

Tropical Resources Institute

# TRI NEWS

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## Message from the Director

This spring, TRI's grant from the A.W. Mellon Foundation was renewed. This funding support has enabled us to continue our program of tropical resource education and to expand our geographical focus beyond Puerto Rico to include other areas in the Caribbean, Latin America and Asia.

In this second issue of TRI NEWS, readers will find information about the Institute's activities as well as those of our cooperators. This newsletter is an aspect of our information management program. Through this publication, we hope to collect and spread information about the work that is being done by our readers. Thus, we would like to encourage readers to send in information about their research or the activities of their organization. In addition, TRI NEWS is looking for illustrations and/or photographs of people and natural resources of the tropical world. Any contributions which TRI NEWS publishes will have a credit line acknowledging the contributor.

Developing joint research and education programs with individuals and institutions in the U.S. and abroad is an important aspect of the TRI program. Through links with other universities and research organizations, we hope to provide students and faculty with access to information, and research and educational opportunities not available in New Haven. We also hope that TRI can serve as a network for all students and professionals interested in tropical resource management by connecting institutions with other institutions, and individuals with individuals.

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## RESEARCH PROFILES

### Nutrient-Use Efficiency in Five Tropical Trees

Deane Wang, Associate Research Scientist

The potential production of biomass in many tropical areas with satisfactory soils and adequate rainfall is higher than that in most of the temperate forested areas of the world. Use of short-rotation, "super" tree species promises even greater yields of fiber for fuelwood, lumber and fodder. On the negative side of these projections, the old ecologists' adage that there is "no such thing as a free lunch" suggests that the long-term consequences of high yield forestry on site quality should be considered. In contrast to the considerable time-scale logistics of studying long (50+ years) forest rotations in north temperate biomes, studies of tropical plantations can be planned and completed in a span of time (5-10 years) compatible with human life-spans and acceptable to supporting agencies.

A research plantation planted in 1980 in southwestern Puerto Rico offered a unique opportunity to investigate the effects of short-rotation, high-yield biomass production on site quality. This plantation, initiated by the Institute for Tropical Forestry (ITF, USDA Forest Service, Southern Forest Experiment Station), caught the attention of Dr. Ariel Lugo of ITF and Professor Herbert Bormann (Yale School of Forestry and Environmental Studies) and a cooperative venture was born. In August of 1985, sponsored by a research grant from TRI, I left for a month-long trip to Lajas, Puerto Rico.

The plantation at Lajas was started with six fast growing species that are planted in tropical areas throughout the world: *Eucalyptus robusta*, *Casuarina equisetifolia*, *Albizia procera*, *Leucaena leucocephala* PR, *Leucaena leucocephala* K-8, and *Cassia siamea*. The *Cassia* did not establish in an orderly pattern, making study of its growth more difficult, and it was not investigated. The trees were planted in blocks and randomized within blocks, thus making statistical comparisons possible. Plots were 10 by 10 meters square, initially planted at 1 meter intervals, and thinned to 2 meter intervals by the end of two years. Our studies of biomass growth and nutrient uptake reflect five years of growth.

Given this experimental design, we felt that it was possible to answer several questions: 1) How does biomass production at this site differ between the five species? 2) How do the trees vary in their nutrient-use efficiency, ie. the ratio of nutrients used to produce a given amount of biomass? 3) What is the nutrient "cost"

of a single rotation, and what is the ability of the soil to sustain multiple rotations? 4) What is the effect of each species on the site, ie. in terms of forest floor and soil profile development?

The plantation plots grew rapidly and produced many five-year old trees in excess of 15 meters in height and 10 cm. To a north temperate ecologist, this rate of height growth was truly astonishing. The most productive species, *Casuarina equisetifolia*, produced the equivalent of 200 dry metric tons/ha in five years (about 40 Mt/ha/yr, aboveground biomass). By comparison, a northern hardwood forest (Hubbard Experimental Forest, New Hampshire) produces between 2 and 7 Mt/ha/yr.

Table 1 compares the five studied species by tissue type and for total aboveground biomass.

Table 1. Aboveground Biomass (Mg/ha)

Species Part	CE	AP	ER	K8	PR
Stemwood	143	101	45	37	24
Stem bark	10	11	11	6	3
Branches	25	4	5	2	2
Leaves	13	3	6	2	1
Dead branches	8	4	1	1	3

CE = *Casuarina*

K8 = *Leucaena* K-8

ER = *Eucalyptus*

PR = *Leucaena* PR

AP = *Albizia*

The ratio of parts to the whole aboveground biomass varies between species and suggests different nutrient-use efficiencies, with higher ratios of leaves and bark to stemwood indicating more costly (for nutrients) total biomass production.

Nutrient analyses of each of the tissue types for a variety of nutrient elements is presently underway in cooperation with Dr. Clyde Asbury of the Center for Energy and Environment Research (CEER, U.S. Dept. of Energy, University of Puerto Rico). Our own results for selected nutrients indicates important differences in nutrient-use efficiency between species (Table 2).

Because of the different rates of growth of each species, the rate of nutrient extraction from the soil for each species (Table 3) is slightly different from the ranking of nutrient-use efficiency (Table 2). For example, *Casuarina*, produced 4 times as much biomass as *L. leucocephala* K8 (199 vs. 47 Mg/ha) using about the same amount of potassium (169 vs. 184 Kg/ha, respectively). These types

of analyses allow forest managers to consider long-term effects of intensive forestry using rapidly growing trees. While not answering the question of long-term sustainability of high-yield biomass production, consideration of nutrient-demands by different species allows management options to be considered.

**Table 2. Nutrient-use Efficiency**  
(Biomass/unit Potassium, Mg/kg)

Species Part	CE	AP	ER	K8	PR
Total abv.	1.2	0.38	0.74	0.26	0.28
Stem only	2.2	0.45	1.0	0.32	0.33

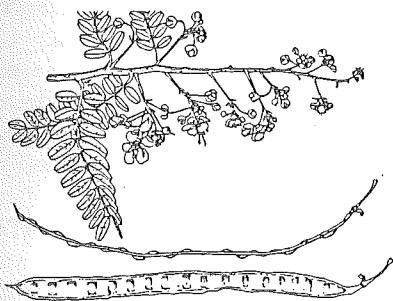
CE = *Casuarina*                      K8 = *Leucaena* K-8  
 ER = *Eucalyptus*                  PR = *Leucaena* PR  
 AP = *Albizia*

**Table 3. Rate of Nutrient Extraction**  
(Potassium, kg/ha/5 yr)

Species Part	CE	AP	ER	K8	PR
Stemwood	62	193	43	75	51
Stem bark	9	58	11	58	33
Branches	40	33	12	27	17
Leaves	46	40	23	23	13
Dead branches	14	6	1	1	4
Total	169	330	90	184	118

CE = *Casuarina*                      K8 = *Leucaena* K-8  
 ER = *Eucalyptus*                  PR = *Leucaena* PR  
 AP = *Albizia*

Future work includes continuation of research on tissue nutrient analyses, analyses of soil properties, comparative analyses of litter nutrient accumulation, and nutrient-use efficiency of these same species at a site in the northern part of Puerto Rico (Corazal).



*Cassia Siamea* Lam.

## *Erythrina poeppigiana* a Resource in Costa Rica Farms

Ricardo O. Russo, postdoctoral fellow\*

*Erythrina poeppigiana* (Walpers) O.F. Cook (Leguminosae: Papilionoideae) is a known as "poro gigante 0extranjere" in Costa Rica and by several common names in other countries such as "barbatusco" in Colombia, "bucare" or "cachimbo" in Venezuela, "amasisa" in Peru, and usually known as "coral tree" or "immortelle" in English (Cook, 1901; Cook and Collins, 1903; Standley and Steyermark, 1947; Holdridge and Pveda, 1975). There are more than 100 species of *Erythrina* throughout the world usually in tropical and subtropical countries of the American, African and Asian continents. They are used as ornamentals, as shade trees for other crops or for medicinal purposes. One other species, *Erythrina edulis* has edible seeds. Several other species are used as live fence posts.

*Erythrina* has a natural distribution range from Bolivia to Panama, although it has proven to be well adapted in other tropical areas where it has become naturalized (Raven, 1974) such as Costa Rica, the West Indies, Africa and Malaysia, where it was introduced as shade for coffee and cacao (National Academy of Sciences, 1979). The tree is found throughout the lowlands and middle elevations in the tropical zones with medium to high rainfall (1500 to 3000 mm and more) with a dry season of 0 to 6 months; altitude in Costa Rica ranges from sea level to about 1400 meters (Borchert, 1980). However, in Colombia and Venezuela, trees have been observed at, or slightly above, 1900 meters.

In Costa Rica, this nitrogen-fixing species has been used as a shade tree for coffee since the beginning of this century. It is interesting that in this country, coffee farmers employ a particular management practice known as pollarding where the tree is heavily pruned. This practice has been found to produce benefits to the associated coffee crop, such as uniform flowering in coffee bushes and ripening in coffee berries, addition of organic matter to the soil, and recycling of nutrients in the system. Furthermore, the pollarded branches can be used as forage.

For instance, biomass production from pollarding twice a year, provided 11.8 tons/ha/year of dry matter with about 230 kg of nitrogen (Russo and Budowski, 1986). Initial experiences at CATIE, Costa Rica show promising results for alley cropping and for interplanting with grasses *Pennisetum purpureum* and *Cynodon plecostachyus* (Kass and Barrantes, 1984; Rodriguez, 1985; Bronstein, 1984). Farmers usually propogate the species by planting large

cuttings (2.5 meters long and 8 to 12 cm in diameter). When established, pollarding once or twice a year is usually practiced and the branches are spread on the ground. The foliage has been fed to small animals such as rabbits and goats with good results. Leaves contain between 25 to 30 percent of crude protein and are readily eaten by cattle. Digestibility varies between 50 and 80 percent, and is highest in the bark of young branches. Swine apparently suffer loss of hair when ingesting leaves. Nitrogen fixation has received little investigation. Escalante, Herrera and Aranguren (1984) and Lindblad and Russo (1986) found annual nitrogen fixation to be around 12 to 40 kg/ha/year when planted for shade in coffee and cacao plantations.

Because of its fast growth, its capability to produce high amounts of biomass, its nitrogen fixing ability, its easy propagation by cuttings, its excellent response to pruning practices and its high content of crude protein, the tree show a high potential as a resource in agroforestry practices.

\* (Last April, Dr. Ricardo O. Russo came from the Tropical Agricultural Center for Research and Training at CATIE in Costa Rica to join the Program for Forest Microbiology (PFM) at the School as a postdoctoral fellow. Dr. Russo is a native of Argentina where he graduated in agronomy from the University of Buenos Aires. He did postgraduate research at CATIE for five years on nitrogen-fixing trees, mainly *Erythrina* spp., under the direction of Dr. Gerardo Budowski, former head of the Renewable Natural Resources Department. Dr. Russo's work with PFM concentrates on *Alnus* spp. and the interaction of *Frankia* and vesicular-arbuscular mycorrhizas.)

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## COOPERATORS

### Virgin Islands Resource Management Cooperative

The Virgin Islands Resource Management Cooperative (VIRMC) was formed in 1982 to bring together local expertise to work towards the solution of resource management problems. VIRMC is made up of the National Park Service and 13 other members which include territorial and federal government agencies, and private research and educational institutions based in the U.S. Virgin Islands, the British Virgin Islands and Puerto Rico. One of VIRMC's research programs is detailed below.

### Initiation of a Long-Term Monitoring Program for Coral Reefs in the Virgin Islands National Park, St. John, U.S.V.I.

Caroline S. Rogers and Evonne S. Zullo

#### ABSTRACT

A long-term monitoring program was initiated for the coral reefs of the Virgin Islands National Park and Biosphere Reserve in recognition of the need for quantitative baseline data to provide information for resource assessment and effective management. Major stresses to the reefs in the park include terrigenous runoff following watershed development, storm damage, and damage associated with boating activities.

Transects were established on coral reefs in Reef, Fish and Hawksnest Bays. Tropical Storm Klaus (Nov. 1984) resulted in a statistically significant decrease in the mean percent cover of live coral (from 26 percent down to 21 percent), an increase in diversity and evenness, and a slight decrease in spatial index at the Fish Bay site. The percent cover by the dominant coral *Agaricia agaricites* decreased significantly from 17 to 11 percent. At Reef and Hawksnest Bays (for which there are only post-storm data), mean percent coral cover was 20 percent and 26 percent respectively.

These quantitative data will serve as a basis for documentation of deterioration or recovery of coral reefs in these three bays. Monitoring and management guidelines for Caribbean coral reefs are presented.

#### INTRODUCTION

Major stresses affecting the coral reefs of Virgin Islands National Park on St. John, U.S.V.I. include: 1)

terrigenous runoff, 2) storm damage and 3) boat damage. One of the major environmental concerns on St. John is siltation of nearshore marine habitats from accelerated erosion following watershed development. Erosion and runoff are potentially serious problems on St. John because of its extremely steep hillsides.

Rapid, and in some cases uncontrolled, development on St. John has led to increases in terrigenous runoff. After heavy rains, bays both within and outside the park have highly turbid water. St. John residents believe that corals in Hawksnest and Cinnamon Bays on the north shore of the island were killed from siltation following exceptionally heavy rains in April 1983 (18 inches in 24 hours). Development of private lands within the park boundary and development outside the park boundary can both contribute to turbidity in park waters. New roads are continuously being carved into the hillsides creating potential for accelerated erosion and runoff.

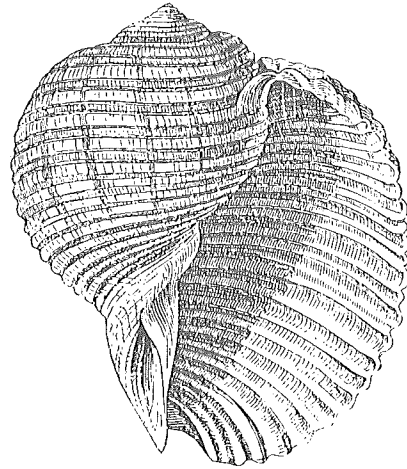
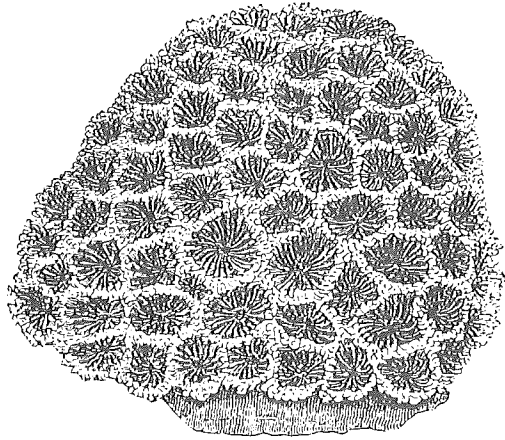
Storms have undoubtedly caused the greatest destruction to coral reefs off the south side of the island. Hurricanes David and Frederic (1979), known to have caused considerable damage to reefs off St. Croix, are most likely responsible for the widespread fragmentation of the dominant branching coral species seen in Fish Bay, Reef Bay, Coral Bay and elsewhere. Tropical Storm Klaus hit the U.S.V.I. on Nov. 6-7, 1984 with winds gusting to 50 knots and very heavy sea swells. About 9 inches of rain fell during the storm but the damage was primarily from the heavy swells rather than turbidity. (The effects of the storm on one coral reef studied during this project are described below.)

Close to one million people annually visit the Virgin Islands National Park, with most of them using marine resources (boating, snorkeling, diving). While not as extensive as storm damage, damage from boats striking and grounding on coral reefs near and within popular bays is a serious problem in localized areas.

Collection of corals for souvenirs and breakage from careless snorkelers are other consequences of excessive use, particularly evident at the underwater trail at Trunk Bay.

White band disease has killed extensive amounts of the most abundant coral at Buck Island Reef National Monument, St. Croix, and on other St. Croix reefs. The disease has not been correlated with human activities. Although present on St. John reefs, it is not currently widespread.

Studies carried out in 1984 by VIRMC resulted in an extensive amount of general information on the nearshore



marine ecosystems off St. John, including qualitative surveys and maps of major benthic communities (e.g. Beets et al, 1985). VIRMC projects for 1985 emphasize an interdisciplinary approach to watershed management in three bays on St. John, including studies of fisheries, sedimentation, and coral reefs. This VIRMC project was initiated as part of a long-term monitoring program for the coral reefs of the Virgin Islands National Park and Biosphere Reserve.

This study had both scientific and nonscientific objectives. The major scientific objective was to carefully select areas for long-term monitoring to allow documentation of deterioration or recovery of coral reefs around St. John. Research was carried out in disturbed and undisturbed watersheds in conjunction with other VIRMC studies. Several 1985 VIRMC studies were intended to begin to answer the following management questions: To what extent is terrigenous runoff affecting the reefs on St. John? Are the reefs within Virgin Islands National Park and Biosphere Reserve deteriorating and if so what can be done to eliminate or minimize the damage?

Critical nonscientific objectives of the project were to involve local people in an applied research study with educational and training aspects, and select methods that would be easily taught and repeated accurately without an extensive amount of training. The eventual goal would be a model monitoring program that could be used by other Caribbean island countries in their parks/reserves. Six individuals have assisted us in this study, five of them College of the Virgin Islands students. We made an effort to use methods which could be easily taught and which might prove suitable for use on other Caribbean islands with limited resources for monitoring and management.

#### STUDY SITES

This study focussed on coral reefs associated with three

watersheds on St. John with different development histories.

*Reef Bay* The Reef Bay watershed has remained undisturbed since the decline of the sugar plantation there in the late 1800s. (A small plot which has been recently cleared in the western portion of the bay is far from the study site.) The study site, near the center of the bay, is along a fairly steep slope ranging from c. 11 m up to c. 3 m. At the base of the slope at about 11 m is a sand channel which often has very turbid water.

*Hawksnest Bay* The Hawksnest Bay watershed on the north side of the island is the site of a new medical clinic. Construction of the clinic in 1982 may have contributed to siltation in the bay. Study areas in shallow patch reefs near the bay's southern shore ranged from c. 3 m deep to the surface.

*Fish Bay* The Fish Bay watershed is currently undergoing subdivision, road building and construction of houses. Although the lands are outside the park, the study reefs are in park waters and could deteriorate with increases in siltation from erosion associated with the rapid development of this area. The shallow study area (3 m) is just seaward of the reef crest and emergent rubble zone of the reef in the eastern side of Fish Bay. The area was severely damaged by Hurricanes David and Frederic. The deeper study site (11 m) is in the forereef area with a well developed and diverse coral community.

At all study sites, with the exception of the shallow storm-damaged area in Fish Bay, the areas with the most live coral and best developed reef structure were intentionally selected because the objective was not to characterize the overall reef, but to establish a baseline against which changes could be compared.

## COOPERATOR NOTES

The **Caribbean National Wildlife Refuge** has several ongoing cooperative research projects on Refuge lands. One of these projects is the Desecheo Island Goat and Booby project. The Desecheo National Wildlife Refuge is a rugged 146 ha island located 22 km off the northwestern coast of Puerto Rico. Historically, the world's largest brown booby colony occurred on Desecheo (J.B. Nelson, *The Sulidae*, 1978). Avifaunal surveys conducted in the 1970s indicated that boobies were not nesting on the island and that they had probably relocated to adjacent Mona and Monito islands. It is believed that factors leading to this major shift of nesting sites in the past were intermittent bombing of the island by the U.S. Navy, eggng and poaching, and the introduction of rhesus monkeys. It is anticipated that by the end of 1986, the removal of rhesus monkeys will be completed and it is hoped that boobies will begin responding with improved reproduction. Research needs that will be addressed are: 1) to determine the number of breeding pairs and nesting success, 2) describe nesting sites, 3) determine breeding chronology, 4) document mortality factors, 5) initiate a banding program to document site tenacity, possible exchange between colonies at Desecheo, Mona and Monito islands, and movement patterns.

In addition, the Caribbean Islands National Wildlife Refuge is interested in documenting the impact, if any, on Desecheo's communities by feral goats and obtaining an idea of their population dynamics. Research needs on feral goats include: 1) to determine population numbers, 2) estimate population age structure, 3) estimate population growth and fecundity rates, and season of births, 4) determine habitat utilization patterns, 5) ascertain food habit, and 6) assess impact of goats on vegetation through enclosure plots and browsing index. Cooperating institutions for this project will be Louisiana State University and Fish and Wildlife Service. Field work is scheduled to begin in January 1987. For more information about this project and other research going on in CINWR, contact Dr. Jaime A. Collazo, Wildlife Biologist, CINWR, Box 510, Boqueron, Puerto Rico 00622.

The first hydrologic investigation of the largest interior valley of Puerto Rico is being conducted by the U.S. **Geological Survey** in cooperation with the **Puerto Rico Aqueduct and Sewer Authority** and the **Department of Natural Resources**. The first phase in the three-year investigation includes comprehensive well and ground-water use inventory. At present, a total of 77 wells have been located throughout the valley, of which 45 are active and 32 abandoned wells. The total ground-water withdrawals for public supply in the valley is about 4 million gallons per day. The drilling of about 15 test wells and the installation of automatic digital

recording instruments for continuous ground-water level monitoring programs were scheduled to begin this summer. Engineer Juan Puig is the Project Chief.

The proceedings of the "Third Caribbean Islands Water Resources Congress" held July 22nd through the 25th of this year in St. Thomas, U.S.V.I. are now available for purchase. The book includes 17 of the 20 papers presented at the Congress. Copies can be ordered at \$10.00 each from the Puerto Rico Water Resources Association, GPO Box 4424, San Juan, PR 00936.

Activities of the **Institute of Tropical Forestry** over the past year included research in plantation culture by Dr. L.H. Liegel, Puerto Rican Parrot Research by Dr. J.W. Wiley, a study on a palm floodplain forest by Dr. Ariel Lugo and a tree growth predictability study by Dr. Frank Wadsworth. ITF held a conference on "Management of the Forests of Tropical America: Prospects and Technologies" from September 22 - 26 at Rio Piedras in Puerto Rico. Topics included: the management outlook, natural forest management, forest plantation planning and practice, utilization and markets and outreach for forest managers. The conference was co-sponsored by U.S.A.I.D., the International Society of Tropical Foresters, the U.S. Forest Service and the Department of Natural Resources of Puerto Rico. Additional information about conference proceedings or other ITF activities can be obtained by writing the Southern Forest Experiment Station, Institute of Tropical Forestry, P.O. Box AQ, Rio Piedras, Puerto Rico 00928, telephone: (809) 763-3939.

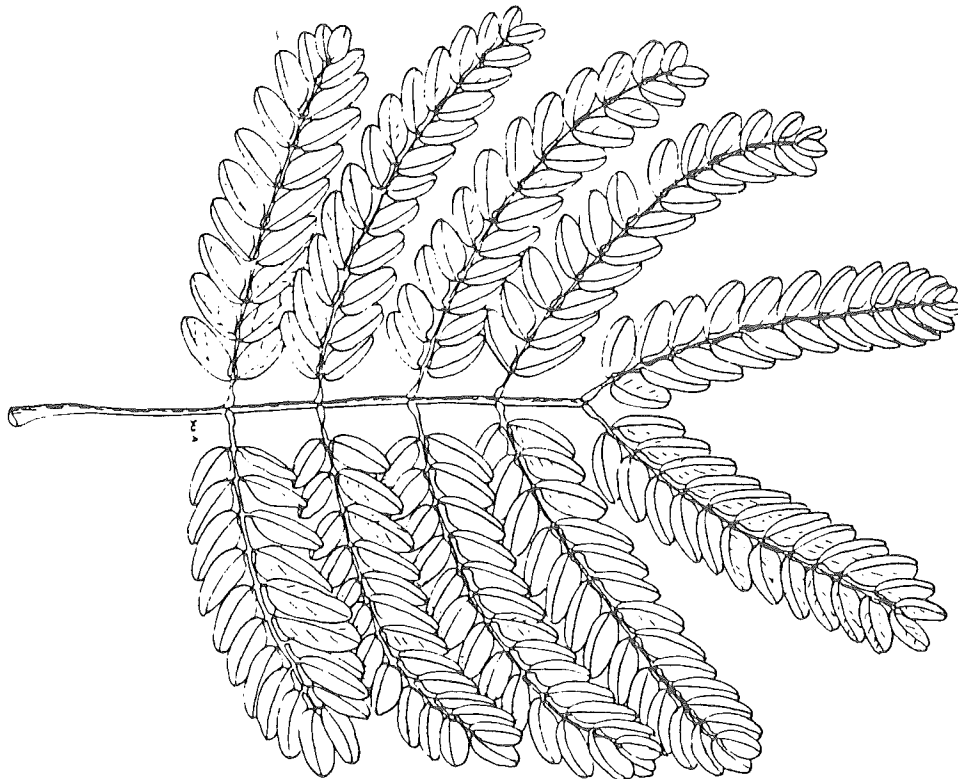
Yale School of Forestry and Environmental Studies currently is in the process of establishing ties with the **International Centre for Integrated Mountain Development (ICIMOD)** in Kathmandu, Nepal. ICIMOD was established in 1983 to promote integrated mountain development in the Hindu Kush - Himalaya. Upland - lowland and regional and international cooperation are essential for rational resource management. ICIMOD was created to fill the need for an international centre through which regional cooperation, via links between decision makers, development program implementors and local communities, could be put into practice. The Centre plays a supplementary and reinforcing role, rather than a cooperative one, with existing institutions of the region. The specific objectives of the Centre are: multidisciplinary documentation and information dissemination, training and applied research, and consultative service provision on resource management and development activities. Regional members include: Afghanistan, Bangladesh, Bhutan, Burma, China, India, Nepal, and Pakistan. For more information about ICIMOD, write them at G.P.O. Box 3226, Kathmandu, Nepal.

Cornell's International Program in Natural Resources has four professionals from developing countries visiting for a year of study and practical experience through the Hubert H. Humphrey North-South Fellowship Program. These professionals are: Mr. Muhamed Noel Ahmed Abou-Zied, Assistant Manager for Ras Muhamed Park, a marine life and coral reef preserve in Egypt; Mr. Kishore Rao, Deputy Director of Wildlife Conservation in the Government of India; Mr. Yoav Sagi, Secretary General of the Society for the Protection of Natural Resources in Israel; and Mr. Francisco Serrano who works on natural resource management and conservation efforts in El Salvador.

Plans are underway for the **College of the Virgin Islands** to become the Eastern Caribbean Center for educational, technical, cultural and scientific interchange. The College, working closely with the territory's Delegate to Congress in March 1984, received initial endorsement to develop an Eastern Caribbean Center from the House of Representatives Interior and Insular Affairs Committee. The Center is envisioned as an international educational institution fully integrated in the College with its primary focus on offering cooperative programs of study, research, and training for the people of the Eastern Caribbean

region. For more information about the Center or about other programs at the College of the Virgin Islands, write Director, Land Grant Programs, College of the Virgin Islands, P.O. Box "L" Kingshill, St. Croix, U.S.V.I. 00950.

**Island Resources Foundation**, which has offices in both the U.S. Virgin Islands and Washington, D.C., completed nine major projects during 1985 and received gifts, grants and contracts funding exceeding \$400,000. One of IRF's projects was a regional fisheries assessment effort under contract for U.S.A.I.D. The objective of this study was to review and evaluate previous donor-funded fisheries development schemes, assess various program development options and provide a preliminary plan for future AID funding strategies in seven island areas: St. Kitts-Nevis, Antigua-Barbuda, Montserrat, Dominica, St. Lucia, Grenada and St. Vincent. Other projects include: a marine archaeological survey in the Virgin Islands at Long Bay in the St. Thomas harbor; and a cultural and historical resource utilization project. A list of IRF publications and further information about research projects can be obtained by writing Dr. Edward Towle, Island Resources Foundation, Red Hook Box 33, St. Thomas, U.S.V.I. 00802.



*Albizia procera* (Roxb.) Benth.



## TRI NOTES

The following notes give brief details of the activities of students, faculty and staff over the summer as well as plans for the upcoming semester. More detailed information about TRI activities can be obtained by writing the Institute.

In March, TRI Director William R. Burch presented an invited paper and participated in a workshop on "Strategies for Improving the Effectiveness of Asia-Pacific Forestry Research for Sustainable Development" at the East-West Center in Honolulu, Hawaii. Dr. Burch is on leave for the fall term of the 1986/87 school year. In September, he traveled to Yugoslavia for the International Union of Forest Research Organizations conference. For the conference, Dr. Burch, along with Dr. Robert G. Lee from the University of Washington, developed the first non-economic, social science session not on forest recreation.

After Yugoslavia, Dr. Burch journeyed to Scotland to visit the University of Aberdeen and Dr. Adrian Marshall at the University's Institute of South-East Asian Biology. Before coming back to the U.S., he stopped in England to visit the Oxford Forestry Institute, where he met with Dr. Jefferey Burley. He also visited Dr. Gill Shepherd at the Overseas Development Institute and Asmeen Khan (MF '85) at Oxfam.

This summer, Dean Gordon spent the month of July in India as part of a consulting team of Winrock International on their agroforestry project. The team visited academic institutions and research centers in Dehra Dun, Jodhpur, Bangalore, Coimbatore and Hyderabad.

In August, Drs. David Smith, Bruce Larson and John Wargo visited several places in Mexico both to explore the possibilities for increasing the number of Mexican graduate students at Yale and to develop ideas for joint research. Two current Doctor of Forestry students, Carlos Rodriguez-Galvez and Enrique Serrano-Galvez, arranged the visits and participated themselves. The group visited the headquarters of the Mexican Institute for Research in Agriculture, Forestry and Animal Husbandry, as well as its field research stations near Mexico City and Yuruapan, and in the State of Quintana Roo. They also visited the main forestry school of Mexico at the Autonomous University of Chapingo, as well as the Colegio Postgraduados, which is also in Chapingo.

Dr. Graeme Berlyn and Dr. Thomas Siccama traveled to Costa Rica in August to look into the area for possible research projects and to check in with master's student Whendee Silver who is working on a socioeconomic survey of secondary forests for land owners in Costa Rica.

Whendee is working in conjunction with CATIE on this project. Whendee's work is an aspect of TRI's Tinker grant program which was established to develop a program of natural resource education in Latin America. Her study addresses the extent and type of forest utilization and specific species economic use, as well as motivation of the land owner to develop and manage secondary forests on a long-term basis.

Another master's student, Alan Ragins, was also in Costa Rica this summer through the Tinker Grant program. Alan worked on a wildlands projects to study information needs and flow at the La Amistad Biosphere Reserve. His work builds upon work done in similar reserves in Puerto Rico and the U.S. Virgin Islands.

Two master's students went to Puerto Rico this summer to work on internships. Judy Stone worked with Jerry Bauer of the Department of Natural Resources Forest Service on a forest inventory project, and Sharon Dougherty worked with Dr. Jim Wiley on the captive breeding project of the endangered Puerto Rican Parrot. The study took place in the Caribbean National Forest (CNF) on Loquillo Mountain. Sharon also worked with Jerry Bauer on an assessment of human use and attitudes towards wildlife in CNF.

On St. John in the U.S. Virgin Islands, master's student Anne Reilly worked on a long-term forest monitoring project developed by John Earhart (MF '84), the New York Botanical Garden and the National Park Service. Dean Gordon visited the Virgin Islands this summer to establish closer ties with the College of the Virgin Islands. During his stay in the Virgin Islands, the Dean had the opportunity to visit Anne and the project site on St. John.

Master's student Kathy Rorison returned to the School this year from Niger where she was working on an agroforestry project with CARE.

TRI distributed funds for research and travel in May. Projects which received funding support include: Dr. Clark Binkley and John Perez-Garcia's project on the effects of alternative tropical deforestation scenarios on timber prices; Dr. Graeme Berlyn and Ambrose Anoruo's project on genetic stability and physiology of Caribbean pine seedlings and regenerated plants; Guillermo Castilleja-Gonzalez's study of tree diversity and dominance patterns in a sub-tropical dry forest in Puerto Rico; and Jeff Vincent's research on the effects of trade barriers upon forest utilization in Malaysia. Jock Conyngham received support for travel to Kenya to do preliminary field work in preparation for his doctoral research on the ethnoecology of interactions between pastoralists and wildlife.

Doctor of Forestry candidate Nora Devoe received support this summer for travel to Ecuador, Panama and Costa Rica to evaluate potential sites for a forest regeneration experiment, and to scope out potential collaborators for the project.

This semester, TRI is sponsoring a new course on plant systematics which is being taught by Dr. Brian Boom of the New York Botanical Garden. Dr. Boom received a grant from The Charles A. Lindbergh Fund for research on "The Panare Indians and Their Forest: an Ethnoecological Inventory in Venezuela and Guyana" in 1985-1986. In addition, Dr. Boom recently received a Fulbright American Republics Research Grant for 1986-1987. The award will be used to conduct field work on the Theaceae in Guyana. The taxonomic study of that family will be for the Flora of the Guyanas project, an international effort coordinated by the Institute of Systematic Botany and the University of Utrecht.

Last year, master's student Jim Chamberlain completed a list of organizations involved in international natural resource management and development. This list is available both to faculty and students and to graduates and others outside of the School. It contains information about the focus of each organization as well as a contact name when available. Anyone interested in a copy of this list, please write TRI.

#### GRADUATES

Many of the master's students who participated in TRI in 1984 have gone on to jobs in international work with development agencies, non-profit organizations or have enrolled in graduate programs. Ed Backus, after working on an AID project in Rwanda, returned to the U.S. and is working for Nature Conservancy International. J.B. Friday and Kathleen Stearns Friday have joined the Peace Corps and are stationed in the Philippines. Molly Olsen is working for the Park Service in Australia. Mark Ashton, after working on a silviculture project in Sri Lanka, has returned to the School to enter the Ph.D. program. Jane Ceraso is working for the Environmental Defense Fund in New York, Bob Clausi is in Sudan, working for CARE, Jon Anderson is working for AID in Senegal and Asmeen Khan is working for Oxfam in England. Two students are working at the School: Peggy Rasmussen King is working for TRI as an Assistant Director and Stephen Lowe is Assistant Director for the Program in Forest Microbiology. Alexander Brash and Jennifer Haaser are enrolled in Ph.D. programs at other universities in the U.S.

Many of the last year's graduating class have gone to Washington for internships or short-term positions. Both



*Inga laurina* (Sw.) Willd.

Ken Andrasko and Julia Falconer had internships with the International Institute for Environment and Development, Mark Dillenbeck worked for the World Resources Institute, Nancy Sheehan had an internship with the National Park Service's Man and the Biosphere program, and Jim Chamberlain is working for the Office of Technology Assessment. In Puerto Rico, Edgardo Gonzalez is working for the Forest Service. In New England, Betsy McGean worked for the Atlantic Center for the Environment in Massachusetts and now is working for the World Resources Institute. Steve Miller was also in New England this summer working for the Shoals Marine Laboratory.

From the class of 1983: Eva Muller and Dave Gibson are working for CARE in Rwanda; Doug Henderson is working for the Peace Corps in the Cook Islands; Vicky Dompka is at the Better World Society in Washington. From 1984: Chun Lai is working for AID in Mali. Also in the Peace Corps in Togo is masters' student Louann Rank who is currently on leave.

Susan Huke (MF '84) is working with Save the Children in Somalia in an agroforestry extension program. She writes that the thrust of her work has been in the provision of seedlings and training to refugees so that they can plant trees around their compounds. The extension program began as a part of a larger three-year forestry program funded through a cooperative agreement with AID and the Somali National Range Agency. The project aimed at establishing a large forestry nursery, fuelwood plantations and conducting research and training activities.

We would welcome any contributions, long or short, by graduates of the School who are doing international work. Please send all news to Katherine Snyder, Editor, TRI News.

## BOOK REVIEW

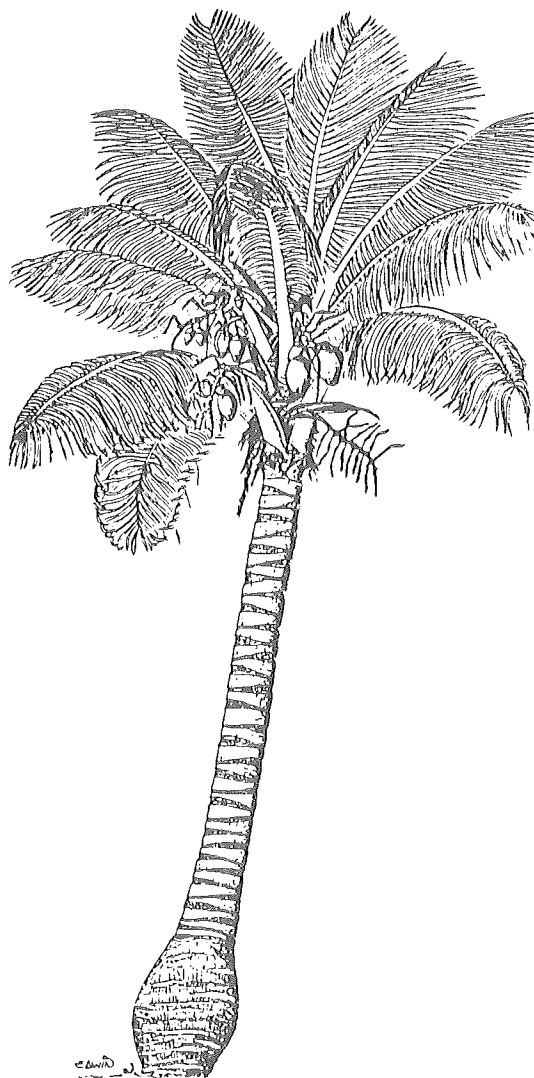
Ramachandra Guha  
Visiting Lecturer in Social Ecology

TREE GROWING BY RURAL PEOPLE. 1986. FAO  
Forestry Paper No. 64, Rome.

This paper is perhaps the first systematic treatment of the social and political issues involved in the continuing deforestation in Third World countries. It begins with a review of the wide variety of forest conservation practices among rural people, and explains the breakdown of these traditional institutions of resource management in the light of recent economic and demographic pressures. It then goes on to identify different reforestation strategies appropriate to different land and tree tenure systems at the village level. The concluding section deals with the wider framework of community and farm forestry, outlining the role of governmental and non-governmental organizations in financing, evaluating and servicing rural forestry projects.

The historical and sociological perspective is welcome, and helps in debunking several myths widely current in the literature. These include: the belief that peasants need to be educated about the importance of tree cover; that rural firewood needs (and not commercial and industrial demand) is the main cause of deforestation; that shifting cultivation has historically been an unsustainable form of agriculture; and finally, that increased state intervention and punitive sanctions are the solution to the present crisis.

The one criticism I would make of this report is its failure to locate rural forestry issues in the context of development strategy as a whole. One could make a strong case that what Michael Lipton has called the "urban bias" in development planning is the root cause for most Third World environmental problems. This caveat notwithstanding, I would emphasize that the present document is a major contribution to the field. In the circumstances, one hopes that distribution of this document to researchers and development activists will be more widespread than FAO papers usually are.



*Cocos nucifera* L.

## LITERATURE

Noted below are selected, recent additions to the TRI bibliographic database. Beginning with the next issue of TRI NEWS, this section will be expanded, particularly in its coverage of technical reports and papers. As previously stated, TRI will list in-house documents and other publications submitted by cooperators and readers. These publications will be indexed, entered into the database, and microfilmed where appropriate.

Searches and printouts of the database will be available on demand. We can also provide copies of some items. For example, we can now loan microfiche copies of FAO documents, like the ones listed below under Technical Reports: FAO". Send your requests to Katherine Snyder, TRI, Yale School of Forestry and Environmental Studies, 205 Prospect Street, New Haven, CT. 06511.

If you do not have publications to send for indexing and filming, send us citations of publications you judge to have special importance for tropical resources management. These citations will be added to the database and will enrich our cooperative effort.

**Bibliographia sobre recursos naturales renovables.** CATIE ; serie bibliotecologia y documentacion, Bibliografia no. 8, 1983. 513 pp.

**The building materials industry in developing countries; an analytical appraisal.** United Nations Industrial Development Organization, Sectoral studies series no. 16, v.1, 1985. 195 pp.

**Conservation, science and society.** UNESCO-UNEP, Natural resource research, XXI, 1984. 2 vols. S 942 +I58 1983 1-2 (LC) Contributions to the first International Biosphere Reserve Congress, Minsk, Byelorussia/USSR, 26 September -2 October 1983.

**Desertification in the Sahelian and Sudanian zones of West Africa.** Steeds, D. The World Bank, 1985. 60 pp. Response to growing concern that not enough had been accomplished to combat the desertification problem in West Africa.

**The ecology of neotropical savanas.** Sarmiento, G. Harvard University Press, 1984. 235 pp. Translated by O. Solbrig.

**Final report; consultative meeting on Asia and the Pacific regional activities on tropical forests.** United Nations Environment Programme, Regional Office for Asia and the Pacific. United Nations, 1983. 169 pp.

**Impounded rivers; perspectives for ecological management.** Petts, G.E. John Wiley & Sons, 1984. 326 pp.

**Indigenous agricultural revolution; ecology and food production in West Africa.** Richards, P. Hutchinson, London, 1985. 192 pp.

**Nutrient cycling in tropical forest ecosystems; principles and their application in management and conservation.** Jordan, C. F. John Wiley & Sons, 1985. 190 pp.

**Preservation of timber in the tropics.** Findlay, W.P. K. ; ed. Martinus Nijhoff/Dr. W. Junk Publishers, 1985. 273 pp. Discussion of the natural durability of the commercially available species in the tropics, hazards they face and means for protection.

**Tools for agriculture; a buyers guide to appropriate equipment.** Intermediate Technology, London, 1985. 264 pp.

**The state of the world's parks.** Machlis, G.E. ; Tichnell, D.L. Westview Press, 1985. 131 pp.

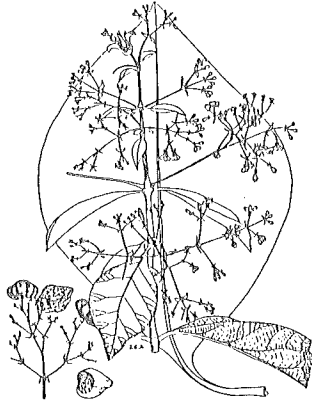
### ARTICLES AND PAPERS

**Confronting industrial pollution in rapidly industrialising countries--myths, pitfalls, and opportunities.** By H. J. Leonard. Ecology Law Quarterly, v. 12, 1985, pp. 779-816.

**Delivery systems for rural development in India: a field view of institutional linkages.** By A. Ray. Public Administration and Development, v. 5, 1985, pp. 353-362. Studies block-level rural development administration and discusses problems of integration and coordination.

**An ecosystem approach to soil conservation.** By H. Hurni. In *Soil erosion and conservation*, Edited by S.A. El-Swaify, and others, Soil Conservation Society of America, 1985, pp. Presents a geo-ecosystem approach to detecting bottlenecks in soil conservation programs.

**Effective conservation farming systems for the humid tropics.** By R. Lal. Soil Erosion and Conservation in the Tropics, American Society for Agronomy, Special Publication 43, 1982, pp. 57-76. Example of mechanized land clearing for agriculture followed by no-tillage system that reduced runoff and erosion.



*Tectona grandis* L.

**Environmental influences on the development of traditional conservation in the South Pacific Region.** By M. D. Chapman. *Environmental Conservation*, v. 12, 1985, pp. 217-230. Examines some assumptions about traditional conservation practices.

**Evaluation of agroforestry potential in sloping areas.** By A. Young. In *Land evaluation for land use planning and conservation in sloping areas*, International Institute for Land Reclamation and Irrigation, Publication 40, Wageningen, The Netherlands, 1986, pp. 106-132. Describes eight examples of agroforestry systems in sloping areas.

**Fragile lands: a theme paper on problems, issues, and approaches for development of humid tropical lowlands and steep slopes in the Latin American Region.** By J. Bremer, and others. *Development Alternatives, Inc.*, 1984, 98 pp.

**Guanaste National Park: tropical ecological and cultural restoration.** By D. H. Janzen. *Project Report*, March 1986, 39 pp. Discusses the plan for an \$11.8 million project based on restoration ecology of 700 sq. km of dry forest in northwestern Costa Rica.

**Heavy industry in a rural tropical ecosystem.** By C. Christiansson. *Ambio*, v. 14, 1985, pp. 122-134.

**People's participation in watershed management: a case study of DVC.** By N. K. Jaiswal, and others. *Journal of Rural Development*, v. 4, 1985, pp. 409-440.

**A soil suitability guide for different tillage systems in the tropics.** By R. Lal. *Soil and*

*Tillage Research*, v.5, 1985, pp. 179-196. Simple rating method to indicate soil conditions where no-till agriculture can succeed and where mechanical tillage is absolutely necessary.

**Rainfall erosion in the tropics: a state of the art.** By S. A. El-Swaify and E. W. Douglas. *Soil Erosion and Conservation in the Tropics*, American Society for Agronomy, Special Publication 43, 1982, pp. 1-25. Assesses the sketchy, quantitative evidence on tropical erosion. Stresses importance of collecting data for erosion prediction and control.

#### TECHNICAL REPORTS: FAO

**Case study of irrigated *Eucalyptus microtheca* plantations in Gezira province, Sudan.** FAO. 1985. 56 pp.

**Coastal aquaculture project for shrimp and finfish in Ban Merbok, Kedah, Malaysia.** FAO. 1984. 35 pp.

**Commission on plant genetic resources.** Sess. 1. Rome (Italy) 11 March 1985. In situ conservation of wild plant genetic resources: a status review and action plan (draft) FAO; IUCN. 1984. 91 pp.

**Committee on forest development in the tropics.** Sess. 7. Rome (Italy) 18 Jun 1985. Action programme on the conservation of tropical forest ecosystems. FAO. 1985. 28 pp. 85W02675 FAO FICHE

**Community forest management at village level: a case study in Badikhe, Panchayat, Lalitpur district, Nepal.** FAO. 1985. 28 pp. 85X02557 FAO FICHE

**Conservation and management of wildlife in Saudia Arabia.** FAO. 1985. 2 pp. 85X02228 FAO FICHE

**Demand and supply of charcoal in urban and rural areas in Thailand.** FAO. 1983. 33 pp. 85X01795 FAO FICHE

**Design of a forest hydrology research programme in Indonesia.** FAO. 1983. 57 pp. 85X01768 FAO FICHE

**Eastern African sub-committee for soil correlation and land evaluation.** Meeting. 5. Wad Medani (Sudan). 5 Dec 1983 (proceedings) FAO. 1985. 210 pp. 85M02805 FAO FICHE

**ECDC seminar on tropical horticulture products.** Nairobi (Kenya). 14 Jan 1985. Report of the ECDC (Economic Cooperation among Developing Countries) Seminar on Tropical Horticulture Products. FAO; ECDC. 1985. 30 pp. 85M02732 FAO FICHE

**Essences forestieres pour le reboisement en Haiti.** FAO. 1983. 56 pp. 85X01844 FAO FICHE

**Evaluation of Gujarat social forestry programme: village social science survey report.** FAO. 1984. 150 pp. 85X02203 FAO FICHE

**Forest management (Eucalypts, India). Report of second mission to the project - May 1984.** FAO. 1984. 61 pp. 85X01849 FAO FICHE

**Forest resource management report-Bhutan.** FAO. 1985. 203 pp. 85W01803 FAO FICHE

**Fuel wood consumption and supply in semi-arid areas, Tanzania.** FAO. 1984. 44 pp. 85W02307 FAO FICHE

**Government inter-agency cooperation with specific reference to soil conservation and watershed management.** FAO. 1984. 13 pp. 85X02757 FAO FICHE

**Initial estimation of fuel wood and fodder yields for management and community forestry in Kaski district, Nepal.** FAO. 1985. 30 pp. 85X02539 FAO FICHE

**Management options for natural forests in the hills of Nepal.** FAO. 1985. 28 pp. 85X02091 FAO FICHE

**Mangrove management in Thailand, Malaysia, and Indonesia.** FAO. 1985. 62 pp. 85M02315 FAO FICHE

**Principios e metodos silvicultura is tropicais, Brasil.** FAO. 1984. 208 pp. 85X01853 FAO FICHE

**A report evaluating the impact of using agricultural residues for fuel as a substitute to insufficient fuel wood supplies.** FAO. 1983. 154 pp. 85X02444 FAO FICHE

**Report on the study tour and practical training at the Pine Improvement Centre and Teak Improvement Centre, Thailand.** FAO. 1983. 47 pp. 85X01862 FAO FICHE

**Seminario sobre recursos alimenticios para pequenos productores en regiones tropicales de America Latina.** Turrialba (Costa Rica) 10 Dec 1984. Informe. FAO. 1985. 43 pp. 85M02809 FAO FICHE

**Systematic index of international water resources treaties, declarations, acts and cases, by basin.** FAO. 1984. 332 pp. 85M01915FAO FICHE

**Wildlife sanctuaries of Bangladesh and some recommendations.** FAO; RAPA. 1985. 5 pp. 85S90101 FAO FICHE

**Workshop on information handling systems for gene bank management.** Alnarp (Sweden). 21 Nov 1984. Information handling systems for gene bank management. Proceedings. FAO. 1985. 91 pp. 85W02829 FAO FICHE

**Workshop on remote sensing applied to land use potential.** Cairo (Egypt). FAO. 1984. 23 pp. 85X02328 FAO FICHE

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**An interpretation of discussion at a workshop on the human factors affecting forestry/fuelwood projects: an agenda for research and development.** 11, 12, 13 February, 1984, Washington, D.C. Working Paper No. 1, William R. Burch, Jr. Tropical Resources Institute, 1985, 98 pp.

**Thinning guidelines for teak (*Tectona grandis* L.)** Working Paper No. 2. Bruce C. Larson and Mohammed Nuruz Zaman. Tropical Resources Institute, 1985, 20 pp.

**Avifaunal reflections of historical landscape ecology in Puerto Rico.** Working Paper No. 3. Alexander Brash. Tropical Resources Institute, 1985, 34 pp.

**Composition and structure of a subtropical moist secondary forest in the limestone region of central Puerto Rico.** Working Paper No. 4. J. Stephen Lowe and P. M. S. Ashton. Tropical Resources Institute, 1985, 27 pp.

**Computer geographic information systems to manage biogeographic data for the design of habitat reserves: a study for the Puerto Rico Conservation Data Center.** Working Paper No. 5. Edward H. Backus. Tropical Resources Institute, 1985, 78 pp.



*Eucalyptus robusta* J.E. Smith

**The demand for non-wood softwood products in Puerto Rico.** Working Paper No. 6. Haydi Boething. Tropical Resources Institute, 1985, 32 pp.

**Descending from the upper reaches: a chemical analysis of a rain forest stream.** Working Paper No. 7. Jane Ceraso. Tropical Resources Institute, 1985, 23 pp.

**Diaz sin escarcha: Yale's Tropical Resources Institute in Puerto Rico.** Working Paper No. 8. Jane Ceraso and Cathy McConnell. Tropical Resources Institute, 1985, 50 pp.

**Interpreter's handbook for hacienda la esperanza.** Working Paper No. 9. David Gagnon. Tropical Resources Institute, 1985, 90 pp.

**Land use changes in rural Puerto Rico and attitudes toward reforestation.** Working Paper No. 10. Robert E. Clausi. Tropical Resources Institute, 1985, 55 pp.

**Orchids, coquis, and scorpions: natural history collections and environmental education in Puerto Rico.** Working Paper No. 11. Peggy Rasmussen. Tropical Resources Institute, 1985, 89 pp.

**Population characteristics of the Hawksbill Turtle (*Eretmochelys imbricata*): a case study of the endangered species act.** Working Paper No. 12. M.H. Olson. Tropical Resources Institute, 1985, 10 pp.

**Selecting sites for reforestation in Puerto**

**Rico.** Working Paper No. 13. J.B. Friday. Tropical Resources Institute, 1985, 47 pp.

**Site index curves for teak (*Tectona grandis* L.) in the limestone hill region of Puerto Rico.** Working Paper No. 14. Kathleen Stearns Friday. Tropical Resources Institute, 1985, 48 pp.

**The underground feral goats of Mona Island.** Working Paper No. 15. Jennifer Haaser. Tropical Resources Institute, 1985, 32 pp.

**Forester's field guide to the trees and shrubs of Puerto Rico.** P. Mark S. Ashton. Tropical Resources Institute, 1985, 136 pp.

**A curriculum guide for a course on gender roles in the community approach to forestry.** Working Paper No. 16. Nancy Sheehan. Tropical Resources Institute, 1986, 82 pp.

**Approaches toward biosphere reserve assessment: case studies in the Caribbean.** Working Paper No. 17. Betsy A. McGean. Tropical Resources Institute, 1986, 84 pp.

**Appendices for report on approaches toward biosphere reserve assessment: case studies in the Caribbean.** Working Paper No. 17a. Betsy A. McGean. Tropical Resources Institute, 1986, 73 pp.

**DNA content polymorphism and tissue culture regeneration in caribbean pine.** Working Paper No. 18. G. P. Berlyn, A. O. Anorou, R. C. Beck and J. Cheng. Tropical Resources Institute, 1986, 50 pp.

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## Acknowledgements

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