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THE ECONOMICS OF CARIBBEAN FORESTRY

PROCEEDINGS OF THE SEVENTH MEETING OF CARIBBEAN FORESTERS AT JAMAICA

JUNE 13-17, 1994

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PREFACE

This publication continues the tradition of Caribbean Foresters that started in Saint Lucia in May, 1982. Since then, Caribbean Foresters meet on even number years and publish the proceedings of the meeting on the odd number year. This year we had the innovation of sharing the meeting with the Caribbean Technical Cooperation Network on Forestry and Related Environmental Matters. A report of this program appears in this publication. The meeting was attended by 45 people representing 15 countries and 7 international organizations.

We thank Roy Jones and the Government of Jamaica for hosting the 1994 meeting and for their superb hospitality. Funding for this meeting was provided by the USDA Forest Service, the US Agency for International Development, the Canadian International Development Agency, and the Government of Jamaica.

These proceedings also include papers presented in Martinique during the Sixth Caribbean Foresters Meeting held in 1992. These manuscripts arrived late and were not included in those proceedings. The theme for the Sixth Meeting was: *Towards sustainable forest resource management in the Caribbean*. This issue also contains an *erratum* on a paper published in the previous volume of the series.

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MEETING CONCLUSIONS AND RECOMMENDATIONS

Carleen Yocum

During the 7th Caribbean Foresters Meeting, the participants broke into small working groups to consider the obstacles and challenges faced by forest management in the region, with emphasis on the theme economics in forestry. The following presents a summary and synthesis of those concerns, and the group's efforts at targeting solutions to overcome them.

ISSUES

Degradation of Forest Resources

Degradation refers to the negative impacts on a site which lead to decreased productivity. The forest resources of most of the insular Caribbean face their greatest degrading pressures from agriculture, commercial development, and fuelwood use. An extreme example is that of Haiti, where forest cover has decreased from 58,000 to 23,000 ha in the 10 year period between 1980 and 1990 (FAO 1985, 1993). The meeting representative from Montserrat presents the case of uncontrolled grazing, which leads to soil compaction, burning, and erosion of lands that could otherwise be reforested. Other activities such as mining and commercial logging threaten the resources of some countries of the region. In the wider Caribbean (including Guyana and Suriname) the estimated rate of annual deforestation from 1981 to 1990 was 122,000 ha (FAO 1993). Demands on the renewable, yet limited, resource to produce quick cash-flows or products for daily subsistence convert forest lands to pasture, crops, mining pits, and hotel sites. Examples of these pressures leading to the forest resource degradation in the Caribbean are clearly articulated in these proceedings.

Undervaluation of Forestry Sector Contribution to the Gross National Product

Many factors must be considered in order to fully appreciate the economic worth of a natural resource. Most of the Caribbean states do not have the reporting systems nor the forest economics expertise in place to evaluate these factors and derive their values. Even more complicated than the assessment of the traditional forest products is the assessment of the value of ecological services and benefits. "How is the price of biodiversity derived?", asked one meeting participant. The functions of forests to protect water supplies, regulate stream flow, prevent erosion and landslides, provide recreation opportunities, wildlife habitat, food, and handicraft and medicinal products have been neglected in the economic formula.

Inadequate Timber Prices

Typically, established timber appraisal systems and competitive market conditions for sale of timber in tropical countries do not exist. Therefore, forest revenues fall short of maximization. This is especially significant in the case of countries with large timber concessions. Governments do not realize the revenues from the public lands, and consequently tend not to consider the current or potential timber resource as a contributor to national income. The forestry management sector, therefore, effects minimal influence in the government decision making process.

In addition, undervaluation fosters poor wood utilization and greater site disturbance by the purchaser of the resource. Hence, further degrading the product supply.

Lack of Networking Between Natural Resource Agencies

Different government agencies and departments share responsibilities for environmental oversight and management within the individual Caribbean countries. In Guyana for example, in addition to the Guyana Forestry Commission other government agencies such as the Geology and Mines Commission exercise the authority to issue resource harvesting permits on forest land.

Coordination between such agencies determine the extent of successful resource planning, protection, and management. Break-down in information dissemination, uncertainty of with whom the integration responsibility lies, and changes in ministerial organization all serve to weaken any attempts that may be made to achieve needed coordination.

Lack of Financial Support

Research and information collection are often considered luxuries in the presence of more pressing demands on local government financial resources. However, questions that are pertinent to the local management of the natural resource, such as inventory data and how to protect genetic pools, need to be addressed. The answers to the questions must then be applied, which also requires financing. In addition to funding, especially in the case of the small islands, the question of local capacity must also be raised. Who will conduct specialized research?

Protecting Forests vs. Development

These two activities are typically considered exclusive of one another. Depending on the level of development, this may well be true. This is a dilemma faced by many of the island states with popular tourist attractions. Consciously or unconsciously, choices are being made by individuals and governments in the region between various types of development and the well being of mangroves, clean water,

renewable wood products, parrot habitat, and forest scenery.

Land development to accommodate increasing population, housing, and food needs is hard for any government to deny. The challenge is to strike a balance. Yet in most cases, the governments are not prepared or capable of shifting the investment strategy.

Ecotourism Demands

In order to generate revenues and raise the public appreciation of the value of forest lands, most resource managers of the region are making some attempt to tap into the tourism market. This entails enticing both local and foreign tourists off the beaches and into the woods. Of 9 Tropical Forestry Action Plans for the insular Caribbean completed in 1993, 7 included ecotourism related projects as priority activities. A successful ecotourism system, however, requires adequate infrastructure, understanding of demand and carrying capacity and mitigation activities to protect the resource from deterioration. These represent costs attached to ecotourism. The forestry departments of the Caribbean tend to be understaffed and underequipped to begin with. Are the land managers ready for ecotourism and its various demands?

Benefits of the Forest to Local Communities

The question raised by the group was how to ensure that the benefits derived from the forest reach people who live nearby. The communities who live within or on the outskirts of a public forest can be a great threat or a great help in its management. If the forest is to be seen as a source of economic value it must at least be able to transfer some of those values to the people who live in close proximity.

Economic Viability

The paramount challenge for many participants is to make sustainable use of the natural resources economically viable in their

countries. This viability may come from primary and secondary forest products such as fuelwood, fibers, essential oils, lumber, and medicinal plants, or it may come from user fees generated by activities such as hiking and hunting. For many of the Caribbean countries, demonstrating in real terms this sustainable economic contribution of the forest to society will prove the only way to ensure its ultimate protection.

RECOMMENDATIONS

Recommendations directed specifically at the above issues and in general include:

- Increase public education and awareness of the role of forestry. Demonstrate the full contribution of forest values by quantifying costs and benefits for each type of activity within the forestry sector.
- Regarding valuation of timber, countries need to be more assertive in their dealings with international bidders, and should focus on establishing and enforcing legal parameters for timber sales. Awareness of the world timber markets including pricing and projections is needed in order to adapt to changes, and capitalize on revenues.
- The need of improved communication systems was repeatedly mentioned. This not only applies within a country, but within the region. It should not be limited to foresters, but include all island resources managers. Information sharing is necessary. This can be facilitated by taking advantage of the electronic networking that currently

exists, and consciously trying to standardize methods and systems of communication within the region. The development of a network to tap forestry expertise within the region is suggested. The Caribbean Technical Cooperation Network on Forestry and Related Environmental Issues is recognized by the group as a resource that should be used more, as well as the International Institute of Tropical Forestry and the Natural Resources Management Unit of the Organization of Eastern Caribbean States.

- A wide application of the multi-disciplinary approach to project planning and implementation should be practiced. Land management and use plans should be developed with this strategy, including considerations for the ecological, social, and economical opportunities and constraints of each country. Utilize the projects outlined in the Tropical Forestry Action Programme reports to direct planning. Pursue funding for these activities.
- Recognize that each island faces different challenges from ecotourism. Within each country, effort should be made to develop interagency coordination and planning for ecotourism development.

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THE ROLE OF FORESTRY IN ECONOMIC DIVERSIFICATION ANTIGUA/BARBUDA

McRonnie Henry

INTRODUCTION

There is much concern about national economies all around the world, and hence of the world economy itself. Antigua and Barbuda is no exception. The economic downturn has impacted severely on all aspects of the society. The Government is being forced, therefore, to look for innovative ways to increase economic growth, and to maintain and enhance the quality of life for its citizens.

In pursuit of a new approach, it is imperative to review the approaches of the past. In doing so, it would become strikingly clear that the "land", and by land I mean country, is not endowed with an infinite capacity to replenish itself. We need to use nature's resources to prosper while ensuring that these resources are conserved for future generations. This is the key to "sustainable development" - making sure that today's growth is not achieved at tomorrow's expense. This is particularly significant in the case of Antigua/Barbuda because of its small size and limited natural resources. The margin for error in our case is extremely narrow.

The economy of Antigua and Barbuda is primarily driven by the tourism industry. Diversification of the economy and the establishment of major linkages with the tourist business are two of the paths identified for future economic growth. The diversification strategy may allow the national economy to have a more diverse base, and perhaps more stability for the economy as a whole. In this context, it can be demonstrated that forestry and related activities can make a positive contribution to the economy of Antigua and Barbuda. The role of forestry should be recognized as being essential to the protection of critical resources such as water and soil, and complementary to developing the tourism product, as well as the quality of life of the people of Antigua and Barbuda.

EXISTING AND POTENTIAL CONTRIBUTION OF FORESTRY AND RELATED ACTIVITIES TO THE NATIONAL ECONOMY

The forest resource currently provides society with a wide variety of goods and services. Some of these goods and services enter pecuniary markets, others do not. The aim here is not to emphasize actual value since very little analysis has been done and consequently, not much reliable data is available. Rather, the intention is to indicate some of the areas in which significant contribution can be realized.

Ecotourism

The scenic beauty and ambiance of the country lends itself to ecotourism as a marketing concept. There are numerous scenic angles of the islands which can be developed and promoted in such a way as to entice many people to visit our shores. Ecotourism can be used as a strategy to foster rural development, particularly in the south and southwest of Antigua and in Barbuda. Training villagers at Old Road, John Hughes, Urlings, Bolans, and Codrington as nature tour guides is a vehicle that not only creates employment but also develops an informal protection mechanism for ecosystems. Because of their vested interest, tour guides become allies in safe-guarding the natural resources which provides their livelihoods.

Elements for fostering eco-tourism already exist and need to be developed. For example, a very knowledgeable custodian already cares for the wildlife of Guiana Island who can be used to manage controlled tours for a fee. At least one (1) tour operator has regularly scheduled nature tours through the Body Ponds/Wallings Forest Reserve area for both cruise ship and stay-over tourists. A project has been initiated, with financial assistance from the International Institute of Tropical Forestry and the Government of Antigua and Barbuda, specifically to

develop the Wallings area for conservation and ecotourism purposes. It is recommended that ecotourism efforts in Barbuda—to the bird sanctuary, caves and other places of interest be expanded and regulated. Existing tours to Great Bird Island in glass bottom boats can also be expanded, but under appropriate management to ensure the sustainable use of the resource. Benefits can also be intangible, as a caring for the environment can be fostered in the national community if guided tours, incorporating conservation messages, are developed as components of the eco-tourism thrust.

Amenity Values

Amenity values include the large number of unpriced values produced by trees and forests, including such services as aesthetics. In a competitive, tourist dominated economy such as Antigua and Barbuda, ensuring an aesthetically pleasing urban and rural environment takes on added importance. The tourist strategy attempts to focus on the upper end of the market; this also tends to be the more discriminating portion of the market which would place a higher value on amenity services. An example of the application of amenity values would be the integration of forest related projects into the St. John's Development Project and along major tourist routes throughout the island.

Agroforestry

In Antigua, agroforestry is not new, having been practiced historically on large and small holdings. However, there is room for appropriate modifications to be applied according to local situations, and the approach is being proposed as a means of increasing land utilization and farm output, particularly fruits and livestock, primarily for the local market. In 1989, Antigua and Barbuda imported over EC\$ 33 million of meat, milk products, and fruits. Forestry can definitely play a greater role, in terms of import substitution, by reducing the level of this import bill.

Fuelwood and Energy

Charcoal (largely for the tourist and domestic recreation sectors) and fuelwood production currently makes a small contribution to the Gross Domestic Product (GDP). Unfortunately, no reliable records exist to indicate the levels of production and consumption. Suitable material is for the most part readily available from pastures in the form of *Acacia* and *Prosopis*. Against the backdrop of the continuing world energy crisis, a case could be made for encouraging the use of alternative sources of energy to save foreign exchange and to utilize natural products generated in the course of development initiatives such as agroforestry and watershed rehabilitation.

Other Areas of Potential Contribution

Management of the mangroves can have an important impact on the fisheries sector. Harvesting of wattle (mainly *Guettarda* sp.) by fishermen to make fish traps, the use of small mahogany *Swietenia* sp. and white cedar *Tabebuia* sp. for boat construction and fence posts, harvesting leucaena *Leucaena* sp. for fence posts and forage, the use of material from the forest for local handicraft and harvesting of lemon grass within the forest zone are tiny sectors with the potential to make a contribution.

SUMMARY

The sectors identified above represent the main avenues through which forestry and related activities can make a positive contribution to the economy of Antigua and Barbuda. They are by no means the only ones. Despite the reputed benefits of the tourism industry, the Government should concentrate its attention on all opportunities for economic growth and optimal use of natural resources. In tandem with other national strategies, the role of forestry and trees needs to be heightened to become an integral contributor in maintaining living standards on a sustained basis.

ACTUAL AND PROSPECTIVE USES OF FOREST VALUES IN CUBA

Esteban Menéndez

INTRODUCTION

The Republic of Cuba is the largest and most populated Caribbean island, with nearly 11 million inhabitants living on 110,900 km² of surface area. At the beginning of this century the country had 5.9 million hectares of forest, 53.2 percent of the national surface area. In 1959, forests had decreased to 1.5 million hectares. National forest policy, developed along the last 34 years (in spite of hard economic limitations), has managed to restore, improve and protect, partly, the forest resources satisfying national necessities with some products, and create the necessary basis for development of a forest industry.

The Government pays attention to the forest sector. Forest productions contribute only 1 percent to the Gross National Product, however forests offer non-quantitative values very important for local life, for example environmental protection, water amelioration, erosion control and preservation of wildlife habitats. These indirect values make it necessary to both manage and guard it adequately.

CUBAN FORESTS CHARACTERISTICS

The Forest Patrimony of Cuba is about 2,922,460 ha, 26.37 percent of the national surface. Of the total national land base 20.9 percent is covered with forests. Native forest occupies 82.61 percent of the total forest area. Cedar (*Cedrela odorata*), mahogany (*Swietenia mahogoni*), baría (*Cordia gerascantus*), najesí (*Carapa guianensis*), and majagua (*Hibiscus elatus*) are the more prominent Cuban hardwood species which were exploited excessively during colonial times and the first half of this century. This has caused it to be impossible today to find timbers with appropriate dimensions for commercial purposes. Taking into account the total area of forest lands, Cuba ranks

first among the other islands and third among all Caribbean countries.

Countries	Forest surface (1000 ha)
Bahamas	186
Belize	1996
Dominica	44
Dominican Republic	1077
Grenada	6
Guadeloupe	93
Guyana	18418
Haiti	23
Jamaica	239
Puerto Rico	321
Suriname	14768
Trinidad and Tobago	155
Cuba	1715

Source: FAO 1993.

The advent of artificial regeneration has generated 403,100 ha of eucalyptus, pines, casuarinas and native species. Cuban forests are divided by categories, with a functional criterion which determines the class of management and use. These categories are: productive forests, water and soil protection, natural reserves, littoral protection, national park, recreation areas, and fauna conservation.

According to the national inventory (1985), Cuban forests increase by 7.5 million cubic meters yearly. The native forest increment is 4 m³/ha/year. Man made forests, depending on species, can obtain above 15 m³/ha/year. Forests not only offer timber resources as natural, environmental and aesthetic values are of great importance as well. For example, the

National Park "Desembarco del Granma" contains one of the more representative systems of marine terraces; in zones such as Sierra Maestra and Ciénaga de Zapata long blocks of forests, characterized by endemic species of flora and fauna can be found. Four zones have been declared by UNESCO as "Biosphere Reserves", due to their natural values. These are "Sierra del Rosario" and "Península de Guanahacabibes" in the west, and "Gran Piedra-Baconao" zone and "Cuchillas del Toa" in the east.

ACTUAL USES OF FOREST VALUES

Wood Products

Productive forests increase 5.0 million cubic meters yearly. Between 1985 and 1992, 13.8 million cubic meters were logged which represented 34.5 percent of the total increased forest growth. Logging level has not exceeded the regenerative capacity of the forest. Forest exploitation and timbers transformation are restricted by material and economic (financial support) and technological difficulties, which reduce possibilities to obtain products with higher aggregate value.

The following figure shows percentage of distribution by uses from timbers logged from 1961 to 1992:

More than 70 percent of logged timbers were used to produce energy, in the form of both charcoal and fuelwood. Forest industry, has historically consumed about 9 percent of the logged timbers. The production of sawnwood reaches 50 to 55 thousand cubic meters yearly, approximately a quarter of the installed capacity. Sawnwood is used in production of buildings, pallets and cases. The direct-use woods include other roundwoods, poles for hanging tobacco leaves, sleepers, posts, etc. These articles are obtained from both the main logging and silvicultural treatments. A very important volume of coniferous roundwood could be possible to obtain in man made forests by means of clearing and thinnings, however it is impossible at the present time because economic conditions are not favorable. Short dimension wood obtained from the clearings or in specialized forests are used as fuelwood by both sugar industry and the general population.

Between 1984 and 1992, 544 thousand tons of charcoal were produced. In the same period 12.4 million cubic meters of timber were consumed as fuelwood, marking a trend of increased consumption, principally due to fuel oil scarcity. Population which uses fuelwood or charcoal has increased 10 percent between 1991 and 1994.

Periods	Total logged	Roundwood	Direct use	Fuelwood and charcoal
1961-1965	100	13.5	18.8	67.7
1966-1970	100	6.0	18.2	75.8
1971-1975	100	7.2	12.8	80.0
1976-1980	100	8.6	15.7	75.7
1981-1985	100	9.0	25.6	65.4
1986-1990	100	9.3	23.7	68.0
1991-1992	100	6.2	17.8	76.0
Total	100	9.0	19.1	71.9

The next figure presents timber productions in some Caribbean countries in 1991.

Country	Principal productions*		
	Roundwood (1000 m ³)	Charcoal (1000 ton)	Fuelwood and charcoal (1000 m ³)
Bahamas	115		
Belize	188		126
Dominican Republic	982	70	976
Guadeloupe	17		15
Guyana	175	1	14
Haiti	5957	95	5718
Jamaica	180	2	13
Suriname	140	3	18
Trinidad and Tobago	72	2	22
Cuba	2159	64	1588

*Source: FAO 1993.

Forest products have a high demand, principally for sawnwood, boards, cellulose, sleepers and others which have been imported traditionally. At this time, when economic conditions have reduced imports, it is necessary to better utilize the local resources. Actual policy foresees activating the forest industry through both self financing and self management, evaluating which production could be performed with foreign investment.

Non-Wood Products

A lot of non-wood products are obtained from forests, the more important ones are seeds, bark, guano (palm leaves used for thatching), and oleoresin of pine. Tannin contained in tree bark is used by chemical and light industries. Oleoresin of pine and seeds are two products which traditionally have been marketed in small quantities, but there is possibility of greater potential.

The next figure shows production level from 1984 to 1992.

Product	Unit	1984-1992
Oleoresin of pine	ton	5442.1
Seeds	ton	3793.8
Bark	ton	5989.8
Guanos	mill.	311.2

In order to better utilize the biomass contained in forests, in the last few years a program has been developing to obtain essential oils and vitaminic powder using both eucalyptus and pine leaves as raw material. Essential oils can be consumed by the chemical industry. Vitaminic powder can substitute about 10 percent of chicken feed.

Complementary Values

Food and honey production, recreation, hunting, ecotourism, environment protection and principally the creation of employment sources, are very important values that forests generate. Coffee, cacao, vines, and fruit production can be found together with forests. Controllable livestock pasturing is possible too. By means of agroforest systems of Khaya and Honduras mahogany plantations the following products have been obtained:

Sheep meat	130 kg/ha/year
Vines	8 to 9 ton/ha/year
Vegetables	4 to 5 ton/ha/year
Beans	0.9 to 1.1 ton/ha/year

The beehives placed in forests produce about 75 percent of the honey crop.

Hunting is practiced by national and foreign hunters. For this purpose there are 80 designated hunting grounds for nationals and 14 designated areas for international visitors where they can practice small game hunting. About 40 thousand Cubans and 100 foreigners participate during hunting season every year.

Ecotourism of a recreation and cultural nature is receiving more interest among natives and foreigners. The rich flora and wildlife, characterized by abundance, diversity and high level of endemic species together with the beautiful landscape lend themselves to this objective. The more prominent areas are: National Park "Desembarco del Granma", where there is a very important system of karst marine terraces and different historic places; and Ciénaga de Zapata, with the most important wetland system in the Caribbean Region, where it is possible to find diverse and abundant migratory bird species such as ducks, flamingos, herons, etc. About 40 thousand people work in different activities such as silviculture, harvesting, protection, forest rangers, etc.

PROSPECTIVE USES OF FOREST RESOURCES

The complex structure of the tropical forest allows a lot of products to be obtained during the logging process. In Cuba its possible to find more than 200 associated species, which makes it difficult to use them all. National inventory of forest resources estimated a total stand volume of 98.2 million cubic meters, 11.9 percent of which is coniferous. By age group the distribution is as follows:

Species	Stand volume per age groups (mill. m ³)				Total
	Young Class 1	Young Class 2	Middle age	Mature	
Coniferous	3.8	5.9	1.6	0.4	11.7
Broadleaf	26.4	32.2	15.6	12.3	86.5
Total	30.2	38.1	17.2	12.7	98.2

The principal characteristics by groups of species in productive species are:

Species group	Principal characteristics			
	Volume (m ³ /ha)	Age (years)	Annual increment	
			Total (mill. m ³)	Per ha (ha)
Coniferous	68	20	0.9	5.6
Precious	62	19	0.5	5.0
Special uses	56	22	0.1	3.2
Hards	49	16	1.5	3.5
Semihards	49	14	0.3	4.2
Soft	58	18	1.4	5.4
Others	37	17	0.3	2.6
Total	52	17	5.0	4.2

The National Inventory and the Project of Development and Organization of Forest Economy allow the design of a strategy that will be carried out during the next 10 years. Forest Economy has foreseen a future development which includes both silviculture and industry. In the last 30 years there has been an increase in man made forests in accord with expected use. For example, in 1993 the following level of plantations by objectives was executed:

-Littoral (coast line)	13,234
-Mining areas	86
-Soils and water	22,208
-Others	2,974
Others	9,184
National Total	79,401

Cuban silviculture will work during the next 20 years in the following activities:

Production (1000 ha)	23,092
-Industrial roundwood	3,908
-Fuelwood and charcoal	16,188
-Sleepers	376
-Posts	549
-Poles	532
-Palms	331
-Activated charcoal	237
-Others	971
Protection	47,125
-Water supply basins	7,570
-Fauna	1,053

Forest management: the Project of Management will be applied rigorously, increasing forest cover to 23 to 25 percent, recuperating deforested areas, increasing the yields of native and man made forest, reforesting about 860 thousand hectares and reconstructing 180 thousand hectares of secondary degraded forest. Clearing and thinning will be done on 1 million hectares of productive forest lands.

Productive forests: the objective is to reach one million hectares of productive forests, including 490 thousand hectares of man made forests with the following potential uses:

	1000 ha
-industrial roundwood	230
-posts, sleepers, mine poles	35
-pencils, veneer sheets, pulp	
activated charcoal	85
-fuelwood	130

Protective forests: the strategy will focus to preserving and increasing forest cover, in order to protect soils, water, wildlife and environment. The objective will be to manage 1.6 million ha of forest. About 375 thousand ha of man made forests will have the following uses:

	1000 ha
-protection of soils and water	215
-conservation and reproduction	
of fauna	42
-coastline protection	26
-recreation and ecotourism	26
-mining areas rehabilitation	10
-others	56

Basins management and agroforestry systems: a special program is being carried out in order to recuperate deforested areas in the north and south watershed of S. Maestra, Sagua-Baracoa and Escambray mountains. Agroforestry and silvo-pastoral systems will be improved into an integrated silviculture which includes agricultural, livestock and forest interests. Silviculture development will do all possible to have the necessary raw material for the industry, which will introduce technological and functional changes. Many objectives have been designed, some of them are being executed, others have stopped, awaiting improvement in economic conditions or any proposal of foreign investment. The principal objectives for the next 30 years will be:

Sawnwood: the main objective will be to increase actual production levels to 300 thousand cubic meters by the year 2010. It will be necessary to modernize some sawmills.

Cellulose: the country has proposed to install a plant in order to obtain 50 thousand tons yearly, which, mixed with bagasse cellulose, will cover local necessities. At this moment some raw material (coniferous man made forest) is on hand, but this objective is stopped for investment.

Particle boards: it is possible to install two plants, the first one will produce 12.5 thousand cubic meters of cement-wood particle board and the other one 20 thousand cubic meters of resin-wood particle board. Significant volumes of wastes which are produced during the sawing process and short dimension wood obtained by clearing or thinning will be used as raw material. In this objective we are waiting for investment too.

Essential oils and vitaminic powder: eucalyptus and pine leaves obtained in felling areas will be used as raw material. The possibilities of production could produce 7.4 ton/year of essential oils and 3.2 thousand ton/yearly of vitaminic powder. This purpose is going on with local resources but would need foreign investments.

Tannin: eucalyptus and pine bark collected during the final felling could provide raw material in order to produce 500 ton of tannin, 442 ton using pine bark and 58 ton of eucalyptus. This objective is stopped due to lack of funding.

Activated charcoal: this important product will be produced using casuarina wood. A lot of areas have been planted and some components finished. At this moment it is stopped due to material difficulties. The level of production could be:

	ton/yearly
-activated charcoal	
granulated	2.0
powder	1.0
-butylic alcohol	0.5
-acetic acid	0.7
-tar	2.0

Raw material charcoal: production level could reach 160 thousand ton/year. For this purpose the process of carbonization must be improved. The use of the Brazilian kiln will be important. Actual production is about 60 to 65 ton/year.

Briquettes: 83 thousand cubic meters of sawdust and wood shavings could be used to make briquettes. This would provide a substitute for charcoal and fuel oil consumption.

Resin: the level of production could reach 3 ton/year of crude resin, which can be transformed into turpentine and colophony. A plant is actually being built which could process 1 ton of crude resin. Other possibilities could be covered with foreign investment.

The National Forests Research Institute is supporting technological development of a group of investigation themes: genetic improvement of pines and other native species, biological fight against pest and diseases, integral use of forest biomass and biotechnology applied to forest reproduction. Hunting and ecotourism are two complementary values which have been designed and programmed for management. Feasibility studies are being carried out which look into incorporating natural areas and hunting grounds as new tourist opportunities for Cubans and foreigners. Fauna inventories and cooperation between different institutions are supporting these purposes.

CONCLUSIONS

In the past 34 years our country has done substantial work in order to revert the degradation process of the forest. The covered surface area has been increased by 53 percent and the main objective will be to accomplish a 25

percent forest cover in the next 20 years. Industrial uses of forest resources have not exceeded 9 percent of total timbers felled because of the absence of mature forests with appropriate dimensions and in existence of other industries which could use short dimension timbers, sawdust and wood shavings. For many years Cuba had imported sawnwood, boards, cellulose and other forests products. At the present time it is necessary to substitute these imports with local productions. An integral program has been designed which foresees the use of man made forests and modernization of the current industry. Some components of this program are going on, but main parts will need financial support. Actual and prospective development of silviculture bring real possibilities to the strengthening of the forest sector. It's necessary that industry push for silvicultural activities in order to obtain competitive yields and more industrial timbers, optimizing the use of biomass contained in the forests. The country is trying to increase and keep traditional forest production, improving others which could supply local demands.

The prospective role of the forest is increasing conservation of biodiversity is an aspect which increases in importance day by day, forest products are in higher demand every day. How could it be possible to reconcile all of this problems? Forest Authorities know that the best management of the forest will only be possible by use and preservation at the same time. For a long time the country has been working in this way, successful results have been performed, but we are not satisfied yet.

LITERATURE CITED

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THE DOMINICAN REPUBLIC

Cornelio Acosta

INTRODUCTION

The Dominican Republic is located in the center of the Caribbean with a population of 7.5 million habitants and territorial area of 48,000 km². Its official language is Spanish and it's politically divided into 28 provinces and the national district. It has the highest peak of the Antilles, Pico Duarte, which is 3175 m above sea level.

Lifes Zones

The Dominican Republic hosts a variety of life zones in accordance with the Holdridge Life Zone Systems. They range from upper montane rainforest to thorny woodland. Also, the Dominican Republic has various lagoons as well as Lago Enriquillo, which is 40 m below sea level.

PLANT PRODUCTION

Systems and Purposes

The most often used systems of plant production in the Dominican Republic are: (1) containerized (plastic bags); and (2) directed root (seedlings planted into individual cells of Styrofoam trays). The National Forestry Service (Dirección General Forestal [DGF]), has 9 projects and 14 subprojects of reforestation distributed throughout the country. The main focus of these projects is watershed protection of hydroelectric plants. The DGF has the capacity to produce 16 million plants annually.

Escuela Nacional Forestal

The National Forestry School (Escuela Nacional Forestal [ENF]), founded in 1968, is located in the center of the Dominican Republic and is a branch of the DGF. Its mission is to train forestry technicians needed for the

development of the Dominican Republic's forestry sector. It is equipped with a forestry seed laboratory and walk-in refrigeration facilities for seed storage and preservation. Until 1992, the school's tree nursery used traditional plant production methods of containerized seedlings. Now, the school uses the more modern method of directed root seedlings in Styrofoam trays.

Substrate Used in Plant Production

The directed root system requires the following mixture: soil - 15 percent, Manure - 30 percent, ashes - 40 percent, fiber - 1.5 percent, and chemical fertilizers with a phosphorus base to develop root system.

Directed root systems have increased potential plant production 400 percent.

Production Yield

Using the directed root system, 1 m³ of substrate can yield 20,000 cells which can be prepared in one person-day of labor. In comparison, using containerized methods, the same 1 m³ of substrate would fill only 2000 plastic bags whose preparation would require 3 person-days of labor. The labor associated with the transplanting of seedlings is almost identical between the two systems, i.e. 500 to 600 plants/person/day.

Plant Production Costs

The cost of plant production is much less per plant in the directed root system which costs approximately US 5¢ in comparison to containerized systems which cost on the average of US 7¢. The directed root system also has the advantage in that the Styrofoam trays utilized are a reusable resource. However, it requires more fertilizer and the survival rate of plants is lower.

Transportation Costs

A 1.5 ton pick-up truck can transport about 30,000 plants in trays per trip. The same truck can only transport 1400 plants in bags per trip.

One person-day of labor yields 400 trees planted per day at an average cost of \$80 per *tarea* using containerized methods. Directed root systems yield 1200 trees planted/day at \$50/*tarea*.

Numerical Comparison of Containerized and Directed Roots Methods.

	Containerized	Directed root
Yield from 1 m ³ of substrate	2000 bags in 3 days labor	20,000 cells in 1 day labor
Cost of plant production/plant	US7¢	US5¢
Carrying capacity for 1.5 ton pick-up truck/trip	1400	30,000
Potential number of plants planted/person/day of labor	400	1200
Cost of tree planting/ <i>tarea</i>	US\$52	US\$76

*Exchange rate at time of this report was US\$1/12.5.

GUADELOUPE FORESTS

Pascal Chondroyannis and Yolande Gall

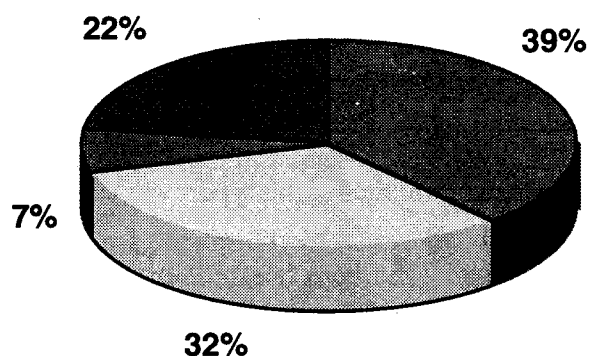
GEOGRAPHICAL SITUATION

Guadeloupe is the greatest of the Lesser Antilles and is in fact an archipelago of 7 inhabited islands:

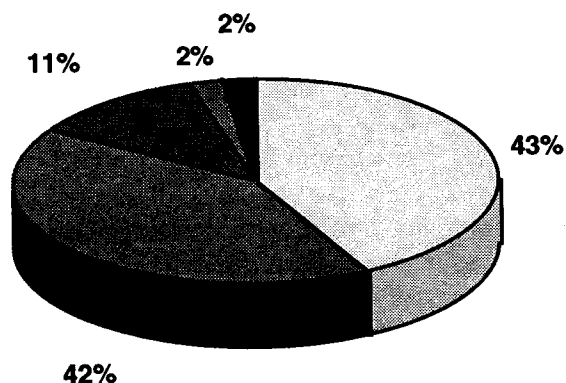
Island	Area km ²	Altitude m
Basse-Terre	848	1467
Grande-Terre	590	135
Marie-Galante	158	204
La Désirade	22	276
Saint Barthélemy	21	280
Les Saintes	13	309
Saint Martin	53	281
Total	1705	

LAND USES (HA)

Forests	66,300
Cultivation	53,907
Uncultivated	12,180
Others	38,113
Total	170,500



FOREST LAND STRUCTURE (HA)



Private forests	28,195
Public forests	38,105
State forests	27,754
State forest located on the coast line	1,502
Community forest	1,394
Mangroves	7,455

FOREST MANAGEMENT ORGANIZATION

Private forests: 28,195 ha - 43 percent of the wooded land.

In spite of the relative importance of private forest area, local obstacles have prevented their economical valorization:

- forest land structure: estates are broken up in tiny parcels (85 percent of forest are less than one hectare);
- building speculation: fertile and accessible lands have been widely deforested for agriculture (sugarcane, banana, food crops). Remaining wooded lands are considered by their owners as real reserves intended to be developed. Touristic development and remission of taxes are attractive incitements to clear the forest for immediate benefit;
- natural constraints: in Basse-Terre, the main mountainous island of Guadeloupe, where 16,000 ha of private forest lie, steep slopes and unstable soils, and bad service roads are the main unfavorable factors. Cyclonic risk is omnipresent;
- lack of references: notwithstanding a few great success, one cannot find locally technical and economical references with which a landowner can agree. Silvicultural methods used by ONF in State forests are not appropriate to their case.

Direct economical stakes (timber yield) in private forest are low, and difficulties to carry them into effect are obvious.

State action, which is managed by ONF, focuses on clearing regulation in order to preserve the forest canopy (ecological and landscape functions) and deals also with the improvement of small-scale wood productions, such as furniture-making.

State forests: 38,105 ha - 57 percent of the wooded land.

The government has committed to ONF the management of its forests (29,256 ha) and the Department's forests (1394 ha) and the application of forest regulations to the public maritime estate (7455 ha of mangroves) in order to protect them (fig. 1). The forest management used by ONF aims at coordinating three general functions assigned to forests:

- production: timber yield, minor products;
- protection: soil conservation, water resources and climate regulation, biodiversity;
- recreation: forest equipment for visitors, making youth aware of nature protection, preservation of diversified landscapes.

The profits made from forests are at one and the same time direct and commercial, and indirect and non-market in their social and ecological dimension. But non-market does not mean worthless.

These benefits are real and noteworthy for instance in such primary activities as agriculture for watershed regulation, protection against soil erosion, reducing change in the weather, preserving biotopes such as mangroves which are nurseries for a lot of useful species. The economical dimension of forest management, though unreckoned, is also obvious for local inhabitants' well-being, and for touristic development, the tendencies of which are moving toward nature discovering as a complement to sea-side leisure activities.

ROLE AND MISSIONS OF OFFICE NATIONAL DES FORETS

The French Forest Service "Office National des Forêts" was created in 1964, as the result of a reform of the former "Water and Forest Administration". This public establishment

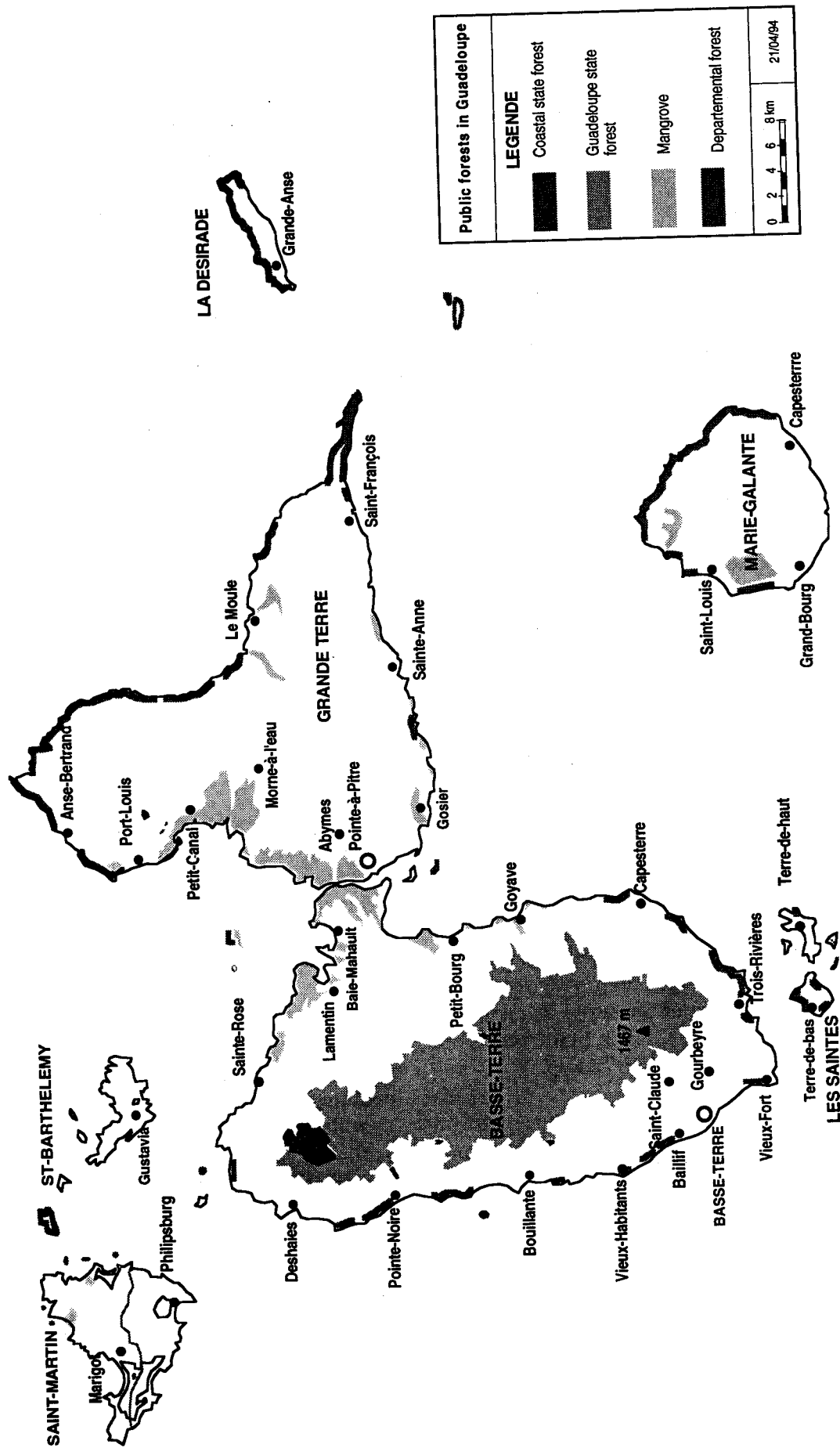


Figure 1. -Map of forests managed by Office National des Forêts in Guadeloupe.

carries out activities which can be divided in three categories:

- state forests management: concerning 38,105 ha of forests belonging to the State and the Department, and spreading over 22 percent of Guadeloupe's total area;
- public utilities missions, committed to ONF by the Minister of Agriculture and Forests. It means in Guadeloupe clearing control over private forests and improvement of small-scale wood productions;
- business activities in field studies and planning, for public and private customers. The kinds of work which are carried out range from forestry and ornamental planting, windbreak, recreation equipments, professional training for environmental professions, ecological diagnostic ...

To carry out these missions, ONF employs 177 persons in Guadeloupe, 55 civil servants, and 126 workmen.

The 1993 expenses reached \$5,380,000 and receipts were \$3,207,000. This debit balance shows the kind of forest management which is performed there.

Protection and recreation are indeed two major goals of our forest management. These activities are at this time non-market ones, meaning a bad balance commercially speaking, the deficit being made up by the national ONF budget.

In fact, only 3079 ha, i.e., 8 percent of the managed area, are devoted to timber production. The remaining 92 percent are protection and recreation oriented.

We have to quote too, that the National Park of Guadeloupe, which started in 1989, includes 16,000 ha of the Guadeloupe state forest management by ONF.

ONF is also the local representative of a public establishment, the "sea-side and riverside conservatory" which buys coastal lands to protect them.

FOREST MANAGEMENT AN IMPLEMENT FOR FORESTERS

The Necessity of Planning in Forest Management

Because of the particularities of the forest environment, its complexity and fragility, actions in the forest cannot just be improvised, but on the contrary, must be decided according to the aims first defined. They must be organized in time and space. These aims are defined in a document called "a forest management plan" which generally covers a 10 year period (fig. 2). They result from a strict analysis dealing with three points:

- analysis of the environment, taking into account ecologic and socioeconomic factors;
- analysis of what has already been done in the forest;
- analysis of the present conditions of the forest.

The forest management plan contains a schedule of work which plans in detail the different measures to use to achieve these goals; they can be work linked to silviculture (cuttings, plantings), equipment (road and tracks), or protection of environment. The management plan includes an economical synthesis reckoning the expenses of works and the expected receipts.

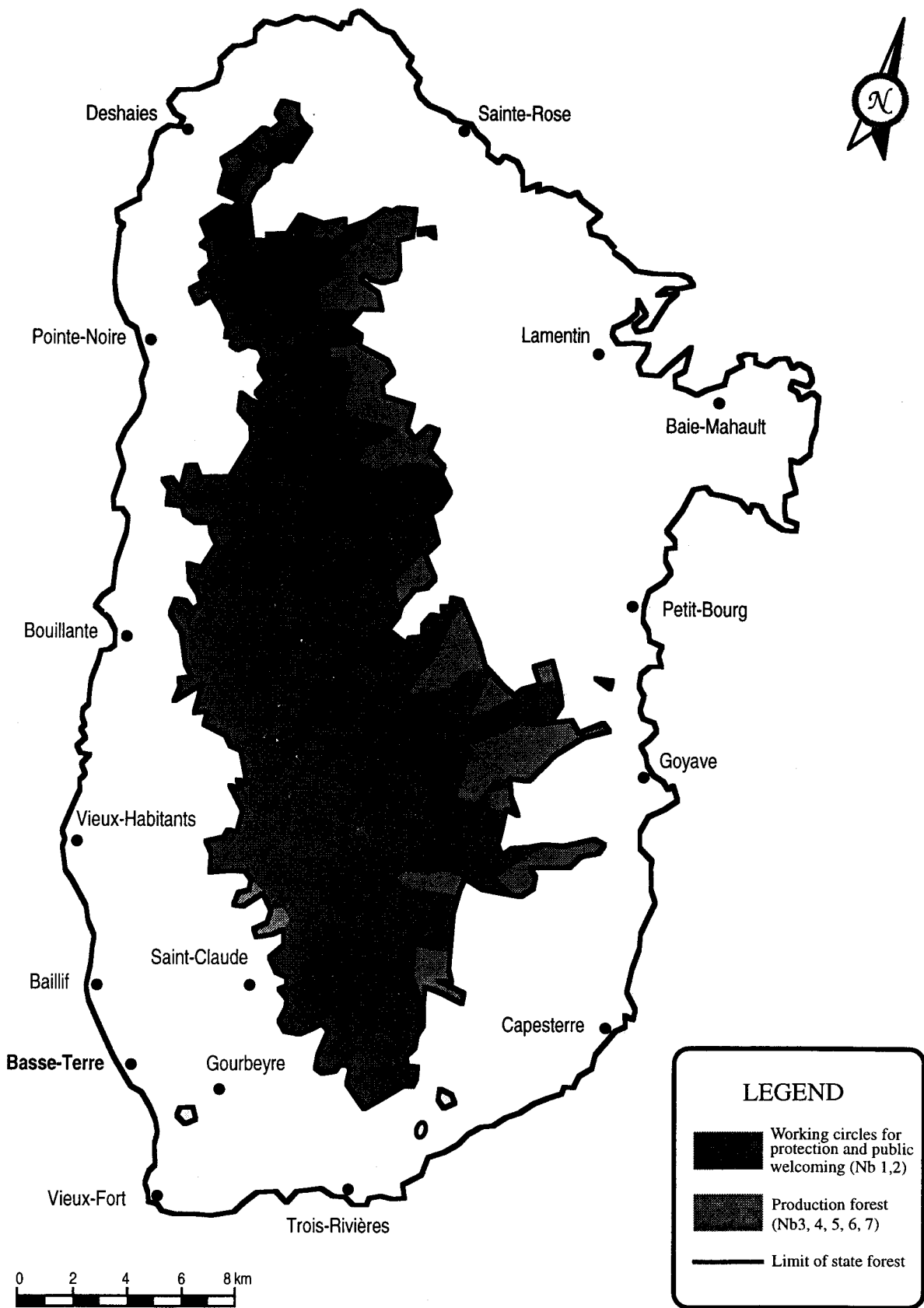
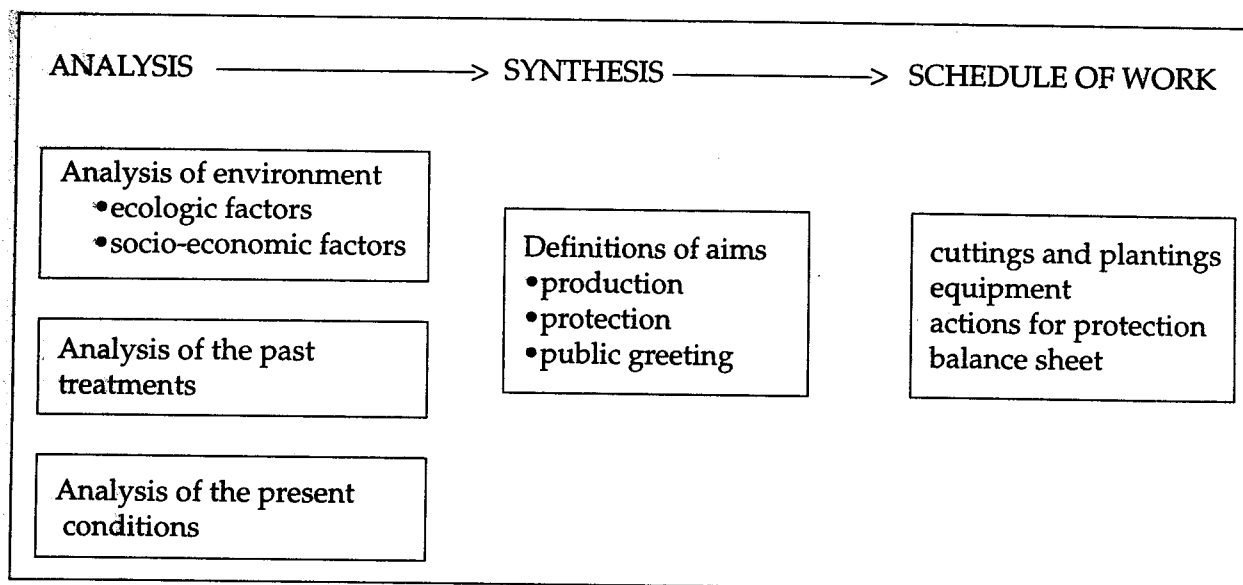


Figure 2. -Guadeloupe state forest management plan.



The Management Plan of Guadeloupe State Forest

The first management plan was drawn up in 1979, it ended in 1990. A second one started in 1991, after Hurricane Hugo, and sets new aims for the forest. It has defined 7 working circles:

ha	
24,496	protection and public greeting
180	landscape protection
1,328	production of mahogany
308	production of mahogany mixed with local species
1,060	production of local species (even-aged crop)
95	production of <i>Podocarpus</i>
287	protection and production of local species (uneven-aged crop).

So timber production concerns 3080 ha out of 27,754 ha of the national forest. The production of local species is still limited. We have just started to apply the first results of the National Institute for Agronomic Research (INRA) dealing with the silviculture of local species. So the main part of our production lies in mahogany (fig. 3).

Broadleaf Mahogany in Guadeloupe Reforestation for Yield

A Few Words About Forest History

Recently, the Guadeloupean foresters realized that the natural forest was not economically profitable.

The lower part of the forest had been over-exploited for agricultural needs especially during the blockade of the Second World War, and the high forest was quiet inaccessible.

So, since 1942, the first plantings of mahogany have started. This species has been chosen because of its fast growth and for the quality of its wood; and Guadeloupean foresters were especially inclined to try mahogany as it had given attractive results in Martinique where it had been introduced in 1902.

Different methods of planting have been used:

- Taungya system mixing temporary cultivation with reforestation;
- line-planting;

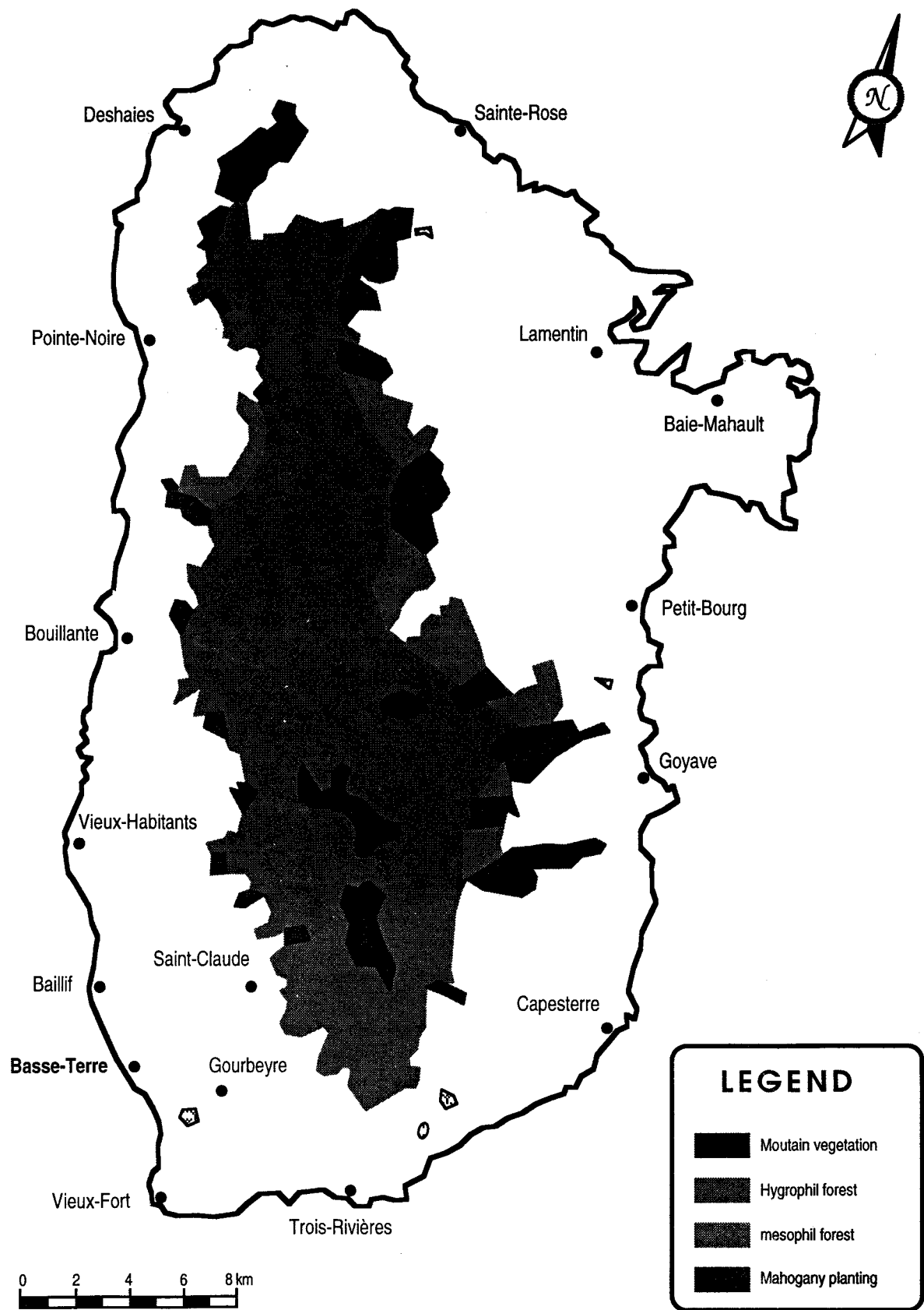


Figure 3. -Guadeloupe state forest vegetation map.

- dense underplanting;
- clear underplanting.

The Present Situation

The first forest management plan proposed to plant 8000 ha with mahogany. Only 4000 ha have been actually planted, at first because of pecuniary difficulties but also for technical reasons.

Indeed, when the first planting started, we did not know much about mahogany ecology and its silviculture. So it did not take a long time for us to realize that the first expectations were too optimistic; mahogany could not be planted just anywhere! In fact, of the 4000 ha already set, only 1600 ha were retained by the current management plan for mahogany yield, the remainder reverting to natural forest. The mahogany oriented areas are chosen from a local yield table based on site indexes and the richness of soil seems to be a major restrictive factor. Recently, two insect pests, spreading over these artificial plantings have made important damages in mahogany:

- Hypsipyla grandella*, this borer is responsible for the bad form of stems. Currently, experimentations are carried out in Martinique to apply a selective treatment based on tree-implant filled with orthene (acephate).
- Hexacolus guyanensis*, this bark beetle attacks well-growing plantings and can kill the trees within 2 months. Biological control has to be studied to fight against this pest which can be very dangerous.

At last, some nice mahogany plantings cannot be exploited because of topographic difficulties; aerial logging with helicopter can be a solution to try according to its profitability.

The Main Actual Problem

Though important, technical questions are not the main problem, but in fact, it lies in the Guadeloupean timber market. ONF can yield roughly 4000 m³ of timber per year, 50 percent mahogany and 50 percent local species. But we can find buyers for them. There is a gap in the process due to lack of demand. Timber merchants are very few and their methods artisanal.

In the past, there were 2 sawmills using local species. They have stopped timber harvesting since 1987. Now they are importing blockwares from Brazil and Guyana, which are transformed into boards and scantlings. So ONF has created its own exploitation unit with fallers and a skidder. Logs are sold on the roadside to a young craftsman equipped with a mobile bandsaw. An agreement has been made to supply him 800 m³ per year. He finds some difficulties to negotiate his sawn timber because of its finishing; the wood quality of mahogany being beside the point.

TIMBER MARKET IN GUADELOUPE

The private yield is difficult to appraise. It is rather a matter of picking according to the needs of the day. Timberwood is sawn directly in the forest with chainsaw, and boards are carried out by hands. There is also a small local production of charcoal, used for cooking. The total yield harvested in private forests should reach between 2000 to 3000 m³.

Year	Volume ³	Value (\$)
1979	1864	30324
1980	281	3353
1981	2885	20696
1982	422	3612
1983	1750	18623
1984	1244	8408

Year	Volume ³	Value (\$)
1985	640	8899
1986	1560	18388
1987	1696	15980
1988	523	13845
1989	98	24476
1990	1289	39603
1991	646	15043
1992	458	27933
1993	582	52388
Total	15938	301571
Annual crop	1063	20105

The current management plan provides for the period 1991-2000 with the following yield and expected incomes:

	m ³	\$
Tabonuco	1300	65,000
Bois rouge	500	25,000
Mahogany	2100	210,000
Miscellaneous	400	20,000
Total	4300	320,000

The main local problem is to sell the timber that we grow and log; this market cannot rationally rely upon a single customer.

Concerning the State Forest, ONF sold the mentioned volumes to the following purchasers:

- from 1979 to 1987, local timber purchasers bought stumpage;
- since 1988, ONF has built up his own logging team with 6 fallers and a skidder. Logs hauled to the roads are sold to a young craftsman using a mobile bandsaw. An agreement fixes that 800 m³ will be sold to him per year with prices from \$100 to \$150 per cubic meter.

Species which are harvested are tabonuco (*Dacryodes excelsa*), bois rouge (*Amanoa caribaea*), and broadleaf mahogany since 1990, because of windfalls due to Hurricane Hugo. The average following prices are given for broadleaf mahogany logging:

	m ³
• felling	\$20
• skidding	\$30
Total	\$50
Selling price on roadside	\$90

Yield harvested by ONF is only a slight part (0.8 percent) of Guadeloupe total consumption (52,612 tons, i.e. 141,000 m³ in equivalent roundwood). It is possible to improve this rate and to aim to fulfill 3 percent of the local needs in ten years when a large part of mahogany plantings will be mature, but these ratios and the quality of timber suggest it would be of higher value if used as veneer.

Local Timber Consumption

The local timber market is supplied at 99 percent by importation (annual needs 60,000 t), and this amount is constantly increasing. Timber comes from ECE, Honduras, Brasil, Guyana, USA, Gabon, and Suriname.

The average price goes from \$500 to \$1500 per ton of sawn timber. The main timber user is the building trade, fastly growing with touristic development and construction of individual houses. Joinery takes second place. Timber importation ranks in sixth place of the import products.

GUADELOUPE FORESTS NON-MARKET COMMODITIES

Reminder of the Forest Balance Sheet in 1993

Receipts	
forests products (timber, hunting location, minor products)	\$233,000
works for customers	\$1,516,000
subventions	\$1,458,000
Total 1993	\$3,207,000
Expenses	
civil servants wages	\$2,132,000
works in state forests	\$1,427,000
works for customers	\$1,821,000
Total 1993	\$5,380,000

This resulting local deficit is made up by the general budget of ONF. These several figures show the little part of direct income in the forest balance of Guadeloupe, and the deficit can be interpreted as the cost that the country agrees to pay for indirect forest values.

Non-Market Forest Values

Among the numerous usefull functions played by forests, the following are especially important in Guadeloupe:

Protection

- soil conservation on steep slopes and fragile soils;
- water resources and climate regulation, especially important in dry coral islands;
- biodiversity preservation, Guadeloupe is, as other Antilles islands rich with endemic species and vulnerable because of human activities.

This important stake explains the creation of the Guadeloupe National Park in 1989, and in 1994 the Biosphere Marine Reserve of "Grand

cul de sac marin", which includes a great part of Guadeloupe mangroves in the MAB UNESCO program.

Recreation

The forest plays a more and more important part in our touristic economy. Tourists are no longer interested only in sea and sun, and wish to discover tropical forest so long as certain facilities are available. In 1979, ONF created the Guadeloupe Regional Park, transformed afterwards into a national park (fig. 4) and has set up a lot of touristic attractions:

- information points with expositions (the Forest House, Volcano House, Woow House);
- a network of walking paths (300 km) and many picnic areas (Carbet falls). Guadeloupe has greeted 340,000 tourists in 1993.

Toward Sustainable Forest Management in Guadeloupe

The short-term prospects on forest stakes in Guadeloupe take as a basis the current management plan which identifies:

- the leading place of protection and recreation in forest management;
- the necessity to keep a forest know-how in spite of a timber economy based on importation.

These statements lead to the following actions:

- protecting the tropical forest, especially facing urban development, by means of ground survey and by developing the scientific knowledge on forest ecosystems with research centers and other Caribbean countries;

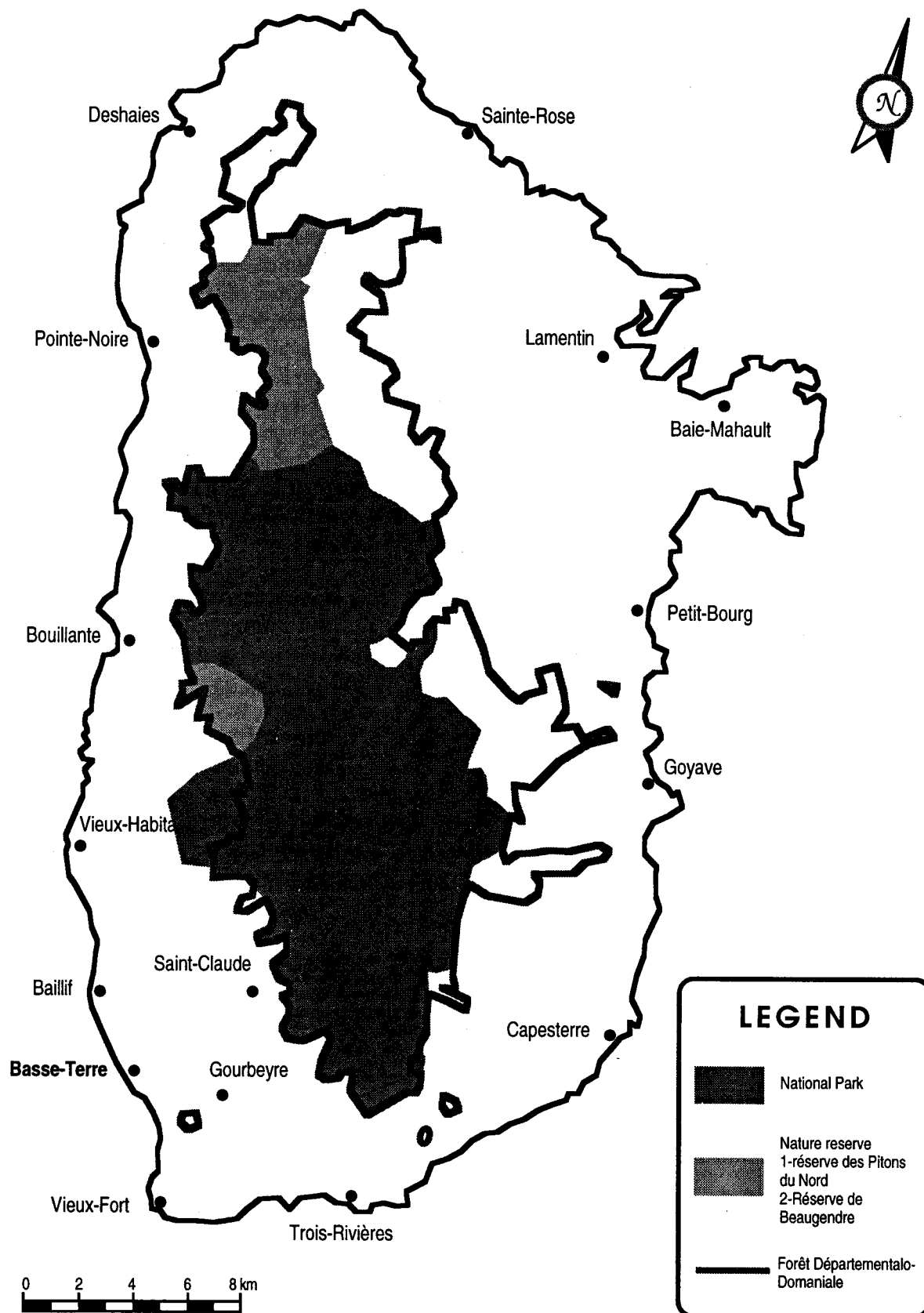


Figure 4. -Guadeloupe state forest protected areas map.

- pursuing the policy of public greeting in forests, so as to protect the environment and to contribute to the touristic development;
- preserving the forest know-how and promote the use of local wood and mahogany. To reach these goals, it is necessary:
 - to make an important effort in technical research on silvicultural problems (natural regeneration, forest dynamics, forest tree breeding). The National Institute for

Agronomic Research works on these subjects in Guadeloupe with interesting outlooks on white cedar (*Tabebuia heterophylla*) breeding in cooperation with other Caribbean countries;

- to improve the joinery and veneer sectors to increase the local demand on native timber;
- improving the forestry techniques to increase their efficiency and reduce the costs;
- investing in information on forest protection.

ECONOMIC CONSIDERATIONS FOR FOREST MANAGEMENT IN GRENADA

Rolox Frederick and Alan Joseph

Location

Grenada is located at the southern end of the Windward Islands, 25 km north of Trinidad, 20 km south of St. Vincent and 23 km south-west of Barbados. There is a total land mass of 34,800 ha (133 mi²).

Climate

The island has a humid tropical climate with some local variations due to mountainous terrain. It is influenced by the North East Trade Winds. The dry season usually extends from January to May and the rainy season for the remainder of the year. The mountainous interior is the wettest while the south western and north eastern areas are the driest. Rainfall varies from 1270 mm in Point Salines to 4060 mm in the mountains. Mean daily and monthly temperatures show little variations, with monthly mean maximum at sea level about 30 °C. Grenada is south of the usual hurricane belt. Carriacou and Petit Martinique always experience much longer dry periods than Grenada.

Geology

Grenada is a geologically young island situated at the eastern edge of the Caribbean Plate which is almost immobile at this moment. It resulted from early volcanic activities during the Pliocene era. There are still signs of geological activities as experienced by the underwater volcano, Kick-em-Jenny in the sea, hot springs and three lakes on the mainland. Initial uplifted sediments of sand, silt and calcareous mud are responsible for fold and formations in the north. The southern areas are volcanic in origin.

Topography

There is a north-south axial range of mountains (peaks 640 m to 840 m) in the interior which is dissected by steep, narrow gorges and valleys. The western side is much steeper than the eastern with many spurs extending to the coast. The southern coast shows evidence of submergence but generally the island is very hilly with more than 50 percent of the island being over 150 m (Weaver 1989).

Eschweiler (1982) studied the slopes of Grenada and concluded the following as shown in table 1

Table 1. *Slope of land in Grenada (Eschweiler 1982).*

Land area (percent)	Slope (percent)
10	<10
20	10 - 20
45	21 - 30
25	> 31

Soils

Eschweiler (1982) also studied the soils and concluded that they are clay (84.5 percent), clay loam (11.6 percent), sandy loam (2.9 percent) and saline soils (1 percent).

In 1959, Vernon et al. surveyed the soils of Grenada. Table 2 summarizes their conclusions.

Table 2. -Percentage of total land area according to soil types (Vernon et al. 1959).

Soil types	Percent of total
Red earths	34.5
Shoal	34.0
Brown earth	22.7
Alluvial	2.6
Shales	1.6
Limestones	1.0
Colluvial	3.6

From both tables it can be concluded that most the soils are of the clay or clay loam type which is well drained and of good fertility. With adequate rainfall and high temperature the soil is a valuable resource which, if properly managed, can grow a wide range of crops. However, slope can be a limiting factor. This implies that soil conservation is very important in any land management/utilization programme on the island.

Vegetation

About 23 percent of the island is forested (including scrubland), most of which is owned by the Government. Seven types of natural vegetation were identified in Grenada.

These are:

1. Montane thickets which are found on the high mountain tops and is dominated by Gommier (*Dacryodes excelsa*).
2. Elfin woodland and palm break which is also found on high mountain tops. The palms usually grow after land slips and storm damage.

3. Rain forest and lower montane rain forest.
4. Secondary rain forests.
5. Dry scrub woodland.
6. Littoral shoreline.
7. Mangrove forests.

Thousand hectares of undisturbed natural climax forest exist. The remainder has been cut at some time.

Endemic plants in Grenada are: *Maytenus grenadensis*, *Oreodoxa oleracea* (Mountain Cabbage palm), and *Danaea* spp. (Fern).

Mission Statement and Objectives

The mission statement of the department is to develop a forestry sector which is managed for production to meet the needs of the population dependent on this sector and at the same time protect the environment.

The objectives are:

1. To manage watersheds for the production of quantity and quality water.
2. Management of wildlife for food production and protection of flora and fauna.
3. Production of timber on a sustainable yield basis.
4. Protection of indigenous species.
5. Produce more food and timber from agroforestry activities.
6. Educate the population on the role and importance of forest in national development.

7. Produce raw material for the handicraft industry.
8. Reforest idle government lands in Grenada and Carriacou.
9. Manage Grenada's wetlands (mangroves, swamps, etc.).

The mission statement and the objectives indicate that the role of the department is to manage the nation's forest for maximum benefit. Therefore efficient and productive use of available resources is integral in developing that sector. These resources are limited, especially land on such a small island where many other factors are competing for them, e.g. agriculture and housing. Price (1989) considers multiple objectives in forest management and indicated that it can cause potential problems to the forest managers. They must consider whether to have more of one product than the other. Beyond a certain point more of one reduces the other (e.g. disturbing fragile habitats during harvesting). "Such conflicts do not produce useful clues for forest managers and achieving most objectives is limited by monetary resources." He suggested that one solution is to recast some specific objectives as targets which are mandatory to achieve or as constraints which must not be infringed. With reducing financial resources allocated to the department during recent years and the need for government to tighten on expenditures, this might be an important consideration for future forest management.

Management of Grenada's forest is affected by economic factors, some of which the department has no control and others which must be considered with other important criteria. These are macro-economic (state of the national economy), micro-economic (application of forest economic theories in forest management), and peoples perception of forests.

Economy

Grenada has a small open economy which has traditionally depended on the agricultural sector (export of cocoa, bananas, nutmegs, fruits, etc.) for most foreign exchange. Recent negative developments (market instability) in that sector lead to a considerable reduction in foreign exchange earnings. Other major sectors contributing to the economy include: government services, tourism, and private sector activities. In 1991 the forestry sector contributed 0.2 percent of Gross Domestic Product (GDP). This calculation was based on the following: (1) sales from forestry department complex at Queens Park; (2) forestry operations; and (3) private sector outputs of small amounts of sawn lumber, handicraft, and furniture.

There was no consideration of the numerous indirect benefits from forestry which contributed to national development, e.g. water extracted, recreation and ecotourism, soil conservation, wildlife hunted, etc.

In an effort to improve the national fiscal position, the government developed its Macro Economic Framework (MEF). Within that MEF, consideration was given to "prevention of soil erosion", but improving the undesirable state of the national economy took precedence over any environmental activities. A Structural Adjustment Programme (SAP) was designed as one of the strategies to achieve the goals of the MEF. The SAP incorporated the following: (1) adjusting the tax system to improve government revenue generation; (2) reduce the size of the public service over a three year period while at the same time improving efficiency; and (3) improving the investment climate.

The government considered this necessary because of the massive foreign debt and a large public service staff. This resulted in a reduction of staff, workers, and resources (table 3) which constrained the department's ability to manage the nations forest resources effectively. It should be noted that the Forestry Department was contributing very little financially to the

treasury. The National Parks Unit was generating revenue from ecotourism (within the forest areas) but this was credited to another department (tourism). Water was extracted from the forest freely by a statutory body (NAWASA) and the public paid for that water but the producers of the water (forestry sector) received no revenues.

Table 3. -Total government expenditures for Forestry Department, 1990-1993 (excluding project funding).

Year	Total expenditure* (EC\$) [†]
1990	1,337,459.00
1991	961,864.00
1992	862,689.00
1993	946,760.00
Total	4,108,772.00

*This excludes expenditures for other sectors such as National Parks.

[†]US exchange rate \$1 = EC\$2.6.

Source: Ministry of Agriculture, Grenada.

Demand for Forest Products

Recent surveys showed that population totals have stabilized (table 4) but household units increased (table 5). The studies further show that the use of propane gas is increasing. This infers that demand for domestic fuelwood is either reducing or stabilized.

Table 4. -National population changes (1960 to 1991).

Year	Population
1960	88,677
1970	93,622
1981	89,088
1991	90,691

Source: Graveline 1992.

Table 5. -Changes in household units and family size.

Year	Household units	No. of persons/house
1981	21017	4.2
1991	24302	3.7

Source: Graveline (1992).

There is evidence that commercial fuelwood demand has been increasing, especially in the rum distilleries. The demand for construction and furniture timber is also increasing rapidly. It is evident that together with plywood, paper products, etc., they contribute to a significant proportion of the national import bill (table 6).

Table 6. -Wood and wood product imports in Grenada during 1991.

Type of product	Value (EC\$ Million)*
Crude wood (mostly sawn lumber)	7.1
Panels	3.9
Boxes, etc.	1.7
Wooden furniture	0.5
Paper products	7.9
Paper	1.9
Total	23.0

*US exchange rate \$1 = EC\$2.6.

Source: Graveline 1992.

It is obvious that there is a large demand for lumber but closer assessment indicates that other products are also of great demand. Water is one of the most precious resources demanded by the people. More than 80 percent of the water being distributed to the population is extracted from rivers whose sources are in the forest areas. Much more is being demanded and NAWASA is endeavoring to meet this demand. Presently, much more water can be extracted from rivers, all having their sources in forested areas.

The use of the forest as an ecotourism destination is expanding and well supported by the tourist sector. There is evidence that many local people also participate in this exploration of the natural beauty of Grenada. National Parks and Forestry Department can work together to develop this product which has the potential of producing financial returns if properly developed, managed, and marketed.

Supply/Forest Industrial Activities

Given the size and terrain of Grenada extensive industrial forestry activities (wood

utilization) are not preferred options. Present activities are limited to the department extraction of forest products (furniture wood, poles, posts, fencing, etc.) within the forest reserve. The main species harvested is blue mahoe (*Hibiscus elatus*). It is used as a substitute for mahogany. The department owns and operates a mobile wood mizer mill and the above products are obtained through an integrated working system. Blue mahoe logs, fence posts, fencing materials, and some posts are all harvested at the same time. The private sector is excluded from these operations in the reserve. They operate on a smaller scale than the department and obtain their logs from private sources. There are four small private sawmills, one being a woodmizer which does not operate full time.

There has been recommendation that these activities on government lands should be privatized but no final decisions are made. A suggestion that a log market be created and buyers bid for the logs offered (competitive pricing) was made by Graveline (1992). This has advantages and disadvantages. Competitive prices will tell the Forestry Division: (1) whether they are spending too much producing the timber and look for more cost effective means of production; (2) whether they are producing types and quality of timber needed; and (3) whether they should leave the timber standing.

Grenada has unexplored areas through which trails and interpretative work can be done to encourage ecotourism development. The numerous varieties of flora and fauna in the forest make interesting packages which must be fully promoted.

In looking at the economics in forestry we have always seen that the forest has never been given its real value and hence not able to compete for funding on an even basis with other sectors. It means that although, we have to struggle to convince policy makers of its true value and importance we also have to use every opportunity to generate more revenue using any possible activity that is considered

sustainable. The department has initiated some activities which can produce additional revenue in the short-, medium-, and long-term at minimal extra costs.

We have introduced line planting of mahogany on eighteen acres of marginal lands at Grand Bras. Mahogany seems to do quite well at lower altitude. It is hoped that this project would serve as a demonstration for farmers who may wish to use this idea to generate more revenue in the long-term on marginal lands. It is also expected that the forest department will use this technique to produce future valuable wood for furniture at relatively low establishment and maintenance costs.

The department started propagation and planting of mauby in Carriacou where there is a problem of overgrazing and there is a need for quick ground cover. The mauby bark makes an excellent drink which fetches a good price on local and regional markets. Our mauby project serves as demonstration to farmers and they have already shown keen interest in this plant since it cannot be eaten by animals.

One other aspect which was introduced is the planting of dasheen for its leaves (Calaloo) and Water Cress. These plants can be grown in streams when areas are cleared or harvested. The costs involved are little, revenue will be generated but will be stopped when the canopies close over the streams.

Christmas trees are planted under power lines in the reserve. Tall trees under the lines are cleared to avoid destruction during inclement weather. The Christmas trees are harvested every two years so they are of minimal danger to the lines. Clearing cost is met by the electricity company when large trees must be cleared but the department maintains the plants. These trees are sold and generate revenue.

It is important to ensure that we use our available land space wisely because there are many sectors competing for lands and our country is small. Many of these activities do not need

any massive initial layout of Capital and could be self sustaining.

People's Perception of Forestry

Forestry has been traditionally considered as a "common resource" for most people although it cannot meet most of the country's needs for wooden products, most of which are imported (table 6). Many people harvest forest products freely and with very little control, hence creating the commons problem as described by Price (1989). He contends that this has many adverse effects, including:

1. The individual perceives only the benefits he receives and allows long-term productivity to be the problem of someone else.
2. The best are removed-loss of gene pool since low grade material remains.
3. It can result in the irreversible loss of species/ecosystems since no replacement is being done and resources diminish as common use pressure increases.
4. No individual is interested in investing to improve the resource since the benefits will be enjoyed by someone else who will not be paying for the enjoyment.

All these must be considered in economic management of forest resources to make decisions which are best for developing the sector given prevailing conditions.

Economic Expansion of Forestry Sector

Production of water is one of the main objective in forest management. At the same time it is imperative that as much revenue as possible is collected by the department from that forest product. There is an acute demand for water in the southern areas which is linked with the expanding tourist and manufacturing industry as well as increasing population.

Ecotourism offer the best option by which much needed revenue can be obtained from the forest. The Forest Department and National Parks unit have demonstrated this potential through user fees for ecotourists but much more work is needed to realize the full potential.

Occupancy rates in the hotels and guest houses increased from 43.3 percent to 67 percent between 1989 and 1992. The length of stay also increased from 7.03 to 7.21 days between 1992 and 1993. Table 7 indicates the records of visitors to Grenada. It is estimated that 55 percent of cruise ship and 70 percent of stay over visitors, visit forest areas during their stay in Grenada.

The authorities concerned must ensure that additional areas within the forest are available for recreational purposes. The terrain may hinder plantation development but is ideal for development as ecotourism destination.

In the MEF there was recognition for action necessary to protect the environment and the need for national population policy as well as

safeguards to prevent soil erosion through deforestation and unprofessional farming practices. Forestry has since been classified high an the Public Sector Investment Programme (PSIP), especially projects under Tropical Forestry Action Plan (TFAP), as the national planners realized that this sector is much more significant in national development than initially thought. In 1991-1994 period three forestry related projects were funded to improve that sector. These are two WFP projects and Levera Park development project. There are other smaller projects designed to promote ecotourism, e.g. at Morne Delice.

The departments must be more aggressive in promoting ecotourism and develop the necessary infrastructures to benefit from that expanding industry. National Parks authorities began implementing a fee paying system for recreation users in selected areas within the forests. This is expected to expand until all visitors pay for that pleasure. The authorities must maximize returns from the forest and creating additional areas for recreational purposes is one way of achieving this goal.

Table 7. -Statistical information on tourist visits to Grenada.

Type of visit	1989	1990	1991	1992	1993
Stayover visitors	68,596	82,750	92,495	87,554	93,919
Cruise ship	120,702	183,159	196,144	195,894	200,061
Expenditures					
Stayover	769,64,700	92,013,000	112,533,900	104,112,842	119,866,380
Cruise ship	5,974,700	9,066,400	9,709,100	9,706,752	9,903,022
Rooms available	1,085	1,105	1,118	1,114	1,428

Source: Ministry of Tourism.

Forest management must expand to cover mangrove areas and other minor forest products (bamboo). Exploitation of these resources are on the increase as the tourism industry expands. These resources are contributing to household income and proper management could help the economy as demand for them increases.

Forest management theoretically requires maximum use of available resources to achieve desired objectives. The various operations should be done with this in mind. In Grenada, there are other considerations. Watershed protection is the most important management objective and must be considered when carrying out any other operation. Logging is integrated with other silvicultural operations. The areas logged must be planted the same year, usually by the same work force. There is no single logging crew. The operations are shifted according to work schedules. Climatic conditions encourage weed growth and usually three weedings per plantation are required annually for three years. In some districts all these operations are carried out by one crew. With limited finance, resources have to be shared and at some times similar work has to be done at the same time in more than one location. Evans (1986) suggested that forest management must be considered in "light of existing economic conditions." He further stated that forestry contribute to national economies but forest management requirements should be done.

Openshaw (1980) stressed the significance of costing the individual forest operations. He indicated that questions, not only why forestry investments, but on spending between forest projects and on different management practices are asked regularly. He suggested that this is the best way of comparing forestry investments with other alternatives. He contends that this gives the best picture of the enterprise and can influence courses of action. This has not been applied in Grenada but should be considered for future management.

Expansion of the forestry sector can also be realized if education is given high priority. Information on importance, best use and conservation practices is important in the overall quest of economic management of the forest resource. To rationalize management of the forestry sector, the department is considering establishing a forest planning unit, as recommended by the Country Mission Team under the Tropical Forest Action Programme. It is hoped that management of the national forest resources will be better organized. Heatherington (1987) indicated that one of the benefits of such a move is "evaluation of resource use options."

Important suggestions made to improve the delivery of services to the people and optimize the use of the resources include:

1. Forestry sector should concentrate on supplying niche markets where some advantages can be achieved.
2. A clear policy is required on the management of national parks and the development of ecotourism.
3. Payment should be made to the Forestry Department for any product extracted from the forest (wood, water, recreation, etc.).

To improve management of the forest resources decisions have to be taken both at policy making and management levels to initiate more efficient use of the available resources. Such decisions must improve the quality of goods and services presently being delivered by the forestry sector to the people.

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ECONOMIC FACTORS IN FORESTRY A GUYANA PERSPECTIVE

Lawrence H. Lewis and G.E. Marshall

INTRODUCTION

There have been significant economic developments in the forestry sector during the past few years. Many of these economic developments relate to the demands of both local and overseas consumers. Through the advent of Government's Economic Recovery Programme and subsequent but similar economic pacts, local and foreign investors were wooed here and many of them opted to invest in forestry. Due to these investments almost the entire area of the permanent forest estate, described as state forests, has been allocated to various entrepreneurs, both local and foreign.

ECONOMICS IN FORESTRY

The attention given to economics in forestry may be assessed in some measure by the area allocated for the permanent forest estate. In Guyana the decision to allocate areas for Permanent Forestry Activity was an easy one. The flat fertile coastal belt can meet most of our agricultural requirements, whereas the undulating, infertile, and acid soils under forest cover do not sustain agricultural activity economically for more than a few months. Since it is hardly likely that farmers of the interior forest areas can compete successfully with their counterpart on the coastland (save for a few crops such as pineapple or peanuts) not even agri-silvicultural programmes have been undertaken.

Economics in forestry is also reflected in the ratio between natural forests and planted forests. The economic advantages of plantations have frequently been illustrated, specifically the higher volumes per hectare. There has been a great deal more difficulty in quantifying the economic advantages of natural forests. In Guyana there are no plantations save for a few experimental plots (approximately 810 ha) of *Pinus* spp.

Foresters are keen to state in national forest policies the management of forest resources for optimum returns in terms of their productive, protective, aesthetic, and recreational functions. It is the optimization of the returns on a forest resource that lays the foundation for economics in forestry.

AMERINDIANS ROLE IN THE ECONOMICS IN FORESTRY

The Amerindians of Guyana have been enjoying good economic returns from our forest resources but these returns have not always been quantified in dollars and cents. Amerindians have obtained small quantities of building materials, meat, medicines, barks, roots tubers, leaves, seeds, fruits, and wooden tools (for hunting and fishing) from the forest.

Arguably, the economic returns have been small but adequate and continuous, and the forest has never lost its character. More stationary groups have engaged in slash and burn agriculture, apparently these activities have no significant impact on the overall ecosystem where they occur. Soils become temporarily more fertile and resulting regrowth of vegetation has provided grazing for herbivores. The cycle is repeated over and over and the economic returns are assured.

More easy to trace and to quantify in economic terms have been the activities of the bleeders of Balata, which is the latex from the Bulletwood tree (*Manilkara bidentata*). The so-called "Pork Knockers" have roamed throughout Guyana bleeding and extracting Balata and ensuring raw materials for industries in and out of Guyana. In rare cases trees die due to the bleeding of its latex. The impact of this activity on the entire resource has been negligible, the economic factors involved have been simple but the economic returns have been significant.

DEVELOPMENT OF FORESTRY ACTIVITY IN GUYANA

Forestry activity in Guyana has since evolved into a more sophisticated and dynamic phase but very little attention has been paid to serious economic analyses. The multiple use capability of the forest is never taken seriously in management prescriptions; even control mechanisms such as minimum royalty and acreage fees put in place by the Guyana Forestry Commission do not seriously address the whole range of products and services available from a particular area of forest resource. One may argue that in Guyana, any serious attempt at quantifying the economics associated with ecotourism or exploitation of minor forest products or any other non-logging resource use, is made difficult by the difficulty in quantifying aesthetic values or production costs for minor forest products.

Logging activity for more than 100 years has been the major economic activity of the forest resource in Guyana but the situation is no better in terms of the demonstration of the interaction of economic elements. Even though it is known that loggers and sawmillers are making money, the local production cost per cubic meter of lumber is among the highest in the world. These high costs are evident because of non-adherence to some basic economic considerations such as inability to quantify the resources under management, poor road construction, choice of logging vehicles without analyzing technical specifications, poorly trained operators, untimely vehicle maintenance schedule, etc. Also low forest charges in the form of royalties and fees do not encourage efficiency.

ECONOMIC ANALYSIS IN VARIOUS SECTORS

Another way of examining economics in forestry is to analyze the functions of the forest in various economic sectors. In the agricultural sector in Guyana, small patches of riparian forest help protect the margins of canals and outfall of sluices. The Sector's massive irrigation

system on the coastal plain is sustained by large volumes of freshwater from forest covered catchment areas. The rat menace in our sugarcane plantations is alleviated somewhat by poisonous snakes and owls in bordering forests.

The forest sector itself generates enormous economic activity through sustained production of wood, fibres, tannins and dyes, latex (rubber and balata), resins, essential oils, fatty oils and waxes, cellulose products, drug plants, and food plants. The diet of Guyanese is frequently supplemented by various foods of plant origin such as heart-of-palm from *Euterpe edulis*; akuruyu, *Astrocaryum tucuma*; Sawari, *Caryocar nuciferum*; and Locust, *Hymenaea courbaril*.

Guyana, the Land of Many Waters, has a variety of rapids and waterfalls for which many feasibility studies on their energy (hydro-power) potential have been prepared. The maintenance of forests in upland catchment areas is vital for the development of such energy units because they (the forests) guarantee a continuous flow of water.

In terms of the pharmaceutical industry, a wide variety of plant parts are being researched to extract useful substances for human medicine. Species such as Congo pump (*Cecropia* spp.), Balsam (*Copaifera* spp.), Quashi bitters (*Quassia amara*), Devil doer (*Strychnos toxifera*) have been under analysis for some time. The protection of segments of the fertile coastal plain of Guyana and its enormous agricultural potential is ensured by the protective function of an extensive belt of coastal mangrove forests. In fact, mangroves, when undisturbed steadily colonize more land and in fact extend the area that eventually becomes available for agriculture.

Forests in Guyana have now assumed a new function in facilitating so-called ecotourism. The number of sites identified for possible ecotourism centres have risen significantly. The forests of Guyana offer tremendous potential for this type of venture with an abundance of exotic trees and shrubs, fauna and drainage, and

topographical patterns including extensive areas of white sand. Economics in forestry depends a great deal on the technological advances made in the utilization of various products and success in marketing them. In Guyana tremendous economic potential of the forests exist, whether or not analysis is made from the technological stand-point or the ecotourism angle.

THE ROLE OF GUYANA FORESTRY COMMISSION

The local regulatory organ in the forestry sector, the Guyana Forestry Commission recognizes the need for economic analysis based on the proper collection of data. Recently, professionals with specialized skills in cost accounting and economics have been employed to study how various fees, commissions and royalties ought to be constructed on a coherent and predictable basis.

Fees, commissions, and royalties generate revenue for the Guyana Forestry Commission that can be used to pay for the monitoring of economic activity in forests. Fees, etc., can also be used to influence forest management practices and the structure of forest industry. For example, raising royalties on a species that is being seriously over-exploited can help reverse this trend. Economically determined area fees can help to ensure that concession sizes are big

enough to permit sustainable management, but not so large that they encourage the holding of large areas of land simply for security or speculation. Different tax rates on the export of processed and non-processed forest products can help to encourage the development of value-added products, thus generating more employment and foreign exchange for Guyana. These are just some of the examples of why economic policies are important.

The Guyana Forestry Commission has been constantly upgrading its information systems and participating in various workshops on project planning and development and preparation of management plans. Application forms for forest concessions and sawmilling respectively now require a more global picture of the applicants capability to sustain the capital requirements of the enterprise and their knowledge of the economics of the business. Special interviews are held with such applicants. Both the officers of the Guyana Forestry Commission and the loggers and sawmillers benefit from such interaction. The Guyana Forestry Commission is currently developing an extension unit which will guide loggers and sawmillers on various key economic and technological issues. The overall objective is to reduce production cost through a knowledge of the economic, technological, and managerial aspects of the business.

THE FORESTRY SECTOR IN HAITI

Louis Buteau

RESOURCES

Estimates of the amount of forest lands in Haiti vary, depending upon the source, from 9 percent (FAO 1975) to 33 percent of the country. These differences (251,000 ha versus 930,000 ha) are the result of semantics in the definition of what is forest land. Some 691,000 ha of the 930,000 ha of forest in the World Bank estimate is severely degraded forest or grassland with scattered trees, and much rehabilitation and reforestation would have to be done to bring most of this land back to any where near its productive potential for fuelwood or timber. Very little, if any, undisturbed forest exists in the country today and essentially no timber or lumber is cut for export. However, when the present area of degraded forest is combined with that of abandoned agricultural lands still suitable for growing trees, there is enough land available to meet the country's fuelwood energy needs, if they are given proper management.

The natural forest vegetation varies according to rainfall and elevation as described below. However, many of the potential economic species have been reduced to scattered occurrences through overcutting. The environmental conditions and forest associations as described in previous IDA and FAO reports are:

1. In the humid highlands (800 to 2000 m elevation, and over 1000 mm rainfall), the main trees are *Didymopanax tremulum*, *Bruellia camocladifolia*, *Ocotea capitatum*, *Weinmannia pinnata*, and *Carya fagdeni*. The only remaining extensive pine forest containing *Pinus occidentalis* is found here also.
2. The forests of the sub-tropical lowlands with high rainfall (over 2000 mm) include *Didymopanax morototoni*, *Byrsonima spicata*, *Alchornea latifolia*,

Guarea trichilioides, *Buchenavia capitata*, and *Pinus occidentalis*.

3. The humid lowlands (1000 to 2000 mm rainfall) are the habitat for the main economic hardwoods: *Swietenia mahogani* (mahogany), *Catalpa longissima* (oak), *Haematoxylon* (logwood), *Simaruba glauca* (ash), *Colubrina ferruginosa* (ironwood); other common trees include *Roystonea regia* (royal palm), *Anacardium occidentale* (cashew nut), and mangoes.
4. The dry subtropical forest (500 to 1000 mm rainfall) occupies large areas; the main species are *Phyllostylon brasiliensis* (boxwood), *Prosopis juliflora* (baya-honde), and *Guaiaecum officinale*; the latter two are in high demand for charcoal. Other common species include *Coccoloba laurifolia*, *Metopium brownei*, *Ouratea ilicifolia*, *Jacquinia*, *Leucaena glauca*, *Amyria*, *Samyda*, *Crythroxylon*, *Exostema* and legumes of the *Croton* and *Capparis* spp. In many areas, the desirable fuelwood species (bayahonde and guaiacum) are subject to overcutting and are in regression, being replaced by xerophytic species, especially *Opuntia antillana* (cactus) and *Euphorbia lactea* (milkstripe euphorbia).
5. In the coastal mangrove forests the main species found are *Rhizophora mangle*, *Avicennia nitida*, *Laguncularia racemosa*, and *Conocarpus erecta*.

FUELWOOD PRODUCTION AND MARKETING

The total estimated wood consumption for energy was estimated at 4.6 million m³ in 1982, while the growth of trees on all forest lands was only 1.7 million m³, a deficit of 2.9 million m³.

As will be discussed later, the present pace of replanting won't provide the growth to overcome this deficit. Using the 1982 figures, it was estimated that the forests of Haiti would be depleted of any meaningful production by the year 1995, when the demand for fuelwood would exceed 6.2 million m³. Using AFORP survey data from 1985 and 1986 of charcoal deliveries to Port-au-Prince, and assuming that the amount of charcoal used throughout the rest of the country is equal to that used in Port-au-Prince, the amount of wood used to make charcoal was 836,000 m³ per year. (Assumes 5 m³ of wood is needed to make 1 ton of charcoal). AFORP studies also indicated that the percentage of charcoal produced in various regions is shifting, but the absolute amount produced in each is increasing. For example, in the 1970's nearly one-half the charcoal delivered to Port-au-Prince came from the northwest, while in 1985/1986, it had dropped to 34 percent. Over this same period 28 percent came from the south, 13 percent from the central, 10 percent from the southeast, 8 percent from the Grand-Anse, and 7 percent from La Gonave. Another study by the same researchers found that the number of peasants making charcoal increased dramatically after the pig eradication program of 1981-1983. A 1985 survey of charcoal producers around the country found 45 percent had been making charcoal 3 years or less and 64 percent producing it 5 years or less. This charcoal is made in pit kilns by piling freshly cut wood, covering it first with grass and green tree leaves and then earth. Once the covered wood is lit the rate of burn is controlled through opening or closing a small number of air passages passing through the eastern wall. The yields are low, some estimate that 5 to 6.67 m³ of wood will make about 1 ton of charcoal, or roughly a 25 percent yield. The majority of producers are farmers who need the income to supplement that earned from their other farm enterprises. While the income per sack produced for the farmer is relatively small in absolute terms, the 1985 AFORP study also found the price of charcoal, and likely sale price to the producer, had increased over the period of the early 1970's to

the mid 80's at a much faster rate than the cost of living. This coupled with the fact that most of the rural population are desperate to find ways to supplement their income has, as documented in a USAID study, resulted in substantial increases in the number employed in making charcoal. In the early 1980's, 50,000 people were estimated to have at least part time employment making and marketing charcoal and fuelwood.

Fuelwood is used primarily in rural areas for cooking. However, rum distilleries also use significant amounts. In the large cities, bakeries, and dry cleaners are significant fuelwood users. The amount of fuelwood entering Port-au-Prince in 1985 was estimated to be 11,850 m³.

The amount of sawn lumber produced in Haiti, almost all pine, was estimated at 5000 m³ in 1980. There are no commercial sawmills for native logs at present. The 1986 AFORP survey found about 37 percent of the lumber delivered to Port-au-Prince came from the Massif de la Selle region (supply source listed as Thiotte and Jacmel), 19 percent from the Massif de la Hotte region (supply source listed as Jereme) and 13 percent from the Central Department. Much of that reported for the two Massif regions was probably illegally cut pine from state lands. At this time the pine forest offers the only possible supply of commercial lumber. However, a substantial forest mangement effort, including reforestation will be heeded before any significant contribution to the nation's lumber needs can be met and any potential export income realized. Estimates of the amount of polewood produced annually differ widely by source. One estimate from 1982 puts it at 42,750 m³. This included poles, posts, and wattle used for housing. Other estimates are as much as five times this.

THE BIG CHALLENGES THE FORESTRY SECTOR OF HAITI HAS TO TAKE-UP

In 1975 already, the FAO warned the Government of Haiti (about the wood short-age)

after an evaluation of the balance sheet production/consumption of wood in this country.

Although the statistical data were not really conclusive, the FAO, taking into account some indicative figures from other studies in some other subtropical areas, developed the following balance sheet information. According to it, three kinds of wood are used for consumption in Haiti: (1) firewood and charcoal; (2) pole, post, and beam; and (3) wood for furniture.

The total yearly consumption of these products at that time was around 4.75 million cubic meters. From that, 4.5 million cubic meters was for firewood and charcoal (from which 3.5 million was for household use and 1 million for semi-industries: bakery, distillery, and so on). For the pole, post, and beam category, 200,000 cubic meters, and for the furniture, 45,000 cubic meters was utilized.

To keep up with this demand, the production (from all sources) was estimated at less than 1 million cubic meters at that time, which means that there was a deficit of 3.75 million cubic meters per year if we take into account the demand of 4.75 millions of cubic meters we have been talking about. To make up for this at that time, at 200 or 150 million cubic meters. If we keep this figure (150 million) and take into account a rate of about 3.75 million cubic meters in 1974 and 7.5 million in 1995 (annual growth rate of the population was 2.48 percent at that time), the forest resources would disappear in year 2000. Other studies done in 1990 have reached the same conclusion.

WHAT CAN THE GOVERNMENT OF HAITI (GOH) DO TO AVOID THAT?

In front of this overexploitation of wood in Haiti, due to the lack of balance between the offer and the demand, a realistic policy has to be followed very quickly by the GOH, policy that should come from these two established facts.

The GOH should return to the Ministry of Agriculture (responsible for the forest sector) a certain amount of good lands in order to produce wood to make up for the deficit. However the land tenure situation is complicated in Haiti, as it is not easy to find good lands in this country.

Moreover, if the GOH launches high scale reforestation work on these eventual lands, it would take 5 to 10 years to have a good production of firewood and 20 to 50 years for the hardwood species, but in the meantime, the deficit would keep on growing.

Then it is very useful to adopt a policy that brings to the country a reduction of the consumption of wood in Haiti.

You can reduce the consumption of wood for furniture, pole, and beam in two ways: (1) by improving the traditional techniques of sawing, that can decrease some important wastes; and (2) by substitution using metallic products and imported woods.

To reduce the consumption of wood for energy, GOH would follow two steps: (1) the conservation of energy, and (2) the substitution of the energy from wood (mainly the charcoal).

In the first case, this conservation would have as a goal to use less charcoal. For that, a large scale distribution of improved stoves should be foreseen in Port-au-Prince (Capital of Haiti) and in other urban areas. The sale of 67,000 stoves would be foreseen during a 3-year period and also the sale of 16,000 stoves "post-ages" (special stoves used for cooking in a specific kitchen) in the same period. Cumulatively, it would represent a level of charcoal saving of about 15,000 tons (about 8 percent of the consumption of this product in urban areas of Haiti).

For this conservation, the GOH should take into account the modernization of the charcoal field by the geographical reorientation of

charcoal activity and by trying to ensure the charcoal activity becomes an environmentally sound one.

In the second case, this substitution would be done from liquid petroleum gas (LPG). The GOH would increase step by step the number of urban consumers using the LPG as the principal fuel; that means 50 percent of households in Port-au-Prince in year 2001 and 20 percent in the other areas for the same period. You would have then, a consumption from 7000 tons in the beginning of the 1990's to 41,000 tons in year 2001.

According to the World Bank (in strategy for household energy in Haiti, June 1991) "The relative increasing of total cost of importation of fuel, would be about 12 percent in 2001. That would represent now, if you take into account the current external exchange equivalent raising of 4 percent of total exportation of the country in 1990..."

Another means that can also bring a substitution that would be worth exploring is biogas. The GOH has already tested it in small scale but we need a good research program for this area.

Those efforts of energy conservation and substitution should not exceed a 10 or 15 year period to avoid a total dependence of Haiti on these products. This period of time could be useful in order to have a forest recovery in the country.

FUTURE PROSPECTS

Simultaneously with these efforts (conservation and substitution), the GOH will seriously invest in the forestry activities in 2 ways: (1) keep working in the creation of a forestry domain for the country with the total involvement of Haitian peasants; and (2) spreading of high quality forest tree species and even fruit tree species in the rural area through agroforestry activities.

The GOH has made some efforts to meet these two objectives before the embargo, mainly through "Le Project Forestier et Protection de l'Environnement (a project made between the GOH and the World Bank) and through the Tropical Forestry Action Plan (TFAP) animated by the FAO.

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ECONOMICS IN FORESTRY IN JAMAICA

Roy S. Jones

INTRODUCTION

Jamaica is situated between north latitude 17°45' and 18°30', and west longitude from 76°15' to 78°30'. The island has a maximum length of 146 miles (235 km) from east to west, and varying widths north to south from 23 miles (37 km) to 51 miles (82 km), and covers an area of 4,411 mi² (11,400 km²). An estimated 80 percent of the entire country is hilly, mountainous and rugged with 51 percent of the island having slopes which exceed 20 degrees, and the highest peak, the Blue Mountain is 7402 feet (2256 meters). Most of the forest areas can be found in these upland areas with concentrated areas of small farmers. Today only the most remote and inaccessible of the forested areas may be considered untouched (an estimated 6 to 7 percent, 191,000 acres [77, 000 ha]). Human activities such as farming, clearing, fire, and the introduction of exotic species have radically and drastically affected Jamaica's forests.

Prior to Hurricane Gilbert which struck on September 12, 1988, estimates of the total area which could be termed forests in the broadest sense (i.e. more than 10 percent tree cover) were between 761,000 acres (308,000 ha) and 1,358,500 acres (550,000 ha); including forest plantations severely degraded and high ruinant lands. From the commercial view of the estimated area of productive natural forest of 77,000 ha 77 percent is state owned while the remaining 23 percent is private. Forest plantations are presently estimated to be 40,000 acres (16,000 ha).

ECONOMIC OVERVIEW

The diverse Jamaican economy has the primary sector agriculture and mining, manufacturing, construction and installation and the service industries, especially tourism, all contributing substantially to gross domestic product (GDP). The performance of the economy severely deteriorated throughout the 1970's due

to a combination of rising oil prices, declining tourist revenue, the ensuing fall in demand for bauxite/alumina, and an over-valued currency. This situation worsened significantly during 1980 when the already weakened economy was buffeted by a major hurricane, the second oil price shock, and the hike in international interest rates. As a result (the IADB reported) not only did real GDP drop by 5.7 percent but inflation rose 27 percent and unemployment jumped to well over 20 percent of the labour force.

To counteract this declining trend, for the past decade the succeeding governments have concentrated on stabilization and a series of structural adjustments. The main features of these include devaluation, dismantling of the import licensing system, tax reforms, monetary, fiscal and financial reforms, and fiscal policy reform, in particular moderation of the growth of current expenditure by the government. The economy has responded slowly and has been having an increase in per capita GDP in real terms even though population growth has averaged about one percent during the last decade. Unemployment, however, has been reduced and stabilized at 16 percent (1992), down from the 24 percent of the 1980's.

The monetary and fiscal policies of the government continue towards strengthening the economic programme with emphasis on higher interest rates, close monitoring of domestic credits, imposition of ceilings on bank credit, reduction of the relative size of the public sector, and reduction of the external debt burden, divestment of government assets and properties, and a deregulated economy. Foreign exchange controls are liberalized with a market driven, privatized economy. This has led to a growth in GDP in 1992 of 1.2 percent, but inflation for 1993 was estimated at 32 percent.

FORESTRY SUBSECTOR IN THE ECONOMY

The role of forestry in the Jamaican economy has been long recognized and this is re-emphasized in the following statements of the national policy framework for development:

1. to achieve real growth in the economy on self-sustaining bases by continually increasing the production of goods and services in the agricultural, mining and tourism sectors;
2. to preserve and protect the natural environment, and sustain, and expand the natural resource base within the context of sustainable development; and
3. to use various approaches to give wide content to the concept of people participation in the economy and the society.

The forestry subsector is inseparably linked to the rest of the economy in numerous ways. Firstly, it is linked through its use of the factors of production viz. forest resources, capital (monetary and material), labour (employment), and information and technology. Secondly, it is linked through its contributions via the production of goods and services, viz. wood products, fuelwood and charcoal, fodder, honey, medicine, support to agriculture via soil protection and irrigation water (watershed management), agroforestry potentials, power and other forms of water supply through flow regulation, contribution to tourism through the conservation of scenic values (ecotourism), craft materials, and the protection and production of national capital through biological diversity.

Many of these linkages between forestry and the economy are not usually considered in national economic accounts because of accounting definition, inappropriate assumptions guiding the calculations, and due to blatant omissions. As a result of these oversights, the contribution of forestry to the national accounts is grossly undervalued in official reports.

INVESTMENT IN FORESTRY DEVELOPMENT

The Government of Jamaica has always been investing in forestry even before the establishment of the Department in 1942. Most of the investment prior to the late fifties was for protection and conservation purposes, but then some establishment of plantation forests began.

The first major investment for industrial plantations was the USAID/GOJ Three Year Forest Development Project which commenced in 1973/1974 at a cost of \$6.386 million for the establishment of 8000 acres (3239 ha) of *Pinus caribaea* plantations. The next major financial investment in industrial forestry was the establishment of the Forest Industries Development Company Limited (FIDCO) in 1978/1979. FIDCO was financed by the Commonwealth Development Corporation (CDC), the World Bank (WB) and the Government of Jamaica (GOJ) from loan funds. FIDCO's major objective was to establish 23,400 acres (9474 ha) of industrial pine plantations. The total investment during the five to six year period for FIDCO was \$62.66 million. Since then approximately \$20 million in external funding has been invested in forestry, agroforestry, and forestry related components of various development, conservation, and protection projects. All these investments are in addition to the government's normal capital and recurrent expenditures.

ECONOMIC RETURNS TO FORESTRY INVESTMENT

From estimates of preliminary surveys, natural forests available for the production of timber on a sustained basis have a standing volume of over two million m³ with total annual increment of 80,000 m³. Pine plantations having suffered the effects of Hurricane Gilbert have a sustained yield estimated at not more than 3000 m³ available over the next 8 to 10 years. The estimates prior to Gilbert for pine plantations was an annual yield of 25,000 m³ rising to 80,000 m³ over a 15 year period. The

marked decrease in timber production, reduction in replacement of timber trees both on public and private lands, and the increase in demand for wood and wood products have major implications for the use of domestic timber. The 1988 estimated requirements for round wood was over 865,000 m³ to satisfy total demand (see table 1). This demand far exceeds supply and therefore Jamaica will continue to be a net importer of wood and wood products. Charcoal and fuelwood account for 725,000 m³ of this round wood demand and studies have shown that plantations for these purposes are very profitable with returns of over 30 percent.

The furniture and wood working industries comprise enterprises ranging in sizes from single artisan using hand tools to large firms employing up to 200 persons and using modern equipment and technology. Most production facilities are "cottage type industry" providing employment for over 850 producers, primarily tradesmen.

Minor forest products in Jamaica are used mainly for agriculture, fishing pots, and craft industries. These include sticks for yams, tomatoes, banana plants, fish pot construction, float/bouys, and matches. The craft industry is very visible and includes carving, wicker work, mats, and straw products. The craft industry operates mostly on an individual

basis with little emphasis on resource generation with marketing directed towards the tourist sector for items produced, and only minor efforts towards the export markets.

In 1991 the projected annual consumption of softwood lumber was 106,000 m³, but local production was only 2000 m³ and imports 90,000 m³ satisfying less than the required annual consumption demand. At the same time, the demand for hardwood was estimated at 33,000 m³ with local production of 30,000 m³, just under 10 percent short of the estimated annual consumption demand for hardwoods. Therefore, with sufficient effort the island can be self-sufficient in hardwood production. This effort should help to save on scarce foreign exchange and provide economic advantage to the forestry sector and the country as a whole.

When the economic returns to all the forest investments and hence their contribution to the national economy/accounts are analyzed, full consideration is never given to the non-wood benefits in the economic and financial equation. Examples of non-wood benefits are the production of good quality water thus reducing the volume of chemicals required for treatment per volume of water, thus resulting in foreign exchange saving. Other benefits include increase in soil fertility resulting in a decrease in fertilizer usage.

Table 1. *-Industrial roundwood requirements estimates as of 1988.*

Type of use	m ³	Percent age
Softwood lumber	40,714	5
Hardwood lumber	86,667	10
Poles and posts - softwood	5,000	1
Poles and posts - hardwood	8,000	1
Fuelwood	300,000	35
Charcoal	425,441	49
TOTAL	865,882	100

GOJ/FAO/UNDP 1990.

DISCUSSION AND CONCLUSIONS

From the information previously provided above, a product assortment (mix) from the forests can be produced. Wood and craft material, can be identified to belong to the natural group of the "Industrial - Goods Classification." Ecotourism, increased soil fertility, watershed protection (management), improved biodiversity and irrigation can also be classified as natural services which are intangible, variable, and may be called specialty goods. The product assortment (mix) which demonstrates the relative strategic significance of offerings the forest sub-sector offers to the public is shown in table 2.

There exists wide product differentiation in forestry as demonstrated above, and additional differentiation can be obtained, as in the case of

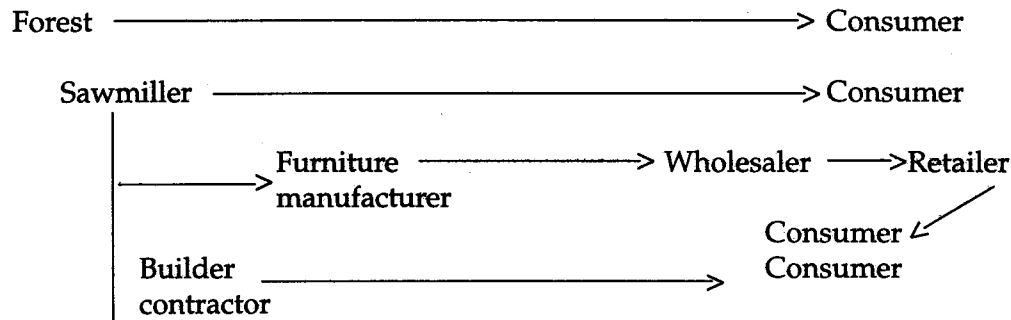
wood differentiation which occurs depending on species and class. The same can be said of most or nearly all the products listed. Ecotourism may be differentiated as to type and quality of accommodation available. Relevant to species the teak, the Jamaica and Honduras mahoganies are classified as premium quality while the W.I. cedar, blue mahoe and Spanish elm are high quality. Species such as Carib pine and Santa Maria are medium quality. Therefore, wood is well positioned in different segments of the market. Craft materials and ecotourism are limited and always well positioned permanently in the markets. Ecotourism also provides for ideal market segmentation, and there is always pricing according to quality products, while bearing in mind the consumers ability to pay in some instances.

Table 2. -Product assortment width and product line length.

	Non-wood	Ecotourism	Watershed
Sawlogs	Wicker	Picnic grounds	Protection from
Utility poles	Watsonia	Picnic shelters	-flooding
Construction posts	Thatch	Tenting	-siltation
and poles	Stones	Group camp	-erosion
Uprights	Tree fern	Hiking trails	Increased
Yam sticks	Bark	Bird watching	fertility
Fuelwood	Charcoal	Swimming	Pure water
Footings	Honey	Resort cottages	-irrigation
Shores	Fodder		-domestic
Pilings			-animals
Rafters			Stream flow
Lathes			regulation
			Power
			generation
			(Intangibles)

Because there are numerous wood products with wide variability, uses, species, and quality, likewise for the other forestry products, a mixed pricing strategy should be used. This

strategy should maximize all economic returns and the following exhibit outlines two distinct channels for the wood product from the forests:



The timber species from the natural forests are divided into five classes with Class 1 (a) the highest and premium price and Class 4 being the lowest, based on the quality of the wood produced. There is no price differentiation between Government and consumer, Government and Sawmiller/Builder/Furniture Manufacturer. The only differentiation which exists is between the Forest Department and FIDCO based on a long-term agreement. FIDCO's prices are "highly subsidized." This pricing strategy for FIDCO needs to be completely reviewed and economic prices charged for the timber they harvest.

improved quality, increased production, and public education and awareness should adequately deal with these constraints.

The economic environment will always assist to control the level of imports so there is no need for import restriction. At the same time additional investments in hardwood and fuelwood plantations which have proven most profitable can make Jamaica self sufficient in furniture wood, production, and fuelwood for energy on a sustainable basis.

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From the external environment at the micro level, there is always competition from imported lumber and raw materials, then at the macro level there is the perception that the imported wood, wood products and craft items, and materials are always better. Therefore,

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ECONOMIC IMPACT OF OVERGRAZING ON THE FORESTRY SECTOR RESOURCES OF MONTSERRAT

Gerard A.L. Gray

INTRODUCTION

Montserrat is a volcanic, mountainous island situated between 16°40' and 16°50' north and 62°9' and 62°15' west; it has an area of 10,260 ha, of which approximately 6000 to 7300 ha are covered by secondary forest. The forested areas provide vital protection for soil and water resources and supply forage, wildlife, charcoal/fuelwood, meat, fruits, honey, medicinal plants, recreation and wilderness areas and small amounts of timber and handicraft materials. This multiple use of the island's forests, has evolved as a result of an almost inevitable and natural sequence of events. However, if the forests are to be devoted to their most productive use, for the permanent good of most and not for the temporary benefit of a few, it behooves us to encourage and promote multiple use forestry. Multiple use implies the management of all the various renewable resources of the forest so that they are utilized in a combination that will best meet the needs of all the people on a sustainable basis.

THESIS

In Montserrat, soil erosion and general ecosystem degradation frequently result from overgrazing of livestock and the employment of cultural practices associated with livestock rearing which do not meet environmentally sound conservation standards.

BACKGROUND

Perhaps the primary environmental problem facing Montserrat today, is the effect of the widespread occurrence of increasingly large numbers of free roaming livestock—mostly goats and sheep. Grazing, on both public and private land, is treated as if it were an open access or common property resource. All such

resources have the characteristic that while "everyone" has the "right" of use, no one has the responsibility to maintain and protect. Therefore, "everyone" finds it worthwhile to use the resource with no other thought than that of immediate and maximum consumption. According to Hardin (1968):

"Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination towards which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a common brings ruin to all."

The problem of "loose livestock", as the free-roaming animals are called, is twofold: (1) Grazing animals destroy vegetative cover and prevent volunteer growth. This leads to the compaction of soils of low bulk density and the loosening of topsoil on steep slopes. (2) Livestock owners often burn vegetation on sloped lands in order to remove less palatable older vegetation and allow growth of younger more palatable fodder. Further adding to the complexity of the problem, is the fact that burning is usually done just before the annual rainy season and the land is still bare when the heavy rains fall. The resulting soil erosion and landslips contribute significantly to the degradation of the island's rural environment. The loose livestock problem involves three different groups of livestock owners. The first group consists of those persons rearing small numbers of animals close to the home to supplement family protein. The occurrence of loose animals among this group is accidental and infrequent; damage occasionally involves the destruction of gardens, but they do not contribute significantly to resource degradation. The second group includes persons with limited or no access to land. In most cases, these landless

livestock owners do not limit their herd size or restrain their animals. These animals are responsible for some destruction of crops, some property damage in residential areas and some resource degradation. It is the third group of livestock owners, however, that is responsible for environmental destruction of more substantial proportions. Its animals are for the most part feral, and there are few systematic attempts to manage or market livestock by these "small farmers". Because of substantial population increases in these herds, animals have moved into many of the upper watersheds where, apart from soil erosion and the resulting reduction in stream flows, there is the possibility of contamination of water supplies. In addition, biodiversity, wildlife habitat and the other benefits listed above are threatened.

DISCUSSION

Grazing/Meat

The issue of loose livestock is an interesting one for although meat is listed as one of the beneficial flows from the forest, it is evident that poor animal husbandry results in the degradation of forestry sector resources.

Approximately 2100 sheep and goats, at a value of EC\$315,000 (US\$121,154) were consumed in 1993; it is estimated that a relatively small proportion of these was gathered from group 3 above. The livestock survey of 1993 estimated the small stock population to be 10,600. However, 15,000 is believed to be a more realistic figure as it is felt that many animals in the wild were not accounted for. A population of 3000 animals is believed to be more than adequate to ensure sustainable meat production for the foreseeable future; this would indicate that a surplus of 12,000 animals (15,000 minus 3000) at a value of EC\$1.44 million (US\$553,846) presently exist in the wild.

The problem is therefore one of control; these animals represent a valuable resource crying out for proper management and utilization. The development of improved techniques of

small stock production on a semi-intensive to intensive basis has shown great promise. Therefore, excess populations could be used, in part, to finance the establishment of such farming systems and the rehabilitation of severely affected areas. It should be emphasized that these farming methods do not necessarily result in a decrease in the total value of meat produced, for improved animal husbandry should translate into increased productivity.

Unfortunately, the irreversible environmental damage that sometimes occurs, although significant, cannot be easily appraised. Since the forestry sector takes its value from the benefits it produces, the following resources are presented to further illustrate the economic impact of overgrazing on the forestry sector.

Land (Soil)

The great importance of site quality on forest productivity (timber and non-timber products) cannot be over-emphasized. It is the inherent vigor of the site that determines the potential productivity of the forest. The basic quality of the land is consequently of the utmost importance.

Loose livestock is responsible for soil degradation in the form of: (1) sheet erosion of topsoil; (2) gully erosion of usable land; and (3) downstream flooding.

Sheet Erosion of Topsoil

The average annual loss of topsoil from undisturbed forest on steep slopes is estimated at 1 tonne/ha/year. Uncontrolled grazing may increase this by a factor of 5 to 10; the consequent reduction in the productivity of the forest is expected to be significant.

Gully Erosion of Usable Land

Gullies are rapidly increasing in width due to accelerated soil erosion. Loss of usable land is estimated at 5 ha/yr. If a conservative 30 percent could be attributed to stock damage,

then the value at, say, EC\$100,000/ha (US\$38,462) would be EC\$150,000/yr (US\$57,692). This figure does not reflect infrastructure that may be lost as a result.

Downstream Flooding

Peak flows resulting from storms have caused considerable damage to land and facilities. Furthermore, the degradation of the coastal and marine environment caused by excessive sedimentation will inevitably lead to loss of revenue from fishing and tourism. These adverse effects could be minimized by practicing good animal husbandry and proper watershed management.

Water

About 9 percent of rainfall infiltrates the ground to supply the springs, giving a potential spring water yield from the Centre and Soufriere hills of approximately 1 million gallons per day (M gpd). Demand is at present approximately 0.75 M gpd but could increase to 0.95 M gpd by the year 2000, thus reaching maximum yield. In the absence of protection, forest cover on water catchment areas will be further degraded. As a result, run-off would be increased and infiltration reduced. Spring water yield is therefore likely to diminish in the short term by at least 10 percent of the present amount, thus falling well below future demand.

It is extremely difficult to cost a commodity, such as water, for which there is no established market value. Delivery of the present demand of 180 million gallons per year is costing The Montserrat Water Authority (MWA) EC\$3.6 million (US\$ 1.39). Delivery cost is expected to increase by over 10 percent if MWA is forced to supplement the supply from limited reserves of ground water. In spite of the difficulty of costing water, the value of water is unquestionable. In the absence of sufficient water for domestic, agricultural and industrial use, public health would be threatened, the standard of living would be lowered and national development would be hampered.

Forest Plant and Animal Products

The direct contribution of the forestry sector to the national economy is 0.5 percent of the gross domestic product; this only includes certain timber products. However, more than 5730 ha have been classified as suitable for forestry development and a further 234 ha for protection forestry so, with proper management the forestry sector can contribute much more to national development in the future than it has in the past. However, effective management and protection of plantations and the natural forest will be largely dependent on effective control of grazing. Plans to establish plantations have had to be abandoned as the cost of fencing to exclude livestock proved to be prohibitive. In addition, much of the land could provide increased quantities of charcoal, fodder, honey, wild meat, such as mountain chicken (*Leptodactylous fallax*) and iguana (*Iguana iguana*) as well as other non-timber products.

Biodiversity

The maintenance of maximum diversity of forest life forms is important so as to keep development options open and maintain the ecotourism package. Endemic species such as the Montserrat Oriole (*Icterus oberi*) and the Galliwasp (*Dipoglossus Montisserrati*) deserve special mention. A number of species of plants, important largely for their medicinal value, offer prospects for product development. The potential value of the benefits of biodiversity, some of which are undiscovered, is difficult to predict but could be very high if a unique product were to be discovered.

Tourism

Tourism on Montserrat was nature oriented long before the term ecotourism was coined. Marketed as "The Emerald Isle of the Caribbean" and "The way the Caribbean used to be", Montserrat has been able to attract visitors through the provision of attractive landscapes, pleasant climate and biological, cultural and historical features. The increasing occurrence

of loose livestock has begun to threaten some of these features. In 1993, tourism contributed EC\$44 million (US\$16.9) to the national economy and is by far the largest foreign exchange earner. Almost all of this value can be considered as willingness to pay for the above attractions. Therefore, it stands to reason that destruction of these attractions would result in decreased visits and revenues from the tourism industry. Any activity that decreases government revenue will have an adverse effect on forestry sector financing as government is put under increasing budgetary pressure to satisfy more urgent national needs such as health care and education.

CONCLUSION

Overgrazing by free roaming populations of goats and sheep has caused severe environmental degradation to the extent that some economic activity is being threatened. Severe soil erosion has lowered forest productivity and has resulted in the loss of arable land and infrastructure. Loose livestock is a deterrent to proper forest management and plantation establishment as the opportunity cost is significant. Finally, the problem is one of control as there is significant excess meat produced; that is, most animals are not harvested. There is therefore need to introduce proper animal husbandry techniques.

RECOMMENDATIONS

It is recommended that active management of loose livestock populations begin immediately. Important components of the management strategy must include:

1. farmers and public education and awareness;
2. introduction and acceptance of acceptable animal husbandry practices (semi-intensive to intensive);

3. procurement of markets to absorb the present excess of meat;
4. vigorous enforcement of the newly amended Animals (Trespass and Pound) Ordinance (1993) to include eradication of excess animals and prosecution of offenders; and
5. rehabilitation and management of affected areas.

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ECONOMICS IN FORESTRY IN PUERTO RICO

Diego Jiménez

The Latin American and Caribbean region has more than half the dense forests of the world and the greatest area of forest plantations of all developing countries. These resources are indispensable for maintenance of environmental quality and represent an economic base for long-term sustainable development. Regional forests also constitute an alternative for increasing the economic well-being of the rural population. The regional forests provide a wide range of industrial products and services indispensable for the home, culture, and social welfare, for which there is a fast growing demand because of raising incomes: sawnwood, paper, and wood-based panels. Apart from fuelwood, forests provide other products essential in rural areas, especially for the poor groups of Latin American societies, such as fruits, medicines, forage, and building materials besides recreation. The forests protect the watersheds which are indispensable to maintain the production capacity of the soil, and therefore, food security and also irrigation works, road transportation systems, and electricity supplies. The animals on the forests indirectly generate job opportunities, mainly through the actual ecotouristic enthusiasm. The forests also constitute the most important reserve of genetic material, which is of paramount importance for future development.

Despite their considerable economic potential and the efforts made by governments in the past, forests in the region are still not properly managed. Forests have practically disappeared from the Caribbean islands. Recent estimates suggest that the present annual rate of deforestation is more than 7 million ha. Less than 2 percent of Haiti is forested, and in the Dominican Republic only 13 percent of the original forest cover is left (FAO 1988). This is largely due to the predominante attitude in the past characterized by a marked tendency to consider the forest as a practically endless

natural resource. Apart from this, a major obstacle to rational use of forests has been the land tenure systems in the region. Forests resources have often been used as "common property", which has led to their virtual exhaustion.

The absorption of the additional population in the region by the year 2000, estimated at some 160 million, will imply a transfer of about 36 million ha to agricultural use. This transfer will of course have to be based on sound policies carried out with determination and efficiency by governments in the region. There is the need and the opportunity to use forest resources better than in the past, in order to earn foreign currency, improve the relative position of the lower-income groups and meet other urgent needs in the region such as those for land for agricultural purposes, homes, and fuelwood. Development based on regional forests resources makes sense in terms of economics, ecology, and rural welfare. These considerations acquire special relevance in periods of economic depression affecting the region. Latin American and the Caribbean area are going through the worst crisis they have experienced in the last 50 years. According to studies made by the Economic Commission for Latin America and the Caribbean, the negative effects will extend until the end of the century. As a result of the crisis, the natural resources basis must be used more intensively and in a much more ordered way, so as to take advantage of future opportunities of sustainable development. However, the necessary action will not happen automatically. Far from it: efficient use of existing opportunities requires a reorientation of forestry policies and strategies. Divorce between traditional strategies and the design of new and productive approaches to forestry should occur in order to orient the forestry economics in the right trend.

In the Caribbean countries, where the area available is very limited and the population density is very high, an intense competition for land has been created. The consequences of land deterioration are clearly visible in several countries. Deforestation has contributed to decertification, in some countries irreversible, increasing the area of arid zones under threat in the region. Areas of low-lying tropical and subtropical zones have been occupied by settlement, either spontaneous or deliberately encouraged by government policies. Extensive areas have been deforested for fuelwood or to free new zones for extensive livestock-raising, one of the main forces in the process of deforestation in the region. Intentional or casual forest fires have destroyed and cleared large area of forested land. Possible action in the forestry field should of course take account of political and structural restrictions using integrated strategies for natural resources use, including interactions with agriculture and livestock-raising within the agroforestry panorama.

Opportunities for forest-based industrialization cover a wide range of technological alternatives, ranging from artisanal establishments and traditional medicinal production to large, high-technology complexes. Although there is only fragmented information available, it is thought that in many parts of the Latin America and the Caribbean regions certain small-scale lines of industrialization are or could be important in generating employment and local income. The great majority of forest-based industrial enterprises in the region employ rudimentary technology, function sporadically, use only a fraction of their installed capacity, and have limited access to human and financial resources. Each country is called to analyze its particular situation and decide and design the proper strategies to develop an action plan for the best use of its forest resources.

Latin American and the Caribbean still depend on the international market to satisfy a total or substantial part of their consumer needs for forest products. Within this scenario, Puerto Rico is not an exception.

Puerto Rico is the eastern-most and smallest of the Greater Antilles. The main island, about 160 km long and 55 km wide, occupies about 8,900 km² including the offshore islands of Vieques, Culebra, and Mona. The small mountainous island, lying directly in the path of the easterly tradewinds, shows a remarkable diversity in its physical environment. The interrelations of local geology, physiography, climate, and soils influence the structure and composition of the forests. Nearly all forest areas in Puerto Rico have been historically heavily influenced by natural disasters like hurricanes and man himself.

The mountain ridge of the island of Puerto Rico is represented by the Central Cordillera, running from east to west and forming the principal hydrological divide. Steep slopes, rugged terrain, and numerous streams and gorges characterize the mountainous region of the island. The Luquillo mountains and the Cayey mountains, an extension of the Cordillera, complete the mountainous features of the island. Foot-hills surround the mountains and merge into coastal lowlands. Forty-five percent of the land surface is above the 150 meter contour and half of that area has slopes greater than 45 percent. A quarter of the land surface is above the 300 m contour, and 60 percent of that area has slopes greater than 45 percent (Wadsworth 1949).

Puerto Rico receives an average of 1800 mm/year of rainfall, mostly orographic. Coastal areas receive from 75 to 150 to 200 mm/year in the windward part of the island (north-east, east, and southeast). Areas of heavy rainfall, in excess of 2500 mm/year, include the summits of Luquillo, Carite, Toro Negro, and Maricao forests. A relatively dry season occurs over most of the island from mid December through the end of March.

The lowest mean annual temperature is 18 °C at Pico del Este (Luquillo Forest), Cerro Maravilla (Toro Negro Forest) and the highest, 27 °C at Guayama in the south coast. The highest temperature ever recorded was 39 °C at San

Lorenzo in August 1906, the lowest 4 °C at Aibonito in March 1911.

Differences in rainfall patterns, as well as geologic and geomorphologic conditions in Puerto Rico, have given rise to a wide variety of soils. The most extensive soils are inceptisols, occupying about 37 percent of Puerto Rico. This order, concentrated in the eastern half of the island, generally on slopes ranging from 20 to 60 percent. The ultisols occupy about 27 percent of the island concentrated in the humid volcanic uplands of the western Cordillera. Mollisols, occupy 21 percent of the island and occur in three areas; tertiary limestone near Lares, southern foothills in the rain shadow of the Cordillera, and scattered alluvial fans and floodplains. For the purpose of plantation establishment, 19 soil associations were recognized on the island (Zambrana 1978). Tree species for wood production, windbreaks, shade, and ornamentals were suggested according to soil associations.

Puerto Rico's population has tremendously increased since the 16th century. There has been a steady immigration of people from all over the world. Recently, Cubans, Dominicans, and Chinese have arrived as well as a continual migration of Puerto Ricans back and forth from the United States mainland. Actual population in Puerto Rico is about 3.7 million persons.

During the early 1920's and 1930's sugar was the dominant cash crop in Puerto Rico and accounted for two-thirds of the island's exports. By 1950, Puerto Rico entered into an industrial-based economy. Land clearing for agriculture, infrastructure, and related urban developments resulted in deforestation of almost 3400 ha including mountainous sites such as Carite, Luquillo, Toro Negro, Guilarte and Maricao, and a few scattered peaks in private ownership (Wadsworth 1950). In 1972 the Department of Natural Resources conducted a land use survey. The results indicated that over 50 percent of the island is classified in agricultural uses, about 30 percent in forests including public and private, about 5 percent water resources, and

some 7 percent as urban and rural residential. This panorama has changed dramatically by 1994, marked by increased forested lands, lesser agricultural areas and increased land use for urban residential.

Puerto Rico's forest system consists of 15 forests, from which 14 area administered by the state government and one by the United States Forest Service. This forest system include 5 coastal forests (Aguirre, Boquerón, Ceiba, Guánica, and Piñones), 4 karst forests (Cambalache, Guajataca, Río Abajo, and Vega), and 6 montane forests (Carite, Maricao, Guilarte, Susúa, Toro Negro, and Luquillo). The state forest system accounts for 62,102 acres and the federal forest accounts for 28,000 acres. The forests of Puerto Rico were classified by Ewel and Whitmore in 1973 according to the Life Zone System developed by Holdridge in 1967. The main forests types in this system include:

- Subtropical moist forest (58 percent of the island). Characteristic of zonal soils and that support trees up to 20 m tall. The woody species are deciduous, but the dominant land cover today are grasses and shrubs. Mangroves are also found along the coast where they appear to grow taller than in other Life Zones. The remnants of swamp forest dominated by *Pterocarpus officinalis* also occur in this Life Zone.
- Subtropical wet forest (23 percent of the island). Include zonal soils that support more than 150 tree species.
- Subtropical dry forest (18 percent of the island). Characterized by deciduous vegetation of slow growth rates in the woody species. Extensive areas of this Life Zone overlie limestone, and some alluvial areas contain saline soils. Mangroves are found in coastal bays and inlets.
- Subtropical rain forest, lower montane wet forest, and lower montane rain forest (represent about 1 percent of the land area).

Occur on clay soils and are dominated by palm trees (*Prestoea montana*), tree ferns, and epiphytes.

Actual forest cover types in Puerto Rico are the result of past and cumulative human impacts on the natural landscape. The main forest classes in actual Puerto Rico are active coffee shade, abandoned coffee shade, secondary forest, plantations, other timberlands, upper mountain forest, palm forest, and dwarf forest. Current non-forest land uses include unimproved pasture, coffee production (under shade and shadeless), and crops such as bananas, plantains, taniars, yams, oranges, mangos, avocados, vegetables, pigeon peas, and garden crops. The remnants of natural forests include the dwarf and palm types, and the colorado (*Cyrilla racemiflora*) and tabonuco (*Dacryodes excelsa*) which are described elsewhere (Little and Wadsworth 1964).

Numerous benefits and uses are derived from forested lands. The multiple use policy is the management strategy adopted in Puerto Rico for the sound management of the forest resources. This policy calls for using the forests resources within a sustainable framework for the production of timber, protection of the watersheds, wildlife habitat, recreation, erosion control, and research opportunities.

Timber

Timberland in Puerto Rico is about evenly divided among sawtimber size, poletimber size, and sapling seedling stands. Sawtimber areas are poorly stocked, while poletimber stands are considerably better stocked. This most extensive stand-size class is a promising area for management practices which would favor the most desirable species. Most stocked timberland occurs in areas with rough topography and slopes greater than 45 percent. More timberland is found on deep volcanic soils in the Subtropical Wet Forest Life Zone than in any other stratus. The rough topography, poorly stocked stands, and efficient technology have been limiting factors for timber production in Puerto

Rico. The timberland areas are mostly composed of forest plantations and native stands that include a variety of forest classes. Commercial stands are generally located on productive and reasonably accessible sites. Non-commercial forest classes are located on relatively inaccessible, high elevated regions where climatic extremes preclude agricultural development and produce forests with undesirable timber characteristics generally occupying the highest exposed ridges and mountain tops. In 1982, forest plantations in Puerto Rico included approximately 13,600 ha in public lands and 32,400 ha in private ownership. The overall success of these plantations and the current area of plantation forests are not certainly known. The major species planted include Caribbean pine (*Pinus caribaea* var *hondurensis*), Honduras mahogany (*Swietenia macrophylla*), eucalyptus (*Eucalyptus robusta*, *E. deglupta*), teak (*Tectona grandis*), Dominican mahogany (*Swietenia mahogani*), blue mahoe (*Hibiscus elatus*), and the hybrid mahogany (*Swietenia* sp.). Numerous other tree species, tested in long series of adaptability trials, account for the remainder of the planted area. Half of the islands tree species have little economic value except locally for fuel (barbecues) or fence posts. Puerto Rico's timberland has been influenced by a series of land uses common in the tropics: removal of valuable timber species, clearing for agriculture, erosion and degradation, and finally abandonment. The forests now beginning to reclaim the land are extremely valuable as vegetative cover, yet they carry low timber volumes and a rather unfavorable mix of species and quality. The merchantable sawtimber volume/ha are generally low. The secondary forest class is actively replacing agricultural remnants where agricultural activities have been abandoned. Mangroves have provided local wood products in the past, however, the acreage has declined dramatically and mangroves are no longer heavily exploited for timber. Mangroves have important non-timber values such as providing shoreline protection, supporting wildlife, serving as spawning areas for fish, and exporting organic matter among others.

Early in the 20th century, forests covered about 20 percent of the island surface, but only about one-third of this forest land could yield wood products other than charcoal or fuelwood (Murphy 1916). The forest cover was practically devastated during the 1920's and 1930's. In 1945 to 1950 the increased industrial activities in Puerto Rico contributed to decline the forest cover. Massive migration of Puerto Ricans to urban centers (1950 to 1980) favored the presence of secondary forest and increased the land coverage through biological successional processes. Land abandonment provided for an increase forest cover on the rural areas. Recent observations show that the forests have been returning in the past 40 years. Privately-owned lands have returned to forest as small hillside farms were abandoned. These degraded lands, unsuitable for cultivation supports most of the forest resources in Puerto Rico. The potential commercial forest region in Puerto Rico includes about 400,000 ha and excludes environmental extremes and the better agricultural land. It is located in the dissected uplands between the fertile valleys and highest, most rugged mountain areas. About 54 percent of Puerto Rico timberland has resulted from abandonment of pasture and cropland. Puerto Rico's forest, as other tropical forests in the region have not been successfully managed for timber production. Difficult working conditions, numerous species, diverse ecosystems and site characteristics, high percentage of poor quality trees, low stocking levels, and variable stand structure are some of the limiting factors to apply sound silvicultural practices for timber management and production.

Water and Erosion Control

Steep topography, heavy rainfall and erodable soils contribute to a high erosion potential. The agricultural activity during the 19th century and early 20th century disturbed over 99 percent of the original forest, causing major erosion and sedimentation problems, leaving only scattered areas of climax vegetation in the Central Cordillera and Luquillo mountains

(Wadsworth 1950). Since 1970 the United States Soil Conservation Service has been playing an active role for avoiding soil erosion in lands under cultivation. Prolonged drought leading to water rationing and severe flooding are recurrent problems on the island. Severe raining also interferes with the opportunities to crop forest trees because of the erodability of the sensitive soils that support plantations or native species of commercial potential.

Rare, Threatened, and Endangered Species

The massive destruction of large areas for agriculture and other land uses has decreased some species to dangerous rarity. Over 600 species of endemic and non-endemic plants have been classified as rare, threatened, or endangered.

The coastal karst and montane forests in Puerto Rico provide critical habitats for endemic as well as rare, threatened, and endangered species of both plants and animals. The rampant destruction of critical habitats has declined important species of medical, ornamental, and nutritional values. The uncontrolled use of pesticides has contributed to the marked reduction in species composition and consequently to a reduced commercial potential of non-timber plant species. Also game animals has been severely impacted by human activities.

Recreation

Puerto Rico's numerous natural attractions (beaches, coral reefs, waterfalls, canyons, scenic mountain and panoramic roads, wetlands, and limestone caves) provide for outdoor recreation particularly in the well distributed 34,000 ha of Federal and Commonwealth forests. Major recreational activities include swimming, snorkeling, picnicking, boating, fishing, camping, hiking, hunting, diving, photographing, or just driving through forest roads. Given the island's limited area and high population density, the existing forest system is a critical resource for both residents and tourists in

Puerto Rico. The actual demand for ecotouristic experiences has increased the use of forest lands for recreational purposes.

Other Forest Land Uses

Historically, the forests of Puerto Rico have been used for research and installation of communication facilities. Almost all of the highest peaks in the forests have been deforested and cleared for installing infrastructure typical of communications facilities (towers, power plants, antennas, etc.) in the industrial counties. Impacts on species composition, soils, and water supplies have decreased the potential of the forests lands for other uses. On the other hand, collection of specimens for research has been another adverse activity on forest resources.

Data collected by the Department of Natural Resources indicates that forest lands in Puerto Rico have been economically used for establishment of recreational areas and camping grounds (fig. 1), installations of electronic facilities for communication (fig. 2), residential uses (fig. 3), attainment of forest products (table 1), and research. Also the forests provide for employment. About 21 direct jobs and 131 indirect jobs have been created in Puerto Rico in 1994.

The lack of sound silviculture management practices, long-term forest management plans, adequate silvicultural equipment, for example a cable logging system, government financial support, and attitudes of the environmental organizations are just some of the limiting factors for a successful economical framework of the forests in Puerto Rico.

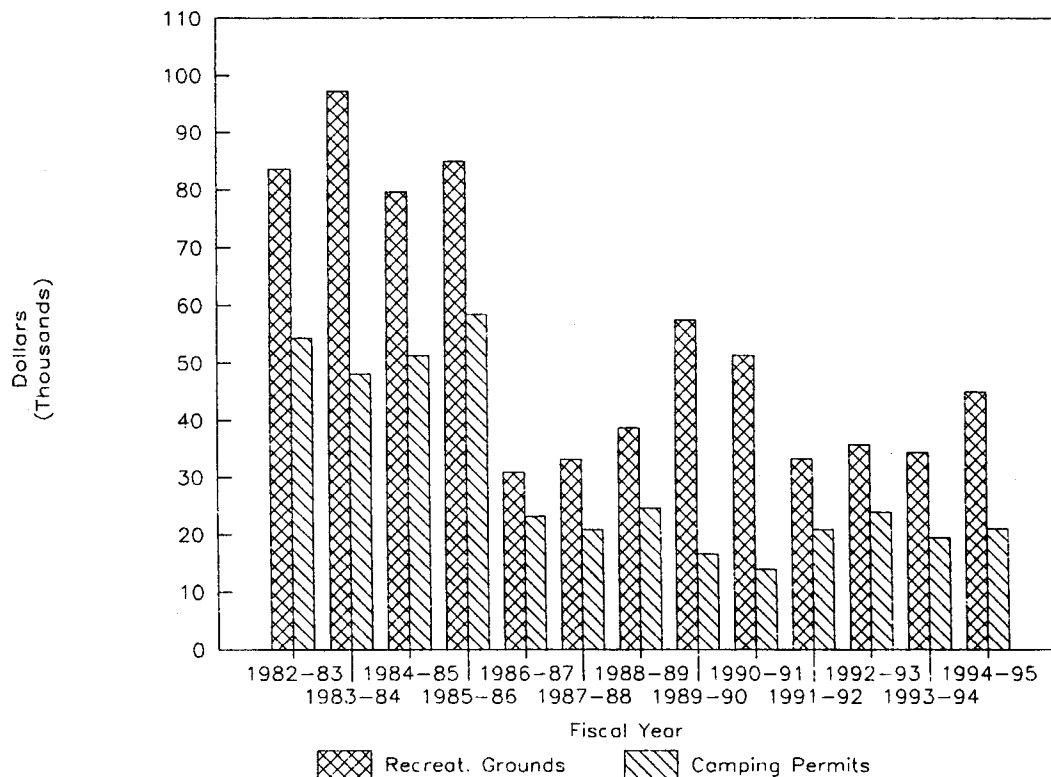


Figure 1. -Revenues from recreational activities on forest lands.

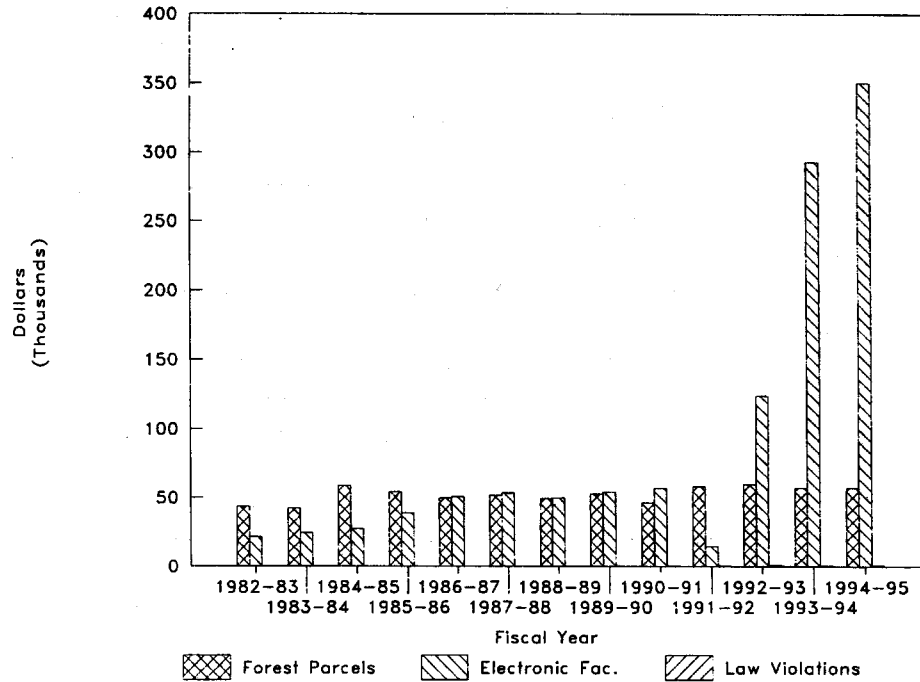


Figure 2. -Revenues from communication installations and other uses.

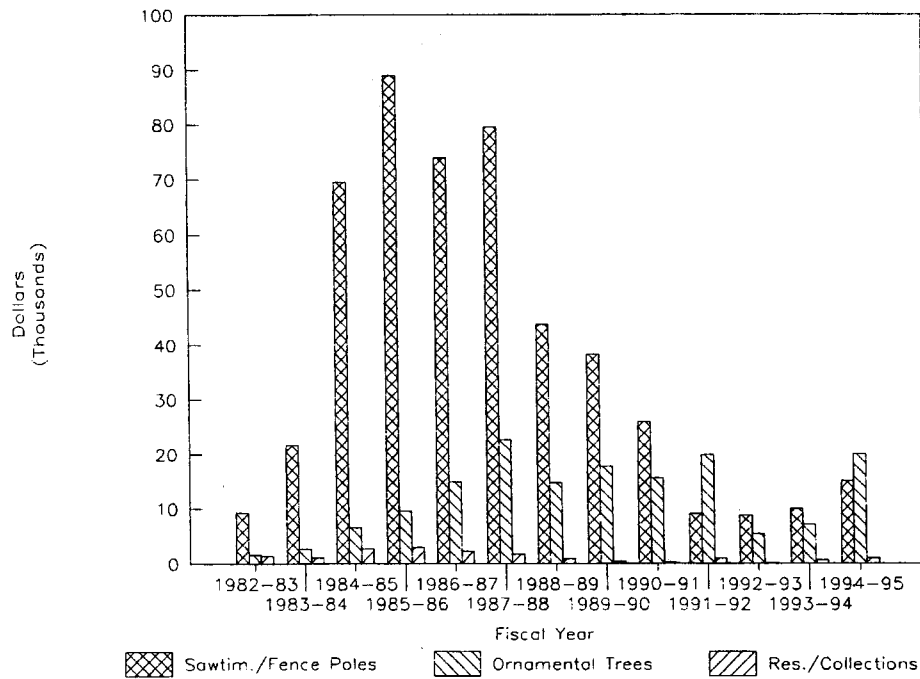


Figure 3. -Revenues from forest products, ornamentals, and research.

Table 1. -Economics in forestry in Puerto Rico (fee/sales).

Fiscal year	Forest land uses			Forest products			Recreational areas	
	Forest parcels	Electronic facilities	Law violations	Sawtimber/ fence posts	Ornamental trees	Research/ collections	Recreational grounds	Camping permits
1982-1983	43,118	21,409	-	9,235	1,586	1,380	83,545	54,300
1983-1984	42,100	24,600	-	21,609	2,691	1,110	97,240	48,100
1984-1985	58,308	27,209	-	69,546	6,583	2,685	79,620	51,305
1985-1986	53,906	38,604	-	88,950	9,600	3,000	84,900	58,400
1986-1987	49,211	50,593	-	73,948	14,850	2,480	30,910	23,148
1987-1988	51,541	53,200	-	79,500	22,604	1,740	33,140	20,900
1988-1989	48,903	49,500	-	43,706	14,689	930	38,702	224,640
1989-1990	52,711	53,906	-	38,250	17,701	350	57,416	16,545
1990-1991	46,126	56,477	560	25,830	15,541	225	51,362	13,895
1991-1992	57,707	14,499	300	9,047	19,830	995	33,282	20,857
1992-1993	59,409	123,685	1,250	8,770	5,383	75	35,770	23,986
1993-1994	57,100	292,644	400	10,021	7,134	600	34,362	19,489
1994-1995	57,100	350,200	800	15,000	20,000	1,000	45,000	21,000
Total	677,260	1,156,526	3,310	493,412	158,192	16,270	705,249	396,565
Mean	52,097	88,964	255	37,955	12,169	1,252	54,250	30,505

The local Legislature indicates that a comprehensive local plan to address the following issues is urgently needed in Puerto Rico:

- Reduce of wood and related forests products imports.
- Increase the employment opportunities and incomes for the Puerto Ricans.
- Maintain and improve the quality of the environment.
- Provide better recreational opportunities in forest lands.
- Protect valuable natural resources such as wildlife, water, and soil.

The following facts should be included in the local plan:

- There exists about 500,000 acres in public and private domain adequate for commercial timber production.
- About 100,000 acres of forest land support poletimber sized trees in Puerto Rico.
- About 100,000 acres of land need to be forested.
- About 100,000 to 150,000 acres of forest lands should be thinned for wood production.
- Fast growing softwood (pine) has proven to adapt satisfactorily to natural conditions in Puerto Rico.
- Hardwood commercial tree species (mahogany, teak, eucalyptus, mahoe) adapt satisfactorily to natural conditions in Puerto Rico.
- The quantity and quality of surface and ground water depend on the forest cover. Runoff, erosion and sedimentation should be significantly reduced for the next

century. Plenty of high quality water for domestic and industrial uses should be available.

The implementation of the comprehensive local plan is worth \$1,000,000 in five years. At the end of the five years period the following results and benefits are expected:

- Creation of direct jobs - 1375 (full time basis).
- Creation of indirect jobs - 2750 (full time basis).
- Direct income to landowners - 4,432,550 (annual basis).
- Decreased imports of wood and wood products - \$43,000.

The following statistics from the Chamber of Commerce of Puerto Rico (1991) clearly indicate that Puerto Rico urgently needs to adopt alternate strategies to supply the local needs for wood and related wood products to satisfy the high demand for these products.

Imports	Million
Wood (for construction)	\$45.1
Plywood	\$61.2
Wood (for furniture: cabinets and novelties)	\$1.5
Paper and paper products	\$593

The Chamber of Commerce concluded that the local market for wood and related products is significant for the economy of Puerto Rico. In 1987 the imports of wood and wood related products accounted for \$1,019.4 millions. The annual rate growth has been increasing since then.

The government of Puerto Rico is becoming aware of the importance of forests for the local economy. In February 1994, the Legislature submitted a Resolution (Resolution of the Senate Number 11) to assign \$100,000 to the

Department of Natural Resources to coordinate with the Department of Agriculture, the Planning Board, and the Administration of Economic Development to conduct a study to assess and economic cost effective benefits of the establishment of a local timber industry in Puerto Rico. During fiscal years 1992-1993 and 1993-1994, the Legislature assigned \$2,000,000 to the Department of Natural Resources for the construction of permanent facilities in the recreational areas of the state forests. Also some significant amendments have been proposed by the Legislature to the Puerto Rico Forest Law (Law Number 133 of July 1, 1975) in order to maximize the economic aspects of the state forests in Puerto Rico. As you have observed we are not including information in this report about private forestry in Puerto Rico. The information in regard to private forestry activities in Puerto Rico is incomplete. The current area of plantation forests in private lands has not been surveyed. Therefore, most of the basic information is unknown.

The development of a private forestry industry in the island may enhance a wise harmony between economic development and environmental quality improvement. The private forestry industry in Puerto Rico will promote the establishment of joint industries technically and economically feasible, socially wanted, and ecologically sustainable. During the planning process for the establishment of this new large-scale industry, the public policy must consider the long period (35 to 40 years) between the implementation of the project-tree planting-and the harvest of timber. Due to this special condition of the forest industry, public policy for promoting private forest industry must also consider financial and subsidiary strategies for maximizing the internal rate of return of private industrial forests.

The development of commercial forest industry in private lands will produce the following private and social benefits:

- Protecting watersheds and minimizing soil erosion and associated problems.

- Generating unskill employment in new private tree nurseries industry, in tree planting and maintenance activities, in timber harvesting, in new private sawmill projects, in timber and wood transportation, wood treatment, ecotourism, and in other associated economic activities.
- Improving environmental quality and enhancing the development of an industrial honey bee industry.
- Increasing the ecological assets necessary to improve wildlife habitat.
- Producing the input necessary to promote new wood handicraft industries.
- Enhancing the establishment of new private ecotourism projects.
- The new private forest industry will commercially produce input for industrial wood furniture industry. This benefit is associated with the indirect economic impact of improving the competition advantages of the local furniture industry in the international market.

The development of a private timber industry in 300,000 cuerdas (1 cda. = 0.97 acre) will generate yearly, after the 40th year of the tree-planting phase, an harvest of 4,001 millions of BF of wood which represent a gross income for the economy of the island of \$8,027.36 millions. This economic activity will create yearly 816 new direct jobs and 4,300 new indirect jobs during the first 10 years of implementing this new industry (tables 2 and 3).

The public policy for enhancing private commercial forestry activities must direct importance to agroforestry projects in the droughty south coast of the island. The *Leucaena* (*Leucaena leucocephala*) may improve production of pasture and new products as pulp for paper industry.

Table 2. -*Timber and post production (300,000 cuerdas [1 cda. = 0.97 acre]).*

Tree planting	204,000,000	trees
Loss (disease) 25%	51,000,000	trees
Trees available for wood and post production	153,000,000	trees
Posts production (total)	68,850,000	trees
Yearly posts production	3,442,500	posts
Trees available for wood production	84,150,000	trees
Cubic foot/tree	158.5	F3
Estimate of BF/tree	1,902	BF/tree
Estimate of timber asset (BF Total)	160,053,300,000	BF
Harvest/year (BF)	4,001,332,000	BF

Table 3. -*Total direct costs (300,000 cuerdas [1 cda. = 0.97 acre]).*

	Annual costs (30,000 cuerdas)	Total costs 10 years (\$) (300,000 cuerdas)
Seedlings and tree planting	\$25,500,000	\$255,000,000
Maintenance	22,500,00	225,000,000
Replacement of seedlings damaged	6,375,000	63,750,000
Infrastructure investment	3,000,000	30,000,000
Salaries (nurseries)	8,656,128	86,561,230
Salaries (timber production)	9,101,664	91,016,640
Salaries of foresters	72,000	720,000
Salaries of forestry technicians	129,600	1,296,000
Total	\$75,334,392	\$753,343,920

The economic model of Puerto Rico designed to allow economic and environmental subsidies to foreign corporations is obsolete. Due to the decisions of the United States Congress to modify the 936 Section of the United States Internal Revenue Code and to adopt the North America Free Trade Agreement

(NAFTA), Puerto Rico must discuss economic sustainable activities for supporting both economic growth and best ecosystems wise management. The economic analysis of a private timber industry indicates that the society will obtain a return of \$10.66 for every dollar invested in this industry.

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NATURE TOURISM: A CASE FOR FOREST CONSERVATION IN SAINT LUCIA

Christopher Cox and Robert Gregg

INTRODUCTION

Physical Attributes

Saint Lucia, some 238 miles² in area, is part of the Windward chain of islands in the south-eastern Caribbean lying at 14° N. latitude and 61° W. longitude between Martinique to the north and St. Vincent to the south. The island is volcanic in origin, and hence possesses a fairly rugged terrain. The interior, which is geologically youthful, is characterized by heavily dissected river valleys, with the highest peaks rising to above 3000 feet. The northern and southern parts of the island are relatively flat and geologically older than the interior.

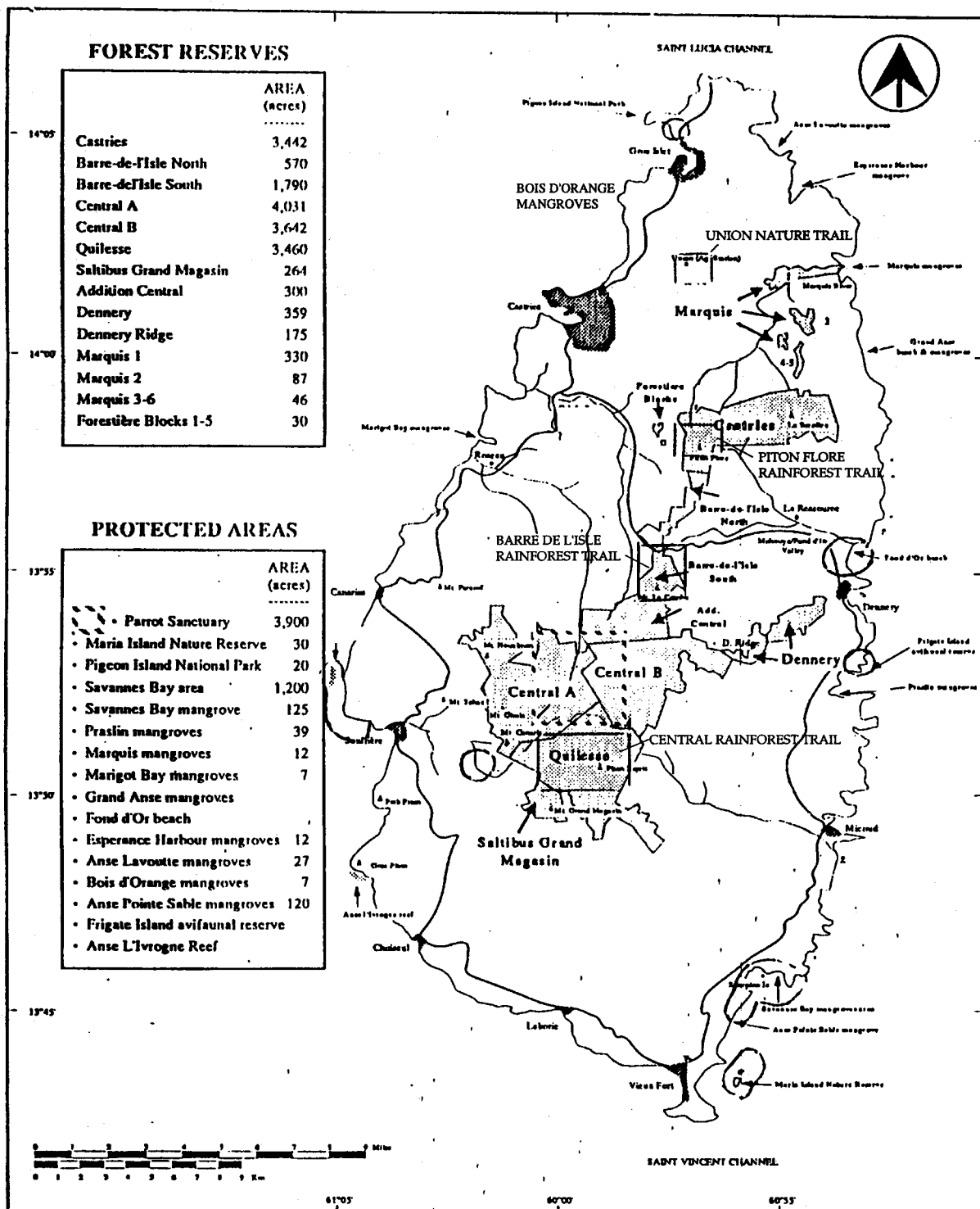
Saint Lucia's rainfall ranges from 60 to 150 inches/year, with the bulk of the rainfall occurring between May and November. Rainfall is heaviest in the interior mountains where orographic rainfall contributes significantly to the water balance. As a result, luxuriant rainforest dominates the area, with a tremendous diversity of plant and animal life, many species of which are endemic to the island. The extreme northern and southern tips, as well as the eastern coastal strip are much drier due to the low topography that provides little orographic rainfall.

Today there is some 53,700 acres of natural vegetation types left on the island and of this, some 18,500 acres is contained within the Government Forest Reserve (Map 1). The rainforest is home to a wide diversity of flora and fauna. There are 5 endemic wildlife species confined to St. Lucia's forests, which includes the rare St. Lucia Parrot (*Amazona versicolor*). The island's forests are also a reservoir for endemic, mostly unstudied plants including Paltivier and Gwi-Gwi Palm among others.

Forest Economics in St. Lucia

Most of St. Lucia's timber demands for the furniture and construction industry are being met by the relatively cheaper and more readily available imported softwood from North America; tropical hardwood utility posts are imported from Guyana. St. Lucia's annual import bill in raw wood products is somewhere in the area of US\$5.4 million. In spite of this there is still a demand for local timber for furniture making, although on a fairly low scale. Consequently, commercial forestry development in St. Lucia has remained on a small scale. The underlying reason for this is the small total area of accessible forest, which makes any sizable harvesting operation costly. Most of the accessible forest lies within the Forest Reserve which is under the strict control of the Forest and Lands Department. The Department allows for a limited amount of utilization in terms of the sale of standing timber and other minor forest produce.

Revenue generated to the Forestry Department comes from three areas; the sale of forest produce, the registration of chainsaws and the provision of a tree cutting service, and forest tours (fig. 1). Traditionally, the bulk of the forest-based revenue has been derived from the sale of wood and non-wood forest produce from the reserve, largely in the form of standing timber. The quantity of trees sold annually is carefully regulated according to abundance of the species and the availability of regeneration to replace those trees removed. All removal is by selection harvesting. Converted products such as treated fence poles and sawn boards are also sold by the department to the public. The major tree species exploited in St. Lucia include Blue mahoe (*Hibiscus elatus*), Honduras mahogany (*Swietenia macrophylla*) from established plantations; and red cedar (*Cedrela odorata*),



Map 1. -St. Lucia Forest Reserves and protected areas, showing location of forest trails.

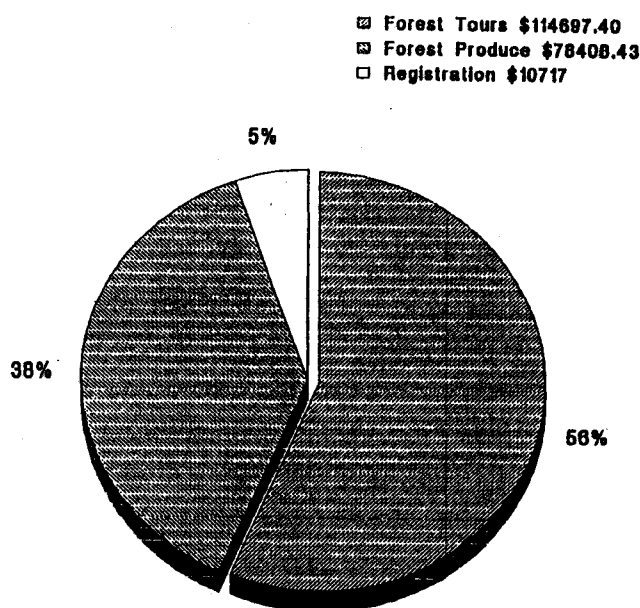


Figure 1. -Sources of revenue to the Forestry Department from April 1993 to 1994.

white cedar (*Tabebuia pallida*), laurier mabre (*Ocotea leucoxylon*), and Bois d'Amande (*Heliconia caribaea*) from the natural forest.

In addition to the wood products, non-wood resources amount for a proportion of the revenue. The sale of Christmas trees, Cypress (*Cupressus lusitanica*) and Norfolk pine (*Araucaria excelsa*) brings in between US\$7,400 and US\$9,200 annually, with a small amount coming from the sale of seedlings from the forest nursery. Minor forest produce such as tree resins, latanier palms and lianas draws in additional revenue through licenses issued to collectors.

The sale of forest produce has traditionally been the major source of revenue to the Department, averaging roughly US\$14,800 between 1993 to 1990. Since then, earnings in this area have increased to some US\$29,000 recorded in 1993/1994 (fig. 2) with a continued upward trend.

The second category of revenue generation is from the licensing of chainsaws and the tree cutting services offered by the Department. All chainsaw owners are required to renew their licenses at the end of each year from the initial registration date. The fees are US\$11.00 and US\$18.50 for saws below 64 cc and above 64 cc, respectively. The earnings in this area are relatively small, below US\$3,700/year in the period between 1983 and 1993. Only in 1993/1994 did revenue exceed US\$3,700 (fig. 2).

The third area of earnings come from forest tours which were for the most part, from the operation the Central Rainforest Trail, and recently supplemented by the Union Nature Trail.

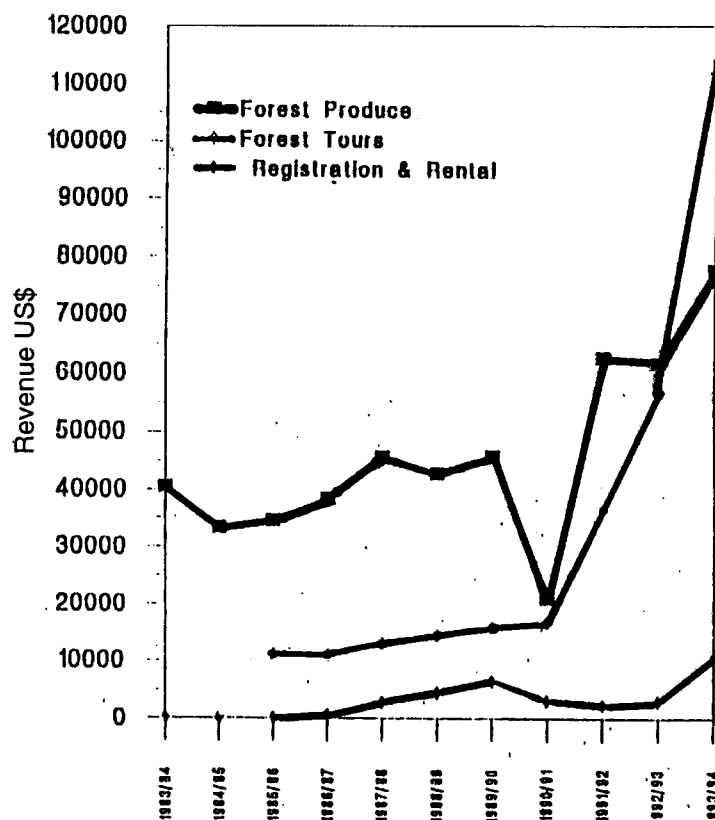


Figure 2. -Revenue generation sale of forest produce, forest tours, and chainsaw rental and registration fee between 1983-1984 and 1993-1994.

This paper will seek to present in more detail the development of the concept of eco-tourism and forest tours. The trade-offs in forest management for recreation versus commercial exploitation will also be explored.

NATURE TOURISM IN ST. LUCIA

Background

Before the 1980's most visitors to the Caribbean region sought after beach, sun and fun as the perfect Caribbean holiday. However, in recent years, there has been a heightened sensitivity in the developed nations of environmental issues and the visitors coming to the Caribbean are now seeking destinations that offer various forms of nature tourism packages. Most of the Caribbean islands are unique in terms of their terrestrial flora and fauna and many islands have pristine marine ecosystems dominated by a great variety of corals and other marine organisms, and these resources are quickly becoming a drawing card for tourism. As a result, efforts to maintain ecological balance and diversity are now being financed by the money spent by visitors who come to experience the natural beauty of the islands. Money in the hands of the local resource users from tourism gives added guarantee for the protection of the resource. Therefore, it is no accident that these have formed the pillars for attracting tourist by the thousands to the island.

Eco-Tourism in St. Lucia

St. Lucia has developed a reputation as a destination where one can experience the more rustic aspects of Caribbean culture as compared to other Caribbean destinations. Consequently, visitors who arrive to St. Lucia often take advantage of the many tour packages in the area of agricultural/plantation tours and nature tours rather than simply the sun-surf-sand package. Of the various nature oriented attractions, some of the more popular ones include the Sulphur Springs, Fregate Islands Nature Reserve, Pigeon Island National Park, recreational diving off Anse Chastanet, Maria Island

Wildlife Reserve and last but not least, the Central Rainforest Reserve and the Union Nature Trail which has become increasingly popular with local visitors as well.

In terms of biological diversity, the island possesses over 1179 known species of flowering plants with an untold number of endemics, and over 150 species of birds and other terrestrial wildlife of which ten are to be found nowhere else in the world. This is an outstanding degree of ecological diversity concentrated in a relatively small area. Some of the notables include the St. Lucia parrot (*Amazona versicolor*) one of the rarest Amazon parrots in the world, the St. Lucia Whiptail (*Cnemidophorus vanzoi*), found only on the tiny Maria Islands off the coast of St. Lucia and the St. Lucia Racer (*Liophis ornatus*), listed as the rarest snake in the world. It is confined to the larger of the Maria Islands. Given those distinctions among many others, St. Lucia indeed possesses a great potential for development of nature tourism and revenue generated in this area clearly illustrates the tangible benefits and values of conservation of St. Lucia's natural resources.

Forest Tours

The Forest and Lands Department commenced guided rainforest tours in 1979 on a trail that traversed the Quillesse Forest Reserve in the southern mountains. The idea was hinged on the fact that the central rainforest was home to the then 13th rarest bird in the world, the St. Lucia Parrot. In addition, the trail crossed the interior from east to west, making it possible for visitors to claim to have "walked across the island" through some of the island's most majestic forests.

In the first year of operations, some 2000 tourists visited the rainforest, providing an income to the department of approximately US\$7,400. Revenue generated went into a sundry deposit and was recycled directly back into making further improvements to the trail, in addition to meeting some overhead costs. However, the sundry deposit was terminated after

1985 in line with changed government policy. Since 1979 the number of visitors to the island's central rainforest has grown steadily over the years to a total of 4023 visitors recorded in 1993 (fig. 3). To terms of trends in earnings from forest tours, some US\$4,100 was recorded for the financial year April 1985 to March 1986. The figure increased very gradually up until 1990/1991 and then doubled from 1991/1992, and each year up until the present. For 1993/1994 the revenue from forest tours reached an all time high at US\$42,500 (fig. 2). This sudden increase was largely due to a doubling in the number of visitors to the forest, and by a revision of the per-head fee from US\$6.50 to US\$10.00 per adult

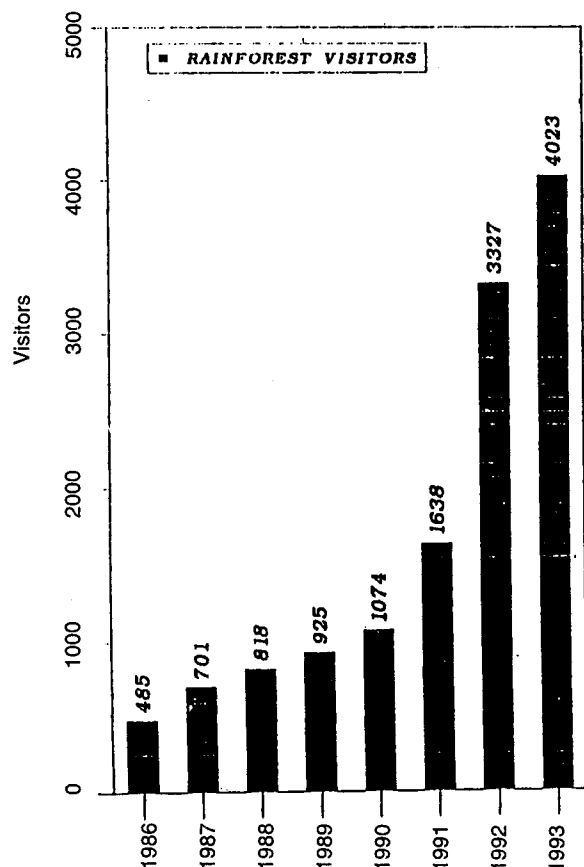


Figure 3. -Number of visitors to the Central Rainforest between 1986 and 1993.

affected in July of 1993. Revenue received for the period between January to April 1994 has already doubled that received in the same period in 1993 indicating a revenue projection exceeding US\$92,600 for the year 1994-1995. With the commissioning of the Piton Flore and Barre de l'Isle Rainforest Trails during 1994, this figure may very well be higher.

Most tours into the rainforest are sold by the Department through the local tour operators whose target group is primarily stay-over visitors from hotels. The client may pay anywhere from US\$28.00 to US\$37.00 to the tour company who in turn provides the clients with transport to and from the forest and a meal. Some operators also include a boat ride as part of the package. The Department provides the guide(s) for a fee of US\$10.00 per adult and US\$5.00 per child under 12 to the tour operator. At the moment, the Department currently has regularly scheduled tours with 7 local operators where each tour operator is assigned a particular day(s) for the tour. At least two operators have a large enough clientele so as to warrant as many as three tours per week.

Trail Development

The Forestry Department currently operates two nature trails, with two others being upgraded to be put into service by the end of 1994.

The Central Rainforest Trail (Map 1) through the Quillesse Forest Reserve has been in operation since 1979 and draws an average of 3500 to 4000 visitors/year. This trail, which is approximately 4.5 miles long, traverses the island's central mountains, and gives the visitor the opportunity to track from one side of the island to another. The added attraction of this trail is the presence of the once endangered but still rare St. Lucia Parrot (*Amazona versicolor*).

In 1991, a massive initiative was undertaken through the CIDA Forest Management Project, in collaboration with the RARE Centre for Tropical Conservation and the St. Lucia Tourist Board

to upgrade the trail to handle the increasing number of visitors. The work involved the surfacing of the walking surface with crushed stones, construction of bridges over ravines, rest facilities, drains, and the erection of interpretive material. To date, about 70 percent of the trail has been surfaced, most of the rest facilities built, and all bridges completed with the interpretive material now being put in place. The possibility exists for even further trail development in the same area.

The other trail in operation is the Union Nature Trail/Mini-Zoo/Interpretive Center (Map 1). This a fairly new attraction, also realized through the CIDA Forest Management Project. The trail leads through dry lowland forest and features a medicinal plant garden, along with a mini-zoo containing a small collection of the Island's indigenous wildlife. Part of the attraction is an Interpretive Center equipped with an audiovisual system, including information panels and models on forest and wildlife conservation. This trail, being relatively close to the city is popular with cruise ship visitors and stay-over guests who are unable to visit the Central Rainforest. This trail is also visited by large numbers of school children. The entrance fee is US\$0.93 per adult and US\$1.85 for a child under 12 years.

There are two other Rainforest trails being refurbished, the Piton Flore Rainforest Trail and the Barre de l'Isle Rainforest Trail (Map 1). Both are relatively close to Castries, and it is anticipated that cruise ship tourist passengers on a tight time schedule will be captured. The Piton Flore trail traverses the mature rainforest and mid-elevation of the flanks of Piton Flora. The main features of this trail are the large mature-old trees that line the route, along with a wide variety of wildlife. While there are no parrots to be observed in this area, the surrounding forests were the last remaining haunts of the endemic Semper's warbler (*Leucospeza semperi*), St. Lucia's rarest bird. To date, the path has been re-defined with limited stones surfacing. The bulk of the work is to be completed by mid 1995.

The Barre de l'Isle trail has the appeal of allowing the visitor to climb to an elevation of 1446 feet to the top of Morne LaCombe. This mountain is located on the Barre de l'Isle ridge and from that vantage point, the Roseau Valley to the west and the Mabouya Valley to the east are clearly visible. The forests around Morne Lacombe are full of parrot activity and provide an added attraction for visitors. The entire walk takes approximately 3 hours to complete. The infrastructural work along this trail is nearing completion, due to be finished by the end of 1994. Most of the trail's walking surface has been covered with crushed stones, and most of the steps have been installed. Currently the interpretive material for this trail is being developed.

Economic Rationale for Development of Forest Recreation

The development of our nature trails has been a costly preposition. Over the past four years US\$106,000 has been invested in the upgrading of the Central Rainforest Walk, the Piton Flore Trail, the Barre de l'Isle Trail and the Union Nature Trail. The funds were committed by the CIDA Forestry Project, US\$42,600; the RARE Center for Tropical Conservation, US\$25,000; and the St. Lucia Tourist Board, US\$3,700. The government matched the remainder of the funding, some US\$33,700 having been spent so far with an additional EC\$91,000 committed for the year 1994/1995. Of the trails, by far the most money has gone into the Central Rainforest Walk, roughly in the area of US\$91,000. This was largely due to the distance of track involved and the heavy infrastructural works that were required. Estimates of expenditures to date on the Barre de l'Isle Trail and Piton Flora stand at about US\$12,400 and US\$2,600 respectively.

When one compares the amount spent on the capital for rehabilitation of the trails to the revenue generated by the tours it is immediately apparent that the return on the investment is being quickly realized. Based on past earnings and revenue projections it is anticipated

that within 3 years, the capital investment would have been paid off. Even factoring in the routine maintenance and salaries for the guides which is anticipated to run in the vicinity of US\$25,200/year, the profit margin from running these trails is quite good (fig. 4).

The above facts provide a basis for a strong argument in favor of preserving forests for the generation of income which is sustainable yet with a relatively low degree of impact to the ecosystem. As is the case for most of the small islands of the Caribbean that still have contiguous forests, the scale of harvest operations has to be restricted due to terrain and simply the non-availability of access to the timber reserves. Another factor that complicates the issue is the character of tropical forests in general. In a given tract of forest the great diversity of tree species means that the high value species are interspersed with a large proportion of commercially non-valuable species and this further marginalizes harvesting operations

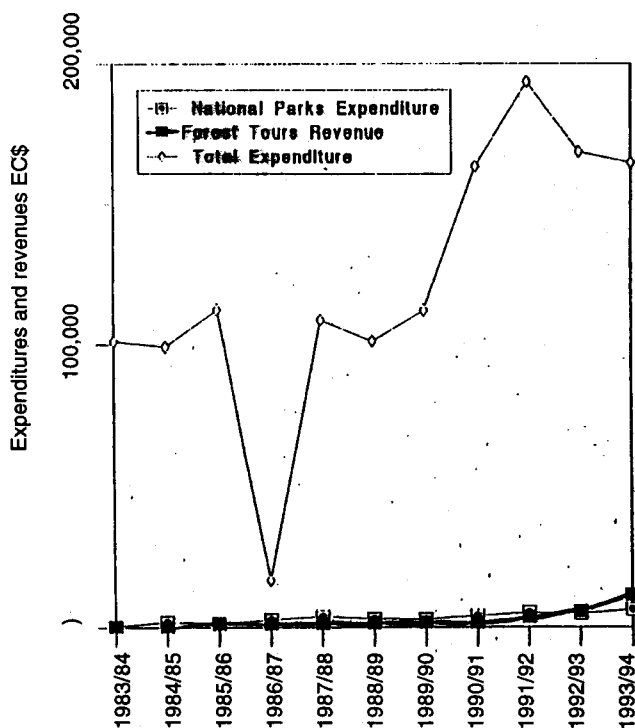


Figure 4. -Comparison between recurrent expenditure (National Parks), total expenditure, and revenue generated by forest tours.

Impacts of Tours on the Forest Environment

While achieving the acceptable levels of visitation so as to realize a return on investment, consideration must be given to the potential impacts on the forest environment. Continual monitoring must be carried out so as not to exceed the trail's carrying capacity. Since no studies on visitor impact on the forest ecosystem have been conducted, it makes it difficult to speculate on the actual extent of the negative impacts on our trails, but there are common problems already being encountered such as pollution, wildlife disturbance, trail degradation.

There are several considerations that must be taken into account in the operation of forest tours, particularly in ecologically sensitive tracts of forest.

One of the first considerations is the impacts on the local flora and fauna. With increasing numbers of visitors, the likelihood of disturbance to nesting birds and other animals in general is increased. A case in point is the degree to which the continual presence of people on the Central Rainforest Trail has affected breeding and nesting habits of the St. Lucia Parrot. It can be expected that human activity will force some species to retreat into other areas in the forest.

Increasing numbers of persons using a single pathway opens possibility of trampling the vegetation adjacent to the trail. Also, over long periods of time, compaction of the soil can lead to impeded drainage possibly resulting in localized erosion.

Pollution is another potential problem. In many cases litter is deposited in places along the trail. All visitors are sternly warned against litter before embarking on the walk and it is emphasized that all garbage is to be carried out of the forest.

Finally, allowing access into the forest opens up the potential problem of unauthorized access

and vandalism of the infrastructure, signs, benches and rest facilities. There is also the risk of persons collecting or damaging orchids and other plants along the trail. In areas where the trail crosses parrot breeding habitat there is always the risk of individuals locating and extracting nestlings for the pet trade.

In terms of positive spin-off benefits, perhaps the most important is the generation of funds from visitation to the trails, and this further contributes to the tourist dollars in circulation in the economy. The more money that is generated from forest tours, the more money that can be funneled into further trail development. The other but no less important benefit is the heightening of public sensitivity to conservation of forests for the generation of income for communities in the vicinity of forest recreational areas. Forest recreation provides the

opportunity for environmental education to increase the awareness among nationals and international visitors of the value of natural resources.

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RESOURCE ECONOMICS IN ST. VINCENT AND THE GRENADINES A CASE IN POINT: MANAGEMENT OF THE COLONARIE WATERSHED

Nigel J. Weekes

INTRODUCTION

"The neglect of the environment in Caribbean economics stands in sharp contrast to the extreme degree of environmental sensitivity of the Caribbean economics. Natural resources are, and have historically been, an outstanding feature of productive activity in this part of the world" (Cox and Embrace 1990).

Issues related to forestry and the environment have long been considered as abstract, important intangibles. More recently, however, we are forced to come face to face with the need for sustainability in the management and use of all resources. As a Caribbean island state, the economic sustainability of our natural resources is becoming a matter of life or death for our people.

All of our productive sectors in St. Vincent and the Grenadines, whether it be agriculture, fisheries, forestry, tourism, cottage industries and/or even manufacturing, depend on, for their economic success, a healthy and sustained environment. There is, therefore, a need to balance various economic and environmental costs with the benefits. However, policy and decision makers are difficult to convince in the absence of quantitative data.

The realization that forests are one of the most important contributors to global environmental conditions and the habitat of tremendous biological diversity that we enjoy has increased the importance of forest management and economics around the world. Small island states like St. Vincent and the Grenadines have to consider seriously the emerging global opinion on the subject, tailoring it to our needs on the background of our own traditional indigenous cultural practices.

Our forest management practices and policies need to be adjusted and, in many cases, developed to ensure that our population receives the many tangible and intangible benefits derived from the forest. They must ensure that we leave for succeeding generations as rich and diverse of an environmental heritage as the one we now enjoy.

BACKGROUND

Approximately 40 percent of the land base of St. Vincent is under forest cover. The primary forest covers approximately 12.7 percent (4300 ha) of the land base. The secondary forest covers some 3451 ha of the island. Most of the natural forests are in very rugged areas. Despite the relative inaccessibility, they are under serious pressure for other land use activities. Further removal of the remaining forest cover would impact on the environmental and ecological equilibrium causing serious social economic consequence.

The scope of forest management in St. Vincent covers approximately thirteen watersheds. Watersheds are appropriate spatial units for ecosystem classification and natural resource planning and management. Through the watershed management concepts, interrelationships and interdependence among resources and resource users become more obvious. It is in the watersheds that we see how "public goods", become the "man-exploited" resources.

The Forestry Division of St. Vincent and the Grenadines was intricately involved in the studies for and development of a pilot watershed management plan in the Colonarie Watershed. The study carried out:

- inventory of biophysical resources;

- definition of past and current land uses;
- determination of resource capability limitations and land suitability;
- determination of current environmental conditions; and most importantly,
- an in-depth analysis of the social economic factors, with emphasis on the population's use of land, water, crops, and forest resources.

The socio-economic study brought out the importance of economics as it relates to forest conservation and management. Having been involved in this study, one gained a first hand understanding of the economic motivations of forestry conservation on the one hand and forest degradation on the other. The Forestry Division is convinced that no plan for watershed management in St. Vincent could be realistic without addressing the socio-economic motivations of the affected population.

The Colonaire Watershed

The Colonaire Watershed is located on the Windward side of St. Vincent and drains through a small alluvial delta in Colonaire Bay at Friendly, about 5 km south of Georgetown. Flowing through the basin is the Colonaire River, the longest watercourse in St. Vincent (11.2 km). Its watershed is the second largest with a drainage area of about 22.7 km², which is equivalent to 6.6 percent of the area of St. Vincent (St. Vincent and the Grenadines 1993). The Colonaire Watershed is divided into three distinct reaches or basins, namely upper, middle and lower basin.

Intensive exploitation of the forest resources within the watershed began in the latter half of the 17th century. From that period, each of the three crops, sugar, arrowroot, and most recently, bananas, which have dominated the country's economy, have used the most productive land base in the watershed.

Upper Basin

This basin lies at an elevation of more than 305 m, covers approximately 71 percent of the total drainage area of the watershed, and is dominated by primary forest, with sporadic banana cultivation.

Middle Basin

The area consists of hilly terrain and lies between 152 m and 305 m elevation. It occupies approximately 14 percent of the total drainage area. Almost all available land in the middle basin has been or is being cultivated, mainly in bananas, compared with no banana cultivation in 1981.

Lower Basin

The area lies below 152 m elevation above sea level and comprises 15 percent of the area in the watershed. It is noted that the secondary forest has almost disappeared, from 22 percent in 1981 to approximately 5 percent in 1992. The following statistics show that the main land use in this area is banana cultivation, 70 percent of which has replaced other commercial crops such as arrowroot and sugarcane. Fruit trees, ground provisions, and pasture are other land uses.

Users

The Government agencies who utilized the Colonaire Watershed include Central Water and Sewerage Authority (CWSA), who harness and provide pipe borne water from the catchment areas in the forest to the surrounding communities, and St. Vincent Electricity Services (VINLEC) Ltd., which also harnesses water for use in their hydro-electric turbines. Both agencies invest large sums of money to harvest high quantity and quality water.

Agriculture on privately owned or lease land is a productive activity on the middle and lower basins. Finally, the Ministry of Agriculture, present as the regulatory agency in the

watershed, often runs into conflict with numbers of informal old and new users of the watershed encroaching on public lands.

Resource Issue in St. Vincent and the Colonarie Watershed

The major environmental problems facing Vincentians today can be summarized as general watershed degradation caused mainly by watershed uses, especially above catchment areas. This problem can be categorized as follows:

- encroachment on public land and deforestation;
- loss of rainforest and its biodiversity and wildlife habitats;
- improper land use on steep slopes and on crown lands by squatters, resulting in accelerated soil erosion, landslides, and sedimentation;
- agrochemical pollution.

These activities degrade the quality of water and may cause related water problems.

In the Colonarie the findings of biophysical resource studies point to the need for the preservation and enhancement of the natural resources in order to ensure sustainability of the socio-economic benefits derived from them.

The socio-economic analysis of these problems show them to be caused mainly by people economically dependent entirely or partly on activities in the watershed including farming, both legally and illegally. The increasing problem of soil erosion, chemical contamination of water supply, decline of wildlife and deforestation is evidence of improper management practices.

Government Failure, Market Failure, and Resource Degradation

Economics is thought to be that exercise in which scarce resources are allocated among unlimited competing needs and wants. The issue of allocation calls on issues of ownership which spread across present and future generations. Moreover, it also forces upon us the issues of efficiency and cost versus benefits.

The major resource issues in the Colonarie Watershed are most easily understood by utilizing a Government Failure - Market Failure model for their interpretation.

Government is the owner of crown land. It is supposed to be the allocator of resources among competing needs/wants and the catalyst to effective market action. Government is also a market actor and empowers water collection, and electricity generation to operate.

As the responsible agent for regulation and allocation of the resources of the forest to the general population, Government has significant investments in the forest. The need for maintaining these investment and then operation is its main concern, and very often government overlooks the presence of illegal operators whose action hamper its operations in the long run.

For instance, present establishment cost for water catchment total about EC\$250,000* which may be spread over 25 years for recovery. Operating revenue for the Colonarie Watershed for providing pipe borne water is EC\$287,000 while operating expenses total EC\$78,000. A surplus on EC\$209,000 is therefore generated which could be used to provide similar service to other communities.

*US exchange rate \$1 = EC\$2.6.

Generation of electricity costs approximately EC\$26,193,000 while it is sold at EC\$33,975,000 creating a surplus/loss of EC\$7,782,000. The contribution of hydroelectric generation to total is on the increase and now accounts for 36.9 percent of the electricity generated in St. Vincent and the Grenadines. Hydroelectric generation is much more efficient and more environmentally friendly. The Ministry of Agriculture's last estimate for forest revenue - timber and fence posts, is approximately EC\$15,000.

On the other hand, one recently deforested acre of banana yields annual revenue of approximately EC\$5,000 to which no cost for purchase of land is applied. A sack of charcoal brings EC\$20. A live St. Vincent parrot fetches about US\$5,000 on the "black market." Exact figures on revenue from production of illegal crops are not available. But recent estimates place it much higher than revenue from traditional cash crops in St. Vincent and the Grenadines.

An examination of the situation however shows that Government does not act as proprietor of forest resources. It fails to exercise unified directing power in the use of the resource and does not discipline the market force. Because it fails to act as it should, we have what we call Government Failure.

Due to Government Failure, the first state of this model, Crown lands became in practice an open access resource. Economic motivation allows otherwise unemployed labor to combine with limited capital in the exploitation of lands water and other resources. This will ultimately result in the production of many negative externalities which become the norm especially in upstream economic activity.

Market Failure is mainly represented in this model as inefficient allocation of resources. In this stage we see the inappropriate use of the chemicals and other materials, bananas being cultivated on marginal and agricultural unsuitable lands, rivers becoming contaminated, over-

harvesting of wildlife, generally an irrational exploitation of the forest.

The next stage in the model is its negative effects. Here we see that the inefficient allocation of resources brings soil erosion, water degradation, loss of wildlife and a shift in economic activities towards those that are totally exploitable of the forest resources.

The final stage in the model is the Impact stage. Here the entire economy suffers from the reduction in agricultural yields, acute droughts, and flash floods. The quality of health in the country declines, all of which brings impoverishment and other social problems ending in migration as people flee to more lucrative, liveable areas.

CONCLUSION

The Forestry Division recognizes that we live in a democratic society where the government of the day is for the people and by the people. As the final authority which must allocate scarce resources for the maximum benefit of the public, much of the responsibility for arresting the situation lies with Government.

Through studies like these that were carried out of the Colonarie Watershed, the Government is becoming aware that forest resources can be efficiently conserved, harnessed and delivered for the economic benefit of the entire population. Government, through its several agencies, must play its role as both a catalyst and a manager in the process of achieving the best use of our forest resources.

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STATE OF THE ART IN FORESTRY NEGOTIATING MAJOR FOREIGN INVESTMENTS IN FOREST UTILIZATION PROJECTS IN SURINAME

Kenneth M. Tjon

INTRODUCTION

Suriname, on the northeast coast of South America, lies in the centre of the Guiana Flora Area, between Guyana and French Guyane. The total land area of Suriname is about 16,400,000 ha of which some 80 percent is covered with undisturbed neotropical rainforest. About 388,000 people are living in the country; the majority (90 percent) is concentrated around the capital of Paramaribo and in small communities in the coastal plain. In the interior, settlements of Amerindians and Bushnegroes are scattered, mainly along the large rivers.

STATE OF FOREST, FOREST PRODUCTS AND FOREST INDUSTRIES

Land Use

A rough breakdown of Suriname's land use is given in Table 1.

Table 1. -*Land use of Suriname (1992).*

Use	Hectares
Timber production	2,414,800
Nature reserves	804,000
Proven timber reserves	407,000
Other forest land	11,228,800
Total forest land	14,855,800
Permanent agriculture	90,000
Permanent pasture	15,000
Shifting cultivation	150,000
Other uses (mining, lakes, etc.)	1,290,000
Land for other use	1,545,000
Total land area	16,400,000

The Forest Estate

The following breakdown of the total forest area is based on physical land features, forest stand composition, and accessibility.

• Accessible forest 3,789,400

To the north of higher hill country and rapids in the rivers. This accessible forest can be divided in:

-Unexploited forest 1,550,000
e.g. mangroves, swamp forest, low savannah forest and parts of high savannah forest, and high dryland forest.

-Exploited forest 2,239,400
e.g. Virola stands, ridge forest, parts of hydrophytic forest, high savannah forest, high dryland forest, and plantations.

• Inaccessible forest (in the hinterland) 11,065,600

Watershed Management and Environmental Protection

The topography of Suriname is generally not severe and the low rate of forest destruction does presently not pose a threat to erosion, floodings and permanent property damage. In Suriname timber yields are usually a little less than 20 m³/ha and especially because of selective harvesting, logging seldom results in severe damage to the forest (Jonkers 1987). Agriculture is for the most part done in the fertile

coastal plain, where it is considered to be a stable and sustainable form of land-use.

Large scale conversion of natural forest outside the coastal areas may not lead to stable forms of intensive agrarian production, due to soils highly susceptible to erosion and problems with weeds, pest, and diseases, unless special measures are taken. The estimated deforestation rate is 0.17 percent/year.

At first sight the large forest area versus the small population size would suggest an absence of pressure on land. However, the destruction of forest by shifting cultivation in newly opened up areas is mostly in the accessible forest belt and can thus be a serious problem. It accounts for approximately 16,000 ha/year.

Forest Production

Approximately 2 million ha of permanent production forest have been given out under concession or annual cutting permit to some 150 concessionaires. These range from large enterprises (Bruynzeel) to small individual loggers.

Tribal communities living in the interior have the traditional rights over a forest part in the vicinity of their villages. Their total forest holding amounts to some 400,000 ha.

The annual area on which felling is done is estimated at 25,000 ha and for the greater part,

under normal circumstances, not more than 20 m³/ha is harvested.

The main problem facing the forestry sector in Suriname in the efficient utilization of the forest resource is the complexity of species occurring in irregular quantities and distribution.

Logging

Logging is a fully mechanized activity in Suriname. Felling is done by chain saws and skidding is generally done by crawler tractors or wheeled log-skidders, or sometimes by combining both. Logging trucks carry timber to the nearest river landing, and from there it is transported by sling boat or barge. However, a notable shift toward road transport can be observed.

Timber production is geared to the demand concentrated in Paramaribo and its surroundings. The total annual removal amounted to some 320,000 m³ in 1980, decreasing steadily to 107,000 m³ in 1991 (see table 2).

Processing

There are about 40 sawmills in Suriname with an installed input capacity ranging from 1000 to 60,000 m³ roundwood/year. The largest mill, with an input of 60,000 m³/year is operated by Bruynzeel, with the only plywood plant in the country (production capacity of

Table 2. -*Timber production volume in 1000 m³.*

Year	Industrial roundwood	Square piles	Minor products	Fuelwood charcoal	Total roundwood production
1980					320.0
1985	189.9	23.3	2.7	1.6	226.5
1990	114.8	0.6	0.5	0.4	116.3
1991	105.2	0.9	0.4	0.4	106.9
1992	118.8	1.7	1.4	0.4	122.3

3,500 m³/annum) and a particle board factory, processing plywood waste, with an installed capacity of 3,500 m³/year.

The sawmilling standards are low in most of the mills, although some minor improvements are noticeable. Poor lay-out, old machinery with low recovery (20 to 50 percent), large range of product sizes, inefficient combination of machinery, and insufficiently trained personnel resulted in low efficiency and high production costs. The latter leads in turn to the replacement of local wood by imported material and to a difficult competing position of Suriname's wood in the international market.

Given its potential, the improvement of the wood industry's operational capacity is necessary in order for the sector to generate a higher contribution towards the national economy. Lack of financial resources (foreign exchange limitations) and training facilities for technical personnel are major constraints.

Non-Timber Forest Products

Nature Tourism

The country's outstanding nature conservation system makes the almost uninhabited and practically undisturbed interior one of the most interesting places to visit for nature lovers. With 674 species of birds, 150 species of mammals, and 4500 plant species (of which, 300 orchid species and 800 woody species) identified, Suriname can easily compete with better known ecotourism countries, such as Costa Rica and Ecuador.

The development of ecotourism is one of the priorities of the Surinamese Government. By stimulating nature tours for tourists abroad, the Government is trying to have international tourism contribute to the national economy. In addition, for the Suriname population the forest and other nature areas are becoming increasingly popular for recreation and tourism.

Wild Flora and Fauna

A low level of trade in wild flora and fauna has existed in Suriname for many years, but has never been considered a serious threat to the flora and fauna of the country. Since legal export out of other South American countries is getting difficult, international wildlife traders now focus on Suriname as a potential supplier.

Nowadays the export of wild flora and fauna has become a lucrative business. Species of interest are mainly: parrots, macaws, parakeets, songbirds, a variety of reptiles, amphibians, and orchids.

In 1987 an export quota system for all wildlife species permitted to be exported was created. Wildlife dealers have to be in the possession of a license to practice their activities of collecting, trading, and such. Since 1981 all exports of wild flora and fauna have to be accompanied by an export permit in addition to a Convention for International Trade of Endangered Species (CITES) permit for species covered by the appendices of the Convention.

A growing interest is nowadays noticeable in the collecting of forest products such as tree bark, herbs, plants, fruits, and roots for pharmaceutical purposes.

Recently a permit was issued by the Ministry of Natural Resources to a Surinamese medicine supply company for the collection of medicinal plants.

The collected material will be processed locally and coded extracts will be sent to a group of large pharmaceutical laboratories abroad for scientific investigations for the productions of medicines, especially against HIV and cancer. It is important to note that if and when the project generates income a substantial part should return to the country of origin and be made available to a so called Indigenous Peoples Development Fund, while assuring the protection of intellectual property rights.

Other Forest Products

People living in the interior are collecting a variety of forest products such as nuts, fruits, palm leaves, grasses, etc., to fulfill subsistence needs. On a very small scale these products are also being traded on the local market.

Hunting and fishing is also done for subsistence and on a small scale for trade by local people. In addition, other people can be engaged in commercial or game hunting and fishing practices.

MOBILIZING THE FOREST RESOURCE BASE

Forest Policy

The national forest policy, as part of the national development policy, contains in brief; management and utilization of forest resources as a base sustained production, industrialization, rural development, and employment, while at the same time; developing and maintaining the other forest functions.

The most important objective of the policy strategies is the utilization, improvement and regeneration of the forest and stimulations of the industry, for the generation of foreign exchange and increased employment and for the diversification of the national production.

Foreign Investments

The steady decline of forest production, which is clearly illustrated in table 2 is a direct result of political instability resulting in guerrilla-warfare in the interior of Suriname, from 1986 onwards.

Virtually all logging camps were hurriedly abandoned, leaving exploitation equipment and machineries at the mercy of the guerrillas, when it became extremely dangerous to be in the forest. All Forest Service station and camps in the interior are now lost, while funds for the

executing of supervision and control are not becoming available. Suriname's major donor, the Netherlands, our former colonizer, has stopped the development aid since 1982, trying to force down the military government.

The Dutch have further more lured the present, democratic administration into a structural adjustment programme, that they would help finance.

After it became clear that Holland was forcing Suriname towards the International Monetary Fund (IMF), the President of Suriname chose for the nil cent-option and sent his Ministers out to other, friendly nations to attract investments into Suriname.

Earlier measures taken in the forestry sector to boost the wood industry and to generate foreign exchange quickly, had resulted in increasing exports of raw logs.

In May 1993, an Indonesian investment group arrived in Suriname to investigate the possibilities of obtaining large forest-exploitation concessions. This Indonesian group proposed to invest some US\$1 billion in a large scale logging and integrated wood processing project. This investment would come into effect as soon as the investment group would be granted a concession of 1 million ha and a reserved area of 5 million ha.

On the basis of a preliminary investment plan, the group was granted a concession of 150,000 ha, while negotiations for the rest of the area applied for would start upon submission of a definite investment plan. The then-in-power, ill-advised Minister of Natural Resources, sorrowfully enough, also signed a preliminary agreement with the Indonesian group for the 6 million ha in August 1993. Negotiations are on-going, as a recently installed interdisciplinary advisory, and negotiating committee is trying hard to get the area drastically reduced. Especially the 5 million ha reserved area has put Suriname in an awkward position since it can

not sincerely offer any part of that area to other interested investors, for as long as the preliminary agreement is not broken up.

Soon after the granting of the 150,000 ha concession to the Indonesian group a Malayan investors group visited Suriname and this resulted in the signing of a letter of intent for 1 million ha of forest for an investment of US\$100 million.

In the meanwhile, yet another letter of intent was signed with a smaller Malayan loggers group, who offered some US\$35 million investment in the sector, for a "modest" concession of 150,000 ha forest land.

These intentions of the Surinamese Government created a lot of noise, from the so called green groups, especially those from the Netherlands. These protests from the Dutch did not impress the Surinamese Government, as it was clear that the Dutch are not really concerned with the development needs of Suriname, as much as they, as an industrialized, first world country, are concerned with the air that they breathe.

At this point I would like to quote the world renowned economist, Lester Thurow, who wrote in his book *Head to Head*: "...people do not pay for clean air, but they do for beef and orange juice. So the Brazils and Indonesia of today have every right to cut down their forest and raise cattle or establish orange groves, in order to fulfill their economic needs."

Very recently a Presidential delegation of Suriname made an official visit to Indonesia, Hong Kong and China. The expectations are high and more Asian investors groups interested in large forest concessions are expected in the very near future.

It is my opinion that forests, especially untouched tropical rain forest, should be regarded as a national asset and as a national, natural, renewable resource. As such they should be conserved, not preserved.

I think the best way to achieve adequate forest conservation lies in putting them to wise use, to mobilize the resource for the optimal benefits to the nation. It is clear that this should be done in a most rational manner, on a sustainable basis.

In order to achieve this goal, an increased effort should be made to strengthen the capacity of the Forest Service and to design a well thought out, workable system for sustainable forest exploitation. Research efforts are now being undertaken, also in forest of the Guyana Shield, to arrive at practical, common guidelines in forest exploitation and post harvesting treatments. Still, more and new financial resources should be made available by the concerned, industrialized countries to enable local institutions to carry out their jobs of improving promising forest management systems, such as the CELOS system, developed in Suriname, and to make possible the institutional strengthening of National Forest Authorities, to adequately perform the supervisory and control functions they gave.

The Government of Suriname, at the moment, has insufficient experience and expertise to conduct negotiations leading to contracts that ensure optimal benefits for the country, without destroying the forest.

That is the reason why Suriname has requested FAO's assistance in this matter. Still, we think that in actual negotiations with foreign investors a number of considerations need special attention.

Foreign investors utilizing a national, natural resource are to be offered a balanced package of financial and fiscal incentives, instead of tax holidays.

- All rights, duties, and fees should be paid in hard currency.
- An environmental impact assessment is a must and should be carried out by a neutral and capable party.

- Infrastructure built by the investors, should become part of the national infrastructure periodically, not at the end of the duration of the project.
- Investors should make substantial contributions to a forest or timber fund, which should enable the Forest Service to execute management and control, research, and training.
- The rights of indigenous people should be respected at all times. Their lifestyle should not be influenced.
- A clear and transparent reforestation or regeneration plan should form an integral part of the contract.
- The financial and social benefits should be clear and substantial, from the very start of the negotiations.
- Consideration should be given to alternatives offered by concerned, rich communities. Mechanisms such as tree adoption funds should be seriously considered.

In short, the investors, in order for them to get a contract signed, should make an offer that the national government almost cannot refuse.

The above list does not have the pretention to be complete. It is my hope therefore that Suriname can learn from her Caribbean colleagues who already have experience with foreign investments of more or less the same magnitude and nature. I would therefore like to invite discussions and advice on the subject matter, so I can return to Suriname after this meeting with yet another tool to help make sure that the country does not gamble away one of its most important resources.

At the end of my talk I would like to stress in simplistic words that it is an utopia for people to think that forests can survive as an island of luxury amidst a sea of hungry people.

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ECONOMIC APPLICATIONS IN TRINIDAD AND TOBAGO FORESTRY

Carlton Sambury and Kenny Singh

ABSTRACT

Very limited research has been done by Trinidad Foresters on the application of economics to forestry practices. Most past studies have concentrated on timber investments. This paper summarizes past efforts and suggests that in view of the country's present unfavorable economic performance and related factors it is now necessary that priority be given to such applications.

INTRODUCTION

The need to optimize economic returns generated from forest resources, whether timber, water, wildlife, recreation/opportunities, handicraft materials, or fruits has for a long time been appreciated in most countries endowed with substantial forest resources. Foresters have indeed perfected the art of valuing timber, and certain other tangible non-timber products, and such values figure prominently in the economies of many countries.

Presently with the realization of the tremendous value of the full range of non-timber products and services very often far surpassing that of timber, there is now increasing emphasis on determining in precise terms such values. More importantly, valuing all such environmental products and services provides the basis for the sustainable exploitation of all forest products, reduces incentives for deforestation, and conserves and enhances the forest resource base. It is in the interest of foresters, therefore, to master such techniques, in order to demonstrate the ability of forestry to contribute "more to the improvement of mankind's quality of life, and to the raising of his standard of living than other competing sectors of the economy" (King 1975). This must, as much as possible be done in the language most politicians understand, dollars and cents.

STATUS OF ECONOMICS IN TRINIDAD FORESTRY

The application of economics to Trinidad and Tobago forestry practices has up to this time received limited attention by local foresters. Some of the work completed, including that of visiting foresters, has included the following:

Cater, John C. 1941. Formation of teak plantation with assistance of peasant contractors. This study analyzed the establishment of teak plantations. Establishment costs for teak using taungya gardeners were listed as:

		per/acre
Year 1	establishment costs	\$13.00
Year 2-5	tending	<u>11.00</u>
		\$24.00

Moore, D. 1962. The utilization of hardwood (teak) thinnings in Trinidad and Tobago. A report on the teak sawmill at Brickfield, Trinidad with emphasis on its then financially successful operations. Products included split fencing, fence posts, small size teak lumber products.

Miller, A.D. 1969. Provisional yield tables for teak in Trinidad. A brief discussion of economic choices open to foresters as a result of the data analysis done and presented in yield tables.

Gane, M. 1969. Priorities in planning: Cost benefit methodology simulation with special reference to forestry and economic development in Trinidad. This study dealt with measuring the effects of forest development (especially teak and pine) on Trinidad's economy and welfare. The author found (among other things) that the welfare benefits which the country derived through the planting programs adequately justified the investment.

Dardaine, S. 1984. The determination of rotation age of teak (*Tectona grandis* L) for Trinidad and Tobago. Selwyn Dardaine. Based on data analysis previously done by Bell, some original research and applicable economic criteria, a rotation age for teak was recommended.

Sambury, C. 1984. Preliminary analysis of investment in Xmas trees by the Forestry Division (Departmental Paper). This study arrived at the same conclusion which an earlier analysis by a Forestry Division Committee had i.e. the production of Xmas trees by the Division was economically unfeasible.

Sambury, C. 1987. Appraisal of investment in teak in Trinidad (unpublished Msc Thesis). He found that at then existing stumpage rates and establishment costs, investment in teak was quite unfeasible. Other more comprehensive analyses and related action, were suggested.

Nagle, G. 1990. TFAP/NFAP Report on forest economics. This study assessed among other things the role of forestry and forest based industries/activities in Trinidad and Tobago, forecasted impact of expanded agroforestry and advised on the assessment of indirect benefits/cost of TFAP on Trinidad and Tobago's economy. He found that:

1. both natural and plantation assets should be managed more efficiently for economic return;

2. there should be an increased efficiency in operations, and further value in manufacture in forest industry and related operations;
3. the range of economic products derived from forest resources (plantation and natural) can be expanded;
4. public agencies charged with forest resource management and conservation can become more efficient in their operations and largely self-sufficient in financing.

Among his recommendations were:

1. private sector production and marketing of all economic products at the forest;
2. the creation of a new autonomous agency for the economic management of production forests on a sustainable basis.

Sambury, C. 1993. Paper (unpub). The case for consistent economic planning and analyses in the Forestry Division. The author makes a case for consistent economic planning and analyses of all projects and activities in the Division.

1980-94. Various Forest Division Committees considered revision of royalty rates. However, detailed statistical and other economical research data are required to justify recommendations e.g., timber. Royalty rates for timber were last revised in 1990. Formula for stumpage (per hoppus foot) for four classes of timber were determined using the selling price of lumber and factoring in costs and profit margins for various processing inputs. A recommendation for the imposition of a reforestation levy for timber extracted from commercial plantations was not accepted.

NEED FOR ECONOMICS' APPLICATIONS IN FORESTRY

Unfavorable State of National Economy

Declining Forestry Division Allocations

The expenditure pattern of the Forestry Division the period 1980 to 1993 is summarized at figure 1. This pattern mirrors the performance of the national economy which in turn reflects the declining fortunes of the petroleum sector. Overall expenditure declined from a high of \$38.7 m in 1984 to as low as \$15.9 m in 1990. Development (capital) expenditure has declined drastically. This has resulted in severe cutback on reforestation programs particularly the regeneration of second rotation stands of commercial plantations. The implications for

future timber harvest and therefore revenue generation are obvious. The decline in capital expenditure has also had negative impacts on infrastructure, including buildings, plant and equipment and forest access roads.

Small Revenues

During the period 1980 to 1989, revenue generated by the Forestry Division remained somewhat static but was boosted in 1990 by increases in the royalty rates for timber, which has consistently been the largest contributor to revenue generation. The second largest source of divisional revenue is the sale of game (hunting) permits. Nevertheless, total revenue continues to be extremely low as compared to expenditure.

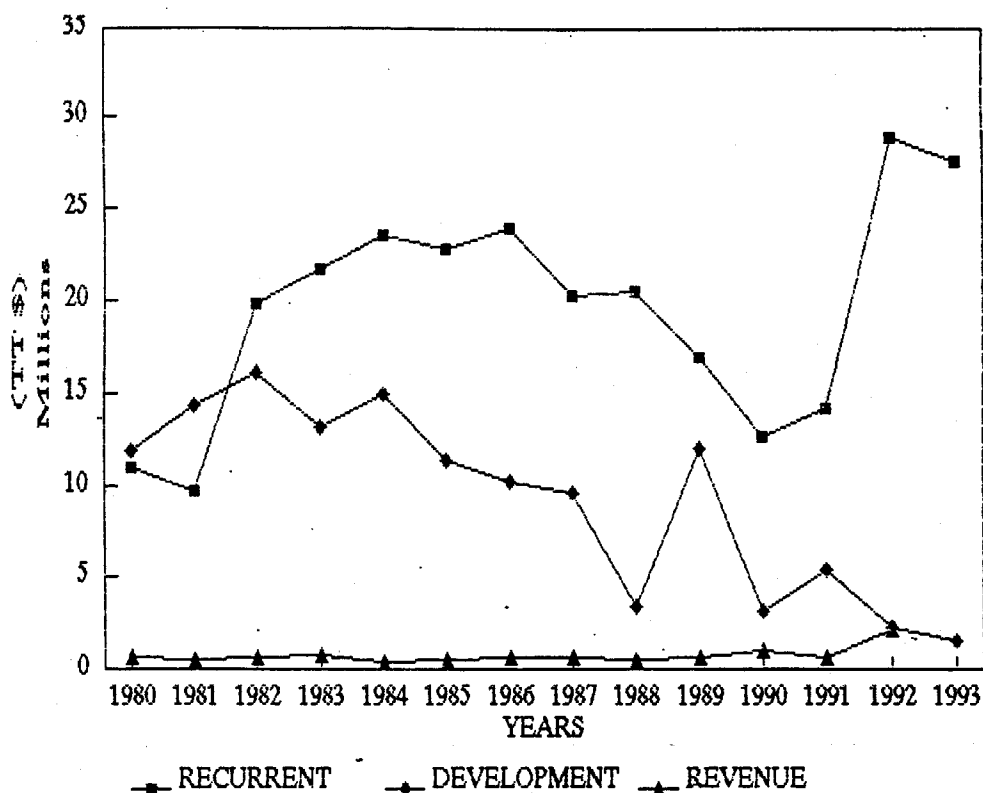


Figure 1. -Forestry Division total expenditure and revenue (1980-1993).

Distribution of expenditures and revenues through sectors of the Division is illustrated at figure 2.

Privatization

Government policy now indicates private sector involvement in the management of public enterprises and greater cost efficiency in the delivery of goods and services by its Ministries.

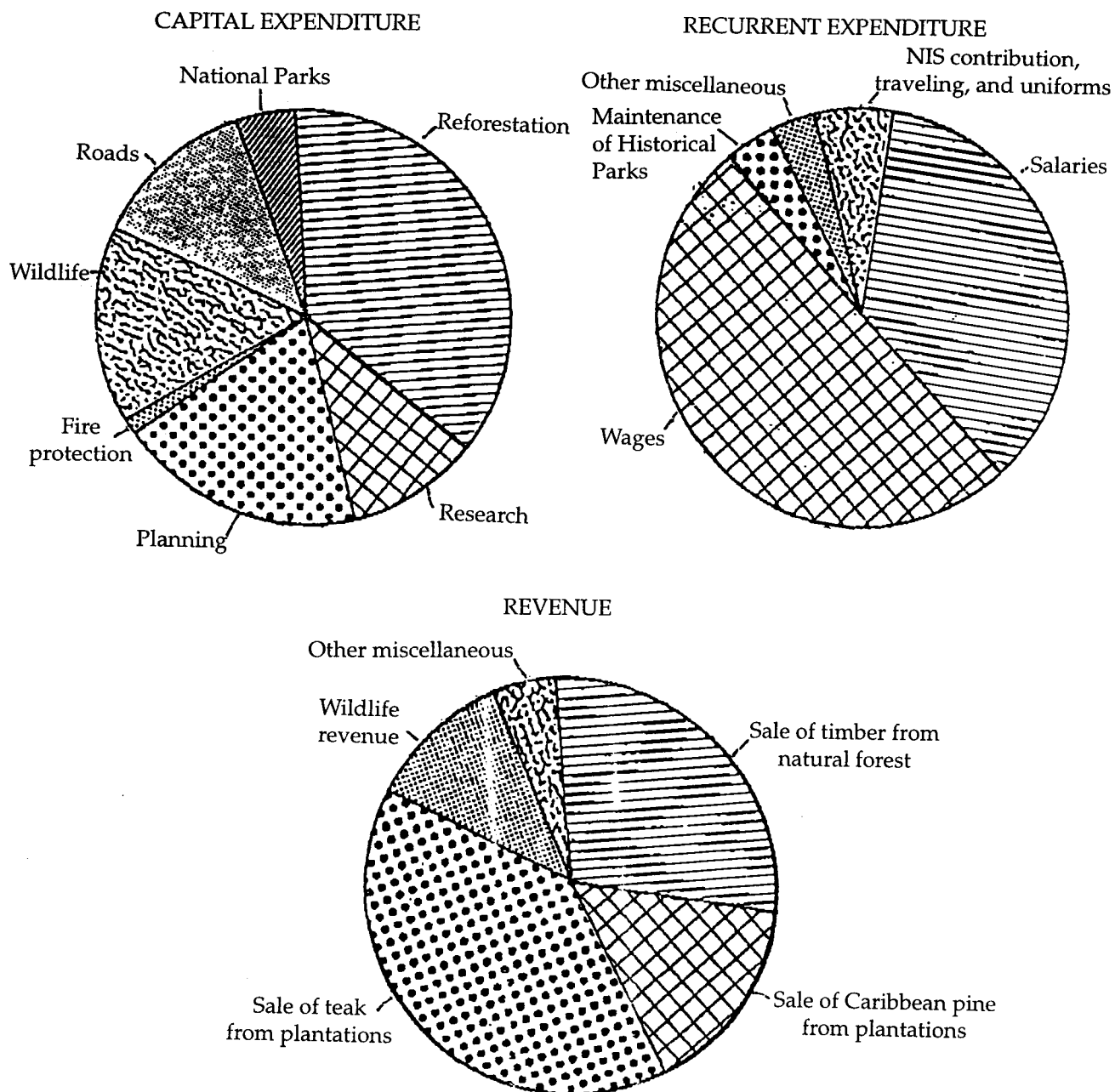


Figure 2. -Breakdown of expenditure and revenue for 1992.

Recent Issues

Recent national issues over the past decade have emphasized the need for economic data providing necessary sound justification. Among such issues are the following:

Agriculture Versus Multiple Use Resource Management

We as professionals need to have adequate justification to enable politicians to take appropriate action based on sound economic, rather than merely social or political reasons. The Nariva Swamp example is interesting in this regard. This matter involves a squatter who sought to win public and official support for his illegal occupation of over 40 ha of wetlands by drawing attention to his investment of over one million TT dollars in plant and equipment and his contribution to national agricultural production. While the court did rule that this "farmer" desist from his illegal occupation of state lands, surely the state's argument would have been more convincing if a proper valuation of the damage done to the wetlands were available.

Determination of Forest Land Value

State valuers and agriculturists use traditional market values for forest land. This is not appropriate since the real worth of timber trees and other perhaps more valuable intangible benefits are not considered. For example, more realistic values are needed for land exchange purposes (e.g. Asa Wright*). Additionally, such valuations are required for compensation when forest land is damaged (e.g. petroleum company).

Justification for Increased Forest Revenue

Fees for Forestry Services. Numerous forestry services are available and have traditionally been offered free of charge by the Division. These services are usually offered at a substantial cost in other countries and it is felt that there is adequate willingness to pay among our consumers. Examples include: Forest recreation, guide services, user fees; consultation services, private forestry management; management of wildlife farms, and other wildlife services.

Increased Royalty Rates. Current royalty rates for timber remain low, and that for non-timber products much lower. However, before higher fees are recommended, an appropriate empirical analysis of the situation is necessary. This is more likely to influence policies if a sound justification is based on detailed and recent data (Ghani and Vincent 1993).

RECOMMENDATIONS FOR NECESSARY STUDIES

Analysis of Revenue-Earning Capacity of Trinidad Forestry

Increased Timber Royalty Rates and/or Addition of Various Other Kinds of Charges e.g. Forest Premium, Development Access

These charges are two examples of a variety of collection systems presently used in other countries (May 1991). The revenue position of the Division could be further enhanced through proposed increases in royalty rates for timber and other forest products and through the introduction of fees and charges for services currently offered free of charge.

*The Asa Wright reference relates to a proposal to compensate the Asa Wright Nature Centre for land acquired by the State via the mechanism of a land exchange. Whilst the parcel acquired by the State has been valued based on an evaluation of the utility value of its resources; the parcel of forested land proposed to be given as exchange is being assessed based on "open-market" value.

Introduction/Increase of Fees and Charges For Various Services

These may include recreation, wildlife, and watershed protection. However, these increases must be based on a sound economical appraisal

Xmas Tree Production

It is felt that more cost efficient production methods may result in a profitable investment for the Division. A more in-depth economic analysis is underway.

Economical Appraisal of Research

Numerous research activities have been ongoing for an extended duration without significant analyses. It is suggested that economic feasibility be a major factor in determining future forestry research projects.

Justification for Teak/Pine Investment (Other Forestry)

More comprehensive studies will be undertaken as recommended by Sambury (1987) and Nagle (1991).

General Project Analyses

As foresters, we must be able to prioritize projects on the basis of the best return to capital given the total resources available, and not simply because it is a parks, wildlife, or reforestation project. Our ability to demonstrate that our proposed projects can contribute significantly to the development of the total economy, and that its contribution will be great enough to justify using the scarce resources it will need, must surely lead to an increase in budgetary allocations instead of severe reductions as have occurred over the years.

Feasibility of Private Forestry

Answers to important questions are required: What minimum level of investment is necessary to allow for sustained economic vi-

ability of private forestry operations? What level and system of incentives or other state support shall be necessary? Finally, what is the cumulative cost of the damage to the natural environment as a result of inappropriate use of private lands?

Ecotourism

Ecotourism is currently being hailed as the saviour for much of our natural environment. There is however, a need to clarify the economic contribution of ecotourism as opposed to other alternatives. The big question is therefore at what cost, ecotourism?

Forest Fires

Each dry season, forest fires ravage our natural forests, commercial plantations and agricultural lands. Apart from these, a number of non-forest values are also negatively affected. These include infrastructure such as roads, bridges, water courses, utility transmission and water quality. Apart from direct and indirect losses associated with forest fires, the cost of remedial work is also quite exorbitant. Yet, investment in forest fire management remains at an absurdly low level. Appropriate economic studies will assist in promoting due recognition for the role and value of fire prevention and control.

CONCLUSION

Forest officers have traditionally bemoaned the scarce resources allocated by national governments to forest management. Our colleagues in the more developed countries have apparently overcome this dilemma by translating their concerns into the language that decision makers most easily understand that is dollars and cents. Perhaps more appropriate to our situation (small states), the difficult task involves assigning values to a set of complex and intangible benefits to be derived from our forest estate as opposed to just timber. And herein lies the challenge. For in attempting to appraise these intangibles, not only shall we be venturing into areas in which few studies have been

done but also into a field in which there can be few universal rules. The value a community attaches to a natural resource shall depend on historical, cultural, social, political and economic considerations. As difficult as the task is, if forest managers in this region hope to engage the attention of decision makers, then we must be willing to discuss our concerns in economic terms.

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CONSERVING REAL VALUES AND ENHANCING PERCEIVED VALUES IN PACIFIC ISLAND FORESTS

Kathleen S. Friday

INTRODUCTION

The discipline of forest economics is an open field in the Pacific islands. Better understanding of forest values is needed for both commodity management and conservation decisions throughout the region. Pacific foresters have moved forward with several initiatives based on economic concepts even though we lack complete valuation. A few of these initiatives which may be of interest to Caribbean foresters are: promotion and marketing of ecotourism; development of criteria for "certified" wood products; influencing Hawaii policy to reflect the value of Hawaii's forest industry; and educating Pacific political and traditional leaders to enhance the perceived value of Pacific forests.

Pacific Geography

The Pacific has three major geographic and cultural areas: Polynesia, Micronesia, and Melanesia. The USDA Forest Service (USDA-FS) Institute of Pacific Islands Forestry (IPIF) is located in the State of Hawaii, an outlier of Polynesia. Hawaii has no National Forest but IPIF conducts research and provides management services to island government forestry agencies. IPIF has served the American-affiliated islands of the Pacific for more than three decades: Guam, the Commonwealth of the Northern Mariana Islands (CNMI), the Federated States of Micronesia (FSM), the Republic of the Marshall Islands, the Republic of Palau (all in Micronesia), and American Samoa, in Polynesia. More recently, IPIF has also begun to work in the islands of Melanesia and Polynesia.

Pacific states and nations vary in size from Papua New Guinea with almost 50 million ha, to Hawaii with about 1.6 million ha and a population of about a million, down to atolls with

very little land area. They vary in affluence from Hawaii (part of the United States) to Third World nations. Most of these islands are still inhabited by their indigenous peoples who retain much of their own culture. Even in the American-affiliated Pacific, indigenous subsistence land management is still practiced by the older generation on many islands, though much traditional knowledge is being lost. Dependence on cash and the Western economy is becoming more and more pervasive. Various sources of income include (in no particular order) stamp sales, agriculture, timber on large islands, intergovernmental transfers, remittances by emigrants, spending by military bases and personnel, land sales and leases, tourism, and fisheries. Population growth ranges from nil on islands such as atolls from which people constantly emigrate, to about 3 percent/year for the Federated States of Micronesia, to more than 5 percent/year on individual islands which attract people from outer islands or which import labor (United States Census Bureau 1991).

The islands served by IPIF are all tropical. They are oceanic islands, having always been isolated from continental land-masses. The Island of Hawaii is 4000 km from the closest continent. The ecosystems of the Pacific Islands tend to have some broad characteristics in common. They generally have high rates of endemism; susceptibility to competition from introduced species; low ecological stability because of small size and fragmentation; and short watersheds.

Pacific Forests

Forests are the natural climax vegetation almost everywhere and most islands retain much forest cover. Common forest types and conditions which occur on various islands include moist forests, primarily at high elevations; mangrove forests; deforested and/or degraded

areas; multi-story agroforests; secondary forests; limestone forests; and plantation forests. More information about Pacific island forests is provided by Newell and Friday (1993).

Dry forests and native atoll forests have been greatly altered or eliminated. Urban forests are becoming a recognized, managed forest type on developed islands.

Forest values include:

- Watershed protection for water quality and soil conservation - This includes mangrove forests to protect shorelines and filter sediments. Forested watersheds protect reef ecosystems, valuable for tourism and fisheries.
- Agroforestry - Products include fruit, vegetables, nuts, tubers, fibers, flowers and foliage for leis, medicines, betel nut (*Areca catechu*), and kava or sakau (*Piper methysticum*)
- Wood - Timber is produced and exported from the largest islands; local uses include timber, poles, fuelwood, and craftwood.
- Meat - Pig, bat, deer, and mangrove crab meat are eaten.
- Biodiversity - Besides its inherent value, there is potential economic value in "gene prospecting" for pharmaceuticals in these areas with many endemic forest species. Mangroves are valued as a nursery for economically important fish species and as an ecosystem linked to marine systems through nutrient flows.
- Human environment - Beauty, cooling, and recreation are values of rural forests and of urban forests on the more developed islands.

FOREST VALUES AND CONSERVATION

In general, forests in the Pacific have suffered from a low perceived value on the part of politicians, other leaders, and the general public in the islands. Many an urban resident or tourist in Hawaii will ask, "Hawaii has forests?", despite the fact that half the state is forested. Many policy makers consider forests to be merely a land bank, to be developed as soon as possible.

This low perceived value clearly hinders forest conservation. As opportunities for development arise, clearing forest is seen as no great cost to count against benefits of the proposed development. The Director of Planning in Tonga once used a figure of about US\$1.50/ha for agroforest which stood in the way of a proposed airport runway expansion. When later questioned by Newell (pers. comm.), he said that "We Tongans value our land" and recognized that the agroforest produced many goods. Nevertheless, while engaged in economic analysis for the airport he had not credited the forest with its due worth. Even where the forest is not in danger of conversion, low perceived values hinder its good management. For example, if agroforestry is not appreciated or if small scale harvesting is overlooked, there will be no action to support and improve these sectors through extension programs or policy support.

Perceived values on the part of leaders or the general public can be addressed in three ways. One is environmental education to raise awareness of ecological, cultural, and even spiritual values of the forest. Such concerns are often lost on people or communities who are concentrating on income and profits, frequently the case where contact with Western society has raised expectations of a material standard of living beyond what the island can currently support. A second is to translate environmental values into dollars. As an example, the state forester of Hawaii frequently expresses the value of forest watersheds in terms of the cost of producing the same amount of water from

desalinization plants (Buck, pers. comm.). A third is to actually increase the economic value of forest by judicious use for timber or tourism. This should serve the cause of forest conservation if decisions to clear the forest for other development are forestalled and environmental impacts are minimized.

VALUATION OF FORESTS AND POLICY IN HAWAII

Taxation

The county of the Big Island of Hawaii provides an example of low valuation of forests leading to unfavorable policy, in this case, property taxes. Myles (1990) provides a full analysis of the problem; to simplify, the two major options for many landowners are land use as pasture (an agricultural classification assessed for tax purposes at \$6 to 208/acre) or as forest (unclassified and assessed at full market value, which could be up to \$10,000/acre and more on residential lots). In either case, annual taxes are 1 percent of assessed value. This tax structure was based on the implicit assumption that while land was valuable, forested lands were idle, and to leave lands in forest deprived Hawaii's economy of productive use of those lands. Assessment at full market value was therefore to discourage speculative land banking. The landowner's economic choice was conversion of forest land to pasture in many cases. The tax policy provided inadequate incentive to leave land forested for its environmental values, and no incentive to invest in forest management.

A Tree Farm Program was established under which landowners would have a management plan demonstrating economic value to forest land. IPIF arranged for a forest taxation specialist to analyze the costs of the policy and to recommend alternative tax structures providing incentives for forest conservation and management (Myles 1990). Awareness of the environmental values of forests rose, putting pressure on the County to remove the disincentive to forest conservation. An agricultural

subclassification for Tree Farms now exists with a more favorable tax rate.

The Tree Farm statute originally required that management plans include harvesting, to demonstrate economic value. Environmental concerns caused that provision to be deleted. Landowners then hesitated to plant and regenerate native forests, questioning whether they would later have a right to harvest the trees under evolving environmental regulations. Although land and timber are private property on fee-simple land, under the Endangered Species Act and Coastal Zone Management Program, native wildlife habitat and watershed values are protected and akin to public property. Therefore, Hawaii's private forests suffered under a twist on the "Tragedy of the Commons" phenomenon. Therefore, amid controversy, the Tree Farm law was amended to assert landowners' "right to harvest" trees which were planted or otherwise regenerated under approved management plans on certain laws.

Industry Analysis

Hawaii forest industry has decided that its interests will be better served in public policy if the economic value of the industry as a whole is better known to policy makers. Industry had previously had a low profile due to its small-scale diversified nature, and perhaps due to a desire to not attract environmental criticism. By 1991, policy makers and the public had become aware that forests have high environmental value, but they were often unaware of the economic importance of forest industry. They were also unaware that many lands would have more environmental values if managed for commercial forestry than if left unmanaged or unforested. An industry analysis (Governor's Agricultural Coordinating Committee 1991) showed that industry's three top priorities had become: (1) real property tax laws and progressive forest management; (2) economic and environmental values of Hawaii forests; and (3) public awareness and understanding of the issues facing Hawaii's forests.

Industry therefore willingly participated in a 1993 survey of hardwood crafts people and artists, major landowners, and construction contractors. Total revenues for Hawaii forest industry were estimated at US\$26 million, with 726 people employed (Halloran and Yanagida 1993). This places forest industry among the top sectors of Hawaii agriculture. The 1993 survey also identified areas in which government could assist industry: reforestation by the State; tree breeding; tax credits for reforestation; harvesting on State lands; and promulgation of sustainable management practices. Partially as a result of this survey, the Hawaii Department of Business and Economic Development is actively working with the Division of Forestry and Wildlife for the first time in years to examine possibilities for commercial reforestation (Buck, pers. comm.).

TIMBER CERTIFICATION

National and International

Timber certification is an economic tool to provide an incentive for "environmentally appropriate, socially beneficial, and economically viable management of forests" (Forest Stewardship Council 1994). It is based on a preference by the public to purchase wood from well-managed forests. Wood products from "certified" operations are labeled and ideally command a higher price from both wholesale buyers and the eventual consumer. Certification is based on compliance with management criteria developed locally or regionally. Certifying organizations in turn should be accredited, to ensure that certification criteria and monitoring adhere to uniformly high standards. The Forest Stewardship Council is in the final stages of becoming an international accreditation body.

Industry questions the costs and benefits of seeking certification. The costs and benefits of improving actual forest management are of course the essence of forestry. Certification, however, carries its own costs. There is concern that criterion development will follow

populist notions of what is believed to be good forest management, rather than being based on science and realities of economics, and thus compliance will be unnecessarily costly (World Forest Institute 1993). Evaluation, monitoring and product tracking for certification itself all carry costs, for example US\$30,000 for initial evaluation of one company by Scientific Certification Systems in California (Hammel 1993). However, simpler certification systems have lesser costs, and costs may be borne by wholesale purchasers or by non-profit certifiers. Finally, although intended to be voluntary, certification or labeling may become required by law in places, or may become practically required as the market demands it. The latter, of course, is the means by which certification is intended to effect good forest management, but costs should still be kept reasonable.

Projected benefits of certification rest on consumer demand, which is difficult to predict or quantify. Winterhalter and Cassens (1993) found that 68 percent of United States consumers would be willing to pay 1 to 20 percent more for certified products. Little or no premium is now likely from industrial buyers or on lumber, but high value-added items might command a higher price if certified. Currently, most producers and wholesalers will find their benefits in market positioning, market share, and the establishment of long-term business relationships based on a sustained, reliable supply (Mater 1993). In the long-term, if certification becomes widely demanded, the price differential will increase.

Hawaii Green Seal Program

In Hawaii, foresters are developing criteria for a certification program called "Green Seal" (Dalla Rosa 1994). Forest industry first championed the idea, believing that Hawaii forest management could be readily certified compared to tropical developing countries. Not coincidentally, some Hawaii environmental groups are calling for boycotts of tropical woods from Hawaii and elsewhere. The committee

working on certification criteria now includes industry, professional foresters, and environmental activists.

Hawaiian hardwoods are mostly used in high value-added products such as picture frames, crafts, and furniture. Much of the market is tourists and local people for whom the products have special meaning. A price premium may therefore be readily available. There is no plan yet for covering program costs but they must be kept low for small landowners.

Our biggest problem now is keeping the program feasible in light of environmental concerns. Hawaii's vulnerable environment, with many rare species, requires careful management. However, if too many costs and restraints are required for certification, the program will be moot because no one will enroll. We will then lose this tool to improve harvesting that is already taking place in native forest, and to influence and assist reforestation. One of the environmental activists on the committee asked, "Why do you foresters always get back to the topic of money?" She does not seem to realize that public funds will only go so far in protecting and restoring forests. To leverage private investment for additional protection, rotation, and reforestation, we need to encourage profit-making systems which add environmental value even if they are not perfect.

"Wokabaut" (Walk-about) Sawmills

The "Wokabaut Sawmill" system in Papua New Guinea (Senn et. al. 1993) is an example of forest management which has been certified as environmentally appropriate, socially beneficial, and economically viable, at least compared to the alternative. The project provides portable sawmills to local communities to enable them to harvest their forests rather than selling timber concessions to outside companies. The community only needs to harvest a relatively small area, because they receive almost all the income, as compared to allowing a company to harvest a large area, from which the community would receive a smaller fraction of the proceeds.

In fact one such project sold its wood as certified but relied upon the certifier for actual marketing under that label. The project found that a higher price could be realized by looking elsewhere for buyers, even though those buyers didn't happen to care about the certified label. In this case good forest management itself was more beneficial to the community than the certification label, but that is how it should be.

FOREST-BASED TOURISM

IPIF is beginning to focus on enhancing the value and perceived value of forests in tourism-based economies. Tourism in the less developed and smaller islands of Micronesia is based on diving. Palau and Chuuk (Truk) offer world-class dives, and the other islands which may be visited on island-hopper flights also offer diving and snorkeling. Guam and Saipan have opted for mass tourism including golf, and their apparent prosperity is looked to by some in the smaller islands as a model for further development. Golf courses and airports for mass tourism compete directly with forests for land. They also have major environmental impacts, especially on small islands with steep terrain and heavy rainfall.

Wylie (1994) reviewed tourism and forest tourism in Micronesia for IPIF. Present and potential forest-based tourism activities include mangrove boat tours and boardwalks; interpreted rainforest hikes; guided visits to archaeological sites, waterfalls, historic sites, and other special sites in the forest; agroforest/farm tour and fruit tasting; sales of handicrafts from forest fibers; bird-watching; bicycle and jeep "safaris"; and hotels in forest settings. Wylie's report analyzed Asian tourism markets and Micronesia's relative attraction and travel costs. He concluded that "although the forest resource base will rarely be the primary attraction, rainforests and mangroves have great potential to contribute to special interest tourism and to the 'critical mass' of visitor opportunities that attract and hold conventional tourists."

The potential direct economic contribution of forest-based tourism can be realized through (1) diversification of tourism programs to avoid over dependence on a single attraction or market segment, such as Japanese dive tourism; (2) providing activities for non-diving spouses and companions of divers; and (3) providing additional activities for divers. The latter two contributions are important for small islands with generally "little to do", resulting in short visitor stays. The idea of forest-based activities adding one visitor-day to each tourist's stay is a simple, obviously economically beneficial idea that can easily be conveyed to island politicians and business people, yet had never occurred to many of them before.

Wylie also found that the indirect contribution of forests to tourism "has greater economic value than is often realized by decision-makers... quantification is difficult, but some studies suggest significant dollar values." These values include scenic quality, wildlife viewing, and sense of place, as well as water quality and protection of the reef ecosystem through watershed protection. Valentine and Wylie (1993) presented some indicators of the economic value of forests to tourism economies. In Fiji, 83 percent of tourism operators and 90 percent of accommodations sector respondents identified environmental quality and natural beauty as having a direct impact on their businesses. About US\$76 million in direct and indirect economic benefits can be linked to tourists attracted by the "rainforest/wilderness jungle" in North Queensland. Wylie recommended that studies be conducted to quantitatively determine and publicize these values.

IPIF intends to apply ecotourism principles to its support of forest-based tourism. Briefly, ecotourism is designed to enable tourists to sustainably "experience the natural areas and culture of a region while... economically contributing to local communities" (Wylie 1994; emphasis mine). The Pacific's smaller and less developed islands have the option to base tourism development on ecotourism. Ecotourism's characteristically small scale may produce

greater local economic benefits than conventional tourism in the following ways: small, diverse programs are less vulnerable to market changes; low volume/high value (tourism) products may produce higher profit margins; the value of undeveloped areas will continue to grow in demand as they become more scarce; decentralization has the potential to bring economic benefits to rural areas and remote islands; imported labor may be avoided; and use of endemic resources may reduce leakage of profits for imported products and materials.

By comparison, an environmental assessment by Bell (1991) estimated land-use values for a proposed golf course and its alternatives in Kosrae. He found that the parcel would yield about US\$121/ha/year gross income under timber management; would add a net value of US\$461/ha/year to the Kosrae economy under traditional agroforestry; or would add the equivalent of US\$10,105/ha/year in jobs from a golf course developed under prevailing investment models. (Bell's analysis assumed that appropriate mitigations would take place to protect environmental values, and these figures do not include economic benefits accruing to foreign investors). However, analysis of to whom the jobs would accrue was very revealing. The Kosrae work force could fill half of the permanent jobs and very few of the construction jobs, so the project would require much imported labor. For Kosrae, with a population of only 7000 and a very conservative religious culture, this analysis was important; an influx of foreign workers was not desired.

In 1994, for Palau, Bell again projected the value of different land-use options, this time including a forest-based tourism option. The hypothetical golf course might gross US\$4.6 million/year, of which US\$350,000/year might accrue to Palauans after debt servicing, imports, etc. In a jungle cruise scenario, only US\$580,000 might be grossed, but US\$454,000 might accrue to Palauans.

IPIF hopes to help conserve Pacific forests by publicizing their indirect values to tourism and by developing their direct tourism values.

INCREASING PERCEIVED VALUES

As the above examples show, foresters' understanding and quantification of forest values has to be tied to communicating those values to the public and to policy makers. IPIF has found that an effective way to do this in Micronesia and American Samoa is to take community leaders to the Philippines to see islands which lack forests. In 1991 and 1992 (and soon in 1994) IPIF staff and island foresters escorted groups including traditional chiefs, pastors, mayors, influential farmers, and womens' group leaders.

On their home islands, people have taken their forests for granted. Forest and agroforest cover is still extensive and reefs are still healthy; the forest rebounds from small-scale clearing. People tend to discount warnings about environmental impacts, and are ready to trade island beauty (about which they are tired of hearing outsiders talk) for material progress.

In the Philippines, primary forest cover is nearly gone, mangroves are being cut rapidly, and the direct and indirect consequences are visually evident in eroding fields, unproductive grasslands, abandoned prawn and fishponds, etc. The Pacific delegation had never seen such muddy rivers before. They could also see poverty related to overpopulation and depletion of natural resources. Perhaps most important, they could see that many Filipinos now valued their forests enough to begin replanting mangroves, adopting agroforestry techniques, and protecting remaining forests.

The key to our project is to select trip participants who will return home and convey what they learned in the Philippines to their communities; hence our choice of those who influence personal values, especially traditional chiefs and pastors. The island of Pohnpei has built a successful series of village meetings and

negotiations of regulations upon Philippine trip participation, and other islands are following suit. A video documenting the trip has been a good asset.

At the conclusion of the 1992 trip we asked participants to list forest values, rank them, and if possible give dollar figures. The Samoan pastors identified over a dozen values and did not quantify them but focused in later sermons back home on the concept that these things were not owned by the present generation but held in stewardship for later generations (that responsibility having been given by God). The Chuukese and Pohnpeian delegations listed over two dozen values and attached dollar figures to both timber and non-timber values but hesitated at watershed protection and reef protection because of the very high value of these ecological functions (Friday 1992).

CONCLUSION

Understanding forest values is critical to government policies and private economic choices which help or hinder forest conservation. Even without economic data on all values, we can use economic concepts and tools to further forest conservation. With or without data, it is important to emphasize communicating with policy makers, opinion makers, and the public. That communication can be enhanced with personal experience such as field trips.

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MEETING OF NATIONAL COORDINATORS OF THE CARIBBEAN TECHNICAL COOPERATION NETWORK ON FORESTRY AND RELATED ENVIRONMENTAL MATTERS IN THE FRAMEWORK OF THE CARIBBEAN FORESTERS MEETING

Claus-Martin Ecklemann

NATURE OF THE NETWORK

The Caribbean Technical Cooperation Network on Forestry and Related Environmental Matters is a mechanism established by national institutions to exchange experiences and knowledge among member countries, basically making use of their own technical, human and financial resources. The Network promotes technical cooperation between the national forest administrations of the member countries.

Network Members

Member countries of the Network include the island states of Antigua and Barbuda, Barbados, Dominica, Grenada, Haiti, Jamaica, Montserrat, St. Lucia, St. Kitts and Nevis, St. Vincent and the Grenadines, and Trinidad and Tobago; as well as the three continental countries of Belize, Guyana and Suriname. The Network focuses on the English-speaking Caribbean but non English-speaking countries are also invited to participate although the working language is English.

Structure of the Network

Each member country of the Network is represented through its National Coordinator, which is the national forestry administration. The national forestry administration then nominates a person who serves as National Focal-point. The Regional Coordinator is elected from the National Coordinators. The Regional Coordinator, in consultation with the National Coordinators, defines the specific objectives of the Network at the regional level. The FAO Regional Office serves as Technical Secretariat to the Network, mainly by providing technical support for the design and programming of Network activities.

Activities of the Network

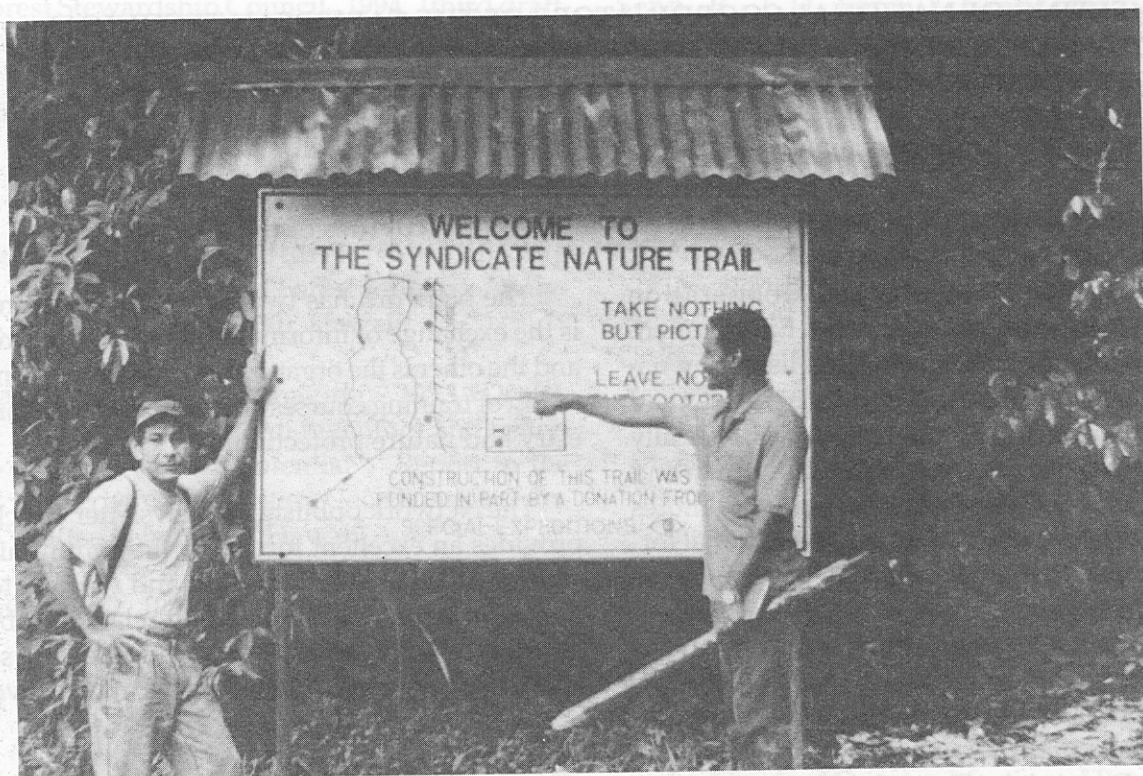
The Network has two main activities: one is the exchange of information via publications and the other is the organization and implementation of training courses and workshops in forestry and nature protection.

The Network publishes a Newsletter which provides an excellent forum for the communication of technical information and for debate on forestry and environmentally related problems in the Caribbean. Apart from the Newsletter, the following Network publications have been issued:

- "The Assessment of Forestry and Related Environmental Matters in the English-Speaking Caribbean" by N. Lackhan
- "The Report of the Round Table for the Establishment of the Caribbean Technical Cooperation Network on Forestry and Related Environmental Matters".

In addition, the Network has already implemented the following two training events:

- "Training Course on Forest Nurseries and Plantations Practices" which was held in Trinidad in June 1993; and
- "Workshop on Natural Forest Management" which took place in Dominica in October 1994.



The development of well-designed Nature Trails as an integral part of Natural Forest Management to attract ecotourism. Workshop on Natural Forest Management, October 1994.

Network Coordinators Meeting

In June 1994, a meeting of the National Network Coordinators was organized in the framework of the Caribbean Foresters Meeting. The National Coordinators were informed of the proposed agenda of the Network meeting by a circular letter prior to the meeting. In those cases where the National Coordinator was not in a position to attend the meeting, he was asked to brief the country representative and to discuss with him or her the agenda as well as the proposed Network activities for his country. The following topics were discussed at the Network Coordinators Meetings:

Medium-Term Programme

The Medium-Term Programme focuses on five areas:

- forestry;
- watershed management;

- national parks, wildlife, biodiversity, environment;
- social forestry;
- research.

Besides the established Medium-Term Programme which was agreed upon at the Round Table for the Establishment of the Network, a list of topics for training courses was added to the medium-term programme. Among these were a "Course on Silvicultural Management's of Dry Forests" and "Silvipastoral Management Systems for Dry Woodlands to Reduce the Negative Impact of Uncontrolled Grazing".

Funding for the Implementation of Programme Activities

It was recommended that the Network obtain additional funds to be able to execute more workshops and training courses. It was

also suggested that financial back-stopping be sought in order to have at least two to three events per year.

Functional Grouping within the Network

In order to be able to offer more specific training courses, it was also recommended that some kind of grouping be defined. For this purpose, three groups of member countries have been distinguished: (1) continental countries, (2) dry islands, and (3) humid islands.

These groupings do not necessarily remain the same for all training events. Themes which are of interest to all countries will be handled collectively, but other matters would involve only particular countries. For example, the

course on "Dry Forest Management" should cover member countries with dry forests which are an important factor in the national forestry.

Election of a New Regional Coordinator

Since the establishment of the Network in 1992, the Forestry Division of Trinidad and Tobago has acted as Regional Network Coordinator. The Regional Coordinator is nominated for a period of two years. In an election by secret ballot, held in June 1994, the Forestry Division of Trinidad and Tobago was re-elected as Regional Coordinator. The Forestry Division nominated Mr. Kenny Singh, Assistant Conservator of Forests, to serve as Regional Focal point.

WHAT EVERY FORESTER SHOULD KNOW ABOUT PRICES AND VALUES

Jan G. Laarman

INTRODUCTION

Pricing is central to forest policy and management. Many problems of distorted forest use and inadequate forest regeneration can be traced to discrepancies between social values and market prices. That market prices do not equate with social values is no reason to forget about pricing as a policy instrument. On the contrary, an economic approach holds vastly more potential for success than failed "command and control" methods (Panayotou 1993).

This paper has three objectives: (1) to outline the valuation framework for forest goods and services, (2) to examine pricing policy within that framework, and (3) to present practical steps for improved pricing.

VALUATION FRAMEWORK

Forests are important in several domains of human welfare (table 1). Many of these forest goods, services, and values lie well beyond the possibility of market pricing. Yet the conceptual framework to define the value of forest outputs is more comprehensive and functional than most foresters recognize. Following a structure still evolving in natural resources economics, total economic value is the sum of use and non-use values (Pearce 1993):

Total economic value = Use value + Non-use value;

Use value = Direct value + Indirect value + Option value.

Direct use value is for goods and services consumed in the form in which they are produced. Indirect use value refers mainly to ecological processes and environmental outputs. Option value is maintaining the opportunity to realize direct and indirect use values in the

future, even if future uses are presently unknown. Finally, non-use value is mainly existence value, or willingness to pay to protect forest resources even by persons who do not obtain use value from them.

Total economic costs in forestry programs and projects are financial expenditures (budget), foregone consumption (opportunity cost), and any negative external costs (externalities). Complete cost accounting makes a point of including opportunities foregone, as when the designation of a protected area results in decreased local extraction. Another type of cost is off-site sedimentation, wildlife damage to crops, and other negative externalities. Alternatively, opportunity costs and negative externalities can be treated as reductions in net benefits within the category of direct use values.

In light of the preceding overview, most forestry reports (e.g., annual statements of accomplishment) contain incomplete and misleading accounts of forest production. Pricing and valuation take on new significance when we study the wider picture of net economic contribution:

Quantifiable Costs	Amount
Budget	- \$BD
Opportunity costs	- \$OC
External costs	- \$EC
Quantifiable Benefits	
Forest products	
Market	+ \$MP
In-kind	+ \$IP
Tourism income	+ \$TI
Grazing	+ \$GR
Net Quantifiable Benefits	-/+ \$QB
Unquantifiable Costs and Benefits	[UCB]

Table 1. -The role of forests in five domains of human welfare.

Protective Services and Influences:

Climate regulation
Regulation of atmospheric composition
Stabilization of slopes, streambanks, water catchments, and sand dunes
Shelterbelts, soil moisture retention
Streamflow regulation, flood reduction
Land reclamation
Buffer against spread of pests and diseases
Nutrient storage, distribution, and cycling
Wildlife habitat
Conservation of biological diversity

Educational and Scientific Services:

Research on ecosystems and organisms
Zones to monitor ecological changes
Specimens for museums, zoos, botanical gardens
Wild stocks for foods, chemicals, biological control agents
Environmental education

Psychophysiological Influences:

Recreation, tourism, sports
Sense of stewardship, peace, harmony with nature
Inspiration for art, literature, music, myth, and philosophy
Historic sites and values

Consumption of Plants Animals and Derivatives:

Timber: logs, pulpwood, posts, poles
Fuelwood: firewood and charcoal
Food products: fish, game, fruits, nuts, berries, seeds, mushrooms, spices, eggs, larvae, honey, syrups, teas, other beverages
Herbs, flowers, medicinal plants, pharmaceuticals
Gums, resins, lacs, oils, tannin, waxes, distillates
Livestock fodder (grass, leaves)
Thatch, ropes and string, weaving materials, silk
Non-wood structural materials (e.g., bamboo, rattan)
Skins, feathers, teeth, bones, horns
House plants and pets

Source of Land and Living Space:

New lands for cropping and grazing Habitat of indigenous (aboriginal) peoples.

Source: Laarman and Sedjo (1992), p. 3.

Surrogate prices, shadow prices, and other approaches help place monetary value on in-kind production (i.e., not transacted in markets), external costs, and opportunity costs. Many if not most of these categories are quantifiable, but only through careful analytical work. The search for valuation approaches inevitably raises difficult questions which may not be answered satisfactorily, but which can stimulate useful dialogue in the forestry sector.

In addition to the quantification, narratives should describe in as much detail as possible the main unquantifiable categories of benefit: education and research; water flows; carbon storage; biodiversity, nutrient cycling, and other ecological processes; option values; and existence values. To the extent that any of these can be estimated and valued within acceptable bounds, they are relocated to quantifiable benefits.

PRICING POLICY

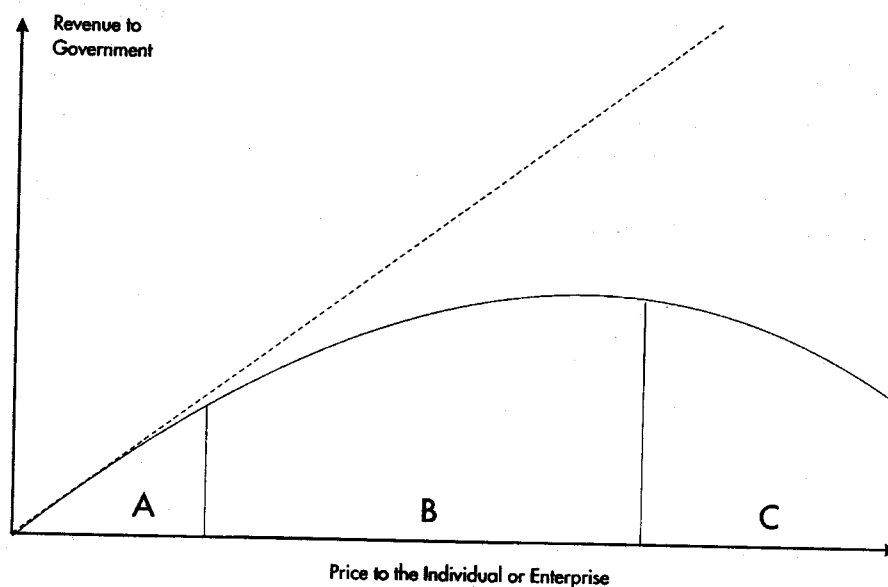
In the context of public policy, the social scarcity of a forest resource is the key to its pricing. As indicated by the preceding framework, only rarely is social scarcity reflected in market prices. Fuelwood extracted from sparsely vegetated areas can be costly in labor time and ecological cost, even if nominally "free." Most water from upland catchments is consumed by individuals downstream who do not pay for it directly. Similarly, many benefits of wildlife conservation are existence values of greatest importance to persons physically distant from the forest.

In this setting of highly incomplete markets, it is neither technically nor politically easy to implement resource pricing. Nevertheless, we should know what is to be achieved by pricing as a guide for thinking about how to correct deficiencies. Pricing strategies should be referenced to four criteria:

- **Efficiency.**—We want to use prices to signal production and consumption. If a forestry department increases (decreases) the price of a certain good it produces or

regulates, demand for it should fall (rise). At the same time, efficiency implies that prices should cover the social costs of production. Hence an environmental fee added to a timber royalty elevates operating costs to loggers and comprises payment for harvest damages (social costs). Imposition of the fee signals that the country desires to reduce the quantity of logging and increase net social returns from it.

- **Equity.**—Equity has two aspects. First, a fair price is proportional to benefits received. Second, price should be proportional to ability to pay. These considerations explain efforts to develop new markets (e.g., to capture existence values of persons living far from the forests), and to employ multi-tiered pricing (e.g., the design of entrance fees which differ for residents and non-residents).
- **Revenue.**—Pricing raises the revenue to pay for the goods and services provided by the public sector, even if forestry revenues flow to a general treasury. Normally, revenue rises and then falls as a price increases (fig. 1). The discussion of the revenue aspect is incomplete without reference to transactions costs, or expenditures for the information, coordination, and enforcement to implement the pricing system. The containment of transactions costs is particularly important under structural adjustment and other pressures to restrain government size.
- **Impacts on enterprises.**—Governments should set prices on what they sell with due consideration for achieving an appropriate mix of private and public activity. For example, the distribution of seedlings at low prices discourages private tree nurseries from establishing. Similarly, low prices for public timber are a disincentive for private landowners to invest in forestry. The "appropriateness" of enterprise mix is a social and political matter for each country to decide, but is affected by pricing policy in each of them.



Range A: Price is small and inconsequential for the individual or enterprise, and revenue rises almost proportionally with price.

Range B: The forest good/service becomes increasingly expensive to the individual or enterprise, and high-cost operations are not viable.

Range C: The price of the good/service is sufficiently high that individuals and enterprises risk illegal operation.

Figure 1. -The revenue curve in relation to the government's price for a forest good or service.

Both through sociocultural choices and for practical reasons, most forest goods and services have no market prices. This refers to climate effects, water production, and landscape beauty. Other examples are fuelwood, fish and game, and other extractive uses at indigenous and household levels. Sometimes these extraction rights are granted through traditional usufruct. In other instances, no market has developed because it is too expensive to exclude users. Thus it is difficult to sell water, amenities, and even fuelwood because of the very high transactions costs which are implied.

On the other hand, governments need to examine forestry pricing more systematically

than in the past. Sometimes the revenue consideration dominates to the neglect of efficiency, equity, and enterprise mix. In other cases government forestry officials set low prices to avoid uncomfortable disagreements with forest industries. Alternatively, forestry officials are offered personal incentives to set low prices.

The distortions caused by bad pricing have direct consequences for social justice and environmental management. Social reformers and environmentalists, often posing as philosophical enemies of the economist, make a big mistake to ignore the economist on matters of pricing.

The realities of pricing become truly complex when considering the many revenue instruments that can be selected. The instruments to price timber include area fees, volume-based charges, and value based charges at different stages from standing trees to manufactured products. Similarly, revenue from nature-based tourism can be generated through general entrance fees, user fees, concession fees, royalties, licenses, permits, taxes, and voluntary donations (Laarman and Gregersen 1994). The optimal mix of approaches is a large subject in itself, and is determined in relation to transactions costs and the four criteria cited previously.

A key question in pricing policy is when to provide forest goods and services at subsidized prices, i.e., at less than their social and environmental costs of production. A subsidy can be a legitimate policy tool to the extent that a country agrees on (1) the special benefits it offers, and (2) the persons who should pay it. The first aspect is often unspecified, and the second ignored.

Thus tree seedlings may generate social benefit and timber cutting may imply social cost, but the arguments in support of this need to be explicit and quantifiable (if possible). The direction of subsidy normally cannot be identified, but often represents income transfers from urban to rural (and foreign to national) locations. This may satisfy forestry authorities, but is it equally acceptable to city populations? Moreover, to what extent does a subsidy imply activity which cannot be sustainable except through continuing financial support from outside?

PRACTICAL STEPS FOR IMPROVED PRICING

Without question, pricing is a most difficult challenge for public forestry administrations. It is a challenge which should not be ignored or passed over. Instead, forestry authorities should view pricing as an important means to help meet sectoral objectives. Here we conclude with five steps to assist with pricing analysis:

- Review pricing history, current objectives, and pricing criteria.—We need to understand the history and reasons for past pricing decisions. Are historical circumstances still relevant today? How well or badly does current pricing policy meet tests of efficiency, equity, revenue generation, and enterprise impact? The search for answers to these questions typically generates additional issues for policy discussions.
- Estimate production and replacement costs by type of product or service (cost recovery).—For social efficiency, the price of a good or service must cover its production costs. A very helpful undertaking is to study nursery production, tree planting, timber sales, etc., in terms of direct (operating) and indirect (overhead) costs of their provision. These costs establish an initial reference for setting prices.
- Review transactions costs in relation to pricing instruments and sophistication.—Sometimes a pricing system requires more administrative cost than is warranted by the value of the resource. For example, we avoid collecting entrance fees to protected areas when the number of visitors is low. Implementation of stumpage sales (appraised value) for timber is socially justified only when administrative costs are less than total benefits (in revenue, equity, environmental impact, etc.). More generally, transactions costs require a careful review to ensure that a government does not spend \$100 in administration to capture \$10 in benefits.
- Adjust prices for non-market costs and benefits.—Prices can be adjusted from their financial (budget) costs of provision in relation to perceived environmental and social aspects. This is not an exercise in granting special favors. On the contrary, it should reflect intelligent analysis of the externalities, intangibles, and other “goods” and “bads” of a particular product or service. It also should reflect policy

on subsidies (for whom, at what cost, and why?). The pricing analysis requires careful reasoning and a public discussion to assess social agreement.

- Establish a strategy to monitor and evaluate pricing.—Prices may become outdated rapidly due to monetary inflation, new national policies, changing budgets, and other economic and political factors. Forestry authorities need periodic assessments so that pricing can be adapted to changing circumstances.

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SPATIAL REALMS OF VALUE AND IMPLICATIONS FOR MANAGEMENT

Robert Walker

INTRODUCTION

Tropical forest resources yield a wide variety of goods and services, exchanged in markets and given freely, both internationally and at local levels. The complexity of forest value, and the spatial scale over which its value is articulated, are sources of confusion and conflict regarding appropriate resource management. A tract of virgin rainforest may be valued simultaneously by indigenous peoples for the game it provides, by migrant settlers for fuelwood supplies, by loggers for its exploitable timber, and by tourists for associated recreational values. In addition, this same hypothetical tract forms part of the tropical forest biome, worldwide. As such, it is valued by those in the world community concerned about biodiversity and about climate change driven by greenhouse gas accumulations in the atmosphere¹.

As with temperate forest land, parcels of tropical forest yield values to a diversity of individuals, with different agendas and preferences, whose cooperation is limited due to transactions costs. The existence of competing uses based on alternative values has found expression in so called developing countries (DCs) in the concept of multiple use, which has become a guiding management principle in public forest lands (Gale 1985). Direct use competition in tropical forest areas is likely to be more intense than in temperate forests of today, given the agents involved, moreover, the stakes are

higher and the interested parties, more numerous and widely distributed. It should come as no surprise that outcomes of tropical forest management—or lack thereof—do not always satisfy all stake-holders².

This paper addresses the issue of tropical forest management, within a framework of value conflicts between dissimilar agents. The social and institutional context distinguishes the forest management problem in tropical areas from that of the temperate zone. This problem consists of organizing a vegetative cover with natural and regulated tree components that achieves Pareto optimality (Russell and Wilkinson 1979) among interested parties.

It is important to consider explicitly at this point the value concept used in the paper, since it forms the social basis for certain forest management phenomena I will attempt to explain. In particular, I refer to the indifference curve approach to value ventured by Hicks (1939), which places value in a realm of individually felt preferences. I give this approach to value a radical interpretation, which nevertheless is fully consistent with the Hicksian development. In particular, individual preferences are wide ranging, need not be limited to goods and services mediated by markets, which need not be in spatial proximity to the value holders. Moreover, these value holders, who together form value constituencies, need to represent the conventional agents of economic theory, namely producers and consumers engaged in market

¹ Tropical rainforest may contain between one half and two thirds of existing species, estimated at between 10 and 15 million in number. Tropical deforestation has resulted in carbon release to the atmosphere at least as great as that associated with fossil fuels (Williams 1989).

² Geography separates interested parties; individuals living in developed countries reside thousands of miles from individuals on the ground, exploiting forest products. Moreover, forming a coherent managerial voice from the world community of conservation-minded individuals would be highly problematic.

exchanges. A forest management bureaucracy, for example, may entertain value, and vigorously pursue its expression outside the market forum.

This value concept is at odds with substantialist approaches that attribute value to the accumulation of some measure, such as labor or energy (Odum 1973; Doherty, Scatena, and Odum 1994). Nevertheless, in the conclusion I will consider circumstances under which the substantialist and indifference curve approaches converge.

The paper is organized as follows. First, it presents a developmental account of forest management approaches in so-called developed countries (DCs) and less developed countries (LDCs). This section draws out implications for the current situation in LDCs, and also discusses fundamental distinctions between the cases. Then, it develops a game-theoretic context for addressing the problem of transboundary externalities in the absence of external political power.

In the discussion, I take resource management to be the regulation of resource use in a goal-oriented fashion. Thus, my definition is not restricted to actions taken by the state, or some state agency; private individuals manage the resources in their possession. Since much forest land is owned and managed by the state; however, especially in tropical countries, the discussion is often implicitly focused on public administration and management. The state is taken to be a formally defined entity both at national and local levels, this definition does not include informal, often tribal, arrangements engaged in the management of communal lands.

INSTITUTIONAL CONTEXT OF FOREST RESOURCE MANAGEMENT

Institutional change affecting forest and forest management relates largely to the institution of property, and the emergence of different property regimes. Boserup (1965) has

noted the misconception of many economists, that land beyond the extensive margin of agriculture—mainly forest—is empty, and therefore a domain of open access (Runge 1981). Anthropology and forest law recognize that indigenous peoples have long inhabited areas of old growth and primary forest (Balee 1989, Schmithusen 1986).

Be this as it may, political and military power in urban centers have historically prevailed over forest domains, and settlers have long treated forest territory as a free good to be appropriated and privatized. Many development programs promote such appropriation, or did so in the recent past, in order to integrate undeveloped forest areas into national economies and to release population pressures building up in primate cities (Hecht 1985, Ross 1984).

Increasing population density plays a role in the creation of institutions, particularly those, such as property, which regulate the use of scarce resources essential to economic well-being (Kelly 1988, Bates 1983, Boserup 1965). In DCs, forest presently exists under both private and state ownership, and the situation of open access is no longer of concern. In LDCs, both private and state forests are also found, although the component of privately held land is likely to be less, in relative terms, than that of DCs. Moreover, communal, ownership—or common property—may be recognized by the state (Schmithusen 1986).

Another distinction between the institutional settings in tropical and temperate countries, relating to forest and forest management, is enforcement of property rights and government regulations concerning forest conservation and protection on state lands. Both public and private forest lands can be invaded and cleared, given sufficient population pressure, when responsible parties are absent or lacking in enforcement resources (Beaumont and Walker, in press; Weaver 1983). Such a circumstance is reminiscent of open access given violation of composition and authority axioms key to resource conservation (Larson and Bromley 1991).

In sum, critical institutional contrasts in forest management between the tropical and temperate context are that: (1) communal properties are likely to be evident in the tropical case; (2) relatively more temperate forest land is under private ownership than public; and (3) property rights enforcement is attenuated in the tropical case, as compared to forest land in DCs. In setting out these distinctions, it is important to consider the developmental aspects involved.

The contrast in relative distribution between public and private lands reflects the continuing existence of frontiers in many tropical countries. States have often appropriated forest areas beyond frontier zones, prior to the arrival of settlers and the institution of private property. The long run extent of forest privatization in LDCs remains to be seen, although conversion rates to alternative agricultural uses is high.

The very extent of public forest lands, in and of itself, presents problems to resource managers in the public sector. In particular, human resources for management and enforcement are diluted simply by a size of area effect, which is partly responsible for administrative weaknesses in tropical forest management (Palin 1980, Repetto 1988, Tirole 1988, Brookfield and Byron 1990).

Forest resource degradation in tropical areas may in part be explained by reference to the institutional setting of the resource base. In this regard, we must consider both that occurring under private ownership, and forest degradation on public lands. Tropical deforestation by private owners is driven by profit maximization, which could involve sale of timber, land clearance in the interest of agricultural use, or some combination³. Evidently, agricultural development is a primary factor in conversions of forest to cleared land. As has been noted, conversions of forest land may be planned by

governments for this purpose (Walker and Smith 1993).

A distinguishing characteristic between tropical and temperate settings with respect to deforestation under private land management is the existence of world markets for the produce of the land, whether it be wood related or a cash crop. It has been argued that, given the global nature of economic relations, the demand for land-based commodities exerted on some arbitrary parcel of tropical forest is greater today than what was experienced historically by developed countries. An implication is that the pace of deforestation under the institution of private property is probably greater in LDCs than what was experienced in the temperate world during comparable stages of development (Walker 1994).

Forest degradation on public lands in tropical countries represents failure in fulfilling the social objectives of forest conservation. While aspects of such failures have been explained in terms of contractual relations between host governments and loggers (Walker 1987, Walker and Smith 1993), other explanations may be provided possibly more relevant to the New World tropics.

A GAME THEORETIC APPROACH

Forest management on public lands, in which various agents attempt to use the same resource, can be addressed by game theory. Moreover, the decisive management contrasts between tropical and temperate countries, to be explicated in the game-theoretic format, are driven by the variations in value between these two settings. In particular, with economic development comes metamorphosis of the interested parties, or agents, whose values in turn are in states of change.

³ One process observed in Brazil, for example, in land occupation is the sale of timber in early years, followed by agricultural development of properties financed by the timber sale (Walker 1994).

Consider the prisoners dilemma⁴ in table 1, showing a production relationship between subsistence farmers and loggers on a public land, such as a national forest. The relationship involves negative externalities. Presumably, the lax use of fire by the farmers, combined with invasive forest mobility due to soil degradation, will reduce profits of loggers in the area. Similarly, careless logging practices leading to hydrologic impacts, for example, will reduce the profitability of farming. I simplify the discussion by assuming that subsistence farmers are engaged in market production.

Intrinsic to the prisoners dilemma is the dominance of individual strategies, which leads to the outcome of greatest environmental cost, represented in the table by unmanaged harvests

and farming practices. In the absence of external power regulating the farmers and loggers, it is in the self-interest of the two agents to abandon management practices, despite the fact that both would improve their lots by appropriate management.

When administrative powers are weak, and the prospects for enforcement, limited, the actual resource management circumstance on public lands reverts to the open access case, when production relations are as given by the prisoners dilemma (Runge 1981). The equilibrium outcome is one in which resource degradation occurs, despite the fact that a Pareto optimum exists with enhanced environmental quality. Thus, the Pareto optimum is only achieved in this case through intervention by the appropriate authorities, presumably a forest service or administration.

⁴ The prisoners dilemma is a two-person "game" (von Neumann and Morgenstern 1944) in which two individuals would be best off cooperating, but face incentive structures which encourage them not to cooperate and seek their own personal gain. Since they both act selfishly, they end up worse off than the untenable state of cooperation.

Table 1. *-Tropical forest setting¹. Profits for farmers and loggers.*

Subsistence farmer	Logger	
	Managed harvest ²	Unmanaged harvest
Managed practices ³ (soil/fire)	(10, 10)	(1, 15)
Unmanaged practices	(15, 1)	(5, 5)

¹ This payoff table neglects collusive arrangements between farmers and loggers for forest exploitation.

² Managed harvesting increases farming profits through watershed protection and other positive externalities.

³ Managed farming reduces wildfire escape and mitigates invasive forest mobility, both of which reduce logging profits.

The tropical circumstance stands in contrast to an illustrative game for the temperate setting, given in table 2. Here, I substitute a recreationist for the subsistence farmer; this recreationist could be a passive recreationist who derives use value through forest existence or options to visit, and does not, in fact, regularly engage in typical recreational activities which are taken to be non-exploitive, so the degradation outcome occurs when loggers fail to engage in prescribed logging behaviors.

This problem shows the dominance of individual strategies, which is consistent with a prisoners dilemma. The equilibrium outcome is one with environmental impact, in the absence of enforcement of logging regulations by some external power (e.g. Forest Service). The equilibrium, however, is Pareto optimal in that there exists no other combination of behaviors leading to simultaneous improvements for both agents.

Be this as it may, the forest administration itself may entertain preferences for environmental quality, reflecting values of the resident citizenry. A non-coercive approach to altering the outcome is subsidization of forest management, which lowers costs of managed harvest to the loggers involved. Such an approach has an

effect, as illustrated in table 2, of switching the Pareto optimal to the managed harvest outcome, in which case the recreationist experiences increased utility, without impact on the logger who remains indifferent between managed and unmanaged logging.

CONCLUDING REMARKS AND SUBSTANTIAL VALUE

Economic development affects institutions responsible for forest resource management, and the preferences of the forest users themselves. Resulting social change tends to provide conditions that solve certain forest management problems by making them go away. The shifting cultivator and the predatory logger leave the scene, to be replaced by recreationists and logging companies subject to public scrutiny. The increasing population densities that follow passage of the agricultural frontier through primary and old-growth forest zones provides the social infrastructure necessary to enforcement, providing that non-agricultural economic opportunity follows in its wake. The importance of the forest administration sector must not be understated, however. Resource bureaucracies are empowered by economic development, and become instrumental to maximizing Pareto optimality, as explicated in the game theory arguments.

Table 2. -*Temperate forest setting. Utility and profits.*

Recreationist	Logger	
	Managed harvest ¹	Unmanaged harvest
Use ²	(U, 5 [10]2)	(U, 10)
Do not use	(0, 5 [10])	(0, 10)

¹ Use refers to non-extractive use; thus, this category covers passive "users" including use for existence and option value.

² The bracketed number indicates profit levels with subsidization.

Despite advances in forest management in many temperate countries, a key problem remains in that tropical forests with global values are frequently administered by forest agencies with few resources, confronting individuals with subsistence-oriented preferences. Much of the value constituency in this regard resides beyond national boundaries, which often forms an effective institutional barrier to value expression.

The substantialist value argument is useful in this regard, in that it implicitly recognizes the importance of ecological function, which it advances as a form of meta-value. On the other hand, the neo-classical approach to value does not, in its indifference curve manifestation, recognize or rank the role of goods and services in the provision of life support to the global community. This possible failing is exacerbated in the case of public goods, when price mechanisms are not available to ration scarce supplies, and when valuations on the part of consumers are fixed.

As I have argued, through, the preferences of individuals do change with economic development, and therefore are not fixed. Moreover, the appearance of new information changes individuals' preference orderings about the goods and services they consume. The attribution of an intrinsic value to some ecological function can ultimately find expression in such preferences, provided the appropriate information is distributed and found credible. This is to say, the neo-classical value may correspond, under certain conditions, to the ecological attribution. In DCs, the provision of such ecological information has been instrumental in environmental conservation and maintenance.

The tropical forest problem, however, is that the forest-conserving preferences in the world today are not strongly felt by tropical resource users and do not, therefore, greatly influence their economic decisions. A spatial dissonance exists between the resource holder and the resource value; national sovereignty greatly impedes value expression in this regard,

particularly since the particular values in question are not marketed (Walker 1994). Such a circumstance creates global risk, and invites discussion on the role, or value, of the tropical forest biome in maintenance of biodiversity and the carbon cycle. This discussion must transcend concerns about appropriate use of terminology.

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6TH CARIBBEAN FORESTERS MEETING

The 6th Caribbean Foresters Meeting took place in Martinique in July 1992. Several of the manuscripts generated from that meeting arrived after the publishing date of the proceedings. Therefore, we have included those papers in this current publication. The theme of the 6th Caribbean Foresters meeting was "Towards Sustainable Forest Resource Management in the Caribbean."

INTEGRAL DEVELOPMENT AND IMPROVEMENT OF SEMIARID ZONES

Aguedo Morales

The Project envelopes the south-southeast region of the Guantánamo province, a narrow and long strip of land with about 51.6 thousand ha. Lands are used for extensive pasturing of cattle and sheep. The more fertile flat areas, are cultivated with tubers and roots, and vegetables, utilizing artificial irrigation.

The Project area encloses a lot of flora and fauna values, characterized by a high endemic worth that makes it one of the more important regions in the country from the point of view of biodiversity conservation. Vegetation includes about one thousand species, of which 150 are endemic. Fauna is represented by 876 species, 271 vertebrates, with 10 percent local endemics and 34 percent national endemics, and 605 invertebrates, with 10 percent local endemics and 28 percent national endemics. In addition, the best Cuban marine terraces system is located within the Project area.

Extreme ecological conditions characterize the area; little precipitation (600 to 800 mm/year), a mean annual temperature of 29.5° C, poor hydrography and degraded soils with low fertility. This situation has conditioned the existence of different ecological systems groups with high fragility and reduced natural productive possibilities.

On the other hand, deforestation, over pasturing and agricultural practices applied without environment conservative rules have produced an evident deterioration; decreasing productivity in agricultural and forestal productions, causing local and neighboring inhabitants with incomes below the national average to emigrate to avoid rough climatic conditions and difficulties in obtaining food and employment.

The Project will try to stop and revert the deterioration process of the ecological systems

located in the semiarid coastal strip Maisi-Guantánamo. It hopes to see environmental improvement, and productive and profitable agricultural and forestal productions, which will raise population and feeding levels substantially, and make feasible firewood obtainment through rational forest management design.

Land use will be reorganized according to the natural conditions, fertility and limiting effects. The principal task will be to rescue arid areas through afforestation, following with conservation and improvement of soils management, and also to establish sample plots where silvopastoral practices can be applied. These activities will foster a rational use of water, soils and forest resources. In order to make this possible, a study will be conducted on the functioning of regional ecosystems as a way to develop a sustainable and rational use of resources, leading to their rehabilitation and restoration.

On the other hand, the studies will focus on the forests important role as a environmental protector and to value its potential for production of medicinal food, honey, and industrial products. The general objective is to elevate local population income and living facilities through the application of a management working plan in order to use rationally the ecological systems located within the Guantánamo-Maisi semiarid strip.

The specific objectives are to:

- establish the regulations on land use in the area, using existing studies;
- execute reforestation in areas damaged by erosion and forest degradation, priority use of native species;

- apply agrosilvopastoral practices to improve productivity and yields of food productions linked with restoration and conservation of ecological systems;
- improve life conditions and employment possibilities for local communities;
- capacitate local workers in techniques and methods for semiarid soil management;
- establish an experimental working plan, introducing fast growing species of commercial value and that are environmentally suitable;
- actualize a protected areas system in order to make a corresponding management working plan;
- determine native flora and phytogenic resources potentialities with the objective of developing non wood productions and increase local population incomes and life standards; and
- organize consumers' goods and souvenirs productions which have a high demand.

The Project will have five years duration in the primary phase, it will be increased subsequently until it obtains a sustainable and balanced management plan in the incidence area.

A reforestation and soil conservation program will cover 2.3 thousand ha in the first phase. A protection and management working plan for 27.4 thousand ha of xerophytic forest, coastal thicket, shrub and mangrove forest will include the establishment of demonstrative areas with agrosilvopastoral practices and ten small factories put into effect to produce consumer goods and souvenirs. At the same time, a research working plan will be developed to improve the current afforestation methods, silvopastoral practices, selection and introduction of promising species from the economic and ecological points of view. The Project will supply about 1000 new jobs (30 percent for women); 500 local farmers, engineers, technicians and administrative staff will be trained on semiarid soil management, administration and conservation of natural resources. It will have an important impact for local economy, particularly on agriculture and cattle productions, improving the living standard of the communities included in the Project area. Subsequent phases will seek to extend the benefits to the southeast strip of the eastern provinces. Primary steps have been taken. The reforestation and rehabilitation of degraded forest areas are in progress, increasing at the same time protection rules for highly esteemed and threatened ecological systems.

FORESTRY AND SUSTAINABLE DEVELOPMENT

Adolphus Christian

INTRODUCTION

During the past few decades the concept of forestry has been rapidly expanding to convey much more than the mere physical aspects of trees and wildlife. It has already been accepted, and the forest is a nation's third greatest resource, only being superseded by its people and the land. Forestry is especially unique in that it is outstandingly powerful in both its tangible and intangible benefits.

THE CONCEPT OF FORESTRY

Man has been able to enjoy the forests in a great number of ways - some direct and simple and others indirect and complex. The importance of the forests for lumber production cannot be over-rated, nor can the generation of funds and employment resulting from that activity be adequately expressed. The knowledge of the many ways in which large sums of money can be derived from trading in wildlife, or dwellers of the forests, is both astounding and appalling. The forests supply food and medicine, while also providing watersheds and protection for water catchments. They are noted for their roles in the carbon cycle, the reduction of noise, the provision of sanctuaries for studies and knowledge, for hiking, for recreation and for peace of mind. The forests also provide tremendous protection for the soil to the extent of rehabilitating terrain and infertile lands, converting them once more to fertile and productive areas.

The Acceptance Of Forestry By The Nation As A Resource

It was once felt that forestry was mainly concerned with protection and law enforcement. And for that reason, foresters and conservationists were erroneously looked upon suspiciously as troublesome and queer

policemen or guardians of the environment. Now, it is very rare to listen to a news cast locally or worldwide without hearing some mention made of some aspect of the environment. Suddenly the world and its top politicians, non-environmental scientists, top businessmen, religious instructors and the general populace are all very much concerned about the deterioration of the environment, especially in regards to the rapid disappearance of the tropical rain forests. The depletion of the ozone layer has certainly caused a stir among complacent, selfish money seekers.

Sustainable Development

Closer home in the Eastern Caribbean Region, it had been long ago realized that the islands, especially the lesser antillean states, had not been blessed with valuable minerals such as gold, silver, diamonds, etc. History tells us that these islands had to depend on their soil for profit. That is, agriculture had to be the income earner, otherwise the economic situation would have been quite bleak. But it now appears that in the wake of much intense competition from other more equipped and competent agriculturally oriented nations on the open European markets for example, these islands now have to search elsewhere within themselves for economic support. Thus, it was no big surprise when the Dominican cabinet Minister for Tourism, Charles Maynard, proposed to the other sister islands that they all put their heads together and sell to the world their islands with their individual aspects as a joint package of tourist attractions. This move, which has direct and indirect associations and roots with forestry, could only have been calculated to defray the inevitable economic plunge that the traditional agricultural economy based islands must be subjected to in the near future. This event has now set the scene for looking at forestry associated sustainable projects or

developments within each individual island. It is intended therefore that this paper deals specifically with the Island of Dominica.

DIRECT TANGIBLE PROJECTS

Lumber

Dominica has seen the birth and death of some three or more major lumber production concerns. These were D.O.M.C.A.N., the smaller concern of the F.I.D.C. and the more recent defunct Dominica Timbers Limited. The North Eastern Timbers Ltd. is now experiencing its seemingly final stages of death. The question is, will it be allowed to die? The point here however is this, each of these lumber concerns had generated a fair amount of employment and large sums of funds. They had all in time succumbed to the island's wild and rough terrain and to its inaccessible treasures of lumber. A fair amount of bad planning as far as the forest management aspect was concerned also characterized their failure. Nevertheless, there is a consistent network of small lumber producers throughout the island, who continue to produce lumber for local consumption. Some of these producers work full time in that field, while others work part-time. However, for both categories, the forest provides an income for their livelihood.

Wildlife

In the Eastern Caribbean, Dominica probably contains the greatest number of hunters. There are basically three types of hunters. There is the hunter whose main income comes from hunting and from in-land fishing. There is the other hunter whose main income is augmented by the income derived from hunting/and or in-land fishing. And there is the third type of hunter who merely hunts for the enjoyment of the rare meat of the agouti (*Dasyprocta antillensis*), or manicou or opossum (*Didelphys marsupialis insularis*), or for the taste of the delicacy of the crab backs or the crappaud or mountain chicken as it is commonly colloquially called. The third, and less serious type income

wise, usually enjoys himself very much while hunting. In all three cases there is a certain degree of dependency upon the forest.

Secondary Forest Produce Projects

In Dominica there are a great variety of secondary forest products on which many people depend full time and part time for employment and income.

Larouma - Ischnosiphon arouma

This mini-bamboo like plant is used to make a wide range of utilitarian handicrafts. Items such as baskets, table mats and hats are all made from the larouma. The raw material which occurs naturally in the rain forests, is harvested by the Dominican carib men (i.e. the indigenous people of Dominica) and skillfully weaved by the women and children. The finished product is exported to the regional tourist oriented islands such as St. Thomas and Antigua for example, while some are marketed locally both to the natives and to the tourists through the local tourist industry.

Vertivert - Chrysopogon ziganioioes

Vertivert or cushcush as it is called in Barbados is widely grown in Dominica. Besides being effective in the use of soil conservation, it is also a raw material for handicraft items such as rugs. These rugs are made in 5 to 45 sq. ft. sizes. 90% of the rugs made in Dominica, are exported throughout the world. Such places as the U.S.A., Canada and the Caribbean tourist oriented islands provide lucrative markets for the product. Regular and full time employment is provided by this sub-industry.

Screw Pine

Such handicraft items as table mats, baskets, hats, table trays, belts and hand bags are made from the raw materials provided by the screw pine plant. Some of the products are exported, while some are sold locally.

Latanier - Cochthrinax martinicensis

Sections of this palm are used for making hats and base brooms.

Bamboo

In Dominica the bamboo plant is used to make a variety of handicraft items. The smaller and younger bamboos for example, are used to build small souvenir boats, jewelry, curtains, lamp shades and many other beautiful ornaments.

*Cocoye Liana Mibi - Stigmatophyllum puberum,
Balisier, Roseau - Gynerium naccharoides, Calabash
- Crescentio cuzete*

All these items of secondary forest produce provide raw materials for a thriving handicraft industry. It is quite clear therefore, that Dominica's handicraft industry directly depends totally on the forest and forestry policy and activity.

Future Developments

At present, the possibility of embarking upon a wooden toy production project is seriously being considered.

Intangible Developments

Education

Dominica has been sighted as one of the most aggressive nations where environmental awareness has been concerned. The years of 1989 and 1990 have been designated as "Years of Environment and Shelter" by the Government of Dominica. The Forestry Division of Dominica had received this information with much jubilation and took the opportunity to press forward with their educational programmes and their sensitizing efforts directed at the Dominican public on environmental matters. While the Director of Forestry and Wildlife, Felix Gregoire sat at the head of the

Years of Environment and Shelter (Y.E.S.) core committee, senior officers of this staff sat on key sub-committees of the Y.E.S. organization, thereby ensuring that the icing was placed on the cake.

The Y.E.S. effort was a tremendous success, thanks to the Government and people of the country. A great deal was learned and much more is yet to be derived from this effort. For the Forestry Division, the responsibility of educating the populace is a continuous one, but much encouragement has been received since the Division's early days of being a lonely voice crying in the wilderness.

Entertainment and Recreation

Annual forestry exhibitions have always provided much entertainment and education to the visiting public. The wildlife section never ceases to attract visitors. The forest is being increasingly visited by the visitors to the island as well as by the Dominicans themselves as they become more and more sensitized to the island's assets and blessings once believed to be gifts and curses from the devil himself.

Protection

Dominica's very natural geographical rugged and wild features demand that much care and attention be taken with its land and soil. Therefore, both the design and by choice, Dominica's forest play a tremendous part in conserving the soil and preventing massive erosion, landslides and loss of lives.

Indirect Developments

Hydro-Electric Power and Water Supply

According to the National Parks Act. No. 16 of 1975, Sections 14 (i, ii, & iii) provisions had been made for the continuation of tapping the water resource within the parks as well as for any eventual expansion in that line. While according to Section 15 (i, ii, & iii) of the same

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Act, provisions had also been made for the tapping of the water resource within the park for the expansion of hydro-electric power.

At present both the local electrical and water companies are enjoying the benefits of those sections of legislation. For example, the local electricity company, DOMLEC has just successfully implemented a 60 plus million dollar hydro expansion project with the Dominica National Parks. It is believed that had it not been for that project which allowed for the switch from the more expensive diesel to water, the people of Dominica would have been paying higher electrical consumer bills since 1990. The project which was conducted in phases, commenced in mid-1981 up to 1990. Another interesting feature of that company is the fact that it also depends on the forests for providing the thousand plus poles (pine and walaba) every 10 to 20 year period. The local water and sewerage company, DOWASCO, by virtue of the nature of its business also depends largely on the forests and forestry activities for maintaining its water catchments, etc. Both

hydro-electricity and water are most essential to a nation's development. Their importance simply cannot be over expressed.

Tourism

In Dominica, the tourist industry is rapidly providing formidable support for the disintegrating banana industry. In that, the tourist industry is providing a great variety of employment to Dominicans who otherwise would have been hard put to find suitable employment. Witness our taxi drivers, tour guides, vendors, and handicraft industry to name a few. And the linkage between forestry and sustainable employment here is the fact that Dominica has no beautiful white sandy beaches to offer to its tourists, rather Dominica attracts the lush, green, rich tropical rain forest loving types of tourists. All these Dominican based sustainable developments mentioned here, though within varying degrees, owe their success to the forests and forestry activities. They cannot by themselves, and without the support of forestry, exist.

GUADELOUPE'S CONTRIBUTION TO THE SIXTH CARIBBEAN FORESTERS WORKSHOP

Patrick Labre

Since 1980, the National Institute for Agronomic Research (Institut National de la Recherche Agronomique, INRA) and the French National Forest Office (Office National des Forêts, ONF) formed a partnership in order to study natural regeneration in the dense rain forest of Guadeloupe. The goal of this study is to design silvicultural practices, based on the natural regeneration of certain forest areas, the richest in native valuable species. These species were classified according to two criteria: abundance in the stand and wood quality. The most frequent species are: *Dacryodes excelsa*, *Amanoa caribaea*, *Richeria grandis*, *Byrsonima laevigata*, *Phoebe elongata*, and *Simaruba amara* (fig. 1).

To carry through this study successfully, we have organized an experimentation process with various thinning intensities on a twelve year period. This schematic was based on the idea that some species are adapted to shade and others to light. However, data on the number of seedlings showed that successful regeneration was generally obtained with an extensively opened vegetal cover. Some observations were made regarding the following species; the fact that *Amanoa caribaea* is not present on a plot prevents any seedling to settle (no scattering) (fig. 2). The abundance of *Dacryodes* adults harms its own seedlings (fig. 3). Among the most valuable species, *Richeria grandis* took particularly advantage of the clearings (fig. 4).

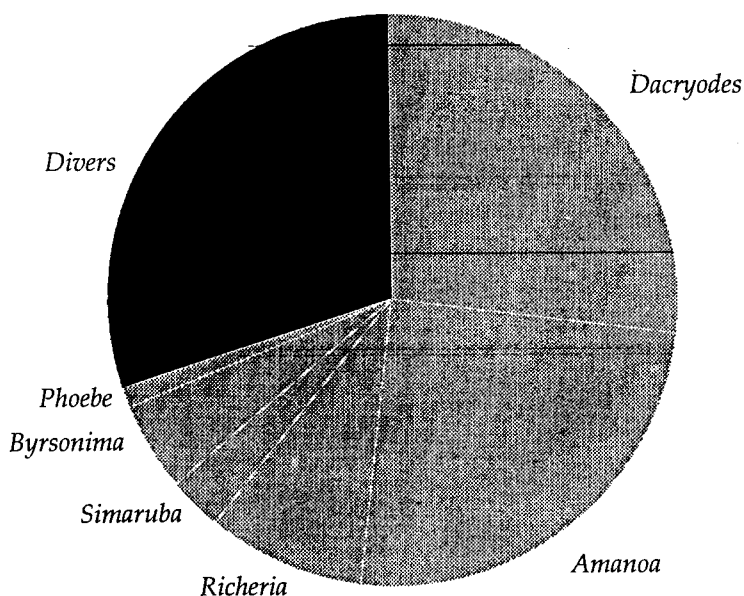


Figure 1. -Basal area distribution.

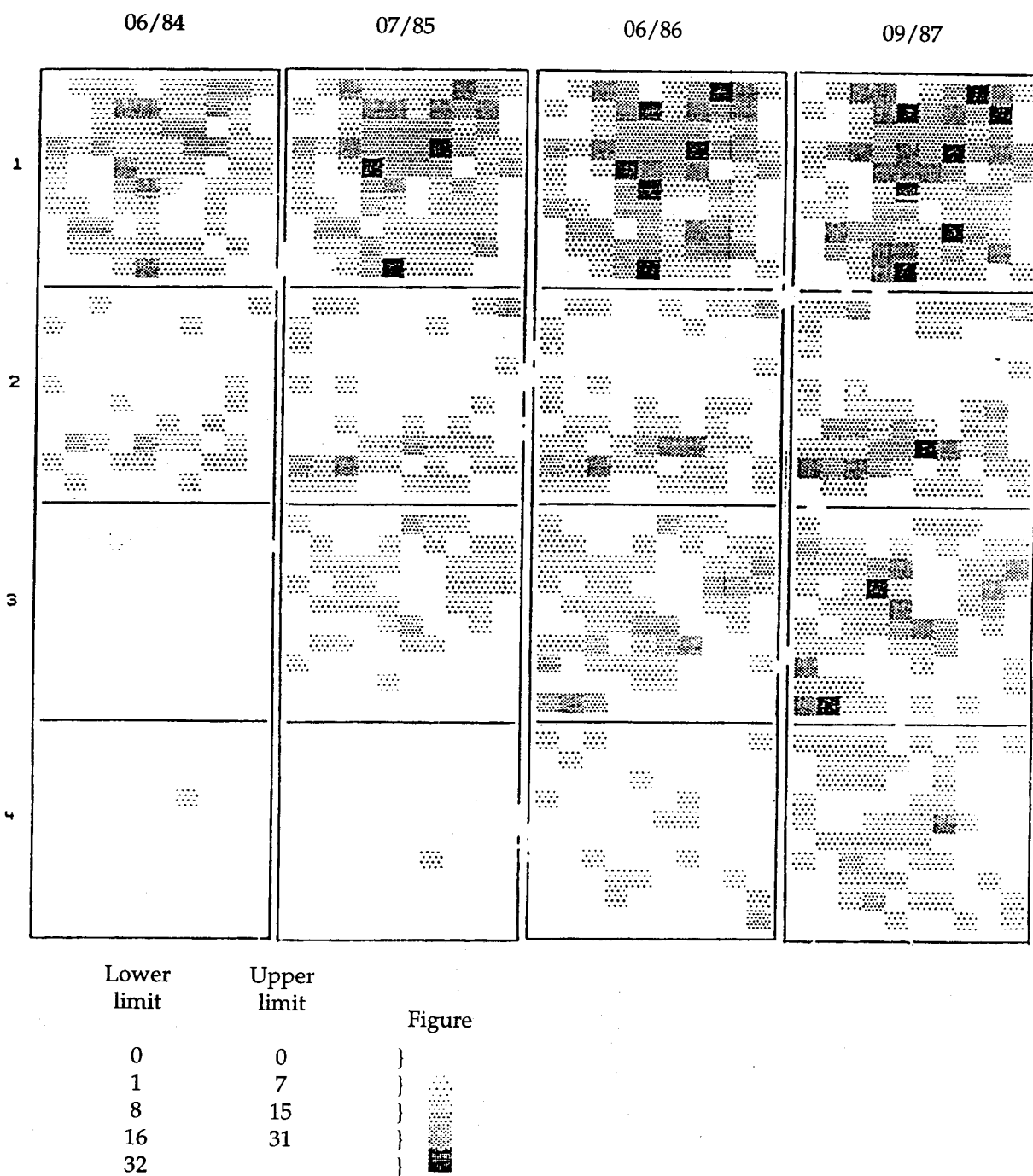


Figure 2. -Seedlings of *Amanoa* (>1 m tall).

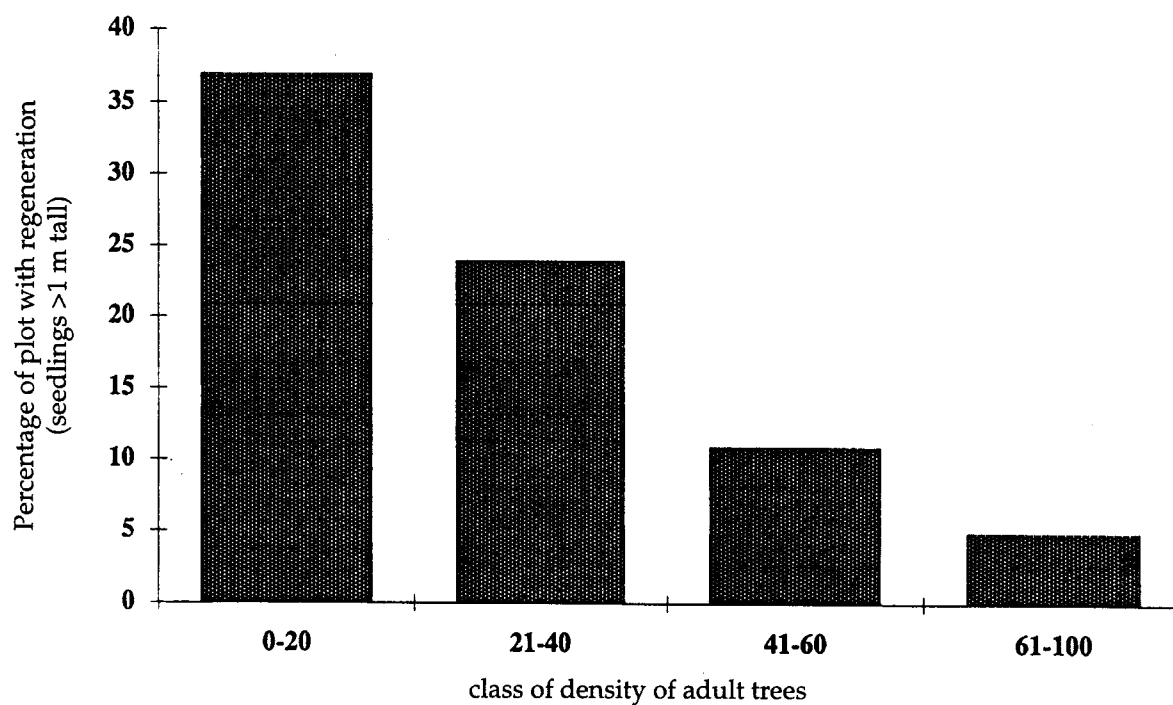


Figure 3. -Relation between seedlings and frequency of adults. Example of *Dacryodes*.

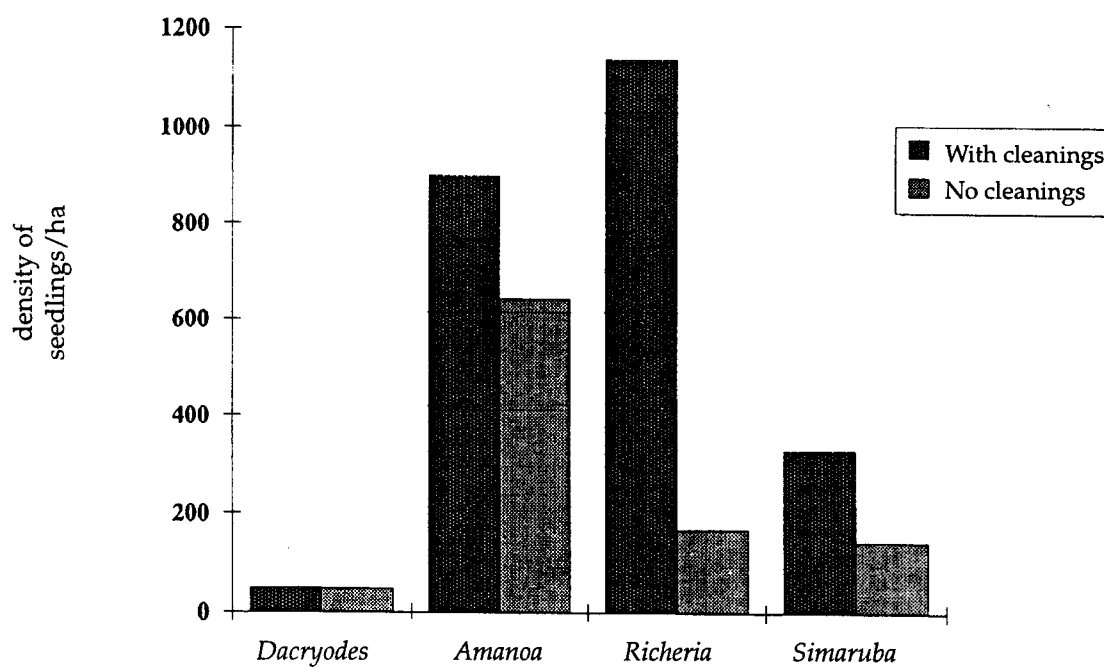


Figure 4. -Importance of cleanings on some regenerations.

The study involved as well the growth of adult trees, and the effects of thinnings on their growth. When there are no thinnings, the average growth is 0.4 centimeters in diameter per year. It can be multiplied by two (especially for *Richeria* and *Amanoa*) in the plots with intensive thinnings. *Simaruba* suffers from repeated thinnings, because it doesn't tolerate sudden light exposure.

Finally, while studying the reaction of our plots after Hurricane Hugo in 1989 (fig. 5), we were able to link this study with the general evolution of Caribbean rain forest. In this forest, the most common species are often the most wind firm (Fig. 6). The regeneration following such a phenomenon certainly explains the importance of certain species, for which the forster can plan a sustainable silviculture with few risks.

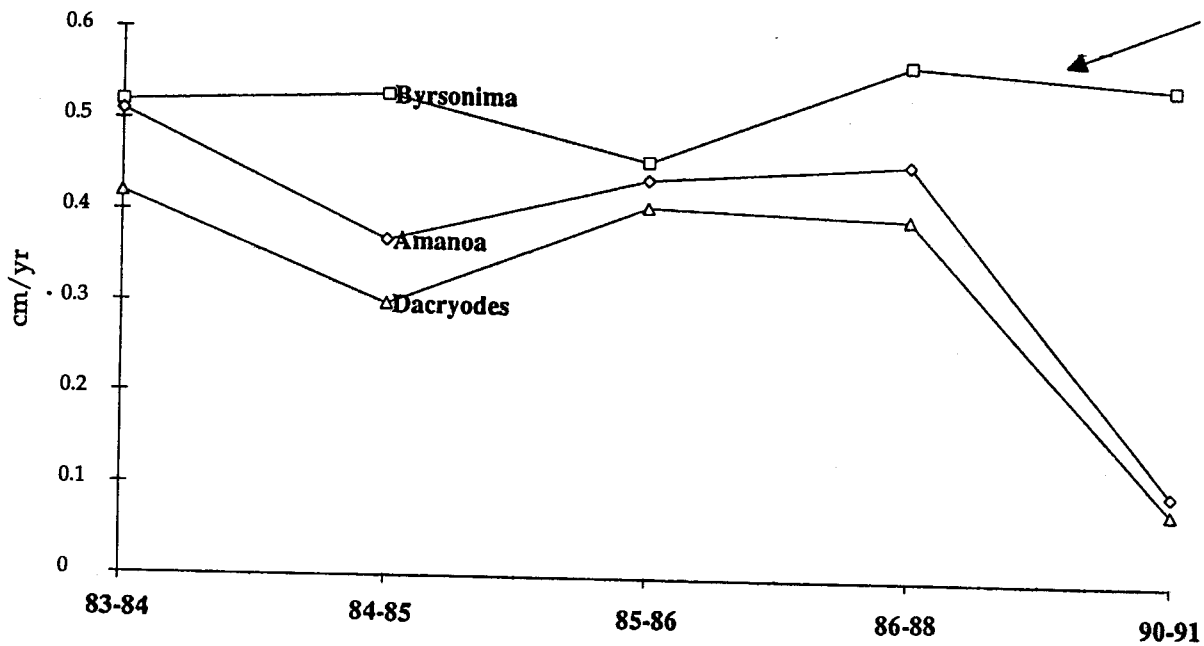


Figure 5. -Growth of some species before and after hurricane (in cm/year at dbh)

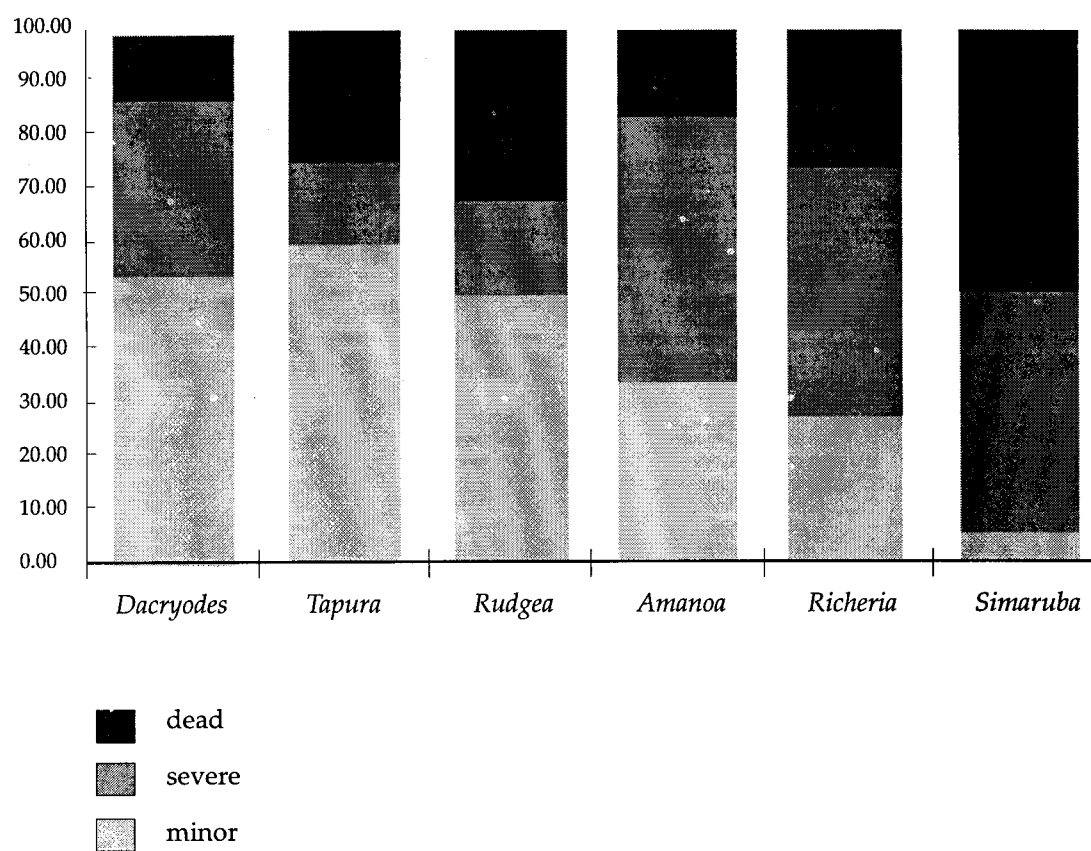


Figure 6. -Distribution of the main species by class of damage.

DEVELOPMENT PLANS OF DISTRICT AND STATE FOREST IN GUADELOUPE

Yannick Perrin

The District and State Forest of Guadeloupe has an area of 28,000 ha, and three main forest types can be found: semi-humid forest (mesophile), rain forest (hygrophile), and mountain dwarf forest and savannah.

PREVIOUS DEVELOPMENT PLAN

Mahogany was introduced after the second World War because of its well known qualities, and, following its success in Martinique, plantations started.

About 3700 ha were planted up to 1979, when the previous management plan was designed. According to the knowledge at this time and the main goals, the forest was divided into 4 blocks:

- Absolute protection block: 15,000 ha, mainly at high elevation. No work was authorized, except for public education and admission.
- Mahogany plantation block: 8000 ha of natural forest to be transformed, mainly in semi-humid areas. 1500 ha were to be planted in the following 10 years.
- Podocarpus block: 500 ha, this species, famous for its high quality wood, was to be developed by natural or assisted regeneration on the west side of high elevation ridges.
- Natural forest block: 4500 ha, experimentation on a sustainable silviculture was to be done, controlled by research institutes such as INRA (National Institute for Agronomic Research).

After 12 years of work, what are the results? The protection block plays its role as the

central part of Guadeloupe National Park. The plantation block was the most difficult to implement: of the 1500 ha scheduled, only 590 were planted, because of various problems:

- it was difficult to find new areas to plant out of steep slopes, and the cost of roads to reach these areas was very high;
- in the most accessible places, in the north of Basse Terre, mahogany does not thrive on ferrallitic soils, and plantations lead to failures.

The podocarpus block was demarcated and regeneration occurs as scheduled. The natural forest block was not implemented as results from on going research is just available now for commercial scale trials.

NEW DEVELOPMENT PLAN

Following the conclusions of the previous development plan, a mapping of mahogany plantations was completed: the map shows that among 4200 ha planted, only 1500 are settled on adapted soil or sites. The remainder is situated in remote areas, where road building should be too expensive, or on ferrallitic soils: mahogany is there mixed with native species which are growing faster. The podocarpus block cannot be extended because of steep slopes. Because of marked relief, the area of natural forest that can be really managed in the fourth block is less than scheduled.

The four main goals of this development plan are :

- A large protection block, 25,000 ha, including the former first block, abandoned mahogany plantations and all remote areas.

- A reduced mahogany plantation block, 1500 ha, limited to the best existing plantations.
- A native species production block, 1200 ha, mainly former mahogany plantations where mahogany is no longer the main goal.
- A natural forest block, 300 ha, where the results of research will be implemented.

CONCLUSION

Because of ecological constraints, mahogany will be reserved to the best sites, and native species will play an important role by plantation or natural regeneration. Protection of primary forests is now the main goal of National Forest Office policy in Guadeloupe.

FOREST AND A SUSTAINABLE DEVELOPMENT IN MARTINIQUE

François Caimail

INTRODUCTION

The first part of my presentation will be centered on the forest and the wood based industry in Martinique. Then I will give an actual solid example of a natural patrimony sustainable management tool: forest development and management plan. We will focus on native species plantations, in order not to repeat the same point exposed by our colleagues from Guadeloupe. The example of Martinique can be used to illustrate how we could go from a "mining" forest exploitation (generally done in tropical forest), to a sound renewable natural resource one. The principal actor for this is of course the forester who, not only has the responsibility to protect the forest and the natural environment, but to organize it for man's use for a long time. He must not isolate the forest from the economical, social, and cultural environment.

FOREST IN MARTINIQUE

When one speaks about environment, what comes to mind right away is a picture of the tree or the forest, before we think of water, air, or the city... I mean the unconscious bond between man and nature, the environment from which he obtained, since a long time, his protection and subsistence. In the Caribbean, the island of Martinique is fortunate in having important natural and forest sites. Surely, the accentuation of the relief, the creation of a Forestry Division at the beginning of the century, the natural reconquest of fallows by trees because of agriculture decline, the economic possibility to use various fuels to replace charcoal and more recently, the willpower of a part of the population and its elected representatives, were solid reinforcement to maintain forest on 45 percent of the island. Again, should we jealously preserve this situation or even improve it? This is the daily mission of the French

National Forest Office (Office National des Forêts: ONF). But do we really know who this forest belongs to? Which are its different types? How was it domesticated by man? Which role does it play and how do we manage it?

To Whom Does The Forest Belong?

We generally estimate that the forest and assimilated areas in Martinique cover between forty and forty six thousand hectares. This represents an important afforestation rate in relation to the very high population density of the island (330 inhabitants/km²). Unfortunately, the forest distribution is not well balanced: large areas throughout the north of the island (mountainous and rainy), more scattered areas in the center and the south (mild relief and a less watered comfortable climate).

In addition, there is a daily breach because of the land status:

- In the south of the island forest belongs mainly to private owners, experiencing for many years dramatic scattered encroachments to the advantage of sprawling urbanization. Encroached, weakened, without any care, this forest can no longer play its different roles. The large forests remaining must be rapidly protected and developed.
- The north of the island remains well afforested because of its steep slopes, rainy climate and volcanic eruptions which killed or chased populations. There, we find most of the public forests, belonging to the State and local administrations. The main one is the Forêt Départementale-Domaniale (FDD) forest (belonging to local "département" [district] of Martinique, but managed as a state forest), which includes the Mount Pelée, Pitons du Carbet, Morne Jacob..., with an area of about 10,000 ha which we will deal

with below. This area is enhanced by more than 1000 ha, bought recently by the "département" of Martinique.

The Coast

Let's remember the public coastal forests, their importance is paramount.

- The Coastal State Forest (Forêt Domaniale Littorale), which is a narrow strip of 81.2 meters on more than 260 kilometers of coast and isles (two thirds of the island coast), totalling about 2100 ha. This natural strip was given state forest status less than ten years ago. Unfortunately, it suffered previously from heavy squatting in some places.

- Forests of coastal conservancy (1000 ha), and mangroves (1900 ha).

A total 16,000 ha of public forest is managed by National Forest Office (ONF).

What Are The Existing Types Of Forest?

Though small, 65 kilometers long and 20 kilometers wide, Martinique has a great variety of landscapes, forests and natural environments, created by wide variations in elevation, exposure to wind, rainfall, and slopes. The temperature and soil fertility, generally good, have less influence. Annual rainfall is about one meter in the south of St. Anne, and eight times greater on the summit of the Pitons and Mount Pelée, with an elevation of 1200 to 1397 m. Vegetation there does not exceed eighty centimeters because of continuous violent winds. Among the different types of vegetation recognized by specialists, we can name the most important categories from the coastal areas toward the hills: mangrove, dry coastal vegetation, the dry forest, the semi-humid forest, the rain forest, the mountain dwarf forest. About 400 native tree species can be found.

What Is The Origin Of This Forest?

Throughout the past centuries, forest in Martinique was victim to many alterations. From a continuous cover in the 17th century, it became what we know today. Deforestation started for farming (tobacco, cocoa, coffee, sugar cane), house building, the precious wood and other timber trade, railway sleepers, and at last, charcoal. Since 1903, a bashful reaction generated the organization of a small forest service and the first mahogany plantations to face up to the still serious wood shortage. But it was on March 16, 1922 that a true forest legislation was established, inspired from the French Law. A Forestry Division was organized in order to improve the situation of forest patrimony.

1933 to 1945: forest demarcation and first commercial scale plantations.

1945 and after: extensive afforestation program and road equipment.

1980 and after: afforestation, logging in old plantations, and touristic equipment.

What Is The Forest For?

The forest is vital for Martinique. It has a paramount protection function added to a growing economic function. This last function developed into two separate aspects: on one hand, traditional wood and by products trade, such as charcoal, and on the other hand, the livelihood of developing tourism which more and more centers on ecotourism.

Protection

The forest plays a fundamental role in the protection of environment, especially in Martinique. Among the most recognized and important functions we can enumerate: climate regulation; air filtration and purification; water regulation (buffer effect); soil protection

against erosion; fauna and flora reserve, preserving a great biological and genetic diversity; at last, contribution to quality, diversity and originality of landscapes.

Wood Production

The existing commercial plantations in Martinique, represent only 10 percent of public forests and 1.2 percent of the total area of the island, but are a major asset. To these 1300 ha, mainly of mahogany mixed with various species, will be added a few hundred ha of natural forest improved with plantations of native species. In fact, it is one of the unique natural resources of the island, renewable and non polluting. These precious trees were planted less than 60 years ago and generated a true wood based industry.

Even though it is still a recent trade, professionals are progressively emerging such as lumber men, sawmillers, carpenters, cabinet-makers as well as small industrial businesses. About 800 businesses live from wood trade and industry. Of course, local wood production, between 5000 and 6000 m³/year, is not sufficient (the wood trade deficit is 80,000 m³ and 200 million francs), but this high quality production will soon reach 75 percent of the demand for the most valuable uses, especially cabinet-making.

Recreational Activities

Public forests generally include sites extensively visited by local population and tourists: rain forest, beaches, isles. It is then an asset for ecotourism development which is more and more in demand. Besides the picnic areas, with tables, benches, shelters, toilets, roads, and parking equipment along the beaches, there are nowadays various tracks (170 kilometers), ecological and botanical trails, natural, and botanical reserves, and very soon, horse riding trails, and fauna watching points. These important investments are mostly sponsored by the Regional and Departmental

administrations. Education and information are the best ways for the public awareness about environment protection.

Forest Must Be Managed

(Obvious for you as foresters, less for an unaware public)

Vegetation in Martinique possesses an extraordinary endurance which often restores human damages; but generally at the expense of quality and diversity of the environment. The mission of the forester is to manage the different forest functions. We will observe it with the example of forest development and management planning.

Protection

In the first place, constant watch on the forest helps keep it free from encroachments, and especially controls squatting along the coast. When this control is not sufficient, or in privately owned forests, it is necessary to call upon law, or even to buy the endangered forests. Other organizations such as, the Botanical Gallery of Fort de France, the Natural Regional Park of Martinique, the Department of Agriculture, the Coastal Conservancy are working together with us in order to enforce this protection role. In order to restore some sites, it is sometimes necessary to replant species that have disappeared. This is one of the activities of the Research Department: to spot, harvest, breed in nurseries, and replant about sixty endangered forest tree species. Then we still have to develop these important areas through public education.

Production

To cultivate forests, there is a need to master silviculture, forest roads construction, logging, skidding, and other techniques. Though the forestry tradition is new in Martinique (less than a century), it is asserted daily to render more and more while being more respectful of nature.

For example, mahogany in plantations is mixed with local species such as *Hymenaea courbaril*, *Genipa americana*, and *Cordia alliodora*, and in less productive areas with genetically improved white cedar (*Tabebuia pallida*). Roads are designed to be less injuring in nature, and may one day be complemented by cable ways to lessen damages. Wood is more completely processed after logging, thanks to small portable sawmills and charcoal ovens. Finally an original bamboo based craft and industry is created. Moreover, important progresses are under way in wood based industry: improvement of sawmilling techniques or technical counseling of craftsmen or industry for wood drying, impregnation and transformation, for utilization of local species, and most of all quality standards and the promotion of local products.

Forest for Leisure

It represents a very large part of National Forest Office activity. Opening natural environment and forests for public leisure is a matter of specialists. It should be planned, organized, and controlled.

Planned. Every site is a particular case which needs specific equipment, compatible with its environment.

Organized. To equip is insufficient; natural sites must be regularly maintained and adapted to the increasing number of visitors. Every year, more than 8000 m³ of trash are collected in forest recreational areas.

Controlled. This fragile and often coveted environment, requires precise control rules for its use, which should not jeopardize neither its perpetuation nor what makes it attractive.

National Forest Office Facts And Figures

National Forest Office is a public institution which implements the State and local administration forest policies; managing 4.1 million

hectares of forests and wildlands in France and about 8 million in the overseas French territories. More than 14,000 engineers, technicians, administrative staff, and workers participate in public forest fundamental missions:

- public property general surveillance;
- economic activity of wood production;
- protection and supervision of wildlands, the fauna and flora;
- as well as different other actions in relation to forest and natural resources for private and public owners as, expertise, work mastership, work achievement.

In Martinique, we step directly in private forest (for clearing control, development, and improvement), and in the wood based industry. The Regional Direction of Martinique employs forty civil servants, and about one hundred forest workers throughout the island. A research department and a wood based industry department, funded by the Regional Administration and the National Forest Office, are joined to the Regional Direction. The budget of 27.5 million francs in 1991, was financed by the National Forest Office, (staff and works), the State, Regional and district administrations (works, studies), and the European Economic Community (EEC).

CONCLUSION

Forest and wildlands are among the fundamental components of Martinique. Their protection, economic improvement and availability for the public are the concern of institutions or administrations, but should widely motivate the population. We work for future generations to whom we must transfer an even more beautiful patrimony.

DEVELOPMENT AND MANAGEMENT PLAN FOR PITONS DU CARBET AND MOUNT PEELE FOREST, MARTINIQUE

Or

How to Reconcile Protection, Production, And The Public Reception

François Caimail

INTRODUCTION

This speech presents a management tool set up for the largest forest of the island: the Pitons du Carbet and Mount Pelée Forest, a 9481 ha District and State Forest (Forêt Departementalo-Domaniale [FDD]). It's a long-term management tool. It will require many decades to accomplish the main goals, 10 to 20 years for logging and work schedules, which establish a guide for the forester while securing continuity in management. It is made of:

- site assessment - which is a thorough analysis of the natural and socio-economical environment: various studies, description of plantation blocks, natural and damaged forest inventories;
- situation analysis with long-term planning - this work is done with great concern, on one hand, to adapt every development plan to the forest and not the opposite; on the other hand to have an objective scientific approach; and at last, to consider the physical, economic, social, and cultural constraints.

Foresters, workers, and scientists contributed to its elaboration during one and a half years. Such planning documents have been used on a regular basis in French forestry for 150 years. They help to manage the forest functions as a whole, and for wood production, to harvest capital increment only, therefore allowing to be renewable.

Description Of The Diversified Natural Environment

It is located essentially in a very rainy area. We observe: the low elevation tropical rain forest (350 to 600 m, rainfall = 3000 to 5000 mm/yr); whether pristine (less than 20 percent); or degraded, for which two phases and 24 types were determined with a statistical survey. Degradation gradients are related either to a more or less strong anthropization of the environment, or to continuous renewal of the vegetal cover because grounds are:

- the dwarf forest and the shrub type transitional savannah (600 to 900 m, rainfall = 4000 to 8000 mm/yr);
- the high elevation shrub type or savannah (900 to 1400 meters, rainfall = 6000 to 10,000 mm/yr);
- mahogany plantations located mainly between 350 and 650 m, aged from 0 to 80 years.

Analysis Of Forest Calling

- This forest blessed with high biological and landscape richness.
- Its main vocation is to protect soil and water resources.
- Wood production forest should be maintained in Martinique
- In the rain forest area, degraded forest only should be developed for wood production.

- Because of its nature and localization, this forest has an entertaining suburban function.

Long-term Management Goals

The forest is divided into three blocks:

- The biological state reserve (4380 ha) to protect natural, biological and forest patrimonies.
- The soil and landscapes protection block (3500 ha) to avoid soil erosion, and for the conservation of the existing natural vegetation and water resources.
- The production block, devoted to high quality wood, still partially planted with mahogany (1300 ha) to which will be added 400 ha of degraded forest. About 250 ha among these 400 will be improved, enriched with the best native species, and support research activities.

The public reception and education could concern these three blocks.

Management Instructions

They plan precisely the type and schedule of work and logging activities for the next decade. Without further particulars of a document containing 100 pages, we can mention: state biological reserves (the organization of a scientific commission, the prohibition of any commercial activity, scientific studies extension, and public education); for the protection block (no forest or road works); for the production block (logging of 240 ha of adult mahogany stands, about 50 years old and more than 60 centimeters in diameter, and re-plantation with mahogany and at least 25 percent of other species; improvement, with native species plantations, of 50 ha of degraded forest).

New techniques are being used in order to mix various species, while trying to reduce the cost of forest work. At last, numerous sites for public reception will be developed.

PRESENTATION OF THE RESEARCH DEPARTMENT IN MARTINIQUE

Michel Vennetier

INTRODUCTION

The presentation of the research department's work is brief, because the main aspects are dealt with during tours on the ground sites (2 afternoons). It is based on a few examples of research, which try to consider the following question (that was the focus point during the meeting): while producing wood and other products, how can productive forest management be combined with its biological assets and the conservation of its production potential?

EXAMPLES OF STUDIES PREPARING THE DEVELOPMENT PLAN OF PITONS DU CARBET AND MOUNT PELEE FOREST

Evolution Of Soils Under Mahogany Plantations

Up to now, mahogany has been planted mainly in pure stands. At a certain time, even seedlings of native species, growing in the afforested zones, were eliminated. Many of the old plantations were done with Taungya system, associated with agriculture. Even if these practices were abandoned, we wondered what could be the plantation's impact on the soil, because production of mahogany, even mixed, remains one of the main objectives in production forest. We also observed growth problems in certain areas with the second mahogany generation on the same plots. This created concerns regarding harmful effects of this species on the soil.

Our study compared soils in two different sites, on two different types of soil, between natural forest less or not disturbed, and neighboring plots planted with various age groups of mahogany (4 groups: 5 to 10 years, 25 to 30 years, 50 or more, 2nd generation 5 to 10 years;

this should enlighten soil evolution in relation to plantation age, if this evolution is noticeable).

Temporary conclusions for the first site are that mahogany does not have a harmful effect on the soil texture, pH or nutrients (in the type of soil studied: young, rich, and well structured volcanic soil).

But, we emphasized the adverse effects of the skidding machines which cause irreparable damage to the soil when passing through the stands: ramming, destruction. Second generation growth problems are related to this phenomenon. The problem of profitable logging being able to preserve soil productivity is raised in this study. This is why cable-ways trials are now scheduled in order to avoid the operation of machines off the forest roads, and to limit the number of necessary roads. This type of exploitation can be costly, but preserve the future. The question of durable management is therefore fully assessed.

Natural Forest: Choice Of A Development

Pitons du Carbet natural forest belongs almost entirely to the rain forest type. It was agreed since the beginning to entirely protect pristine and less disturbed forests that are only very few. Degraded or secondary forests areas seemed important and they especially needed to be studied, in order to answer the following questions:

- Where is the boundary between pristine and degraded forest ?
- How can we improve degraded and secondary forests, and if we can, to what extent should we do it?

Considering the previous works, it was certain that these degraded forests had, at least in

some areas, a great flora and fauna wealth and some rare species, sometimes endangered. The study tackled three points:

- A botanical survey to spot rare species and those that would be endangered by eventual works, and the identification of particular biotopes deserving attention. This research generated a program of multiplication for 25 endangered species.
- Demarcation of pristine forest areas to be strictly protected. As for the first point, this assessment was based on Jean Pierre Fiard's criteria. He is a botanist from Martinique who has thoroughly studied these forests. These zones, often parcelled, were extended and then grouped together to form vast and coherent units, demarcated by natural indisputable boundaries such as rivers and ridges.
- In secondary or degraded forest, a two-part inventory:

A preliminary survey was conducted based on 10 transects (about 100 informal site surveys) in order to define the boundaries of the inventory zone and to organize measurements and notation methods.

A precise statistical inventory, including 120 plots of 1,000 m² based on a systematic network. We recorded for every tree, diameter, height, length of commercial bole, regeneration and epiphytes; for each plot, gaps, crown cover, land slides, orientation, slope, elevation; and for species a notation regarding the predominance and abundance (50 species or groups of species were considered separately).

This inventory gave rise to two types of results:

- a quantitative knowledge of the forest: volume, basal area, height (classified by species) botanical composition, regeneration, commercial timber volumes;

- a classification of the different types of forest according to statistical analysis, differentiated by characteristic quantitative and qualitative elements.

So we gathered all the scientific elements necessary to choose the management's options most adapted to each type of forest; and to propose a development, only if we are sure that it will be economically sustainable, and will preserve or even improve biodiversity.

SOCIOECONOMIC STUDY OF PRIVATE FOREST

Private forest represents two thirds of the forest area in Martinique. It is not at all developed. It is composed mainly of low quality stands, which spontaneously appeared on agricultural fallows, but a few good stands exist in protected sites. The survey aimed at obtaining the necessary elements for defining a development policy for the rehabilitation of these abandoned forests. The largest private forest unit in the south-west of the island, representing all types of owners, was chosen as the survey site. It includes territories of three cities and more than 4000 ha.

- After reporting the limits of forests and fallows on the land registry, according to aerial photographs, site controls, and precise available maps, we performed an exhaustive inventory of forest owners (more than 600). A typological and ecological forest map was drawn.
- According to size of the property, owner's professional activity and residence situation, we classified the owners by types.
- At last, a survey was done selecting a sample of owners, representative of each type.

The results of this study indicate that an important majority of owners (more than 75 percent) has as a goal the urbanization (at least partially) of their afforested lands, for tourism

or housing. This land speculation depends on the continuous increase of land prices for housing and a strong demand. Almost none of the owners would accept to sell to a public administration. Few of them are planning a forest development. This is the kind of urbanization, dispersed or individualistic and without any planning that hinders all future possibility of rational and productive forest management. The survey shows that a public policy based on land purchase is unrealistic.

Because of the present difficulty to impose respect of land use planning on private land out of towns, only a new policy, different from the current ones, would be able to save the future and integrity of the private forest: land regrouping and re-parcelling, taking as far as possible

into account the owner's desires, while protecting large homogenous forest ensembles. The loss of these private forests would constitute an important economical handicap for the future of Martinique because it represents more than two thirds of the forest area that could potentially be improved for wood production. The cost of wood importation for the island needs, public urbanization network, landscape devastation deleterious to tourism, and the cost of the biologic wealth losses (still not well known) are enormous in its trade balance. This is why the organization of the private forest, with a original and dynamic land use planning, is necessary for a sustained development.

ERRATUM

CHARCOAL PRODUCTION AND USE IN SAINT VINCENT AND THE GRENADINES

David Dunkley, author of the paper "Charcoal production and use in Saint Vincent and the Grenadines" published in pages 39-45 of "Towards Sustainable Forest Resource Management in the Caribbean, Proceedings of the Sixth Meeting of Caribbean Foresters at Martinique, July 20-24, 1992" (for full citation see below) wishes to further clarify some data published in his article.

Page 41, under FINDINGS, first paragraph, reads:

This is equivalent to approximately 18,000 cubic meters of wood annually using the FAO estimate of 167 kg of charcoal per cubic meter (FAO 1990). This figure is based on 100 percent conversion of wood to charcoal. However, this conversion percentage is unrealistic using the earth pit charcoal-making method. A more reasonable conversion is 30 percent (FAO 1987). This implies that approximately 55,000 cubic meters of wood are consumed to produce the 138,260 sacks of charcoal.

should read:

If FAO data (1987) on charcoal to wood weights are modified to account for inefficiencies, there are approximately 5.5 kilograms of wood per kilogram of charcoal. Therefore, 16,720 tones of wood are utilized to produce charcoal. This implies that approximately 23,060 cubic meters of wood are consumed to produce charcoal, based on 725 kilograms of wood per cubic meter (FAO 1990).

Page 42, Table 1, first item reads:

Economics

should read:

Economics (\$, gas runs out)

Page 42, Table 1, third item reads:

Economics and cooking preference

should read:

Economics/cooking preference

Citation:

Zepeda, G. and A.E. Lugo, editors. 1994. Towards sustainable forest resource management in the Caribbean. Proceedings of the Sixth Meeting of Caribbean Foresters at Martinique, July 20-24, 1992. USDA Forest Service, Institute of Tropical Forestry, Río Piedras, Puerto Rico. 55 p.

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