

CASE STUDIES ON FORESTRY ACTIVITIES IN THE EASTERN CARIBBEAN AND JAMAICA  
---Page Break--- This project was funded by the U.S. Agency for International Development (the Preface has details). ---Page Break--- 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 ---Page Break--- ---Page Break--- TABLE OF CONTENTS Preface Forestry Training for Young Dominican Foresters Ronald Charles The Establishment and Functions of a Central Nursery Albert Galtion Establishment and Management of a Forest Nursery Julius Georges Training as Related to Forestry in Jamaica Lewellyn A. Hall Inventory and Potentials of Forest in Antigua McRonnie Henry Reforestation Following Hurricane David Ashton Lugey Plantation Management and Protection Peter Vidal Development of a Forest Nursery in St. Vincent Edgar Willéame Watersheds Watershed Management for St. Vincent George Beache Watershed Management for St. Lucia Augustin Charles Vincent Ernest Meander Forde The Good Hope Watershed in Dominica Stephen Durand Conservation of Water Gloria A. Mortley Watershed Management for Dominica Charles Warty ---Page Break--- ---Page Break--- Wildlife A Study on the Biology and Status of the Ramier (*Columba squamosa*) in Dominica Wildlife Management for St. Lucia Wildlife Protection for St. Vincent Wildlife Improvement and Protection Population Study of the St. Vincent Parrot Protection of Wildlife Protection of Forest and Wildlife in Dominica Egbert E. Bethel Michael Bobb Jules Gideon Cordice Timothy B. Harry Lennox Quammie Brenon Samuel Randolph Winston ---Page Break--- ---Page Break--- 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 (U.S. Geological Survey, U.S. Soil Conservation Service); state agencies (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. Men and the Biosphere Program. The group recommended that field and practical applications of knowledge in the training be a 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.

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 every time 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 homelands. Ariel B. Lugo Rio Piedras August 16, 1986  
---Page Break--- 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 Ministry of Agriculture, but has full autonomy over its operation. The Division was set up in the 1940s. 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, post-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 sole 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 headed by a Director and is ably assisted by a Deputy Director. They are responsible to the government for carrying out the 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 land and insects affecting the forest. The section, until recently, was headed by an Assistant Forest Officer, 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, headed by an Assistant Forest Officer. Today it is headed by the Director as provisional head, and 3 Forest Cadets who supervise and direct 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, which 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 envisaged that this officer could be molded 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 headed 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 vital for all personnel in this section. The coordinator of this section is presently participating in this training program. ---Page Break---

Utilization This section is responsible for utilizing forest products. Small-scale logging operations are being

carried out. The section is still engaged in work after Hurricane David (which swept over Dominica in August 1979). The section is headed 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 subdivided training into three specific categories: professional, technical, and vocational 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 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 of the 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 the general work of a cop are necessary skills needed by a trained person who can prepare proper charges for 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 Division's 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 headed 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 at the older Forest Guards, who are not desirous of continuing education because of age. Regarding newly appointed Forest

Guards 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 posts 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. ---Page Break--- 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 workings in forestry, wildlife management, and law enforcement. 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 group 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 for 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, but the benefits would be beyond limits. I cannot overemphasize 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 does exist, and something must be done to ease the plight of the Division. Officers in the field should be exposed to one 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 exists today can be cured. Should we make any major thrust into our forestry program, training is highly required. It cannot be overemphasized 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.L. Kulkarni 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).

---Page Break--- 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. Lago, 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. ---Page Break---

APPENDIX 1 Government. Deputy Director Assistant Forest Officer (1) Protection and Silviculture, research, Utilization, National conservation extension Parks Senior Assistant Superintendent Forest Officer Assistant Forest Officer (2) Forest Rangers (5) Temporary Guards and Forest Technicians Forest Cadet (1) ---Page Break---

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, all of which the present strength of the forestry organization is woefully inadequate. DAH, Kulkand, ---Page Break--- {IN THE FORESTRY AND NATIONAL PARK Canada m/s Supervisor Superintendent Canada of Parks ECIAF Assistant Forest Officer Trinidad re aoe ok USA Senior Clerk National Parks 2 2 2 6 months USVI Parks Technician Sav doctor 20202 o carpentry 20020 2 Beye Nursery management, = 222 -10- ---Page Break--- 'THE ESTABLISHMENT AND FUNCTIONS OF A CENTRAL NURSERY Albert Galtion 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 means 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 and 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 andesitic parent material, with huge rocks both on the surface and below the topsoil, which is very shallow. When there is heavy rain, the soil becomes saturated.

and soggy, which results in certain areas becoming swampy. 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 considered as ideally located. It is on state-owned land and there is a forest station close by. A Pinus 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 designing two rivers, which flow down the mountainside some 365 m (400 yds) up; 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 equipment 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 a priority:

1. 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. 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 rainforest, 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 globulifera*.

2. 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 extensive cut down, a secondary dry forest with species like *Picrasma antillana* is dominating. Most of the land is privately owned except for the Cabrits Peninsula, which is under the supervision of the Forestry Department. The owners of these areas should be approached and encouraged to do some tree improvement planting. Here, the aim should be the 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.

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 reactivate them. Species that can be used are the exotics *Tectona grandis*, *Swietenia* spp., *Pinus* and *Hibiscus elatus* plus some of the local appropriate 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, it 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 importantly, 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 benefit 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 fungi.

## 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 *Dactyodes* 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 equipment, 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 FOREST NURSERY Julie 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, while 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 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 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's 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-tailly, could be fatal. High mortality rates 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 let's 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 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 others, results are poor.
- Diseases: There are not, to my knowledge, any dread-diseases, but there are effects on Honduras mahogany (*Swietenia macrophylla*), which is troubled by shoot borers, and blue mahoe (*Hibiscus elatus* species).

Caterpillars and butter "Seed orchard - the nursery requires an orchard which would help increase the seed program and also decrease the soil diseases. The more one could avoid collecting seeds in various parts of the 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 who would labor in making nursery activities would now be engaged in other areas. "Soil tests - they should be carried out 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 rent, 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) 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 is an extension nursery, which 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 about 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, because of remote locations and the relatively small

requirements of 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 are 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. iotii* 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: the site is carefully selected to take advantage of natural features, in the above case the site was a recently felled eucalyptus 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 the 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 pests, 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 shortfalls 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; base 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 stones 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. ---Page Break---

### 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 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 towns 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 faraway 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 the 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 cause 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 sulfur dioxide (SO<sub>2</sub>), hydrogen fluoride (HF), and ozone (O<sub>3</sub>), can be carried downwind onto nurseries 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 the 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 should be considered. It is in this light that I say that very special and careful consideration should be given to the following recommendations. 1. 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.

Close. 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. A 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 to use the Agriculture Reference 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 the 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 land should be planted. Extra workers, about six to be exact, would cost per year. ACKNOWLEDGEMENTS I profit from this opportune privilege with gratitude to acknowledge Ariel Project Leader, Institute of Tropical Forestry: Ravin Maldonado, Course Kilda Echevarria, Secretary; JoAnne Feheley, Librarian; and to all lecturers and staff, but most especially my advisor, Leon H. Liegel, Soil Scientist of the Institute of Tropical Forestry. ---Page Break---

## 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 1940s 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 1970s 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 (NIC), 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 were drawn from the Forest Department. The 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 its organization various sections, namely: Administration and Management, Research, Regions, Soil Conservation, and Training.

### Administration and Management

The Management section is headed 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 headed 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 headed by a Senior Research Officer and has four local researchers as

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 fieldwork but very little office work due to the limited knowledge of office procedures. A special employment program for high school graduates was initiated by the previous government, assigning students to 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 accommodate the foreign exchange costs for training and equipment. In 1980, a Senior Research Officer under the 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 headed 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, construct and maintain forest roads, and perform land clearing. Therefore, we think in terms of qualified personnel to perform these functions, this is another area in which I feel some form of training should be given.

Training: This section was set up through a loan from the 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 the 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. ---Page Break--- 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 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 efficient as well as 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) for 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 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 on 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's 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 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 these people to do 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. 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 gained 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 B. Appendix available at the Eastern Caribbean Institute of Agriculture and Forestry

(ECAES) Trinidad at the technical level: Terr F Gane silviculture 1 # 0 Management & Photogrammetry 2 » Introduction to Park and Reserve # Wildlife Management T » Dendrology # General Forestry c) Wood Technology i) x Forest Surveying co) » Surveying ® Botany? Geology, Soils and Soil Fertility? Genetics 20 = sociology Pr - Introductory Economics 2 = Care and Use of Tools ag 20 Forest Health 2 as a common course to both Forestry and Agriculture students; APPENDIX 1 (Continued) Year II Number of Hours Theory Practical Silviculture 17 20 30 Silvicultural Systems 20 30 Forest Management 40 6 Forest Policy and Law 20 Administration and Personal Management 60 Recreation Management 20 0 Wildlife Management 11 20 20 Watershed Management I 20 20 Watershed Management II 20 20 Forest Engineering 40 6 Forest Utilization 20 30 Fire Protection 20 30 Pathology 20 20 Forest Influences 10 Project Total Hours 430 450 Map of Jamaica Showing the 4 Regions Jamaica 1 General 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 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 brush 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 some 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 (an 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 areas for agriculture, mainly bananas and tree crops. The forest is an unmanaged source of fence posts, 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, fence posts, and sawwoods.

Environment: The island is conveniently divided into three main regions: The limestone areas of the north and northeast. The terrain is undulating 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, has several ridges.

generally running northwest to southeast. The alluvial soils vary from deep sandy loams to heavy clay foils. The alluvial soils tend to be stony and shallow, and the influence of parent material is pronounced. The southwestern hilly region, which attains 402 m (1319 ft) at Bogs Peaks, has a number of summits and ridges around 305 m (1000 ft). Relative relief is considerable, with deeply incised valleys and a radial drainage pattern. The main soils of this region are moderately heavy,

well-drained, and shallow over andesites, basalts, or tuff. Where tree vegetation is absent, erosion is active, and soils are consequently stony and shallow. This southwestern 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. 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 conservation of natural woodland. From a conservation viewpoint, 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. 20  
---Page Break--- The conservation, re-forestation, and production combined, then economic benefits of improving derived enhanced. Programs can be areas would be FORESTRY DEVELOPMENT Forestry is the responsibility of the Department of Agriculture. Recently, there have been some attempts 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 an 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. Seed material came from places as far as Hawaii, the U.S., and the Philippines. Currently, there are three small stands. Heights indicated 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. The main limiting factor is climate, and in particular rainfall, which averages only 1163 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 on 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, they are aware of the gravity of the situation. There is a need to conserve what natural forest remains and to combine this with great foresight 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. <n ---Page Break--- **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 exists 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 viewpoint. 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 one area would require re-forestation or be 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 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 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 more.

The sampling method recommended for tallying trees is located in Appendix 1. The instruments required for conducting 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 should take steps, wherever possible, to provide training at a higher level for interested and qualified candidates not only in forestry, but in environmental quality as a whole. 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 consideration, 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 findings 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.

---Page Break--- 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 saplings. 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 summary information by timber types and other factors. APPENDIX 2 Instruments Diameter measurements: diameter tapes, calipers, and pentaprisms. Height measurements: rangefinder, Abney level, altimeter (Haga, Blume-Leiss, others), and hypsometer. Basal area measurement: 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. ---Page Break--- 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 expend its knowledge towards the planting and development of fast-growing species which can substitute the slower-growing native species. Such would greatly fit 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 (19,925 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 caribaea*), and to a lesser extent, bois denasse (*Licania* spp.), 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 (*Simarouba amara*), cre cre (*Miconia* spp.), and bois diable (*Licania ternatensis*), which typically replace vegetation on old agricultural clearings due to nitrogen deficiency. In the poorly drained slopes of the interior, there are mang rouge (*Tovomita plumieri*) and mang blanc (*Gomphia 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 savanna and mapou (*Pisonia* spp.) which are found at higher elevations than the kapok, also found in that area.

### The dry scrub woodland

merges into the seasonal forest and most of these lands have been cultivated, 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 xerophytic or dry community of woody plants, grasses, and shrubs. 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 woginye, montany, bwa bandi, and bva vorry. Many of the trees found in the rain forest can be seen in the montane forest, e.g., the mang worry and the movisif. 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 17 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, 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

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. Fifteen 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 the 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 8 woodworking training centers; 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 m<sup>3</sup> (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-growing 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 the people of the northern area (where it is located). The Picard River, which is one of the rivers under threat from this program, has been recently made a reserve area, and a reserve boundary line has just been completed by workers of the Forestry Division. Apart from these programs, there are no major programs going on, mostly due to the lack of financial and technical expertise. Another major problem is that for the past two decades, there has 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 Goanier area, some replantings of native species like the gomier and carapite were conducted.

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 on 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 on the need for introducing new species to places which have been devastated. This in itself would create more awareness of the needs of the 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 trials 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 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. More needed at present is some 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, by 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. Lago.

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 Hilda Echavarria, who spent long hours 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.F., 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., J. Applefield, 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. Trewin, Kev. 1980, Emergency rehabilitation of agriculture and forestry sectors following Hurricane David. ---Page Break--- 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 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 (*Tovosita plusiere*), bois cote (*Tapura antillana*), and fenille doree (*Micropholie chrysophylloides*). The secondary forest, which has been devastated by shifting cultivation, is commonly colonized by *Hernandia* species. Tree fern, bois canon (*Cecropia peltata*), and la glu (*Sapium*) 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 are 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 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 branched, 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 was formerly employed in shipbuilding, 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 in shipbuilding, 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 land. 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, 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 insects and diseases; special traits for uses such as bag, newsprint, or glossy writing paper. Obtain maximum gains or improvements in the shortest time possible.

Seedling Seed Orchard: Plant seedlings from superior seed phenotypes (low 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; avoids vegetative propagation of species that are difficult to graft; is easy to establish if only open-pollinated progeny are used; uses two cycles of selection 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 the orchard is established; the 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. ACKNOWLEDGMENTS: 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 acknowledgment should be given to Mr. Elvin Maldonado, Course Coordinators Leon H. Liegel, Soil Scientist and advisor; Mrs. JoAnne Feheley, 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, a 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 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 1,234 m (4,049 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. As a result, some of the teak was planted, and a small plot of Honduras mahogany (*Swietenia macrophylla*) was established. These plants have grown fairly satisfactorily but suffered severely from the shoot borer (*Hypsipyla*). There are no records of further silvicultural work until the early 1950s 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 guianensis*), mahogany, red cedar (*Cedrela* spp.), 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. ---Page Break--- 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 1960s to 26 ha (65 acres) in 1981. Small areas: 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 ill areas, with a view to charcoal production. To this end, species like *Leucaena* and *Calliandra* are being tested. Plans include trials with some of these species in the Grenadines for fuelwood. 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 is hard-pressed to accommodate the level of production now realized. It is completely fenced with wallaba posts 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 the bags, which are neatly stocked in the yard; and as is expected, the soil 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, the low level of production, and the 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 spot weeding, which 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 younger 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. ---Page Break---

**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, 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 as the expansion and development of the nursery is concerned. ---Page Break---

**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 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 seedlings per year, used to plant approximately 16 ha (40 acres). For 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 bed. 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 made, a budget can then be drawn. ---Page Break---

## WATERSHED MANAGEMENT FOR ST. VINCENT

### George Beache St. Vincent INTRODUCTION

Watersheds are the foundation of conservation and development programs for soil and water resources. Such programs aim to increase the productivity of these resources and 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 reflects the richness of our natural environment 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 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 km<sup>2</sup> (133 sq mi). The Grenadines are relatively small islands comprising some 51 km<sup>2</sup> (20 sq mi) 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 rise sharply from the sea. The highest peak is La Soufrière, which reaches 1,214 m (4,048 ft) in height, and which erupted in 1971 and in 1979. The Grenadines are relatively low islands, but somewhat mountainous for their size. Their peaks range from 152 to 234 m (500-800 ft), with one peak measuring 308 m (1,010 ft).

The average rainfall in 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 Soufrière 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, shallow soils with very little depth of weathered material are present.

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 960 m (3,215 ft), Morne Garu and Richmond Peak 1,058 m (3,471 ft), and Soufrière 1,214 m (3,983 ft). Each of these peaks represents a part of a chain of volcanic craters, but only La Soufrière 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 (*Calophyllum calaba*), and Tourists Tree (*Bursera simaruba*). The Elfin forest was located in the area of La Soufrière, 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 at present; there is evidence that shows that legislation was drafted after 1985.

Updating of the recommendation as well as the government's approval to apply forest protection legislation are needed. I hope that any recommendation 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 means 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. ---Page Break---