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Message from the Director

We now have fiber optic cables strung beneath the Pacific to link North America with Asia for clearer message transmission. Yet, the messages are likely to remain confusing. In spite of all the promissory messages that the world is becoming a global village or a common community of shared visions there are equal tendencies to pull into competing economic, religious and ethnic visions.

Even the calm voice of science has its sharper cadences. When some physicists working at a Utah laboratory claimed they had found the means to produce fusion energy, it would seem their real production was a general hostility by their scientific colleagues.

Our old friend, the general educated reader, is treated to one group of scientists proclaiming global warming and imminent disaster due to the folly of industrial society. Whilst another group threatens the world with global cooling due to the same causes. The 1988 drought was widely interpreted as a harbinger of the global warming, until another group of scientists examined the historical record and found the pattern to be part of a "natural" cycle that had gone on quite well prior to the advent of industrial man.

Many of us are aware that wonderous as the green revolution has been, for many human and ecological communities the revolution has borne painful costs. Recently, we have seen the revolution of miracle trees that were tested under ideal conditions then sold to farmers as miracles to solve the fuelwood crisis. Again, wonderous as these "miracle" trees may be there have been a whole series of unanticipated consequences. Often the farmers who adopted the species at great risk bear tremendous costs (unanticipated pest infestation and resulting loss of trees and crops, saturated markets and below cost sales.) Meanwhile the scientists seem to prosper with ever more research funds and international meetings to "solve" the consequences set in train by their singular enthusiasm and failure to consider the full context of such introductions.

In recent months biologists and media publicists in the temperate countries have followed a long run of excitement on the tragic loss of tropical forests. This has led to much condemnation of governments in tropical countries for permitting their forest to be devastated. When these countries plead they must cut these forests to provide employ-

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ment for their people there is general derision for their lack of global responsibility. However, the US Forest Service and the Forest Products Industry in the Pacific Northwest have proclaimed they must continue to cut the last of the old growth, temperate rain forest as forest-dependent communities will collapse and thousands of workers will be unemployed. Such are the sad tales from those who attend to the "bottom line."

On the other side are the tales from the "bleeding heart" sentimentalists. More than one tropical forest department has been condemned by socially concerned people for this department's failure to "consider" the needs and wishes of the "people" in regard to the forest. However, what is often not noted is that the "people" are often "trespassing" on public forest land. Of course the socially concerned are seldom disturbed by such matters. Yet, a recent edict by the New York City Parks Commissioner demanded that homeless people no longer set up lodging in the City Parks. Indeed, the homeless were seen to be monopolizing and otherwise privatizing what is public open space. Of course, one can imagine that the socially aware persons think it is terrible to not let the homeless set up camp in Central Park, still one does wonder just how many homeless can be accomodated on 840 acres of the most expensive forest land in the world.

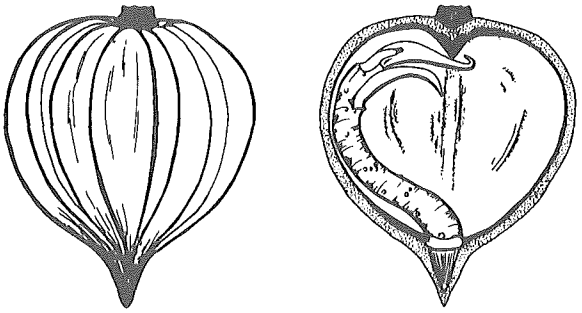
These little stories should not permit us a sigh and a sinking into fashionable despair. They should be cautions to us all. Science is produced by fallible human beings, its self-corrective nature requires a great deal more time than many of us are willing to wait for. Nevertheless we should beware of self-appointed experts filled with certainty rather than humility. We should be equally skeptical of those who come bearing single solution gifts of wonderous solution. There are hardly any human and ecological problems of single cause and therefore single solution.

Those who would "solve" our problems must provide evidence of consideration of multiple threads of consequence from their innovations. They must offer evidence of real analysis for a full range of biophysical, social, cultural and economic reverberations stirred by their dropping the stone of technical fix into the ecological pond. Finally, we should always seek means by which those who propose the adoption of particular innovations are those most likely to bear the costs of any unanticipated consequences.

The leadership of humility, the cautious compromise with possible consequences and the fixing of accountability upon those who propose changes have a long institutional tradition. That institutional tradition is called democracy. It is often much slower than technical expertise, yet in the long run it is probably a good deal more efficient.

It is part of the wonder of our species that at just the time when many countries are discovering the tremendous efficiency of democratic institutions, those with long traditions of such institutions are becoming impatient with the slow working of their due process efficiencies. As professionals we rather fancy that our expertise gives us the right to tell others what to do, so that any talk of democratic accountability for our professional actions seems upside down as to how we would like the world to work. Yet, consider that in the forestry and natural resources professions we manage other people's property to serve a future we can only dimly perceive. In such a realm of ambiguity and doubt our expertise may be even more dependent upon the efficiency check of democratic accountability.

Ours, of course, is not the perfection of fusion produced in a cold jar. Ours is of roots and leaves and soil and human effort and all the mystery of life. Ours is missed chances and joy over close approximations. Closeness, not perfection is our victory. Ours, of all the professions, should be one of humility, of caution, of direct and regular accountability. Not even a thin screen of trees along the road hides, for very long, our several small and large mistakes. It seems more likely, that at the level of mistakes rather then perfection is where we begin to find the center of our particular global village.



Pelliceria rhizophoreae

RESEARCH PROFILES

Ranching, Logging, and the Transformation of an Amazonian Landscape

Daniel Nepstad, PhD '89

INTRODUCTION

Human activity is rapidly changing the structural and functional characteristics of Amazonian ecosystems, altering regional hydrology, elevating concentrations of CO_2 in the atmosphere, and reducing species diversity. Strategies to conserve the regulatory functions performed by Amazon forests, and the numerous species of which they are composed, must look beyond the preservation of pristine forest reserves and consider the potential for forest recovery in the wake of the deforestation process. While forest regrowth is relatively rapid following such forms of deforestation as slash and burn agriculture, forest recovery on abandoned, grass-dominated pastures with histories of heavy use can be extremely slow (Uhl *et al.*, 1988).

The significance of semi-permanent, abandoned pastures in eastern Amazonia goes beyond the forests that they displace, for these highly flammable ecosystems increase the likelihood that fire will be a component of this landscape for decades to come. In the Paragominas region of northeastern Pará (Figure 1), ranching and logging activities threaten to reduce the landscape to a frequently burned mosaic of abandoned, grass-dominated pastures and regrowth forests. In this article, I discuss the human activities and ecological processes that underly the transformation of the Paragominas landscape and briefly outline a strategy by which regional forest degradation might be averted.

RANCHING AND LOGGING IN THE PARAGOMINAS LANDSCAPE

Prompted by reports of vigorous grass production following forest conversion to pasture, Brazilian policymakers chose in the early 1960s to subsidize cattle production in Amazonia through low interest loans and other financial incentives (Hecht 1982). Paragominas arose as one of several centers of the burgeoning Amazonian cattle industry that resulted from these incentives. Reputedly fertile soils and the proximity of the Belém-Brasilia highway, paved in 1969, lured thousands of settlers to the area. By 1985, 23% of the Municipality of Paragominas, a total of over 6,200 km^2, had been cleared and planted in pasture (Brazil, Superintendência de Desenvolvimento da Amazonia, unpublished data).

Grass production rates in pastures of the Paragominas region were often high during the first two to three years after formation, perhaps because of the pulse of phosphorus (P) and other nutrients released into the soil through burning of the forest biomass. The availability of soil P declined rapidly, however, falling to levels of the mature forest within 10 years of formation. As P availability dropped, the nutrient-demanding forage grasses, such as *Panicum maximum*, were gradually outcompeted by opportunistic shrubs (e.g. *Stachytarpheta cayennensis*) and herbs (e.g. *Paspalum* spp.). High stocking densities (>1 animal/ha) accelerated the replacement of forage grasses by weedy shrubs and herbs. By 1988, roughly half of the estimated 10 million hectares (ha) of Amazonian pastures formed on previously-forested land was in an advanced stage of degradation (Serrão and Toledo, in press) and much of this degraded pastureland was abandoned.

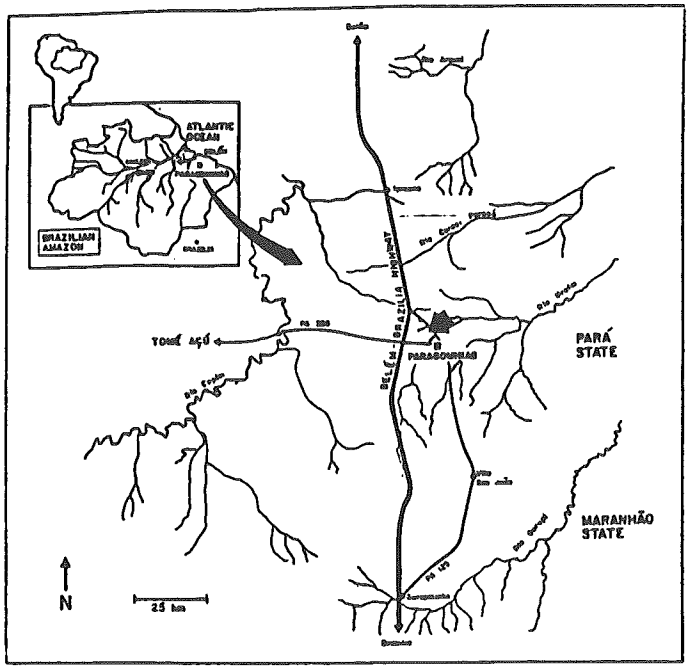


Figure 1. The Paragominas Region. Studies referred to in the text were conducted at Fazenda Vitoria ("Victory Ranch") indicated by the short arrow.

Forest recovery following pasture abandonment in the Paragominas region depends on the history of site utilization (Uhl *et al.*,1988). Biomass accumulation is rapid where pastures are abandoned within one year of formation because of poor grass establishment. In the absence of fire, regrowth secondary forests on abandoned pastures with histories of light use may regain most of the biomass of mature forests in less than a century. However, only a small proportion of the original flora and fauna may be represented in these regrowth forests.

The potential for forest regrowth can be greatly reduced when pastures are reformed through bulldozing or are used intensively, through a combination of high grazing density (>1 animal/hectare for a period of eight years), repeated burning and weeding, and herbicide application. Ranchers bulldoze degraded pastures to clear away logs, stumps and woody debris and to remove the root systems of weedy grasses, shrubs and woody sprouts in preparation for planting. In this process some topsoil is scraped away and relic tree root systems are destroyed. The soil is then disked, fertilized, and planted with the commercial forage grasses *Brachiaria humidicola* or *B. brizantha*. Eight years after abandonment, one pasture near Paragominas that had been reformed through bulldozing, fertilization, and replanting was dominated by weedy grasses and shrubs, contained only 5 Mg/ha of living, aboveground biomass and supported no trees species that were native to the original forest (Uhl *et al.*, 1988).

Since there are numerous impediments to tree establishment from seed in abandoned pastures (Nepstad, 1989), management practices that kill or remove vegetative sources of new tree shoots favor the formation of semi-permanent, abandoned pastures. Although these semi-permanent, abandoned pastures are rare in the Paragominas region, they demonstrate the potential for pasture management practices to yield non-forest ecosystems that may persist long after pasture abandonment. The current trend among ranchers in eastern Amazonia is moving away from light pasture use and abandonment and toward heavy pasture management (Serrão and Toledo, in press). A hidden cost of pasture reformation for sustained cattle production is the risk that, should these systems fail, a highly flammable ecosystem will be produced, one that may fuel regional forest degradation.

While many ranches have failed in the Paragominas region, the lumber industry has expanded. Logging companies gain access to most of the region's forests by extending the infrastructure of dirt roads associated with ranches. In 1986, there were more than 300 registered sawmills in the Municipality of Paragominas which were sawing lumber extracted from mature forests at the rate of ca. 20 m^3/ha. On one logged site, 46% of the adult trees were knocked down or topped in order to harvest 3.4% of the trees.

Ranching and logging practices are transforming the Paragominas landscape into a mosaic of active pastures, regrowth forests on abandoned pastures, semi-permanent abandoned pastures, and logged forests (Figure 2). In contrast with the native forests of the region, which may never be ignitable under the current climatic regime, the altered ecosystems are highly flammable. They have an abundance of relatively dry organic matter fuel close to the ground due to a reduced canopy density and increased incident solar radiation. Pasturelands (active and abandoned) are the most flammable ecosystems in the Paragominas region. They can be ignited within one day of a rain event during the dry season. Regrowth forests and logged forests can catch fire within ten days of rain. Since there are annual droughts of at least 30 consecutive days in Paragominas, and numerous droughts of shorter duration (Nepstad, 1989), all of the anthropogenic ecosystems are vulnerable to fire during several weeks each year. During the severe dry season of 1987, roughly half of the secondary growth forest in the Paragominas region burned, mostly by accident, as fires initiated in pastures expanded into adjacent forests (personal observation).

Burns kill tree seedlings and saplings, and favor plant species that sprout following fire. Lianas often proliferate in frequently burned forest because of their exceptional capacity to sprout following stem damage and their rapid elongation under high light conditions. Fires initiated in pasturelands of the Paragominas region therefore set back forest recovery processes and drive the replacement of mature, species rich forest with forests of smaller stature, dominated by sprouting trees and lianas (Figure 2).

ALTERNATIVES TO REGIONAL FOREST DEGRADATION

In the likely event that semi-permanent, abandoned pastures expand in eastern Amazonia, it will become necessary for humans to facilitate forest regrowth in these highly flammable ecosystems if we hope to reduce the incidence of fire and the resulting degradation of the region's forests. However, forest regrowth is limited by numerous obstacles to tree seedling establishment (Nepstad, 1989). Tree invasion of abandoned pastures is largely restricted to species that: (a) are disseminated into these ecosystems from nearby forests; (b) have seeds that can escape predation by the abandoned pasture animal community; (c) have seedlings that are unattractive to abandoned pasture herbivores, or can sprout following shoot removal; (d) are tolerant of drought; (e) root deeply soon after germination; and (f) are resistant to fire

damage. All of these characteristics can be found within the tree flora of the Paragominas region, but few species possess all of these traits. Several tree species of regrowth forest and treefall gaps are disseminated into abandoned pastures by bats and birds, but many of their small seeds and seedlings fall prey to abandoned pasture animals. The large seeds of some mature forest tree species escape seed predators, and their robust seedlings survive herbivory, tolerate drought, root deeply and sprout following fire. These species, however, are not disseminated into the abandoned pastures. Apparently the only tree species that can produce new shoots in grass/shrub vegetation are those that were present prior to pasture abandonment and expand clonally through root sprouting. These include *Solanum crinitum*, *Stryphnodendron pulcherrimum*, and *Vismia guianensis*, or the small-seeded trees species that are disseminated into the abandoned pasture in sufficiently large numbers to occasionally escape the numerous post-dispersal barriers to establishment (e.g. *Zanthoxylum rhoifolia*).

The establishment of a treelet or a mature tree in the abandoned pasture can improve the probability that other trees will also invade. Initially, the mature tree can facilitate additional invasion by providing perches and food (if it is fruiting) for frugivorous, seed-carrying bats and birds, thereby increasing the diversity and number of tree seeds that are deposited beneath its crown. As the mature tree expands through crown growth or root sprouting, grasses are shaded out and tree invasion is further enhanced. This occurs because dry season soil moisture deficits are less severe and root competition/ interference encountered by new seedlings may decline. With the reduction of these limitations to dissemination, seedling survival and seedling growth, tree invasion beneath the mature tree increases, and a new "island" of trees begins to form. As tree islands expand and coalesce, more seed carriers will move between nearby forests and the abandoned pasture, fuel production (by grasses) will decline, and the ecosystem will become less flammable.

Strategies for reforesting semi-permanent, abandoned pastures should be designed to minimize the required inputs of capital and maximize the contribution of ecological processes. Abandoned pastures may be reforested cheaply if techniques for catalyzing tree island formation can be developed. The initial goal of reforestation strategies should therefore be the

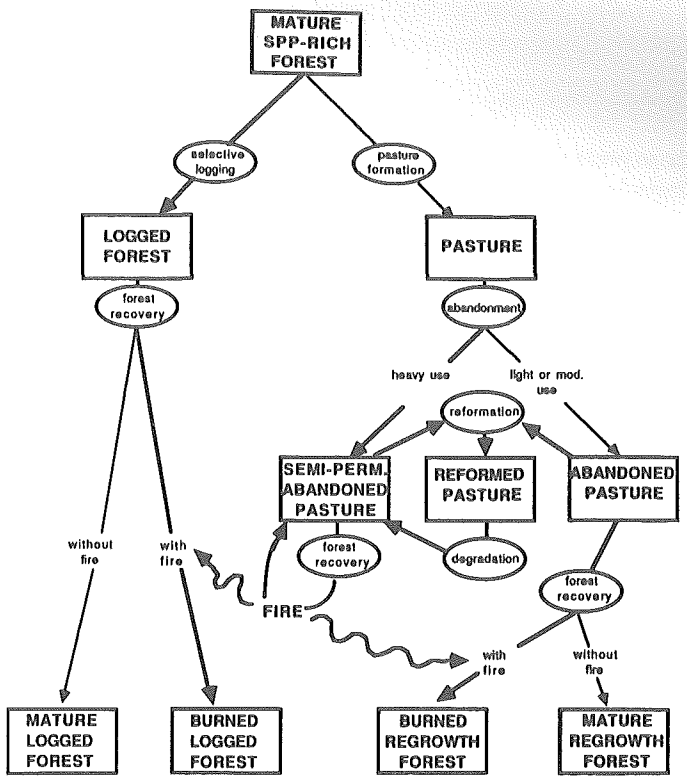


Figure 2. Suggested pathways of ecosystem transformations in the Paragominas landscape.

establishment of trees that attract a wide variety of seed-carrying animals. Several fruit trees native to eastern Amazonia may be good candidates for planting in abandoned pastures. For example, *Platonia esculenta* ("bacurí") is a large-seeded, deep-rooting forest tree that sprouts vigorously from its roots and produces a high quality fruit that is easily marketed in Belém. *Radlkoferella macrocarpa* ("guajará preto") exhibited 100% survival in grass/shrub vegetation at Fazenda Vitoria. It produces an edible fruit, and is common in mature forests of the Paragominas region. *Spondius mombin* ("taperebá") is a vigorous sprouter, produces a large-seeded, marketable fruit, and can be propagated from stem cuttings.

The viability of a reforestation strategy for semi-permanent, abandoned pastures in eastern Amazonia depends on the economic decision-making of the region's land owners. The ranchers who now control this land spend money to eliminate trees from pastures, and they have little economic incentive to finance tree-planting projects. Ranchers have two specific reasons for not wanting to reforest grass-dominated, "abandoned" pastures. These pastures provide a source of emergency forage during the dry season when high-quality forage supplies are depleted (Serrão and Toledo, in press), and unforested lands are easier to hold against expropriation than forested lands (Hecht *et al.*, 1988).

The most appropriate audience for strategies to reforest abandoned pastures is the future generation of land holders. As lumber supplies are depleted in the Paragominas region, ranchers will lose the revenue needed to finance pasture reformation and land may become available for other uses. Several land-uses may replace ranching and logging, such as charcoal production from residual wood in logged forests, or shifting cultivation. Both of

these practices would intensify the process of forest degradation in the Paragominas landscape (Figure 2).

A third land-use scenario includes the establishment of tree cover on abandoned pastures in the Paragominas region while providing a livelihood for many more people than are currently supported within this area. In this scenario, innovative farmers establish agricultural systems on abandoned pastures to produce a variety of tree crops, such as fruits and latex. The development of tree-based agriculture in the Paragominas region would reduce the flammability of the landscape by establishing tree cover on abandoned pasture, the most flammable ecosystem of the region. Tree-based agricultural systems would also reestablish mechanisms of forest regrowth in abandoned pastures, so that if these systems are eventually abandoned, forest recovery would proceed rapidly. The tree-based agricultural systems of Japanese immigrants in Amazonia may provide a model for the agricultural development of semi-permanent, abandoned pastures.

CONCLUSION

Highly flammable, semi-permanent abandoned pastures are fueling the degradation of the Paragominas landscape. Knowledge of the barriers to forest regrowth can serve as a basis for developing strategies to reforest these ecosystems. Reforestation techniques should be designed to overcome barriers to tree seedling establishment and to catalyze natural forest regrowth processes. There is little incentive for ranchers to reforest abandoned pastures. Reestablishment of tree cover on abandoned pasturelands may depend on the installation of tree-based agricultural systems by a future generation of enlightened land holders.

SELECTED BIBLIOGRAPHY

Hecht, S. B., R. B. Norgaard, and G. Possio. 1988. The economics of cattle ranching in eastern Amazonia. Interciencia 13:233-240.

Nepstad, D. 1989. Forest Regrowth in Abandoned Pastures of Eastern Amazonia: Limitations to Tree Seedling Survival and Growth. Ph.D. Dissertation, Yale University.

Serrão, E. A. S. and J. M. Toledo. In press. A procura de sustentabilidade em pastagens Amazonicas. In: A. B. Anderson, Ed., Alternatives to Deforestation: Steps Toward Sustainable Utilization of Amazon Forests. Columbia Univ. Press, New York.

Uhl, C., R. Buschbacher, and E. A. S. Serrão. 1988. Abandoned pastures in eastern Amazonia. I. Patterns of plant succession. J. Ecol. 76:663-681.

Changes in Belowground Nutrient Pools Following Disturbance in a Puerto Rican Tropical Forest

Whendee Silver, PhD Candidate

Disturbance is a key factor in the dynamics, structure, and function of tropical ecosystems. Tropical forests are very dynamic. They are characterized by frequent natural disturbance in the form of tree falls, landslides, hurricanes and fire. Human-induced disturbance is also common in the humid tropics; the rate of tropical deforestation, driven by forestry and agricultural activities, continues to increase due to population growth and development pressures. To better understand the short- and long-term impacts of disturbance in tropical forests, we need to learn more about the ecological changes that take place after disturbance and the mechanisms controlling resilience and recovery. In this study I am exploring the effects of small-scale deforestation and subsequent gap formation on the forest ecosystem nutrient cycle. The study focuses on the role of soil and roots as nutrient conservation mechanisms following disturbance.

The questions addressed are:

1. What is the spatial variability of belowground ground nutrient pools in the intact forest and how does this change after disturbance? How does the removal of the aboveground biomass affect the belowground component?

2. What are the relative roles of roots, soil, and regrowing vegetation on nutrient conservation after disturbance?

3. How important are roots and soil microsites in controlling belowground nutrient fluxes?

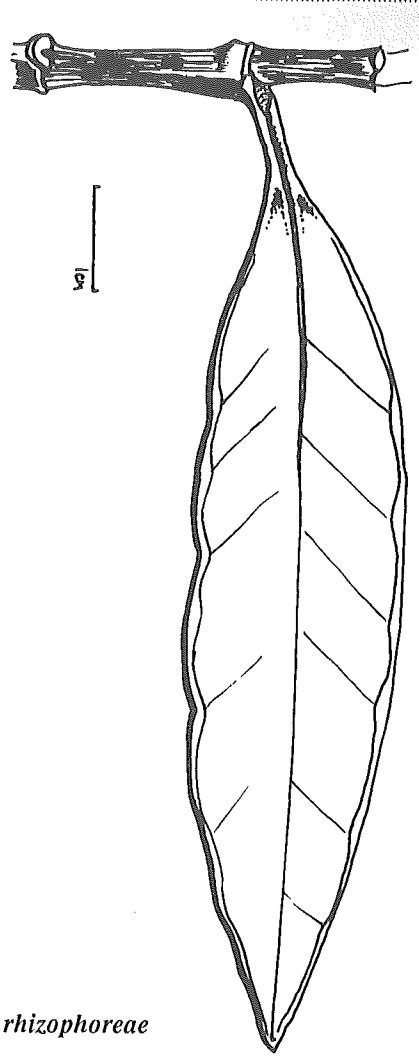
The study site is located in the Luquillo Experimental Forest which is part of the larger Caribbean National Forest on the eastern end of Puerto Rico. The research plots are adjacent to the Bisley Research Watersheds and

within the study area of the Long Term Ecological Research Project (LTER). Supported by the National Science Foundation, the LTER program has brought together a group of researchers from Puerto Rico and other areas of the United States to address questions of disturbance ecology in the Caribbean National Forest. My project is supported by the Andrew W. Mellon Foundation. We are also collaborating with LTER scientists at the Institute of Tropical Forestry (ITF) and the Center for Energy and Environmental Research (CEER), both based in Puerto Rico.

Our preliminary task was to characterize the spatial variability of belowground nutrient pools for the watershed area. With these data we can construct contour maps of belowground nutrients and estimate pool sizes. During the summer of 1988, Dr. Art Johnson of the University of Pennsylvania, and Professors Tom Siccama and Kristiina Vogt, of Yale F&ES, accompanied me and a host of others as we descended upon Puerto Rico for a "Southern Big Dig". In the rain, we spent seven days digging, measuring and sorting until we had sampled soils and roots from approximately 200 locations distributed throughout the watersheds. I stayed for the duration of the summer with two assistants, Tom Schwartzman and Allison Churchill (U. Penn) to finish the sampling and to process the soil and roots we had collected.

This year, we will finish all preliminary sampling and harvest the experimental plots. The two plots, which are to be cleared in June, 1989, have been intensively sampled for soil nutrients and root properties. Although allometric equations have already been developed for many of the tree species occurring on the plots, we will collect additional allometric data for a few individuals to supplement the existing database. The biomass removed from the plots will be weighed and subsampled for chemical analyses. After the aboveground component has been removed, intensive sampling of soils and roots on the plots will continue for a period of six months in order to characterize changes in these nutrient compartments. In addition, I will conduct experiments aimed at determining the role of regrowth vegetation, root decay and root persistence in nutrient conservation after disturbance.

The main working hypothesis for this study is that roots play a major role, both physical and chemical, in nutrient conservation after disturbance. Roots may serve as soil anchors in mountainous areas such as the Luquillo Forest, limiting soil and water movement and thus decreasing the risk of erosion and associated nutrient loss. In addition, many tropical species have the ability to sprout quickly after disturbance; they quickly reestablish nutrient uptake and growth by taking advantage of relic root systems which remain intact. Moreover, we know very little about



Pelliceria rhizophoreae

rates of decomposition and nutrient release from roots in humid tropical ecosystems. Slowly decomposing roots may in fact serve as sites for nutrient retention, only gradually releasing nutrients into the soil to make them available for plant uptake. On the other hand, rapidly decomposing roots add organic matter to the system which is rich in nutrient elements, in comparison to the highly weathered, nutrient poor mineral soil.

The results generated in this study will serve as a preliminary database for soil and root chemical and physical properties for the Bisley Watershed area. The study will also provide information on the effects of small scale harvesting in this ecosystem. These data will be an aid in future management decisions for the Luquillo Experimental Forest. The information generated by this research will serve as a point of comparison for LTER sites, both temperate and tropical, thus adding to the pool of information on ecosystem processes worldwide.

MASTER'S RESEARCH

Sustainable Development and Tropical Forests: Use of Non-Timber Forest Products in Petén, Guatemala

Robert Heinzman, MES '89
Conrad Reining, MES '89

Continued population growth and economic expansion in Central America, attended by poverty and social inequity, have converted two-thirds of the region's forests to other uses (Nations and Komer, 1984). Forest conversion has been predicated on worthy objectives such as regional development and employment benefits. Yet these objectives often have remained elusive while resource degradation continues to threaten the region's social stability and ecological and economic productivity (Leonard, 1987).

Increasingly, alternatives to nonsustainable land uses in forested regions center on objectives that combine the conservation of forest resources with development planning. For achievement of such objectives, conservation of tropical forests must offer economic incentives that benefit the people who live in and around these forests (McNeely, 1988).

One important alternative is found in the exploitation of the tropical forest's inherent biodiversity by harvesting its diverse botanical resources. These resources are grouped into several categories, including: ornamental plants, latexes, resins, spices, medicinal plants and roundwood construction materials. In sum, they comprise a portfolio of non-timber forest products (NTFPs) that can potentially be harvested on a sustainable basis while leaving the forest ecosystem relatively undisturbed. Forests designated for the extraction of NTFPs are called extractive reserves.

These extractive reserves and the economic opportunities they provide for local people are attractive for several reasons. From an ecological standpoint, species diversity is protected and important ecosystem functions remain intact. Economically, the total net present value (NPV) of forests used as extractive reserves may be greater than the short-term gains accruing to activities that clear forests (Repetto, 1988). Extractive reserves often provide important sources of rural employment and cash income. Socially, these economies inhibit the inequitable land tenure patterns that often develop in the wake of deforestation.

The Department of the Petén, in northeastern Guatemala, illustrates these issues. In the past 20 years, agricultural frontier expansion and logging activities have rapidly increased rates of forest conversion. More than 30% of the forest cover has been eliminated thus far. Thin and fragile soils unsuitable for agriculture characterize most of the Petén ; meanwhile, unsustainable shifting agriculture continues to push into previously undisturbed forests. These forests are host to a diverse array of NTFPs that have been extracted for decades and sold on regional and international markets. As a result, both the elimination of NTFP-producing forests and growing human populations are increasing pressure on the existing extractive forest reserves and their botanical resources.

Our recent research, in conjunction with Juan Jose Castillo and Dr. James Nations, describes the economy and ecology of the most economically important NTFP extracted from the Petén — the foliage of several species of the palm genus *Chamaedorea* (Heinzman and Reining, 1988). Millions of individual leaves from this understory palm, known as *xate* in Guatemala, are harvested and exported each year for the floral greens market in the United States and Europe. Other important NTFPs in the Petén include the seeds of allspice (*Pimienta officianalis*), which are also sold internationally, and latex from *chicle* (*Manilkara zapota*), which is used for medicinal drugs and high quality chewing gum.

We investigated the social, economic, and biological impacts of *xate* as an extractive product. Our study included: 1) inventories of plant densities in both protected and unprotected areas (with the assistance of Mexican palm specialist Ermilo Quero); 2) quantification of the distribution of benefits within the extractive industry; and 3) comparison of the NPV as an extractive forest reserve for *Chamaedorea* to the value of similar forest land converted for agriculture.

The results of our analyses reveal that overharvesting of this common property forest resource has reduced plant populations to under 3000 individuals/ha. This represents a reduction of 30% from the observed density in protected forest. We were also able to document the high levels of employment generated by the extraction of *xate* and its important role as a source of off-farm cash income. Moreover, the NPV of forest land utilized as an extractive reserve, even based upon depleted populations of *Chamaedorea* spp., is competitive with other land uses that convert forests. All of the NTFPs combined provide an income of several million dollars from relatively undegraded forest, making extractive reserves the most valuable land use in the northern Petén where forests have already been depleted of valuable timber.

In February 1989, the Guatemalan government passed legislation designating nearly 14,000 sq km of the Petén as protected areas. As the law is implemented, additional forest areas will also likely be included as extractive reserves. The segment of the Petén above 17°10' north latitude — approximately 10,000 sq km — is also being considered for designation as a Biosphere Reserve under UNESCO's Man and the Biosphere Program. The challenge for Guatemalan conservationists charged with the task of managing this forested region is to protect the resources from short-term overharvesting.

One very important question remains: Is there a level of extraction for each species that provides economic benefits yet does not diminish the productivity of the species? In more general terms, is the use of forest land as an extractive reserve truly sustainable? Any answer begs definition of sustainable development, a phrase widely used and little understood. To determine what is and is not sustainable development requires a close, interdisciplinary analysis with rules or parameters. The outcome of such an analysis would provide information that could ensure the future productivity and benefits of these forests by promoting measures that control the level of harvesting. This will require diverse biological, social, and economic information, and will constitute the focus of our future research and the efforts of many others seeking alternatives to forest conversion in the tropics.

REFERENCES CITED

Heinzman, Robert and Conrad Reining. 1988. Sustain able Forest Management in the Northern Petén , Guatemala: The Economy and Ecology of Xate Palm. USAID/Guatemala Report 520-0000-0-00-8532-00. Tropical Resources Institute, Yale F&ES

Leonard, H. Jeffrey. 1987. Natural Resources and Economic Development in Central America: A Regional Environmental Profile. Transaction Books:New Brunswick.

McNeely, Jeffrey A. 1988. Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources. IUCN:Gland, Switzerland.

Nations, James D and Daniel I. Komer. 1984. Conservation in Guatemala. World Wildlife Fund-US:Washington, DC.

Repetto, Robert. 1988. Overview. In: Robert Repetto and Malcolm Gillis (eds.). Public Policies and the Misuse of Forest Resources. Cambridge University Press:Cambridge.

Swietenia macrophylla

Beyond "Technological Fixes": Integrating Social Variables in Nepali Biogas Projects

Phillip Liu, MES Candidate

As problems of deforestation and land degradation intensify in developing countries, government planners are looking to alternative, environmentally benign energy technologies that can meet rising rural energy demands. Biogas or gobar gas generators hold great potential because they produce clean-burning methane gas through the bacterial decomposition of dung and other waste organic matter. In addition, the generators preserve the value of the wastes as fertilizer by killing pathogens and parasites living in the dung and destroying weed seeds, while at the same time conserving as much as 95% of the nitrogen (Santerre, 1984).

Nepal, like its large southern neighbor, India, is turning increasingly to biogas generation. The government's "Seventh Plan" (1985-90) declares biogas as "highest priority" and sets the goal of installing 4000 generators at a cost of 16 million rupees. As India's experience has shown, however, the project's ultimate success or failure will depend on whether the government views biogas generation solely as a technology fix to improve fuel sources and reduce deforestation or as a holistic means to raise the living standards of the rural poor. The former is strictly a question of environmental protection and, if considered in isolation, is doomed to failure. The latter connects environmental protection with the imperative of food security. It is a calculus more likely to succeed, but only if biogas production can be integrated into the social fabric of rural Nepali villages.

LESSONS FROM INDIA

Drawn by the potential for cheap, abundant, and clean energy, India initiated a massive effort in the mid 1970s to introduce biogas technologies into rural areas. The simple, alluring concept of transforming wastes into useful energy has held such strong appeal for government planners that 100,000 generation units have been installed during the fifteen year interim.

Like the metallurgical alchemists of an earlier age, however, these planners' expectations have gone largely unmet. Mechanical failure, abandonment and appropriation of generators by affluent villagers have plagued the program and contributed to low adoption rates among rural populations. Some observers blame these problems on design flaws, mechanical failures and high costs. While important, these explanations overlook a crucial concern rarely considered in the planning process: the social appropriateness of biogas technology.

In their enthusiasm to transfer biogas technology to rural people, Indian planners often have been guilty of underestimating its practical complexities. For example, the bacterial reactions required for conversion of waste to energy are highly temperature and pH sensitive, demanding skilled observation and adjustment. To villagers with minimal mechanical or scientific training, these biogas generators may represent little more than "black boxes" which require non-local technical advisors. Consequently, the generators not only fail to empower local people, but also entrench the attitude that the technology belongs to the foreign agency or government. In the absence of continued external support, many rural Indian biogas units have fallen into disrepair and eventual abandonment.

"...biogas generators, like other forms of introduced technology, are capable of impacting local populations on numerous non-technological levels which may confront existing roles and values..."

Moreover, biogas generators, like other forms of introduced technology, are capable of impacting local populations on numerous non-technological levels which may confront existing roles and values. Firewood collection in Nepal, for example, represents more than a chore but also serves an important social function for rural women. Bajracharya (1980) observes, "[firewood gathering] is a leisurely affair that provides an opportunity to escape from domestic drudgery." Will women perceive biogas technology, which eliminates the need for firewood collection, as a threat to their social institution? Without active inclusion of women in planning or provisions for substituting alternative social events, women may be suspicious and reject the foreign technology. In order for planners to anticipate such related issues, they need an understanding of the impacts that their

technology holds for existing cultural norms, economic relationships and patterns of resource use. The disappointing results of India's projects should serve to warn Nepali planners that technology transfer cannot occur in a social vacuum. Broader social, economic, political, and biophysical contexts must be considered from project inception through evaluation. The required knowledge can only be gathered through a rigorous and systematic evaluation of both the technology and the target village.

ADOPTION APPROACH

One conceptual framework that allows planners to analyze the potential social impacts of an innovation on a population is the "adoption approach" described by Burch and DeLuca (1984). "Adoption approach" provides a means of identifying what patterns of social exchange affect the adoption or rejection of new technologies and ideas. It defines four types of innovations: technology, taste, rule, and value which are associated with the functions of efficiency, conformity, order relations, and stabilization of basic relations, respectively (Table 1). Traditionally, planners have focused almost exclusively on technology and values.

TABLE 1: Adoption Approach Applied to Biogas Planning

Innovation	Function	Example from Biogas
Technology	efficiency of action	Cleaner-burning fuel source
Taste	conformity	Idea of modernity or progress
Rules	order relations	Relations between castes Relations between sexes
Values	stabilization of basic relations	Concept of "*juto*" or spiritual pollution Transition from self-reliance to market-economy Valuation of traditionally free resource

Rejection of new technologies more often will result from unacceptable changes in taste or from real or perceived challenges to existing social norms and structures. Drawing an example from Nepal, the critical order relations that may be disrupted by the introduction of biogas include relations between the sexes and relations between castes. Traditionally the task of fuelwood collection has fallen to women, while the operation of machinery has engaged men. The introduction of biogas generators clearly cuts across these well-defined roles and could upset social relations.

An even greater risk to people targeted as adopters is a new technology's potential to disrupt established value systems. For the villager who has used only noncommercial tree species as fuelwood, conversion to gobar gas stoves represents more than increased efficiency. It implies the necessity of a value change from energy self-sufficiency to participation in an interdependent market economy for purchase of cement, piping and other materials needed for building and maintaining a biogas generator. Similarly, biogas systems may result in localized valuation of dung — traditionally a free resource. Developing an awareness of a technology's potential as a social change agent is critical if planners are to gain insights into appropriate intervention strategies. The farmer who cannot justify the cost of a biogas generator to improve his cooking efficiency may be more amenable to a community effort that uses the gas produced to run a village water pump or oil press.

INTEGRATION OF NEPALI SOCIAL VARIABLES INTO BIOGAS PROJECTS

Successful introduction of biogas into the rural Nepali village requires that planners appreciate the technology's multiple levels of impact. Consideration must be given to the socio-economic patterns within the village, its political climate, and its biophysical setting, in addition to technical issues. In short, the traditional planning processes must be reworked to address a range of potential impacts.

Involvement of villagers from the earliest stages of planning is crucial. Rapid Rural Appraisal (RRA) is ideally suited for stimulating local participation. RRA attempts to evaluate the needs and resources of a community in an iterative and interdisciplinary manner. Using techniques such as observation, key informant interviewing, and social mapping, small multi-disciplinary teams involve villagers in every step of project design. RRA encourages a shift in the decision-making process from external planners to local villagers, thereby increasing the villagers' responsibility for and commitment to the project. This intensive learning process can also draw out potential problems, such as inequitable distribution of rights or resources, that may be ignored by exogenous planning. Local management of the planning and implementation stages can facilitate the transfer of managerial and technical skills that will enhance the villagers' self-sufficiency.

Local participation is essential to successful adoption of biogas projects because it involves the transfer of a foreign and sophisticated technology. This is particu-

larly true of Nepal, where energy is typically not perceived as a major limitation by rural villagers. Bajracharya's study (1980) of a hill village in the eastern part of the country suggests that adequate food supply is their primary concern. He observed that "the people are more preoccupied with the means of increasing their food supply than conserving their fuel demand." In view of his observation, it is unlikely that villagers will adopt biogas technologies unless projects addressing food production or other basic needs are integrated into biogas projects. RRA allows precisely this type of insight to be gained by planners through their intensive study and interactions with villagers.

In fact, Bajracharya (1984) later demonstrated the efficacy of participatory planning by facilitating a biogas project in Western Nepal. Through mediation and negotiation between a government program to promote rural energy production and villagers in need of improved food production, he successfully combined a biogas generator with a rice-hulling mill. By recognizing the potential for linking a government initiative with an actual village need, he was able to transform an energy improvement project into an integrated means of rural development.

CONCLUSION

Successful integration of biogas generators into Nepali villages will be predicated on an understanding of the opportunities and constraints of biogas technology and on the needs of the receiving villagers. Ultimately, adoption of an innovation lies in the hands of hundreds of individual, household and community decision-makers. Community participation is therefore crucial if adoption of biogas technology is to occur. Innovative marriages between rural village priorities and national development plans, as demonstrated by Bajracharya, hold great potential for improving living standards for the rural poor, but these initiatives demand intensive interactions between planners and villagers. Techniques such as Rapid Rural Appraisal facilitate such interaction, while the "adoption approach" posited by Burch and DeLuca provides a theoretical underpinning for analyzing the potential social impact of intervening technologies.

Participatory planning involves a large investment of time and commitment on the part of planners. Experience has demonstrated, however, that inadequate consideration of socioeconomic variables will result in projects that not only fail to meet intended technical goals but will entrench and may even exacerbate social inequities. As one observer has noted:

> Gobar gas projects resulting from "apolitical" technocratic planning will be like cooperatives, agricultural extension programs and irrigation schemes. Ostensibly designed to help the poor, these programs ended up reinforcing the structures responsible [for entrenching social inequities]. (Briscoe, 1979)

The technology-fix strategy has left a trail of broken and abandoned biogas generators throughout the countryside of India. The urgency of the plight of the rural poor in Nepal calls for new, creative approaches to tackling energy problems.

SELECTED BIBLIOGRAPHY

Bajracharya, D. 1980. Fuelwood and Food Needs Versus Deforestation: An Energy Study of a Hill Village Panchayat in Eastern Nepal. Honolulu: East-West Center.

Bajracharya, D. 1984. Organizing For Energy Need Assessment and Innovation: Action Research in Nepal. in: Rural Energy to Meet Development Needs: Asian Village Approaches, eds. M.N. Islam, R. Morse, and M.H. Soesastro, pp.279-336. Boulder: Westview Press, Inc.

Burch, W.R. and D.R. DeLuca. 1984. Measuring the Social Impact of Natural Resources Policies. Albuquerque: University of New Mexico Press.

Santerre, M.T. 1984. Financial and Resource Analyses of Anaerobic Digestion (Biogas) Systems. In: Rural Energy to Meet Development Needs: Asian Village Approaches, eds. M.N. Islam, R. Morse, and M.H.Soesastro, pp.415-472. Boulder: Westview Press, Inc.

COOPERATORS

The East-West Center - Honolulu, Hawaii & Kasetsart University - Bangkok, Thailand

In this section we offer brief descriptions of two of our cooperators in Asia and a few details about their current activities related to natural resource management. We conclude with a description of a forestry curriculum development conference held in Koen Khan, Thailand at the end of last year. Participants in the conference included faculty and resource professionals from many cooperating institutions in the region.

The East-West Center's "Adopt a Park" Program

The **Honolulu Zoo Hui** and the **National Trust** in Fiji have become partners through a new protected area initiative developed by the **East-West Center's Environment and Policy Institute.** The "Adopt a Park" program directly links conservation organization donors with individual parks or reserves in the developing nations of the Asia-Pacific region. This new program, devised by biogeographer Dr. James Juvik, directs crucial support to ongoing efforts to preserve biological diversity.

The East-West Center in Hawaii was founded in 1960 "to promote better relations and understanding among the nations of Asia, the Pacific, and the United States through cooperative study, training, and research." Currently, there are over 2000 research fellows, graduate students, and professionals in business and government working with the Center's international staff on issues related to the Asia-Pacific region, including: population, resources and development, the environment, culture and communication.

Protected areas in tropical developing countries are in desperate need of sustained financial and technical support. The Center's "Adopt a Park" program targets conservation organizations whose limited resources prevent direct involvement in international protection work. Channeling a modest amount of financial assistance, combined with technical support, directly to an adopted partner offers significant opportunities for initiation or enhancement of protected area management.

The East-West Center's match of Zoo Hui and the National Trust in Fiji is the first "Adopt a Park" project. The National Trust established Fiji's first national park in 1980 by leasing the 70 hectare Yaduataba Island. The island is inhabited by a newly discovered lizard, the Crested Iguana. Elsewhere within its range, the iguana is threatened by introduced predators such as feral cats, habitat destruction from overgrazing by goats, and clearing of forest lands for agriculture. Severe budgetary limitations had prevented the Trust from developing effective protection, species monitoring, and management policies for the sanctuary.

Zoo Hui has agreed to "adopt" the iguana sanctuary and contribute financial assistance ($8000-$9000) for an initial five year period. This relatively small fund will provide a salary for the current volunteer warden and facilitate numerous other management efforts. In addition, the Zoo Hui, the East-West Center, and the University of Hawaii will join forces to provide technical support for the development and implementation of reserve management policies. Field work completed by Dr. Juvik will lay the groundwork for research monitoring and management planning. An exhibit at the Zoo Hui will feature the Yaduataba Island "Adopt a Park" project and promote public awareness of conservation problems associated with islands in the Pacific region.

Dr. Juvik and East-West Center Research Associate Lawrence Hamilton are developing a list of candidate protected areas in Asia and the Pacific. The Center's educational and training programs have drawn together an extensive network of protected area managers eager to develop contacts through "Adopt a Park." Organizations interested in "Adopt a Park" or other East-West Center programs are encouraged to contact Drs. Juvik or Hamilton at the Environment and Policy Institute, East-West Center, 1777 East-West Road, Honolulu, Hawaii 96848. In addition, a bimonthly newsletter, Centerview, is available free of charge to readers interested in the Center.

Kasetsart University - The Regional Community Forestry Training Center

Kasetsart University was founded in Bangkok, Thailand in 1943. The Faculty of Forestry is actually somewhat older than the university itself, dating back to 1935, when the Royal Forest Department opened the first Thai Ranger School in the northern community of Phrae. The university is modeled after the "land-grant" institutions in the U.S.; It maintains close ties with ten research and experiment stations located throughout the country and places a strong emphasis on applied research in agriculture, forestry and fisheries. Due to rapid growth in demand for trained professionals in all three of these specialties a separate agricultural campus was established in Nakor Pathom Province in 1979.

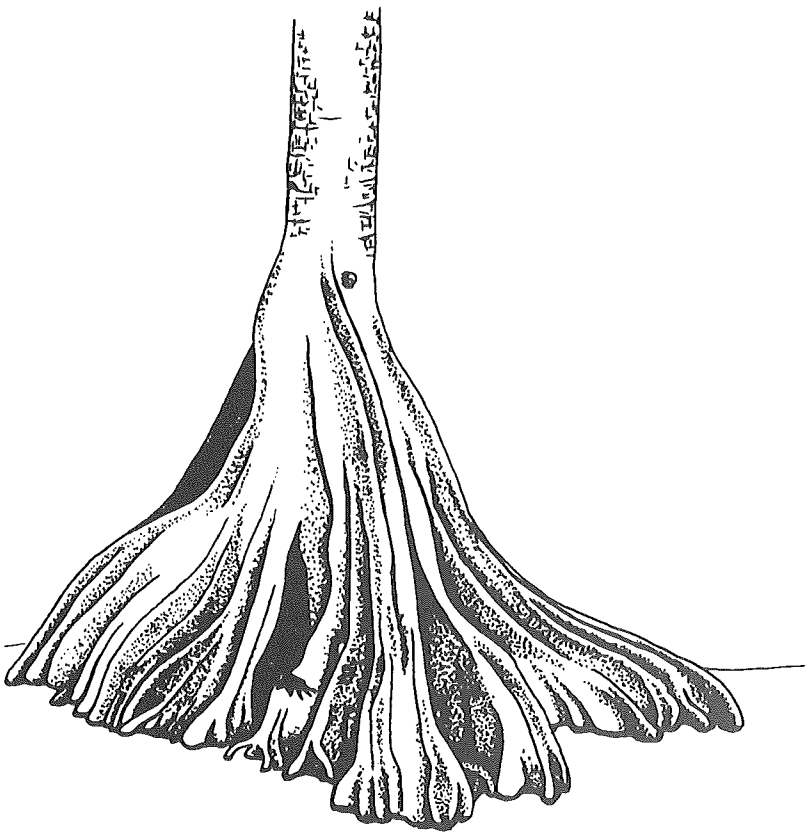
The University has recently established a Regional Community Forestry Training Center (RECOFTC) with the dual aim of training extension agents in community forestry management principles and providing technical services throughout the region. The first Certificate Course on Community Forestry Training ran from June through December of last year and was completed by 13 participants from many different countries including; China, Nepal, Pakistan, Malawi, Uganda, Lesotho, Malaysia, Indonesia, the Philippines and Thailand. The course included modules on Environmental Procedures, Human and Economic Behavior, People and Natural Resource Interactions, and Planning, Management and Application.

One of the most highly acclaimed features of the course was field work in five villages near the training center. The participants spent a portion of each month living and working in a village environment confronting a range of forestry problems they are likely to encounter in their home country. The trainees were required to develop a community forestry program for each village using the principles and ideas presented in class lectures and field trips. The ultimate goal of the Center is to develop the trainees abilities to involve community members in the planning and management of their forest resources. Learning to ask the right questions and then plan, implement and evaluate community forestry projects on the basis of the villagers' responses will be a definite step in that direction. Readers interested in additional information about RECOFTC can contact Dr. Somsak Sukuvong, Director, Regional Community Forestry Training Center, c/o Faculty of Forestry, Kasetsart University, Bangkok 10900, Thailand.

Social Sciences in Asian Forestry Curricula Project

USAID's Forestry/Fuelwood Research and Development Project is currently sponsoring the implementation of a project entitled "Social Sciences in Asian Forestry Curricula" initiated last fall with a workshop held in Khon Kaen, Thailand (November 27 - December 2, 1988). The workshop brought together university professors and administrators, researchers, and field practitioners from eight Asian countries, the Netherlands, and the U.S. During this workshop participants had an opportunity to discuss priority issues related to the integration of the social sciences in forestry curricula and to formulate recommendations for addressing these issues. Dr. William R. Burch was assisted in facilitating the workshop by Yale F&ES alumni Dr. J. Kathy Parker (Ph.D. '85) and Bob Clausi (MES '85). Several members of an Advisory Group of distinguished foresters and social scientists from Asia shared in this responsibility.

The workshop was unique in being the first conference ever held specifically on the topic of interdisciplinary forestry curriculum development. The recommendations that came out of the workshop fell into three broad categories: interdisciplinary research and linkages between research and curricula; curriculum design and the development of educational materials; and organizational issues. Documentation of the workshop, currently in preparation includes: proceedings; a volume of papers contributed by some of the participants; a curriculum design questionnaire; excerpts from selected forestry-related social science literature; a social forestry bibliography, and a directory of key forestry contacts in Asia. The second phase of the SSAFC project will include a working meeting between Dr. Burch, Dr. Parker, and a small group of their Asian colleagues in order to develop operational guidelines for integrated curriculum development based on the workshop recommendations



Pelliceria rhizophoreae

COOPERATOR NOTES

These Cooperator Notes offer a few details about the general focus or specific research and educational activities of various organizations. We welcome any submissions by our readers on their research or their institution's activities. Please send information to Peter Jipp, Editor, TRI News, Yale School of Forestry and Environmental Studies, 205 Prospect St., New Haven, CT 06511, call (203) 432-5118 or FAX (203) 432-5942.

Hydrologic processes in micro-environments and tropical regions will be the focus of next year's **International Symposium on Tropical Hydrology and Fourth Caribbean Islands Water Resources Congress.** Scheduled for June 25- 29, 1990 in San Juan, Puerto Rico, the Symposium and Congress are being organized by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Asociación Puertorriqueña de Recursos de Agua, the Water Resources Research Institute, the Water Resources Research Center, the University of Puerto Rico, the University of the Virgin Islands, the American Water Resources Association, and the United States Geological Survey. Three concurrent sessions are planned to address, respectively, surface water, ground water, and water quality. The Symposium and Congress promise to highlight tropical applications of recent advances in water resources technology, which, until recently, have been applied primarily on a continental scale and to temperate climatic regions. Symposium organizers have issued a call for papers with a deadline for submission of July 31, 1989. Abstracts not exceeding 250 words are requested. More information about the event and about the criteria for paper submission can be obtained by writing or calling Dr. Rafael Muñoz-Candelario, Water Resources Research Institute, University of Puerto Rico, Mayagüez Campus, P.O. Box 5000, Mayagüez, Puerto Rico 00709-5000, telephone (809) 832-4040 extension 3540.

Micro-computers can contribute significantly to the efforts of individuals working in the agricultural sector of developing countries. In recognition of this, **Wye College of the University of London** has announced two short courses exploring the use of micro-computers in agricultural development. The courses will be held over a ten week period from July to September and October to December, 1989. They have been designed specifically for persons working in the agricultural sector of developing countries and emphasize practical application of widely used micro-computing concepts. A course application form can be obtained from N.J. Spooner, Department of Agricultural Economics, Wye College, Wye, Ashford, Kent TN25 5AH, England.

The **International Union of Forestry Research Organizations (IUFRO)** reports that senior officials from major multilateral agencies, donor countries, foundations, developing countries and international non-governmental organizations met late in 1988 to strengthen their commitment to tropical forestry research. Known as Bellagio II, the meeting identified five priority research areas including: agroforestry and watershed management; natural forest ecology and management; tree breeding and improvement; forest products utilization and marketing; and policy and economics. As an expression of support for these initiatives, the Bellagio participants agreed that it was necessary to conduct a cost evaluation of a global network for tropical forestry research, to be carried out under the direction of the Consultative Group for International Agricultural Research (CGIAR). Additional information about the meeting and future activities of the Bellagio conferees can be obtained by writing Oscar Fugali, Special Program for Developing Countries, IUFRO-Secretariat, Seckendorff-Gudent-Weg 8, A-1131 Vienna, Austria.

The **PROSEA (Plant Resources of Southeast Asia) Project** entered the second year of its three year "Project Phase" by sponsoring its first International Symposium in Jakarta, Indonesia. The May, 1989 gathering brought together scientists, policy makers and donors interested in making information concerning southeast Asia's plant resources more available and easier to use for education, research, extension work and industry. The symposium focused on the range of strategies available to catalogue the region's plant resources using the latest in information technology. Financing mechanisms were also discussed. Further information about the symposium's recommendations and about the entire PROSEA project is available from the Secretariat, Prosea First International Symposium, P.O. Box 234, Bogor 16122, Indonesia.

The **International Union for the Conservation of Nature and Natural Resources (IUCN)** marked its 40th anniversary late in 1988 with a series of celebrations and a special edition of the IUCN Bulletin. At the celebrations in Paris, IUCN unveiled its goal for the next 40 years of tropical forest use and conservation: "to ensure that 50% of existing tropical forests are conserved through a careful balance of protection and sustainable exploitation." In addition to reviewing the organization's venerable history, the Bulletin (Volume 19, 1988) also contains several thoughtful articles on nature and natural systems from cultural and scientific leaders worldwide. Our readers may also be interested in several recent publications from IUCN's Tropical Forest Programme. A representative sample includes:

1. "Transmigration and the Environment in Indonesia: The Past, Present and Future" by Anthony J. Whitten, Herman Haeruman, Hadi S. Alikodra and Machmud Thohari, 50 pp., illus., 1987, (US$7)

2. "Conservation Planning in Indonesia's Transmigration Programme: Case Studies from Kalimantan" by John Davidson, 136 pp., illus., 1987, (US$15)

3. "Buffer Zone Management in Moist Tropical Forests: Case Studies and Guidelines" by Sara Oldfield, 56 pp., illus., 1988, (US$7)

These publications, the IUCN Bulletin and additional written information about IUCN and publications of the Tropical Forest Programme are available from the IUCN Conservation Monitoring Centre, 219c Huntingdon Road, Cambridge, CB3 ODL, United Kingdom.

The **Asian Institute of Technology (AIT)** has announced that it will join the **University of California, Berkeley** in holding its July, 1989 Advanced Management Program for Asia-Pacific Managers. The program is designed for engineers and technologists who are involved in development and implementation of strategies to carry out national development projects. The program agenda is broad, covering management strategy; structure and process; strategic human resource management; management styles; high performance managers; management science as an aid to decision making; marketing management; accounting and control; and financial management. Further information about the program is available from AIT's Continuing Education Center, GPO Box 2754, Bangkok, Thailand. In other news, AIT reports that HRH Princess Maha Chakri Sirindhorn of Thailand has joined the Institute's Interdisciplinary Natural Resources Development and Management (INRDM) program in conducting a land use/land cover study using digital high resolution imagery. A primary goal of the study is to identify remote sensing technology most appropriate for the specific needs of Thailand. Begun in June, 1988, the study has focused on the Thai village of Narathiwat because its varying farm sizes and cloudy weather offer conditions representative of the physical variation throughout much of Thailand.

In an effort to educate a global audience about the environmental and development challenges facing Indonesia, **The Indonesian Environmental Forum (IEF)** has initiated an internationally circulated, English-language newsletter called Environesia. IEF is an umbrella non-governmental organization representing over 600 Indonesian organizations working in the environment and development fields. IEF has taken on this effort in the spirit that solving problems requires initiatives which facilitate and take advantage of open and effective communication with the global community. As example of what Environesia offers , the December, 1988 (Volume 2, number 3) issue explores the often neglected linkage between women and the environment. Four separate articles discuss implications of environmental degradation for the welfare of women throughout Indonesia. For subscription information, please write to the Editor, Environesia, WAHLI, Jalan Perjernihan I, Kompleks Keuangan no.15, Pejompongan, Jakarta 10210, Indonesia.

Another new publication joined the ever-growing stream of information on international natural resource use and management in December, 1988. This effort, the Asia Pacific Forest Industry News, is the product of the **Asia Pacific Forest Industries Development Group (APFIDG)**, a regional project of the Food and Agriculture Organization of the United Nations (FAO). The project is jointly financed by the United Nations Development Program (UNDP) and the Finnish International Development Agency (FINNIDA). The overall goal of the APFIDG is to plan for future stability of the dwindling forest resources and related industries in the Asia Pacific region. According to Team Leader Sein Maung Wint, Asia Pacific Forest Industry News will highlight trade patterns and medium term market developments in some key markets for Asia Pacific forest products. In addition, they will provide commodity price information will especially assist newcomers to the business of exporting the region's forest products. The publication is issued quarterly and can be obtained by writing Asia Pacific Forest Industries Development group, c/o UNDP, P.O. Box 12544, 50782 Kuala Lumpur, Malaysia.

FAO's Regional Office for Asia and the Pacific (RAPA) continues to issue a steady stream of informative publications. In addition to periodicals such as Rural Energy in the Asia-Pacific Region and the wildlife management-oriented TIGERPAPER, the agency has also compiled a number of general publications containing information on forestry sector developments in the Asia-Pacific region. A list of these publications is available from Dr. Y.S. Rao, Regional Forestry Officer, FAO Regional Office for Asia and the Pacific, Maliwan Mansion, Phra Atit Road, Bangkok 10200, Thailand.

TRI NOTES

Dr. François Mergen, former Dean of the School of Forestry and Environmental Studies, will be retiring this year after a long and prestigous career in international forestry and forest genetics. Dr. Mergen conducted his research on forest genetics in conjunction with the Southern Forest Experiment Station in Lake City, Florida. He worked closely with both the National Research Council and the National Academy of Sciences on multiple aspects of agroforestry, resettlement camps, and fuelwood production in arid and semi-arid regions. For the past several years Dr. Mergen has served as the Consul of his native Luxembourg in New Haven, Connecticut.

Faculty research related to tropical resource issues continues to increase in scope and diversity. TRI has helped support the two year tenure of visiting soil scientist **Dr. Phillip Sollins**, who conducts seminar classes in tropical soils. In collaboration with Oregon State University, Duke University, the Organization for Tropical Studies, the U.S. Environmental Protection Agency, and the University of Costa Rica, Dr. Sollins is involved in numerous research endeavors involving ecosystem response to natural and man-made disturbance. Sollins is studying such topics as how the interactions between microbial processes and tropical soil charge chemistry affect nutrient availability, and the influence of soil physical structure on nutrient leaching and mineralization.

Dr. Kristiina Vogt, who joined Yale F&ES last fall, conducts research on carbon allocation by plants and the effects of man-made disturbances on plant energy allocation and development. She is currently engaged in work on root ecology in the Long-Term Ecological Research (LTER) project in Luquillo National Forest, Puerto Rico.

Dr. Florencia Montagnini, who joined the Yale F&ES faculty this past January, is conducting research on the influence of several different tree species on localized soil fertility and nutrient cycling. The information generated by her study will be most useful in the design and management of agroforestry systems. Her current study is based in Costa Rica. Dr. Montagnini will also be a TRI team member investigating a proposed collaborative research and curriculum development program with the Federal University of Paraiba in Northeastern Brazil.

Dr. Tom Siccama, TRI's Field Studies Director, continues to pursue his work with trace elements and their cycling in both temperate and tropical terrestrial ecosystems. This year, Dr. Siccama led two field trips to Puerto Rico. The first group, comprised mainly of students in the master's degree program, spent two weeks during the fall break studying field techniques in tropical ecology. On the second trip, which included a week long visit to the Dominican Republic, several master's students were joined by candidates from the doctoral program here at Yale F&ES as well as students and faculty from Cornell University.

TRI Director, **Dr. William R. Burch, Jr.**, is currently involved in the implementation of the "Social Sciences in Asian Forestry Curricula" project (SSAFC) as part of USAID's Forestry/Fuelwood Research and Development (F/FRED) Project. This SSAFC project began in June,1988 and is scheduled to run through August,1989. It is designed to support the integration of the social sciences in university forestry programs in Asia, and to strengthen the role of forestry and social science professionals in improving farm, community, and other forestry programs throughout the region.

Guest Lectures

The Yale School of Forestry and Environmental Studies and the Tropical Resources Institute hosted a number of distinguished scholars and practicing professionals during the spring semester. Several of these individuals came to New Haven to take part in the seminar, "Ecology, Economics and Ethics: The Broken Circle." This seminar series was jointly sponsored by the Andrew W. Mellon and Geraldine R. Dodge Foundations. The seminar was convened by F. Herbert Bormann and Stephen R. Kellert, of Yale F&ES, and Jan A.J. Stolwijk of the Yale's Department of Epidemiology and Public Health. It was coordinated by doctoral candidate, Anne M. Hooker. There were a number of internationally recognized experts on tropical resource issues among the participants.

January 19: **Edward O. Wilson**, Professor of Science and Curator of Entomology in the Museum of Comparative Zoology at Harvard University, delivered the first lecture in the series entitled "The New Imperative: Respect for Nature." His suggestions for addressing this imperative included: 1) a new effort in systematics attempting a complete survey of global biological diversity, 2) a refined social science designed to calculate the opportunity costs of lost diversity, and 3) a careful consideration of the potential for linking conservation activities with sustainable resource utilization.

March 6: **Norman Myers**, Senior Fellow of the World Wildlife Fund and Senior Associate for the International Union for Conservation of Nature and Natural Resources

who serves as an outspoken proponent of the preservation of biological diversity, spoke on the linkages between biodiversity and global security.

April 6: **Malcolm Gillis**, Professor of Public Policy and Economics and Dean of the Graduate School at Duke University, brought an enlightening global/financial perspective to bear on the issues being discussed in the seminar. Dr. Gillis cited various public policy incentives which fuel tropical deforestation and advocated a restructuring of the system of national income accounting that would reflect the degradation and destruction of natural resources.

All thirteen lectures from the series will be collected in a seminar volume currently in preparation.

TRI arranged for a visit by the Director of the Kew Botanical Gardens, **Dr. Ghillean Prance**, in the month of February. Dr. Prance served as Director of the New York Botanical Gardens (NYBG) for 25 years before accepting his current position in England. During his tenure at NYBG Dr. Prance taught a yearly course in Economic Botany at Yale F&ES. After an informal dinner with students of the school, Dr. Prance spoke on the "Utilization and Conservation of Plants in the Amazonian Rainforest." His remarks highlighted the extent of the deforestation in the Brazilian state of Rondonia and some current research initiatives focusing on the economic alternatives presented by the establishment of extractive reserves.

Also in February, Professor Sanga Sabhasri, Permanent Secretary of the Ministry of Science, Technology, and Energy in Thailand, visited the School. Dr. Sanga received his PhD in Forest Ecology from the University of Washington in 1961. On his return to Thailand, he served in numerous capacities at Kasetsart University, and more recently as Secretary General of the National Research Council of Thailand (1973-81). Dr. Sanga has vast experience in international activities, has co-authored two books and over 100 scientific papers, and is well known for his achievement in promoting the advancement of science and technology in the ASEAN and Asian countries. Dr. Sanga presented a lecture at F&ES en-titled "Forest Resources, Technology and Thai Society."

Mr. S.A. Shah, retired Conservator of Forests, Indian Forest Service, and faculty at the Forest Research Institute in Dehra Dun, India, returned to F&ES on March 31 to present a talk on "Sustainability as Related to Indian Forest Management Systems: An Historical Perspective." Mr. Shah was one of the original leaders in the planning and implementation of the social forestry movement in India. With over forty years of forestry experience, he has served as a member of the Prime Minister's All India Committee, as advisor to the World Wildlife Fund and the Nehru Foundation for Development in Gujarat, and as social forestry consultant for the Asia Development Bank and the Ford Foundation. Mr. Shah is currently a forestry advisor, particularly to Indian NGOs involved in community forestry programs.

On April 28, Ms. Marilyn Hoskins, Community Forestry Officer at the U.N. Food and Agriculture Organization in Rome, Italy spent the entire day at the School meeting with small groups of students. Following an informal brown-bag discussion, she presented a seminar entitled "Integrating Social Sciences into Community Forestry." Ms. Hoskins' particular interests and expertise concern rapid rural appraisal methodologies, the integration of women in forestry planning and management, and participatory monitoring and evaluation of resource projects.

This spring, the student's **International Resources Group** organized their annual symposium on the theme of restoration ecology. Bruce Goldstein, Conrad Reining and Carla Wise coordinated the fund raising, publicity and logistics of the event. Three prominent speakers explored the principles, techniques and prospects of restoration ecology. **William Jordan**, co-editor of "Restoration Ecology" and founder of Resource and Management Notes, spoke on the potential use of restoration ecology as an acid test for ecological research. Dr. Jordan currently works at the University of Wisconsin Arboretum. The arboretum is the site of the nation's first ecological restoration project, a 24 ha tallgrass prairie established by Yale F&ES graduate Aldo Leopold in 1935. **John Cairns, Jr.**, from the Center for Environmental Studies at the Virginia Polytechnic Institute and State University in Blacksburg, Virginia, addressed the group on his particular area of interest, the recovery of polluted rivers and streams. The third speaker, **Jeffrey Gritzner**, recently appointed Director of the Project on Resource Management in Sub-Saharan Africa at the World Resources Institute, previously spent 10 years on the staff of the National Academy of Sciences (NAS). While at the NAS, he directed the Program for Prescriptive Revegetation in the West African Sahel. His talk described this work which involved many local scientists and incorporated long-term social and historical change in a program of revegetation and rehabilitation.

LITERATURE

Noted below are selected, recent additions to the TRI bibliographic database. Searches and printouts of the database will be available on demand. We can also provide copies of some items. We would welcome any papers or reports you could send for inclusion in this database. These publications will be listed in the next issue of TRI NEWS. If you do not have publications to send, please mail us citations of publications you judge to have special importance to tropical resources management.

NATURAL RESOURCES MANAGEMENT

Soil degradation and the future of agriculture in sub-Saharan Africa. Lal, R. Journal of soil and water conservation, 43(6):444-451, 1988.

Soil erosion and nutrient losses in seasonal tropical agroecosystems under various management techniques. Maass, J. M. ; and others. Journal of applied ecology, 25(2):595-608, 1988.

Agroforestry and decision-making in rural development. Wood, P. J. Forest ecology and management, 24(3):191-202, 1988.

Towards a science of sustainable upland management in developing countries. Carpenter, R. A; Harper, D. E. Environmental management, 13(1):43-54, 1989.

Failed paradigms, neglected wisdom, and environmental reality; an approach to the rehabilitation of the West African Sahel. Gritzner, J. A. Technology in society, 10(4):469+ 1988.

Lessons from EIA for Bicol River development in Philippines. Abracosa, R; Ortolano, L. Journal of water resources planning and management - ASCE, 114(5):517-530, 1988.

PLANTS, ANIMALS, TREES

Estimating aboveground net production and grazing harvest by wildlife on tropical grassland range. Cox, G. W; Waithaka, J. M. Oikos, 54(1):60-66, 1989.

Abandoned pastures in Eastern Amazonia. 1. Patterns of plant succession. Uhl, C. ; and others. Journal of ecology, 76(3):663-681, 1988.

Abandoned pastures in Eastern Amazonia. 2. Nutrient stocks in the soil and vegetation. Buschbacher, R. ; and others. Journal of ecology, 76(3):682-699, 1988.

Population, swidden farming and the tropical environment. Russell, W. M. S. Population and environment, 10(2):77-94, 1988.

Tropical deforestation; some effects on atmospheric chemistry. Goreau, T. J; De Mello, W. Z. Ambio, 17(4):275-281, 1988.

The future of the forest-ecosystem rehabilitation in the tropics. Lugo, A. E. Environment, 30(7):16+ 1988.

Ungulate management and conservation in the Peruvian Amazon. Bodmer, R. E. ; and others. Biological conservation, 45(4):303-310, 1988.

Halting the rhino's demise; sanctuaries and captive breeding programs must counter habitat loss and the rhinoceros-horn trade. Cohn, J. P. Bioscience, 38(11):740-744, 1988.

SOCIAL, CULTURAL, ECONOMIC

Carrying capacity, population growth and sustainable development - a case study from the Philippines. Western, S. Journal of environmental management, 27(4):347-368, 1988.

Obstacles to effective management of conflicts between national parks and surrounding human communities in developing countries. Hough, J. L. Environmental conservation, 15(2): 129-136, 1988.

Is a turnaround in Africa possible without helping African women to farm? Gladwin, C. H; McMillan, D. Economic development and cultural change, 37(2):345-370, 1989.

Aboriginal property rights. Ortiz, R. D. Law & society review, 22(5):1055+ 1988.

Development and the environment - a Third World perspective. Kumar, P; Sharma, K. K. Forestry chronicle, 64(6):464-468, 1988.

The economics of cattle ranching in Eastern Amazonia. Hecht, S. B. ; and others. Interciencia, 13(5):233-240, 1988.

Land ownership and land tenure as measures of wealth and marginalisation; evidence from Northeast Thailand. Rigg, J. Area, 20(4):339-344, 1988.

Some simple economics of improved cookstove programs in developing countries. Jones, D. W. Resources and energy, 10(3):247-264, 1988.

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