the new event. It is essential to test a fairly large number of spp before the most suitable ones are selected for example in Brazil, out of 140sp of eucalyptus tried, only few could reach reproductive age in plantation. In Nigeria, particularly in 1760s more than 80 spp were introduced. A final choice range between 5-10 in eucalyptus. Out of 30 conifers tried only pinus ceribace and apocarps were selected for extensive plantation. It is desirable to test of introduced spp order wide range site and climatic

condition. In reliable result to be achieved; it is also necessary to keep the number of trial plots with the limit capable for careful supervision and control generally we have 3 types of spp trials

Elimination trials

Is an essential screening trial in order to eliminate the forest candidate and distinguish the best. They are composed of small plots intended to be run for short period. Because cost of cultivation and maintenance are reduced by reducing tree spacing. In Nigeria plots with only 25 tree are used at 90 cm^3 spacing replicated 4 times usually in a random block design for at least 2 years, assessment are made at the end of each dry season. During the trial period, the entire area must be kept tree of weed and grasses by frequent clearing

Growth trials

Spp that has passed the elimination trials are now consider for growth trial, the aim of the growth trial is to ascertain some important features or characteristic such as the stem form, wood quality, again the growth rate with respect to CAI, MAI, the spp tolerance, the canopy development, the rooting pattern, flowering and fruiting rate under various condition, the suitability to diseases and pest attack. This trials range between 5 – 10 years. The difference between the spp with respect to all these characteristic may be slow but with time they start to come out; Te plot size is usually 20m x 20m (0.04 ha). It is usually replicated 5 times in random block design, spacing is usually 1.8m

Yield trial

After 10 years in the growth trials, few spp best suited for particular objective are now selected for the third stage, the aim is to obtain exact information with respect to volume incensement per ha. Other attribute to be accessed are timber quality and special problems relating to conversion and utilization.

This type of trials needs to run to full rotation and may ever after to 2^{nd} and 3^{rd} rotation to able to study and alls the mate ace requirement to that spp. in that particular rent the minimum singe is alls 0.8 to 2.3 to on replication of plot is very high ,this is necessary is provide pomposity formation for comparative study some of the meanest that are taken at cultural volume gritty height means weal wood quality and texture.

Read site tolerance.

Plantation establishment act

(1) Boundary demarcation

These are 3 reasons by we must elimination

(1) It is important to desalts boundary with respect to objected land owner parlay where garcon and bung is being practical

(2) It goatees a legal cooing to avoid trees asperser veered direct.

(3) It reduces the teary to mistakes and acceded palpation boundary are frequent minced by bang fence erected for the purpose of protection, they tenses are usually costly and should be constructed to the standard needed to guarantee satiety. The height should be kept to a minimum with concrete pillars or treated poles should be erected at inter vales parties way at corners and changes to directions.

A map showing boundary details distances and aye adjacent land meat be kept.

(2) Site preparation

When an area is considered marginal or reproductive or where it is poor stocked with in economic spp. it becomes necessary to replace such area with economic tree. The success to replacement to control teensy violation while he com to prepay plantation site with the lowest possible cost: the following must be satisfied.

(1) provision it ready access (it must be cakehole)

(2) the site capacity must not be treaded so as to guarantee Evan group and development

(3) Laclede must be totally eliminated

(4) Burrowing holes must be availed

(5) Tree must not be subjected to deceive expose or dedicator immediate after plainly

(6) Debris must not present the trees plated to acacia strut tones at realer interval

Where these conditions a met it is possible to minimize the slayers of under stocking of plantation and reduce cost on subsequent cost on subsequent cost on land preparation

Site Clearing

This involves total destruction of the existing vegetation or occasionally partial as in the case of environment planting. This clearing could be carried out either manually with the use of a machine.

Hand Clearing

This method is predominant in the tropics, the following act the condition which will warrant the use of hand

(1) Physical limitation such as trilling or rigged furrow where the topography and soil condition avoid the use of tractor.

(2) Adverse economic conditions where the area to be cleared are too small for the use of tractor

(3) Manual clearing could be employ to effect a clean plantation using fire since it ensure continuous spend of fuel.

(4) The effect on the soil in certain circumstance where the topography is favourable, tractor clearing could have adverse effect such as removal top soil trampling or the soil which lend to soil compaction.

(5) The major disadvantage of stand clearing is that it is slow, labour intensive and require close supervision

Use of machine

This method is use especially where total destruction of the existing vegetation is needed, it is advocated where

(1) scarcity of unskilled labour due to increase in standard of living or availability of alternative employment

(2) generally where this is an effective afforestation programme

The limitation to machines are as follow:

(i) slope of the soil area

(ii) the skill of the operator (he must be skilled)

(iii) the soil condition

Chemical clearing

Since mechanical clearing can be limited to soil topography and manual can be limited due to scarcity of labour the next alternative is chemical clearing, it could be use in conjunctive with other methods.

Generally chemicals are use to a limited scale, they are use in partial opening or in selective thinning. Chemical poison such as sodium arsenate or hormone such as 2.4 D, 2.5 ST have been extensively use in Nigeria. Those chemicals used in controlling weed are called weedcide white those that use to poison wood are called arboricida.

Fire clearing

Fire in the tropics is the most important tools for land clearing, over 90 of plantation area are usually clearweed using fire, the success however depends or whether condition and the quality of fuel burning in wet climate is generally by pre killing of large trees up to six minutes before following. Such trees are usually prevented around the boles or slashes made or their bark. This pre killing causes to die out prior to following.

Ground preparation

This is the second aspect of land preparation, it follows after site clearing two major activities are involved

Territory of land that is highly susceptible to erosion. It is possible to carry out preparation of ground for cultivation with the use of machine depending or site of operation.

Advantages of land preparation

(i) Grasses and/or litters which otherwise should have been born are buried and added to the ground to increase soil nutrient.

(ii) The vigous of perennial grasses that would act as weed is reduce due to exposure of their root.

(iii) The grasses and weeds are buried before large quality succeeds in reproducing.

(iv) Moisture loss during the dry season could be reducing with very good land preparation.

(v) It facilitates early planting.

Planting operation

(1) Direct seeding

Direct seeding on account of its relative cheapness, it is usually adopted where the spp is indigenous or likely to be adapted to the ecological environment.

(2) Also when sufficient viable seeds are available

(3) Where there is no urgent need for immediate planting

In most areas seedlings are usually employ due to the problem of seed years

Reasons for using seedling

(1) When spp do not produce viable seeds but can only do well vegetative.

(2) Seedlings prove to be the most effective method of plantation establishment or difficult site particularly in dry regions.

(3) Seedling is usually the most successful or site where competition for vegetation covers is very strong.

(4) It is preferred where seed supplies are limited or costly to procure particularly in case imported seeds.

(5) It allows for uniform spacing and guarantee better utilization of the plantation site.

(6) Use of seedlings facilitates weeding and subsequent management operations.

Disadvantages

(1) The cost of producing seedling is very expensive.

(2) There is difficulty in transportation to the planting site (with the risk of physiological shock from the nursery to the site).

(3) High requirement both in number and skill of the planting team (personnel).

(4) Unskilled of careless planting resulting poor survival rate, not determination which subsequently affect the quality of the tree produce.

Plating method

Planting at forest trees is done either manually or mechanical

Manually planting

With report to manuals planting 2 methods are involve which are (1) Notching and (2) pit planting

Notching in its simplest form consist of cutting a slit on the ground with a slave or mattock, opening the slit wide enough to insert the root of your seedling and finally closing the pit with the front hill. Variation consist of either or T. notch or a t-notch, both makes a double slit which takes longer time but ensure better spread of the root system. Notching can be used only with naked rooted plant.

Dibbling: This is a variation notching method in this technique, a hole is drilling into the ground with a crowbar into the ground, the soil is slightly leveled against the ground. Dibbling is used mainly for imported cutting and stumps.

Pit-planting

Bare noted or pitted stocks can only be placed in notch pit, however, all types of planting stock can be planted in pit where larger pit are used for large sized nursery stocks. The pits are usually dug with a spade or broad bladed mattock, the top soil is normally kept separate from the soil, such that it can be fill in first out to time of planting. At the end of operation, the soil in the pit should be leveled or slightly higher than the surface ground leaf. This is to allow earth sinking after rain or watering, for the same reason; it is normal to burry the root cover or few can after consolidation such that it remanding at the surface of the ground where the root cover is exposed, survival could be the paradises.

Mechanical planting

Planting machines are used to handle naked root stocks, if correctly adjusted, they generally gives better survival due to less not distortion, they also cover very quickly more ground than manual, however they can only be economically utilized over large area, they can also be limited by topography and vegetation.

Direct sowing

In direct sowing methods, the seed is soda directly on the plantation site, as an established practice particularly in the tropical, it has been tried and found reliable with few spp, it is usually successful with large seeded tree such as Gimelvna abovea as occasionally, it can also be used to supplement culling selective removed of seedling in nursery natural regeneration. Direct sowing of pinus caribea and 0^0 carpa have been successfully practiced in poorly stocked forest. The attraction of the direct sowing is that you avoid the nursery operation; also, little or no literature is needed to arrive at what to plant. Some tree develops naturally and this enhances seedling stability.

Disadvantages

(1) Germination percentage are usually very low, therefore more seed will be refused to achieve adequate stocking.

(2) In the nursery, seedling receive daily attention to obtain the best result, this can not be done in direct sowing or the site (no adequate cac.)

(3) Newly germinated seedling are easily suppressed by weeds and the lost of weed control can be high.

(4) Planting are usually poorly and irregularly stocked even when the seeds are sowed at regular interval.

(5) Poor weather condition could kill the entire crop.

(6) To enhance success, the seeds must be pre-traded with insecticide and pesticide to resist biological damage.

(7) The sowing site must be very well prepared to enhance germination.

Causes of failure in plantation

I. Wrong spp selection

II. Inadequate site preparation

III. Poor planting stock plant seedlings at higher morphologically and physiological quality.

IV. Careless handling of planting stock.

V. Bad/wrong planting techniques

VI. Neglect of weeding operation.

General rules in planting operation

- Insert the root into the soil up to the root-wilier.
- Avoid damaging roots.
- The soils around the root must be firmed either by hilling or knot pressure.
- Remove impervious materials before planting.
- On dry site temperature the planting position must maximize water retention.
- Stumps should not be forced into the ground, they should be placed in specially prepared holes and formed with soil around them.
- In arid-region, plants or seedling may be placed in special deep holes to ensure that the root reaches more of the soil, deep planting of tall seedlings can sometimes be done to prevent through Iron wand erosion. Time of planting. (28 – 7 – 8w).

  Correct timing particularly with respect to lifting of plants is very artificial to success a planting operation. the occurrence of wet season determines when planting schedule commences conventionally the best time to plant is when soil is moist when atmospheric condition is humid with minimum evaporation rate, this is to avoid decision of the young transplant. In regions larcas where there are pronounced wet and dry season planting operation should commence with the onset of regular and continuous rain, the use of pitted plant however extends the latitude of planting season since such plant could tolerate variable climatic condition than naked root stock. The moon source of mortality of transplanted seedling is evaporation transpiration stress; this stress can be minimized by 3 practices

(1) Plant your seedling when the soil moisture level have return to yield capacity (field capacity is the maximum quality of moisture that a given or texture coved retained) the on set or the commencement of wet season is unpredictable because the 1st rain are frequently followed by long dry spell.

(2) Plant on clouding days (with very high humidity

(3) Use or employ balance seedling (seedling of high morphological and physiological grades

Packaging and transportation of planting stock

Container plant or pitted plants are usually transported in trays or bites. The major disadvantage of this pitted plant is the space requirement. Lifting and packaging of base rooted are less costly therefore handling of these seedling must be kept to a minimum and should also be protected from wind/adverse erosion, accurate records must be kept of all plant dispatched from the nursery as part of stock control, these enables the standing tree to e related back to the original stock and in-turn to the seed batch.

Temporary storage of lifted plants

In temperate continues, dominant plant are often kept in cold storage for few weeks, this allows lifting and dispatch of such plant in orderly manner, it also enable the plant, to be available immediately when suitable weather occurs. Cold storage has been tried in the tropics but has not been very successful particularly in pinus spp.

Plantation tending operation

Several silviculture operations to ensure that the plantation are established and protected to the production stage.

All these operations are collectively termed tending operation. in other word, tending refers to all culturing operation carried out for the benefit of forest plantation at any stage of their life cycle. Some of the operation includes, beating-up, weeding, chamber cutting, fertilizer application use of fire twinning and pruning.

Weeding

The amount of weeding regard in any given plantation vary with into soil, season, condition of site when planted, size of the plant stock and the degree of tolerance of the spp weeding is generally carried out by hand using matchet, hoe occasionally by machine, it can also be done chemically from the forestry point of view, the chemical are divided into herbicides and arbiricide. Herbicide is chemicals which kill the plant by desiccating the leaves and upsetting the hormonal balance or interfering with its metabolism. They are usually used to kill/control grasses and herbaceous weed. Arboricides are those chemical uses to kill woody growths.

Cleaning

After beating up and weeding of the plantation, the next is usually cleaning, this is carried out in other to prevent desirable tree or scarp long from been suppressed by undesirable spp. The need for cleaning arises in situation where the method of cutting and site preparation employed create favourable condition for both desirable and desirable spp. Consequently, cleaning operation involves removing all undesirable growth.. sport and other poorly turn spp of undesirable trees competing with other potential. Trees must be removed, dissected and infected trees must also be removed. Cleaning should be done as soon as

individual tree that treating the health if economic trees as observed. The age when need becomes necessary varied with rate of growth spp and the initial spacing. The operation can be carried out using matchet, saw or poisoning.

CLIMBER CUTTING

There are 2 major type, the herbaceous and the woody climbers. Herbacesous climbers are problems only at the early of stages of plantation, the woody climber can be a terrible nuisance both in sichinger and checking the stem, damaging the crown or sending it over. This removed required great care this is because a mass of materials (dead materials in the crown) could be too heavy for the saplings, furthermore, climbers grow extremely last when cut, consequently, it is advisable to cent them in 2 places and to damp them with poison. It has been recognized that improper execution of climber cutting contributed to the failure of tropical shelter word system (TSS). Refined improvement in climber cutting enhances utilization by the forest floor by the desired spp where this is done in on even aged stand, it could be refers to as selective thinning. It is also refer to as improvement cutting in an un-even aged stand. Improvement cuttings are the preliminary operation to set the stage for systematic thin trees may be harvested, fueled or poison; this again must be done as early as possible.

FERTILIZER APPLICATION

1. To correct a specific deficiency of nutrient elements.
2. To establish a crop on hitherto marginal soil
3. To stimulate growth of the tree

the distribution between the 3 is not precise as fertilizer may be done for one or all the three reasons stated.

Although, increase in yield is the main improvement expected other benefit, such as reduced susceptibility to diseases and damages from post and drought as included.

Timmy of the fertilizer application fertilizer could be apply at any of the four stages of the late of plantation

1. At establishment for maximum response
2. During post establishment stage into canopy closure when deficiency begin to show.
3. At pole stage during early thinning so that the thinning operator will give a better response
4. Pre-telling application at fertilizer best telling stage 3 and 4 are largely experimental and are not widely practiced. Responses at those stages are generally poor. Generally, fertilizing at stage 1 and 2 gives great response, it should also be noted that fertilizing is not just a single operation but apply 2 or 3 times with the life cycle at the plantation.

FIRE TRACING

This is one of the methods of preventing forest fire, fire tracing is to necessitate of ride such that when fire occur, it should be fire as a silvicultural tool in plantation management able to prevent its spread onto another block fire tracing should be kept away from inflammable materials.

The planned or scientific application of fire is called controlled burning controlled burning is used for the following reaction.

1) To reduce the load of fuel so as to lessen the intensity and resistance of wildlife.
2) To prepare site for regeneration by removing some of the little and exposing the mineral soil.
3) To tricot off the release of seeds and to control weeds.

4) To remove infectation of cartoon insects and incidence of cartoon chisecteb

Controlled burning is widely and successfully practiced as a natural and economic tool of achieving the above purposes. It is recognized that in certain infertile soil while conservation of organic matter and nutrient are essential for long term production, controlled burning may be ruled out with repute to sight preparation.

Thinning operation

Thinning is the act of removing some of the stems in an immature forest stand with the aim of creating better condition for growing and quality of wood of the removing trees. The main objective of thinning could be summarized as follows:

1) To redistribute growth potential of stand to optimum advantage i.e to regulate the distribution of the growing space for the tree crops.

2) To utilize all the materials produced by the forest stand during rotation incidental objective which follow this growth redistribution are

- Reduction of fire hazard
- Reduction of likelihood disease
- Retention of trees with desirable hereditary nice and source of seed supply. The position of the grown is all important and continent criteria for deciding which tree to remove the usual crown classification are

(i) Dominant (ii) co-dominant(iii) inter-mediate (iv) suppressed trees.

Dominant

These trees with crown above the general level of ground cover receiving full light from above and also from this side. They are well developed and larger than other tree.

Co-dominant

These are shorter than the dominant tree but they contribute part of the general canopy. They also receive full light from above but comparative little from the side but their crown is more less crowded.

Intermediate

These tree are shorter than the dominant a co-dominant, usually they are about $2/3^{rd}$ of the dominant tree. Most of trees in these categories are top tree and receive light from above but very little from the sides. They have crown crowded at the side

Suppressed

Trees in this class have their height half of the dominant trees crown are usually entering below the canopy of the general level. They receive no direct light either from above or from the sides they rely on sun necks.

On the basis of these classification: thinning methods have been described which are

Low thinning – crown thinning and selective thinning.

Low thinning

Trees removed are chosen mainly from the crown classes, again there are 5 different grades are recognition which are

- Grade A - very light

Dead and dying trees

- Grade B - light, diseased, dead, dying and some suppressed trees
- Grade C - moderate, trees removed are over top trees for grade B
- Grade D - heavy thinning, trees removed are very top trees for grade B
- Grade E - very heavy thinning, trees removed are the whole stock is reduced to $2/3^{rd}$ of grade D

from these table above, except for grade D and E, low thinning is essentially sanitary in nature characterized by slight reduction in root competition, it is also not very economical since there is hardly market for the dead trees, it is however simple and wisely related to the natural course of stand development.

Crown thinning

This is always refers to as thinning from above it is also called high or thinning in the dominant, it involve removed of tree from the upper canopy so as to stimulate with development of the promising tree in the same size classes.

Most of the tree removed are as from the co-dominant which generally from the moon canopy, however, intermediate trees interfering and potential crop trees may also be removed. Crown thinning is likely to decelerate the dying of lower branches of trees it is more textiles and that demand greater sills on the part of the forester. The first approach is to removed poorly from dominant and wolf trees, the subsequent operation will now depend on the choice of final tree crops with good crown which can respond to rapid selective

Selective thinning

This is useful where for example pulp and paper is the object of management and where the market for the thinning is restricted to a certain minimum sizes, it gives quick economic returns, it however, retail the period of growth to a certain diameter class.

The effect of thinning on tree growth and wood quality

Thinning reduces the original stocking and create more space for the residual trees. Certain of the bole that were further to not able to form branches because of low light intensity with corresponding low light compensation point will now be exposed to sufficient sun light such that lateral bole and branches will develop consequently, thinning leads to a crown ward movement of the crown, the distance will of course

depend or the intensity of thinning where the thing is light, they will be slight effect or diameter growth and wood quality it is here seen recorded that there is a two relationship between intensity of thinning and ring width, the greater the intensity of thinning, the less the proportion of early wood formation. A forester must choose the appropriate thinning intensity to ensure that it doesn't result into creation of to more space for the residual trees; This is because excessive space for residual trees result into tapering which reduces the wood quality. Slight or moderate thinning in the other side decrease branching and axial variability. The effect of thinning a individual tree varied with crown classes and age trees in a suppressed crown class are very sensitive to thinning. Trees in the dominant crown class are least sensitive to thinning while those in the intermediate crown class are more sensitive than the dominant and less sensitive than the suppressed.

Pruning

Pruning is the removal of light and dead branches along the lower bole of a standing tree to improve wood quality in plantation where the rotation age is shorter and the aim is to produce, knot tree timber, pruning is usually employed. There are two types of pruning which are self or natural pruning.

This is done by patiently waiting for the physical or biological agent in an event to eliminate lower branches, generally it involves the killing and sheding of branches followed by healing of the wounds, usually it proceeds from the ground upward and yield more veer wood until virtually all the branches has been walled in.

The rate of healing of this lower branches is determined by the initial density of the forest stand and vigor of the tree consequently, closer spacing is advocated where natural pruning is to be employed. Generally natural pruning is low and can hardly be satisfactory in modern plantation.

Artificial pruning

This is the act of removing from lower portion of the stem so that the quantity and quality of the harvested will be enhanced.

Tools for pruning

Good pruning imp-lies that every plant made should be close to the tree trunk leaving no splinter or smoke stumps to interfere with carious formation. The choice of the appropriate tools used depends or a number of tractors

- The inherent characteristics to the bark
- The size of the branches to be removed
- The skill of the operator

Generally best results are obtained if the operator are allow to employ the tools that are familiar with some of the tools indicate hand saw and pruning saw.