

This guide is divided into six major areas: 1) general stage setting for situations in the region, past and present, 2) overall nursery establishment and planning, 3) seed management, 4) small-scale (traditional) operations, 5) general management considerations, and 6) large-scale operations. Where subject overlap occurs within major sections, it is so indicated within parentheses.

The guide is technical because it is assumed that the readers are individual nursery managers or administrators who already have a graduate degree in forestry, agriculture, agronomy, crop science, or a related discipline and have practical nursery experience, at least in their own countries.

Keyword: Guideline, Nursery, Seed, Silvicultural technique, Nursery operation

2-4 Plantation Establishment

- site preparation, planting, coppice, direct seeding, mycorrhiza, enrichment planting, soil, etc.-

MARGARIDA DE MENDONCA BELLEI et al.

Mycorrhizal succession in young *Eucalyptus viminalis* plantations in Santa Catarina, Southern Brazil

Forest Ecology and Management, Elsevier, Netherlands

Vol. 54 (1-4), 205-213, 1992, English

A survey of mycorrhizae - vesicular-arbuscular endomycorrhizae (VAM) and ectomycorrhizae (ECM) - was carried out in roots and soil samples collected in young (2- to 15-month-old) *Eucalyptus viminalis* plantations in two forestry regions in the Santa Catarina State, southern Brazil. Percentages of root colonization and spore counts in soils were assessed in May, August and November or January. The overall trend of mycorrhizal colonization showed an early decline for VAM and a later increase for ECM as the plants aged. Vesicular-arbuscular endomycorrhizae colonization was consistently predominant in young stands (up to 7-8 months old), while ECM were predominant as the stands aged. Both types co-existed in all stands, regardless of the region and sampling period. Regional differences were found in the intensity of VAM colonization, but not in ECM colonization. Numbers of spores in soil were not, in most cases, correlated with stand age or VAM colonization. A trend towards a decrease in spore numbers in November and January was detected in both regions. The role of some ecological factors in the dynamics of the dual mycorrhizal system is discussed.

Keyword: Eucalypt, Mycorrhiza, Ecology, Plantation

A.P. ALUKO

Soil properties and nutrient distribution in *Terminalia superba* stands of different age series grown in two soil types of southwestern Nigeria

Forest Ecology and Management, Elsevier, Netherlands

Vol. 58 (1-2), 153-161, 1993, English

Soil properties and nutrient distribution under *Terminalia superba* Engl. and Diels (Afara) stands of 11, 13 and 15 years of age and the adjacent natural vegetation at two sites in Onigambari and Sapoba in southwestern Nigeria were compared.

The two sites differed in climate, parent materials and soil properties. At Onigambari, the organic matter, total N, available P and Cu were higher in the natural vegetation than in the plantations. The decreases observed in the nutrient levels in the plantations may be due to nutrient immobilisation in the growing *Terminalia superba* trees. Soil changes and foliar nutrient contents in relation to plantation age series are also discussed.

Keyword: Soil, Soil texture, Soil nutrient, Natural forest, Plantation

P.J. SMETHURST, N.B. COMERFORD & D.G. NEARY

Predicting the effects of weeds on K and P uptake by young slash pine on a Spodosol

Forest Ecology and Management, Elsevier, Netherlands
Vol. 60 (1-2), 27-39, 1993, English

Observed uptake of K and P from a Spodosol by slash pine (*Pinus elliottii* Engelm. var. *elliottii*) grown alone or in competition with weeds (mainly species of *Panicum*, *Dichanthelium* and herbaceous dicotyledons) was compared with uptake predicted by a model based on solute transport theory. Two 35 day periods were simulated during which there was significant observed uptake by pine in weed-free areas (mmol K and mmol P), but little or no uptake by pine in weed areas. Regressions of predicted versus observed uptake of either K or P by pine were not significantly different from a 1:1 line. Hence, the model quantitatively predicted the effect of weeds on uptake of these nutrients by pine. However, uptake of both nutrients by weeds was over predicted by 300-400%, which resulted in the under-prediction of soil solution concentrations in some cases. These results verify the model for predicting uptake of K and P by slash pine (but not for weeds) under these conditions. In weed-free areas, model results suggested that soil solution concentrations were lowest in the 10-26 cm depth directly under the stem, and that most uptake was from the 10-50cm depth of soil within a 30 cm radius of the stem. Model results are presented that illustrate the potential utility of this approach to studying nutrient uptake by young plantations

Keyword: Pine, Soil, Weeding, Site condition, Plantation

P.J. SMETHURST, N.B. COMERFORD & D.G. NEARY

Weed effects on early K and P nutrition and growth of slash pine on a Spodosol

Forest Ecology and Management, Elsevier, Netherlands
Vol. 60 (1-2), 15-26, 1993, English

Slash pine (*Pinus elliottii* Engelm. var. *elliottii*) seedlings were grown on a Spodosol with and without total weed control. During the 187 days after planting, shoots and roots of both trees and weeds were sampled four times to determine (1) the effects of weeds on early K and P nutrition and growth of slash pine, (2) the correlation between either above-ground weed biomass or live coverage and the root-length density of weeds, and (3) provide a data set to test a nutrient uptake model. During the initial 187 days, trees in the weed treatment lost half their initial K content, yet biomass and P content remained unchanged. Concentrations of K in needles from this treatment concurrently decreased from 7.7 to 2.5 mg Kg⁻¹. Even trees in the weed-free treatment lost K for the first 116 days before taking up significant amounts of K and P and increasing four-fold in biomass by Day 187. Tree root growth rates were also reduced in the presence of weeds. Grass root-length density was poorly correlated with above-ground biomass or live coverage (r^2 values 0.37 and 0.47, respectively). Hence, above-ground attributes of weeds were considered poor surrogates for root-length density.

Keyword: Pine, Seedling, Brush cutting, Growth, Soil fertility, Biomass, Root system

P.M. HOLMES & R.M. COWLING

Effects of shade on seedling growth, morphology and leaf photosynthesis in six subtropical thicket species from the eastern Cape South Africa

Forest Ecology and Management, Elsevier, Netherlands
Vol. 61 (3-4), 199-220, 1993, English

We investigated the plasticity of seedlings to shade in six shrub species common in subtropical thicket, in order to assess their microhabitat preferences for regeneration. *Cassine peragua* and *Sideroxylon inerme*, which also occur in adjacent forests, were the most shade tolerant and would be unlikely to require canopy gaps for recruitment; their relative reduction in growth in dense shade was slight, as was their increase in leaf weight ratio (LWR); leaf inclination was adjusted to near horizontal in dense shade and maximum net photosynthetic rate (A_{max}) remained fairly low in sun-acclimated plants. *Rhus glauca*, which also occurs on forest margins, demonstrated the highest growth rates, especially in the open, and together with its high potential A_{max} is well-equipped as a pioneer, and would benefit from canopy gaps for establishment. *Cassine aethiopica*, which is also common in coastal forests, was slower growing than *Rhus*, but less shade tolerant than *C. peragua* and *Sideroxylon* and would probably benefit from canopy gaps for establishment. *Pappea capensis* and *Schotia afra*, which also occur in open savanna vegetation, demonstrated a growth and morphological pattern indicative of

species adapted to periodic drought, in having a high ratio of woody conductive tissue to leaf tissue with accompanying slow growth. Their relatively poor performance in deep shade suggests that canopy gaps would benefit their recruitment. We concluded that canopy gaps may be essential for recruitment of the full species complement in sub-tropical thickets.

Keyword: Seedling, Natural forest, Shrub, Under planting, Light intensity

J.O. ADEJUWON & O. EKANADE

Soil changes consequent upon the replacement of tropical rain forest by plantations of *Gmelina arborea*, *Tectona grandis* and *Terminalia superba*
Journal of World Forest Resource Management, UK, Vol. 3 (1)
47-59, 1988, English

This study investigates the changes in soil properties fifteen year after tropical rainforest was replaced with plantations of *Gmelina arborea*, *tectona grandis* and *Terminalia superba* in the Ikere Forest Reserve of Ondo State, Nigeria. Most soil properties in the plantations are not significantly different from those in the rainforest, despite significant differences in vegetation characteristics. The plantations have a high tree density and/or ground cover and are deemed capable of protecting the soil in similar way to the rainforest. It is concluded that the replacement of tropical rainforest by plantations does not have a serious impact on most soil properties.

Keyword: Man-made forest, Natural forest, Vegetation, Soil texture

OLUSEGUN EKANADE

The nature of soil properties under mature forest and plantations of fruiting and exotic trees in the tropical rain forest fringes of SW Nigeria
Journal of World Forest Resource Management, UK
Vol. 5 (2), 101-114, 1991, English

Soil samples were collected from under forest, fruit trees (*Anacardium occidentale* and *Psidium guajava*) and exotic timber trees (*Gmelina arborea* and *Tectona grandis*) in the forest fringes of southwestern Nigeria, and analysed for certain physical, chemical and nutrient properties. Results indicate that most soil properties are significantly degraded under the fruit trees, and some under the exotic trees when compared with those under the forest. The possible reasons for these results are discussed and soil management and land use planning strategies for the plantations are suggested.

Keyword: Soil, Soil texture, Land-use

JOHN J. EWEL

Litter fall and leaf decomposition in a tropical forest succession in eastern Guatemala
Journal Ecology, 64, 293-308, 1976, English

One of the most important functions of a fallow period is the accumulation of mineral nutrients and organic matter by native second-growth vegetation. The litter on the soil surface acts as an input-output system, receiving inputs from the vegetation and, in turn, decomposing and thereby supplying materials to the soil and roots. Litter accumulates on the soil until litter fall equals litter decomposition, after which the amount of litter accumulated on the soil surface oscillates around some mean steady-state value. The dynamics of this accumulation process are of particular interest in the lowland humid tropics, where rates of litter production and decomposition are high.

This study was designed to investigate litter in successional tropical vegetation, with special emphasis placed on determining the effects of age of vegetation, species and soil type on leaf decomposition. The study was carried out in the humid lowlands of eastern Guatemala, where shifting cultivation is the primary means of subsistence for a rapidly growing population of Kekchi Amerindians, who are migrating into the area from the overpopulated highlands.

Keyword: Fallow, Soil nutrient, Litter, Decomposition

CARL F. JORDAN & RAFAEL HERREBA

Tropical rainforests: are nutrients really critical?

The American Naturalist, Vol. 117, 167-180, 1981, English

Nutrient poor forests are more common in the tropics than in the temperate regions, but most of the work on nutrient cycling in the tropics has been carried out on nutrient rich sites such as those in Puerto Rico and Costa Rica rather than nutrient poor sites such as those in central and eastern Amazonia. Consequently, there has been confusion as to whether nutrients are critical in tropical forests. Productivity and nutrient cycling in nutrient rich and nutrient poor forest ecosystems do not differ greatly as long as the ecosystems are undisturbed. However, when the forests are cleared for agricultural purposes, the nutrient poor systems quickly lose their productive potential, whereas the nutrient rich systems do not. The nutrient poor ecosystem is able to maintain its productivity under undisturbed conditions through a variety of nutrient conserving mechanisms, the most important of which are associated with the humus and root layer on top of the mineral soil. These mechanisms are destroyed when the nutrient poor forest is cleared for agricultural purposes.

Keyword: Ecosystem, Soil, Soil nutrient, Tropical forest

ELADIO CHAVES & WILLIAM FONSECA

Teca *Tectona grandis* L.f. especie de arbol de uso multiple en America Central

Serie Técnica Informe Técnico No. 179, CATIE-ROCAP (596-0117), Costa Rica, 47, 1991, Spanish

MADELENA, a project for planting multi-purpose tree species, has provided technical handbooks on such species to farmers, technicians, local officials in charge of agriculture and forestry, and students since 1986.

These handbooks introduce silvicultural techniques for selected species with the intention of improving local living conditions and preventing the natural environment from deteriorating.

This book summarizes accumulated knowledge and data on the planting of *Tectona grandis* L.f. in Central America. This species is one of those planted in low marshy areas in Central America in order to produce firewood, stakes and building materials used in rural areas. It is planted because of its relatively fast growth, suitability for windbreaks and hedges, and good quality.

Keyword: Multipurpose trees, Silvicultural technique, Teak

CARLOS REICHE, DEAN CURRENT et al.

Costos del cultivo de arboles de uso multiple en America Central

Sevie Técnica, Informe Técnico No. 182, CATIE-ROCAP 596-0117, Costa Rica, 70, 1991, Spanish

In Central America, reliable and adequate information on labor productivity and cost is available in respect of the nursery, planting, tending and harvesting operations of multipurpose tree species (AUM).

The Center for Tropical Agricultural Research and Training (CATIE) has conducted a systematic survey of the efficiency and cost of nursery and foresting operations in several areas in Central America. The Center intends to establish an efficient and low-cost production system in compliance with the policy of establishing a project for a socioeconomic study of multipurpose tree species. The survey covered Guatemala, El Salvador, Honduras and Costa Rica.

This is a final report of the three-year survey, containing 1) Nursery operations, 2) Manual and mechanical land preparation under various conditions, 3) Planting, 4) Tending, 5) Liberation-cutting and thinning, and 6) Utilization.

Keyword: Multipurpose trees, Nursery operation, Silvicultural technique, Wood utilization

JICA PROYECTO

Seccion de plantaciones forstales

MAG-SFN-JICA, Proyecto Capiibary, Paraguay, 31, 1991, English

This publication is a textbook compiled for training conducted by Paraguay/JICA Project, Capiibary, Paraguay.

The training aimed to disseminate silvicultural technique developed by the Project.

The topics discussed here are concept of afforestation and reforestation, goals of affo/reforestation, programming forestation plan, etc.

Keyword: Afforestation, Silvicultural technique, Guideline

JICA PROJECT

Manual metodos silviculturales

No. 002, Proyecto Capiibary, Paraguay, 76, 1987, Spanish

This publication is a silvicultural manual. It is compiled for staff of the Paraguay/JICA Project, Capiibary.

The topics discussed here are site preparation, spacing, planting methods, seedling transport, tending, pruning, thinning and agroforestry.

Keyword: Afforestation, Silvicultural technique, Agro-forestry

JOSÉ PALOMINO YAMAMOTO, MARCIANO BARRA CASTRO et al.

ensayo de plantacion de especies tropicales nativas con diferentes tipos de planton en la selva central del Peru

INIAA gtz, Documento No. 70, San Ramón, Peru, 44, 1991, Spanish

The results of trials during from 12 to 18 months are introduced, with different types of seedlings for nine native species in the Oxapampa region, in the Jungle of Central Peru.

In each trial, the survival rate was evaluated under different environmental conditions.

The results are as follows:

- Walnut tree direct sowing at the site is the most recommended method (98%), but there is a need to protect the seeds against possible predators, especially in areas where squirrels abound.
- Bare-rooted seedlings are the most adequate for "ulcumano", which benefits from the shelter cover (94%).
- Wild "anona" showed a better survival rate with the cuttings (100%) in open field.
- Yellow oak survives adequate (62% - 100%) with three types of seedlings under high and low "purma" canopy, white oak survives with "pan de tierra" (96%) under high "purma" canopy; huariño oak does not attain the minimum survival rate of 75%, no matter the site or type of seedling; wild cabbage attains a rate slightly above 75% with the three types of seedlings under high "purma" canopy; "palo leche" seems to be very flexible: survives adequately (75% or more) under all trial field conditions with bare-rooted seedlings and "pan de tierra"; "huampo" has a 79% survival rate under low "purma" canopy, using cuttings.

Keyword: Planting, Indigenous species, Mortality, Bare root seedling, Cutting, Direct seedling

JOSÉ PALOMINO YAMAMOTO, MARCIANO BARRA CASTRO

Ensayos silviculturales con especies y procedencias nativas en la selva central del Peru

INIAA gtz, Documento No.69, San Ramón, Peru, 58, 1991, Spanish

This document is the result of the processing and analysis of the latest assessments carried out by the INIAA's San Ramón Forest Research Station between 1988 and 1989.

A total of 17 species trial, native to the central jungle were tested in the Villa Rica and Oxapampa, under open field plantation and "purma" canopies, and in enrichment strips. Two to five years old plots were used and the results indicate that: "ulcumano" thrives in acid soil and enrichment strips; walnut trees were vigorous in slightly acid to neutral soil and enrichment strips; wild cabbage and annatto tree (caspi) tolerates strong lightning but, they grow better under "purma" canopy in slightly acid soil; wild "anona" tends to grow better in slightly acid soil, but suffers from strong attacks of nematodes (threadworm). The remaining species commercially known as oak, have slow growth and, because of their behavior, the establishment of extensive

plantations is not recommended.

The trials were carried out on different years, so the duration vary. As a result, in some cases, it is concluded and recommended to continue with the evaluations, either to realize the forest management of the already established plantations (of more than 7 years old) or to facilitate the establishment extensive pilot plantations with the species that showed best results.

Keyword: Enrichment planting, Species trial, Soil texture, Under planting

DELWAULLE, J. GARBAYE & G. OKOMBI

Stimulation of the initial growth of *pinus caribaea* morelet in a plantation in the Congo by control of mycorrhiza

Bois et Forêts des Tropiques, France

No. 196, 25-32, 1982, Spanish

Pines can be successfully planted in intertropical Africa only through the simultaneous introduction of ectomycorrhizian fungi, which are lacking in indigenous associations. It used to be common practice in Africa to regularly inoculate nurseries with soil from existing plantations in order to maintain mycorrhization. The result were often disappointing, because most mycorrhizae were due to *Rhizopogon luteolus*, a fungus which does not easily withstand drought and high temperatures.

It was recently shown that other pure strains can help to improve the growth of saplings. This is notably the case with *Pisidithus tinctorius*.

This article sums up the results of experiments carried out on this subject in the region of Pointe Noire.

Keyword: Mycorrhiza, Nursery, Soil

M.M. SCHOENEBERGER

Endophytes of *Eucalyptus*

Proceedings of the 6th North American Conference on Mycorrhizae,

Forest Research Laboratory, USA, 444-444, 1984, English

It has been demonstrated that mycorrhizae play an integral role in tree nutrition and that *Eucalyptus* spp. form mycorrhizae.

Objectives of the study:

- 1) to determine the occurrence of endo- and ecto-mycorrhizae on *E. regnans* in forest soils,
- 2) to determine the early growth effects of endo- and ectomycorrhizae on *E. regnans*.

Objective 1 was pursued via a greenhouse bioassay using soils collected from the Central Plateau Region in New Zealand. The effect of coplants on mycorrhiza formation was also investigated in the bioassay. Objective 2 was resolved using known ecto- and endomycorrhizal symbionts of *E. regnans*.

Keyword: Mycorrhiza, Mycorrhizal fungi, Eucalypt, Growth acceleration, Growth promotion

PH. MIALHE & J. PIOT

Upper volta: Trials preparation and plantation of bare rooted *camaldulensis*

Bois et Forêts des Tropiques, France

No. 188, 32-45, 1979, Spanish

Trial bare-rooted plantation reveals that the favourable period is shorter than for potted plantation. The stumps must be more than 2 mm in diameter, and it is desirable to prune the roots. The article concludes with a recapitulation of all the practical rules to be followed for the bare-rooted planting and production of *E. camaldulensis*.

Keyword: Eucalypt, Tree species, Bare root seedling, Nursery operation

SAKIBUN BIN MOHD. HUSIN & MOHD. SHARIF BIN KUDIN

Plantation techniques of *Hevea brasiliensis* in Malaysia

**Tropical Forest, Proceedings International Forestry Seminar,
Penerbit Universiti Pertanian Malaysia, 267-281, 1980, English**

This paper summarizes the essential operations in rubber planting with emphasis on those involved in opening up new land. It focuses on the proven current techniques of planting rubber as recommended by the Rubber Research Institute of Malaysia and other organisations. It also compares some specific operations adopted between the conventional and the new planting techniques. Where possible cost data is also presented.

Keyword: Non-timber products, Silvicultural technique, Cost analysis

NICHOLAS MALAJCZUK, NORMAL JONES & CONSTANCE NEELY

The importance of mycorrhiza to forest trees

Land Resources Series, the World Bank, USA, No. 2, 10, English

The aim of the report is to examine the important and intricate relationship which higher plants (such as trees and shrubs with their easily identifiable stems, branches, leaves, flowers and fruits) have with soil microorganisms (minute living organisms usually invisible to the naked eye which do not have the advanced forms of plants and animals placed in other kingdoms of living things). In particular, the paper will deal with the relationship between plant roots and mycorrhizal fungi.

Keyword: Root system, Mycorrhizal fungi, Microorganism

DIANE L. HAASE, JAMES H. BATDOFF & ROBIN ROSE

Effect of root form on 10-year survival and growth of planted

Douglas-fir trees

Tree plant's notes: U.S. Forest Service, Washington, D.C., USA

V. 44 No. 2, 53-62, 1993, English

Douglas-fir seedling were planted with three root-form treatments including C-roots, L-roots and J-roots. After 10 years, there were no significant difference in outplanting performance between the three root-form treatments on a good site in Western Oregon. The results are in agreement with those of other studies, which suggests that when no other confounding planting errors are present, deformed root systems play a less dramatic role in subsequent field performance than is generally thought. These results in no way imply that poor planting is acceptable.

Keyword: Root system, Planting, Seedling, Growth, Mortality

B.A. OLA-ADAMS

Effects of spacing on biomass distribution and nutrient content of *tectona grandis*

Linn. f. (teak) and *terminalia superba* Engl. & Diels. (afara) in south

- Western Nigeria

Forest Ecology and Management, Elsevier, Netherlands

Vol. 58 (3-4), 299-319, 1993, English

The effects of four different spacings (teak stand: 1.37m × 1.37m, 1.98m × 1.98m, 2.9m × 2.9m and 3.96m × 3.96m; afara stand: 1.8m × 1.8m, 2.8m × 2.8m, 4.3m × 4.2m and 6.1m × 6.1m) on biomass and nutrient distribution in *Tectona grandis* and *Terminalia superba* have been studied at the Gamhari Forest Reserve, south-western Nigeria.

Biomass estimates (10^3kg ha^{-1}) were 317.26, 293.14, 382.23 and 225.57 for square spacings for 1.37m, 1.98m, 2.9m and 3.96m respectively in *Tectona grandis* and 149.78, 127.33, 90.77 and 86.16 for square spacings of 1.8m, 2.8m, 4.2m and 6.1m, respectively, in *Terminalia superba*.

In *Tectona grandis* the initial growing space did not significantly affect the total stand dry weight. However, there were significant differences between spacings in dry weights of small branches and big roots. Total biomass in *Terminalia superba* decreased with increasing spacing. With the exception of the stemwood dry weight, the other tree components showed no significant differences between spacings.

Tectona grandis showed no consistent pattern of total nutrient with spacing. In *Terminalia superba* the

total content of phosphorus, potassium and magnesium decreased with increasing spacing.

Keyword: Biomass, Teak, Growth, Soil nutrient, Planting distance

WALTER H. SCHIACHT et al.

**Aboveground biomass accumulation in coppicing woodland,
northeast Brazil**

Forest Ecology and Management, Elsevier, Netherlands

Vol. 55 (1-4), 201-208, 1992, English

Most tree species in the caatinga of northeastern Brazil coppice readily after clearing. Five stand ages, ranging from 1 to 40 years post-clearing, were compared to determine biomass production and details of recovery in regenerating caatinga woodland. Complete removal of the tree canopy resulted in a seven-fold increase in first year production of herbaceous vegetation. By the second year, woody plant leaf biomass was comparable to that of the 40-year-old stand. The rapid initial growth of coppicing trees is associated with current annual increment of woody biomass apparently culminating by the 50% of that estimated for the 40-year-old caatinga. Caatinga recovery appears to involve a trend in species important in the understory from annuals to perennials and in the overstory from trees of coppice origin to those originating from seed.

Keyword: Felling, Natural forest, Natural regeneration, Biomass

2-5 Tree Breeding

MILTON KANASHIRO

Melhoramento genético de freijó (*Cordia goeldiana* Huber)

CPATU Documentos, 15, EMBRAPA-CPATU, Belém, Brazil

11, 1982, Portuguese

This is the program for the genetic improvement of Freijó (*Cordia goeldiana* Huber) developed by the National Program of Forestal Research (IBDF/EMBRAPA). The characteristic of the species are discussed - selective exploitation, low population density, frequent years of low production - that make difficult to obtain seeds. Considerations regarding the program in execution are taken, while treating the test of lineage (already installed), the progeny test (to be installed) and the vegetative propagation through grafting and cutting ("estaquia"). The realization of progeny tests is considered to great importance, due to the contrasting results, mainly as for shape of the origins Tomé-Açu and National Forest of Tapajós, planted in beiterra, PA.

Keyword: Tree species, Breeding, Vegetative propagation, Provenance test, Progeny test

JOHN B. RAIN TREE & DAVID A. TAYLOR (editors)

**Research on farmers' objectives for tree breeding, report of a workshop
following a regional study in Asia**

Winrock International Institute for agricultural Development

132, 1992

In 1989, scientists in the Multipurpose Tree Species Research Network undertook two regional socioeconomic studies: one on farm and village forest- and land-use practices, and a second on farmers' tree-breeding objectives. The former, involving 13 researchers and 26 communities in 6 Asian countries, was designed to provide a basis for understanding patterns of land- and tree-use and trends across national and cultural boundaries (see Mehl 1991). The second study, involving 14 researchers and 31 communities in 7 countries, built upon the first for the more specific aim of describing tree species and characteristics preferred by farmers.

This is the report of a working meeting held in Kandy, Sri Lanka, in September 1991, at which the researchers who took part in the latter study informally reviewed their substantive findings and methodological

experience.

The report is intended for two main audiences. The information on farmers' chosen species and characteristics is intended to help tree breeders and other foresters to understand the demand of farmers as a client group. While some of the preferences and ideotypes expressed by the farmers in the study cannot be addressed through breeding programs alone, they can inform foresters as to which varieties and management practices are most likely to be adopted by farmers in these areas.

Keyword: Multipurpose trees, Social and economic analysis, Evaluation, Rural community

ERIC LANDIS, NORMAN JONES & JAMES SMYLE
Commercial applications of cloning for forest plantations
Land Resources Series, The World Bank Asia Technical Department
Agriculture Division, USA, No. 5, 15, 1992, English

When the subject matter for this Technical Note was first evaluated by the World Forestry Institute it was found that a vast amount of literature relates to research into various aspects of vegetative propagation by very little to the commercial application of results. It was decided then that this paper should attempt to focus tree planters on the value of this technology in order that it be more widely used. There is strong evidence that introduction of these now simple and proven practices can, in most cases significantly increase productivity. Of course, there are certain safeguards which must be understood and implemented and also acceptance that a change from raising traditional planting stock to clonal material requires investment in facilities and training and a lead-in period.

Keyword: Vegetative propagation, Seedling

ROBERT A. WHEELER
Guide to management of Leucaena seed Orchards
Winrock International/Kasetsart University, Thailand
18, 1991, English

The Leucaena Seed Production (LSP) project set out to establish foundation of seed orchards in Asia. These facilities would provide aid for development and increase of selected Leucaena species and hybrids validated for high psyllid resistance/tolerance as well as for growth and form. Individual seed packets sent to the five LSP sites contained seed from selected trees in the field at the Waimanalo Research Station, Hawaii. This breeding program focuses on maintaining a broad genetic base while conducting intensive tree selection. The broad genetic base is maintained through use of composites of open pollinated seed from selected parents.

Keyword: Seed orchard, Breeding, Fast growing tree species, Genetic resources.

NANCY GLOVER & NORMA ADAMS (editors)
Tree improvement of multipurpose species
Multipurpose tree species network technical series, Winrock,
USA, Vol. 2, 112, 1990, English

The volume begins with guidance on the collection of genetic resources for species and provenance/progeny trials, as well as for conservation. William, Hughes, and Louridsen highlight the importance of collecting the greatest possible genetic diversity within a species.

A successful tree improvement program begins by defining the traits that need improving. Glover points out that since MPTs are often planted on marginal sites, emphasis should be on producing trees better suited to stress environments.

Experiments must be properly designed to obtain reliable results. Matheson reviews experimental design from randomization to nested designs.

Keyword: Guideline, Genetic resources, Multipurpose trees, Breeding, Design of experiment

2-6 Natural Regeneration

DON FABER-LANGENDOEN

**Ecological constraints on rain forest management at Bajo Calima,
Western Colombia
Forest Ecology and Management, Elsevier, Netherlands
Vol. 53 (1-4), 213-244, 1992, English**

A forest harvesting system using skyline cables was evaluated for its effect on secondary forest structure and tree species richness of lowland rain forests in the Bajo Calima Concession, western Colombia. Forests were sampled using six 0.1 ha plots in mature primary forest and sites 0.4, 4, 8 and 12 years since logging. Clear-cutting reduced overstorey (trees greater than or equal to 10 cm dbh) basal area, biomass and richness to 7%, 4%, and 17%, respectively, of primary forest levels. By the twelfth year 46% of basal area, 37% of biomass, and 38% of richness had returned. However, 63% of biomass and 50% of richness were composed of 'core pioneer' species.

Keyword: Natural forest, Natural regeneration, Biomass, Growth, Logging

J.N.M. SILVA

**The behaviour of the tropical rain forest of the Brazilian
Amazon after logging
Green College, Oxford, UK, 302, 1989, English**

A logged over Brazilian Amazon 'Terra Firme' tropical forest situated in Santarém region, State of Pará, was studied for its natural regeneration dynamics and stand development after logging.

Experimental logging was carried out in 1979, removing 75 m³ ha⁻¹ from an average of 16 trees per ha and 63 species.

Malayan Linear Regeneration Samplings carried out on three occasions, one before logging in 1975, and two others in 1981 and 1985, two and six years after logging, revealed that the stocking of commercial species was 41%, slightly over minimum required according to the Malayan standards. Opening the canopy had induced natural regeneration of desirable species. The number of stocked quadrats rose to 76% six years after logging, an increase of 85%. Stocking with potentially commercial species was always very high (over 90%) in all assessments, reaching nearly 100% six years after logging. Regeneration and growth of light demanding commercial and potential species accounted for a considerable proportion (over 30%) of the total stocking.

Stand development was monitored through 36 permanent sample plots of 0.25 ha each, established and measured two years after logging, and remeasured four times since then.

Keyword: Tropical forest, Natural regeneration, Selective cutting, Felling

JOÃO OLEGÁRIO PEREIRA DE CARVALHO

**Manajo de regeneração natural de espécies florestais
EMBRAPA-CPATU, Belém, Brasil, 22, 1984, Portuguese**

This paper deals with some important aspects to study forest management with natural regeneration like abundance, frequency, dominance, volume, diameter distribution, structural profile, sociological aspects and ecological importance of each species in the forest; growth of natural regeneration; silvicultural treatments which should be applied in natural forest; and a model of exploitation which considers the initial structure of forest, production, and spatial distribution of species. It presents also information about the research on management in natural forest which is done in the Brazilian humid tropics by the National Program of Forest Research.

Keyword: Natural regeneration, Stand condition, Forest management, Felling

J.O.P. DE CARVALHO

Structure and dynamics of a logged over Brazilian Amazonian rain forest

Oxford, England, U.K., 215, 1992, English

The phytosociology and dynamics of a *terra firme* dense forest of Brazilian Amazonia were studied over an eight-year period. The study area covered 180 ha, of which 144 ha were logged at two intensities (T1 - logging of trees ≥ 45 cm dbh, T2 - logging of trees ≥ 55 cm dbh) and 36 ha were left unlogged. Four measurements were done in the exploited forest: one year before logging, then one, five and seven years after logging. The undisturbed forest was measured three times over the study period. Changes in floristic composition, species diversity, spatial distribution of trees, forest structure, growth rate, in growth and mortality were analyzed over the period in both logged and undisturbed areas.

Overall changes in the forest structure, floristic composition and natural regeneration were not significantly different between the treatments nor between logged and unlogged forests during the eight years. It appears that the logged area will rapidly recover its initial composition without intervention. There were a higher number of species in the more intensely logged plots than in the lighter logged forest during the post-logging period. The number of light-demanding species increased in high canopy opening. Only by the end of the study period were growth rates significantly different between logging intensities. A slightly higher increment occurred in the higher exploitation level. Growth rate was higher for light-demanding species in the logged forest, with a greater increment in the heavier logging intensity.

Keyword: Natural forest, Felling, Stand composition, Growth rate, Succession

N.R. DE GRAAF & R.L.H. POELS

Investigation into the feasibility of selective forest and related natural forest management systems for permanent use of tropical rainforest in the Amazon region and the Guyanas
Project proposal, Brazil, 6, 1991, English

In Suriname, it was investigated whether the natural forest in itself could be made economically valuable in a sustained way. To this end the CELOS Silvicultural System (CSS) was developed by many years of empirical research. In this system a permanently productive forest is developed by light and careful exploitation of the original forest, repeated every 20-25 years, and by treatments by which trees of commercial species are favoured.

It is expected that such a managed forest can compete economically with other land uses on many poor tropical soils. Such a land use system could then be an important weapon in the fight against deforestation. This 'natural' production forest would, for instance, be very well suited to form a buffer between the cleared areas and fully protected nature reserves. Illegal occupation can be stopped better by a forest area that is clearly in use and managed in a sustained way than by an unoccupied natural forest, by many still regarded as waste land, free for everybody to take. The CSS may be applicable also in the moist (*terra firme*) forests of the Amazon Basin and the other Guyanas. The ecological and socio-economic conditions for successful application of the CSS and strongly related systems should be defined more explicitly and for more combinations of climate, soil and forest type.

Goal of the proposed research is to investigate the ecological basis of selective management systems for natural forest, like CSS and to determine the applicability of such systems for different ecological areas, especially for those areas where the decline in forest area is strongest and the need for alternative land uses greatest. Final goal is to improve land use planning.

Keyword: Natural forest, Selective cutting, Cutting cycle, Forest operation

FRANCIS E. PUTZ & MICHELLE PINARD

Natural forest management in the American Tropics: an annotated bibliography
USAID and USDA (Office of International Cooperation and Development
- OICD), USA, 340, 1991, English

Approaches to natural forest management include a diversity of methods for extracting timber and other

forest products while maintaining forest cover. This bibliography was compiled to facilitate application of available research findings on natural forest management, to encourage better communication among forest managers, and to stimulate further research. Although there are no clear lines of demarcation between natural forest management and other types of forestry, for the purposes of this bibliography we include enrichment planting but exclude many plantation management studies and projects. Agroforestry and social forestry are also not included unless based on management of natural forest.

Primary emphasis in this bibliography is on the American tropics, but we include citations to noteworthy studies on projects from elsewhere in the world.

Keyword: Natural forest, Enrichment planting, Forest management, Research and development

BRYAN FINEGAN

El potencial de manejo de los bosques húmedos secundarios neotropicales de las tierras bajas

**Serie Técnica Informe Técnico no. 188, CATIE, Costa Rica
29, 1992, Spanish**

The management potential of neotropical secondary lowland rain forests is reviewed in the light of the increasing land area occupied by them and the continuing destruction of primary forests. The ecological group of long-lived intolerant trees, or big pioneers, is shown to consist almost exclusively of commercial or utilizable trees which are abundant and fast-growing in secondary rain forests throughout the neotropics. The timbers are relatively light and lack natural durability but these factors do not constitute problems for utilization. The Trinidad Shelterwood System is analyzed, demonstrating the technical and economic feasibility of secondary forest management in situations in which markets accept timbers of long-lived intolerant species. It is concluded that while the biological management potential of secondary forest is general in the neotropics, favourable market conditions are not, but the growing demand for and shrinking supply of forest products should change this in the future.

A population-based model of secondary succession is used as the framework for a simple preliminary sequence of silvicultural treatments, based upon a monocyclic approach. The ecological sustainability of secondary forest management is considered to depend on the maintenance of ecosystem function which, in poor soils, may be broken down by the relatively intensive interventions of a monocyclic system. This is by no means certain, however, and research is needed. Secondary forests usually constitute habitat islands and this must be taken into account in their management, especially with respect to natural regeneration from seed. The relatively high productivity of secondary forests and their potential for management through simple operations, in combination with certain crops if desired, are considered to suit them for incorporation into small and medium farm production systems.

Keyword: Secondary forest, Forest management, Natural regeneration

PATRICIA NEGREROS-CASTILLO & CARL MIZE

Effects of partial overstory removal on the natural regeneration of a tropical forest in Quintana Roo, Mexico

**Forest Ecology and Management, Elsevier, Netherlands
Vol. 58 (3-4), 259-272, 1993, English**

In a tropical, semi-evergreen forest in Quintana Roo, Mexico, a study was conducted to observe the effects of partial overstory removal (creation of multiple gaps) on natural regeneration, with special attention to commercially valuable tree species. Five 0.5 ha plots were subjected to different levels of overstory removal of 0%, 8%, 28%, 45% and 55%. The regeneration population 3 years after overstory removal was similar in density and composition to the population before overstory removal except for an unidentified liana that was not found in 1986 but was moderately abundant in 1989. Regeneration of commercial tree species (tolerant and intolerant), noncommercial tree species, and nontree species were compared with the residual basal area and percentage of basal area removed. Frequency of intolerant commercial species increased as residual basal area decreased. Frequency of tolerant commercial species was not affected by residual basal area or percentage of basal area reduced.

Keyword: Natural forest, Natural regeneration, Selective cutting, Stand condition

R.E. GULLISON & J.J. HARDNER

The effects of road design and harvest intensity of forest damage caused by selective logging: empirical results and a simulation model from the Bosque Chimanes, Bolivia

Forest Ecology and Management, Elsevier, Netherlands

Vol. 59 (1-2), 1-14, 1993, English

Selective harvesting in tropical forests has been shown to cause considerable damage to residual trees in stands that have relatively high densities of commercial trees. To complement existing studies, we measured forest damage caused by the selective harvesting of mahogany (*Swietenia macrophylla*), a very low density species in the Bosque Chimanes, Bolivia. Secondary damage along main roads and skid trails accounted for most of the damage measured in the study site. Total damage was low (4.39% of the study area), but results from our simulation model suggested that damage could be decreased by up to 25% by requiring main roads and skid trails to be linear.

Keyword: Natural forest, Selective cutting, Forest damage, Logging, Mahogany

3. FOREST DAMAGE AND PROTECTION

3-1 Forest Fire

J. BOONE KAUFFMAN

Survival by sprouting following fire in tropical forest of the eastern Amazon

Biotropica 23 (3), 219-224, 1991, English

Current anthropogenic activities in Amazonia are resulting in the widespread occurrence of fire; an ecosystem that is believed to have evolved in a fire-free environment. Even in areas away from intensified human land use, warmer and drier climatic conditions could increase the probability of fire in tropical forests. In this study the capacity of tree species to sprout following fire in disturbed moist tropical evergreen forests was quantified. Additionally, mortality and the modes of survival of standing forest trees at four sites were measured. Crown mortality ranged from 64-97 percent. Eight months after fire, 36-69 percent of all trees present on the sites at the time of burning were dead (i.e., no sprouting occurred). Out of 124 species measured (500 total individuals), 46 percent had the capacity to sprout from subterranean tissues and 27 percent sprouted from epicormic tissues. Forty-one percent of sampled species were found to lack any capacity to sprout vegetatively. The percentage of individuals that survived by sprouting varied among tree species. Survival of the 14 most common species encountered ranged from 15-83 percent. Survival also varied among sites and this was primarily attributed to differences in fire severity. Fire severity and plant mortality were greatest in selectively logged forests that were intentionally burned for pasture conversion (>65% mortality).

One ecological advantage of sprouting over establishment from seeds is rapid regrowth and a greater capacity for exploitation of limited resources in tropical forests. Mean sprout height was 0.8-1.6 m for 8-month old sprouts and 4.2 m for 20-month old sprouts.

Keyword: Forest fire, Shoot, Forest damage

MUOGHALU, JOSEPH I., AKANNI, SAMUELO & ERETAN, OLANIYIO

Litter fall and nutrient dynamics in a Nigerian rain forest seven years after a ground fire

Journal of Vegetation Science, IAVS, Sweden

4, 323-328, 1993, English

Seasonal litter fall and mineral element content (N, P, Ca, Mg, K) of regrowth forest communities at the base and on the slope of an inselberg in Ile-Ife, Nigeria, were studied 7 years after a ground fire ravaged the forest. Litter fall ($t\ ha^{-1}\ yr^{-1}$) was 4.6 (total), 4.2 (leaf), 0.3 (small wood ≤ 2.5 cm diameter) and 0.1 (reproductive parts: fruits and flowers) in the base community and 6.4 (total) 5.4 (leaf), 0.9 (small wood) and 0.1 (reproductive parts) in the slope community. There was significant monthly variation in litter fall in two communities with lowest amount of litter recorded during the wettest months of the year (May-August) and the highest amount during the dry season.

Keyword: Forest fire, Litter, Litter layer, Forest floor

NOR AINI AB SHUKOR

Recovery of *Acacia auriculiformis* from fire damage

Forest Ecology and Management, Elsevier, Netherlands

Vol. 62 (1-4), 99-105, 1993, English

An assessment of damage and recovery of *Acacia auriculiformis* in a provenance trial at the Universiti Pertanian Malaysia was undertaken following an accidental surface fire. The results showed significant differences ($P < 0.05$) between provenances in their ability to recover vegetatively after being affected by different levels of foliage scorch, with the 1 hr. S. Balamuk (16103) provenance being the best. The ability to resprout

is possibly a result of the insulating properties of the bark, which protects the dormant buds present underneath it. The results provide a basis of selection of suitable provenances for future breeding for fire resistance and for fire management and silvicultural treatments of this species.

Keyword: Forest fire, Forest damage, Man-made forest, Acacia

3-2 Pests and Diseases

B. GRAY

Observations on insect flight in a tropical forest plantation

II, III. Flight activity of platypodidae (coleopters)

Zeitschrift für Angewandte Entomologie, Germany

75, 1, 72-78, 282-286, 1974, English

Small number of platypodidae were collected in sticky traps a period of 25 years in a Hoop Pine plantation near Bulolo in Papua New Guinea. Of the 15 species trapped, four were new and four others had not been previously recorded in the Bulolo area. The majority, 68.6%, of the 169 specimens collected in the Bulolo area. Flight activity fluctuated considerably over the period of study and some relationship of activity was evident with weather. A greater number of platypodids were collected during the day than at night. Considerably more beetles, 47.3%, were collected off the traps around the tree in the most exposed situation. Generally there was only a slight directional flight response, except for a more marked diurnal response shown for collections around the most exposed tree.

Keyword: Pest/Insect damage, Plantation

3-3 Climatic Damage

LEON H. LIEGEL

Assessment of hurricane rain/wind damage in *Pinus caribaea* and

Pinus oocarpa provenance trials in Puerto Rico

Commonwealth For. Rev., UK, 63 (1), 47-53, 1984, English

In 1979 hurricane-associated heavy rains and high winds caused four distinct kinds of mechanical injury or damage in 5- and 6-year old *Pinus caribaea* and *pinus oocarpa* provenance trials in Puerto Rico. These sites are part of the International Pine Trials sponsored by the Commonwealth Forestry Institute (CFI) in Oxford, England. Assessments at six widely separated and environmentally diverse sites across the island showed 22% total (blow-down plus lean) damage for *P. caribaea*, 52% for *P. oocarpa*. Blown-down mortality alone averaged 2% for *P. caribaea*, 13% for *P. oocarpa*. For *P. caribaea* trials, sites with high foxtail percentage did not show greater wind breakage than sites with low foxtail percentage. Overall, windthrow and lean were both major damage categories, stem and branch breakage were minimal, and there was no defoliation. Relationships between environmental or stand variables and damage percentage were generally curvilinear, not linear.

Keyword: Pine, Forest damage, Wind, Wind damage, Plantation, Undergrowth

JOHN K. FRANCIS & ANDREW J.R. GILLESPIE
Relating gust speed to tree damage in Hurricane Hugo
Journal of Arboriculture, 19 (6), 368-373, 1993, English

From 17 through 19 September 1989 Hurricane Hugo passed through the Antilles from Guadalupe to Puerto Rico, causing severe damage to ornamental and shade trees. Damage to 1226 trees of 81 species on 18 urban and rural sites was related to maximum wind gust speeds. Damage (defoliation, minor branch breakage, major branch breakage, trunk snap, and tipping) began at gust speeds of about 60 km/hr, increased rapidly with gust speeds to about 130 km/hr, and although highly variable, did not worsen at higher gust speeds. The most severe forms of damage are apparently avoided if the crown surface area is reduced quickly by loss of leaves and the crown surface area is reduced quickly by loss of leaves and twigs. Palms were more wind resistant than broadleaved trees.

Keyword: Forest damage, Wind, Wind damage

JOHN A. PARROTTA & D. JEAN LODGE
Fine root dynamics in a subtropical wet forest following
hurricane disturbance in Puerto Rico
BIOTROPICA, 23 (4a), 343-347, 1991, English

Fine root dynamics were evaluated at four sites in a subtropical wet forest in Puerto Rico over a period of 13 months following disturbance by Hurricane Hugo in September 1989. Live fine root standing stocks (to a depth of 10 cm) declined to zero over a three month period after the hurricane and fluctuated greatly thereafter. maximum fine root biomass (49 g/m^2) occurred in June 1990. Dead root standing stocks (mean 423 g/m^2) were relatively constant through the study period. Recovery of fine roots following the initial hurricane-related mortality appears to be a slow process, regulated at least initially by environmental factors such as precipitation.

Keyword: Root system, Forest damage, Wind damage, Wind

4. FOREST MENSURATION AND MANAGEMENT

4-1 Growth, Increment of Trees and Stands

L.H. LIEGEL

Status, growth, and development of unthinned Honduras pine plantations in Puerto Rico

Turrialba, Vol. 34, No. 3, 313-324, 1984, English

Pinus caribaea Morelet var. *hondurensis* Barr. & Golf., known locally as Honduras pine, pino hondureño, or pino caribaea, grows well throughout most of Puerto Rico. Besides protecting soils from erosion, Honduras pine offers a potential local source of raw material for posts, poles, and sawtimber when planted on land unsuited for crops or other land uses.

This report summarizes findings from an island-wide inventory made from 1975-76 to assess growth and development of Honduras pine plantations.

Seventy plantations representing 93 ha were located in an island-wide inventory of Honduras pine plantations in 1976. Mean annual height and diameter growth for dominant trees in 28 plots averaged 1.6 m and 2.0 cm respectively; plantings were 4 to 14 years old and were located in five major soil regions. Data are summarized for several stand features, including volume, bark thickness, basal area, form, live crown, foxtails, seed and cone production, injury/disturbance, and nature of understory vegetation.

Keyword: Pine, Plantation, Forest inventory, Growth, Height increment, Diameter increment, Stand

JOHN K. FRANCIS

Merchantable volume and weights of mahoe in Puerto Rican Plantation

Research Note, USDA, Forest Service, Southern Forest Experiment Station, USA, SO-355, 4, 1989, English

Mahoe (*Hibiscus elatus* Sw.), a fast-growing tree whose wood is considered valuable, is planted and managed primarily in the West Indies. Until now, volume and weight tables have not been available for the species. Data used in this paper were collected from 50 felled trees in a range of sizes from plantations across Puerto Rico. Using linear regression techniques, equations were derived to construct tables for merchantable bole volume, with and without bark, and green and dry weights of merchantable boles. A local volume curve is also presented that can be used to estimate merchantable volumes with bark from diameter measurements at breast height. Heartwood diameter can be predicted from inside-bark diameter and height on the stem.

Keyword: Tree species, Fast-growing tree species, Diameter Breast Height, Stem volume

SANDRA BROWN & ARIEL E. LUGO

Biomass of tropical forests: a new estimate based on forest volumes

Science, the American Association for the advancement of Science, USA, Vol. 223: 1290-1293, 1984, English

Recent assessment of areas of different tropical forest types and their corresponding stand volumes were used to calculate the biomass densities and total biomass of tropical forests. Total biomass was estimated at 205×10^9 tons, and weighted biomass densities for undisturbed closed and open broadleaf forests were 176 and 61 tons per hectare, respectively. These values are considerably lower than those previously reported and raise questions about the role of the terrestrial biota in the global carbon budget.

Keyword: Biomass, Volume, Stand, Broad leaved tree

GERALD P. BAUER & ANDREW J.R. GILLESPIE
Volume tables for young plantation grown hybrid mahogany
(*Swietenia macrophylla* X *S. mahagoni*) in the Luquillo experimental
forest of Puerto Rico
Research Paper SO-257, USDA, Forest Service, Southern Forest Experiment
Station, USA, 8, English

Reforestation began in the Luquillo Experimental Forest (LEF) in 1931 and continued until 1985 (Bauer 1987). The most active period of planting was between 1934 and 1945. After an assessment of the reforestation effort, the USDA Forest Service (USFS) initiated a silvicultural program to establish mahogany. *Swietenia macrophylla*, *S. mahagoni*, and an interspecific hybrid between these two species, *S. macrophylla* x *S. mahagoni*. have all been planted, although only the hybrid has been planted since 1963. More than half the total area planted to mahogany has been line planted in secondary forests.

Growth and development of young mahogany plantations in the LEF have been studied. However, individual tree volume estimates and volume tables were never developed. The primary objectives of the present study were to (1) estimate individual tree volume and (2) develop local and general mahogany volume tables for young plantation-grown hybrid mahogany.

Keyword: Mahogany, Plantation, Growth, Stem volume, Standing tree volume table, Commercial tree species

ANDREW J.R. GILLESPIE, SANDRA BROWN & ARIEL E. LUGO
Tropical forest biomass estimation from truncated stand tables
Forest Ecology and Management, Netherlands
48, 69-87, 1992, English

Total aboveground forest biomass may be estimated through a variety of techniques based on commercial inventory stand and stock tables. Stand and stock tables from tropical countries commonly omit trees below a certain commercial limit, often ≥ 35 cm. Biomass estimates made from such tables will fail to include from 25-45% of the total stand biomass. Using stand tables generated for large forested areas, we describe several methods of estimating the numbers of stems in one or two missing small-diameter classes (truncated stand tables) based on the numbers of stems in the larger size classes. We show that an exponential model reasonably approximates diameter distributions among most diameter classes in various types of tropical moist forest. The most accurate method of estimating the number of stems in smaller (missing) diameter classes used the ratio of the numbers of stems in the two smallest diameter classes. The error of estimation of total stand biomass using this approach (10-12%) was always less than the error incurred by omitting the missing classes (25-45%).

Keyword: Biomass, Stand

ADRIAN ARES & NORMAN PEINEMANN
Provisional site quality evaluation for coniferous plantations in
Sierra de la Ventana, Argentina
Forest Ecology and Management, Elsevier, Netherlands
Vol. 54 (1-4), 89-94, 1992, English

Provisional forest site classes were established for the most widely planted conifers in a temperate, hilly zone of Argentina. Growth data were obtained from 72 unmanaged stands. Aleppo pine (*Pinus halepensis* Mill.) was studied on 22 sites, Monterey pine (*Pinus radiata* D. Don.) on 20 sites, and cedar (*Cedrus deodara* (Roxb) Loudon) and Italian or common cypress (*Cupressus sempervirens* f. *horizontalis* (Mill.) Voos) on 15 sites each. Site index, regarded as the height of dominants at the base age of 25 years, was determined by using stem analysis. Site indices as well as yields were higher for the species of genus *Pinus*, particularly for *P. radiata* followed by *Cedrus deodara* and *Cupressus sempervirens*, respectively. Data from stem analysis pointed out that the mean annual increments in the stands did not culminate even at the age of 30 years.

Keyword: Conifer, Pine, Growth, Species trial, Mean annual increment

S. B. KARMACHARYA & K.P. SINGH
Biomass and net production of teak plantations in a dry tropical region in India
Forest Ecology and Management, Elsevier, Netherlands
Vol. 55 (1-4), 233-247, 1992, English

In an age series of teak plantations (4, 14 and 30 years old), raised in a dry tropical region in northern India, an analysis of the standing crop biomass and above ground net production was made through non-destructive methods. Allometric regressions were developed relating girth to weights of bole wood, bole bark, branch, leaf and inflorescence. Annual girth increments were recorded. The above ground biomass ranged from 25.7 to 76.9 t ha⁻¹. The proportion of woody biomass was 56% of the total at 4 years, increasing to 91% of the total by 30 years. On the contrary, the proportion of leaf biomass decreased from 34% of the total at 4 years to 7% at 30 years. Very high above ground net production was obtained at 4 years (25.6 t ha⁻¹ year⁻¹), but net production decreased with age (14 and 12.9 t ha⁻¹ year⁻¹ at 14 and 30 years). The share of bole decreased from 54% of total net production at 4 years to 44% of the total at 30 years, with increase in age much less bark than wood was produced. The reproductive parts comprised 2% of biomass but accounted for 9% of net production at 30 years. At 30 years these plantations attained the level of biomass and net production found in uneven-aged natural dry deciduous forests of the same region.

Keyword: Teak, Plantation, Biomass, Growth

J.W. HAUSER, W.M. AUST, J.A. BURGER & S.M. ZEDAKER
Drainage effects on plant diversity and productivity in loblolly pine (*Pinus taeda* L.) plantations on wet flats
Forest Ecology and Management, Elsevier, Netherlands
Vol. 61 (1-2), 109-126, 1993, English

Silvicultural practices are under increased scrutiny with respect to environmental impacts and intensive forestry is often cited as a contributing factor in the decline of biodiversity. However, there are few studies which evaluate the long-term impact of forest operations on plant diversity and production. The objective of this project was to determine the rotation age effects of three site preparation methods on plant diversity and productivity in wet pine flat plantations.

The study area consisted of three wetland sites in the coastal plain of Virginia. Treatments were originally established in 1969 to study the effects of site preparation on loblolly pine (*Pinus taeda*) growth. The three site preparation treatments applied were: chop and burn, bedding between windrows (windrow-bedding), and secondary ditching. This study was conducted in 1991 when stands were near rotation age (22 years).

Plant diversity was lowest and total biomass highest on the windrow-bedding treatment. Windrow-bedding appeared to increase pine growth by providing seedlings with more available soil volume and by reducing the vegetative regeneration of hardwoods and shrubs, thereby decreasing diversity. Secondary ditching increased pine growth by lowering water table levels, but had little effect on plant diversity.

Keyword: Man-made forest, Pine, Growth, Site condition, Biomass

JICA PROJECT
Manual dendrometria
No. 003, Proyecto Capiibary, Paraguay, 34, 1987, Spanish

This publication is a manual of forest mensuration. It is compiled for staff of the Paraguay/JICA Project, Capiibary, Paraguay.

The manual deals with measurement methods of tree and stand increment, and forest inventory.

Keyword: Tree growth, Measurement

CARL F. JORDAN & EDWARD G. FARNWORTH
Natural vs. plantation forests: a case study of land reclamation strategies for the humid tropics

Biomass and productivity were compared in two plantations and in one stand of natural regeneration on similar sites in a premontane moist forest region of Puerto Rico. While initial growth rates of plantation species were higher, after four decades productivity of the natural regeneration plots was equal to or greater than productivity of the plantations. For the first 44 years, above ground biomass of natural regeneration increased at an average annual rate of $3.8 \text{ t}\cdot\text{ha}^{-1}\cdot\text{yr}^{-1}$, but the last year of the study it was $14.7 \text{ t}\cdot\text{ha}^{-1}$. Biomass increment of a pine plantation averaged between 8 and $10.5 \text{ t}\cdot\text{ha}^{-1}\cdot\text{yr}^{-1}$ except for one year when the rate was much lower, possibly because of hurricane damage. A tropical hardwood plantation averaged close to $4 \text{ t}\cdot\text{ha}^{-1}\cdot\text{yr}^{-1}$ for 41 years. It is suggested that in countries where funds for land reclamation are limited, intensive plantations may not always be the best strategy. Natural regeneration or shelterbelt plantations may be suitable alternatives.

Keyword: Biomass, Plantation, Natural forest

J.N.M. SILVA, J.O.P. DE CARVALHO & J. DO C.A. LOPES
Growth of a logged-over tropical rainforest of the Brazilian Amazon
Proceedings of the Seminar on Growth and Yield in Tropical
Mixed/Moist Forest, 1988, Kuala Lumpur, Malaysia
117-136, 1989, English

Growth of a tropical rain forest of the Brazilian Amazon was monitored for a period of eight years after experimental commercial logging operations. Average diameter growth rate was 0.5 cm year, comparable to similar results elsewhere. Increment of individual trees was not correlated with tree size but a strong correlation was found when mean increment by diameter class was considered. Light had a strong influence on growth. Trees receiving full overhead light grew up to three times faster than trees receiving only side or diffuse light. The beneficial influence of canopy opening on growth disappeared three to four years after logging although individual species kept high increment rates even eight years after logging.

Keyword: Tropical rain forest, Felling, Growth, Light intensity

JOSÉ NATALINO MACEDO SILVA
Metodologia utilizada na construção de tabelas de volume
EMBRAPA-CPATU, Belém, Brasil, 21, 1988, Portuguese

This paper deals with methodology for constructing volume tables in tropical forests. The usual types of volume tables are described as well as the mathematical models and the use of computers to obtain volume equations. Statistical aspects related to volume equations are discussed, specially the problems concerned to the selection of sample trees and regression analysis. Finally, the criteria for selection of volume equations among several models and some methods used for comparing volume equations are discussed.

Keyword: Standing tree volume table, Standing tree volume

J.N.M. SILVA, J.O.P. DE CARVA et al.
Growth and yield of a tropical rain forest of the Brazilian
Amazon 13 years after logging
Growth and Yield Estimation from Successive Forest Inventories,
Proceedings from the IUFRO Conference, held in Copenhagen,
14-17 June 1993, 250-259, 1993, English

Diameter increment, volume production, recruitment and mortality were reassessed in a silvicultural experiment in the Tapajós National Forest, State of Pará, Brazil, 13 years after an experimental logging. The forest was left to regenerate with no subsequent silvicultural intervention to evaluate the behaviour of such an approach for forest management. Thirty-six permanent sample plots established in 1981 for monitoring stand development have been measured six times. The behaviour of the stand parameters was studied in three periods, viz 1981-1987, 1987-1992. From the first to the second observation period diameter growth of all species has decreased from 0.4 cm year^{-1} to 0.2 cm year^{-1} . The average for the second period is similar to an unlogged

primary stand in the same forest. The annual mortality rate had a slight increase from 2.4% to 2.6% per year while recruitment rates fell from 5.4% to 1.8%. Recruitment of commercial species also fell from 5.4% to 1.3%; volume production fell from 6.1 m³.ha⁻¹ to 4.2 m³.ha⁻¹. Similarly the average volume production of commercial species decreased from 0.9 m³.ha⁻¹ to 0.7 m³.ha⁻¹. Considered as a whole, the stand had a positive balance, i.e., basal area, volume and number of trees increased in the eleven-year studied period. The average values for diameter increment, ingrowth and mortality were, respectively, 0.3 cm.year⁻¹, 3.1% p.a. and 2.2% p.a. Only 6 trees per ha of the commercial group (32 species) of merchantable size (45 cm DBH) were available in 1992 corresponding to a volume of 18 m³.ha⁻¹. However, updating the list of marketable timbers with 29 new species presently being utilized, the number of trees of a logging size increased to 15 trees per ha, corresponding to a volume of 54 m³.ha⁻¹.

These results support previous recommendations for application of silvicultural treatments at 10-year intervals to allow reasonable growth rates, to promote natural regeneration of valuable species and to replenish the volume extracted.

Keyword: Forest management, Felling, Succession, Forest inventory, Regeneration, Growth

J.L. WHITMORE & L.H. LIEGEL

Spacing trial of *Pinus caribaea* var. *hondurensis*

USDA Research paper, An Institute of Tropical Forestry Publication, USA

SO-162, 1-8, 1980, English

Pinus caribaea var. *hondurensis* is widely planted for its fast growth and versatile wood. Trials were begun on this species at four sites in Puerto Rico in the early 1960's to test which spacing would most rapidly produce stems suited for a wide range of products. Growth in height and diameter equaled that observed in other tropical countries where this pine variety is planted, and exceeded growth of temperate zone pine by far. Wood specific gravity averaged 0.48, and yields of over 45 m³/ha/year were not uncommon. A spacing between 7x7 and 10x10 ft would produce fairly large stems in a short rotation. Closer or wider spacing may be desired depending on the end product sought.

Keyword: Pine, Tree species, Growth, Mean annual increment

ANDREW J.R. GILLESPIE et al.

Biomass estimates for tropical forests based on existing inventory data

State-of-the-art methodology of forest inventory: A symposium proceeding

246-253, 1989, English

Biomass estimation is becoming important for a variety of planning and scientific applications in many tropical countries. Biomass inventories in many areas of the world are rare or nonexistent, so that biomass estimates must be based on other types of information. Most countries have some inventory-based estimates of forest volumes. We have developed a toolbox of approaches for making point and interval estimates of total above ground biomass based on various type of forest volume inventories.

Keyword: Biomass, Growing stock, Carbon cycle

SANDRA BROWN

Tropical forest and the global carbon cycle

Current Topics in Forest Research, Proceedings of a National Symposium,

Florida, USA, 49-54, 1986, English

The uncertainty about the role of tropical forests in the global cycle is due to many factors, including problems of estimating (1) forest biomass, (2) losses of soil carbon from forest clearing, and (3) rates of wood decomposition. Estimates of biomass of tropical forests based on extensive forest volume data give significantly lower values than estimates based on direct measurement methods. A major source of error in converting commercial volumes to total biomass is the high variability in the expansion factors (ratio of total biomass to commercial biomass) that suggests a need for regional estimates rather than for highly aggregated ones as has been done in the past.

Keyword: Carbon cycle, Biomass, Tropical forest, Growing stock

PETER L. WEAVER

Tree growth in several tropical forests of Puerto Rico

Research Paper, USDA Forest Service, Southern Forest Experiment Station

SO-152, 15, 1979, English

About 2400 individual stems ≥ 4.1 cm d.b.h., and representing about 100 species, from six plots in three Life Zones, some with edaphic variation and/or silvicultural treatment, scattered throughout Puerto Rico, were studied for varying periods, usually ranging from 24 through 30 years but in one instance for only 2 years. Also, more than 11,000 mangrove stems ≥ 1 cm at ground level were followed after clearcutting on 3 plots consisting of two separate treatments and a control.

The periodic annual increment for all stems ≥ 4.1 cm, regardless of species or crown class, ranged from about 0.05 cm/yr in the Guánica dry limestone forest of the southwest (Subtropical Dry Life Zone) to about 0.45 cm/yr in the Piñones mangrove and early secondary rainforest at Saint Just, both in Subtropical Moist Life Zone.

Keyword: Tree growth, Ecosystem, Mangrove, Growth

NORMA R. ADAMS & FOSTER B CADY (editors)

Modeling growth and yield of multipurpose tree species

Multipurpose Tree Species Network Technical Series, Winrock

USA, Vol. 1, 1-57, 1988, English

MPTS has been compiled to outline a history of yield models, present the various approaches to modeling tree growth and yield, and assess their appropriateness for modeling growth of MPTS. This volume begins with an overview of the information required for MPTS yield prediction. Rose presents the uses and limitations of traditional yield tables, which may include various management regimes. Next, Harrington reviews the simulation models of tree and stand growth. Before a model is designed to predict MPTS yield, scientists need to assess the strengths and weakness of past approaches. An approach for modeling MPTS can then be outlined, identifying the proper level of resolution and the processes to be included based on available data.

Keyword: Multipurpose trees, Tree growth, Yield table, Growth

HAROLDO BASTOS DA COSTA & PERMINIO PASCOAL COSTA FILHO

Segurança operacional de exploração florestal mecanizada

Circular Técnica Número 42, EMBRAPA-CPATU, Belém, Brazil

20, 1983, Portuguese

The forestal activities present generally great personal risks, and in a mechanized exploitation these risks become greater due to the use of heavy equipments.

Normally, the majority of the forestal activities in the Amazon are executed in empiric form, are badly planned and with an untrained staff, resulting thus in danger to people and damage to the equipments. These risks may be minimized perfectly through a better planning, a suitable organization and a permanent supervision of the activities.

In order to solve these problems, the medium and large scale companies must mechanize their exploitation on "terra firma" (solid earth), to make the working team have a greater favor of the residual forest and to train the local man-power.

The main objectives of this book are:

- To make the lumber enterprising sector aware of the risks in the forestal activities, and
- To show the necessity to train the man-power in the activities of forestal exploitation.

Keyword: Forestry, Forest management, Mechanization, Training, Study and training

FRANCIS Y.C. CHAI & VALERIE M. LEMAY

Development and testing of diameter increment model for mixed swamp forests of Sarawak

Forest Ecology and Management, Elsevier, Netherlands

Vol. 58 (1-2), 51-64, 1993, English

The variability of diameter increment of commercial species of the mixed swamp forests of Sarawak is high, partly because of the large number of species represented. It may be desirable to combine several species together to obtain a diameter-increment estimation equation because of the cost of sampling and the fact that some species may occur infrequently, and for simplicity. In this study, a diameter-increment model was developed and fitted for three different modeling levels, defined as individual species, two groups of species (light-demanding versus shade-tolerant species) and one group of all species combined. These three modelling levels were compared using estimated standard error, Pseudo R^2 , mean prediction error, mean-squared prediction error and mean absolute prediction error based on validation data. Modelling at the individual-species level resulted in only slightly better predictions compared with the one-group level; no real gain was noted for the two-group level compared with the one-group level. For most species, the one-group level resulted in predictions similar to the individual-species models. The one-group level is recommended, although some individual-species models are useful for those species which give poor predictions using the one-group model.

Keyword: Natural forest, Diameter increment, Growth, Intolerant tree, Tolerant tree

JOSE ANTÔNIO ALEIXO DA SILVA et al.

A volume equation for mangrove trees in northeast Brazil

Forest Ecology and Management, Elsevier, Netherlands

Vol. 58 (1-2), 129-136, 1993, English

An individual tree volume equation was developed for mangrove trees in northeast Brazil. On each of 50 felled sample trees, the volume of the main stem, branches and stilt roots with diameters greater than 3 cm was determined using Smalian's formula. The volume model $VOL = [\lambda(\beta_0 + \beta_1 DAR + \beta_2 HDAR + \epsilon_1) + 1]^{1/2}$, where VOL is volume of the tree (m^3), DAR is diameter at the height of the highest stilt root (cm), HDAR is distance from the DAR to the ground at low-tide level (m), λ is transformation parameter, β_0 and β_1 are coefficients of the model, and ϵ_1 is error component, provides good estimates of the volume. The final equation, as well as a volume table generated with the equation, are presented.

Keyword: Mangrove, Stem volume, Volume table

T. TIETEMA

**Biomass determination of fuelwood trees and bushes of Botswana,
Southern Africa**

Forest Ecology and Management, Elsevier, Netherlands

Vol. 60 (3-4), 257-269, 1993, English

In order to establish a relation between tree fresh biomass and tree dimensions, samples of 14 tree species indigenous to Botswana were measured, cut and weighed. The relation best suited to the indirect estimation of total tree fresh weight was the regression between tree fresh weight and stem basal area at ankle height (5-10 cm above ground level). The regression curves of the 14 tree species overlay in a narrow band. On the basis of the measured data points of all 14 tree species a single regression curve is calculated: the combi-line. The combi-line satisfactorily describes the relation between stem basal area and fresh weight for most trees. A comparison of the combi-line with some tree species from elsewhere in Africa, India and Europe shows that the combi-line also describes, to a large extent, the basal area-fresh weight relation for those trees.

Keyword: Biomass, Tree species, Indigenous species, Shrub, Diameter grade

4-2 Forest Management

R.A. PLUMPTRE & D.E. EARL

**Integrating small industries with management of tropical forest
for improved utilisation and higher future productivity**
Journal of World Forest Resource Management, UK
Vol. 2 (1), 43-55, 1986, English

Techniques developed in Uganda and Ghana are described by which small industries such as charcoal making, fuelwood production and mobile sawmilling, were used to increase utilisation of moist tropical forest. These industries, together with the growing of some food crops, were integrated with forest management to obtain enriched natural forest or a crop of *Gmelina arborea* with an overstorey of valuable young natural forest trees retained from the original forest. The benefits in terms of employment, output from the industries and food for the surrounding population are described and the need to demonstrate tangible benefits to local people if the forests are to be retained is emphasised. Costings show that conversion of natural forest in this manner can be achieved profitably or at a very low cost and suggestions are made for wider application of this system of managing tropical forest.

Keyword: Forest management, Rural community, Wood utilization

STEPHEN E. McGAUGHEY & HANS M. GREGERSEN (editors)

**Forest-based development in Latin America: an analysis of
investment opportunities and financing needs**
Inter-America Development Bank, Washington, D.C., USA
215, 1983, English

The purpose of this book is to explore the prospects for accelerating the economic development of forestry and forest industry in Latin America, including the Caribbean subregion, in member countries of the Inter-American Development Bank (IDB). The book's central theme is to ascertain the many future opportunities as well as factors that will limit or stimulate the growth of public and private sector investments in the forest-based sector in years ahead. The sector is viewed in broad terms to encompass activities from forest management and timber extraction through the stages of primary processing, including energy, sawnwood, wood panels, pulp and paper production. It also incorporates social and protection forestry such as watershed management and resource preservation.

The study on which this book reports grew out of an increasing recognition throughout the world that Latin America will have an important place in the international market for wood products of all kinds in the next two decades, because of its substantial natural resource base and its now demonstrated capacity to establish forestry plantations and processing facilities.

Keyword: Forest management, Forest conservation, Forestry, Wood utilization, Watershed management

LAURA E. COTTLE & GERARD F. SCHREUDER

Brazil: A country profile of the forests and forest industries
Workshop Paper, CIN TRAFOR: University of Washington, USA
No. 27, 13-33, 1990, English

This paper presents the forest resource. General overview is described about the forest resource of global view.

The better examples of forest management are in the southern regions of Brazil where sophisticated forest management of plantations is carried out by numerous private companies.

Very little forest management of tropical forests is carried out in Brazil though there have been some attempts in the national forests. There is a 600,000 ha pilot project coordinated between the IBDF and FAO with integrated forestry and forest management systems at Santeren on the Tapajos river.

Keyword: Forest resources, Natural forest, Forest management

JARI

Improved utilization of tropical forests: silviculture in plantation development

The forester, USA, No. 31, 57-71, 1979, English

Jari Florestal & Agropccuaria is a private company operating on owned lands in Brazil. Mixed tropical hardwood forests are being used for local consumption then converted to plantations of malina (*Gmlina arborea*) or pine (*Pinus caribaea* var. *hondurensis*). Silviculture is intensive, the objective being production of pulpwood, sawlogs, and veneer bolts.

Keyword: Forestry, Forest management, Plantation

DENNIS ANDERSON

The economics of afforestation, a case study in Africa

The World Bank Occasional Paper, The World Bank, USA

No. 1, 86, 1987, English

This book has four main contents:

1. To provide a brief overview of the extent and causes of the loss of trees in farming area in Sub-Saharan Africa (Chapter 1).
2. To review policy options and outline an approach for evaluating afforestation investments (Chapter 2).
3. To demonstrate, using a case study in northern Nigeria, the usefulness of the approach for the economic analysis of afforestation projects in general (Chapter 3-5).
4. To propose topics for research on the efforts of rural afforestation (Chapter 5).

Keyword: Deforestation, Afforestation, Forest management, Forest policy

5. FOREST CONSERVATION

5-1 Watershed Management

RAFI AHMAD, F.N. SCATENA & AVIJIT GUPTA

**Morphology and sedimentation in caribbean montane stream:
examples from Jamaica and Puerto Rico**

Sedimentary Geology, Netherlands, 85: 157-169, 1993, English

This paper presents a summary description of the morphology, sedimentation, and behaviour of the montane streams of eastern Jamaica and eastern Puerto Rico. The area is located within a 200 km wide seismically active zone of Neogene left-lateral strike-slip deformation which defines the plate boundary between the Caribbean and North American Plates. Tropical storms, occasionally strengthening up to hurricane force, affect the region periodically. This is an area of steep, mass-movement-scarred hillslopes which supply a large amount of coarse sediment to the rivers. From the description presented, we have constructed a model for the rivers of this region controlled by both neotectonics and periodic large floods.

The drainage density is low with a near-rectangular stream network. The gradients are steep with boulder accumulations in the channels, their location at times related to the presence of large past landslides on hillslopes. Narrow, steep and confined channels occur in the mountains, but in wider sections and lower down near coastal plains, flood depositional forms appear in coarse valley alluvium. Small-scale deviations from the general pattern occur locally, controlled by variations in lithology, neotectonism, seasonality in flow, etc. This model for Caribbean montane streams differs considerably from the standard descriptions of alluvial rivers for which a number of detailed studies are available.

Keyword: Watershed, Watershed management, Flood

DANIEL G. RITCHIE

Strategies and technologies for Asian Watersheds

Asia Technical Department, The World Bank, USA, 19, 1992, English

The main focus of the review is upland areas, for it is there that most damage to watersheds takes place, and there that it has the main effect. Upland areas have in the past generally been sparsely populated. But increases in lowland populations have led to growing migration to fragile lands whose geology often makes them already especially prone to erosion.

Keyword: Watershed management, Watershed, Soil loss, Flood, Watershed conservation

JOHN B. DOOLETTE & WILLIAM B. MAGRATH (editors)

Watershed development in Asia

Work Bank Technical Paper, The World Bank, USA

No. 127, 228, 1990, English

This review of watershed development issues arose from the realization that a number of current and planned World Bank supported projects in the Asia regions deal with the linkages between upland productivity and environmental conditions and are, in various ways, motivated by concern with downstream impacts such as flooding and sedimentation.

In Chapter 1, Magrath and Doolette present a discussion of the major watershed development problems of the Asia Region. In Chapter 2, Doolette and Smyle examine the fundamental building blocks of watershed management projects. In Chapter 3 and 4, Magrath demonstrates how benefit-cost analysis techniques can be used to assist in the selection of watershed management technologies. In Chapter 5 Banerjee takes an revegetation of denuded forest land. Molnar, in Chapter 6, explores one of the most analytically troublesome subjects in conservation policy, land tenure. Morgan and Ng, in Chapter 7, elaborate the connections between

planning, monitoring and evaluation of watershed projects.

Keyword: Watershed, Watershed conservation, Watershed management, Evaluation

5-2 Soil Conservation

GLENN O. SCHWAB, DELMAR D. FANGMEIER et al.

Soil and water conservation engineering - fourth edition

John Wiley & Sons, New York, USA, 507, 1993, English

Soil and water conservation engineering is the application of engineering and biological principles to the solution of soil and water management problems. The conservation of natural resources implies utilization without waste so as to make possible a continuous high level of crop production while improving environmental quality. Engineers must develop economic systems that meet these requirements.

In this edition the text material has been brought up to date, but it continues to emphasize engineering design of soil and water conservation practices and their impact on the environment, primarily air and water quality. Furthermore, the production of food and fiber remains an important consideration because of increasing United States and world population.

As in previous editions, the purpose of this book is to provide a first-course professional text for undergraduate agricultural engineering students and for other interested in soil and water conservation. Subject matter on all the engineering phases of soil and water conservation is included, as is a limited section on hydrology. The first chapter covers general aspects with some worldwide implications; Chapters 2 through 4, hydrology; Chapters 5 through 8, erosion and its control; Chapter 9, conservation structures; Chapter 10, earth dams; Chapter 11, flood control; Chapters 12 through 15, drainage; and Chapters 16 through 21, irrigation.

Keyword: Environmental conservation, Soil conservation, Water conservation, Erosion, Irrigation, Land conservation

JITENDRA P. SRIVASTAVA, PRABHAKAR MAHEDEO TAMBOLI et al.

Conserving soil moisture and fertility in the warm seasonally dry tropics

Work Bank Technical Paper, The World Bank, Washington, D.C., USA

No. 221, 81, 1993, English

An imbalance among natural resources, population, and basic human needs exists in many regions, but is particularly acute in the developing countries of the warm seasonally dry tropics (WSDT). The WSDT are found primarily in Sub-Saharan Africa, Southwest and Southeast Asia, Central and South America, and northern Australia, and include approximately 21 percent of the world's population. Although the region's soil and water resources vary substantially, as a whole the dry tropics are resource-poor, and large areas are heavily exploited, leading to severe pressure on the resource base. Three factors render these regions particularly fragile: insufficient precipitation, low soil fertility, and rapid loss of soil organic matter in cultivated soils. As human and animal populations rapidly increase (except in Australia), and thus require more intensive cropping systems, traditional methods of coping with risk and drought in the WSDT - nomadism and long fallow periods - are being forced to change.

The paper briefly describes the ecoregion, identifies the main constraints, and offers a series of technological options for sustainable development through the conservation of soil moisture, the prevention and control of soil erosion, and the improvement of soil fertility. The paper is designed to serve as a guide for policymakers, project managers, and agriculture operations staff in evaluating options and designing programs for the WSDT. References have been provided for those requiring additional background material or more technical information.

Keyword: Water conservation, Soil conservation, Erosion, Soil improvement, Soil management

R.G. GRIMSHAW

Vetiver grass (*Vetivoria zizanioides*)

A method of vegetative soil and moisture conservation

ICARUS ADVERTISING PRIVATE LIMITED, India, 72, 1988, English

This handbook has been prepared to support field workers and farmers in developing appropriate soil and moisture conservation measures using vegetative systems.

Vegetative systems of soil and moisture conservation have proved cheaper and more effective when implemented correctly. The system is being tested in farmer's fields in a number of locations in India.

Vegetative soil and moisture conservation measures are not only extremely cheap (less than 1/10 - 1/100 the cost of constructed banks and water ways) but the farmers can do the work themselves, and if they have the planting materials at no cost. Once vegetative hedges are established (this usually takes two of three seasons) they are permanent.

Keyword: Vegetation, Forest land conservation, Soil conservation, Water conservation

OMAR SATTAUR

Grass grows into a hedge against erosion

New Scientist, 1-2, 1989, English

John Greenfield, a senior agricultural adviser to the World Bank, first saw the value of vetiver grass in conserving soil and water more than 30 years ago when he worked in the Fiji islands. Plantations of sugar in the hills left the land prone to soil erosion. Greenfield and others tried building bunds but they repeatedly fell apart under heavy rains.

Vegetative barriers such as elephant grass and pigeon peas similarly failed to inhibit runoff and loss of soil. "The only thing that worked was vetiver grass", says Greenfield. The cost of making vetiver barriers only one-tenth to one-hundredth that of building and repairing bunds. Farmers can grow the hedges themselves and once established, they require no maintenance.

Vetiver hedges are dense and can grow as high as four metres to form effective windbreaks for crop plants that need shelter. An aromatic oil in its roots repels pests such as rats and snakes. Established hedge are unpalatable to livestock because the stems and leaves are tough and fibrous.

Keyword: Vegetation, Soil conservation, Erosion, Forest land conservation

Hedgerows in the Philippines: To adapt or adopt?

Ag-Sieve, Rodale Institute, USA, Vol. VI (3), 6-7, 1994, English

In 1987, researchers introduced contour hedgerows to the claveria on-farm research site in Msamis Oriental Province in the Philippines. The purpose was to reduce soil erosion and build up soil nutrients in an area where more than half of the farmers cultivate land with a slope of greater than 15%. Hedgerows caught on and have spread in the Philippines, not because researchers introduced the perfect technology, but because they worked with farmers who adapted the hedgerows to their farms. They eventually developed a product that best suited farmers' needs and, as a result, reduced soil erosion by up to 90%. Today, contour hedgerows in the area are dramatically different from those introduced five years ago. Farmer-to-farmer training has ensured hedgerows a foothold in the region and perpetuation of the technique.

Keyword: Soil fertility, Erosion, Soil conservation, Forest land conservation

MICHAEL D. BENGE

Windbreak and shelterbelt technology for increasing agricultural production

Agro-forestation series, S&T/FENR, USAID, USA

#6, 215, 1987, English

The contents are select abstracts and the addresses of the attendees from the Proceedings of the International Symposium on Windbreak Technology held in Lincoln, Nebraska, June 23-27, 1986. The enclosed

abstracts were selected as to their relevance to application in the developing countries.

Windbreaks and shelterbelts make more moisture available for plants by decreasing wind velocity across the soil, which reduces the evaporation of surface soil moisture. Wind erosion is also decreased, especially on sandy soils. Wind-blown sand shears newly emerged plants or buries them, causing a high mortality rate.

Keyword: Wind, Wind damage, Shelterbelt, Soil conservation

NORMAN E. BORLAUG et al.

Vetiver grass, a thin green line against erosion

National Academy Press, Washington, D.C., USA

169, 1993, English

In 1956 John Greenfield was handed a problem: to grow sugarcane on the hills of Fiji. With all the flat land fully used, his company had resolved to expand production up the slopes. The trouble was that the hillsides on that Pacific island nation were too dry for sugarcane – one of the thirstiest of crops – and the soils were too erodible. Putting cane fields on the slopes could be disastrous to the company, the cultivators, and the country.

Greenfield located the vetiver plants growing beside a nearby highway. He had his work crews dig them up, break off slips, and jab the slips side by side into the soil to form lines across the hillsides.

The vetiver slips quickly took root and grew together to form continuous bands along the contour. The runoff that normally poured off during tropical storms was slowed down, spread out, and even held back behind the "botanical dams". The soil was prevented from leaving the site; it settled out of the stalled runoff and lodged behind the grass walls.

Keyword: Water conservation, Soil conservation, Land conservation, Erosion

6. FOREST PRODUCTS

6-1 Timber

JOAQUIM IVANIR GOMES

Indícios de hibridação natural entre *Hevea brasiliensis* (H.B.K.)
Muell. Arg. e *H. camargoana* Pires com base na anatomia da madeira
Boletim de Pesquisa No. 52, EMBRAPA-CPATU, Belém, Brasil
24, 1983, Portuguese

The wood anatomy of *Hevea brasiliensis* and *H. camargoana* showed that these two species are easily separated by the characteristics of rays and vessels. The occurrence of intermediate such elements suggests the possibility of hybridism in natural conditions. *H. camargoana*, occasionally presented spiral thickening on cells of the axial parenchyma and on the fibers, a characteristic for the first time observed in the genus *Hevea* and this was detected in some samples of the supposed hybrid trees.

Keyword: Tree species, Wood physics

E.D. MALDONADO & R.S. BOONE

Shaping and planting characteristics of plantation-grown
Mahogany and Teak
Forest Service Research Paper, USDA Forest Service, USA
ITF: 7, 22, 1968, English

The study reports on some machining characteristics of Puerto Rico plantation-grown mahogany and teak. Also included is small-leaf (West Indies) mahogany from St. Croix, U.S. Virgin Islands. Shaping and planing were chosen for evaluation since these operations are decisive in exposed furniture parts. Mahogany from forest-grown stands in Mexico, Honduras, and Peru; teak from Burma; and two temperate zone timbers, sweetgum from the United States and birch from Canada, were tested for comparison to the locally grown woods.

Samples of small-leaf mahogany from St. Croix proved superior in shaping and planing properties to those of all other woods tested. In shaping, bigleaf mahogany from the Rio Abajo plantation and the hybrid from Harvey rated as good as the imported mahoganies or even better. In general, all the mahoganies performed well in planing. Local plantation-grown teak proved, in shaping, to be as good as forest-grown teak from Burma. Fast-grown plantation mahogany is not significantly different in density from slow-grown stems. Shaping quality is only weakly correlated with specific gravity and growth rate.

Keyword: Mahogany, Teak, Wood quality, Wood work

GISEL REYES et al.

Wood densities of tropical tree species
Southern Forest Experiment Station, USDA Forest Service, USA
15, 1992, English

Wood density information for a large number of tropical tree species is presented in units of oven-dry weight in grams per cubic centimeter of green volume. The data base includes 1,280 entries from tropical America (40 percent), tropical Asia (36 percent), and tropical Africa (24 percent). The most frequent wood densities were 0.5 to 0.8 g/cm³. In all three tropical continents, the most frequent class was the 0.5 to 0.6 g/cm³. These data are useful for a wide variety of practical and scientific applications, including the estimation of forest stand biomass from wood volume data.

Keyword: Wood quality, Density, Tree species

M. CHUDNOFF, E.D. MALDONADO & E. GOYTIA
Solar drying of tropical hardwoods
Forest Service Research Paper, Forest Service, Institute of
Tropical Forestry, Puerto Rico, ITF-2, 1-25, 1966, English

The lumber solar dryer is a wood-framed structure covered with thin transparent materials that permit transmission of shortwave solar energy. Baffled fans provide air circulation. Air exchange is regulated using adjustable vents and mist sprayers permit some additional control of relative humidity. At Rio Piedras-San Juan, temperature, relative humidity, and solar radiation are fairly uniform throughout the year, being slightly more favorable for rapid lumber drying during February - March.

Keyword: Wood drying, Wood utilization

MARK PLOTKIN & LISA FAMOLARE (editors)
Sustainable harvest and marketing of rain forest products
Island Press, Washington, D.C., USA
325, 1992, English

There is a growing realization in the environmental community that if conservation projects are to succeed over the long term, local peoples must materially benefit from these efforts. Too often, industrial forestry in the tropics has had terrible social and environmental costs. But unlike wood, nontimber forest products (fruits, fibers, medicines, and so forth) can often be harvested without any damage to the ecosystem. This labor-intensive, capital-extensive approach is well suited to local conditions in many tropical countries. If we are to manage the forest as a renewable resource, we must pay increased attention to the potential of nontimber products.

Nevertheless, several serious questions exist concerning the best way to bring nontimber forest products to local, national, and international markets: What species offer the greatest promise? What levels of harvest are sustainable? How can native peoples best be compensated for their knowledge and their efforts?

In order to answer these and other questions, Conservation International (CI) and the Asociación Nacional para la Conservación de la Naturaleza (ANCON) invited experts from around the world to a meeting held in Panama City, Panama on June 20 to 21, 1991. This book is based on the proceeds of that meeting.

Keyword: Forest management, Non-timber products, Social and economic analysis

C.I. OGBONNAYA
Effects of nitrogen sources on the wood properties of *Gmelina arborea*
relevant to pulp and paper
Forest Ecology and Management, Elsevier, Netherlands
Vol. 56 (1-4), 211-223, 1993, English

The effects of different nitrogen sources and levels of application on the physical and histological properties, and on resultant values relevant to pulp and paper production, of *Gmelina arborea* seedlings on latosolic soil were investigated. The nitrogen sources were: nitrate-nitrogen ($\text{NO}_3\text{-N}$) supplied as potassium nitrate (KNO_3), ammonium-nitrogen ($\text{NH}_4\text{-N}$) given as ammonium sulphate ($\text{NH}_4)_2\text{SO}_4$, ammonium nitrate-nitrogen ($\text{NH}_4\text{NO}_3\text{-N}$) applied as calcium ammonium nitrate ($\text{CaNH}_4(\text{NO}_3)_2$) and urea-nitrogen (urea-N) fed as compound urea. The levels of application were 0.0, 2.5, 5.0 and 7.5 g N per plant. The control treatment received no form of nitrogen fertilizer.

All the nitrogen sources improved the specific gravity of *gmelina* wood on latosolic soil. The longest fibre cells were produced with $\text{NO}_3\text{-N}$ and the shortest with $\text{NH}_4\text{-N}$. Urea-N produced the narrowest fibre cells while $\text{NH}_4\text{-N}$ produced the widest fibres with the thickest walls. The coefficient of suppleness was not affected by the nitrogen sources. In relation to the control trees, urea-N and $\text{NO}_3\text{-N}$ sources produced a significantly higher slenderness ratio. Runkel ratios obtained with the various nitrogen sources were homogeneous. In nearly all the parameters measured, the optimal values were recorded with the first level of nitrogen application (2.5 g N per plant). The implications of the findings on pulp and paper production using *G. arborea* grown on

latosolic soil are discussed.

Keyword: Fast growing tree species, Fertilization, Wood quality, Wood utilization, Pulp, Wood physics

6-2 Non-timber Products

LUCIO PEDRONI

Sobre la producción de carbón en los robledales de altura de Costa Rica

Serie Técnica Informe Técnico No. 178, CATIE, Costa Rica

27, 1991, Spanish

The area of highest charcoal production in Costa Rica is located in the oak forest of the Talamanca mountain range along the Panamerican Highway between the villages of El Empalme and Villa Mills.

In this area, environmental impact and yield of charcoal production was evaluated comparing the traditional method of pits and the use of a transportable metal kiln. For this purpose, 23 pits and 11 production cycles using a transportable metal kiln were studied and 30 charcoal producers of 3 communities were interviewed.

The results of the study suggest that the traditional method of charcoal production leads to an excessive exploitation of the forest and does not produce attractive returns.

It is argued that using appropriate methods of forest regulation, organization and management, a more rational, sustainable and profitable forest utilization can be achieved, which would allow charcoal production exclusively from residues of the forest exploitation.

Using transportable metal kilns for charcoal production reduces the environmental impact. However, due to high construction costs, it will be necessary to demonstrate that the use of kilns guarantees attractive financial returns.

Keyword: Charcoal, Environmental assessment

Agroforestry that works for people

Ag-Sieve, Rodale Institute, USA, Vol VI (3), 1-2, 1994, English

In some tropical farming systems, cash crops compete with food crops for labor and land. In the smallholder rubber and swidden system of Borneo, the opposite is true. Rubber cultivation complements and enhances the growth of subsistence crops in swiddens - temporary agricultural plots cut from primary and secondary forests. A study of the farming practices of the Kantu' people in West Kalimantan highlights the benefits of rubber cultivation.

Fourteen families in the Kantu' longhouse of Tikul Batu own 66 separate rubber gardens, an average of almost five gardens per house-hold. Each garden, a little less than a hectare in size, contains 200 to 400 trees. Swidden cultivators use excess land and labor resources within the swidden system to cultivate the rubber gardens.

Keyword: Social and economic analysis, Agro-forestry, Non-timber products, Land-use

STEPHEN F. SIEBERT

The abundance and site preferences of rattan (*Calamus exilis* and

***Calamus zollingeri*) in two Indonesian national parks**

Forest Ecology and Management, Elsevier, Netherlands

Vol. 59 (1-2), 105-113, 1993, English

The abundance and site preferences of *Calamus exilis* and *Calamus zollingeri* were studied in primary forests of Kerinci-Seblat National Park and Dumoga Bone National Park, Indonesia, respectively. Forty sample

plots, each 0.05 ha in size, were established at random in principal rattan collecting areas in both parks. In each plot the number of rattan plants and canes, predominant light regime, soil nutrient characteristics and soil drainage patterns were measured. An average of 284 *C. exilis* plants with 191 mature canes and 1910 m of harvestable cane were observed per hectare in Kerinci-Seblat National Park. An average of 38 *C. zollingeri* plants with 86 mature canes and 2660 m of harvestable cane were observed per hectare in Dumoga Bone National Park. Populations of *C. exilis* (number of plants and canes) were negatively related to high light intensities. Conversely, populations of *C. zollingeri* (number of plants and canes) were positively related to high light intensities, specifically those associated with gaps in the forest canopy. Implications of rattan abundance and light preferences for cane harvesting and forest management are discussed.

Keyword: Rattan, Site quality, Growth, Environmental condition, Non-timber products

7. SOCIAL FORESTRY

SHOUQIN G ZHOU

Cultivation of *Amomum villosum* in tropical forests
Forest Ecology and Management, Elsevier, Netherlands
Vol. 60 (1-2), 157-162, 1993, English

Amomum villosum is a medicinal herb of high economic value. It has been widely cultivated as an underplanted crop both in natural forests and in tree plantations, which are now becoming a major type of agroforestry farming in Southern Yunnan, China.

This paper deals with the ecological characteristics of *Amomum villosum*, and techniques and benefits of its cultivation in natural forests and tree plantations, on the basis of the investigation and related available material.

Keyword: Agro-forestry, Non-timber products

WILLIAM R. BURCH, JR.

The uses of social science in the training of professional social foresters
Journal of World Forest Resource Management, UK
Vol. 3 (2), 73-109, 1988, English

In contrast to traditional forestry, which concentrates on the production of industrial wood, social forestry is primarily directed to community sustenance and improvement, and therefore requires the development of special skills on the part of those who practice it. Such skills are more concerned with human relationships than silvicultural manipulation or tree cultivation, and are often lacking in foresters trained according to conventional curricula. This paper identifies some important practical requirements in social forestry projects and relates these to key aspects of social science theory, methods and findings (i.e. assessment, tenure, institutional, community and innovation studies) which can improve project design and implementation and contribute to the development of social forestry as a discipline in its own right. The paper concludes with a suggested curriculum for a training programme for professional social foresters.

Keyword: Social forestry, Training

D.A. GILMOUR & G.C. KING

Management of forests for local use in the hills of Nepal.
1. changing forest management paradigms
Journal of World Forest Resource Management, UK
Vol. 4 (2), 93-110, 1989, English

Since 1950 the Government of Nepal has shown a dramatic change in its attitude towards the condition of hill forests. Early indifference changed to an acute awareness as the extent of the deforestation problem became better known and its impact on village life became better understood. The initial reaction was to attempt to enforce protection through nationalisation legislation. However, this failed. During the past 28 years there have been several legislative changes which have reflected shifts in policy aimed at handing back the forests and forest management to the village users themselves. This change has been accompanied by the emergence of a new forestry paradigm which can be described as "people centred" as opposed to the earlier "forest centred" one. This new paradigm became necessary as it was no longer possible to solve the problems of community forestry by remaining within the older paradigm. However, as the two paradigms presently co-exist, there is a potential for misunderstandings and conflicts between the protagonists of the two groups.

Keyword: Forest conservation, Forest development, Rural community, Social forestry

G.C. KING, MARY HOBLEY & D.A. GILMOUR
Management of forests of local use in the hills of Nepal.
2. towards the development of participatory forest management
Journal of World Forest Resource Management, UK
Vol. 5 (1), 1-13, 1990, English

The implementation of community forest management in Nepal requires the development of a management plan in consultation with the forest users. In the first of two case studies described, the process of management plan development started with the calling of public meetings and the rapid writing of a plan. This result in the domination of the forest committee by local elites. The people who most use the forest were isolated from the process and knew very little about it. The management plan can be implemented only with the authority of the Forest Department staff. This was because the intervention by project and Forest Department staff was carried out with insufficient understanding of the nature of local communities, forest users, etc. In the second case study, a lengthy period was spent in the village, building rapport and developing an understanding of the local situation with all the groups who had any interest in the forest. The agreement was drawn up in the village, by the villagers who most used and depended on the forest. Implementation is being carried out by the users with advice given, when requested, by Forest Department field staff. The implications of institutionalising such a process into a government department are discussed.

Keyword: Community forestry, Rural community, Forest development

SILVIO BRIENZA JUNIOR
Programa agroflorestal da EMBRAPA-CPATU/PNPF para a Amazônia Brasileira
CPATU Documentos, 9, EMBRAPA-CPATU, Belém, Brazil
11, 1982, Portuguese

The program of agricultural/forestal research of EMBRAPA-CPATU/PNPF for the Brazilian Amazon is presented herein-after. The studies are recent and include initially the identification of the systems already used by the farmers of the region. Actually some of these modified systems are left over in the camp. We mention also the agricultural cultivations of short and medium cycle, and flower species, such as those with agricultural and silvicultural characteristics desirable for the agricultural/forestal systems.

Keyword: Research system, Agro-forestry

KENNETH G. MACDICKEN & NAPOLEON T. VERGARA (editors)
Agroforestry: classification and management
John Wiley & Sons, New York, USA, 382, 1990, English

Agroforestry is an ancient land use of great promise as a new agricultural science. Traditional farmers have long used trees in combination with livestock and annual crops, yet agricultural science has in the past largely ignored the role of trees in farming systems. The 1970s saw an awakening of interest in this new field of science, which has since captured the attention of researchers, development agencies, and governments.

This book efforts to collect and collate in a systematic manner current information on agroforestry practices and systems in most of the major agroecological zones of the world. In addition to describing these systems and practices, this volume covers important issues of design, economics, research, and extension.

The contributors to this volume have prepared reviews of current knowledge of agroforestry systems, practices, and management as well as some of the research and development issues that face individuals and institutions working in this important field.

Keyword: Agro-forestry, Intercropping, Land-use

DEAN CURRENT, ERNST LUTZ, SARA SCHERR et al.
Agroforestry - case studies
The World Bank, Washington, D.C., USA
536, 1994, English

This publication is case studies of agroforestry projects implemented in the Central America and Caribbean.

The publication contains overview and economic and institutional analysis of the agroforestry projects in Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua.

Keyword: Agro-forestry, Social and economic analysis

P.K.R. NAIR

The prospects for agroforestry in the tropics

**World Bank Technical Paper No. 131, The World Bank, Washington, D.C.,
USA, No. 131, 77, 1990, English**

Agroforestry has come of age remarkably during the past 10 to 15 years. However, the lack of a synthesized 'package' of technical and socio-economic information on agroforestry is a serious drawback in channeling development assistance to agroforestry projects. The objective of this report is to fill this gap. By reviewing the scientific information currently available, the report seeks to establish the scientific basis and principles of agroforestry and to evaluate field research on agroforestry practices; it also discusses the economic and socio-cultural aspects of agroforestry, as seen by a 'non-expert'. A comprehensive bibliography is appended to the report.

Several important conclusions emerged from this review are the following.

- Agroforestry systems are many and varied, as are their functions, roles and outputs.
- There is ample scientific evidence to indicate that the benefits to be derived from agroforestry could be considerably increased by appropriate scientific intervention.
- Scientific studies in agroforestry have been very limited, and thus the potential of agroforestry remains vastly under-exploited.
- The main scientific foundation of agroforestry is the multipurpose tree. The success of agroforestry will depend upon the extent to which the productive, protective and service potential of multipurpose trees is understood and exploited (through research) and realized (through development and extension efforts).
- The current trend in agroforestry development shows an imbalance between large-scale development projects and inadequately low levels of research and educational support.

Keyword: Agro-forestry, Social and economic analysis, Evaluation, Multipurpose trees

CYNTHIA C. COOK & MIKAEL GRUT

Agroforestry in Sub-Saharan Africa: a farmer's perspective

**World Bank Technical Paper, The World Bank, Washington, D.C.,
USA, No. 112, 94, 1991, English**

This study reviews agroforestry practices in Sub-Saharan Africa as seen from the farmer's perspective. The literature on agroforestry was reviewed in order to identify a limited number of successful experiences for further field study. Seven case studies were then conducted by an interdisciplinary team, covering indigenous and innovative systems found in the highlands of East Africa, the semi-arid zone, and the humid lowlands of West Africa.

This review identified a number of issues that need to be considered in the design and implementation of agroforestry projects for Africa in order for them to be successful. Key findings include the importance of understanding the economics of agroforestry systems from the farmer's point of view as well as from the broader perspective of the benefits to society. Project evaluation should therefore take into account local markets and opportunities for off-farm employment offered by tree products, as well as the opportunity costs perceived by farmers in making adoption decisions. In Africa, trees are integral parts of agro-sylvo-pastoral farming systems and should be considered in sociocultural context, with particular attention to the constraints imposed by customary and legal rules regarding land and tree tenure. Recommendations are made for the technical, economic, social, and institutional design of projects and for the direction of future research.

Keyword: Agro-forestry, Social and economic analysis

ANGELO MALIKI BONFIGLIOLI

Agro-pastoralism in Chad as a strategy for survival

**World Bank Technical Paper, The World Bank, Washington, D.C.,
USA, No. 214, 49, 1993, English**

The paper is a wide-ranging multi-disciplinary study of the system within which Sahelian agropastoral groups in Chad live and work. It examines the key features of a traditional rural society, describing the Chadian agropastoral universe as a coherent whole, governed by an internal dynamic that operates according to its own rationalities within an environment of uncertainty.

The consequences of war, climatic conditions and the interplay of economic mechanisms are just some of the random factors that augment the atmosphere of insecurity. In attempting to counteract this insecurity, the Chadian agropastoral society has surrounded itself with traditional organizational practices which regulate the behavior of its members: networks of mutual support and interdependence, division of labor among household members, hierarchically-ordered decision-making, etc. Down through the generations, this society has also built up a fund of appropriate technical knowledge, which accommodates the rhythm of the seasons and ensures optimum production results, whatever the circumstances, from its crop-growing and pastoral activities.

Accurate knowledge of the mechanisms of this society facilitates definition of appropriate analytical concepts and design of suitable tools for the observation, measurement and analysis of economic behaviors. Through its cultural and sociological description of a traditional society, the paper allows the investigator a twofold perspective: that of economic analysis, which attempts to explain behaviors, and that of statistical observation, which attempts to measure them.

Keyword: Agro-forestry, Arid region, Social and economic analysis

PETER A. DEWEES

Trees, land, and labor

**World Bank Environment Paper, The World Bank, Washington, D.C.,
USA, No. 24, 52, 1993, English**

Smallholder tree cultivation and management is a common form of land-use in high-potential areas of Kenya. Some practices, such as the planting of trees on field boundaries, are strongly embedded in customary notions of land and tree tenure. Others, such as the planting of black wattle (*Acacia mearnsii*) woodlots, are more recent innovations, introduced to produce commodities for domestic and export markets. This study explores the economic dimensions of tree growing in Kenya, using land-use studies and the results from a household survey in the upper coffee/lower tea zone of Murang'a District.

Keyword: Agro-forestry, Social and economic analysis, Land-use

NATIONAL RESEARCH COUNCIL

Microlivestock

**Board on Science a Technology for International Development,
National Research Council, National Academy Press, USA
449, 1991, English**

Like computers, livestock for use in developing countries should be getting smaller and becoming more "personal." Conventional "mainframes," such as cattle, are too large for the world's poorest people; they require too much space and expense. "Miniframes," such as the conventional breeds of sheep and goats, have an increasingly important role to play. But "tiny, user-friendly" species for home use are the ones highlighted in this report. Authors have called them "microlivestock."

There are two types of microlivestock. One consists of extremely small forms of conventional livestock - such as cattle, sheep, goats and pigs. The other consists of species that are inherently small - poultry, rabbits, and rodents, for instance.

Keyword: Agro-forestry

REMKO VONK & RACHEL SAFMAN
Kenya agroforestry project: some new ideas
SAIS The Johns Hopkins University, USA, Social Forestry
44, 1991, English

The need to combat desertification, the fuelwood shortage, and environmental degradation has been acutely evident to development professionals since the early 1980s. Perceiving tree planting as inherently effective and universally appropriate solutions to these problems, donors and host governments have aggressively pursued agroforestry projects. In the process, however, local social and economic factors often have received short shrift. Hence, community participation has rarely outlasted external funding and support, because villagers were not fully persuaded that they had much to gain by planting and maintaining trees on public lands.

Against this backdrop, a CARE International project has been breaking new ground in western Kenya by targeting family farm plots rather than village commons. The Agroforestry Extension Project (AEP) grants control of trees to individuals on their own land rather than using villagers merely as labor to plant public tracts. In the eight years since its inception, the AEP has covered more than 300 communities in Siaya and Nyanza Districts.

Keyword: Planting, Social forestry, Forest policy

GARY S. HARTSHORN
National forest management by the Yanasha forestry cooperative in
Peruvian Amazonia
128-137, English

Five native communities of Amuesha (Yanasha) Indians in the Palcazu valley of eastern Peru formed a forestry cooperative to manage their natural production forests on a sustained-yield basis. Long, narrow (30-40m wide) strips are clear-cut to maximize utilization of timber and to facilitate natural regeneration of trees. The strip clear-cuts are rotated through a production forest so that uncut primary forest or advanced secondary forest borders a harvested strip. The clear cutting of narrow strips in a production forest promotes excellent natural regeneration of hundreds of native tree species. Local processing of timber for sawwood, preserved posts and poles, and charcoal adds considerable value to the native forest products. Timber production from Amuesha forest lands, local processing (sawmill and preservation plant), and marketing of forest products are vertically integrated through the operations of the Yanasha forestry cooperative. Net returns (after local processing) are projected to be \$3500 per hectare harvested.

Keyword: Community forestry, Sustainable management of forest, Forest management

ANTHONY STOCKS & GARY HARTSHORN
The Palcazu project: Forest management and native Yanasha communities
Journal of sustainable Forestry, The Haworth Press, Inc.
Vol. 1 (1), 111-135, 1993, English

This paper presents some of the background and the current operations of a novel management system incorporating landholders in tropical forestry.

The pilot program is taking place among native Amazonian Indians, the Yanasha of eastern Peru, and is based on several social assumptions: (1) Appropriate land management in the Amazon forests must be carried out by the poor resident landholders or it will not be carried out at all, as Amazon governments lack the capability of controlling land use in any detailed way; (2) The people who own land and live on it have the major interest in its preservation for sustained production; (3) Investments must take place in the sectors of smallholders and native communities; (4) Long-term training programs are vital aspect of the investments; (5) Such communities must be given the means to manage their natural resources with an economic return.

Keyword: Forest management, Social forestry, Forest development, Social and economic analysis

MARTHA E. AUERY, MELVIN G.R. CANNELL & CHIN K. ONG
Biophysical research for Asian agroforestry
Winrock International, USA and South Asia Books, USA, 292, 1991, English

The purpose of this volume is to provide a framework for examining some of the biophysical principles underlying agroforestry. Arguments in favor of growing trees with agricultural crops are often based on untested assumptions, and many of the critical biological issues have not been addressed previously. This volume differs from others in that it focuses on evaluating rather than describing agroforestry systems.

This volume includes chapters on experimental design specifically for agroforestry research and chapters investigating plant, soil and livestock interactions.

The social implications of biophysical research are addressed in the chapter by Hocking. The chapter by Jones and Lowry is unusual in that it approaches the objective of increasing fodder availability by improving fodder quality and digestibility, not by increasing the biomass yield from agroforestry systems. The chapter by Briscoe goes beyond small farm agroforestry systems to explore silvicultural applications for industrial and government lands.

Keyword: Agro-forestry, Silvicultural technique, Tree species, Social and economic analysis, Research system

JO ELLEN FORCE
Tropical tree planting and global climate change
USDA, USAID, University of Idaho, USA, 44, 1992, English

This report examines some of the approaches to increasing tropical forestry activities through the direct involvement of local people in appropriate forestry development activities. Forest programs started in the past few decades have provided valuable information on local people's participation in forestry. Technical considerations for tropical forestry activities; including natural management, tree growing technologies and spaces, and cost considerations are reviewed. The potential benefits of tropical forestry activities are examined.

Keyword: Forestry, Social forestry, Silvicultural technique, Community forestry

Agroforestry in Burkina Faso: a careful balance
Ag-Sieve, Rodale Institute, USA, Vol. VI (3), 2-5, 1994, English

According to a recent study the benefits of leaving the trees in the fields outweigh the costs. Sorghum grain yield under the Karité and the néré are reduced by an average of 50% and 70% respectively. However, the fruit the trees produce is worth more than the sorghum yield loss.

The study area in Burkina Faso is 150 km west of the capital Ouagadougou, within the territory of the village Oula in the Mouhoun Province. The region is sparsely populated. The natural vegetation is a mixed shrub-tree savanna. About 10% of the village territory is cultivated by farmers who rarely use animal traction or fertilizers. Tree canopies on cropland, largely dominated by Karité and néré, cover 10 to 15% of the area.

Researchers examined tree characteristics, crop growth and production and site characteristics to determine the effect of trees on crop production.

Keyword: Agro-forestry, Social and economic analysis, Food production, Forest utilization

MICHAEL D. BENG
Contour hedgerows of woody perennials reduce erosion.
Agro-forestation series, S&T/FENR, USAID, USA, 12, 1-37, 1987, English

Agroforestry systems using nitrogen-fixing woody perennials, such as *leucaena leucocephala* and *Gliricidia sepium*, planted in contour hedges on hillsides, have proven to be an inexpensive and effective technology to control soil erosion, improve soil structure, and increase crop yields. Simultaneously, these systems produce abundant forage and fuelwood.

Keyword: Tree species, Legume tree, Nitrogen fixation, Erosion, Agro-forestry, Fuelwood/Fire wood

8. OTHERS

WORLD BANK

Forestry: the world bank's experience

A Work Bank Operations Evaluation Study, Operations Evaluation

Department, The World Bank, Washington, D.C., USA, 49, 1993, English

This is the first OED review of Bank experience in the forestry sector. The review examines three areas: development performance of Bank-financed operations, implementation experience, and sector work. Its aim is to provide a more solid foundation for helping the Bank's operational staff and policy makers design projects and establish adequate policies. The most important reason for undertaking such study is the need to take stock of experience in a sector central to the development/environment debate. As perceptions about the role of forests in development have changed, donor agencies are making efforts to expand their lending programs. It is important to review past experience and assess the extent to which new lending modes and strategies are needed. This review presents a detailed account of the Forestry Policy Paper, issued in 1978.

The study assesses several dimensions of the Bank's experience in forestry development: project performance, principal determinants of performance, performance of forestry project components, implementation issues, and evaluation of sector work. By considering these dimensions, this study is able to make operationally useful recommendations for projects and policy.

Keyword: Forest development, Forest policy, Forestry

U.S. FOREST SERVICE

Training manual for forestry technicians in the caribbean

An Institute of Tropical Forestry Publication, U.S. Forest Service,

Washington, D.C., USA, 1985, English

As part of the U.S. Government's contribution to the Caribbean Environmental Action Plan, the U.S. Agency for International Development funded two training courses for Caribbean Islands junior foresters. The training was conducted at the U.S. Forest Service, Southern Forest Experiment station, Institute of Tropical Forestry in Puerto Rico. This training was a direct response to the concern expressed by many island governments in a Caribbean foresters meeting held in St. Lucia.

This document summarizes the lecture and field materials used in the training. Because of the diversity of staff and the emphasis on field training (50% of the course was outdoors), the manual is not in book-form narrative.

Keyword: Training, Guideline, Study and training

T.M.B. ABELL

The application of land systems mapping to the management

Indonesian forests

Journal of World Forest Resource Management, UK

Vol. 3 (2), 111-127, 1988, English

Land system, land use and land status maps for Indonesia are presently being compiled for Sumatra and have been completed for Irian Jaya and Kalimantan. The maps are being prepared primarily to assist the Department of Transmigration in selecting possible sites for development. They are also seen to be of value to other land use planners including the management section of the Forest Department. The current method of classifying Indonesian forests is explained and suggestions are made for its improvement by linking the land system maps to a potential erosion index.

Keyword: Land-use, Forest management, Forest conservation

M.S. ROSS & D.G. DONOVAN

The world tropical forestry action plan: can it save the tropical forest?

Journal of World Forest Resource Management, UK

Vol. 2 (2), 119-136, 1986, English

Although the main aim of the tropical forestry action plans prepared by the World Resources Institute and FAO Committee on Forest Development in the Tropics was to reduce tropical deforestation, the authors suggest that the plans avoid tackling the issue of deforestation directly and that the focus of attention is primarily on remedial action. The activities proposed in the "new" plans are not significantly different from previous forestry development activities. These have not proved successful in stemming forest destruction and a change in approach is needed. An improved programme would include: the involvement of all countries and groups who wished to participate; gaining the support of governments at highest levels; cross-sectioned review of government policies and programmes; long-term assistance in policy development and planning; reviews of the programmes of development assistance agencies to ensure they are not working at cross purposes; and an examination of developed country policies.

Keyword: Forest management, Forest development, Forest policy, Forest conservation

ALAN GRAINGER

Quantifying changes in forest cover in the humid tropics overcoming current limitations

Journal of World Forest Resource Management, UK

Vol. 1 (1), 3-63, 1984, English

The present limitations of LANDSAT satellites, e.g. low resolution and infrequent recording of images of areas in the humid tropics, are described, and there is a review of the ways in which such limitations are likely to be reduced over the course of this decade. Attention is paid to the role of semi-automatic techniques for analysing satellite imagery, both from the point of view of increasing the sophistication of monitoring techniques, and also examining the feasibility of an operational continuous monitoring system. The development of efforts by UN agencies to establish such a system are described, progress is critically reviewed, and suggestions are made concerning the appropriate technical requirements and organizational possibilities for a successful programme of this kind.

Keyword: Forest inventory, Research and development

JOHN O. BROWDER

Lumber production and economic development in the Brazilian Amazon:

Regional trends and a case study

Journal of World Forest Resource Management, UK

Vol. 4 (1), 1-19, 1989, English

Prevailing theories about the nature of economic expansion in the Brazilian Amazon have focused almost exclusively on production relations and land conflicts in the agrarian sector. This paper suggests that the region's growing urban sector is an important but little studied component of the process of capital expansion in Amazonia. The industrial wood sector is now a leading sector in the economy of the Amazon region and the economic foundation of many frontier urban settlements. It therefore provides a window onto the processes of urbanization, industrialization and capital accumulation in the Brazilian frontier. The recent growth of industrial wood production and processing in the Amazon is described, and a case study examines the forward linkages of the lumber industry and its impacts on employment, household income and value of production in several key sectors of the local economy of a frontier town, i.e. transport, construction, furniture and fuelwood.

Keyword: Forest development, Rural community, Wood utilization, Social and economic analysis

JOSEPH A. FUWAPE

**Contributions of forest industries to rural community development
in Nigeria**

Journal of World Forest Resource Management, UK

Vol. 6 (1), 41-47, 1991, English

The distribution of the main sawmills, plywood and particle board factories and pulp and paper mills in Nigeria is described, and their contribution to rural development in Nigeria by providing employment, building roads, and improving local amenities is quantified. Sawmills are the most widespread forest industry, and their total work force could exceed 16,000 people. Total employment in the forest industries is estimated at 80,335 with another 29,649 in forest operations.

Keyword: Forest development, Wood utilization, Rural community, Social and economic analysis

Dirección de Investigación Forestal y de Fauna

Ensayos de especies forestales exóticas y guía para su zonificación en la sierra Peruana

Proyecto FAO/Holanda/INFOR (GCP/PER/027/NET), Peru, 87, 1985, Spanish

Over 100 species, mainly Eucalyptus, Pinus and Cupress, have been experimentally planted in mountain areas in Peru. Recently, zoning has been attempted to determine which species are suitable for specific mountain areas.

This book serves as a guide to zoning. It begins with the history of forestation in Peru. Optimal places for future forestation activity are proposed. Knowing environmental conditions is essential to the zoning of mountain areas. This book analyses various factors which may affect the topography, soil and climate of such areas in Peru and then shows the results of tests on tree species (their growth about five years after planting). It also introduces the zoning method using these results.

Keyword: Site classification, Site condition, Tree species

INSTITUTO FLORESTAL

Revista do instituto florestal

Instituto Florestal, São Paulo, Brazil

Vol. 3-2, 127-190, 1991, English/Portuguese

This is Vol. 3-2 of "REVISTA DO INSTITUTO FLORESTAL" (*Rev. Inst. Flor.*) replacing the "SILVICULTURA EM SÃO PAULO" (*Silvic. S. PAULO*) and the "BOLETIM TECNICO DO INSTITUTO FLORESTAL" (*Bol. Téc. IF.*) both edited by this institution and interrupted at the end of 1989. Scientific articles, scientific notes and bibliographic reviews are edited in this publication.

Keyword: Research and development

INSTITUTO FLORESTAL

Revista do instituto florestal

Instituto Florestal, São Paulo, Brazil

Vol. 3-1, 126, 1991, English/Portuguese

This is Vol. 3-1 of "REVISTA DO INSTITUTO FLORESTAL" (*Rev. Inst. Flor.*) replacing the "SILVICULTURA EM SÃO PAULO" (*Silvic. S. PAULO*) and the "BOLETIM TECNICO DO INSTITUTO FLORESTAL" (*Bol. Téc. IF.*) both edited by this institution and interrupted at the end of 1989. Scientific articles, scientific notes and bibliographic reviews are edited in this publication.

Keyword: Research and development

INSTITUTO FLORESTAL
Revista do instituto florestal
Instituto Florestal, São Paulo, Brazil
Vol. 2-2, 115-226, 1990, English/Portuguese

This is Vol. 2-2 of "REVISTA DO INSTITUTO FLORESTAL" (*Rev. Inst. Flor.*) replacing the "SILVICULTURA EM SAO PAULO" (*Silvic. S. PAULO*) and the "BOLETIM TECNICO DO INSTITUTO FLORESTAL" (*Bol. Téc. IF.*) both edited by this institution and interrupted at the end of 1989. Scientific articles, scientific notes and bibliographic reviews are edited in this publication.

Keyword: Research and development

INSTITUTO FLORESTAL
Revista do instituto florestal
Instituto Florestal, São Paulo, Brazil
Vol. 2-1, 114, 1990, English/Portuguese

This is Vol. 2-1 of "REVISTA DO INSTITUTO FLORESTAL" (*Rev. Inst. Flor.*) replacing the "SILVICULTURA EM SAO PAULO" (*Silvic. S. PAULO*) and the "BOLETIM TECNICO DO INSTITUTO FLORESTAL" (*Bol. Téc. IF.*) both edited by this institution and interrupted at the end of 1989. Scientific articles, scientific notes and bibliographic reviews are edited in this publication.

Keyword: Research and development

INSTITUTO FLORESTAL
Revista do instituto florestal
Instituto Florestal, São Paulo, Brazil
Vol. 1-2, 119, 1989, English/Portuguese

This is Vol. 1-2 of "REVISTA DO INSTITUTO FLORESTAL" (*Rev. Inst. Flor.*) replacing the "SILVICULTURA EM SAO PAULO" (*Silvic. S. PAULO*) and the "BOLETIM TECNICO DO INSTITUTO FLORESTAL" (*Bol. Téc. IF.*) both edited by this institution and interrupted at the end of 1989. Scientific articles, scientific notes and bibliographic reviews are edited in this publication.

Keyword: Research and development

INSTITUTO FLORESTAL
Revista do instituto florestal
Instituto Florestal, São Paulo, Brazil
Vol. 1-1, 250, 1989, English/Portuguese

This is the first number of "REVISTA DO INSTITUTO FLORESTAL" (*Rev. Inst. Flor.*) replacing the "SILVICULTURA EM SAO PAULO" (*Silvic. S. PAULO*) and the "BOLETIM TECNICO DO INSTITUTO FLORESTAL" (*Bol. Téc. IF.*) both edited by this institution and interrupted at the end of 1989. Scientific articles, scientific notes and bibliographic reviews are edited in this publication.

Keyword: Research and development

EMBRAPA-CPATU
1° simpósio do trópico Úmido, flora e floresta
Anais, Proceedings, Departamento de Difusão de Tecnologia,
Brasília, Brasil, Vol. II, 493, 1986, English/Portuguese

In 1982, the "Committee on Selected Biological Problems in the Humid Tropics" defined the humid tropics as "those areas of the earth's land surface where the mean annual biotemperature in the lowlands is greater than 24°C and where annual rainfall equals or exceeds potential evaporative return of water to the

atmosphere".

The humid tropics, by the geographic and climatological concepts, are the regions of the Earth between the Tropics of Cancer and Capricorn, with high temperature and air humidity, with large amount of solar radiation and, in general, covered by broad-leaf evergreen forests.

The 1st Symposium on the Humid Tropics emerged from the necessity to collect the maximum possible amount of information – presently available in a scattered manner – on natural resources of the ecological region of the humid tropics and technologies on available for rational utilization of the resources for agricultural production which is necessary for the well-being of the communities of the region and for exporting.

A very significant response from the scientific and technical community to this effort can be observed from the fact that 312 papers were submitted to the Symposium with the participation of 700 researchers from several states of Brazil and from 23 other countries.

The Proceedings of the 1st Symposium on the Humid tropics consist of six volumes as follows: I – Climate and Soil; II – Flora and Forestry; III – Temporary Crops; IV – Perennial Crops; V – Pasture and Animal Production and VI – Multidisciplinary Themes.

Keyword: Tropic, Natural resources, Forestry, Graze, Food production

CPATU-EMBRAPA

Pesquisas florestais da EMBRAPA na região Amazônica
CPATU Documentos, 13, EMBRAPA-CPATU, Belém, Brazil
13, 1982, Portuguese

The results achieved by the National Program of Forestal Research (PNPF) in the Amazon region are presented herein. The actual priorities of the research are concentrated in five basic lines: Exploitation and Management, Silviculture, Genetic Improvement, Agricultural/Forestal Systems, and Ecology. Within these orientations for research, 19 projects are in progress, involving 57 experiments distributed within the States of Pará, Amazon, Roraima, Acre and the Federal Territories of Amapá and Roraima.

Keyword: Research system, Silvicultural technique, Breeding, Ecology, Agro-forestry

CPATU

Encontro sobre pesquisa florestal na região do Tapajós
EMBRAPA-CPATU, Belém, Brazil, 69, 1991, Portuguese

The conference on the forestal research in the Region of Tapajós, conceived by CPATU with the participation of IBAMA and SUDAM, constitutes a rare opportunity for the producers and researchers to discuss some of the main results that the research has already achieved in the said area.

The success of this event will not remain the exclusive merit of CPATU. All those who, directly or indirectly, have participated in this event, also merit the laurels of this success. Actually, it is not easy to realize events of this kind, for which it is important to have the cooperation of all the sectors involved in the Amazon problems.

On the other hand, it is stated that this Conference is not conclusive. Due to the short period of time that has been provided, it remains clear that it is necessary to proceed with events of this kind, always trying to approach the producers with this research and through these contacts to refine their orientations and to contribute in an effective manner to the development of the Amazon rural environment.

Keyword: Research system, Research and development

PERMÍNIO PASCOAL COSTA FILHO & JOSE MARIA LIMA

Noções de exploração mecanizada para floresta de terra
firme-caso curuá-una
EMBRAPA-CPATU, Belém, Brazil, 20, 1992, Portuguese

In recent years the Brazilian government has called for efforts to increase the productive capacity of the Amazon forest, so that this region be provided with the same rate of social and economical development (with real effectiveness) as for the other regions of the country.

It is essential to provide a radical and practical transformation in the rudimentary methods used in the exploitation, with the utilization of a modern and rational methodology, based mainly on a high level of mechanization of the various operations.

In consideration of all these problems, it has been intended through this work to give some orientations on the plan of forestal exploitation, taking as an example the case of Curuá-Una, where an inventory with the floristic mapping has been realized on an area of 1,000 ha.

It has been intended also to provide a technical help regarding the methods for the mechanical exploitation in the wood of "terra firma", in order to ensure the rationality of exploitation activity and the continuous supply of raw material to the lumber industries.

Keyword: Forest development, Forest management, Forest utilization, Mechanization

JOSÉ ADERITO RODRIGUES FILHO, ARI PINHEIRO CAMARAO et al.

Avaliação de subprodutos agroindustriais para a alimentação de ruminantes

EMBRAPA-CPATU, Belém, Brazil, 15, 1993, Portuguese

With respect to the high cost of concentrated foods, traditionally used and imported from other regions, the productive systems for milk or meat in the Amazon are based almost exclusively on the use of voluminous foods, exploited in condition of pasture or cutting, without giving attention to the nutritional requirements of the animals and, therefore, causing low rates of productivity by the herbs.

Considering the economical potential of some cultures exploited in the region, following which the improvement leaves a great amount of residues, a study has been developed with the aim to identify and evaluate the various subproducts existing in the region, through the chemical composition and nutritive value, that may be benefited rationally in the feeding of ruminant animals, reducing thus the actual regional dependency and the final cost of production.

Keyword: Deforestation, Graze, Grazing forest

PNPF-EMBRAPA

Programa nacional de pesquisa florestal, período 1983-1985

EMBRAPA, Brasília, Brazil, 35, 1982, Portuguese

The National Program of Forestal Research (Programa Nacional de Pesquisa Florestal, PNPF) is part of the cooperative system of research of EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária = Brazilian Agricultural Stock-Farming Research) to which Number 035 has been assigned. On the other hand, it is endowed with special characteristics since it resulted from the Agreement signed on May 4, 1977 by IBDF (Instituto Brasileiro de Desenvolvimento Florestal = Brazilian Institute of Forestal Development) and by EMBRAPA.

The National Research program has been presented to the Brazilian forestal community in a meeting held in São Paulo in 1978, during which it has been analyzed, discussed and approved. Its implementation was due in the same year and actually PNPF has 72 projects which include 440 experiments installed in 18 Units of the Federation.

The program as presented herein will be developed in the period from 1983 to 1985.

Keyword: Research system, Research and development

SIMÓN TEITEL

Industrial and technological development

Inter-America Development Bank, Washington, DC., USA

293, 1993, English

Industrial and technological development are closely intertwined, but in ways not yet fully understood. It is the purpose of this collection of essays to present key characteristics of both the manufacturing industries and the process of technology transfer, adaptation, and development. Although the focus is on the developing countries, many of the concepts and insights developed in the book also apply to industrialized countries. The

first six chapters cover topics related to technological characteristics of the manufacturing industries, while the last six deal with aspects of technology acquisition and the development of technological capabilities.

Keyword: Research and development

ELLIOTT A. NORSE

Ancient forests of the pacific northwest

Island Press, Washington, D.C., USA, 327, 1990, English

This book focuses on one geographic region of the United States, but its basic story – with amazingly few variations – is being repeated from the North Woods of Maine to the flatwoods of Florida, from the Brazilian rainforests of Rondonia to the Australian gum forests of Queensland. The Pacific Northwest is hardly unique. Indeed, in nearby British Columbia, ancient forests are disappearing even faster. Driven by uncontrolled population growth and escalating demands, people are destroying the resource base on which we depend.

Our only chance of achieving and sustaining a decent standard of living lies in understanding living systems. This book, then, is an attempt to equip us for maintaining the source of our wealth and well-being in one very special corner of the Earth. You might think that understanding is not enough. But I believe that if enough of us understand that these remarkable ecosystems are vital to our self-interest, we cannot help but find the ingenuity and wisdom to protect their integrity. Indeed, I would wager that people who once sold or logged them will become their staunchest and ablest defenders.

Keyword: Deforestation, Forest resources, Natural resources, Environmental conservation

MIKAEL GRUT, JOHN A. GRAY & NICOLAS EGLI

Forest pricing and concession policies: managing the high forests of West and central Africa

World Bank Technical Paper, The World Bank, Washington, D.C., USA, No. 143, 77, 1991, English

The theme of this paper is that proper pricing supported by new concession policies can encourage and support sustainable management and conservation of the forests of West and Central Africa, reflect the values of the forest resources, and finance forest management.

Forestry departments in most West and Central African countries are weak, under-funded and under-equipped. Without vehicles and per diems enabling them to do field work, staff are office-bound, under-employed, and unable to inspect concessions, enforce regulations, or supervise forest revenue collection. Until the forestry departments can be strengthened, a simpler system of forest fees that emphasizes bidding and concession fees is recommended. The forest revenue and concession policies proposed involve the following components.

1. An annual concession rent, which should be the major revenue source, to replace the present multiplicity of forest fees, that are often not collected.
2. Where competition is adequate, the level of the annual concession rent should be set by competitive bidding.
3. Logging concessions should be replaced by forest management concessions.

These recommendations are developed from a review of the major issues in West and Central Africa forestry.

Keyword: Forest development, Forest policy, Forest management, Sustainable management of forest

DANIEL HILLEL

The efficient use of water in irrigation: principles and practices for improving irrigation in arid and semiarid regions

World Bank Technical Paper, The World Bank, Washington, D.C., USA, No. 64, 107, 1988, English

This book is in the nature of a primer, providing a basic review and analysis of the principles governing soil-crop-water-climate relationships, irrigation, and the efficient utilization of water in arid and semiarid regions. It presents a critique of traditional and of current irrigation concepts and practices, pointing out the needs and potentialities for improving the efficiency of land and water use in developing countries. Starting from a basic analysis of the environmental, physiological, and agronomic factors affecting irrigation, the book contrasts historical and modern approaches to management. It then describes methods of scheduling irrigation and of measuring irrigation water, and compares alternative irrigation systems. It also specifies the requirements and methods of drainage and salinity control. Finally, this book discusses some of the human considerations involved in the vital task of developing sound, appropriate, and sustainable irrigation systems.

Keyword: Arid region, Land-use, Soil conservation, Water conservation

MARK W. MOFFETT

The high frontier, exploring the tropical rainforest canopy
Harvard University Press, Cambridge, Massachusetts, and London,
England, 192, 1993, English

The immediacy of his writing and the intelligence of his photography make the canopy's fantastic architecture and unearthly inhabitants accessible to the general reader. In the tradition of the great nineteenth-century explorers, he captures the struggles of the individual scientists and the passions that enable them to brave perilous situations in pursuit of their work. *The High Frontier* is a modern classic of scientific discovery.

The contents of this book are as following.

- 1) Tree climbing for grown-ups
- 2) Seeing the forest for the trees
- 3) A palace of many floors
- 4) Gardens in the sky
- 5) Tapping the ground
- 6) Insects on a rampage
- 7) Furred and feathered on the top of the world
- 8) A floral symphony
- 9) Treetop game between plants and animals
- 10) A science nears maturity

Keyword: Ecology, Environmental protection, Ecosystem

JUDITH GRADWOHL & RUSSELL GREENBERG

Saving the tropical forests
Earthscan Publications Ltd., London, UK
207, 1990, English

This book grew out of a conference sponsored by the Smithsonian Institution, Friends of the National Zoo and the World Wildlife Fund-US in December 1985. The conference was organized to bring together people involved in developing positive approaches to tropical forest conservation.

The conservation effort cannot focus solely on establishing forest reserves (although large reserves are a necessary part of any conservation strategy). Unless the surrounding areas are developed in a sustainable manner and local communities are sympathetic to the protection of woodlots, greenbelts and larger parks, forest conservation will probably not succeed. Tropical forest conservation projects, therefore, must include not only forest reserves, but innovative approaches to economic development as well.

Clearly this volume is far from comprehensive; it is meant to spark debate and further research rather than to provide definitive answers. We believe, however, that the challenge of saving the tropical forests is so great that any attempt, however limited, to address the problem should be brought to public attention.

Keyword: Sustainable management of forest, Forest conservation, Environmental conservation

NATIONAL RESEARCH COUNCIL

Toward sustainability: soil and water research priorities for developing countries

National Academy Press, Washington, D.C., USA

65, 1991, English

Population growth, intensified land use, environmental degradation, and agricultural productivity are interrelated issues. Although agricultural technology has performed well in the last 20 years to meet the needs of a vastly larger and generally more prosperous world population, there is concern that those initiatives have peaked and that the technologies in use focus mainly on the best sites – flat areas with ample water and few soil constraints. Scientists in the United States and throughout the world are worried about the decline in productivity in many soil and water systems, especially in the high population growth regions – Africa, Asia, and Latin America.

Soil and water resources provide the foundation upon which agriculture is based. But successful agricultural production systems require a combination of biological and societal resources. This is a complex and dynamic mix of variables. In view of the evolutionary nature of agricultural systems, it is important that the setting of research priorities be an ongoing process. Research priorities must be reassessed and adjusted periodically to serve the problems at hand. A mechanism is needed for evaluating and reiterating priorities to keep them fresh, flexible, and responsive to current needs.

The search for ways to achieve sustainable agriculture and natural resource management will require changes in our traditional approach to problem solving. Researchers must cross the boundaries of their individual disciplines; they must broaden their perspective to see the merits of indigenous knowledge; and they must look to the farmer for help in defining a practical context for research.

Keyword: Forest conservation, Environmental conservation, Research and development

CHRIS WEMMER, RASANAYAGAM RUDRAN, FRANCISCO DALLMEIER et al.

Training developing-country nationals is the critical ingredient

to conserving global biodiversity

Bio Science, Vol. 43, No. 11, 762–767, 1993, English

Growing awareness of global change has hastened a range of responses by international bodies, governmental agencies, and nongovernmental organizations concerned with biological conservation. A paucity of qualified personnel in many developing countries has frustrated the implementation of foreign technical assistance, particularly in the environmental conservation sphere.

Given the urgency of averting widespread environmental disaster, several personnel training programs have been developed in recent years, and the demand for them has increased annually.

The Smithsonian Institution's first conservation training program was developed by the National Zoological Park in 1980 in response to a request for a curriculum in primate population censusing and ecology by the National Institutes of Health (NIH). The Smithsonian training courses and their derivatives and the international and regional centers are enhancing the technical and scientific capacity of developing countries to deal with the biodiversity crisis.

Keyword: Forest management, Study and training, Environmental conservation

F. DALLMEIER & F.A. DEVLIN

Forest biodiversity in Latin America: reversing the losses?

Journal of Tropical Forest Science, 5 (2), 232–270, 1992, English

Throughout Latin America's forested regions, a number of factors are causing reduction and degradation of habitat and the elimination of species. One of the world's richest store houses of biodiversity is under severe stress. Innovative research projects and initiatives for sustainable forestry hold promise for habitats and biodiversity. In particular, reliable research provides the information necessary for sound conservation measures and sustainable use strategies. Ultimately, however, the peoples of Latin America must change their basic attitudes and beliefs about the value of the forest if biodiversity is to be preserved. Also, mechanisms need to be in place which enable them to value the forest.

Latin American governments have failed to take into account the importance of forest biodiversity because of intense pressure to adhere to steady timber yields. This out-moded forest management regime is adhered to most aggressively in socioeconomic climates dominated by poverty, runaway population growth, lack of access to farm land and debt burdens that encourage intensive exploitation of resources for short-term profits.

Keyword: Forest management, Deforestation, Sustainable management of forest, Biodiversity

SIMÓN TEITEL (editor)

**Towards a new development strategy for Latin America
The Inter-America Development Bank, Washington, D.C., USA
403, 1992, English**

This book explores the reasons behind the region's past successes and more recent failure. Drawing on selected tenets of the work of distinguished economist Albert Hirschman, the authors examine the economic performance of Argentina, Brazil, Chile, Colombia and Mexico during the period from 1950 to 1980. Chapters on each country alternate with chapters on conceptual issues related to Hirschman's seminal thinking. Topics include the advantages and disadvantages of attempting "more than one thing at a time" in economic reform; the use of dichotomies in development thinking; "linkages"; technology; the definition of a new role for the state; commercial policies; and the recommendation of a development strategy for Latin America.

Keyword: Forest development, Forest policy, Social and economic analysis

PETER L. WEAVER

**Trip report: Forestry research, management and technology
transfer opportunities in Amazonia
International Institute of Tropical Forestry, Puerto Rico
33, 1993, English**

From March 7 through April 29, 1993, government institutions, universities, NGOs, foreign cooperators, and others, were visited Belem, Manaus and Santarem to explore on-going forestry activities (forestry research, management and technology transfer) in the Brazilian Amazon. Visits to field sites were also included when feasible. The list, organized alphabetically by city, contains the major entities involved with forestry and agroforestry and should help orient USFS cooperators working in Brazil. The list is not complete and should be revised, updated and augmented as time permits. As is evident, there are numerous opportunities for cooperative programs and projects.

Keyword: Extension work, Forestry, Research and development

ROBERT J. BUSCHBACHER

**Natural forest management in the humid tropics:
ecological, social, and economic considerations
AMBIO, Royal Swedish Academy Sciences, Sweden
Vol. 19, No. 5, 253-258, 1990, English**

Commercial logging is theoretically a relatively benign form of exploitation for tropical forests, but in actuality has not been practiced on a sustainable basis. This article begins with a brief historical overview of natural forest-management systems, showing that several have been sustainable from a silvicultural viewpoint. However, these have never been carried out on a large scale because of economic and social limitations. To overcome these obstacles will require: improved economic analysis methods that recognize the long-term and external benefits of forest maintenance; elimination of incentives for forest conversion; redesign of concession agreements and royalty and tax systems to provide incentives for long-term management; and involvement of local populations in forest management, both in terms of planning and receipt of benefits.

Keyword: Natural forest, Forest management, Social and economic analysis, Forest policy

MATTHEW A. PERL et al.
Views from the forest, natural forest management initiatives in Latin America
Report on a workshop, Tropical Forestry Program, World Wildlife Fund, 30, 1991, English

The workshop objectives were to: 1) compare and contrast the experiences of the pilot projects to improve upon the current state of knowledge; 2) analyze the projects with regard to their technical aspects, social aspects, economic and financial aspects and administrative and institutional aspects; 3) highlight the most important project successes and problems, focusing on those related to project design and implementation as well as those stemming from larger policy causes; 4) exchange ideas and information among project practitioners and identify project needs; and 5) publish the results of the workshop and disseminate the information.

This paper provides a detailed account of the workshop, including a description of its structure, profiles of each of the participating projects, and discussion of the proceedings.

Keyword: Forest management, Evaluation, Extension work

JIM TOLISANO et al.
Environment assessment
Biodiversity support program; Costa Rica, 77, 1993, English

In July 1992, the U.S. Agency for International Development (AID) in Costa Rica requested that the Biodiversity Support Program (BSP) conduct an environmental assessment (EA) of the proposed extension of the Forest Conservation and Management (BOSCOSA) Project in Costa Rica. The purpose of the proposed project is to develop and demonstrate natural forest management, sustainable agriculture, ecotourism, and biodiversity conservation technologies in southwestern Costa Rica. This EA occurred before the design of the proposed project extension was final, enabling USAID/Costa Rica to incorporate the recommended measures and procedures from the EA into the final BOSCOSA extension design in order to ensure the environmental soundness of the activity.

Keyword: Environmental assessment

WILLIAM F. HYDE & DAVID H. NEWMAN
Forest Economics and policy analysis
World Bank Discussion Papers, The World Bank, Washington, D.C., USA, No. 134, 92, 1991, English

This paper identifies the essential features of the forestry economics literature emphasizing what is different about forestry and what are forestry's important features for project and program analysis. The important conclusion, is that economic tools are both available and appropriate for the analysis of a wide range of forest policy problems.

The presentation begins by reviewing the conceptual issues underlying production of wood and fiber and other forest resource services, including off-site services. Two characteristics that receive special attention are 1) the embodiment of both productive capital and final output in any standing forest inventory; and 2) the long time periods that often distinguish forest production. A third distinguishing characteristic is the joint production nature of many forest resource services. Finally, few other productive activities share forestry's pervasive confrontation with underpriced joint outputs. These differences of degree largely explain the development of a distinct literature on the economics of forestry.

Keyword: Forestry, Forest resources, Forest utilization

STEPHEN E. McGAUGHEY & HANS M. GREGERSEN
Investment policies and financing mechanisms for sustainable forestry development
Inter-American Development Bank, Washington, D.C., USA
126, 1988, English

This report concentrates particularly on the financing needs and issues of nonindustrial private forest (NIPF) landowners. Millions of such forest holdings throughout the region cover millions of hectares of forest land. In most cases, the holdings are small, from one-half hectare or less up to 100 to 200 hectares. Sometimes the owners are members of cooperatives or community groups, either for production or for marketing. In the aggregate, the NIPF group is an important base for developing productive rural enterprise and should be considered a viable target group in forestry development programs.

Keyword: Forest management, Forest policy

DANIEL RITCHIE

A strategy for Asian forestry development

Asia Technical Department, The World Bank, USA, 20, English

Forestry in Asia is in crisis. Deforestation is accelerating as rising populations and incomes increase the demand for land and wood products and as a new awareness of the importance of forest ecosystems is sweeping the region and the world. This loss of forest poses alarming economic and environmental costs. New policies, adopted in 1991, commit the World Bank to giving greater emphasis to effective management and to forest conservation, both through its own work and through international co-operation. This paper discusses the policy reforms needed if Asia's forests are to be wisely used and outlines the strategy the Bank is pursuing in forestry and related lending.

Keyword: Deforestation, Forest conservation, Forest utilization, Forest management

FOREST SERVICE, U.S.A.

Tropical forestry annual report

USDA Forest Service, USA, 76, 1993, English

People around the world are expressing growing concern over the need for conservation and better management of tropical forests. Recognizing that tropical forest conservation is a global concern, forest resource managers in the United States are seeking ways to work with their colleagues in tropical countries to contribute valuable management and technical skills to the conservation effort. To promote this cooperation, the USDA Forest Service initiated the Tropical Forest Program (TFP) in 1990. This program provides a way for the Forest Service to engage in training, exchanges of technical specialists, and other forms of cooperation. Through this process, the TFP provides information to natural resource managers to foster reasoned decisions about managing tropical forests. The TFP also allows the Forest Service to support international, governmental, and environmental organizations through cooperative projects. The TFP activities complement those of the United States Agency for International Development (USAID), and some TFP training courses and other actions have been developed jointly with them.

Keyword: Tropical forest, Forest protection, Training, Forest conservation

JEFF M. SIRMON (editor)

The forest support program

Report to the U.S. Agency for International Development, USDA

Forest Service, USA, 73, 1993, English

In 1993, both the Forest Service and USAID experienced significant changes in the organization and implementation of their international forestry programs. This report reflects modifications made by both agencies and their evolving priorities.

This year's annual report presents activities and accomplishment by region of the world: Africa, Asia/Near East, Eastern Europe and the Newly Independent States, and Latin America and the Caribbean. The geographic programs are followed by discussions and accomplishments for each area of technical assistance: agroforestry, education and training, private voluntary organizations, social forestry, natural forest management, and donor coordination.

Keyword: Agro-forestry, Training, Study and training, Forest management, Natural forest

DAVE LEONARD

Soils, crops and fertilizer use

Program and Training Journal Reprint Series, Virginia, USA

No. R8, 162, 1977, English

Peace Corps' Information Collection and Exchange (ICE) was established so that the strategies and technologies developed by Peace Corps Volunteers in their field work could be made available to the wide range of development workers who might find them useful. Training guides, curricula, lesson plans, manuals and other Peace Corps-generated materials developed in the field are collected and reviewed: some of these materials are reprinted; others provide an important source of field-based information for the production of manuals or for research in particular program areas.

Keyword: Study and training, training, Guideline

MICHAEL D. BENGÉ

Evaluation of and recommendations for research on fast-growing

tree-species for wood energy production in the dendro-thermal,

charcoal production and gassification for irrigation projects

Forest & Natural resources, USAID, USA, 125, 1983, English

Trees as a short-term rotational crop are a new approach to an old practice - wood for energy. The Philippines has taken the lead through three projects: Dendro-thermal, Charcoal Production and gassification for Irrigation. Under all three projects, large plantations of fast-growing trees are being established on underutilized lands that are generally low in soil fertility and dominated by cogon grass, *Imperata cylindrica*.

These projects have caught world-wide attention and the development agencies in many developing countries are waiting to see if the Philippine experience succeeds or fails.

This publication is a report on evaluation of these projects.

Keyword: Fast-growing tree species, Non-timber products, Wood chemistry, Charcoal, Silvicultural technique

CHRIS REIJ, PAUL MULDER & LOUIS BEGEMAN

Water harvesting for plant production

World Bank Technical Paper, The World Bank, USA

No. 91, 124, 1988, English

This report is the most comprehensive review to date of available literature on water harvesting for plant production. It covers a broad range of topics, including terminology and classification, environmental factors, production aspects and socio-economic issues. Although the report covers publications from various continents, special attention is paid to information on water harvesting in Sub-Saharan Africa.

It is quite commonly believed that water harvesting can significantly increase plant production in the arid and semi-arid tropics. The report, however, indicates that the available information does not always support this view. In several countries, substantial research has been done on specific water harvesting techniques, and interesting yields have been obtained at research station, but these techniques have not been adopted on a significant scale by farmers. Most water harvesting projects in Sub-Saharan Africa are still carried out on a "trial and error basis".

Keyword: Arid region, Semi-arid climate, Research and development

MOHAN MUNASINGHE

Environmental economics and sustainable development

World Bank Environment Paper, The World Bank, USA

No. 3, 112, 1993, English

This paper explains the key role of environmental economics in facilitating the more effective incorporation of environmental concerns into development decisionmaking. Traditionally, the economic analysis

of projects and policies (including the techniques of shadow pricing), has been developed to help a country make more efficient use of scarce resources. However, "externalities", mainly those arising from adverse environmental consequences, often have been neglected in the past. It is also important to recognize the social and ecological objectives that are a part of sustainable development, and to reconcile these concepts and operationalize them within the economic framework.

This paper reviews concepts and techniques for valuation of environmental impacts that enable such environmental considerations to be explicitly considered in the conventional cost-benefit used in economic decisionmaking. Key related aspects including environmental impacts of economy wide policies (both macroeconomic and sectoral), discount rate issues, and multi-criteria analysis are reviewed.

Keyword: Forest development, Environmental conservation, Evaluation, Environmental assessment

DAVID W. PEARCE & JEREMY J. WARFORD

World without end

The World Bank, USA, 42, 1993, English

This booklet attempts to pick out some of the highlights of the book *World without End: Economics, Environment, and Sustainable development*. As will be seen from the book's table of contents, which appears at the end of this booklet, the book's coverage is comprehensive. It details theoretical aspects of environmental economics, and it shows how these theories can be applied to developing countries, tropical forestry and agriculture, energy and industry, population and poverty, international trade, and the "global comments".

Keyword: Environmental conservation, Tropical forest, Sustainable management of forest

ADALBERTO VERISSIMO et al.

Logging impacts and prospects for sustainable forest management

in an old Amazonian frontier: the case of Paragominas

Forest Ecology and Management, Elsevier, Netherlands

Vol. 55 (1-4), 169-199, 1992, English

The Brazilian wood industry is highly mobile. Over the past 20 years the eastern Amazon developed from a logging backwater to the principal hardwood processing center in Brazil. This occurred because of a decline in hardwood stocks in the south of Brazil coupled with the development of good transport, energy, and communications systems in eastern Amazonia.

We studied the structure and economy of the wood industry along a 340 km stretch of the Belém-Brasília Highway in eastern Amazonia. Of the 238 sawmills present in this study region in late 1989, 79% were installed in the 1980s. Ninety-seven percent of the mill owners came from outside Amazonia. Most (63%) of the mill establishments were vertically integrated, engaging in both forest mill processing and forest logging.

Keyword: Sustainable management of forest, Forest development, Wood utilization, Social and economic analysis

APPENDIX

LIST OF INFORMATION RESOURCES

USA

National Agricultural Library

Address: Beltsville, Maryland 20705, USA

Identification of parent organization:
U.S. Department of Agriculture

Type of Service:
Library

Geographic coverage of information resources:
World-wide

Subject coverage:
Agriculture; forest; forestry and related subjects

Types of indexes provided for access to the services:
Computerized index

Identification of target users:
Public

Types of services provided for users:
Back-up services (library loans, document copying)

Charge of services:
Charge for photocopy

Procedure required for applying services:
Direct request by form

World Bank Bookstore

Address: 701 18th Street, N.W. Washington, D.C. 20433, USA
Tel: (202) 473-2941 Fax: (202) 477-0604

Identification of parent organization:
The World Bank

Type of service:
Publication

Geographic coverage of information resources:
World-wide

Subject coverage:
National resources; agriculture; fisheries; forest; forestry; population, food and nutrition,
etc.

Types of indexes provided for access to the services:

Publication catalog

Identification target users:

Public

Procedure required for applying services:

Direct request; regional distributors

(Japan: Eastern Book Service, Hongo 3-chome, Bunkyo-ku 113,
Tokyo. Tel: 3818-0861)

Inter-America Development Bank Bookstore

Address: 1300 New York Avenue, N.W., Washington, D.C. 20577, USA

Tel: (202) 623-1753 Fax: (202) 623-1709

Identification of parent organization:

The Inter-America Development Bank

Type of service:

Publication

Geographic coverage of information resources:

Latin American and the Caribbean

Subject coverage:

Water; energy; development; trade; environment; forest, etc.

Types of indexes provided for access to the services:

Publication catalog

Identification target users:

Public

Procedure required for applying services:

Direct request

Smithsonian Tropical Research Institute

Address: 900 Jefferson Drive, Suite 2207, Washington, D.C., 20560, USA

Tel: (202)-633-8095, (202)-786-2817 Fax: (202)-786-2819

Identification of parent organization:

Smithsonian Institution

Type of service:

Library

Geographic coverage of information resources:

World-wide

Subject coverage:

Biosphere; Forest; Forestry, etc.

Identification target users:

Insiders; need appointment for outsider

Types of services provided for users:

Computerized index; back-up services

The Smithsonian Institute has 18 libraries classified by categories which are open to the public by appointment only, Monday-Friday, 8:45 am to 5:15 pm.

Smithsonian Institute Press

Address: Department 900, Blue Ridge Summit, Pennsylvania, 17294-6900, USA
Tel: (717)-794-2148, (800)-782-4612

Type of service:

Publication

Geographic coverage of information resources:

World-wide

Subject coverage:

Science; culture; religious studies; anthropology; art, etc.

Types of indexes provided for access to the services:

Publication catalog

Identification target users:

Public

Procedure required for applying services:

Direct order by form; order by phone

National Academy Press

Address: 2001 Wisconsin Avenue, Harris Building, Room 384, Washington, D.C., 2007, USA

Identification of parent organization:

National Academy of Science

Type of service:

Publication

Geographic coverage of information resources:

World-wide

Subject coverage:

Agricultural sciences: biology; computer science; earth sciences; education; environmental issues; food and nutrition, etc.

Types of indexes provided for access to the services:

Publication catalog

Identification target users:

Public

Procedure required for applying services:

Direct; mail order by form; order by phone;
regional distributors

Japan: Maruzen Co., Ltd., P.O. Box 5050, Tokyo

John Wiley & Sons, Inc.

Address: 605 Third Avenue, New York 10158-0012, USA

Tel: (212)-850-6000, (212)-850-6088

Telex: 12-7063 Cable: JONWILE

Type of service:

Publication

Geographic coverage of information resources:

World-wide

Subject coverage:

Agriculture; agricultural engineering; forestry; biochemistry; biology; medical sciences
and related areas, etc.

Types of indexes provided for access to the services:

Publication catalog

Identification target users:

Public

Procedure required for applying services:

Direct request; order through regional offices

Regional office in Japan

Tokyo Liaison Office

Meguro Nishiguchi Mansion 2-403

24-11 Kamiosaki 2-chome, Shinagawa-ku, Tokyo

AGRI BOOKSTORE

Address: 1611 North Kent Street, Arlington, VA22209, USA

Identification of parent organization:

Winrock International

Type of service:

Publication

Geographic coverage of information resources:

World-wide

Subject coverage:

Agriculture; live stock; bioengineering; development/policy; environment; fertilizer; soil
management; forestry; agroforestry; pests and diseases; marketing, etc.

Types of indexes provided for access to the services:
Publication catalog

Identification target users:
Public

Procedure required for applying services:
Direct request; fax; E-mail; order by phone

Island Press

Address: 1718 Connecticut Avenue, N.W., Suite 300, Washington, D.C. 20009-1148, USA
Tel: (707) 983-6432

Identification of parent organization:
Center for Resource Economics

Type of service:
Publication

Geographic coverage of information resources:
World-wide

Subject coverage:
Nature; environmental, etc.

Types of indexes provided for access to the services:
Publication catalog

Identification target users:
Public

Procedure required for applying services:
Mail order; fax; order by phone

Puerto Rico

International Institute of Tropical Forestry

Address: Call Box 25000, Rio Piedras, PR00928-2500, USA
Tel: (809)-766-5335 Fax: (809) 766-6302

Identification of parent organization:
USDA Forest Service

Type of service:
Library

Geographic coverage of information resources:
World-wide

Subject coverage:
Forest; forestry and related subjects

Identification target users:
Researcher; public

Type of services provided for users:
Quick reference services; library loan; photocopying

Charge of services:
Free

Procedure required for applying services:
Direct request

Brasil

CPATIL EMBRAPA

Address: Trav. Enéas Pinheiro s/n - Bairro do Marcos-Caixa Postal, 48
CEP 66095-100 Belém, Brasil
Tel: (091)226-1941/226-1741/226-7364 Fax: (091) 226-7364
Telex: (091) 1210

Identification of parent organization:
Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)

Type of service:
Library

Geographic coverage of information resources:
Latin America

Subject coverage:
Agroforestry; forest; forestry and related subjects

Types of indexes provided for access to the services:
Computerized index

Identification of target users:
Researchers and general

Types of services provided for users:
Quick reference services; library loan; photocopying

Charge of services:
Charge for photocopies

Procedure required for applying services:
Direct request



LIB