The Handbook of Training Technology: Ecological Restoration of Degradation in Forests

Eco-technical Models of Three Degraded Forest Types

(1) Afforestation of severely degraded land (Mode 1)

- **Goal:** adopt artificial planting afforestation measures to form primary pioneer plant communities and restore vegetation cover as soon as possible. In the near future,the severely degraded forest will form a kind of plantation with different structures of arbor, shrub and grass. Moreover, it can produce short-cycle industrial raw wood and fiber.
- **Selection of tree species:** Choose light-demanding, poor site tolerant, fast-growing and nitrogen-fixing *Dalbergia cochinchinensis* to create a pioneering community, which not only improves local forest environment but also gains better economic benefits.
- **Community design:** Plant seedlings evenly and retain the original shrubs and herbs properly, as shown in the Figure 1:

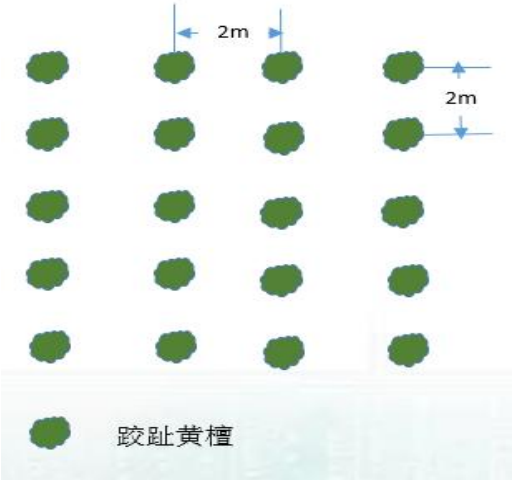

Figure 1 Even planting pattern

- **Technical measures:**

--Site selection: Choose a suitable forest land with convenient transportation to the community. The slope is below 25 degrees. The soil degradation on the site is not serious. The thickness of the organic layer is about 5cm and above. The thickness of the soil layer is above 80cm. It contains less gravel and has a loose texture. Water and fertilizer retention ability is good, located in the lower slopes and valleys.

--Afforestation land clearing: If the slope is large (above 25 degrees) and there are many weeds and shrubs in the afforestation land, it should take the strip clearing method to remove the weeds and shrubs on the afforestation land and place them on the non-planting belt. The belt width of planting and non-planting are both 2m. Afforestation land with lower slopes can be fully cleared, and the miscellaneous shrubs can be moved out of the afforestation land.

--Site preparation: The size of the open planting hole is 50cm × 50cm × 30cm. The topsoil is placed separately from the core soil during site preparation. At 15-20 days before the afforestation, the topsoil is backfilled, and then the core soil is backfilled until the pit is filled.

--Initial planting density: 2500 seedlings per hectare, and plant spacing are evenly distributed by 2m × 2m.

--Seedlings: Container seedlings of *Dalbergia cochinchinensis* is over 35cm in the height.

--Planting: Planting is arranged right after the soil is wet in the rainy season. After the soil in the planting pit is totally wet, choose high-quality seedlings for afforestation. Before planting, remove the container bag and avoid loosening the soil around the seedling. First, dig a small hole as the same size as the container. Second, put the seedlings in the hole straightly, and then return to the soil. Third, step the soil on it, then return 3-5 cm of loose soil.

--Tending the new planting: Tending grass is carried out 2-3 times a year for the first 3 years after planting. During the growing season, weeds and shrubs with a radius of 1m are eliminated around the center of the seedling to ensure normal light for the seedling. At the same time, the buds are cut off and one trunk is retained.

(2) Reconstruction and reconstruction of moderately degraded secondary forest (Mode 2)

- **Goal:** Through inter-planting the tree species under the storey, the forest coverage and canopy density of low-quality and low-efficiency forest are increased. A multi-layer community structure is formed by adjusting species composition, which in turn improve the economic benefits and strengthen the water conservation efficiency in ecologically fragile areas.
- **Selection of tree species:** Local precious tree species such as *Dalbergia cochinchinensis.*

Community design: Considering the vegetation distribution characteristics, the status of water and heat resources and site conditions in natural forests, make full use of forest gaps to improve natural regeneration. Using the cluster planting method, 4 plants were planted in each cluster (Figure 2). In the later stage, one dominant tree for each cluster was selected and cultivated as a target tree depending on the growth performance. Other trees were gradually cut down.

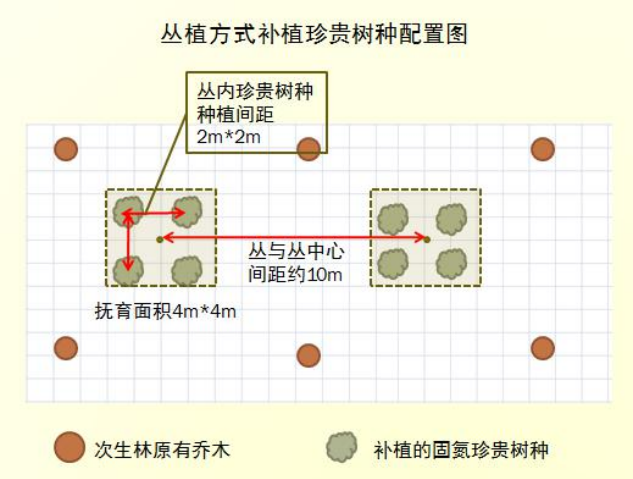

Figure 2 Cluster planting pattern

- **Technical measures:** In the rehabilitation and reconstruction area, replant the mother tree in the cluster planting method. After planting, soil loosing, weeding and young forest tending are conducted. Meanwhile, the natural resilience of the tree roots and seeds help form mixed tree species forest.

--Opening forest windows: Replanting precious tree species such as *Dalbergia cochinchinensis* with high economic value in natural degraded forest as target tree species, 90-120 forest windows per hectare, and the distance between forest windows is about 10m. If the stand still has other tree species with higher cultivation value, they are first selected and marked according to the target tree standard, and the number of windows for replanting should be reduced according to the number of target trees.

--Clearing and preparing the land: Open the forest window in the secondary forest and the diameter is about 4-5m. Cut and clear the weed and bushes, and then dig 4 planting holes in the forest window. The planting hole size is 50cm × 50cm × 30cm.

--Seedlings: container seedlings is over 50cm.

--Planting: Plant when the soil is wet. The method is the same as Mode 1.

-- Tending: Tending of young tree is the same as Mode 1.

--Natural regeneration: Pay attention to the maintenance and tending of regenerated seedlings of higher value tree species during the management process.

(3) Natural restoration of lightly degraded forest (Mode 3)

- **Goal:** For degraded forests with a certain number of target tree species, use natural resilience as much as possible to artificially promote the restoration of degraded ecosystems.
- **Selection of tree species:** According to the composition of tree species in the community, select 3-5 main tree species with high economic value, dominant layer, well growth and good-shaped stem form as target trees for key cultivation.
- **Community design:** The original structure of the forest will not be damaged during the management process.
- **Technical measures:** Adopt low-interference management measures, select 3-5 main tree species and focus on the cultivation of 100 target tree species per hectare. Competitive trees of the target tree are removed to promote the growth of the main tree species. Make full use of the forest environment to artificially promote natural regeneration.

--Criteria of target tree selection:

First, dominant tree species in the community
Second, the economic value is high
Third, dominant tree in the dominant layer
Fourth, good stem shape
Fifth, no damage

--Mark the target tree : Draw a ring mark on the breast diameter with red paint immediately after selecting the target tree.

--Remove interference tree: After selecting the target tree, select the trees that affect the growth of the target tree as interference trees according to the light utilization of the forest canopy, cycle them with temporary ropes at the breast height, and remove them as soon as possible. The removed trees can be used out of the forest land or left to rot in place.