(1a)

Check soil erosion

Eg Mangrove roots

Khejri - long roots

① tree root bind soil

② wind break + shelterbelt

③ humus ⇒ Mulching. - reduce velocity.

④ Improve infiltration.

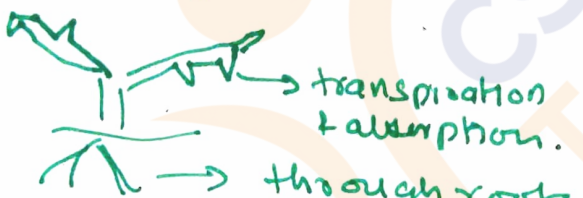
⑤ Biotic interaction.

Steps:

① Afforestation in cities - farm forestry, social forestry.

② Agroforestry to promote.

③



(1b)

① micro climate - JNU + IITD abhi 2°C cooler

② transpiration - moisture more.

③ root absorb moisture - capillary action

④ GW recharge thus increases capillary action

⑤ ↓ soil erosion → thus moisture entered.

⑥ Attract rainfall.

⑦ Succession stage preparation

⑧ Canopy - shade on soil. tapri

⑨ protection from frost.

Control run off:

① Riverine forest buffer

② rainfall - GW recharge.

④ Barrier to flash flood.

③ Banganga through Corbett.

④ contour Bounding - ↓ Ravines chir pine + deodar in himalayas.

(10) Objective ✓

① Eco return

② Intermediate yield return

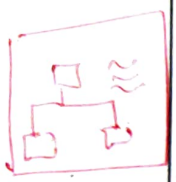
③ growth → reduced competition

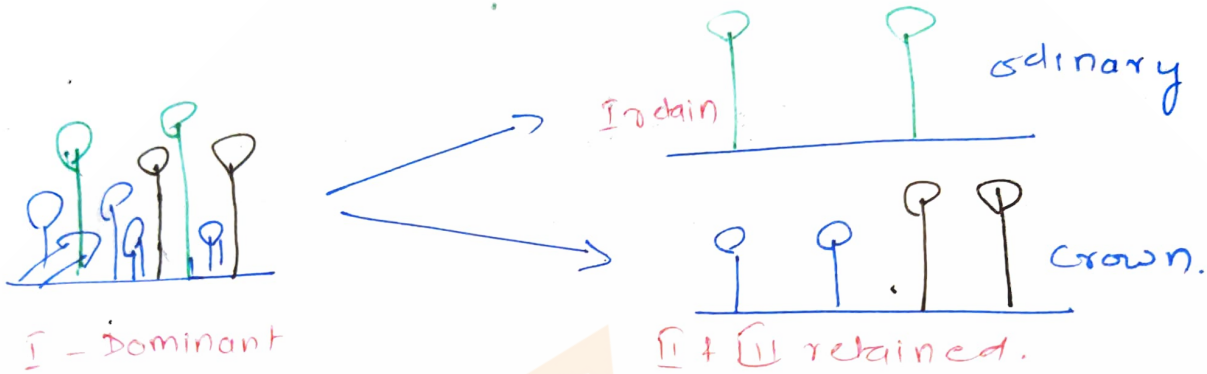
④ opening up canopy - light

⑤ Increase MAI

⑥ Reduce rotation

⑦ Clear & Straight bole.





ordinary - easier, soil erosion, human,

Crown - light - canopy opening, difficult to extract, large number.

Grades

Light thining - III, Id

Moderate - III, Ib, Id

Heavy - III, II, Ic, Id.

V. Heavy - III, II, Ib, Ic, Id.

V. Heavy - III, II, Ib, c, d + few Ia.

d) Characteristic
① 3 month / 5 month growing season
② low moisture
③ physiological dry soil
soil & air dryness.
④ below freezing

Leh → kargil
Lahul Spiti
13-16

Soil working.
① Breaking hard pan of soil.
② Contour farming.
③ Frost + snow hardy species
④ Microclimate.
↳ deodar – Southern.
chir pine – northern

Planting tech.
① done before Spring.
② frost hardy species.
for (Abla spicata)


↳

↳

Nursery bed.
↳ Seed treatment

e)

Forest (Matured. Stand)
↑
Clear cut
↓
regeneration establishment
←
rrrrr regeneration establishment

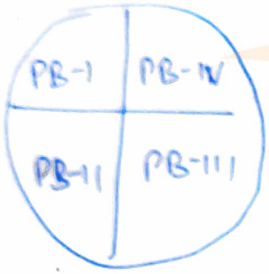
① Area – coupe (annual)
② Advance growth (Sal in Bihar)
③ Thining – 6-15-30-50 yrs.
④ Threat – Sal Borer, die back.
⑤ Felling after seedripening.

rainfall 60-120cm Coppice & root suckers

2a) Azadirachta indica → Evergreen (deciduous in dry)

- frost sensitive → young form
- drought resistance

Silviculture system - Shelterwood system.

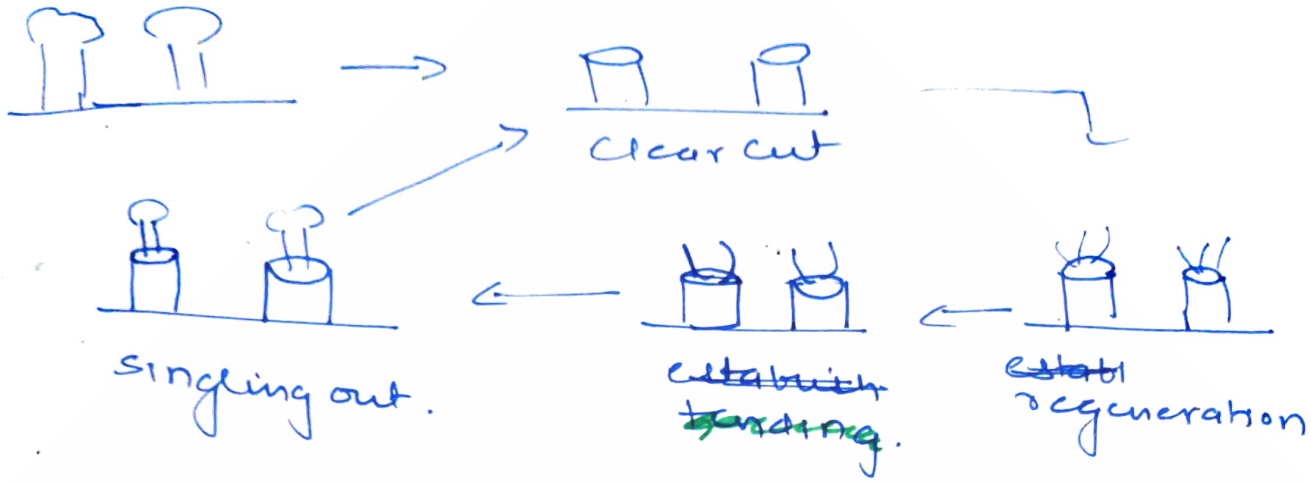


- Natural regeneration - seeds
- artificial - stump planting.

- felling → pollarding/lopping.
- Protection from frost - weed removal not in winter.

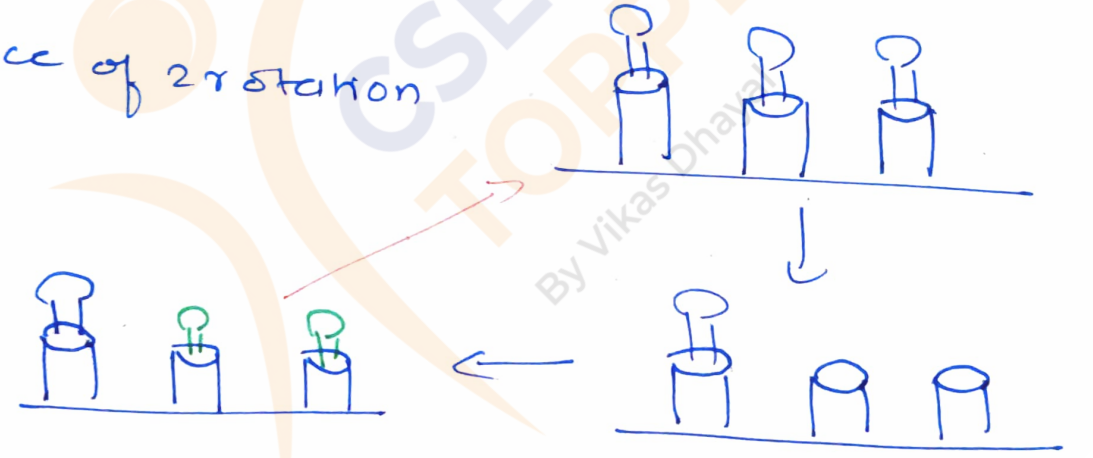
Wild → medicine, fodder, oil seed

(2b.)



Different coppice

1. Simple coppice.
2. Coppice of 2 rotation



3. Coppice with Standards
4. Coppice with reserves.
5. Shelterwood coppice system.

(39) Soil organic matter.

Importance - [Soil aggregate] | mulching |

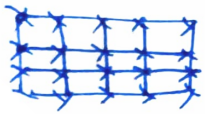
① nutrients to plants water retention | Buffer capacity

② absorb greenhouse gas - carbon stock

③ Reduce soil erosion due to compaction to soil.

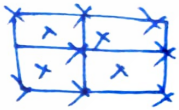
Line

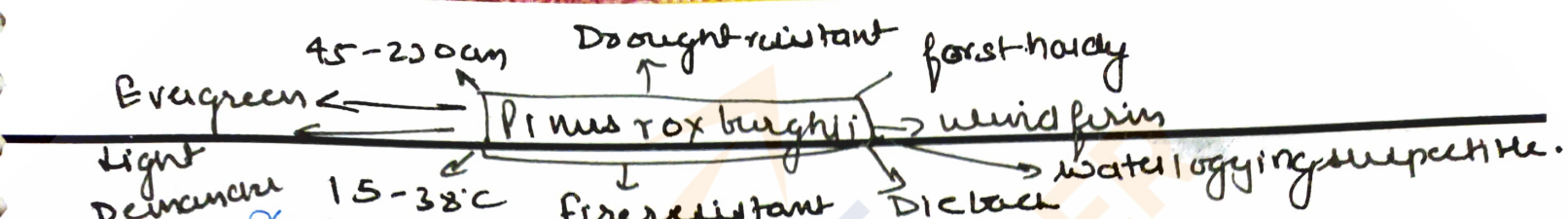
Square



Triangular

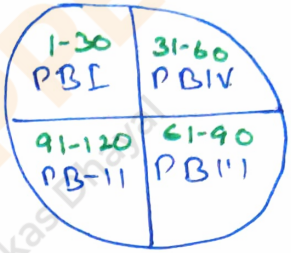
Quincux





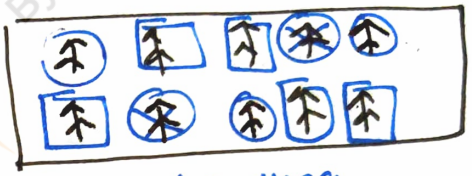
Pinus Roxburghii

Pattern of felling



① Seedling felling →
secondary felling → final f.

②



seedling
○ Primary felling
⊗ secondary felli
□ final felling.

2015 Section A

(1)

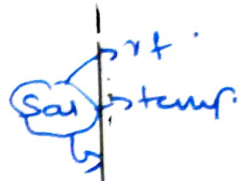
a) Progressive dieing from tip to backward where shoot dies but root remain alive.

Problem. Adaptation.

① Increase rotation.
② decrease ecoreturn / yield.
③ fire hazard
④ soil erosion.

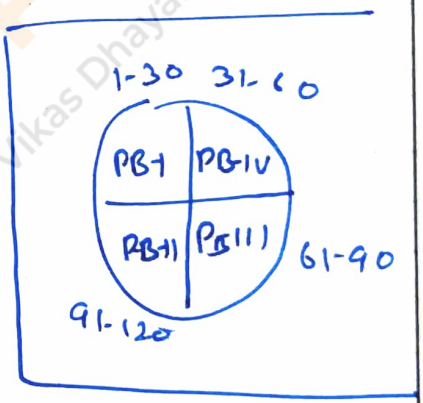
① root network ↑
② adaptability to harsh climate.
③ survive vagaries of nature.
④ lower weed growth.

WF) ↓ drip, ↓ grazing controlled, control nursery.



b) Shelterwood system. —

age group.



factor affecting:

Internal: ① germination percent
② Afterripening ③ Drought / Frost hardness
④ water content ⑤ size. ⑥ Season of collection.

External.

① Moisture ② Air ③ Light ④ Temprature
⑤ seed bed ⑥ grazing ⑦ weed.
⑧ Topography.

(c) ~~Good~~ Shorea robusta. Rf - temp.

① setback
② Population & grazing pressure.

~~Conditi~~ System selected - Shelterwood.

Reason - i) frost protection.
ii) soil erosion
iii) easier felling and transport.

Odisha, Bengal - Irregular Shelterwood. Failed systems

① Regeneration not at www
② long regeneration / rotation ratio

(d)

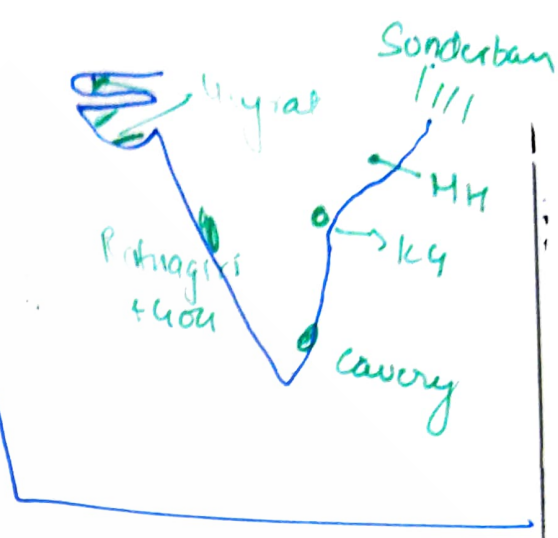
ⓐ Better succession adability
ⓑ suitability to microclimate
ⓒ ~~Improved~~ reduced failure of regeneration.

For eg: Indian irregular system in Sal and deodar as improvement over shelterwood in UTTRAKHAND

a) Better economic return
e) Aesthetic value f) L rotation.
g) Increase forest cover
h) Agroforestry - avoid allelopathy. i) HYV

e) Mixing of salt & freshwater.

* Mangrove - 0-10 ‰
  20-30°C Nands -
  4 B- champion + seth.



Management.

① ~~Shelter~~ selection system.

a) felling - annual cope to be worked out

b) Entire forest is covered in 20 yr.

c) Practiced in Myanmar, Pakistan, Bldesh.

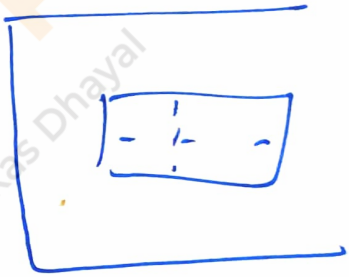
d) Light demanded.

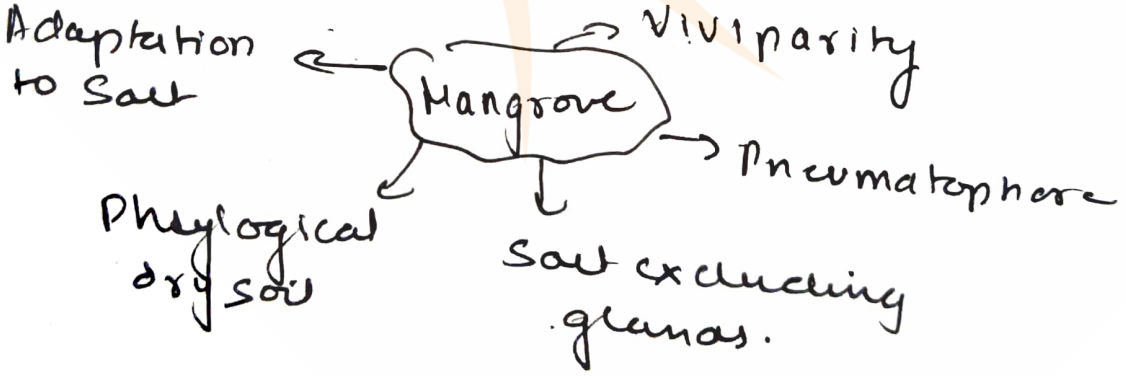
a) succession stage
Als → R → D → P/N

② Selection cum improvement -

a) different annual coupe.

b) weed - avoided through





20) To reduce the mortality - ↑ PP → treatment of seeds necessary.

Issues

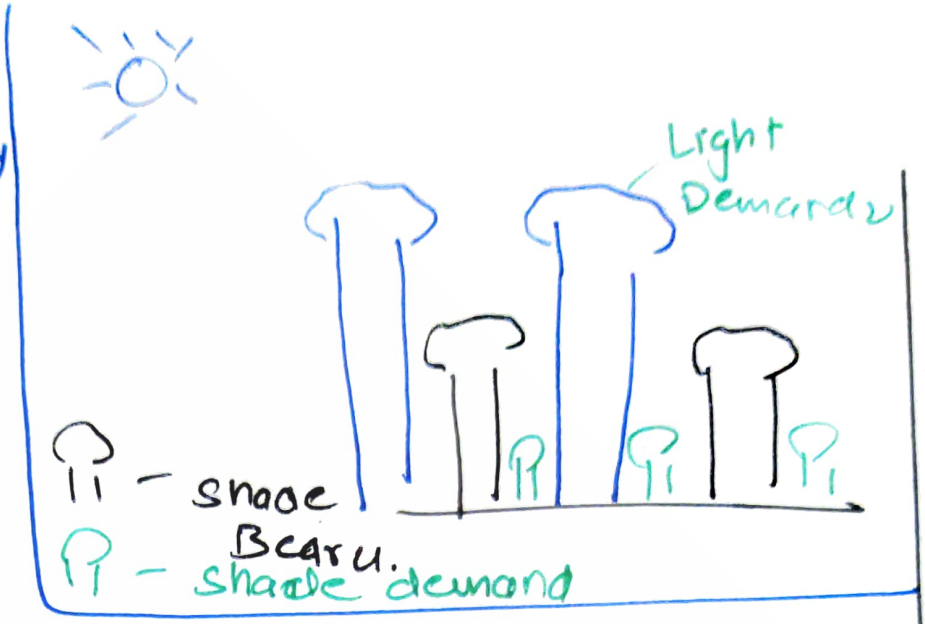
1. hard coat
2. Viability issue
3. Immature embryo
4. fleshy fruit.
5.

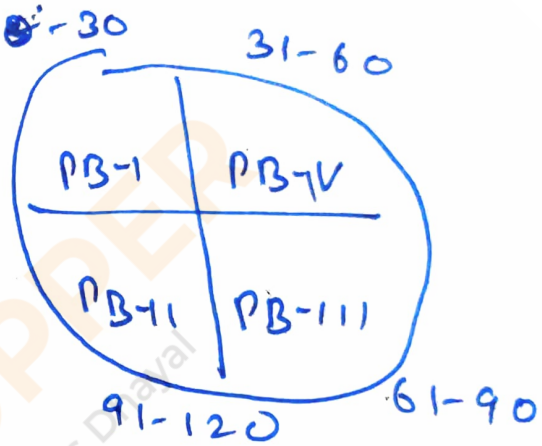
Treatment

1. Hot water treatment
2. Acid treatment
3. Cutting hard coat
4. Applying plant growth hormone (KNO_3)
5. Applying pesticide (Pb_3O_4 Red lead)

Uniform shelterwood system - age class instead of age.

Divided into Periodic Blocks.





Management

① Felling pattern -

seeding felling → secondary → final.

② ensuring proper light availability - canopy management.

③ Method of regeneration.

a) light bearer - advance growth or seedling

b)

Eg:
- Teak in moist sal of UP.

Tangible

1. Forest produce such as honey, gum, resin
2. Wood / timber for furniture / sleepers etc.
3. Source for forest based industry - Pulp.
4. Ensuring farm income - agroforestry.

Intangible

1. CO_2 storage
2. fresh air
3. soaking pollution
4. Aesthetic beauty.
5. Biodiversity.

(39) 'Hardening off' - resistance acquired by the nursery plant due to repeated exposure to shade and sunlight.

Objectives.

① Reduce mortality - ↑ plant percent
② Improve drought resistance
③

Frost factor. OM, water colloids, size, water content, ~~Pz DA Vet, Pz~~ Mineral present.

(b) Shorea Robusta. → Irregular shelterwood. (Punjab)

was introduced in Himachal Pradesh, Uttrakhand. after failure of uniform shelterwood.

Sal → ~~Ecic~~ c, die back, coppice ↑ RS.
→ Evergreen sp
Light Demander
→ Fire / Frost / Drought / Wind.

Why introduced. → regeneration not at will
→ die back ↑ large opening of area to frost.

Pattern → ① large regeneration → thus crop uneven age.
② Reservation of mature tree as

c) 5 species - Mangrove — A. officinalis, A. apicata, S. apicata, R. mangle, E. agalocha. heritiera fomes

Cold Desert → Rododendron, Pinus roxburghii, Pinus Wallichania, Abies alba, Cedrus Deodu Salix alba.

MALTS

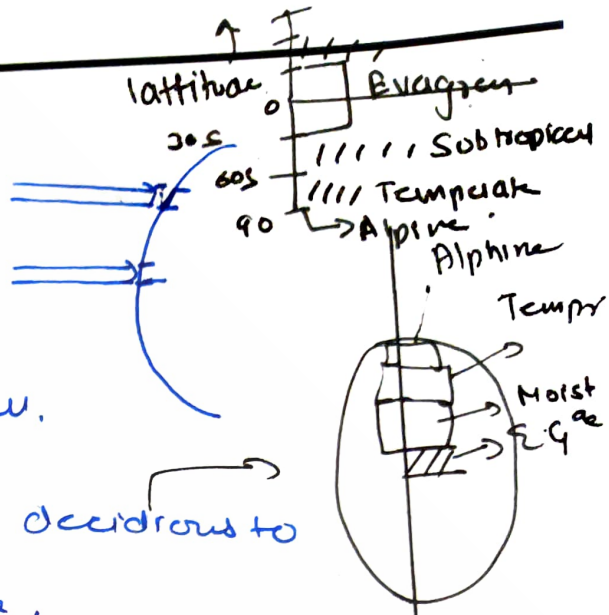
4a)

① More heat incident @ equator.

② Western side 0-30 } more
Eastern side 30-60 } rainfall.

③ Equatorial to m. evergreen to deciduous to temperate to dry alphine.

④ Evergreen ~~tre~~ species in rf and conifers

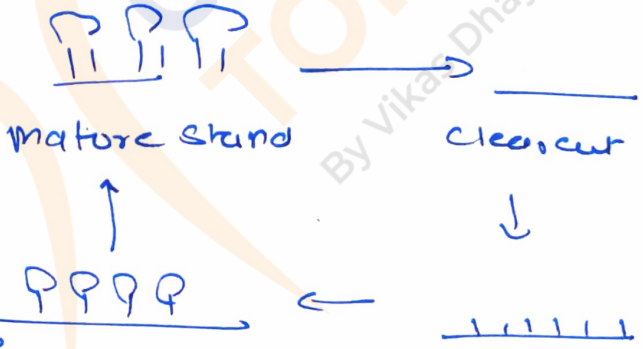


b) Tectonagranais is a -

Clearfelling.

a) felling of trees on marked area

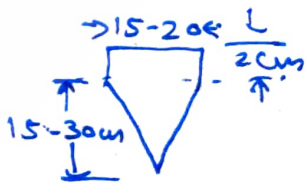
b) Forest divided into coupe ⇒ coupe = Forest Area / Rotation.



③ Rotation - CAI & MAI coincide.

Artificial regeneration

Stump planting.



Climatic condition → soil dryness - Physiological dry
→ low rainfall. (10 mm in Kargil)
→ low growing season
Desertic & subdesertic condition.

Strategies.

① Ability to grow in short season
~~Reduce transpiration loss.~~

② withstand Cold temperature - Conical shape

③ Broadleaves - low transpiration loss

④ Grass & shrub - more than trees in higher altitude.

⑤ Unpalatable leaves, snow hardy, Drought & frost hardy.

Necessities.

① CCO return - more of sil. syst

② HYV - tree improvement

③ Reduce failure -

④ Plantation in problematic soils

⑤ Reduce cost of sowing

⑥ Asthetic improvement

⑦ Advance to WP Plant percent / UC - UF

(10) Bamboo - 3type of flowering.

i) Gregarious flowering. - Bambusa bambus

ii) Sporadic flowering.

iii) Annual flowering... - Bambusa tuscata.

Reason for death. not starvation but few possible

① transfer of nutrition to younger plant.

② energy intense process of

③ resource - light etc.

Result ① Mizo - rat population blast.

② complete shedding

(16)

(1c)

Mixed forest - 25% of species.

Complete utilization.

① reduced soil erosion - complete covering.

② Light demander - shade bearer - shade demander.

③ Multipurpose use - neem

④ More income.

Issues ① felling damage ② not annual yield ^ fluctuate

(1d)

Agroforestry:- tree cover + agri crop.

Benefit

① More income

② less erosion

③ Increased yield

Khejri with Bajra.

④ Micro climate improved

⑤ Ground water recharge

constraint

① Competition for nutrients

② Shading.

③ Increased net poplar - Soyabean -

④ Allelopathy.

(e) Selection System.

Area of application.

a) Uneven forest - regeneration not at will
b) Attack of pest / disease
c) frost d) soil erosion.

Felling pattern.

a) Annual coupe - all operations done.
b) Light operation :- canopy.

Tending operation.

a) diseased & dead b) over mature
c) not of eco. Imp d) management of canopy. ratio maintained.

(2a) Concept Pioneer → → → Climax
Seres.

Types. Xerach / Hydrach Primary / secondary.

Eg: Mangrove / desert.

Factors - Active / Passive.

Theories ① monoclimax ② multiclimax
③ Mosiac theory ④ ?

39

Plantation schedule - various inputs provided/ operations to plants starting from sowing to felling.

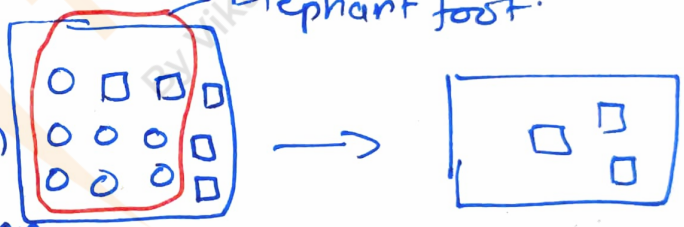
Factors.

a) Seed quality b) Soil bed c) Age of plant.
d) season e) die back f) drip h) grazing.
i) attack of pest & disease j) moisture. k) shading
l) hardening off.

b) Genetic drift

↓

Shift in genetic variation other than natural selection.



Hardy-Weinburg. - in absence of external factor - Mutation, migration - genetic variation is constant over generation.

c) **Uniform system.**

Area of application.
① Frost
② long establishment
③ Wind erosion.

Felling pattern: **Tending:-**

Silviculture - study of trees and their interaction with forest. It is applied portion of silvics (which deal with biology of plant).

Application

① Tree improvement - phenology helps us to distinguish superior genotype and help establish SSO / CSO.

② Forest management - to determine the rotation & obtain sustainable yield.

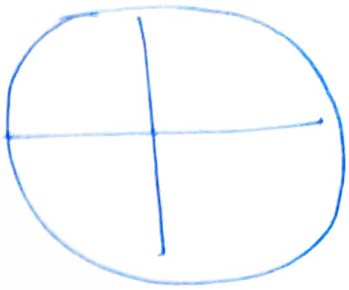
③ Mensuration - we would use {bark measuring devices} for the plant with useful bark. For eg: Acacia & catechu

(b) ~~RDAVIs~~ & MALTs.

Water content, water holding colloids, size, osmotic pressure, rate of transpiration.

(c) Shelterwood – Age class.

Periodic blocks.



Factors – Internal | External.

① growth ② Edaphic ③ terrain

④ Climate – frost / drip ⑤ grazing

(d) Cold deserts – Leh, Ladakh, Kargil, Lahul spiti.

(e) 17-42, Frost tender, Drought hardy, 75-190 cm.

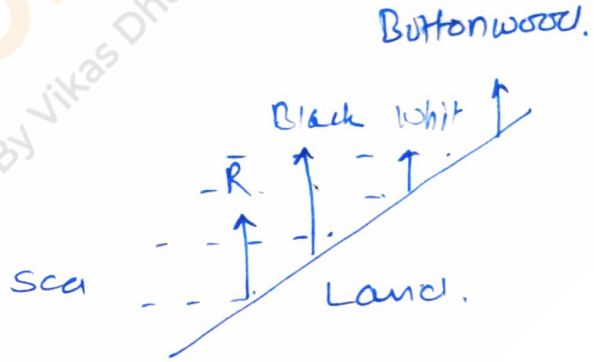
29 Dominant - highest

Dominated - $\frac{3}{4}$th of dominant.

Crop Ht -

Top Ht -

(1) Deltaic mangrove.



c) Acacia catechu - wind firm, frost hardy, Drought resistance

↓

15-45°C temp. Tends to fire

50-200 cm rainfall. deciduous, light demanding.

common name - katha

uses - katha for digestive problem, katha for chewing, bark used to treat.

Regeneration method.

Seed treatment - passing through animal.

24 hour soaking in water

Natural regeneration. - through seeds collected.

Populus deltoides. - deciduous 75-120 cm,

Water logging - ve, wind, frost, drought tve.

Regeneration.

Seed treatment -

3a) artificial means

Afforestation - growing forest where there is no forest for along time.

Technique → sowing
→ Aerial seeding
→ transplanting.

choice - ravine land.

① drought hardy
② break surface pan.
③ Aerial seeding is effective (a.v. p. juliflora)
④ cheaply available
⑤ do not become weed

b)

Coppice with standard. -

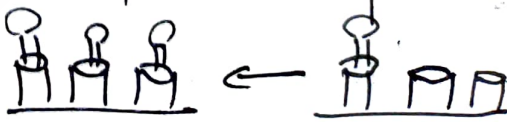
few species are reserved to provide protection to coppice.

A: Applicability - ① frost prone
② soil erosion
③ seedling growth/ seed bearer
④ protection from sun.

disadvantages:
① vigour decreases
② uneven age.

Felling-

① few trees are retained.
② lower storey - even age upper - uneven
③ superior trees selected - act as seed bearer
④ Mode of regeneration
lower storey - coppice
Uppa -



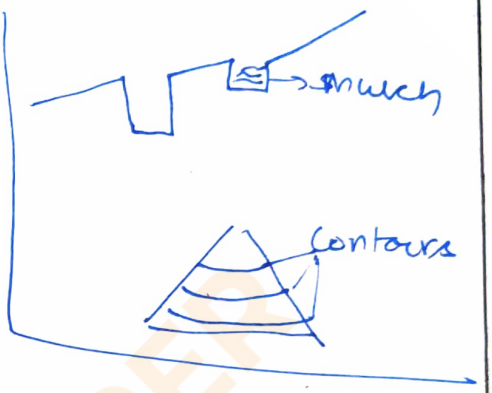
diff ① rotation ② Stacy ③ objective

(40) Biotic interference — ① Soil borer
② Parasites & climbers
③ weed growth.
④ grazing & browsing
⑤ crushing seedlings.

Method & measures

① contour farming & mulching

② Tending operations.
weeding in initial.
cleaning in pole
thining in tree stage.

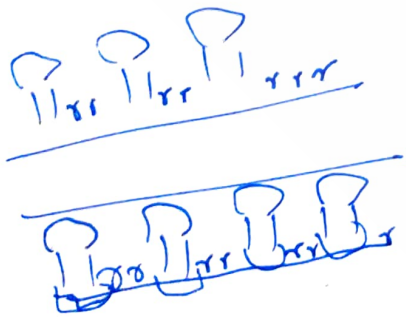


③ Rotational grazing ④ JFM ⑤ Agroforestry — khgri with Bajra (pearl millet)

b)

~~Resource~~ **Objective** ① waterlogging ② salinity
③ reduce runoff.
④ bind flood bank soil - ↓ erosion
⑤ improve microclimate
⑥ reduce evaporation loss.

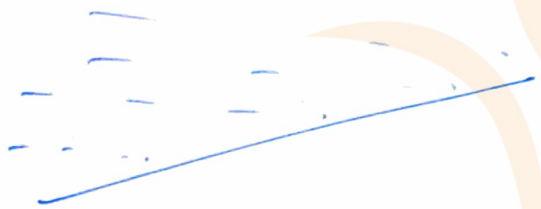
Silvicultural system



2 Storey forest —
① light demander / shade bearer.

c) Causes of degradation

① conversion of wetland
② thermal pollution -
③ pollution in rivers.
④ Encroachment ⑤ oil spills
⑥ Climate change - sea level.



factors responsible.

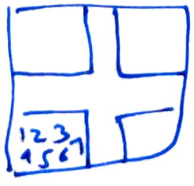
① Succession stage.
② Species chosen R mangle.
③ Purpose of use -
④ mode of regeneration
⑤ fish Bone technique.

(1) Semi Evergreen.- acacia catechu,

WU Evergreen.-

b) Phenology. S. characteristics- regeneration-

(c)



(a) Pest attack, introduction of exotics, genetic resource rotation, recreation, aesthetic, soil erosion, less labour and cost, suitability to microclimate.

(c) Grafting. scion + stock - grow as single part.

wedge shape.

2 (a) Indian Irregular shelterwood system. -

~~Andaman Modified~~ Par. Puyar.

1. dbh - 150 cm are ~~cut~~ first - applicable to evergreen
2. Regeneration not at will
3. Danger of loss of fertility
4. Avoid immature death of trees.

Rotation - higher
Produces Uneven age

Uniform

Mode of felling	PB -	PB
Age group.	Even	Uneven
Objective	Protection from frost	Regeneration not at will

(3a)

Felling HT - from where cut - domestic

① exposed to etc animals & herbivorous if

② too high

② too low - susceptible to pest.

felling intensity.

① too early - extraction of resource - reduce soil fertility.

② too long - gigorious flowering - may lead to pest attack & economic loss.

(b)

4a)

① With increasing altitude

→ Juniperus
→ Pinus wallichiana
→ Pinus roxburghii
→ cedrus deodara

② Aspect of slope

southern slopes - deodar as northern cold

③

a)

① Salix alba - White willow wood.

② Azadirachta indica - fodder.

③ Acacia nilotica - leaf & few wood.

④ Hardwickia binata - Andhra.

b) Moist tropical forest -
- Wet Evergreen
- Moist Evergreen
- Moist deciduous
- Littoral & swamp forest

c) Thining - felling in financially immature tree for the benefit of growth of stand.

Types of thining:
- Mechanical
- Ordinary
- Crown
- Elite
- Maximum crop Advance

Chosen → ordinary.

① dead & diseased removed

② less grown removed

③ easy to carry out - low damage

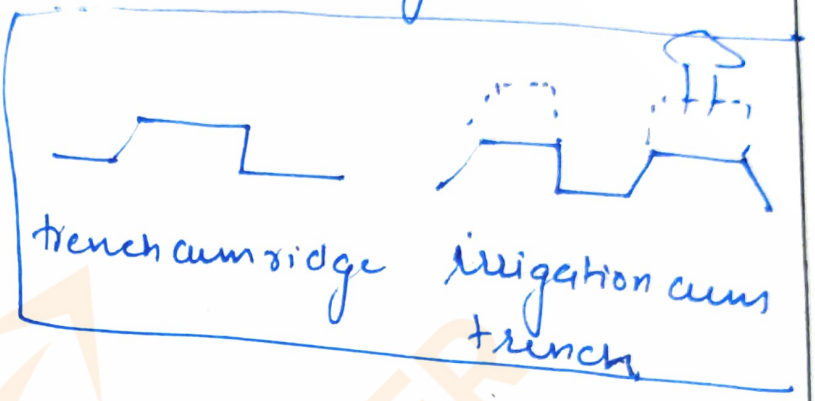
④ Shade demander can be grown.

a) Cold desert
b) Kargil
b) Ladakh

Characteristics:

① Physiological dry soil ② low growing species
③ low rainfall 10 mm Kargil ④ low temp. — desert
⑤ melting

Overcome: ① species. ② succession stage.
③ Irrigation technique
④ contour farming.



b) Sand dune stabilisation - LDN.

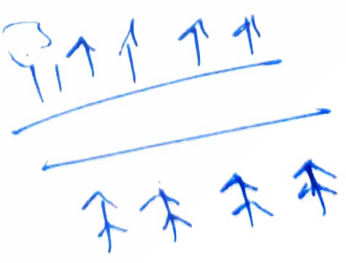
Unstabilised → Stabilised → Partha.

① choice of area : succession stage.

lichen → mosses → herbaceous plant → perennial shrub → thorny plants.

② choice of species ④ dispersal of seeds.

④ Riparian along 14



c) **Felling of bamboos**

① mark bamboos to cut ② 3-4 yr felling cycle.
③ 1-2 yr - excluded ④ old as standard.
⑤ Rhizome should not be cut ⑥ slant ⑦ no splitting.

Consequences ① all bamboo clumpdie. (Bambusa Bambos)
② chances of pest attack Mizoram plague.
③ food shortage possibility

Measures ① collect seeds before falling.
② ~~Co~~ Cutting ~~rhizome~~ rizhome before flowering
③ collection of fallen seeds

Q4 a) Unique characteristics. pneumatophores / Viviparity / salt excreting / thin cuticle / salt tolerance / waterlogging tolerant /

~~Hinoca~~ Avicennia → Rhizophora → Bruguiera → Nipah / Pandanus.

b) Physiological dry soil when plant unable to absorb.
Moisture — high salt content — Mangrove
freezed water. — Cond & sat

Succession.

Subclimax - population of community prior to the climax.

Pioneer → subclimax → climax.

Importance - ① exotic introduce ② rotation ③ economic value ④ selection of species ⑤ silvic system. ⑥ conversion.

Vegetative propogation - any missing part capable of

Advantage: if no seed, true to type, selection ↑, clonal so: easy mature

disadvantage: reduced vigour, low adaptability, not all plant

(10) Stand table – tells about volumed form of tree and diametral ht distribution.

Preparation ① Single variable
Multi variable. ③ Area of application

② collection → Graphical
④ thining -
→ least square
Regression

(b) GEO — Over sametime, GEO, communication
Sun schronous - Pole to Pole, LEO, remote sensing.

Satellite Image
Remote sensing.

(1c)

(e) smooth stump.

① divided into 4 part

② counting 5!-10 & so on - using pin

③ cutting sapling of 1m, 2m, 3m - to determine age & dia

Info it provides. ① Age vs diameter

② Complete growth of plant.

③ Drought years if any.

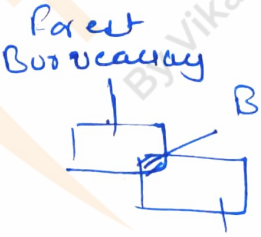
Issues:

① Wayring. faltering.

② not visible in hardwood

③ season w/o growth.

a) JFM - 1FP 1988.



(JFM)
Better conservation of Forest
Social need.

+ve impact.

① Reduction in FF.
Eg: Haldwani division appoint Eco Cadet corps.

② Social need - JEEVANI - TUBRI - Arogyaparna.

③ ABS - 2000 - Aichi mct. ④ Dev of tribals.

-ve issues

① competition ② hesitation in Forest officials

③

(19) From establishment to regeneration felling

time taken is known as Rotation. It refers to no. of years tree was alive.

Physical rotation – ↳ Maximum volume output

↳ Silvicultural rotation ↳ technical rotation

↳ maximum economic output return ↳ maximum return.

(20) Growing stock = total volume grown.

① Partial enumeration (intensity)

② Complete enumeration.

need for enumeration ① predict growth | qs ② Prepare V Table

③ Determine WP success ④ necessary intervention ⑤ Plan future action plan

⑥ economic return expected ⑦ find yield.

⑧ effect of Sil operation.

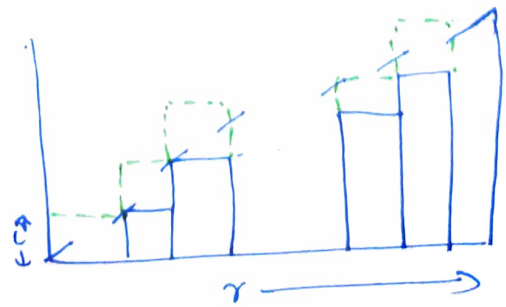
(21) Regulation of Yield. ~~Area~~ – ~~yield volume~~

Area, Area & Volume, Volume, Qas, Increment; Diameter.

ir = I

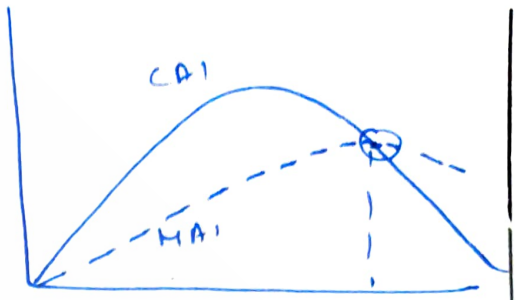
Before felling

After felling.



2c

MAI - Mean AI & CAI



Observation

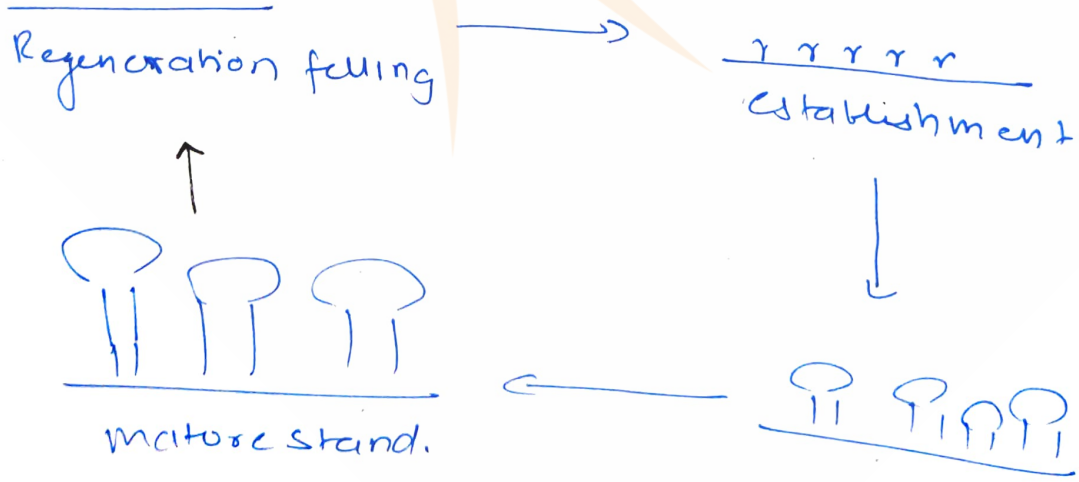
① CAI achieve maximum before MAI.

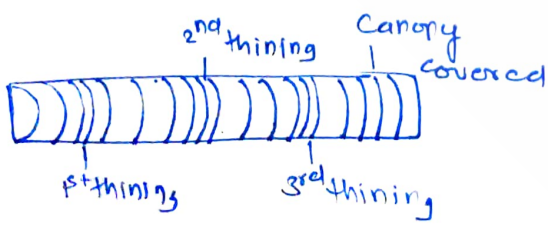
② At point of intersection, MAI is maximum & rotation.

④ Role in forest management.

① obtaining Normal forest.
② deciding Rotation ③ making yield stand.
④ Predicting stand quality.
⑤ Determine utility of WP operation.

3a Even — ① normal age gradation
② similar age

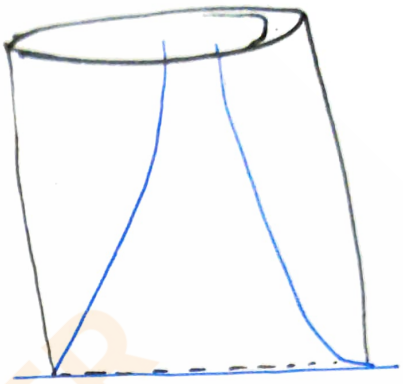




Tree stem form - form which stem form take wot 3D structure. such as parabola, neloid etc

Volume of tree

Volume of cylinder with same base



Calculation

① From stem Analysis

② from yield table

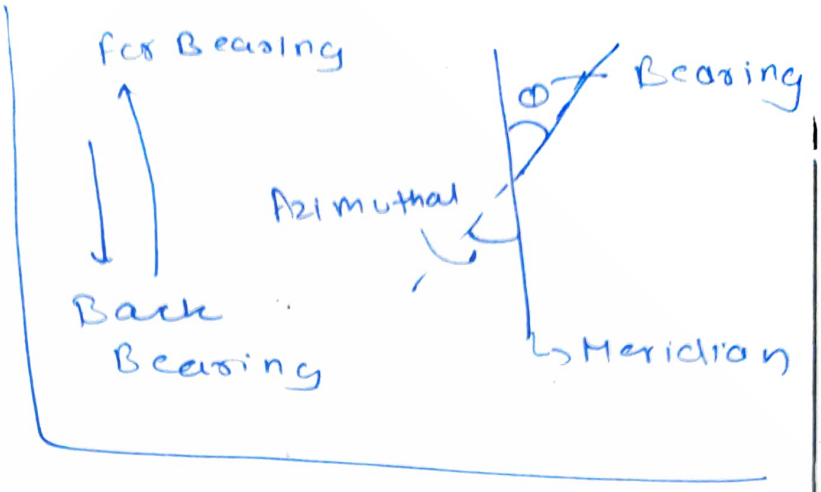
③ Direct measurement

Use- ① Economic return ② Edaphic factor

③ Site quality ④ selecting superior tree.

(c) Preservation plot - isolated point kept out of human intervention to ~~stud~~ conserve flora & fauna.

(a) Placing a compass and finding sampling Point



(b)

(-ve) ① when not visible ② magnetic ③ chaining not possible ④ near boundary

(+ve) ① Quick ② accurate ③ large area.

(c) Peculiarities → type of rotation
→ yield mgmt
→ silviculture system
→ working plan - long duration

Suggestions ① working plan by DFO & WD - detail
② changing silvi culture practices based on research
Eg: Indian Irregular Punjab Shelterwood.

a)

① Annual crop Vs tree crop

② Soil - fertilizer

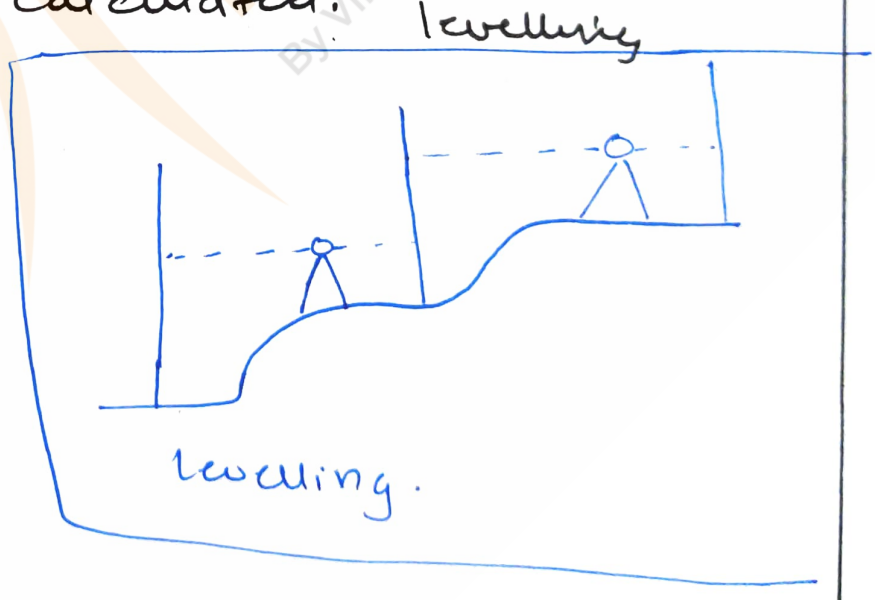
① Light Demander Vs shade bearer Vs shade demander.

② Soil - Microorganism or natural indrigent

b) Geodetic height: is calculated.

Useful.

① Countour map. - equal ht



Usefulness

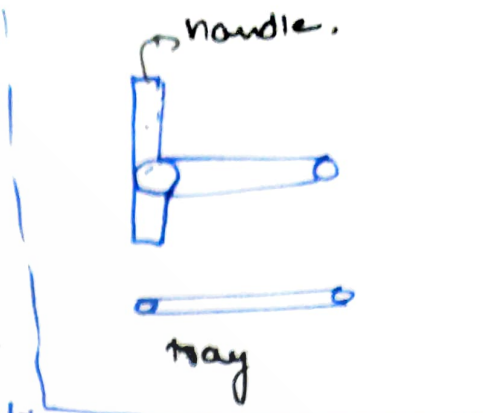
① Prepare maps

② forest road and ways can be developed.

a)

Increment borer imp.

a) predict the growth
b) any retarding
c) check growth d) yield regulation
e) yield is standing

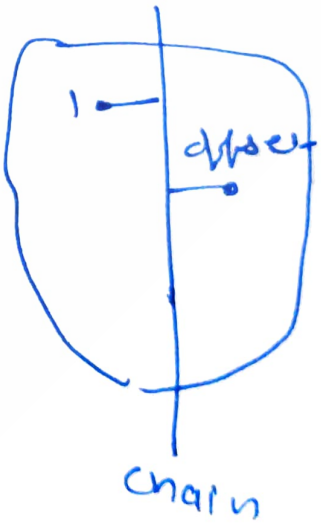


IV impact. ① If not closed, wound - pest attack.

② Deformation in trees. - if too deep cut xylem phloem.

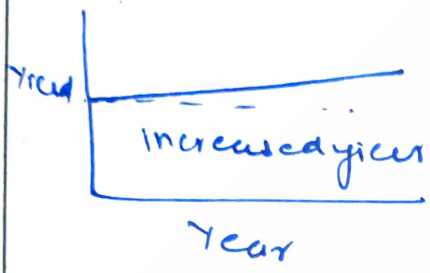
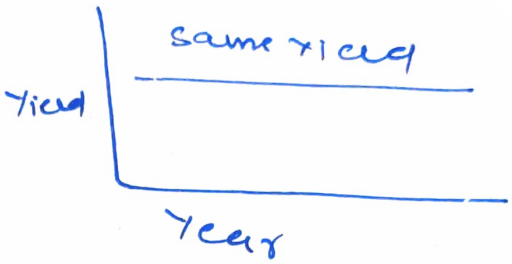
c) Requirement-

① offset
② Chain
③ Pin / Pegs
④ Plumb bob
⑤ Cross staff
⑥ Tape
⑦ Ranging Rods.
⑧ Field Book



Factor. ① Visible ② Chained around

③

Progressive Yield	Sustainable Yield.
① ~~Increased same amount~~ yield due to silvicultural development	① Producing same amount every year.
	

Progressive. ① linked to with forest. ② pp ↑ ③ ↓ soil fertility ④ Rain climate ⑤ carbon capture.

⑥ We cannot harvest ~~ye~~ more than we grow over a long term.

Yield over long period is always less than or equal to growth.

Theoritically:

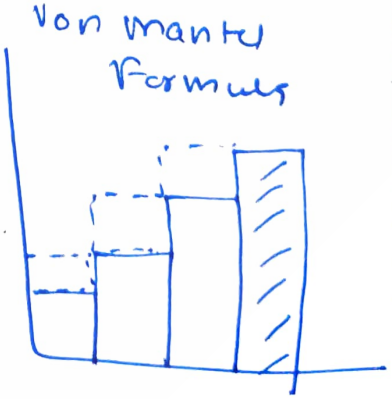
using normal formula.

$$Y = \frac{V}{P} + \frac{iP}{2} = \frac{V}{P} + \frac{i}{2}$$

$$\frac{V}{P} = NGS \qquad Y = NGS + \frac{i}{2}$$

$$Y = \frac{2NGS}{r}$$

Von Manted Formula

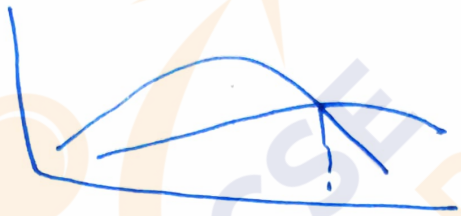


∴ Increment in nth yr

harvest in nth years

(c)

Rotation →

	Min. volume	
felling.	when CAI meets MAI 	when reproduction & vigour decreases to produce yield & quality seeds.
Suitability	↳ for highest eco return ↳	↳ to yield good quality seeds ↳ to assist natural regeneration in OS & SS

(a)

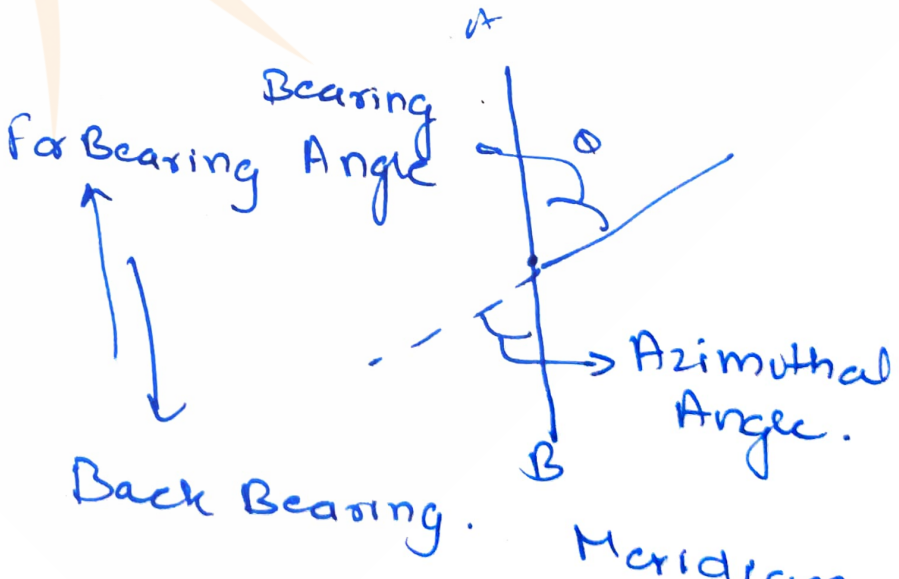
(b)

- Landuse
  - CLAD – Density
    - Age class.
  - Composition
- Stock maps
- Regeneration

- Uses of Map-
  1. Plan forest Mgmt
  2. Easy travelling – reduced cost.
  3. Easy Connectivity.
  4. Avoid damage to seedling.
  5. Alt. routes.

(c)

Precaution
1. not near magnetic objects
2. visible from each other
3. accuracy required is low.
4. Straight table.



a) Bitre Formula = $a + b.\frac{c}{L}$ c = Point from base

Hoga formula

b $a + b \ln(\frac{c}{L})$

L = length

$a + b = 1$

Taper - reduction in basal area as height increases.

Tapa table - compilation of change in stem diameter between 2 measured points divided by length.

Type of taper table. → diameter tapes table

→ form class taper table.

(b)

1 a) Age → Even / Uneven

Species → Principle/Pure → Mixed.

Use → Protected → Protection → Village / Timber → NTFP/MFP Avenue.

Legal status → RF / PP / VF

Significance: ① Guide to sil. operation ② JFM ③ Edaphic factor ④ Mgmt - people involved ⑤ employment.

b) normal growing stock. - same amount of volume added, which may be equal to removal (or cut) aka yield.

c) Stump - 4 round counting ignore half.

Significance: 1) age v dia 2) ht v dia 3) age v sht.
② preparation of yield table ③ site quality.
③ previous growth trend.

Understanding past growth. ① low dia - drought. → wind
② hanging - inadequate nutrients ③ wind pattern.

narrow wide

fails ① Dieback ② season of no growth

29) Working Plan prepared by MoEFCC on recco of 2 PWPR → 10-15 years operations

NP - MoEFCC, 10-15yr, Broad, no day to day
AP - DFO, 1yr, based on WP, day to day.

change needed. ① Time period Mid term evaluation

(19)

Pattern of felling - overmature / diseased / low value / interfering / canopy management / Avoid frost pest -

Regeneration - Natural - Seeds, Root sucker, Ad. growth. AR - Broadcasting, transplant.

Yield Management :-> Biology formula.
-> Successive enumeration

Felling cycle - annual coupe.

b) GIS - data + Map. Component - Software - Hardware - Data - Vector data - Liveware

Pure science:
① Tech. knowledge
② Geology + IT
③

Other aspect:
① topography map.
② field level correction / Ground truthing needed.

c) Collabration - JFM - 1988 NFP.

Better knowledge - utilising TK - reporting forest fire - labour employment - social welfare. - medicine

a) Practices — ① Yield determination. - allowable cut.

② Determination of growing stock.

③ Pattern of felling

④ Regeneration mode.

⑤ Marketing & transportation.

⑥ Labour management.

c)

- temporary
- fair weather
- permanent.

Essential investment

① forest survey.

② reduce mortality

③ Prepare forest map

④ Easy transportation

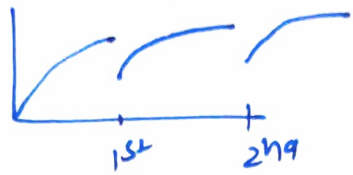
⑤ Access to areas.

⑥ Easy monitoring.

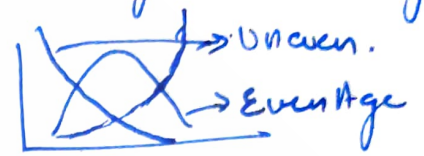
2a) Stand Structure distribution - age gradation is a facet.

Factors affecting.

① Thining



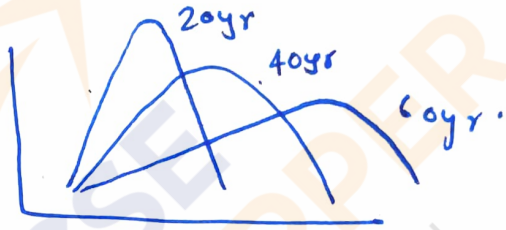
② Even Age / Uneven Age.



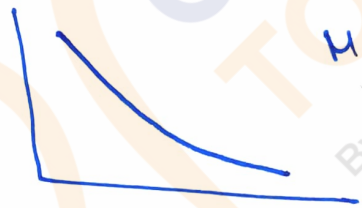
③ Light - ④ Silviculture system. ⑤ Light demand / shad.

⑥ fast growing / slow growing ⑦ pest - disease -

DBH Even Aged.

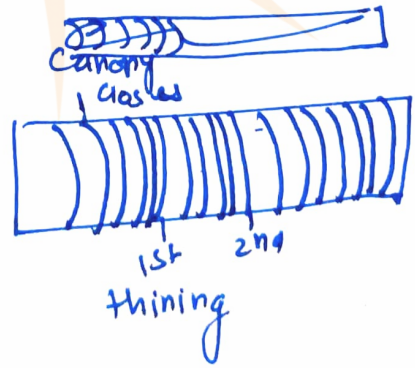


Uneven Age

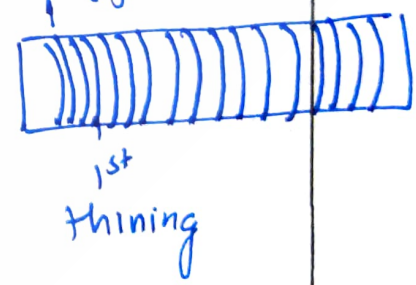


Moltage.

Growth Pertrce



Competition for light



b) Survive load -

c) ① Weak

b) We cannot yield more than we grow in perpetuity.

① By Area : Von Mantel Formula.

$$Y = \frac{2NGr}{R}$$

~~Mason formula~~

② Area & Volume ⇒ Hartig Method ~~$V_B - V_A + M_B$~~

$$Y = \frac{V}{P} + \frac{i}{2}$$

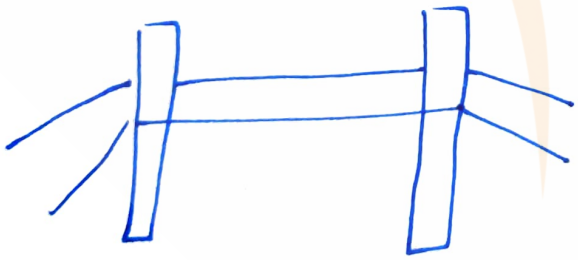
③ ~~*~~ GS & Increment

④ Exploitable diameter.

③ a) Application. — MODIS / Resourcesat III

forest mapping / forest fire / geology / soil condition / texture / Watershed mapping / habitat management / aried photograph - growing stock.

b)



Points to consider.

① no. of vehicle load.

② ~~bucket~~ strength and hardness.

③ Cantilive support to avoid bending & fatigue

④ Young's Modulus.

Socio ecological - ① Grazing ② MFP ③ Afforestation ④ soil erosion ⑤ microclimate impacted. ⑥ changes in succession ⑦ changes in economic value ⑧ Nutritional exploitation - thus soil Productivity impacted.

c)

① sloped increase soil erosion and

Eg: landslide on steepslope in himalayas.

② Western ghats — more landslide on windward.

~~landslide~~

③ Microbes and nutrients on southern aspect.

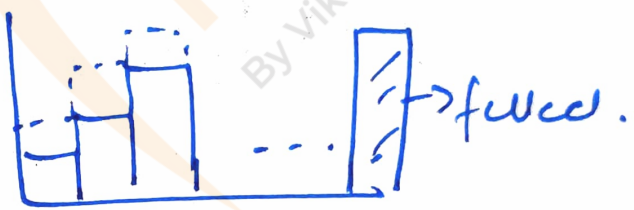
1c) Normal Age gradation _ Clear felling

Normal Age Class - shelterwood system.

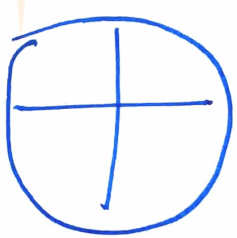
Role in forest management

① Easier yield calculation.

$$Y = 2\frac{NGS}{R}$$



$$Y = \frac{V}{P} + i/2$$



②