

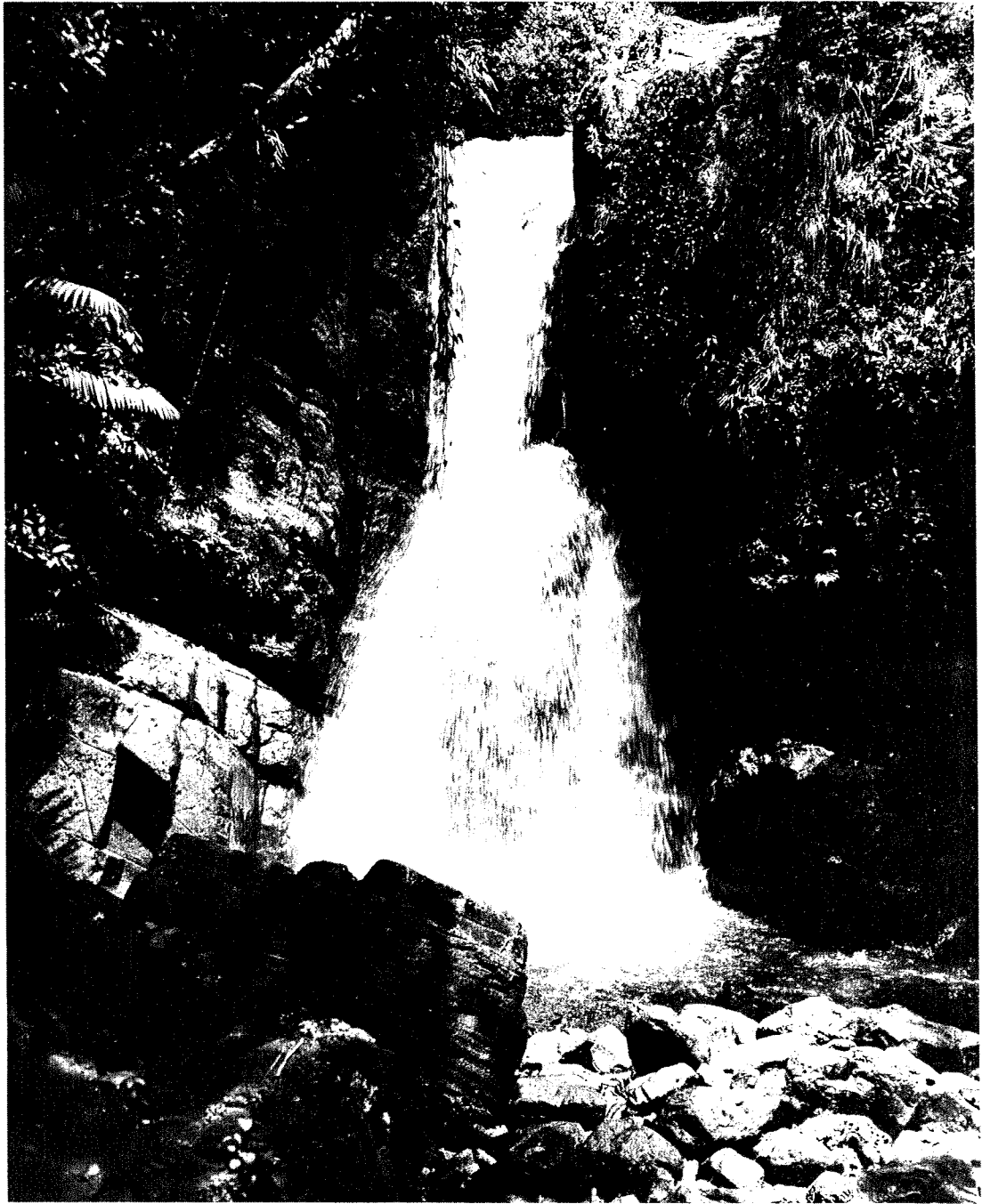
McDowell

CASE STUDIES

ON FORESTRY ACTIVITIES

IN THE EASTERN CARIBBEAN

AND JAMAICA



AN INSTITUTE OF TROPICAL FORESTRY PUBLICATION

1984

This project was funded by the
U.S. Agency for International
Development (the Preface has
details).

CASE STUDIES ON FORESTRY ACTIVITIES IN THE EASTERN CARIBBEAN AND JAMAICA

Recommendations by Students of the Tropical Forestry and Environmental
Quality Courses held at the Institute of Tropical Forestry in Rio Piedras

Edited by Ariel E. Lugo

Institute of Tropical Forestry
Southern Forest Experiment Station
U.S. Department of Agriculture
Forest Service

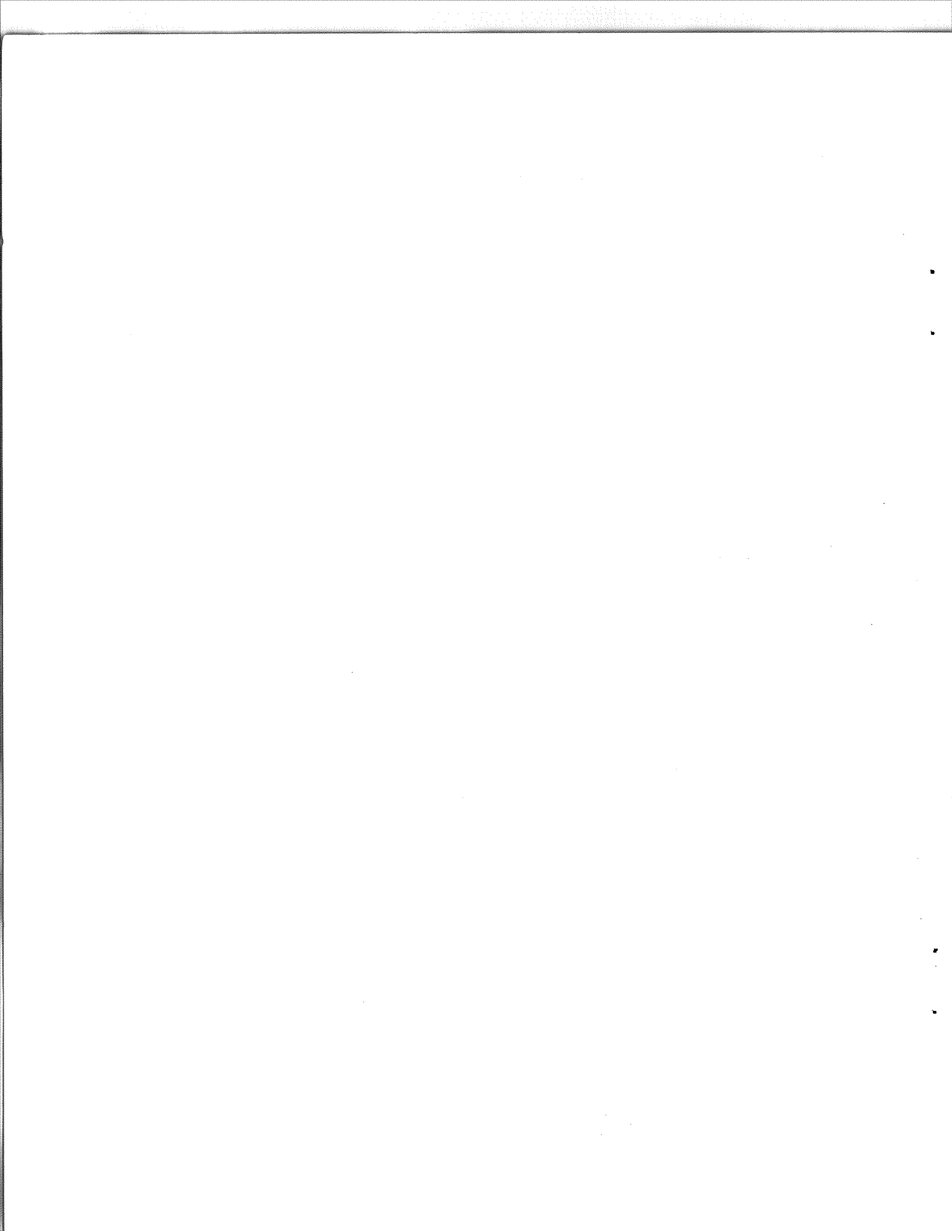
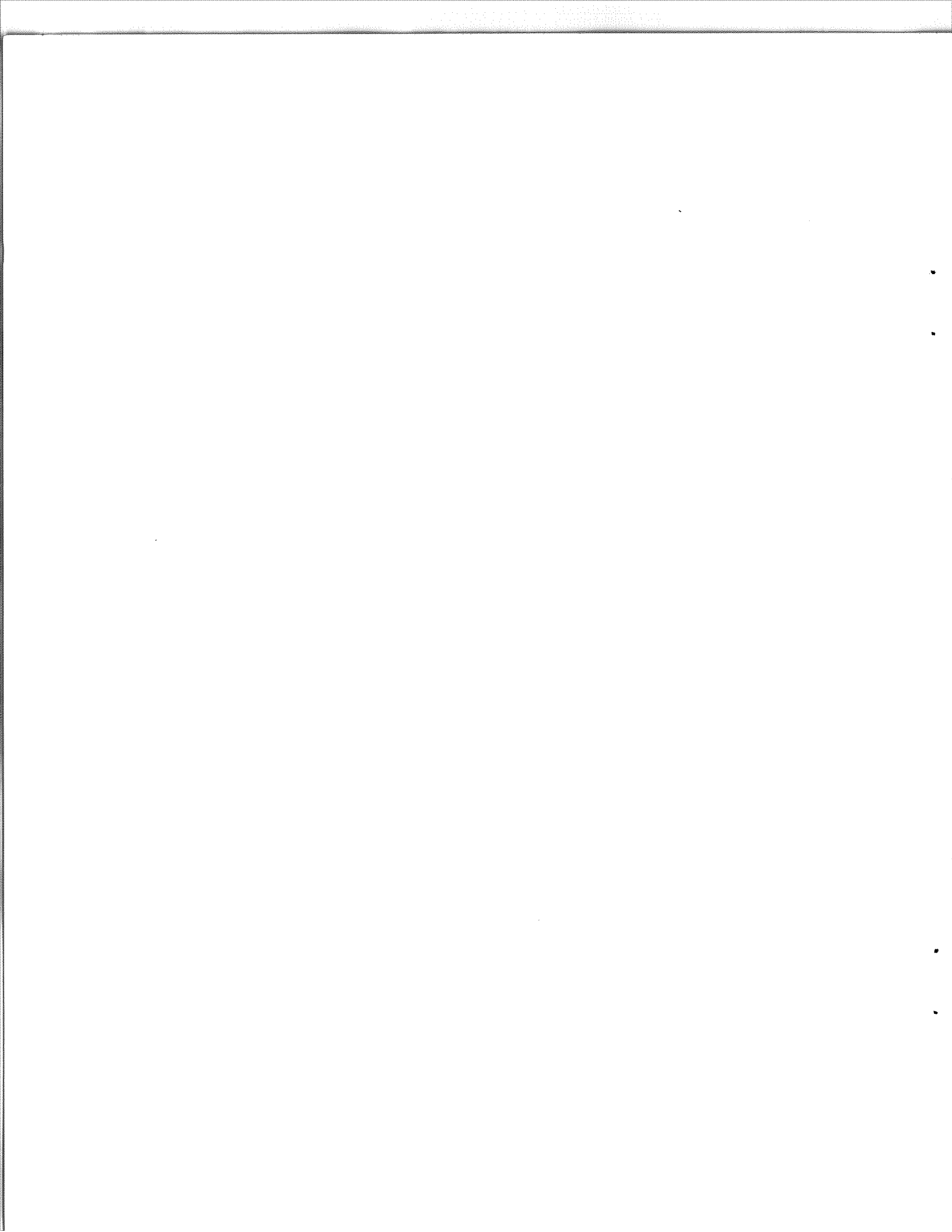


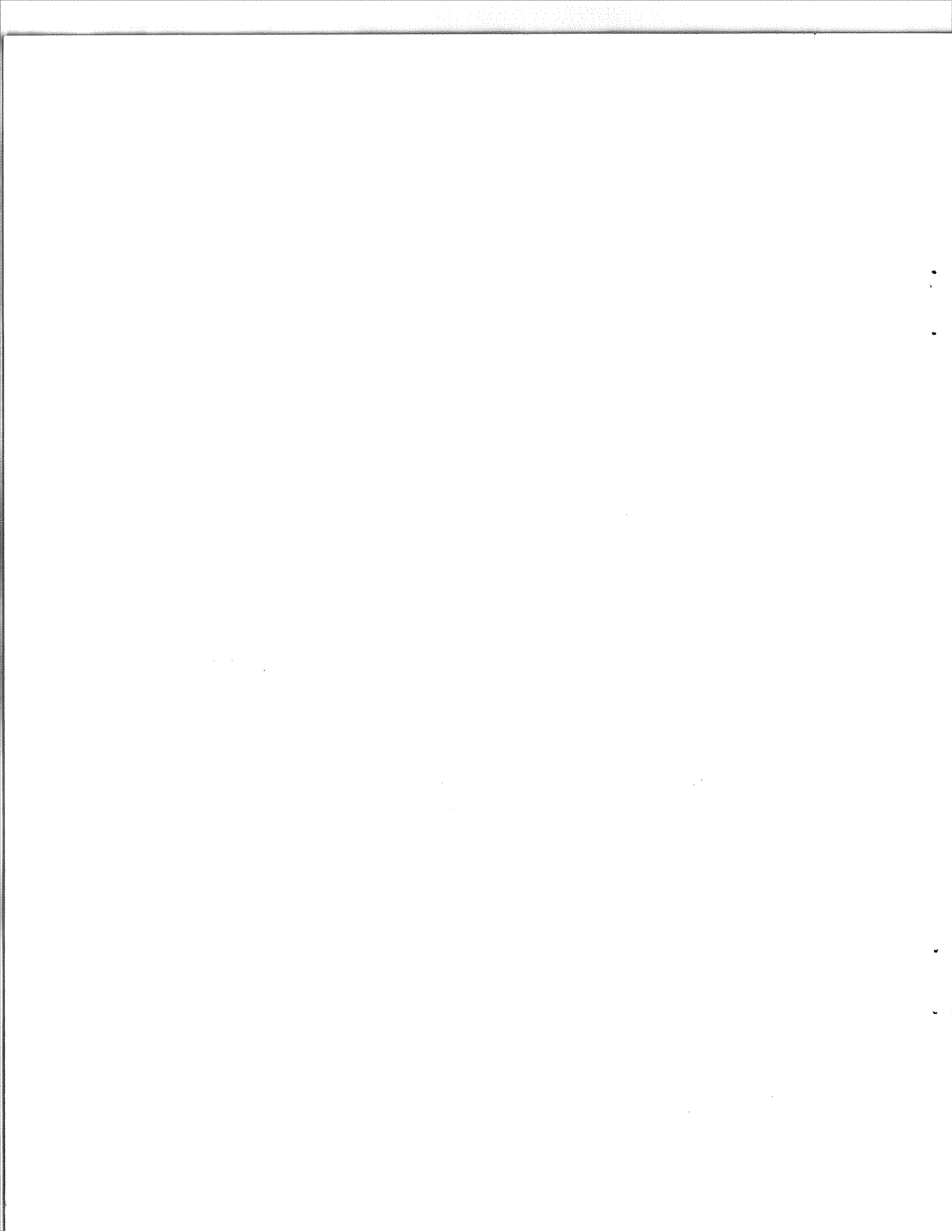
TABLE OF CONTENTS

	Page
Preface	1
<u>Forestry</u>	
Training for Young Dominican Foresters	2
Ronald Charles	
The Establishment and Functions of a Central Nursery	11
Albert Gallion	
Establishment and Management of a Forest Nursery	15
Julius Georges	
Training as Related to Forestry in Jamaica	21
Lewellyn A. Hall	
Inventory and Potentials of Forest in Antigua	29
Mc Ronnie Henry	
Reforestation Following Hurricane David	37
Ashton Lugay	
Plantation Management and Protection	42
Peter Vidal	
Development of a Forest Nursery in St. Vincent	47
Edgar Williams	
<u>Watersheds</u>	
Watershed Management for St. Vincent	54
George Beache	
Watershed Management for St. Lucia	64
Augustin Charles	
Vincent Ernest	
Alexander Forde	64
The Good Hope Watershed in Dominica	77
Stephen Durand	
Conservation of Water	79
Gloria A. Mortley	
Watershed Management for Dominica	90
Charles Watty	



Wildlife

A Study on the Biology and Status of the Rammier (<u>Colymba Squamosa</u>) in Dominica	Egbert E. Bethel	98
Wildlife Management for St. Lucia	Michael Bobb Jules	102
Wildlife Protection for St. Vincent	Gideon Cordice	114
Wildlife Improvement and Protection	Timothy B. Harry	121
Population Study of the St. Vincent Parrot	Lennox Quammie	126
Protection of Wildlife	Brenon Samuel	131
Protection of Forest and Wildlife in Dominica	Randolph Winston	136



PREFACE

As part of the U.S. Government's contribution to UNESCO'S Caribbean Environmental Action Plan, the U.S. Agency for International Development sponsored two three-month training courses on tropical forestry and environmental quality in Puerto Rico. The courses were designed for young Caribbean foresters working for the forestry divisions of eastern Caribbean islands and Jamaica. The training was conducted in the Institute of Tropical Forestry of the US Department of Agriculture Forest Service's Southern Forest Experiment Station. The 24 course participants represented 7 islands. Staffing was from the Institute and its collaborating institutions including other U.S. Forest Service units (e.g., the Caribbean National Forest staff and Region 8 headquarters staff in Atlanta); other federal agencies in Puerto Rico (e.g., U.S. Geological Survey, U.S. Soil Conservation Service); state agencies (e.g., Environmental Quality Board, Department of Natural Resources); and private consultants. The course outline, summary of lecturers, lecture material, and staff are available in another Institute publication.

Training of tropical foresters from eastern Caribbean islands was a main goal of the Caribbean Environmental Action Plan, and the top priority recommendation of the Caribbean islands that participated in the first and second meetings of Caribbean Foresters held (respectively) in St. Lucia and St. Vincent. A combined total of 45 delegates from 10 islands attended these meetings sponsored by the U.S. Man and the Biosphere Program. The group recommended that field and practical applications of knowledge in the training be priority. Accordingly, the course was designed to include 50% of the time in field work either observing or doing forestry and environmental quality exercises. Classroom work provided the background needed to understand field activities. In addition, each student was assigned an advisor and was requested to develop a case study suitable for presentation to their island governments. The idea was to analyze any subject or local issue related to forestry or environmental quality that had relevance to their jobs. Using library resources and their experience in the course, students were to make a proposal of how the subject should be approached if they were given the resources to do it. This publication collects the case studies prepared by students of the two training courses. Although they have been edited for style, the ideas, and recommendations of their authors have been left intact. The publication of these case studies satisfies a promise I made to the course participants and one that they remind me of everytime I visit the lovely islands of the eastern Caribbean. It is my hope that the island governments and international donor agencies pay attention to what these young islanders have to say about forestry and environmental quality in their home lands.

Ariel E. Lugo
Rio Piedras
August 16, 1984

TRAINING FOR YOUNG DOMINICAN FORESTERS

Ronald Charles
Dominica

INTRODUCTION

To set this topic in perspective, it is imperative that I provide an overview of the organization responsible for forestry activities in Dominica.

The Forestry Division in Dominica falls under the auspices of the Ministry of Agriculture, but has full autonomy over its operations. The Division was set up in the 1940's. At that time, most members of staff were from the United Kingdom and the local personnel included War Veterans that had just returned from World War II. Today most senior positions (Rangers) are held by these local staff. The foreigners have long retired.

With limited know-how and skills, the Division set out to introduce forestry activities in Dominica. This involved protecting virgin forests, law enforcement, watershed protection, plantation establishment, research, etc. Time and again an occasional researcher would arrive to conduct a specific assignment for a specific period of time. Today much of the work of local and foreign personnel is evident around the island.

The Division, after struggling on with limited staff, is not only responsible for forestry activities but is also responsible for the National Park System. This Park system was set up by an Act of Parliament in 1975, and brought more responsibility to the Forestry Division,

STRUCTURAL ORGANIZATION OF THE FORESTRY DIVISION

The Forestry Division in Dominica is divided into five sections: Administration and Management; Protection and Conservation; Silviculture, Research, and Extension; Forest Utilization; and National Parks (Appendix 1).

Administration and Management

This section is head by a Director and is ably assisted by a Deputy Director. They are responsible to the government for carrying out government's forest policy. They are charged with planning and directing the Division's activities. All appointments are made by the Public Service Commission. Recently, another senior officer was added to that team.

Protection and Conservation

This section is the "power-house" of the Forestry Division. It is responsible for reserves, water-catchments, law enforcement, research on wildlife, soils, and insects affecting forests.

This section, until recently, was head by an Assistant Forest Officer, who was directly responsible to the Director. In turn, the Officer has under his charge four Forest Rangers, nine Forest Guards, one Forest Cadet and temporary Forest Guards, including Forest Trainees.

Each Forest Ranger is responsible for a particular range (area) and among his duties as Law Enforcement Officer, Researcher, and Forester, he is responsible for Forest Guards under his charge who themselves, are performing the same duties as the Forest Ranger. Most rangers are seriously lacking formal training. Moreover, they are close to retirement. The same can be said of Forest Guards. Only recently, four Forest Guards were appointed. They are also in need of training.

Having been charged with law enforcement, supervising workers, and patrolling, very little attention has actually gone to research, since all these are full-time tasks. Suffice it to say that present officers still remain without the basic know-how in research techniques.

Law enforcement in itself could form an integral section within the Division's structure. However, due to the lack of trained personnel, the protection section is carrying these responsibilities, sometimes with very poor showing in court.

As was said above, this section was, until recently, head by an Assistant Forest Officer. Today it is head by the Director as provisional head, and a Forest Cadet who supervises and directs daily routine work for personnel in the field. As part of his duties, he is also a Law Enforcement Officer, and a "prosecutor" for court cases.

Recently an education program was initiated. This included visits to schools, clubs and youth groups. This also forms part of the activities of the protection section. The school program was initiated by the former head of the protection section.

The Forest Cadet operating in this section is without any formal training. He is a high school graduate and has only working experience. It is envisage that this officer could be moulded into a formidable forester. This section is in a very pathetic situation.

Silviculture, Research, and Extension

This section takes care of reforestation program, especially after the hurricane of 1979. Before the hurricane, the section was mainly involved in maintaining existing plots, studying flowering plants, establishing trial plots, conducting school programs, and as part of the extension work, conducting a roadside beautification program. Some research into flowering plants was started but was also discontinued after the hurricane.

Until recently this section was head by an Assistant Forest Officer, but today the Deputy Director is provisional head and a newly appointed Forest Guard is the coordinator of the routine work. Within this section there is one Forest Ranger and a number of non-established workers. Proper training is essential for all personnel in this section. The coordinator of this section is presently participating in this training program.

Utilization

This section is responsible for utilizing forest products. Small scale logging operations are being carried out. The section is still engaged in salvage work after Hurricane David (which swept over Dominica in August, 1979). The section is head by an Assistant Forest Officer and two Forest technicians. All other workers are non-established.

National Parks

The author does not feel competent enough to talk about the operations of the National Parks. However, the National Park program was initiated in 1975, and to date a National Parks system exists. Lands have already been demarcated and are legally protected. Until a separate body can be established, the Forestry Division is responsible for National Parks. There is however, a Parks Superintendent, recently appointed, an interpreter, and a planner. Most field work is done by Forest Rangers and Guards of the Forestry Division.

TRAINING REQUIREMENTS

For purposes of this report, and also to simplify matters, I have sub-divided training into three specific categories: professional, technical, and vocation level training.

Having completed a professional course, which usually lasts for three to four years, a candidate will be equipped to fill the post of a Forest Officer. A technical course program will surely equip a candidate to hold the post of an Assistant Forest Officer, which by our department's standards can head any one of existing sections or new ones that could be created. Vocational training will be limited to Forest Rangers and Guards and to some extent to Forest trainees.

As of August 1979, the Division was blessed with the services of six Assistant Forest Officers, and one Senior Assistant Officer. For various reasons this number has dwindled in such a manner that the number to date stands at only two. Some officers have had divisional transfers, e.g., from Forestry to National Parks. Others have left the state service.

To reach the level of staffing we had before the hurricane, at least four more officers should be trained to fill the posts of Assistant Forest Officers.

Notwithstanding the need for Assistant Forest Officers, the Division is in dire need of professionalism in its approach to forestry activities. Already, the two professionals within the Division are bogged down with administrative matters, rendering it impossible to carry out their professional work. Undoubtedly, an additional professional could head the research department of our Division.

In a previous section, I mentioned that officers of the protection

section act also as law enforcement officers. To be an efficient law enforcement officer, one must have specialized training. Knowing how to approach offenders, investigating a case, interpreting the law, handling of court matters, and the general work of a cop are necessary skills needed by our officers. The services of a trained person who can prepare proper charges on forest and wildlife offenses, represent the Division in court, and even advise on future legislation are also necessary. Presently this area of work within the Division is lacking.

Resident biologists are needed in order to complete the Divisions research programs, in particular with our wildlife and plant species. General biologists can do well in starting the programs. Research work on our two endangered species of parrots (Amazona aurusiaca and Amazona imperialis) should receive professional attention. Already, work has begun under the distinguished leadership of the former wildlife officer.

A plant biologist is urgently needed to help in the Division's plant identification, plant ecology, and taxonomy programs. These programs could be initiated and head by that individual. Presently, there are a number of disappearing plant and animal species that need attention.

Should the above training needs materialize, the field staff should also be equipped to support this new wave of professionalism. Specialized training should be given to them. Such training could include programs and short courses in general forestry, law enforcement, public relations, research, and the like. This training would be aimed for the older Forest Guards, who are not desirous in continuing education because of age.

Regarding newly appointed Forest Guards, they should be given the opportunity to pursue specialized courses in subjects commensurate with the training requirements. The same can be said of Forest Rangers. Since the present Forest Rangers are near retirement, their post will undoubtedly be filled by experienced young men. They should be given the same opportunity, since the more technical or professional the Division becomes, the better it is for the country and the environment as a whole.

The question now arises as to who needs training? The answer is simple. All those officers who show signs of interest and dedication to work. Presently within the Division, there is a cadre of young men eager to get the job done, but lacking knowledge. Already a step has been taken, and four of them are presently participating in this short course. Another course is being planned, and other trainees will follow. The next step is to find formal training opportunities for these individuals in one or more of the areas mentioned above.

There are also the two Assistant Forest Officers already mentioned who deserve pursuing further education to add a professional touch to their work.

RECOMMENDATIONS

In presenting my recommendation, I wish to emphasize that the Division's training needs must be looked at from two perspectives: immediate short-term training and long-term training.

Immediate training should gear present staff to cope better with existing situations. Already a step has been taken in the right direction with the organizing of a short course in Puerto Rico. More officers should be given the opportunity to participate.

The courses should aim at instilling within the candidates the basics of the workings in forestry, wildlife management, law enforcement, and research. The courses should be designed in such a way that at the end, candidates will have acquired just what they need to begin a career in forestry.

It should include all junior officers and Forest Rangers. Emphasis should be placed on young men and women wanting to work with the Division.

It must be realized that there is a need to replace the officers who have in one way or the other left the Forestry Division. Thus, it is necessary that the candidates have the opportunity to pursue courses which will equip them for these posts. Two years after this writing, there should be a new "crop" of officers coming into the Division. This will in some way ease the short-term training needs of the Department.

In a previous section, I mentioned the need of at least one additional professional Forester within the Division. The second phase of our training program could start here. The training for a professional job will last between 3-4 years, but, the benefits would be beyond limits. I cannot over emphasize the need for this officer. Since Dominica does not possess any institution that could satisfy this training need, possible locations in the U.S.A., Canada, or the United Kingdom, should be considered.

The need for law enforcement officers do exist, and something must be done to ease the plight of the Division. Officers in the field should be exposed to some form of training, either locally or at some study/attachment assignment in the U.S. or neighboring French Forest agencies. Emphasis should be given in training an individual who will be a full fledged law enforcement officer. The U.S. Park System operates and offers some training in law enforcement to its personnel, and it would be wise to explore the possibilities of sending one or two officers to this institution.

When we were given this assignment, as part of this training course, I felt it really necessary that I forget other aspects of forestry, i.e., the areas of work or forestry activities. I know that besides training the division is faced with lots of problems. However, I believe that with the advent of a training program within the department, much of the headache which exist today can be cured. Should we make any major trust into our forestry program, training is highly required. It cannot be over-emphasized that the Forestry Division in Dominica is in dire need of trained and equipped officers.

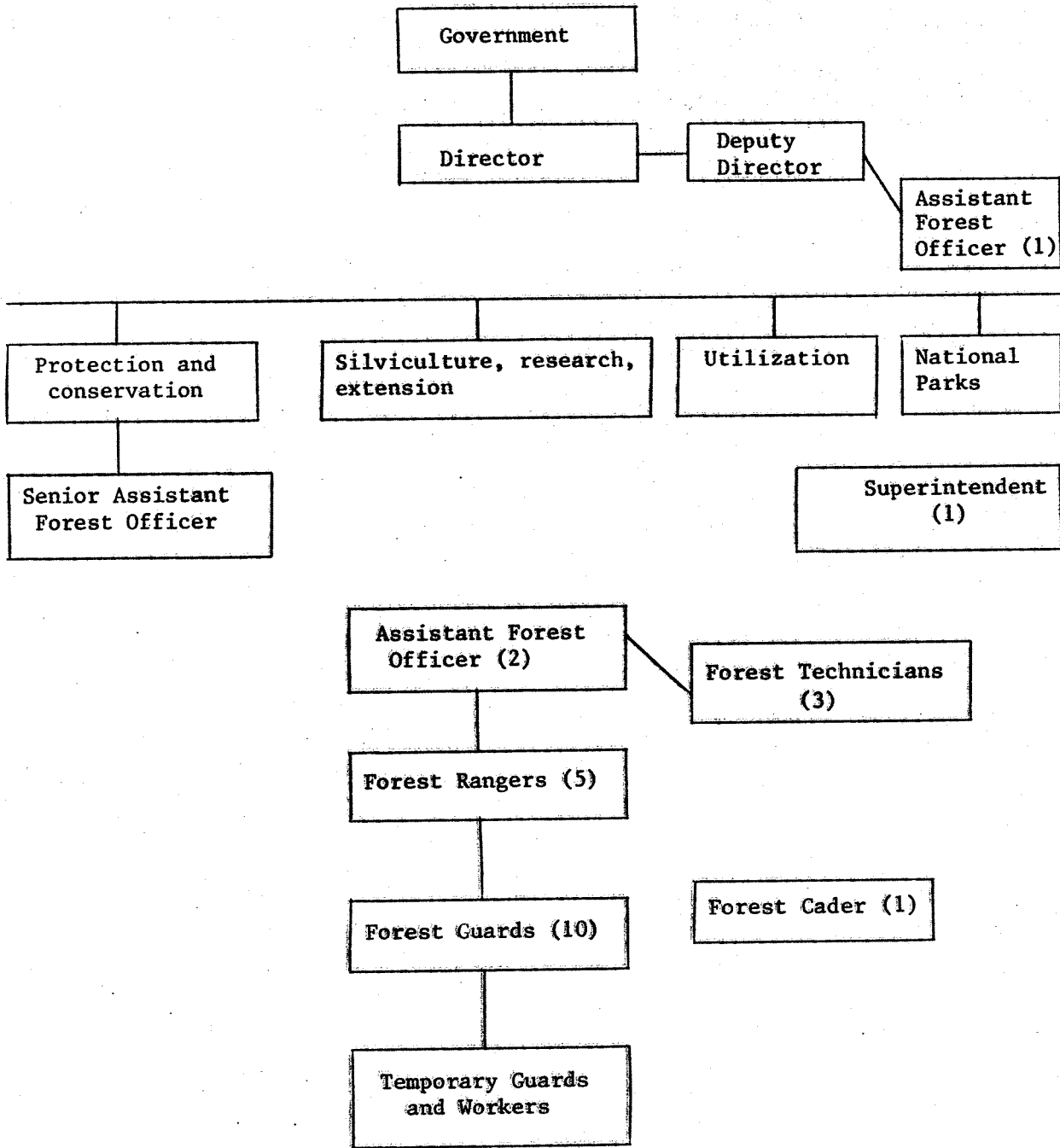
I would also like to present as additional information and support, sections of a paper, prepared by D.H. Kulkani on "Appraisal of Forestry Activities, Manpower and Training Requirements in Dominica," (Appendix 2).

Another document prepared by Felix Gregoire (Deputy Director) was submitted to government for consideration (Appendix 3).

ACKNOWLEDGEMENTS

The writer is indebted to all those who in one way or the other assisted in this work. He would like to thank most sincerely the kind guidance of Dr. Ariel E. Lugo, Project Leader, Institute of Tropical Forestry, who took time to advise and assist; Mr. Felix Gregoire of Dominica Forest Service, who provided reference materials; to Ms. Nilda Echevarria, Secretary of the AID Project, who rendered indefatigable efforts in typing and to all those who gave encouragement to continue this work.

APPENDIX 1



APPENDIX 2

Appraisal of Forestry Activities, Manpower, and Training Needs in Dominica

"The forestry sector in Dominica, perhaps like some other sections, is evidently functioning under a constraint of staff shortage. Instead of undertaking all essential activities the sector is in a position to pursue only such as the available staff can cope with".

"If the assessment of future manpower requirements of Dominica's forestry needs to be objective and purposeful, it has to be based on a clear, if implied optimism that at least in the long run the above kind of retardative circle would become breakable."

"The Dominica National Structure Plan prepared under the mandate emanating from the Town and Country Planning Act (1975) envisages, under forestry, substantial activities on reservation conservation, reforestation, watershed and environmental protection and logging, for all of which the present strength of the forestry organization is woefully inadequate."

D.H. Kulkani

APPENDIX 3. TRAINING REQUIREMENTS FOR 1981/82, 1982/83, AND 1983/84, IN THE FORESTRY AND NATIONAL PARK SECTION OF THE MINISTRY/DEPARTMENT.

Course description	Number of places and year required			Duration including commencement date	Venue	Post for which training will equip candidate
	81/82	82/83	83/84			
Management of natural resources	1	1	1	3-4 yr - 1st Sept.	UK/USA Canada	Forest Officers
Parks administration	1	1	1	1 yr	UK/USA Canada	Supervisor Superintendent of Parks
General forestry technical level	3	3	3	2 yr - June	ECIAF Trinidad	Assistant Forest Officer
Vocational executive secretary	1	-	1	1 yr	USA	Senior Clerk
National parks	2	2	2	6 months	USVI	Parks Technician
Saw doctor	2	2	2		UK	
Carpentry	2	2	2	1-2 yr	Trinidad	Forest Technician
Nursery management	2	2	2		Jamaica	Assistant Forest Officer

THE ESTABLISHMENT AND FUNCTIONS OF A CENTRAL NURSERY

Albert Gallion
Dominica

INTRODUCTION

The need for a permanent central nursery to serve the forestry needs of Dominica has been realized for some time. With the damage caused by Hurricane David in the forest, there is a great need for reforesting the badly damaged areas as a mean for achieving soil and water conservation. Recently, a reforestation program funded by the International Labor Organization demonstrated the consequences of the absence of a central nursery. Therefore, with the assistance of that organization, one is now under construction. There is an existing nursery at the Botanical Gardens but because of its location and environmental conditions, it cannot act as a central nursery. This nursery is being used for horticultural purposes, i.e., the production of ornamental species.

Unfortunately, the location of the nursery being constructed has certain limitations and it is with this in mind that I shall make some suggestions to mitigate these limitations.

LOCATION OF NURSERY

The site of the new nursery is situated close to the northern boundary of the National Park at an elevation of 457-610 m (1500-2000 ft). Annual rainfall ranges from 381-508 cm (150-200 in) and the average temperature is approximately 21-27°C. The soil is of volcanic origin, being formed from andisitic parent material, with huge rocks both on the surface and below the top soil, which is very shallow. When there is heavy rain, the soil becomes saturated and soggy, which results in certain areas becoming swampy. No allowance was made for future expansion of the building after the site was excavated. Most of the land around is privately owned and is being used for agriculture but because of the shallow soil, farmers are not investing much in the area. As an example, Geest Industries once owned a big citrus plantation in the area but because of lack of root penetration down to the subsoil the trees died. The plantation was sold to individuals who also tried to farm but had little success.

Another limiting factor is that there is no source of water available during the dry season, which will be detrimental to the plants. Also, the area experiences very windy conditions due to the fact that the site area is partially open all around. There is no neighboring village nearby.

Nevertheless, the site is close to the road and is relatively flat and can be considered as ideally located. It is on state owned land and there is a forest station close by. A Pinus caribaea and mahogany plot was located on this site.

To mitigate some of the site limitations, certain steps can be taken. First, soil will have to be brought in from elsewhere to improve the texture and composition of the present soil; compost piles should be made. An irrigation system should be set up to distribute water. This can be achieved by damming two rivers which flow down the mountainside some 365 m (400 yds) away; the water would be pulled in by gravity flow. Windbreaks will have to be planted along the boundary to control wind damage. Species like Calophyllum calaba can be used.

Living quarters should be built to accommodate workers. This will mitigate unreliable public transportation in the area and the long distance from the nearest villages. It is not feasible for workers to move up and down. Lateness for work and shorter working hours will result, thereby affecting production. An advantage of having the workers living in the area is that security of the tools and equipments will increase. Also, because of living near the nursery, the workers will have a greater interest in their occupation and in the care of the seedlings.

OBJECTIVES OF NURSERY

The main objective of a nursery is seedling production but seedlings can be used for a variety of purposes. Below I list those purposes that I consider priority.

Reforestation, soil erosion control, and protection of watersheds

Prior to Hurricane David, the needs for this objective were moderate. Reforestation was restricted to areas impacted by squatters, and to a former logging site of a Canadian lumber firm. Soil erosion was sparse. The occasional landslides occurred after heavy rains due to poor agricultural practices on steep slopes. However, since the passage of the hurricane we have been experiencing heavy soil erosion and there are now open areas, particularly in steep inland watersheds.

The production of fast growing species, especially local ones instead of exotics which might not adapt too well in the rain forest, is important for this application. The species used should not be considered for their ultimate timber value but only for their protective value; e.g. Sterculia caribaea and Symphonia globilifera.

Improvement of dry forest

Dry forests exist along the west coast of the island, from Roseau in the south to Portsmouth in the north. The soil is a grainy, sandy loam derived from the overflow of the now dormant volcanoes in the central ranges. These areas were once virgin forests, but due to the extensive cut down, a secondary dry forest with species like Picrasma antillana is dominating. Most of the land is privately owned now, except for the Cabrits Peninsula which is under the supervision of the Forestry Department.

The owners of these areas should be approached and be encouraged to do some tree improvement planting. Here, the aim should be production of species

for charcoal; they will have to be fast growing species such as Leucaena spp. This would help offset the crisis for domestic oil use. The owners could also grow agricultural crops in between trees. These areas are the habitat of the famous Black crabs (Gecarcinus ruvicolor), which is a popular delicacy. The areas are prone to bush fires during the dry season.

Timber Plantations

With the destruction of some of our plantations there is the need to re-active them. Species that can be used are the exotics Tectona grandis, Swietenia spp., Pinus caribaea and Hibiscus elatus plus some of the local species mentioned earlier.

Agro-silviculture

This activity is becoming an integral part of forestry because of its effectiveness. In an agricultural country like Dominica, where farming is done in difficult terrain, agro-silviculture can be useful. Once again, because the land is privately owned, success depends on how well forestry personnel with help from the Agricultural Extension Officers can influence the farmers. This system can also be used to some degree where squatters are located. There are different techniques under the system, but I think the taungya would be the most useful.

Research

This would involve scientific work on physical and chemical characteristics of soils, adaptability of species to climatic conditions, disease and insect vulnerability of seedlings, and the effects of chemical fertilizers on the soil. With information on these features, it would be much easier to carry out any silvicultural program with a positive measure of certainty. To carry out these objectives small trial plots will have to be set up, with both exotic and native species.

Extension

This involves all other miscellaneous work such as roadside plantings, ceremonial, recreational and educational programs and so on.

ADMINISTRATION

There should be a resident nursery manager to carry out the operations. He should have knowledge of business management, experience in supervising workers and most important the "know how" in rearing and growing forestry seedlings. Any member of the staff can qualify, though that person should undergo some on-the-job training for some time, preferably overseas.

The manager would be an assistant to the Silviculture Officer and both will be responsible to the Deputy Director of the Division. There should be a nucleus of seasonal and experienced workers. This includes a foreman and four

other nurserymen and three women. These workers should know about carrying out nursery techniques of plant propagation such as budding, grafting, pruning, and hybridizing.

SEED COLLECTION AND STORAGE

Seeds should be collected locally from genetically superior parent trees. With the information from research, the workers should know when to collect the seeds in the forest, The seeds should be picked from the trees not from the ground. Seeds should be imported only from reputed firms. It will be a good advantage if a Seed Orchard is also established. Seeds should be properly stored in order to maintain the viability percentage throughout storage time, protection being taken against insects, rodents, and fungus.

SEED GERMINATION

The Container and Bare-root system should both be used. There can also be one or two seed bins to be used for more sensitive species that need extra care; e.g. Eucalyptus spp. and Dacryodes spp. Seedlings should always be protected from the climate, insects, and animals. There should be proper coordination between the germination period and transplanting.

MAINTENANCE

Weed removing, maintenance of beds, drainage systems, vehicles and equipments, as well as building repairs are important in a nursery.

Record keeping is essential to any business venture, and nursery management is no exception. Day to day records should be kept on every activity that is being carried out at the nursery e.g., time spent on any work, method used, and number of workers involved.

CONCLUSION

Because of the local financial constraints and the high inflation rate I did not venture into cost estimation for the operations of the nursery. The operations of the nursery will be carried out immediately. I can only end here with a bit of optimism that the central nursery shall become a reality and be able to function as one. Any success of other silvicultural activities depends on the advantage of having a central permanent nursery.

ESTABLISHMENT AND MANAGEMENT OF A FOREST NURSERY

Julius Georges
St. Lucia

INTRODUCTION

In the tropics there is an endless variety of forest nurseries, sizes alone ranging from temporary beds of a few square meters producing only a few thousand seedlings, to large, highly organized nurseries covering several hectares and producing several million seedlings annually. The need for forest nurseries emphasizes an important difference between agriculture and forestry. The farmer sows seeds where his crop is to grow, the forester, in most cases, sows seeds and raises seedlings in a nursery and then plants them elsewhere on land to be reforested. There are two main reasons for this. First, recently germinated seedlings of most tree species fail in competition with other plants and it is impractical to give each tiny seedling, 3-4 m apart in a plantation, the care needed for survival. Therefore seedlings are raised together, free of any competition, until they are sturdy enough for planting out. Secondly, only in a nursery can the forester afford to provide growing conditions to raise healthy vigorous plants. Mainly for reasons of economics, the forest planting sites receives a minimum of soil preparation, fertilizing, and maintenance.

Most forest nurseries produce plants for a specific program, e.g., reforestation, soil and water conservation, windbreaks, etc. Thus seedlings must be of the required species; ready at the right time, e.g., beginning of the wet season; of the right size and sturdiness; and produced in sufficient numbers for the planting program.

At present St. Lucia has a nursery serving the entire island forestry needs. But the transportation of these seedlings or plants from the nursery to the southern part of the island where they are to be planted, e.g., De-Mailly, could be fatal. High mortality rate occur because of road conditions and other problems. Many times the plants get to the planting area late and have to be left overnight, to be planted the next day. I propose a few suggestions to eliminate and modify the existing problems, by first of all saying lets have a new nursery, for this would definitely help eliminate problems.

PRESENT NURSERY AND PROBLEMS

The central nursery has a labor force of about 14 people including 1 foreman and 4 women, who together join their hands and try their very best to cooperate with the bulk and stress of the work which the nursery management makes them responsible for. In the nursery, activities are constant or rather consistent and also at a consistent pace for almost, if not all the time every day.

In the nursery, things are not always bright as one expects and many problems prevail which I will mention later. The location of our nursery is

good. It is situated in a relatively flat area with a very low salinity and away from the coastal area which has salt laden winds. A river flows nearby, drainage is good, there is little soil compaction and there are no animals grazing the beds.

The nursery's production is mainly for the forest activities. It supplies the different forestry ranges with the required kind and amount of plant species needed so that reforestation and afforestation can be carried out throughout the island. In this way we will maintain the small amount of forest left and also try to improve on the percentage for as one man said "La foway say la vie."

Problems facing the nursery are as follows:

- Plant shortage - this is due mainly to an inadequate amount of seeds sown and also to early requests to the nursery manager for certain quantities of plants.
- Germination - in this area the nursery is not constant, some years there are good results from seedlings and in other's results are poor. The reason should be investigated,
- Diseases - there are not, to my knowledge, any Dread-diseases, but there are effects on Honduras mahogany (Swietenia macrophylla), which is damaged by the shoot borer called Hypsiphyla grandella, and blue mahoe (Hibiscus elatus) a species troubled by caterpillars and butterflies.
- Seed orchard - the nursery requires an orchard which would help increase the seed program and also to decrease the soil diseases if any. The more one could avoid collecting seeds in various parts of an island forest, the greater the chances of stopping the disease, pest, and insect problems. There would also be more production in the ranges because the men which would labor in making nursery activities would now be engaged in other areas.
- Soil tests - they should be carried out so as to determine the pH condition of soils and also to know which and how many species should be in an area.

PLANNING FOREST NURSERIES

The first decision is whether to establish a formal nursery or to obtain seedlings from elsewhere. Factors of remoteness, cost, and availability of a site are all important, but usually an annual requirement of 20,000 seedlings is the minimum needed to justify starting a small nursery.

Types of Nurseries

There are three main types of nurseries. A permanent nursery (forest) which supplies seedlings for many years and usually in large numbers. A temporary flying nursery, which is established for a short period of time, usually less than five years, to meet a specific but temporary local need.

The third type, an extension nursery, rarely forms part of a regular plantation program but is established to provide plants of many species useful to the local community for amenity, firewood, fodder, posts, and poles.

There has been much discussion whether to have several small scattered temporary nurseries, or one large permanent one. However, the two types of nurseries should not be seen as exclusive alternatives but ones suited to different needs. Moreover, in a major plantation project both may have a place.

Temporary or flying nurseries

Both because of remoteness and the relatively small requirements of plants, much of early plantation development in the tropics were based on temporary nurseries.

The temporary nursery is located near or within the planting area on flat ground where the soil is workable and a regular water supply (perennial stream) is available. This confers several advantages: nearness to the planting site improves survival because transit time between nursery and plantation is short and plants suffer less from overheating, windburn, and loss of soil and bruising due to vibration on long journeys; transportation costs of bulky plant containers is reduced; the capital investment needed is low; and by having many small nurseries, isolation of diseases and other damages is much easier.

The main disadvantages and the reasons why the trend is towards large permanent nurseries, include: high cost per plant arising from a small scale of operation and low level of supervision; lack of permanent installations limits species grown to ones not requiring special attention; and greater risk of damage and theft owing to less on site supervision.

Permanent nursery

All major projects have at least one permanent nursery, though its functions may include supplying temporary nurseries at remote stations. The preference for permanent nurseries is illustrated by the kind of reasons why South African Forest Investments (SAFI) in 1978 abandoned their 10 small nurseries to concentrate all production of Pinus caribaea and P. elliotii seedlings in one centralized, efficient nursery, able to produce two million plants/year, as well as moving to the nursery bare rooted production methods replaced by raising plants in containers.

Advantages of the permanent nursery are: site is carefully selected to take advantage of natural features, in the above case the site was a recently felled P. patula stand where the soil was an easily workable sandy loam and virtually free of weed seeds; staff live near the nursery in permanent housing which results in better care and supervision; the concentration of capital investment enables purchase of modern silvicultural aids, cultivation and irrigation equipment, sprayers to control pests, diseases, and weeds, etc; high production, high survival and good quality make for efficient operation and consequently lower unit-cost per seedling; and centralized operations permit easier planning, maintenance of records, and stock control, which

allows better forecasting of production and costs.

NURSERY MANAGEMENT

Successful nursery operations depend on many factors including: selection and development of a suitable site; efficient supervision and administration, adequate planning, forecasting and control procedures, and orderly timing of operations; use of appropriate cultural methods; and protection from pest, diseases, and other damage.

This list shows the complexity of nursery work. Perhaps more than in any other forestry operation, planning, organization, and control are required to avoid large surpluses or short-falls in seedling production.

The main operations in a nursery include: planning, controlling, and recording at all stages from receipt of seed to consignment of plants to the forest; seed storage and pre-treatment; soil preparation in the seed bed or container; basal fertilizer production and top dressing to control seedling nutrition; sowing seed and/or rooting cuttings; operations of pricking out, standing out, undercutting, lifting, transplanting, etc; control of weeds; protection against climatic damages - irrigation, shading, and protection against fungi, insects, and animals; and packaging and dispatching of plants.

A qualified forester normally is in charge of a large permanent nursery. In most cases, a core of specialized labor is permanently employed and is familiar with all routine nursery operations.

SOILS AND TOPOGRAPHY

Areas designated for nursery beds should be as flat as possible. For drainage control, beds should be constructed with proper contour and slope rather than giving a slight slope to the entire nursery area. Areas subject to flooding or having steep slopes and large stone or rocks should be avoided. Former forested sites containing numerous subsurface roots, formerly cultivated sites that have known root pathogens or weed problems and areas with wolf trees are also avoided. Now, for container production, native soil type is not so important since potting media is brought in from outside. But, for the traditional field nursery, using seedbeds subject to drainage, trafficability and nutritional problems, soil and topographic considerations are crucial.

Soils between sandy loam and silt loam have good drainage and do not compact easily; they also till easily and do not crust over following rains or irrigation.

Heavy clay soils are undesirable since they cause root breakage in lifting bare root stock; they also require greater monitoring to detect poor drainage and associated poor root system development. Optimum pH values vary according to the species growth: e.g., for pines, the range is usually pH 5.5-6.0; for hardwoods, slightly higher pH values around 7.0 are suitable, when acidity drops below pH 5.1 or is much higher than 7.0 corrective actions must be taken.

NURSERY SITE AND LOCATION

Careful siting of a nursery is important. Not only is it where substantial investment and development takes place but it has a strategic value having a large concentration of labor available for rapid deployment in case of forest fires or other emergencies. Choice of location is determined by factors of management and silviculture.

Of first importance for management is a good access to and within a nursery at all times. Secondly, a continuous water supply for irrigation is usually essential. Other facilities such as electricity and telephone are desirable. Where water is not supplied by main services, a nursery must be sited by a perennial stream. Thirdly, there should be ready access to local labor, and the nursery manager should be housed within or near the nursery. Commonly, nurseries are sited near townships.

Labor

Locating nurseries near town or villages allows unskilled workers and laborers to commute short distances to the nursery work site. Since much nursery work is seasonal, people can supplement their income through other jobs found in their communities or their own small farms. If labor must be brought in from far away cities, and housed and fed in work camps, expenses will be very high.

Water and Air

Preferred water sources are large lakes or pollution-free rivers and streams. Water can be pumped to elevated tanks and then distributed under pressure through a sprinkling system. Before tapping public water systems, check first if supply is adequate and free from excess minerals. Monitoring all water sources once a week for excess salts, especially calcium, is important. Higher salt levels can raise pH, causing roots to rot, or may be toxic to plant roots or affect nutrient availability. Soil pH above 7.0 is less favorable for mycorrhizal growth and tends to favor the pathogenic fungi that causes damping off.

Air pollution may be a problem in developed or even in remote areas, depending on local wind and related factors. Photo-toxic pollutants, including sulphur dioxide (SO₂), hydrogen fluoride (HF), and ozone (O₃) can be carried downwind onto a nursery and settle out directly on seedling foliage; they may also enter the nursery area indirectly through incoming rainwater. In extreme cases, acid rainwater has burned seedling foliage and caused death of seedlings.

PROBLEM RESOLUTION

I will make a few suggestions which may prove to be costly, but due to the importance that forests have in our communities, I think that they shall be considered. It is in this light that I say that very special and careful consideration should be given to the following recommendations.

- A new nursery should be established in the southern part of the island, which is Vieux-Fort, where suitable land may be available.
- It should be a permanent nursery with about twenty plus people employed.
- Seed collection should be from its orchard which would put a stop to low production in the sense that the hands which were all occupied in nursery activities in their ranges would now be engaged elsewhere. This would also control the spreading of diseases, pests, insects, etc., and one would only have to worry about the existing problems caused by those mentioned above and not by incoming ones.
- Good and proper irrigation system should be installed.
- Easy access to and through the nursery area must be included.
- In the absence of a forestry owned lab, permission should be sought so as to use the Agriculture Lerence Lab for the purpose of carrying out soil tests.
- Proper training or rather a qualified nurseryman should be sought to maintain the runnings.
- The importation of exotic seeds for our nursery is recommended, provided proper checking for diseases is undertaken.
- We must also consider the timing of seed collection relative to time of planting.
- I also suggest that we should have a research department, to undertake the nursery problems, in fact, forestry problems on the whole.

The need for two transports will arise (pick-up, vans) the cost of which together ranges somewhere in the region of \$45,000 (ECD). In determining the species to be planted, I suggest that all species which will grow on our island should be planted. Extra workers, about six to be exact, would cost per year.

ACKNOWLEDGEMENTS

I profit this opportune privilege with gratitude to acknowledge Ariel Lugo, Project Leader, Institute of Tropical Forestry; Edwin Maldonado, Course Coordinator; Nilda Echevarria, Secretary; JoAnne Feheley, Librarian; and to all the lecturers and staff, but most specially my advisor, Leon H. Liegel, Soil Scientist of the Institute of Tropical Forestry.

TRAINING AS RELATED TO FORESTRY IN JAMAICA

Llewellyn A. Hall
Jamaica

INTRODUCTION

The Forest Department of Jamaica is one of many departments to fall under the Ministry of Agriculture. The Department began its operations in the early 1940's with help from the Government of Jamaica and from UNDP, FAO, and USIS. With a minimal staff and little experience, training was a necessity, as forestry was a new industry in Jamaica.

From its inception, the objectives of the department were to establish plantations of various species as well as to protect "mother nature", which means natural forests. It was not until the 1970's that a research unit was established within the Department. From that time until now, we have been having expert researchers coming to the island to give their professional advice as a means of on-the-job experience.

In early 1979, there was a significant change within the Forest Department. A new company was formed by the name of Forest Industries Development Company (FIDCO). With the creation of this new company, many forest department technocrats were taken to this commercial venture.

The project is being funded by the Jamaica National Investment Corporation (JNIC), which is a government owned subsidiary, the World Bank, and the Commonwealth Development Corporation (CDC). There is not much training needed in this sector (FIDCO) since most of the experienced personnel was drawn from the Forest Department. This company presently leases all the government owned pine plantations from the Forest Department. They are presently involved in logging operations and in the establishment of more pine plantations with a scope to extend their operations over the years to come.

STRUCTURAL ORGANIZATION OF THE FOREST DEPARTMENT

The Forest Department has within it's organization various sections, namely: Administration and Management, Research, Regions, Soil Conservation, and Training.

Administration and Management

The Management section is head by the Director of Forests, who is assisted by a Deputy Director. They are the ones responsible for carrying out the government forest policy. Meanwhile, the Administration section is head by a Forest Administrative Officer and has subsections in Personnel (responsible for employment and the department records), and Accounts (responsible for the budgeting of the Department). With limited experience and training in the lower half of the Accounts and Personnel sections, things tend to get a bit complicated at times.

Research

This section is head by a Senior Research Officer, and has four local researchers or project leaders. The function of this unit is to carry out all aspects of research in the forest.

Each project leader is a professional specialized in one particular aspect of forestry. They are assigned technicians to perform most of the field work but very little office work, due to the limited knowledge of office procedure. A special employment program for high school graduates initiated by the previous government, assigned students to the different Government Ministries. As a result, unskilled personnel had to perform research work.

This program has since been discontinued. Presently, the Forest Department is committed under the terms of the World Bank, IBRD/CDC and Forestry Development loan to do all research work necessary for the development and conservation of forestry in Jamaica. Funds are being provided by this loan to accomodate the foreign exchange costs for training and equipments. In 1980, a Senior Research Officer under ODM Technical Assistance Program was recruited to assist in developing the research program. This officer will be here for a period of five years.

Regions

A region is a branch of the main office that performs certain activities in a section of the island. There are four such regions namely: Southern, Northern, Western, and Central. Each region is head by a qualified graduate, who holds the post of Forest Officer (attached is a map of Jamaica showing the various regions). Each Forest Officer has with him a Forester, a Headman, a Forest Warden, and casual workers.

The regions are there to establish and maintain plantations, to construct and maintain forest roads, and to perform land cleaning. Therefore, we think in terms of qualified personnel to perform these functions, this is another area on which I feel some form of training should be given.

Training

This section was set up through a loan from World Bank, IBRD/CDC, in order to carry out all work necessary to provide training for the forest sector. Funds are being provided under this loan to cover foreign exchange costs of all training required.

The need for training at all levels in the forest sector is recognized. To achieve the targets identified, a Senior Training Officer and a Training Officer have been recruited under ODM Technical Assistance Program, to assist in developing career paths for individuals hired by the Department. Presently, there is a Training Officer at the technical level in the Department. The presence of this Training Officer and the Training Program have helped somewhat. Numerous in-house trainings as well as overseas trainings have been held.

Soil Conservation

This unit was recently transferred to the Forest Department from the Engineering Division of the Ministry of Agriculture. Incidentally when Soil Conservation joined in with the Forest Department, the name of the new organization became "Department of Forestry and Soil Conservation". However, most of the soil conservation work is done through projects and is not totally dependent on the government of Jamaica for funding. Some of the responsibilities are:

- Identify, plan and implement major soil and water conservation projects and then hand these over to the regions for the production and maintenance aspects.
- Advise on policy and legislation on land use and all matters related to soil and water conservation.
- Provide personnel training in soil and water conservation locally, and identify scholarships and training opportunities abroad.

TRAINING REQUIREMENTS

For purposes of this report and to simplify matters, I have divided training into three categories: on-the-job experience, in-house training, and overseas training.

These three categories of training, in my estimation, will cover all aspects of forestry. When we think in terms of on-the-job experience it is basically gaining some knowledge of the proper know-how from superiors, hence a better work performance. This training could be considered for all categories of forestry workers.

In-house training could be recommended to all categories of forest workers as well, but to be more specific, to research technicians, administrative staff, and field workers. Going through this training (done by Senior Officers or professionals), would prepare these workers to perform an efficient as well as a quality work. This training could and should be done locally by means of seminars.

Overseas training shall be applicable to personnel in the management field and qualified personnel with a scope for improvement. It can either be on a short-term basis, which would entitle the participant(s) to a diploma, or on a long-term basis (degree course) at a forestry college or company. By doing so the course would certainly prepare the candidate(s) to a senior post or a post that would be created. The question that now hangs in the air is who needs training? The answer to that is, personnel who show signs of interest and dedication in their work as well as possess some form of qualification so as to enhance their chances of being selected for training should there be an opening. Presently within the Department, workers are eager to get the job done, but lack of training has hampered that. Already steps have been taken to alleviate this problem. Presently, there are several personnel involved in overseas training at short or

long-term level. Meanwhile, we have been having in-house training in the island for all categories of workers. So one can be optimistic about the future as far as training forest personnel is concerned.

On a whole, I can only hope for the continued support towards training not only in Jamaica but in the rest of the islands.

RECOMMENDATIONS

In presenting my recommendations, I wish to emphasize that the Department training needs shall be seen from two perspectives: immediate short term training, and long term training.

Immediate training should prepare present staff to cope better with the existing situation. Already, steps have been taken in the right direction, with the organizing of a short term course here in Puerto Rico. The courses should be designed in such a way so as to give candidates a head start in pursuing a career in Forestry. Emphasis should be placed on young qualified personnel desirous of working with the Department, as well as capable personnel who are already in the service.

It must be realized now, that there is a need to replace the officers who have left the Department in one way or another. Thus, consideration must be given to personnel who are in line for such a post to obtain training so as to fill the vacancies. The training for this professional job shall last 3-4 years, at a forestry college. Seeing that Jamaica does not possess any institution that could satisfy this need, therefore, I suggest some possible locations: Trinidad (diploma courses), United Kingdom, USA, and Canada (degree courses). See appendix for subjects offered in Trinidad. There are cases where individuals are performing duties that are above their level of employment. Short-term training or in-house training should be considered in order to prepare this people to make a better work.

I am not in a position at present to identify the areas which have vacant posts and therefore need professional personnel. But what I can say is that there is a need for professionalism in all areas within the forest sector.

When we were given this case study, as part of this training course, I was a bit confused as to what aspect of forestry I should write on. I came to the decision of training. One of the reasons was that if it weren't for training I would not have been here making this report. Although, there are other problems which exist in the department, I believe that with the advent of training much of the existing problems would be solved. With the new training program now initiated by the Department it cannot be over-emphasized the dire need for trained personnel within the Forestry Department of Jamaica.

ACKNOWLEDGEMENTS

I must extend my sincere thanks to Mr. Roy S. Jones, Director of Forestry Department in Jamaica, for his presentation of Forestry of Jamaica,

from which I gain most of my information. This presentation was made in Castries, St. Lucia and is now available in book form titled "Forestry in the Caribbean", US MAB Report No. 7, edited by Dr. Ariel Lugo and Sandra Brown.

APPENDIX 1

Training that is available at the Eastern Caribbean Institute of Agriculture and Forestry (ECIAF) in Trinidad at the technical level

Year I

Courses	Number of Hours	
	Theory	Practical
Silviculture I	60	90
Mensuration	40	60
Photogrammetry	20	30
Introduction to Parks and Recreation	20	30
Wildlife Management I	20	30
Dendrology	20	30
General Forestry	20	--
Wood Technology	10	30
Forest Surveying	20	30
Surveying*	20	30
Botany*	40	60
Geology, Soils and Soil Fertility*	40	--
Genetics	20	--
Sociology	20	--
Introductory Economics*	30	--
Care and Use of Tools*	10	20
Total Hours	420	445

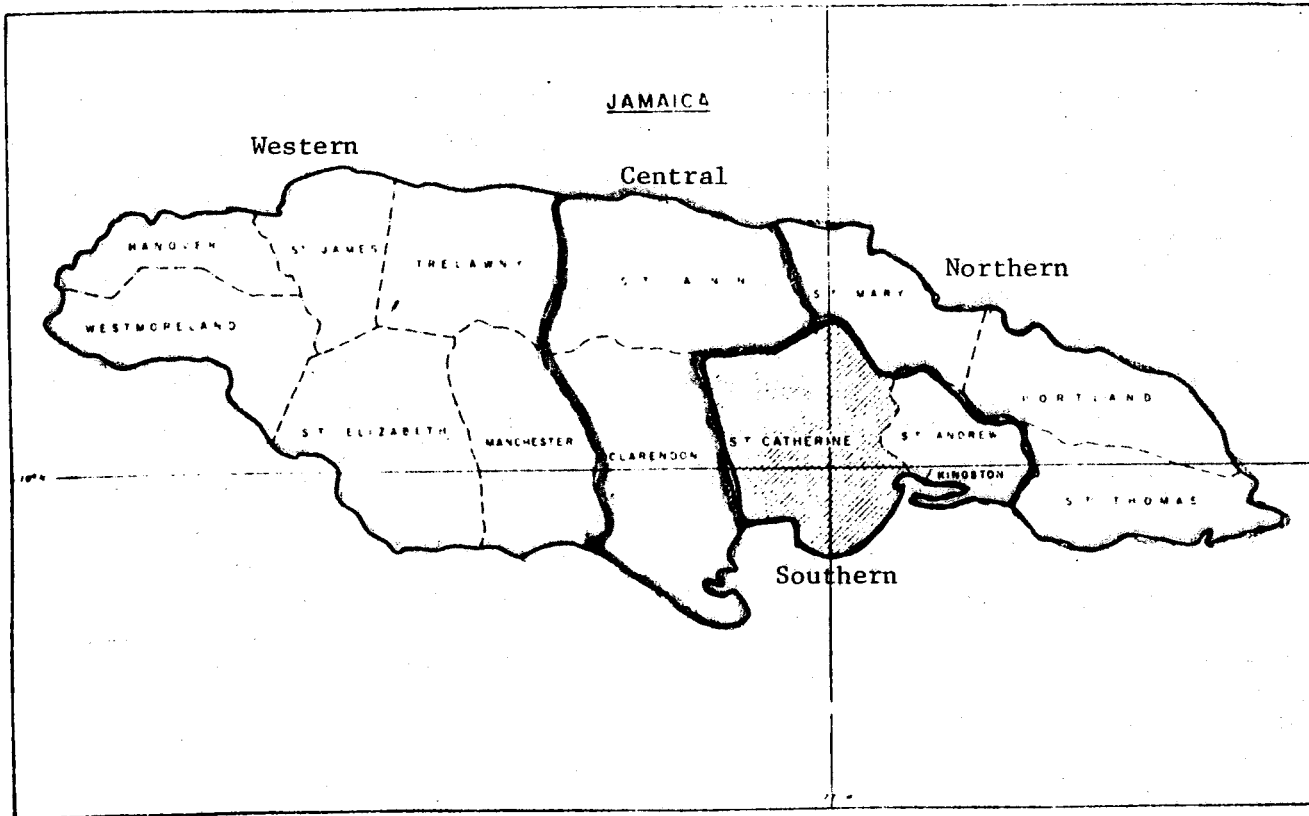
* Common course to both Forestry and Agricultural students.

APPENDIX 1 (Continued)

Year II

<u>Courses</u>	<u>Number of Hours</u>	
	<u>Theory</u>	<u>Practical</u>
Silviculture II	20	30
Silvicultural Systems	20	30
Forest Management	40	60
Forest Policy and Law	20	--
Administration and Personal Management	60	--
Recreation Management	20	30
Wildlife Management II	20	30
Watershed Management I	20	30
Watershed Management II	20	30
Forest Engineering	40	60
Forest Utilization	20	30
Fire Protection	20	30
Forest Entomology and Pathology	20	30
Research Practices	20	--
Forest Influences	10	--
Project	<u>60</u>	<u>60</u>
Total Hours	430	450

Map of Jamaica Showing the 4 Regions



INVENTORY OF FOREST RESOURCES IN ANTIGUA

McRonnie Henry
Antigua

INTRODUCTION

Forestry in Antigua is faced with several problems and setbacks. These include the lack of a rational forest policy and forest development, a lack of forest awareness and interest by the people in general, and inadequate governmental legal and enforcement powers. There are also physical limitations related to the climate and land area.

Fortunately, although it is not possible to eliminate all of them, none of these problems prevent the initiation of an essential forestry development and research program. An inventory of the forest resources and potentials is needed as a reliable factual base on which to make and pursue reasonable plans in accordance with our needs.

HISTORY

The island, like most of the other islands in the Caribbean, was once densely forested. With the onset of settlement and the subsequent pressures on the land due to development (the need for space, shelter, food, clothing and fuelwood), attrition, and the effect of fire, the situation began to change dramatically. The percentage of bush cover is now considerably reduced. The removal of vegetation, especially from the slopes, gave rise to accelerated erosion and reduced the capacity of the land to retain water.

Following the abandonment of sugar cane and the estate system, the pressures on the forests (steeper slopes, higher elevations) eased considerably. People could utilize more of the flat lands for their agricultural activities. This situation favored the emergence of the secondary forest, which for the most part developed slowly, due mainly to the marginal rainfall (average of 1143 mm (45 in) per year) and to the reduced fertility of the soil because of previous erosion.

Today a few farmers utilize and depend upon private lands in forest lands for agriculture; mainly bananas and tree crops. The forest is an unmanaged source of fenceposts, charcoal, firewood, wattles, and timber, all of which are in great demand. If the trend of uncontrolled cutting of the natural woodlands continues, there will be a rapid depletion of the forest resource, with disastrous consequences. Already, the country relies on importation, at a great cost, for practically all its poles, fenceposts, and sawwoods.

ENVIRONMENT

The island is conveniently divided into three main regions:

The limestone areas of the north and north-east. The terrain is

ondulating and the soils are mainly clays or clay loams over calcareous deposits.

The central plain which is for the most part below 15 m (50 ft) in elevation. There are several ridges, generally running north-west to south-east. The alluvial soils vary from deep sandy loams to heavy clay soils. The alluvial soils tend to be stony and shallow and the influence of parent material is pronounced.

The south-western hilly region, which attains 402 m (1319 ft) at Bogg Peaks. There are a number of summits and ridges around 305 m (1000 ft). Relative relief is considerable, with deeply incised valleys and a radical drainage pattern. The main soils of this region are moderately heavy, well drained and shallow over andesites, basalts or tuffs. Where tree vegetation is absent, erosion is active and soils are consequently stony and shallow.

This south-western hilly area is of interest to forestry activities. The island's largest tracts of secondary forest are found in this area. It is the area that receives the most rainfall, with an annual average of approximately 1524 mm (60 in). The island's major watersheds are also located in this area. For those reasons the area is fairly fragile and should be protected at all cost.

It is expected that a forest inventory would provide the necessary information relating to this area. That would give us the opportunity to approach the situation in the best manner possible.

The mean maximum temperatures range from 27.9°C (82.3°F) in January to 30.6°C (87.0°F) in August and the mean minimum temperatures vary from 22.4°C (72.2°F) to 25.5°C (77.9°F). Almost half of the rainfall occurs from August to November, with a marked dry season between February and June.

FORESTRY NEEDS

The main forest produce needs are firewood, charcoal, fenceposts, poles and sawn lumber. In addition to these needs, provisions should be made for recreational activities, and the protection of wildlife.

Firewood, charcoal, and fenceposts are produced locally, while poles, sawn lumber and some fenceposts are imported. Locally produced firewood, charcoal, and fenceposts are obtained mainly from uncontrolled cutting in natural woodlands. As a consequence, some areas of natural woodlands are steadily being depleted. This is one of the factors underlying the need to set up a forestry section and to maintain the areas of natural woodland.

From a conservation view point, there is a need to preserve natural woodland and vegetation on the steeper slopes and hills. In other areas, the process of accelerated erosion requires re-forestation and other physical measures to arrest further degradation and harmful effects on the environment.

In short, there is an established need to conserve what natural forest remains, to restore degraded areas, and to develop production plantations of fast growing species to meet local demands for fuelwood, posts, and poles.

If conservation, re-forestation, and production programs can be combined, then economic benefits of improving degraded areas would be enhanced.

FORESTRY DEVELOPMENT

Forestry is the responsibility of the Department of Agriculture. Recently, there have been some attempt at establishing a forestry section. I have had some basic training and exposure in forestry at the Eastern Caribbean Institute of Agriculture and Forestry, Trinidad, along with what I have received here at the Institute of Tropical Forestry. I am more or less responsible for forestry activities.

There are six forest rangers charged with the responsibility of patrolling and protecting the forest and natural woodlands from indiscriminate cutting and reporting any unusual or serious developments therein. Each ranger is assigned a separate section, but may be called upon to render support in any area where he might be more urgently needed.

There are several non-established workers who are mainly concerned with the development and maintenance of parks and gardens, but can also be called upon to perform other duties related to the forest.

There is an active program of delineating forest which should be continued, because without defined boundaries, protection of the remaining forest is almost impossible. The cost of present boundary cutting is high, and studies should be made to determine methods which will increase the efficiency and output of this operation.

Some research has been done in the past few years on the adaptability of certain exotic tree species. These species include:

Pinus caribaea var. hondurensis and var. bahamensis. This experiment had as its main objective the introduction of appropriate strain of mycorrhiza. Several types were tested. Only one showed any sign of taking.

Eucalyptus spp.: Several species were tried, but because of poor conditions and insufficient knowledge of proper techniques, the experiment was a failure.

Leucaena leucocephala: By far the most successful trial has been that of Leucaena. Varieties came from places as far as Hawaii, the U.S.A. and the Philippines. Presently there are three small stands. Results indicated heights in excess of 9 m (30 ft) and diameters exceeding 15 cm (6 in) in approximately three years.

IMPEDIMENTS TO FORESTRY DEVELOPMENT

As mentioned before, there is a need for a rational forest policy and for the initiation of forest development in Antigua. But there are a number of constraints to forestry development.

Environmental Limitations

The main limiting factor is climate, and in particular rainfall, which averages only 1143 mm (45 in) per year. The main disadvantage is that low rainfall averages limit the rates of tree growth. However, with proper techniques and suitable tolerant fast growing species, it might be possible to achieve adequate yields of minor wood products such as fuelwood, posts, and poles. There is also the less critical problem of insufficient land area which arises, as we seek to achieve a reasonable balance between the need (on the forest) for wood and conservation, and other forest needs.

Absence of Forestry Institutions

There is no definite forest policy to act as a guide, however broad it may be, in determining the type of management to which an area is subjected. There are no clear statements as to the needs and the emphasis to be placed or the means of supplying those needs through the proper approach and appropriate management of the forest. There are no established rules to follow. Lacking also are the various infrastructure components necessary for establishing and implementing such a policy.

A Lack of Forestry Tradition

Traditionally, the people of Antigua are agricultural people. The forest was just a convenient source of wood for housing, fuel, and crafts. There was no thought about maintaining its productivity to achieve a sustained yield. Perhaps, the idea or view was that it could never end. This was an unfortunate situation because today a great percentage of the forest is depleted to a level below what the country can really afford. Sadly, the masses are still unaware of the gravity of the situation. There is a need to conserve what natural forest remain and to combine this with reforestation programs and plantation production systems of fast growing trees to provide for those needs. Indiscriminate cutting is still carried on to a considerable degree.

Inadequate Legal and Enforcement Powers

Whatever legislation occurs, appears to be very vague and inadequate. There are no means of carrying them out, and the public is not made aware of the laws and regulations.

Lack of Trained Personnel

There is not enough trained personnel to initiate and execute a rational forestry policy. There is a need for greater knowledge of technical forestry techniques for development.

RECOMMENDATIONS

The following actions are needed:

A study to determine how a forestry section can best be established and developed in the Department of Agriculture; formulation of a forest policy along with a legal basis for action; the staffing, training, and funding to implement this policy; and, reliable data of forest needs, including present conditions, markets, pricing, etc. This information would help to establish a base for planning.

REASONS FOR A FOREST INVENTORY

Forest inventory may be taken to mean the preparation of a detailed descriptive list of the forest and its components. This list would include identification, location, quantity, and value of each forest component. It is normally related to a period of time and the information must be reliable and satisfactory.

The objective of all forest inventories is to describe quantitatively populations in such a manner that the results are practically useful for purposes of forest management, planning, execution, and control. From these data the forester can select, from the multitude of possible alternatives, those that are likely to best serve future needs.

Before any specific detailed plans can be made, it is necessary to determine what actually exist on the ground, its relative location, and its potentials. This of course, must then be related to broad-based plans; plans which indicate the trend or direction in which Antigua would like to go. These plans must be in direct accordance with the country's needs. For instance, if there is a need for a greater supply of fence posts, then one would have to determine, among other things, if those needs could be satisfied from the existing forest, and for how long a period.

The aim of this inventory should not be purely the assessment of the production potential of the forest. It is more and more recognized that the conservation of forest plays an important role in the regulation of climate and of the water regime, and thus significantly affects all surrounding environment including agricultural production. The inventory should be pursued in such a manner as to take into account this view point.

Watersheds, therefore, become a very important area of study, especially on a small island with low precipitation. It is very important as a consequence, to locate, demarcate, describe, and protect by way of management these critical areas.

In order to plan effective forestry programs for Antigua, there is a need to determine first of all, the precise boundaries of existing forest, whether public or private, and the prevailing conditions that would determine their treatment. This would provide information as to the area of forest. Then, the extent of area that should remain under forest, regardless of present condition or ownership. This information determines what needs to be done; if some areas would require re-forestation or left to natural regeneration and succession, or if exploitation can be done in some areas against others.

These areas should be properly identified, demarcated and protected. They should be described in detail from the inventory perspective.

To accomplish the above, it will be necessary to have on hand;

Topographic maps, soil maps; and land use and land ownership maps. These maps and other recorded information should be supplemented by actual ground reconnaissance. Field plots where measurements are taken should be marked permanently so that they may be periodically remeasured to show trends in tree growth, composition, and wood volume.

Along with the investigations being carried out on the forest and potential forest areas, there should be some form of meaningful survey being conducted to determine the present and future demand on the forest. This data should be related to use, markets and pricing, etc. for fuelwood, posts and poles. In addition, there is a need for accurate projections based on the expected use of the forest for protection services, wildlife, recreation, and water.

The sampling method recommended for tallying trees is located in Appendix 1. The instruments required for conduction measurements are listed in Appendix 2. Suggested measurements to be taken on trees are listed in Appendix 3.

RECOMMENDATIONS FOR INVENTORY

Personnel

The formation of field units comprising a superior, one or two assistants along with the rangers that are presently functioning.

Training

Special sessions shall be held whereby crew members can be instructed as to the reasons behind the need for an inventory, how it should be approached, what is required for practically carrying out an inventory, what types of measurements should be taken, what instruments are necessary and how to use them, and to record and analyze data, etc.

I also recommend that the government take steps, where ever possible, to provide training at a higher level for interested and qualified candidates; not only in forestry, but in environmental quality as a whole.

Equipment

A list should be drawn up of the various instruments and pieces of equipment that will be needed not only for the inventory exercise, but for looking forward towards the information gathered and forestry in general.

After careful considerations, a budget should be drawn up that would allow for purchasing the equipment and materials. Orders can be placed to "Forestry Suppliers, Inc.", from whom there is a catalogue.

Documentation

Careful records should be kept of all proceedings in the field and office. The information gathered in the field should be carefully documented. If possible, copies of any important or interesting finding should be sent (hopefully on a reciprocal basis) to institutions such as the Institute of Tropical Forestry in Puerto Rico, and others.

FINAL RECOMMENDATIONS

In the interest of forestry development in the country I recommend, briefly, the following:

- The establishment and development of a forestry section in the Ministry of Agriculture.
- Development of a forest policy.
- The staffing, training and funding necessary to implement such a policy.
- The legal requirements necessary to make the policy effective, and the means of enforcement. This includes well defined boundaries.
- Collection of reliable data of the markets (production, demand) and pricing for fuelwood, posts, and poles. Predict and promote demand of the forest for other purposes including recreation, education, water wildlife, fruits, etc.
- Personnel should receive the best training possible, both at home (in service) and at higher levels wherever and whenever possible.
- In the initial stages, the services of a technical officer from international or bilateral sources for 1 or 2 years, should be considered.
- Active programs of education and public awareness, through various channels, including lecture visits to schools.

APPENDIX 1

Sampling Method

Method: line plot cruising.

In line plot cruising, only a percentage of the total forest is measured. Sample areas are a series of plots arranged in a grid pattern. The number of plots their diameters, and the distance between grid lines determine the percentage of the area sampled. The samples are characterized by:

A series of circular plots (occasionally square or rectangular) arranged in a grid that encompasses the forest area. The plots are fixed in size according to the size of the vegetation being sampled. Distance between the plots in a line, and distance between lines are adjusted according to the percentage of sample desired.

Plot size is usually 1/4 to 1/5 acre for sawtimber and smaller for pole timber and sap lings.

A single person may cruise plots efficiently.

Brush and fallen trees are not a problem because the cruiser is not required to tally trees while running a compass line.

The data tallied are separated by plots allowing rapid summaries of information by timber types and other factors.

APPENDIX 2

Instruments

Diameter measurements: diameter tapes, calipers, and pentaprisms.

Height measurements: rangefinder, abney level, altimer (Haga, Blum-leiss, ets.), and hypsometer.

Basal area measurements: wedge prism B.A. Factor 10.

APPENDIX 3

Tree Measurements and Information

Species, height, amount of defect, merchantable height and volume, total volume, bark thickness, and regeneration.

Statistics - Analyzing the data mathematically based on inventory design.

REFORESTATION FOLLOWING HURRICANE DAVID

Ashton Lugay
Dominica

INTRODUCTION

Hurricane David, which struck Dominica in 1979 had adverse effects on the forests of the island. Approximately 70% of the forest area was severely affected mainly in the southern part of the country. Since then, several plans were initiated to stimulate forest recovery, especially in the worst affected areas.

Some of these projects have started and progress is reasonable in spite of technical and financial limitations. There are other projects which will take a longer time to implement e.g., the development of local species to merchantable size, as they were prior to the hurricane.

In view of these factors it has become imperative for the Forestry Division to expand its knowledge towards the planting and development of fast growing species which can substitute the slower growing native species. Such would greatly assist the Division in the post hurricane reforestation efforts and would also be a sound base for the trial and implementation of plantings of exotic species in the future.

FOREST COVER BEFORE HURRICANE DAVID

The forests of Dominica are divided into five climax plant formations which are: rain forest and lower montane forest, palm brake, montane thicket, elfin woodlands, and dry woodland scrub. Other types of land uses range from secondary forest to pastures and farmland. The humid or rain lower montane forests (19,926 ha) represent over 2/3 of all forested areas. It is in this type that large diameter trees are found.

Merchantable timber found there includes gommier (Dacryodes excelsa), chataignier (Sloanea spp.), and carapite (Amanoa caribea) and to a lower extent bois demasse (Licanea terantensis), which is numerically important but not a merchantable wood due to the high content of silica. In addition, there are invading pioneer species like bois carrot, bois blanc (Simaruba amara), cre cre (Miconia spp.), and bois diable (Licanea terratensis), which typically replace vegetation on old agricultural clearings due to nitrogen deficiency. In the poorly drained slopes of the interior, there are mang rouge (Tovomitia plumieri) and mang blanc (Bonita daphnoides).

To a lesser extent, in areas with elevations below 300 m are the dry scrub woodlands whose trees have very small and hard leaves. They are mainly short trees, but among them are dominant trees like the purple flower savannet and mapou (Pisonia sp.) which are found at higher elevations than the kampeck, also found in that area.

The dry scrub woodland merges into the seasonal forest and most of these lands have been ultimated, and the area has been replaced by secondary forest. Sometimes the dry scrub woodland is lost to cultivation or burning of the forest to provide pasture land. This is replaced by a xerophytic or dry community of woody plants, grasses, and sedges.

The montane forest grows between the rain forest and elfin woodland. The trees there are shorter than those of the rain forest. This is mainly due to wind velocity in the vicinity. In this area there are many epiphytes and the canopy is not as dense as that of the rain forest. Trees found in this area are mainly weginye, montany, bwa bandi, and bwa worry. Many of the trees found in the rain forest can be seen in the montane forest e.g., the mang worry and the mowisif. The chataignier can be occasionally seen.

Above 1000 m elevation is the elfin woodland or dwarf forest, whose name describes the low stature of its tree species. This is mainly due to low temperature and high winds. The leaves are thick and rigid and the most common tree is the kakle, which makes up at least 60% of all trees found there. Their branches have mosses (Bryophytes) and shrub mosses (Lycopodium) on them.

HURRICANE DAVID AND THE DAMAGES IT PRODUCED

On Wednesday August 29, 1979, Hurricane David, described as the most intensive in this century, lashed Dominica with a wind velocity averaging 92 km/hr, but gusts of 241 km/hr at the center. The hurricane passed just south of Soufriere and affected the island for 10.2 hrs. Besides housing and communications, which were severely damaged, an estimated 40% of the island forests between St. Joseph and Marigot, moving northwards and westward, sustained little damage, but almost 70% of all trees were uprooted, broken, twisted or badly damaged. Included among them were commercial species like gommier and carapite whose regeneration may take many decades. Virtually, every other tree that remained standing suffered severe damage and defoliation, and it will take a long time before certain species regain their crowns.

Several months after the hurricane, when timber was urgently needed for construction, salvaging of timber was negligible. Despite proposals and projects requesting aid for this activity, salvaging was done mainly by the Forestry Division and private farmers. A great percentage of downed timber was left on the ground and most of the needed wood was imported.

A few months following the hurricane, an assessment of the damages caused to the forest and forest plantations was made by a USDA Forest Service team. In total, 15 circular plots were studied in a variety of locations. Because of limited time, it was not possible to focus the attention on the main timber tracts in and around the northern and central forest reserves. Only 3 of the 15 plots were located in this area.

In spite of severe problems with access to the forest, it was possible to make an evaluation of the extent of damage. The evaluation indicated that tree survival was higher in the subtropical dry forest life zone, located on the leeward side of island. However, on the windward side, it was only in the subtropical wet forest that some tree survival was evident (45%), and in the

lower montane forest, survival was 33%. Because of the higher tree density in the lower montane area, more trees were unharmed there.

On the leeward side, in plantations of teak, mahogany, and blue mahoe, 10% of the trees were broken in the subtropical dry forest life zone, and 22% in the subtropical wet forest. Where there were larger trees, uprooting was prevalent and the survival represented 60%, and 85% of the total tree density on the subtropical wet and subtropical dry forest life zone plantations, respectively.

REFORESTATION EFFORTS

Present Projects

A two year special work program for Dominica, sponsored by the International Labour Organization (I.L.O.), started in March 1981 and included a forestry component. This component involved: (a) reforestation and soil conservation in five watersheds with an area of 1103 ha (2725 acres); (b) the construction of five forest stations in the areas to be reforested; (c) construction of 24 km (15 miles) and repair of 8 km (5 miles) of forest roads; (d) the construction and operation of a wood-working training center; and (e) construction of a nursery at the Botanical Gardens. These programs have proved to be fairly successful. However, because of the limited funds provided and the extent of damage present, it was only possible to do some of the areas under consideration. As a result, there are many areas still affected by the hurricane in which reforestation is critically needed.

There is also a Rotary/CIDA project in which 5000 m³ (2 million board feet) have been approved by the government, mainly on a salvage/construction project for two years. This program has also proven to be very successful. However, replanting of species that are cut down by natural regeneration, a process that would take decades, and the need for planting fast exotic species once again should be given attention. This project operates in or around watershed areas, which in the long run can affect the supply of water to people of the northern area (where it is located). The Picard river, which was one of the rivers under threat from this program, has been recently made a reserve area and a reserve boundary line have just been completed by workers of the Forestry Division.

Apart from these programs, there are no major programs going on, mostly due to a lack of financial and technical expertise. Another major problem is that for the past two decades there have been no major forest inventory carried out (the last one was done in 1962). That in itself, is a major problem which has hampered management of plantations and the precise evaluation of the amount of timber found in the country previous to Hurricane David.

Despite these setbacks however, the Forestry Division has taken upon itself to rectify some of the immediate problems, e.g., in the D'leau Gommier area some replantings of native species like the gommier and carapite were made, but on a small scale, because of the lack of a forest nursery. The traditional method of planting is used. Also, a plant nursery was established in the Botanical Garden where exotic and local species are grown and planted in the vicinity.

Future Activities

The Division has plans for reforestation, but financial and technical factors prevent implementation. Despite these, there is also the problem of setting up forest plantations in elevations below 300 m (1000 ft), because lands are privately owned.

To alleviate this problem (at least partially), the Forestry Division has introduced the taungya system to some farmers. In this system, agriculture and forestry go hand in hand. If a person has a piece of land planted in bananas, among the bananas one could also plant forest plantation species. So far, this has proved to be a relatively good way of alleviating the problem of forestry, but it is practiced in a very small scale and much needs to be done as to the teaching of the "new" system.

Another positive effort by the Division has been the awareness it has given to the youths on the forest through its magazine "Vwa Diablotin" (Voice of the Diablotin, now an extinct bird species). This project has gone through very well with the public, especially in schools, and has attracted much attention and "sympathy" to the needs of the Forestry Division. It is hoped that in the near future there will be more emphasis placed on reforestation, and in the need for introducing new species to places which has been devastated. This in itself would create more awareness to the needs of the Forestry Division.

CONCLUSION

Although recovery through natural regeneration is evident, the total recovery of the forest to what it was before Hurricane David would take centuries, especially among the indigenous merchantable species like the gommier and carapite, which take about half a century to reach that size. However, refoliation of the forest canopy is more or less back to its normality, especially in the rain forest.

On the other hand, there are areas that sustained very heavy damage, especially towards the south of the island, where regeneration is somewhat stagnated and even four years after the disaster it has very little vegetation and tree growth is very slow. It is in these areas that one expects regeneration to be slow and that trial of exotic and indigenous species should be made.

There are certain factors which could be pointed out that prevent the Forestry Division from functioning as it should. The main one being that the Division, which is a sub-division of the Ministry of Agriculture, is given very little recognition and is regarded as a place only for trees, and it is said that people don't eat trees. As a result there are certain forestry proposals which get very little or no support in the House of Assembly.

Another major problem which has severely affected the progress of forest activities is the problem of transportation, which has been a major setback. This problem has been partially alleviated because of the post hurricane efforts by certain foreign international bodies like the I.L.O. But there is

still a great need for more.

There is also a lack of training among forest staff, and an urgent need for training especially at the diploma level. Although there has been training at certain times, the knowledge received is very limited to the time available. Despite this, however, there is a general improvement in the qualified Assistant Forest Officer.

Also needed at present is more research. Researchers from the USDA Forest Service in Puerto Rico should assist the Division in various forestry techniques, and in identifying suitable areas for the production of exotic species.

Despite these setbacks the Division has achieved some of its primary goals, e.g., making forestry reach the schools. This in itself is a very good achievement, which we hope would be helpful in the future.

ACKNOWLEDGEMENTS

The writer would like to extend his sincere appreciation to all those who contributed in one way or the other in making this case study possible. Special thanks to Ariel E. Lugo, Project Leader, Institute of Tropical Forestry; the teaching staff, especially Leon Liegel, Soil Scientist, for expert advice; Edwin Maldonado, Course Coordinator; JoAnne Feheley, Librarian, who assisted in research; and Nilda Echevarria, who spend long hours in typing the material for reading. Also special thanks to the rest of the staff for their kind cooperation.

REFERENCES

- Economic Commission on Latin America. 1979. Report on the effect of Hurricane David on the island of Dominica.
- Edwards, J. and D. Dunn. 1978. The forest of Dominica.
- Liegel, L.H. 1983. Growth development and hurricane resistance of Honduras pine in Puerto Rico. Pages 28-48 in Puerto Rico Department of Natural Resources Ninth Symposium. Puerto Rico Department of Natural Resources, San Juan, P.R.
- Lugo, A.E., M. Applefied, D.J. Pool, and R.B. McDonald. 1983. The impact of Hurricane David on the forests of Dominica.
- Lugo, A.E., and S. Brown (eds.) 1982. Forestry in the Caribbean. Proceedings of the First Workshop of Caribbean Foresters held in St. Lucia.
- The conservation Foundation. 1970. Dominica-a chance for a choice.
- Trenawan, K.w. 1980. Emergency rehabilitation of agriculture and forestry sectors following Hurricane David.

PLANTATION MANAGEMENT AND PROTECTION

Peter Vidal
St. Lucia

INTRODUCTION

St. Lucia's Forestry Division was established in 1946 and has 10.81% of the total island forest lands under its management. Whereas approximately 1/4 of the forests are classified as exotic plantations, some 161 ha (400 acres) are planted with Honduras mahogany (Swietenia macrophylla) in large plantations, and quite a few in some patch areas. There are 405 ha (1000 acres) of blue mahoe (Hibiscus elatus) and less than 10 ha (25 acres) each in teak (Tectona grandis), and pine (Pinus caribaea). St. Lucia is a mountainous country, and most of the plantations are established on steep slopes (between 45°-60°). Some of these plantations have received enough maintenance, while others receive very little attention.

Plantations are not new in St. Lucia's forests. Plantations offer the possibility of maintaining and improving the usable wood yield of any given acreage of land. New lands are scarce, and since the population is growing rapidly, there is a great demand for more wood. Therefore, plantations have to be studied and managed in order to increase production. Our natural forest stands are disappearing rapidly, a reason why there is such a great need for planting, managing, and protecting plantations.

Plantations are established throughout the island in the following places: Forestiere, Louvette, Marc, Dennery, Quillesse, Soufriere, and Millet.

CURRENT NEED FOR WOOD PRODUCTION

St. Lucia imports more wood than it can produce locally. Since the population increases, there is a great demand for building materials, fuelwood, furniture, etc. In 1980, Hurricane Allen struck the island and our forests suffered great losses. One of the ways to initiate recovery is by introducing line planting in the natural forest.

The forest has quite a number of shrub areas with little or no commercial value; a few species found there are: paletuvier (Tovomita plumiere), bois cote (Tapura antillana), and fenille doree (Micropholis chrysophylloides). The secondary forest, which has been devastated by shifting cultivations, is commonly colonized by hermitelia species. Tree fern, bois canon (Cecropia peltata), and la glu (Sapium caribaeum) plantations should be established in these areas.

ACTUAL PROBLEMS

Plantations have been established in areas where the product cannot be extracted and converted due to bad roads, and in some areas, thinnings cannot

be made or done too late. We are not getting the best timber potential from the trees. The Forestry Division is being faced with erosion problems, e.g., gully erosion, which are causing damage to our soils and trees. The Forestry Division is also experiencing problems with farmers who are squatting within plantations.

SPECIFIC WORK

Some actions that can help to improve our plantations are: (1) carrying out proper planting programs; (2) learning more about thinning techniques; (3) using the proper method in thinnings; (4) control soil erosion by introducing check dams in plantations. Because of the extension of unthinned and unmanaged plantations already existing in St. Lucia, I think it would be beneficial to start basic thinning research.

I would like to study thinnings in the Dennery Range starting with species such as the Caribbean pine, Honduras mahogany, and blue mahoe. This initial study should be done in plantations which have never been thinned. I would like to start with the basal area reduction thinning to determine the volume over bark of the trees left after the thinning, and to compare the response of different species. The conditions under which certain species outgrow others should also be studied.

THINNING DEFINITION AND OBJECTIVES

The definition of thinning, given in Terminology of Forest Science, is a felling made in a stand at any time between establishment and initiation of a regeneration; cutting or clear felling in which the trees removed are the same species as the trees favored. Thinning is done for many reasons of which the chief ones are to: reduce the number of trees in a stand so that the remaining ones have more space for crown and root development; encourage stem diameter increment and to reach a usable size sooner; remove dead, dying, diseased, and any other trees which may be a source of infection for, or cause damage to, the remaining healthy ones; remove trees of poor form: crooked, forked, basal sweep roughly branches, etc., so that all future increment is concentrated only on the best trees; favor the most vigorous trees with good form which are likely to make up the final crop; and provide an intermediate financial return from the sale of thinnings.

EXOTIC WOOD QUALITY AND USE

West Indian Mahogany

West Indian mahogany is commonly planted in St. Lucia throughout the island. This first discovered species of mahogany, the world's premier cabinet wood, is easily recognized by its distinctive leaves. The sapwood is whitish or yellowish. The heartwood is reddish, pinkish, or yellowish when freshly cut, gradually turning to a dark, rich, reddish brown. The wood is moderately hard, heavy (specific gravity 0.7-0.8), and strong. It is very resistant to decay and to attack by dry-wood termites.

The wood is used chiefly for furniture, cabinet making, interior

finishing, and veneers, being easy to work and taking a beautiful polish. It formerly was employed in ship building, construction, and for beams. Roots and stumps of large trees are especially prized for their irregular wavy grain. It is considered superior in quality and durability to the wood of the honduras mahogany. The astringent bitter bark has been used in medicine.

Blue Mahoe

Blue mahoe has a tall straight trunk. The sapwood is light brown, and the heartwood is rich chocolate brown, resembling old mahogany.

The wood is rather hard, heavy (specific gravity 0.7), fine textured, very durable, and very resistant to attack by dry-wood termites. A now scarce furniture wood, it is used occasionally for turnery, musical instruments, posts, poles, building materials, and constructions.

Teak

One of the world's best known and most valuable timbers, it is important on ship building, particularly for decking. Its many other uses include fine furniture, flooring, joinery, interior trim, frames, doors, paneling, carving, turnery, tanks and vats, and laboratory fixtures. Thinnings from plantations have been established on government forest lands.

Caribbean Pine

The wood is reddish brown, soft, moderately lightweight (specific gravity 0.61-0.66), and used widely as a general utility lumber. Good for building materials and many other uses.

TREE IMPROVEMENT: OVERALL OBJECTIVES

Objectives of tree improvement programs are to:

- Provide the desired improved seed in commercial quantities. Individuals grown from improved seeds grow faster and have better wood quality traits than the same species growing in wild or natural stands.
- Develop a broad genetic base for the species desired; one purposely tries to include parents from many areas and environments that are well adapted (e.g., grow well) or have specific worthwhile traits, (e.g., higher wood density, straight bole, narrow crown, etc.).
- Develop strains for special problem areas or for specific products such as adaptability to wet, dry, or marginal sites; special resistance to insect and diseases; special traits for uses such as bag, newsprint, or glossy writing paper.
- Obtain maximum grains, or improvements in the shortest time possible.

Seedling Seed Orchard

Plant seedlings from superior seed phenotypes (tree parents) to produce mass quantities of genetically improved seeds. Advantages of this method are that:

- it includes many initial parents, using a broad genetic base;
- avoid vegetative propagation of species that are difficult to graft;
- it is easy to establish if only open-pollinated progeny are used;
- uses two cycles of selections which can be completed in one operation; and
- seed production can be combined with progeny testing.

Grafted Seed Orchard

In this method, both flower and seed production begin soon after orchard is established; orchard can be located in the most economic and convenient place for seed production; outstanding genotypes are used many times to produce large amounts of seed; and related matings in orchards are minimized.

RECOMMENDATIONS

- More emphasis should be placed on plantation management e.g., thinnings, pruning, study and research, and silviculture.
- More funds should be made available. Thus, the timber production will be greater in terms of volume. Soil and water conservation programs could be implemented in plantations. Funds will also make possible the acquisition of a chainsaw for the purpose of thinning and other plantation exercises.
- Our labor force should be increased in order to reach the maximum production possible.
- Roads should be on our priority list thus thinnings can be converted and utilized.
- Studies should be made on disease and pest control within plantations.

ACKNOWLEDGEMENTS

The officer responsible for this project acknowledges with gratitude Dr. Ariel E. Lugo, Project Leader, Institute of Tropical Forestry, through the U.S. Department of Agriculture, Forest Service and the funding Agency for International Development who sponsored this course. Further acknowledgement

should be given to Mr. Edwin Maldonado, Course Coordinator; Leon H. Liegel, Soil Scientist and advisor; Mrs. JoAnne Fehelley, Librarian; Ms. Nilda Echevarria, Secretary; and to all the lecturers and staff and to all who made this experience possible.

DEVELOPMENT OF A FOREST NURSERY IN ST. VINCENT

Edgar Williams
St. Vincent

INTRODUCTION

Approximately 16,600 ha (41,500 acres) of the total acreage of St. Vincent belongs to the state. However, no recent survey has been made to ascertain the area currently under forest cover. In addition to the natural vegetation, there is a "thrust" in the direction of plantation development. The primary objective is the conservation of soil and water, with some attention given to the preservation of wildlife. Timber production is considered to be very important but is presently treated as secondary because of a lack of funds to establish large plantations, difficult terrain, and lack of roads.

As the country presses on towards development, the need for timber production and the consequent exploitation of the forest becomes more acute. Hopefully, the constraints mentioned above can be overcome.

As harvests increase we need to have the means of replacing trees which would be removed in order to ensure a sustained yield. This would require a nursery of enough capacity to permit the production of many kinds of seedlings in sufficient quantity and of the best quality.

At present there is a small functioning nursery. However, it is considered inadequate in view of the country's already felt needs and foreseeable future. It is my objective, as the supervisor of the nursery, to highlight the problems as they appear, state requirements and make recommendations with an aim of expanding and improving the present nursery.

ENVIRONMENT

Topography

St. Vincent is extremely mountainous. Viewed in the distance, the land appears to rise sharply from the sea. The highest peak, La Soufriere reaches 1245 m (4084 ft).

Rainfall

The average annual rainfall ranges from 152 cm (60 in) around the coast to 406 cm (160 in) in the central mountains. Rainfall is as low as 89.9 cm/yr (35 in/yr) and as high as 226 cm/yr (89 in/yr) in the Grenadines.

Soils

Mainland St. Vincent is volcanic in origin. There are no large sedimentary deposits. All the soils are relatively young. The layers of ash thrown out during volcanic activities of Soufriere are still weathering. Generally speaking, the soils of St. Vincent are friable and readily eroded.

Water

Mainland St. Vincent obtains all its domestic water from a number of streams and springs in watersheds located in most of the central mountain ranges. In the Grenadines, dependence on rainfall for domestic water is high. Water is collected in private tanks, community (concrete) catchments, and from public ponds. There are a few artesian wells.

FORESTRY ACTIVITIES

Silviculture

In 1941, several hundred teak (Tectona grandis) stumps were obtained from Trinidad. Some of these were planted in the botanic gardens. They have grown extremely well, giving an average diameter of 23 in (57.5 cm) in 40 years. At about the same time that the teak was planted, a small plot of Honduras mahogany (Swietenia macrophylla) was established. These plants have grown fairly well, but have suffered severely from the shoot borer (Hypsiphila).

There are no records of further silvicultural work until the early 1950's when both teak and Honduras mahogany were planted in an effort to stabilize a village on the west coast which was threatened by a type of erosion previously unknown in St. Vincent. Large clumps of soil had been sloughing off close to the village at almost daily intervals, and had posed a serious threat. The two species planted, while not the most suitable for the particular situation, especially from a ground vegetation point of view, have grown well and have in fact done much to arrest the erosion and give some stability to the village.

From 1962 onwards, silvicultural work, even though still limited, became part of an ongoing forestry program. Recognizing the need for soil and water conservation and forest improvement, mainly in our watershed and catchment areas, emphasis has been and continues to be in these aspects of forestry.

Seedling Production

Pinus caribaea, blue mahoe (Hibiscus elatus), cypre (Cordia alliodora), teak (Tectona grandis), galba (Callophylum calaba), boardwood (Simaruba amora), mahogany, red cedar (Cedrela spp.), and yellow poui (Tabebuia serratifolia) seedlings have been produced on a regular basis. Some of these seedlings are produced in the existing small nursery; but again, it is stressed, that the nursery is too small, and with too many limitations.

Plantings are carried out mainly in the watersheds, utilizing lands which have been previously used as kitchen gardens by land renters. There are six such watersheds, four being main sources of domestic water supply while two supply water to hydro-electricity plants.

Annual rates of plantation establishment vary from a total of 6 ha (15 acres) in the 1960's to 26 ha (65 acres) in 1981. Small areas, I admit, but there has been some improvement. This increased rate in 1981 has been possible due mainly to financial assistance from USAID under its Basic Human Needs Program, administered by the Caribbean Development Bank. Work under this project is still in progress. There are now approximately 75 ha (185 acres) of blue mahoe, 30 ha (75 acres) of Pinus caribaea and 18 ha (45 acres) of Honduras mahogany, these three being the major species established so far. Growth has been satisfactory particularly in the blue mahoe and pine plantations.

The 1973 fuel crisis highlighted the need for more charcoal and fuelwood. The Division is currently establishing plots of fast growing exotic species on some coastal areas with a view to charcoal production. To this end, species of Eucalyptus, Leucaena, and Calliandra are being tested. Plans are to do trials with some of these species in the Grenadines, for fuelwood and forage.

It is with these ever expanding needs in mind that I call for an expansion and improvement of the present nursery. The problems being experienced at the nursery should be addressed in a more meaningful way if any progress is to be achieved in terms of satisfying our needs.

THE PRESENT NURSERY

Location

The present nursery is situated in the Botanic Gardens approximately 1.28 km (0.75 miles) from Kingstown, the capital.

Size

It is approximately 0.03 ha (0.7 acres) in size, all of which are being used. Already, the nursery it is hard pressed to accommodate the level of production now realized. It is completely fenced with wallaba post and barbed-wire. In the event of expansion, this fence would have to be removed and replaced at the new boundaries.

Soil

Dark, well drained, friable clay-loam. Not all seedlings are produced in seedbeds. Some are grown in plastic bags, which are neatly stocked in the yard; and as is expected, the soil in the bags is usually mixed.

Labor Force

There is one supervisor, myself, whose responsibility is to oversee all the activities of the nursery, including making day to day decisions and ensuring the execution of the directives of the Forest Supervisor.

There are three laborers; one female and two males. Their responsibilities involve the day to day activities necessary for the production and care of the seedlings. These activities include: preparation of seedbeds and bags for planting, sowing of seeds, spray watering, fertilizing, and other tending operations. This labor force is considered to be adequate, due to the small size of the area and the low level of production and lack of sufficient funds.

Capacity

Approximately 15,000 seedlings are produced each year in bags and another 35,000 are grown in open beds. These are used to plant approximately 16 ha (40 acres) annually.

Cultural Operations

The tending operations carried out by the workers from day to day are designed to produce the best seedlings possible. This includes such operations as:

- which spot weeding is done periodically to reduce the competition from weeds and to help aerate the soil;

- watering which is usually done manually by hose or by watering can. The hose, because it delivers water at a greater pressure, is usually used only for more developed seedlings. The watering can is reserved for the tiny seedlings, as it delivers water at a much lower pressure than the hose and is not likely to cause as much damage. The water is obtained via water mains to which the hose is hooked up. This exercise becomes tedious at times, considering the number of seedlings to be watered and the frequency of watering;

- fertilization including sulphate of ammonia, N, P, and K. Sulphate of ammonia is usually applied at a rate of approximately 1 oz/plant (varying slightly depending on the size of the plant), one month after germination; and

- protection although very little is done in terms of protection of seedlings. The surrounding fence acts as a physical barrier against such roving animals as goats, sheep, cows, etc. However, practically nothing is done to protect against insects and diseases. Specific insecticides are not usually applied as a preventive measure or used to eradicate diseases that might already be occurring. Consequently, the productivity of the nursery is reduced due to such factors as damping off and severe insect damage.

Seed Collection

Most seeds are collected locally. Pinus caribaea seeds are imported since there are no suitable seed production and collecting areas.

Seeds are collected directly from the trees at a time when they are just about maturing. Trees from which seeds are collected are carefully chosen for their good form and performance. Seeds are collected by climbing the trees with bags and hooked sticks.

Seed Growing

Seeds may be sown directly into prepared seed beds or into plastic bags. Seeds are sown when they are collected, usually on an average of three times in a year.

Maintenance

There is a fairly good maintenance program at the nursery. Attention is given first of all towards maintaining the fence which surrounds the nursery. The pipes are kept in good condition to ensure an unrestricted flow of water so vital to the upkeep of the nursery. The seed beds are kept in good condition by maintaining the edges, loosening the soil, and keeping the drains clean and opened. The buildings are kept in good condition through constant repair and replacement.

PROBLEMS

The nursery itself is one of the most important features in forestry. It forms as it were a foundation for the establishment of plantations and reforestation programs. With the increasing need and development of such plantations, the nursery and its functions are coming more and more into prominence and assuming larger dimensions.

When the above factors are taken into account, it immediately becomes obvious that the physical and managerial aspects of our nursery need changes. The physical boundaries need to be extended to provide more space for the increase in quantity of seedlings. The necessary supporting infrastructures must be developed in such a way as to provide maximum protection, comfort, and efficiency.

The managerial components of the nursery must also be improved markedly in accordance with the physical improvements, in order to ensure a higher level of production and efficiency.

Below is an account of what, in my view, is immediately required in order to achieve the desired objectives, as far the expansion and development of the nursery is concerned.

RECOMMENDATIONS

Capital

The government should look into the possibility of providing sufficient funds to effect the necessary expansion and improvement of the present nursery. Forestry is expected to play a greater role in the overall economic development of the country, consequently, there would be a greater reliance on the nursery to provide the vast amount of seedlings that will be required to meet the needs.

Size

The area of the present nursery is inadequate and restrictive. There is not sufficient space to produce the number of seedlings that will be required. At its present dimensions and capacity, it is producing only about 50,000 seedlings per year, used to plant approximately 16 ha (40 acres). At a desired planting rate of 32 ha (80 acres) per year, the nursery should produce approximately 100,000 seedlings/year.

Obviously, to produce this many seedlings, a larger nursery would be necessary along with other improvements in the form of infrastructure and labor. There is sufficient land adjoining the present nursery which, if approved, could be incorporated into the nursery quite easily, and this would go a long way in meeting the needs of the nursery as far as size and capacity are concerned.

Infrastructure

There is a need for adequate supporting infrastructure. It is not sufficient to increase the size of the nursery, without putting there the necessary buildings, roads, water delivery systems, storage facilities, etc. These are some of the necessities required in order to make the nursery functional.

Labor

There are presently about four workers, including the supervisor, at the nursery. If the nursery were to be expanded and developed aiming at a production level as projected above, it would obviously require more laborers of different categories.

Seed collection, Storage and Sowing

A sufficient amount of seeds would have to be collected in order to realize the established goals. This may require the initiation of new and improved techniques for collecting seeds.

On the site, there would have to be improved methods of storing seeds, to maintain their viability. This may require a cooling system of some sort. Seeds must be treated with the greatest of care when sowing whether into

plastic bags or directly into the seed beds. There must be adequate compensation for the number of seeds and seedlings that would be lost in the process of production.

Cultural Operations

The operations of weeding, watering, protection from insects and diseases, and other damages must be strictly adhered to. This would require the stocking and use of chemical agents such as insecticides and herbicides.

Maintenance

All aspects of the nursery must be properly maintained to reduce overall cost, and increase efficiency and productivity.

Duties of Nurserymen

It is the duty of the nurserymen to produce the thousands of seedlings needed for reforestation and plantation development. To get the quality, quantity and variety needed, the growers have to observe more carefully in exact sequence, a number of well defined procedures. For example, they must know the cycle of seed time for the various species, they must know the ideal germination conditions as far as a particular species is concerned and also the most favorable growing conditions.

From the time they sow the seed in the nursery until the trees are ready to be transplanted to the planting site, the men must care for the seedlings scientifically to make them strong enough to stand the hardships they will encounter in their permanent home.

Coordination

One of the most important factors and one which must never be overlooked is the aspect of timing. There is a most realistic need for proper timing and coordination of all operations both in the preparation of the nursery and planting site to accommodate germination and growth of trees, through the time when the plantation is fully established.

I suggest that a study be made of the situation and a detailed plan be drawn up. If this plan is approved, a budget can then be drawn.

WATERSHED MANAGEMENT FOR ST. VINCENT

George Beache
St. Vincent

INTRODUCTION

Watersheds are the foundation of a conservation and development program for soil and water resources. Such programs are designed to maintain the productivity of these resources at not less than their present levels and to help raise those levels to meet increasing requirements. They are based on the recognition that the land and water resources are interdependent and must be used so that each reinforces the productivity of the other.

Watershed management is not a new idea. It is widely used in many other countries. Our failure to use it more extensively reflected the richness of our natural endowment and our relatively low population density. Watershed management has always offered the possibility of maintaining or improving the yield of any acreage, as well as the protection of streams. Because new land is scarce and the population is rapidly growing, we can no longer afford to let our resources deteriorate. Further, as the population shifts towards the city an increasing load is being placed on the watersheds in the northern sector of the country. Here erosion becomes a serious threat and watershed management practices must become an integral part of basin development. In their original state, watersheds were covered with trees, grass, or barrens, according to the inherent productivity of their soil, the amount of rainfall, the slope of the land, and other natural factors. Human entry set forces in motion which unless counteracted, may eventually destroy the usefulness of the land. Cutting down trees, plowing of soil and harvesting of crops, and the establishment of industries which use the land and pour their wastes into streams, are threatening the land.

During the past decade, most of our valuable soils were depleted due to a lack of knowledge by the majority of our small farmers, who carried out the wrong practices in farming either on private, crown lands, or in forested areas. Because of the malpractices in cultivation, especially on the steep hillside slopes, severe damages such as run-off which eventually leads to erosion, have occurred. Trees, which once played their role in forming the anchorage for the soil, are no longer available. Because of this, siltation is taking place in the streams, and the quality and quantity of water has been reduced drastically. The effects of the bare depleted soil can be observed in the vicinity of Delcer where the people suffer for water during the dry season. Today, because of the great demand for water, proper management is required if the demands are to be met. Therefore, it is imperative that our forests, soils, and water be manipulated in such a way as to alleviate and solve the problems we are now facing.

PHYSICAL SETTING

St. Vincent and its dependencies, the Grenadines, form part of those islands in the Caribbean basin usually referred to as the Windward islands;

which lie between Grenada in the south and St. Lucia, its nearest neighbor in the north. The mainland of St. Vincent has an area of 340 km² (133mi²). The Grenadines are relatively small islands comprising some 51 km² (20mi²) in area.

The state of St. Vincent and the Grenadines attained independence from Great Britain on October 27, 1979. According to the 1979 census, the population was about 111,170. St. Vincent is densely populated; the majority of the inhabitants live around the coast and in compact small village communities.

Description of the Island of St. Vincent

St. Vincent is extremely mountainous, and seen from the distance the mainland appears to raise sharply from the sea. The highest peak is La Soufriere, which reaches 1214 m (4048 ft) in height, and which erupted in 1971 and in 1979. The Grenadines are relatively low islands, but somewhat mountainous for their size. Its peaks range from 152 to 234 m (500-800 ft), with one peak measuring 308 m (1010 ft).

The average rainfall St. Vincent ranges from 152 cm (60 in) around the coast to 160-406 cm (63-160 in) in the central mountains. St. Vincent and the Grenadines are exposed to hurricanes and other natural disasters as are the other groups of islands in the Caribbean.

Geology and Soils

The mainland is of volcanic origin, being one of the youngest islands in the Antillean arch. There are no large sedimentary deposits. All the soils are relatively young. The layers of ash thrown out by the volcanic activities of La Soufriere are still weathering; more of these have been added during the past 3 years. The whole northern end, extending to about 1/3 of the island, is reported to be covered with volcanic ash. Generally speaking, the soils of St. Vincent are friable and readily eroded. Cementation of the subsoil, where it occurs, is only incipient and the cemented layers readily decompose. In the Grenadines shoal soils with very little depth of weathered material are common.

Topography

The island is composed of volcanic material which has produced an elliptical land surface 29 km (18 mi) long and 17 km wide. It is mountainous, with a central range of hills whose principal peaks are Grand Bonhomme 980 m (3215 ft), Morne Gary and Richmond peak 1058 m (3471 ft), and Soufriere 1214 m (3983 ft). Each of these peaks represents a part of a chain of volcanic craters, but only La Soufriere is active. It caused considerable damage during the 1979 eruption. After the previous eruption, in 1902, the coarser fragments consolidated into agglomerates, which were easily eroded. The coastal areas show some terrace levels, which are particularly noticeable on the exposed eastern side. The relatively sheltered western side shows a gentle and more rolling landscape.

The Mountains of St. Vincent

The mountains of St. Vincent extend from north to south and all are found within the forest reserve areas. Mount St. Andrews divides the island into a northern and a southern sector. Only the valleys at the foot of the mountains, and the coastal belts are habitable.

FOREST TYPES

On the mainland there are about 254 plant species. The species more frequently found are: blue mahoe (Hibiscus elatus), galba (Callophylum calaba), and lourier (Laureacea spp.). The Elfin forest was located on the area of La Soufriere, but after the last eruption it was destroyed and no regeneration has occurred yet.

FOREST POLICY AND LEGISLATION

There is no effective forest policy or legislation in the island, but there is evidence that shows that legislation was drafted after Beard's work in 1945. An updating of any recommendation as well as the government's approval to any forest protection legislation are needed. I hope that my recommendations can be helpful if the proper legislation is approved, and that we finally protect our watersheds and forest areas.

THE USE OF THE FOREST

Forests existed before humans evolved on earth. Afterwards people learned about the forest and began exploitation. The forests are where the large body of water supplies come from. In order to operate our factories, electrical equipment, and our banana processing plants, we depend on hydroelectrical power, which is supplied by our water resources.

The forest supplies us with wood for fire, timber for construction, and food. In this classroom, where we generally sit to attend our daily classes, the furniture is made from products of the forest. In some parts of the world there are large plantations of rubber trees, which are grown to supply us with rubber, which is then converted into tires to be used on our vehicles. In some remote areas, not only in St. Vincent, people are still using firewood and coal as a mean for preparing their food, because they cannot afford to buy gas.

THE PREVAILING WINDS

The major winds that blow on the island are the northeast trade winds, which blow from between St. Lucia and Barbados. During the dry season they bring a cool and refreshing atmosphere but during the rainy season, they are usually accompanied by torrential and thundery rain showers.