Reforestation and Restoration of Native Vegetation and Biodiversity to Degraded Landscapes in China

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Abstract The extent of degradation and of biological simplification in the world's forests is attracting widespread attention, and there is common agreement that some form of reforestation should be carried out on these degraded lands. The forest loss is already acute in China. Because of the bed weather and the growing population, developing a new reforestation technique, using which plants can be established under natural conditions, is a difficult question in China. Seed-base revegetation technique was proposed and the trial project was implemented near Xiaolangdi Dam, Hena Provience, China.

Key word : reforestation, storation, direct seeding, degraded landscape

Introduction

There is consensus in the scientific community that the current environmental degradation and destruction of many of the Earth's biota is considerable, and is taking place on a "catastrophically short timescale"[3]. Habitat loss is the leading cause of both species extinctions[5] and ecosystem service decline[1]. For many people biological diversity (biodiversity) has an intrinsic value ; humans have a responsibility toward other living things, and obligations to future generations. More fundamentally, ecosystem services involve the purification of air and water, detoxification and decomposition of wastes, regulation of climate, regeneration of soil fertility, and pollination of crops. On a more anthropocentric level, natural ecosystems provide human society with food, fuel and timber.

Generally, the removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity. In many countries, massive deforestation is ongoing and is shaping climate and geography. Deforestation results from removal of trees without sufficient reforestation, and results in declines in habitat and biodiversity, wood for fuel and industrial use, and quality of life. The extent of degradation and of biological simplification in the world's forests is attracting widespread attention. The intentional planting of perennial, woody species is a standard method for increasing forest cover, restoring forest ecosystems, and enhancing biodiversity in a deforested area. There is common agreement that some form of rehabilitation should be carried out on these degraded lands. However, there is much less agreement over how this should be done. This paper proposes to summarize the status of deforestation and reforestation in China, and through plot tests to find an alternative for reforestation and restoration of native vegetation and biodiversity in semi-arid degraded areas.

History and status of reforestation in China

The forest loss is already acute in China. Driving Forces of deforestation involve bad weather, degradation, population, land use et al. In the 1950s hills were stripped of trees to fuel steel furnaces and to clear farmland. That has left hillsides unable to trap rainfall, worsening summer floods that often kill hundreds of people along the Yangtze River in central China, and in the northeast. In the '90s, efforts to expand grain output led to the clearing of more hillsides and

farming in areas with fragile soil that quickly gave out and turned to wasteland. Farming, timber harvest, and erosion have degraded the forestlands by 38%[7]. Recently, extensive efforts are being made by the Chinese government as well as local farmers to preserve remaining forested areas, restore damaged habitat, and implement agricultural practices that take fewer tolls on the forests[7]. For instance, promoting reforestation after the Yangzi River floods of 1998, China has turned the aim of forestry production to protect natural forests, wildlife and natural reserves, to prevent soil from eroding and grassland from turning into desert, *e.g.* placing a logging ban along the Yangtze and Yellow rivers, suggesting only an unprecedented effort can stop the expanding deserts, chronic droughts and deadly flooding blamed on wholesale logging. The plan would sharply reduce timber cutting by state timber companies, including areas of southwest and northeast China where the last old growth forests are now being cut. Also in 2003, China has started an ambitious program to convert farmland to forests in the 24 provinces, a plan to convert 14.66 million hectares of farmland into forests and to cover 17.33 million hectares of barren land with trees by 2010.

Seed-base revegetation method

Planting or direct seeding : an alternative to reforestation

Basic ecological processes (nutrient, water, energy cycles, and succession) have been disrupted in degraded landscape. Successful restoration will depend on repairing these functions so the sites can become self-sustaining. Planting and direct seeding are the most useful techniques for restoring ground cover or reforestation of degraded lands in semiarid area.

Forest plantings can plan a key role in harmonizing long-term forest ecosystem rehabilitation (or restoration) goals with near-term socio-economic development objectives[2]. Recent studies have showed that plantations established for the production of timber and other forest products can facilitate, or "catalyze" native forest succession in their understories on sites where persistent ecological barriers to succession would otherwise prelude recolonization and enrichment by native forest species[5]. The potential advantages of direct seeding over other plantation establishment techniques (i.e. planting of nursery-grown seedlings, wildlings or rooted cuttings) include cost savings associated with nursery care and planting, as well as the possibility that trees established by this means may develop more naturally, and quickly, than would transplanted seedlings and cuttings. The root system develops naturally without the twisting, girdling, or spiraling that often occurs in traditional containerized seedlings. Most important, the taproot grows at its natural rate without any premature termination or damage. The taproot is able to penetrate deeply to the water source while also providing a firm anchor to the seedling and food storage to help ensure survival. There are, however, significant disadvantages of direct seeding that usually outweigh these advantages, *i.e.* typically very low germination survival percentages resulting in either inadequate plantation stocking and/or increased seed cost to compensate for poor germination and survival, poor early seedling growth relative daily care, and increased seedling mortality associated with weed competition in addition to increased susceptibility to poor weather conditions[2]. To overcome these disadvantages of direct seeding, we developed a new reforestation technique, *i.e.* Seed-base revegetation technique.

Summary of Seed-base revegetation technique

The Seed-bases are 10 cm high, 10 cm in diameter and with a cavity 2 cm in diameter in the Seed-base center which is manufactured using a specific press appliance. The materials of Seed-base consist of soil and organic compost (with a volume rate of 1 : 1), and are added with slow release fertilizer 5 gL^{-1}. This technique can be used as a Seed-base direct seeding method or Seed-base seedling planting method. When using the Seed-base direct seeding method, we can dig a small hole, put Seed-base inside, seed in the cavity

and cover the seeds with a proper soil depth suiting to the species. When using the Seed-base seedling method, Seed-bases are placed on metal net trays, spaced approximately 15×15 mm, thus roots in Seed-base stock type had been air-pruned. After some weeks sown, Seed-base seedling can be moved to plant.

Results of the trial project

The native species such as *Prunus davidiana*, *Platycladus orientalis*, *Robinia pseudoacacia*, *Ulmus pumila* were used, the first in Seed-base direct seeding method and the other in Seed-base seedling planting one. The experimental plots were initiated in degraded hill near Xiaolangdi Dam, Jiyuan, Henan Province, China. The trial project was implemented from 2002 and the investigations were formally performed till this year.

The Seed-base can promote the formation of vigorous and healthy root system[6]. It can promote roots to grow to the gravity direction along the cavity in the Seed-base. The taproot was developed, the lateral root was sturdy and distributed evenly. Compared with containerized seedling, Seed-base could promote the below-ground growth. But the differences of root/shoot ratio and height growth were not remarkable. Our results suggest that Seed-base is an important nursery practice which could improve the forest stability.

Discussions

It is important to implement ecologically-based and sustainable practices for reforestation of disturbed lands in a semi-arid ecosystem. Artificial regeneration is an alternative for restoration on degraded lands and where a desirable seed source is not present. When seedlings are planted with their original containers, the container wall (*e.g.* paper or peat) can cause a barrier between the root ball and the forest soil, which hampers both root growth and free movement of water. Roots of seedlings grown in Seed-base can grow into the soil as soon as possible, and as a sequence the seedling could avoid water and nutrient stresses. By using a no-till drill to plant in the degraded area, the surface soil can be held. And because of no irrigating, plants can be established under natural conditions, under which the plants would have a better chance of long-term survival. But fencing the restoration sites to decrease grazing pressure and decreasing weed competition prior to planting desired native species will be necessary.

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