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Restoration and Reclamation Strategies in Tropical Forest Lands

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Even though the term "restoration" is now understood as "the act of restoring to a former state of position…or to an unimpaired or perfect condition" (Bradshaw, 1997), to the farmer in India or the Amazon, "restoration" is akin to rehabilitation which restores the land to a former "productive" state (Hamilton, 1990). As in many developing countries, there is an intimate connection between the land and its people. When the land suffers from excessive soil erosion or deforestation, often, so do the people. Unfortunately, environmental damage is frequently caused by these same people. In the foothills of the Himalayan Mountains there exists an effort to reclaim a watershed damaged by clearing forests and grazing. Initiated by the local government and adopted by the people, the program is reducing soil erosion while providing incentives for locals to continue working toward a solution. Half way around the world in the Amazon rainforest, a shift from small-scale cropping to grazing cattle on medium to large-scale pastures is hindering natural regeneration and restoration of the forest. Among the challenges to restoration in both locations is the need to develop guidelines for plant establishment and the need to change human behavior.

Watershed rehabilitation efforts in the Himalayan Foothills

Within the hills and rugged Himalayan foothills (Shiwaliks) in northern India, lies the State Forests of Khol-Hai-Dun. It is here that Forest Department managers have been studying ways in which to rehabilitate a degraded tropical forest watershed (Dhar, 1994). The subtropical climate is considered typical, receiving an average rainfall of 1100 mm annually. Summer temperature are hot, often reaching 40° during the months of May and June (Dhar, 1994).

Because of past misuse, the hillside forests were at an advanced stage of soil erosion with few trees, particularly young ones, prior to the initiation of the rehabilitation program. Trees had been cleared for agriculture and herds of cattle were brought in to graze (Dhar, 1994). The village farmers who raised crops at the base of the hills were experiencing problems resulting from excessive soil erosion. Lake Sukhana, which supplied water for irrigation during the dry season, had lost 70% of its water holding capacity due to siltation (Dhar, 1994). To amend the erosion problem, forest managers initially proposed that the forests be closed to grazing and logging for ten years. The site may have been rehabilitated, but because the Forest Department lacked the enforcement needed, grazing and felling continued, thus preventing the desired recovery. Historically, lack of cooperation from the local community had been a reoccurring theme. In this case, the Forest Department felt that gaining the trust and cooperation of local people was necessary to achieve the goal of rehabilitating the forest watershed. Their strategy was to implement local scale projects aimed at reducing soil erosion and improving farming conditions.

Solutions to problems

Construction of small earthen dams to reduce sedimentation in Lake Sukhana produced tremendous results (Dhar, 1994). Not only did this intervention greatly reduce the rate of

sedimentation, but it also provided additional water for several critical irrigation periods. Farmers experienced increased wheat yields of more than four fold. In addition to changing attitudes toward the hill country, the farmers' distrust toward the Forest Department decreased and a new relationship was formed (Dhar, 1994).

The newly formed relationship provided a great opportunity for positive work to proceed in rehabilitating the communities' watershed. Once the people were receptive to the advice of the Forest Department, projects that had failed in the past could again be implemented successfully. The farmers trusted that the elimination of open grazing and illicit tree removal was in their best interest, "as otherwise the dams would silt up and much needed irrigation water would be lost" (Dhar, 1994). Subsequently, cattle were moved from the hills and were fed in stalls. Cutting live trees was abandoned in favor of collecting dead trees and branches lying on the forest floor.

The newly adopted practices not only resulted in erosion control, but also in a new economic resource. In addition to trees growing on the hillsides, other vegetation including grass grew there as well. Villagers had the option of harvesting the hillside grasses to feed to their cattle or sell the grass to the nearby communities. One could speculate that it was the economic incentive that further promoted this particular project.

The Forest Department saw recognized the success of this project and repeated it in many other communities (Dhar, 1994). However, since the number of projects increased rapidly, and the number of Department staff did not, project management issues arose. Conflicts between neighboring villages required foresters to change roles from policing villager behavior to facilitating local decision-making (Dhar, 1994). Responsibility for watershed management was given to the villagers, allowing them the freedom to work within a set of by-laws established by the Forest Department.

Analysis of Success

While the watersheds are moving towards rehabilitation at variable rates, progress is clearly being made. In three catchment areas managed by the Sukho Majri village, the number of trees increased from 103, 64, and 27 per hectare, in 1980, to 549, 1227, and 794 per hectare in 1994. Also, previously eroded soils are slowly being rebuilt by an average of 0.5-tons/ hectare of leaf litter per year (Dhar, 1994). This is considerably less than that of a well functioning forest, but it is a move in the right direction. The most encouraging aspect of the project is that it is now in the hands of the people (those who directly experience its benefits), to sustain the rehabilitation projects.

Problems and Constraints of Rainforest Restoration and Reclamation in the Amazon

The humid tropics have received attention from the media lately because of large-scale forest degradation. The most recent worldwide assessment, conducted by the United Nations (UN) Food and Agriculture Organization (FAO), estimates that over one million km^2 of tropical rainforest and moist deciduous forest was destroyed during 1981-90, an annual deforestation rate of 0.8% throughout the decade (Dowton, 1994). For comparison, this amount of deforestation is equal to clearing a forest half the size of Minnesota each year for ten years. However, cutting

down rain forest is not inherently negative. In fact, it has been shown to be a sustainable practice under certain conditions. The system of shifting cultivation, otherwise known as slash and burn or swidden and fallow agriculture, has been used successfully in the Brazilian rain forest for many years (Bewick, 1994). However, the rate of clearing has increased dramatically over previous levels. To better understand why this is occurring, it is necessary to take a closer look at the system of shifting agriculture and the recent trends of forest use.

The evolution of a problem

In slash and burn agriculture, the farmer (originally an indigenous person) moves into a mature/stable area of the forest and prepares it for farming by cutting down trees and using fire to clear the land of remaining vegetation (Bewick, 1994). Farm plots tend to be relatively small, usually around one hectare, which is typically just enough to provide subsistence to one family. The plot is farmed for a relatively short time, usually less than ten years (Bewick, 1994). After the plot is no longer productive, the land is abandoned and allowed to go fallow. It is during the fallow time that the forest is able to regenerate and, if given enough time, restore itself to pre-disturbance conditions. However, the recent pressure of an increased population has lead to more frequent disturbances and longer residency of farmers. The combination has resulted in slow to no recovery of cleared areas and an increasingly fragmented forest. In addition, farmers have begun to convert the farms to pastures for grazing cattle, which further compounds the problem (Bewick, 1994).

It has been suggested that tropical forest restoration efforts need to focus most on these highly degraded pasturelands (Uhl, 1988). There are several obstacles, however, that need to be overcome before a pasture can be transformed back into a forest. To address these obstacles requires consideration of both the ecological factors and social factors (Hartman, 1996).

There are three major differences between clearing for pastures and clearing for grazing that affect the potential for successful restoration to forest. First, the amount of weeding and the frequency of fire necessary to control the growth of woody species is much greater in pastureland than in farming plots. Secondly, the size of a pasture is typically much larger than that of a subsistence plot. Fazenda Nova Vida (New Life Ranch) is one of the largest cattle operations in the southwestern Amazon (Josh 1997). With over 21,000 contiguous hectares and more than 18,000 head of cattle Fazenda Nova Vida is much larger than that of any subsistence farmer’s plot. Although typical grazing areas maintained by local individuals are much smaller than Fazenda Nova Vida, grazing areas are still larger than subsistence plots. Practices such as frequent weeding and burning, "frequently will destroy all means of on-site woody regeneration and further homogenizes the site, thus eliminating establishment microhabitats" (Uhl, 1986). The larger size of pastures makes seed dispersal from surrounding forests less likely (Uhl, 1986). The long occupation of the site for pasture results in soil compaction and decomposition of slash that normally serves as microhabitats for seedlings (Uhl, 1986). The last major difference, time spent occupying a site, is much longer in duration than that of a shifting farmer. Because the pasturelands tend to possess these characteristics, forest regeneration is more problematic.

Possible Solutions

Restoration ecologists who wish to correct the problems that are associated with pastures, must address the challenges that native seed on a pastureland restoration site. The following is a list adapted from Uhl (1986).

- Few seeds of forest trees are being dispersed into pasture environments.

  Fewer than 15% of forest species are adapted to long distance dispersal by wind. The remaining 85% would need to rely on birds, bats and mammals for seed dispersal.

  Most seeds that do arrive are killed by seed predators (e.g. leaf cutter ants and small rodents).

- The few seeds that do manage to germinate eventually die because of harsh environmental conditions associated with open pastures such as drought.

The proceeding impediments can be overcome to some degree by the assistance of humans. Seed dispersal can range from high tech farming equipment to labor intensive hand seeding. Seed predation can be partially overcome by planting seedlings or by planting seeds that are more predator resistant. Finally, harsh environmental conditions, such as intense solar radiation and drought, can be met with shade-cloth and irrigation, although these solutions may be of limited usefulness in poor countries where the expense of shade-cloth and irrigation is prohibitive.

As of yet, there are not any established guidelines to which we can compare the successes and failures of a "pasture-to-forest" restoration effort. However, guidelines may eventually be developed based on factors such as degree of disturbance, spatial scale, energy input to the system and pre-disturbance conditions. Furthermore, efforts to involve local individuals in restoration have not been well documented.

Assessment

Despite the apparent lack of documented cases illustrating how the Amazon people can be involved with forest restoration, one could draw several conclusions based on similarities between the Indian people and the Amazonians. Economically, developing nations share many of the same characteristics. Typically, the people are very poor, and often struggling to survive. Financial margins are lacking and long term sustainability is often sacrificed for short-term gain. In India, a government agency came initiated the watershed recovery. Without it, destructive farming practices may have continued indefinitely. Because of the lack of local financial resources in the Amazon, a similar governing agency would be required to provide the needed assistance to farmers. Such assistance could include nutrient management, alternative cropping systems such as agroforestry, or by developing a rainforest lumber market based on sustainable practices. The first two actions have the potential to decrease the volume of land going into pasture; however, they do not address the restoration of degraded forest. The last alternative could have the greatest impact if it was found to be profitable. It would place a higher value on existing forests while developing a situation where new forests would be welcome. Since trees

would have more value, ranchers and farmers would have incentive to allow forest regeneration to take place on pastures and fields.

Another possible solution would be to reduce the overall impact on forests by limiting the human population concentrated in the forests. This would have the effect of reducing the intensity and frequency of disturbance, thus promoting natural regeneration of degraded sites. The difficulty in this proposal lies in persuading local people to move from their forest to towns or cities. Like the other plans, economic incentives would need to play the largest role. If the cities can provide a better living, local people just might go.

Conclusion

Tropical rainforests around the world are continually faced with the pressure of an ever-expanding population. This population is often faced with relatively few sustainable options for survival. This is illustrated in how Brazilian farmers now frequently rely on the destructive practice (to the forests) of raising cattle to provide their annual income. Between current research, education and finding better ways to accommodate local people, repairing damaged ecosystems may slowly become a reality.

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