

ARTIFICIAL REGENERATION

REGERATION

NATURAL

ARTIFICIAL

NR + AR

अरण्ये ते पृथिवी स्योनमस्तु

Artificial Regeneration



- “The renewal of a forest crop by sowing, planting or other artificial methods.”
 - The crop so obtained
- Plantation: Forest crop raised artificially, either by sowing or planting.

Means of AR

- Direct Sowing: Sowing of seed directly on an area where a crop is to be raised.
- Planting: Transferring of seedlings or plants in the area to be regenerated after they have successfully passed the critical stages of germination and initial development.
 - Nursery grown seedlings, more economical
 - Wildlings: natural seedlings

Objects of AR



- Risk of deterioration and loss of soil.
- Crop composition: Do we need to change original crop composition for better output?
- Density of stocking
- Yield : AR gives higher yield
- Time factor: AR saves time – crops with shorter rotation
- Objectives of management: AR Agroforestry, wasteland reclamation, production forestry, specific objectives

OBJECTS OF AR



- REFORESTATION
 - “Restocking of a felled or otherwise cleared woodland by artificial means.”
- AFFORESTATION
 - “establishment of forest by artificial means on an area from which forest vegetation has always or long been absent.”
- *ENRICHMENT / GAP PLANTING*
 - *“Planting of seedlings in gaps or in understory to increase the canopy density of a forest.”*

REFORESTATION: WHY

objects of reforestation



- Assist/ supplement natural regeneration
- Improve the quality & quantity of the forest produce
- Replace natural regeneration where NR is uncertain, slow & uneconomical
- To restock degraded forests (eg. Post fire reforestation)
- To change the crop composition to more desired species
- Introduction of exotics
- To utilize and reclaim wastelands
- To generate employment

NR vs AR



Sl.n o.	NR	AR
1.	No control over spacing and stocking	Desired spacing and level of stocking
2.	Uncertain, slow, initial stages of growth exposed to biotic and abiotic damages	More certainty of survival germination and initial stages of growth are under well managed conditions in nursery
3.	Lacks uniformity, uneven aged crops	Gives uniform, even aged crops
4.	Maintains genetic and species diversity by virtue of being mixed crop	Narrow genetic base
5.	Does not allow change in species composition as per objectives	Allows change in species composition
6.	Lower cost	Higher cost

CHOICE OF SPECIES

Species for AR is to be selected based on:

Geography – climate, soil, topography

Ecology – Stage of succession

End-use or objective of management

Growth rate

Ease of establishment

Effect on the site

1. Climate & Micro-climate

- Important to have weather data / info
- Use native species as indicator
 - *Glycosmis pentaphylla* indicator of Teak
 - *Clerodendron infortunatum* indicator of teak and Sal
 - *Viola* sp. Indicator of Deodar
- Analyse information regarding performance of exotics in similar climate



2. Soil conditions

- Important to know soil type of the area
 - Type, Nutrient status, Depth, Structure, composition
- Plant indicator species
 - Soils with high concentration of soluble salts:
Tamarix, Prosopis juliflra, Salvadora oleoides



3. Topography

- Topography influences micro-climate and edaphic factors
- Terrain – smooth even, undulating, plain, mountainous
- Rockiness
- Aspect in the hills



4. Ecological considerations

- Stage of succession:
 - Eg. Khair and Shisham on riverine areas Doon area
 - Wattle Acacias and Eucalyptus grown in grasslands of Western Ghats (Kerala) resulted into failure



5. Objectives of management

- Objective of management
 - Wasteland reclamation, bio-drainage
 - Eco-restoration of degraded forests (Shola forests, evergreen forests, mangrove restoration)
 - Beauty
- End use
 - Market oriented



Shola Forest, Western Ghats



Restoration of Shola grassland ecosystem in Pambadum Shola, Munnar



Mangrove plantation, Andamans



6. Growth Rate

- Short rotation tree crops for market consumption
- Consideration to cover the canopy as soon as possible
- Fast Growing species



- Fast Growing Species:
 - Species which has a height increment of 60 cm per annum in the earlier stages of its life and which gives a minimum yield of 10 cu.m / Ha / yr in a short rotation of 10-15 years.
- Indigenous fast growing species: *Acrocarpus fraxinifolius*, *Ailanthus excelsa*, *Anthocephalus cadamba*, *Bombax ceiba*, *Gmelina arborea*, *Melia azaderach*
- Exotics: *Eucalyptus sp.*, *Broussonetia papyrifera*, *Populus sp.*, *Acacia mangium*, *A. auriculiformis*



7. Ease of Establishment

- The species should be easy to establish on the given site
 - Establishment of sal is affected by Die back hence very difficult



8. Effect on the site

- The species selected should not deteriorate the site
 - Allelopathy
 - Large consumption of ground water
 - Allergy causing pollens (Eg. Pollen allegry of *Acacia auriculiformis*)





which method of AR to be followed?

CHOICE OF METHODS OF AR

- SOWING
- PLANTING

SOWING

- Putting the seeds directly into the soil where plantation is to be raised.
 - Broadcasting
 - Line sowing
 - Strip sowing
 - Patch sowing
 - Dibbling
- Seed treatment
- Pelletization – encapsulation of seeds




PLANTING

- Planting nursery raised seedlings after they have crossed initial development stages that are vulnerable to damages
- Seedlings, Tall plants
- Stumps (as in teak)
- Other propagules (grafted propagules)




SPACING

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- Rate of growth of species
 - Fast growing sps wider, slow growing sps closer
 - Branching pattern
 - Many branching closer to facilitate natural pruning
 - Height of plants
 - Higher plants wider spacing
 - Site factor
 - Drier sites closer spacing
 - Objectives
 - Fruit production: wider spacing (as in seed orchards)
 - Small timber: Closer spacing
 - Cost
 - Closer spacing is costlier
 - Inter-cultivation

Choice between sowing & planting



- Species characters
- Site characters
- Availability of planting material
- Cost



Sowing Vs. Planting

	ADVANTAGES	DISADVANTAGES
SOWING	<ul style="list-style-type: none">•Less cost•Less time•Early root development is good	<ul style="list-style-type: none">•Large quantities of seed are required•Seedling mortality is higher
PLANTING	<ul style="list-style-type: none">•Less seed quantity•Bird damage eliminated•Success percentage is greater	<ul style="list-style-type: none">•Costlier•More labor intensive

Choice between pure and mixed crops

<i>Criteria</i>	<i>Pure</i>	<i>Mixed</i>
<i>Soil deterioration</i>	<i>Higher</i>	<i>Lower</i>
<i>Resistance to diseases</i>	<i>Low</i> <i>Skeletonizer & defoliators</i> <i>in teak</i> <i>Sal borer in Sal</i>	<i>High</i>
<i>Increment & yield</i>	<i>Higher</i>	<i>Lower</i>
<i>Difficulty in execution of silvicultural operations & mgmt.</i>	<i>Lower</i>	<i>Higher</i> <i>(different rotations, growth rates etc)</i>



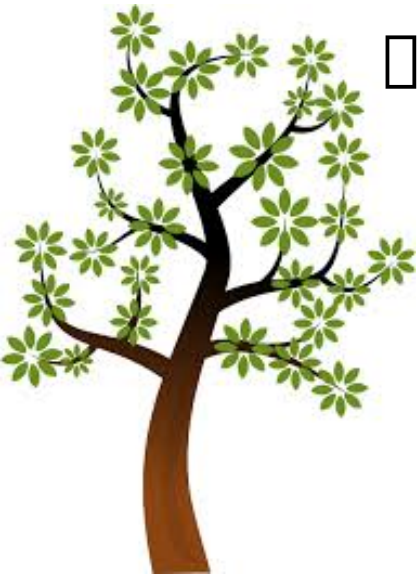
KINDS OF MIXTURES

- Temporary mixture
 - Secondary species is mixed only for a part of the rotation of primary / main species
 - Protection from frost, sun
 - Ground cover, suppress weeds
 - Early competition
 - Additional revenue

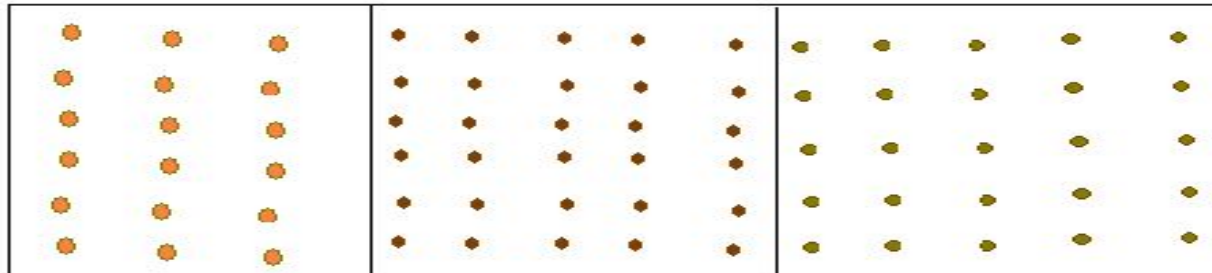
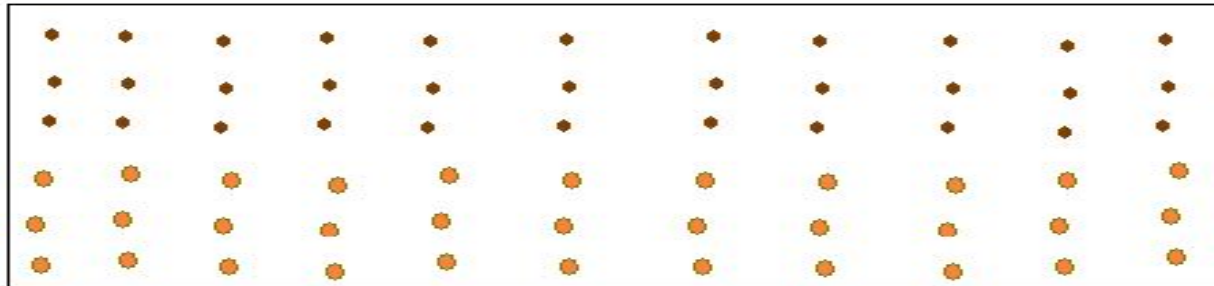
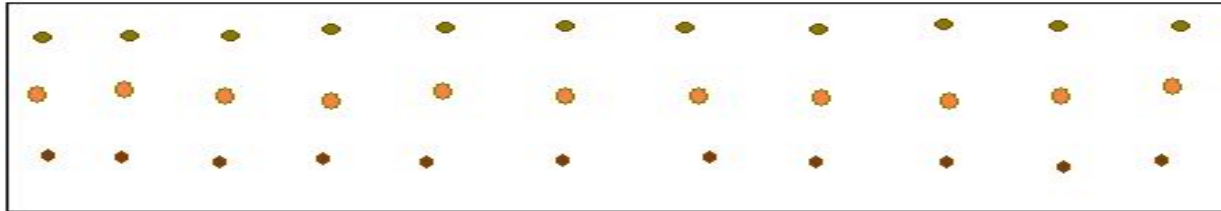
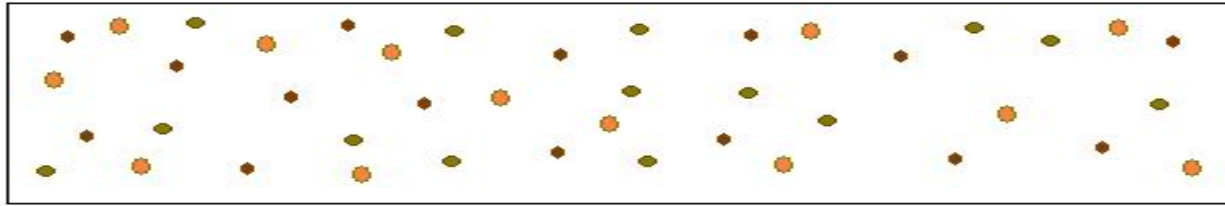


Contd...

- Permanent Mixture
 - Accessory sps. remain throughout rotation of main species
 - Horizontal or even-aged mixture: All the species mixed are in the overwood or of same height (khair & sisham, sal and *T. Tomentosa*)
 - Vertical or uneven aged or storeyed mixture: Main species in top canopy and others below it (Teak & bamboo, Sal & Jamun)



Patterns of mixture



RECAP

