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Schmidt, Lars Holger; Prasetyonohadi, Djoko

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Assisted Natural Regeneration (ANR)

Introduction

Assisted Natural Regeneration (ANR[1]) is a method for enhancing the establishment of secondary forest from degraded grassland and shrub vegetation by protecting and nurturing the mother trees and their wildlings inherently present in the area. Regeneration refers to generation turnover i.e. the entire reproductive cycle; in ANR regeneration especially focuses on seed dispersal, seedling establishment and growth. ANR aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regeneration such as soil degradation, competition with weedy species, and recurring disturbances (e.g., fire, grazing, and wood harvesting). In addition to protection efforts, new trees may be planted where natural regeneration of late successional species is poor. Such enrichment planting (or sowing) is considered equivalent to natural dispersal and thus within the framework of ANR. In contrast, large scale plantings where natural occurring regeneration plays a minor role, is generally considered falling outside the concept of ANR. With ANR, forests grow faster than they would do if relying entirely on natural processes.

Succession and accelerated succession

Ecological succession is an ecological process denoting a change in the species structure of an ecological community over a period of time. The community begins with a relatively simple structure and with few pioneer species and develops towards increasing complexity until it becomes stable or self-perpetuating as a climax community, which is characteristic for a given climate, soil hydrology or other site specific factors. Lowland rainforest, peat-swamp forest, riparian forests are example of climax vegetation types at their most species diverse an biomass accumulation stage. As the pioneers contribute to alter the microenvironment, late successional species (LSS[2]) appear and eventually oust them by shading. Some pioneers are short-lived while others will survive into the climax stage and may even be able to regenerate in gaps.

Development from pioneer stage to climax stage may take many decades because pioneer vegetation, though initially creating a suitable environment for LSS, also exerts a certain competition with them. One aim of ANR is to speed up the natural succession process by favouring LSS at the expenses of early pioneers.

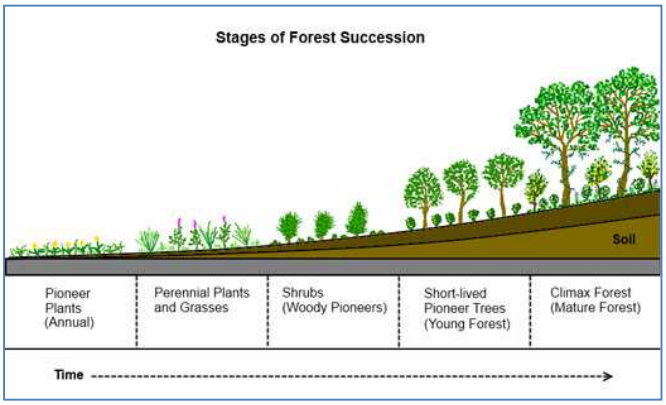

Fig.1. Theoretical model of succession from pioneer stage towards climax forest. ANR aims at shorten the duration of succession, hence reaching the stage of climax forest faster than it would do if left entirely to natural processes

[1] The 'A' is sometimes translated 'Accelerated', referring to an expected faster natural regeneration than without ANR

[2] The term 'Late Successional Species', here abbreviated LLS is sometimes referred to as climax species or non-pioneer species.

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Release thinning

LSS have short-lived desiccation sensitive (recalcitrant) seed. They germinate immediately after dispersal and have the ability to stay dormant as seedlings or saplings for several years in shade awaiting light gaps to occur. If there is a stock of under-storey dormant or slow growing plants of LSS, these can be mobilised to grow by creating light gaps, thereby stimulating their growth. Before release thinning is performed, the stock of understorey seedlings and saplings should be surveyed. Some seedling description guides exist. In many cases it is difficult to identify non-fertile[3] material including seedlings to species level. However, for regeneration studies, identity to genus level usually suffices.

Fig. 2. Release thinning by girdling unwanted pioneers

Release thinning should be undertaken where a sufficient understorey LSS stock is present. Usually release thinning takes places in 2-3 cycles with 1-3 years intervals depending on forest conditions. Where the canopy is mainly made up by pioneer species, a drastic reduction of pioneers will open up the canopy too much and mainly benefit the stock of undergrowth pioneer species. It is important both for regeneration and arborescent animals that an upper storey canopy is maintained. Where LSS occur at the upper canopy, neighbouring pioneers may be removed.

Release thinning may prioritise removal of special unwanted species, for example invasive exotics such as *Acacia mangium* and *Bellucia pentamera* (syn. *B. anxinanthera*) in Harapan. On the other hand, some pioneers are long lived (e.g. *Koompassia* spp.) potentially growing to several hundred years and forming a natural components in climax forests.

Removal of unwanted trees should be carried out with as little damage to the remaining trees as possible. Small to medium size trees may be cut down. Medium or large pioneers may be killed by girdling (removing bark at the entire circumference of the trees). Girdling rather than killing have three main advantages: 1. It avoids physical damage to other trees that is inevitable if trees are cut down. 2. It stretches canopy opening over a period over some weeks during which the understorey can adapt to the new light conditions. 3. Large standing dead trees often attract biodiversity during their decomposition.

Fig.3. Exotic *Belucia pentamera* from S. America, an invasive all dominating woody weed in Harapan

Many species have the ability to re-sprout after cutting or girdling. Hence, though killing the top will set back the trees, it does not necessarily kill it. Additional spraying with systemic[4] herbicide will often help killing the stump altogether.

Promoting natural dispersal

In much degraded forests, open grassland or exotic plantations, the stock of LSS may be low. However, if good forest appears within dispersal distance, LSS may appear as the pioneer species establish themselves. Most late successional species in tropical forests are animal dispersed. Birds, bats and several mammals disperse seeds by eating or transporting the fruits, leaving seeds to germinate wherever they are deposited. Unfortunately many fruit dispersers are

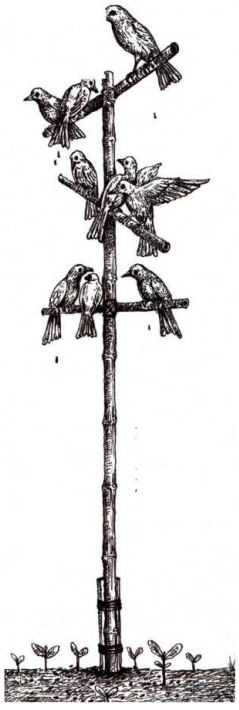

Fig.4. Bird perch creating resting places for frugivores. While resting the birds defecate leaving possible seeds under the

[3] Non-fertile (also called sterile) material is plant material without flowers and fruits.

[4] A systemic herbicide is absorbed by the tissue and transported with sap flow to other parts of the plant where it can kill the cells.

reluctant to venture into very degraded land as such environments are inhospitable to them, offering no food or breeding places. Without moving frugivores, there i s no transport /dispersal of seed. To break this vicious cycle, seed dispersers may be encouraged to move into degraded forests by planting early fruiting species, establishing nest boxes or raising bird perches. So-called framework species are species that tend to attract a large number of frugivores and hence promote dispersal of seeds from natural forest whenever dispersers move from there into the degraded forest.

Enrichment planting

Important LSS species may be absent if dispersal distance is long, of if natural dispersal agents are missing. Especially large seeded species have reduced or no natural dispersal since large mammals (like Rhinos and Elephants) have disappeared from most natural forests. Wind borne dipterocarps don't travel far, and if not present as an understorey and there is a long distance to wild sources, invasion by natural means could take centuries. If such species are wanted, for example because they are considered valuable trees for the future, or because they are rare and needs special conservation efforts, they must be introduced either as plants or as seeds. Enrichment

Fig 5. Enrichment planting with LSS (here wild Ginseng) may integrate conservation by including rare endangered species.

planting is not necessarily uniform; normally enrichment planting should be done only in areas where available seedling regeneration of LSS is small.

Enrichment may use seedlings or seed as basic material. Seeds are easier to transport and seed of LSS often germinate and establish well in natural forest away from mother trees (where predation can be very high). However, most LSS have short-lived seeds and since species rarely seed at the same time, direct seeding is difficult for mixed species restoration of LSS.

Selected readings

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Authors: Lars Schmidt, Djoko Prasetyonohadi

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