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Reclamation of Lowland Tropical Forests After Shifting Agriculture

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INTRODUCTION

The debate about deforestation in the tropics focusses on the negative impact of shifting cultivation on forests. In Guatemala, the annual rate of deforestation is 2.0%, meaning 90,000 hectares are lost each year. (IIEE/WRI 1986) There are varying reasons for deforestion - increased agricultural expansion, rising demand for commercial forest products, wood meeting the local demand for construction and fuel, and finally, the clearing of forest for the grazing of cattle. The region of Izabal is located in the eastern tropical lowlands of Guatemala. The area consists of tropical deciduous forests, a main river Polochic, that drains into Lake Izabal. The foothills of the Sierra de Santa Cruz range (on the north side of Lago Izabal) and the Sierra de las Minas (south) are the predominant landform, steeply graded and up to 800meters in height, with a low percentage of what would be considered arable land. The mean annual temperature is >24 C, and the mean annual precipitation rate of 4,000-8,000 mm with no more than four months having less than 200mm. (Carter 1965) describes the soils as being

> . . . . "Sebach, a dark brown friable clay approximately 30 cm in depth, deriving form and overlying serpentine. Setal soils are derived from alluvium, are considerably deeper (50-60cm), and may be classed as reddish-brown, friable clays. Semuc soils are also reddish-brown, derive from and overlie serpentine, are 60-80cm deep, and have an excellent claly base structure".

These soils are likely Ultisols. Although these soils are acidic and low in reserves of essential nutrients, the constant warm temperatures, abundant rainfall, and even allocation of sunlight permits extensive plant growth. Broadleaf evergreen forests are the dominant vegetation. I recognised various hardwood and fruit/nut trees such as palm (*Mauritia spp.*), papaya (*Carica spp., C. papaya*), cashew (*Anacardium occidentale*), cacao (*Theobroma cacao*), avocado (*Persea americana*), rosewood (*Pterocarpus spp.*), mango (*Mangifera indica*), amongst the ceiba, cedar, citrus, coconut, leguminous trees, and vast array of plant material, herbaceous and woody that comprised the area of El Estor and the surrounding villages that were anywhere from a 2-12 hour hike from the town.

Having resided there for three years (1985-1988), I've also encountered the consequences of deforestion that afflict the inhabitants (K'ekchi' Maya) of this region. Fuelwood scarcity meant hours of foraging when the labor could have been utilized more productively. In talks at villages, concern was raised over declining production of annual crops, and as (Gergesen 1989) states

> . . .Researchers have shown that a gradual reduction in forest cover in

> tropical environments is associated with decreased rainfall infiltration, increased runoff, accelerated water erosion and soil loss, reduced nutrient uptake, reduced nitrogen fixation, reduced replenishment of soil organic matter, increased wind erosion, and other harmful influences that contribute to a decline in soil fertility and crop yields.

Reclamation is critical, given the relationship between forests and soils, water conservation, and watershed stabilization. Again, (Gergesen 1989)

> . . .Trees can use rainfall in the most manageable and least wasteful means for production purposes. First, the crowns of the trees and associated understory plants break the force of raindrops so that they do not shatter the soil surface on impact and cause erosion. Then, the organic litter of fallen leaves acts as a sponge, absorbing the rainfall into the soil mantle to a considerable depth with a minimum of soil on the surface.

The Maya K'ekchi' migrated to Izabal, from Alta Verapaz (more temperate highland forest) during the 1950's in search of land to cultivate. They encountered a sparsely populated region of lowland tropical forest with relatively fertile soils. The K'ekchi have had to adapt their form of land rotation cultivation (utilized for centuries in the highlands) to an area that had been virtually ignored since the Conquest. It is common to refer to this type of cultivation as "swidden", or "slash and burn", and is defined by (Atieri, 1995) as

> . . .an agricultural system in which temporary clearings are planted for a few years with annual or short-term perennial crops, and then allowed to remain fallow for a period longer than they were cropped. Conditions that limit crop yields, such as soil fertility losses, weeds, or pest outbreaks, are overcome during the fallow time, and after a certain number of years the area is ready to be cleared again for cropping. Thus, these systems involve a few years of cultivation alternating with several years of fallow to regenerate soil fertility. Typically there are three types of fallow: forest fallow (20-25 years), bush fallow (six to 10 years), and grass fallow (less than five years).

Because of rapid population growth, grass fallow is increasingly the choice of subsistence agriculturalists. When fallow systems are shortened, weed growth explodes and soil fertility declines which result in soil losses and nutrient depletion. Thus, the length of the fallow period becomes a critical factor for the long-term sustainability of these temporarily cleared plots. For the K'ekchi', as cultivation becomes intensified because of demands for incomes above subsistence, and prevalence of cash cropping, the length of the agricultural season is extended, and the conditions that maintain a productive soil deteriorate.

A different perspective to bring to projects designed to assist in soil conservation and address sustainability issues of agroforestry in the tropics, is the recognition of indigenous knowledge systems (IKS) that may facilitate in creating positive change in attempting a form of regenerative agriculture within the context of shifting cultivation. An example of K'ekchi' soil management practice is the utilization of leaf litter from nearby forests to improve till and moisture retention of intensively worked vegetable plots. The role trees play in soil protection is recognized by the Maya. The litter layer covering the soil help reduce surface erosion while improving structure. The penetrating root system of trees serves an important function in stabilizing the soil, especially on slopes. Farmers influence microclimate by retaining and planting trees to reduce temperature, wind velocity, evaporation, and direct exposure to sunlight. (Altieri 1995) suggests

> . . .Polycultures and agroforestry patterns are not developed at random; rather they are based on a deep understanding of agricultural interactions guided by complex ethnobotanical classification systems. . . In Mexico, Huastec Indians manage a number of agricultural and fallow fields, complex home gardens, and forest plots, totalling about 300 species.

A reclamation project working with the K'ekchi' should incorporate the use of IKS utilizing their knowledge about the physical environment (soils, climate, etc.), biological folk taxonomies, and the experimental nature of traditional knowledge in management practices.

One of the things I noticed about shifting cultivation was the similarity between the agricultural plot and the adjacent forest.

> Rather than being separate categories of vegetation, milpas (small cleared fields) and mature forest patches are different stages of the cyclical process of shifting agriculture. Even mature vegetation is part of a more extensive management system that includes sparing trees in the milpa and protecting and cultivating useful plant species during the regrowth of the forest patch. These forest patches, along with other uncut areas where the mature vegetation is protected or where useful tree species have been encouraged or transplanted, can be considered forest gardens, managed forests, or modified forests. (Altieri 1995)

The K'ekchi' imitate the structure and diversity of tropical forests by planting a variety of crops with different growth habits. Plots as small as a tenth of a hectare may contain a dozen or more species, each with a different form: coconut or palm, with a lower layer of citrus and papaya, a shrub layer of cacao or coffee, tall and low annuals such as corn and beans, and a spreading ground cover of squash. The Maya practice a type of agroforestry similar to that described above and the use of forest gardens at the village level demonstrates the abundance of useful trees and plants: 60-80 species in a family plot, and some 100-200 species in a village. (Herrera Castro 1990) This biodiversity provides building materials, firewood, food, medicine, and fodder. For the K'ekchi', the common trees are the same ones found in the forest - papaya, guava, citrus, etc. These agriculturalists also plant or protect trees along the edges of, or scattered throughout the milpas. "Many of these trees are nitrogen-fixing species (e.g., *Acacia spp.*, *Leucaena spp.*, and *Mimosa spp.*), and the abundance of these species reflects centuries of human selection and protection" (Flores Guido 1987).

The feasibility of regenerative projects is dependent on acceptance by the villagers to commit to long term transition from a solely agricultural cropping system to one of agroforestry. Shifting cultivation may form part of an agroforestry system that represents an integrated use of land, and is characterized by structure, sustainability, increased productivity, and adaptability. (Nair 1983) describes factors that should be considered in

> . . .arranging component plant species when grown together, their growth form (both above and below ground), management requirements for the system, and additional actions such as soil conservation. Thus, plant arrangements are site specific and possible patterns include: 1). Intercropping tree species with annual agricultural crops, planting both herbaceous and woody species simultaneously (or in the same season). 2). Clearing strips about one meter wide in primary or secondary forests at convenient intervals and planting shade-tolerant perennial agricultural species such as cacao. Subsequently, as the planted species grow up, the forest vegetation will be selectively thinned, and in about five years there will be a two or three layer canopy consisting of the perennial agricultural species and the selected forestry species. 3). Introducing management practices such as thinning and pruning to allow more light to penetrate to the forest floor and planting selected agricultural species between rows of trees. 4). In hilly areas, selected tree species can be placed in lines across the slope (along the contour) in different planting arrangements (single rows, double rows, alternate rows), with varying distances between rows; soil-binding grasses can be established between the trees along the contours. The area between the rows can be used for agricultural species. 5). Close-planting multi-purpose trees around plots of agricultural fields. The trees will form living fences and windbreaks, provide fodder and fuel, and mark boundaries of plots.

The ultimate goal of any agroforestry project is the conservation of the forest ecosystem while satisfying the needs of local farmers for goods and income. Essential to success in slowing deforestation would be to improve water infiltration, create hedgerows against winds, in-crop legumes (e.g., Acacia spp.), mulch use of grasses, increased tree crops of high forage value, tree stands for fuel and structural timber, using pioneer species to reclaim eroded land, and the preservation of natural stands of trees.

Some environmental constraints of agroforestry projects could be considerations such as: shading by tree crowns lowering yields and quality of associated agricultural crops beneath the trees; competition between trees and associated crops for nutrients and water which reduces production of either or both crops; competition for space above and below ground may reduce overall yields; the moisture content of the air layer at the level of the agricultural crop may be increased and favor fungal and bacterial diseases; trees take up and store nutrients over a long period of time, which could result in nutrient loss when the trees are harvested.

To expect villages to adopt practices that promote sustainability of forest management without the active input of the agriculturalists is to invite failure. Time is a huge factor in the transition towards regenerative techniques and knowledge. Many of the indigenous are nomadic agriculturalists because of social/political/economic/environmental factors beyond their control. In all honesty, long-term projects run great risks of not being viable for the Maya to attempt.

Pilot projects which stress soil conservation and agroforestry options at an accessible level for the participants, including educating people to be promoters of more sustainable methods could create ways for shifting agriculturalists to compare their system and adapt to a more permananent form of cropping systems that is integrated with the surrounding forest. An example, though long term, would be terraces with contour tree planting in a milpa next to a grass fallow milpa. After several years, one would be able to assess the advantages/ disadvantages of agroforestry to shifting agriculture.

BIBLIOGRAPHY

Altieri, Miguel. (1995) Agroecology: The Science of Sustainable Agriculture. Westview Press, Inc. Boulder, CO (pp. 130-142, 247-254).

Carter, William, C., (1969) New Lands and Old Traditions: K'ekchi' Cultivators in the Guatemalan Lowlands. Univ. Florida Press, Gainsville, FLA (pp. 13-18).

Flores Guido. (1987) Yucatan, tierra de la leguminosas. Revistas de Universidad Autonomia de Yucatan No. 163 (Oct/Nov) (pp. 33-37).

Gregersen, H.M., Draper, D., Elz, D. (eds.) (1989) People and Trees: The Role of Social Forestry in Sustainable Development. Washington D.C. The Economic Development Institute of the World Bank (pp. 1-38).

Herrara Castro (1990) Estudios ecologicos en los huertos familiares Maya. Report to Maya Sustainability Project Riverside, CA. (pp. 3-14).

Nair, P.K.R., (1983) Tree integration on farmlands for sustained productivity of small landholdings. Environmentally Sound Agriculture W. Lockeretz, (ed.) New York: Praeger. (pp 333-350).