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APPENDIX A

Observations on the Costs and Benefits of Different Tree Species

Ronald Smith

The following paragraphs will discuss the comparative benefits of lumber vs. charcoal vs. fruit. I will begin with a few brief comments on the fruit industry in Haiti, and some of its implications as we think of directions for reforestation. The fresh fruit industry in Haiti represents private enterprise at its worst. The extreme perishability of fruit commodities means that the buyer has all the cards, and the seller has none. When the middle man decides to buy a hundred sacks of mangos and take them to Port-au-Prince, he knows that he is taking a big risk. If he has not unloaded his merchandise within forty-eight hours, he stands to lose the whole investment. He must take this into account when he buys from the grower; risk, then, is translated into low prices. It is the de-centralization of this industry in Haiti that saves it from complete pillage. Each farmer has two or three fruit trees in his garden. In years when prices are good, he sacks them up and moves them to the marketplace; in years when prices are not good he lets them fall on the ground, or feeds them to his animals. It is important to understand that it is precisely because he has not covered a great deal of his land space with fruit trees, that the peasant is able to afford the occasional loss that he suffers when he can't sell his fruit. If, for example, half of his average were in fruit trees, the years of loss would be intolerable, and

he would soon be forced to reduce the number of fruit trees in favor of less perishable items.

Bearing this in mind, I am preparing a chart comparing the production and income potential of the different fruit products, but with the cautionary note that the information could not be projected out as the earning potential of peasant landholdings unless the marketing problems spoken of above were solved. The information contained in the chart is a combination of my own experience with the various fruits here in Haiti, and information contained in booklets published by CONSEJO DE BIENESTAR in Caracas, Venezuela.

Variety	Spacing	Trees per hectare	Production per tree	Production per hectare	Price per volume	Gross per hect. per year
Orange	6 meters	275	5 sacks	1375 sacks	\$.40-sack	\$550.00
Grapefruit	6 meters	275	4 sacks	1100 sacks	\$3.00-sack	\$3,300.00
Avocado	8 meters	156	8 sacks	1248 sacks	\$2.00-sack	\$2,496.00
Mango	12 meters	70	35 sacks	2450 sacks	\$.20-sack	\$490.00

It is my belief that the wise approach to planting fruit trees in Haiti is to space them out a few here and a few there over a large land space owned by many independent farmers. This will help guard against scarcity while at the same time working within the same marketing framework described above.

Lumber

The lumber trees can be divided into two groups; the moderate to slow growing hardwoods, and the faster growing lightweight hardwoods. The first group would be represented by mahogany (Swietenia mahogoni and Swietenia macrophylla), oak (Catalpa longissima, cedar (cederela odorata) and Tavernon (Lysiloma latisiliqua). These are the time tested first choice woods for everything from cabinet lumber to cement forms in Haiti. They are prized for their natural resistance to insects and warping which is rather important since they are most commonly used without benefit of treatment or paint. The second group of lightweight hardwoods is represented by Bois Blanc (Simuraba glanca, Blue Mahos (Hibiscus elatus), Sablier (Mura crepitans), and Saman (Pathosolobium saman). These woods give a faster yield, but of inferior quality to the above mentioned hardwoods.

Below is a comparison in outline of the two groups of hardwoods:

<u>Medium to Slow Growing Hardwoods</u>	<u>Lightweight Hardwoods</u>
1. Planting to harvest - 25 years	1. Planting to harvest - 15 years
2. Average value per stem - \$50.00	2. Average value per stem - \$37.50
3. Stems per hectare - 400	3. Stems per hectare - 400
4. Gross per hectare per year-\$800.00	4. Gross per hect. per year - \$1000.00

The value per stem is based on the present price for which a twenty inch Diameter-Breast-Hight tree can be sold to the sawyer while it is still standing. The number of stems per hectare is based on a spacing

of five meters distance. As can be seen from the comparison, the time factor as well as the income per hectare per year both tip the tables in favor of the lightweight hardwoods.

However, the time involved in either of these approaches is a real problem to the Haitian peasant who must see continuous returns from his land in order to survive. It is true that he can intercrop with his regular gardening practices for the first three or four years, but he is inevitably going to face a long period of time during which the forest canopy has been formed, and gardening is impossible. The other real drawback to the hardwood forest is that it will be seen as a "one-time-around" business; after one big harvest the likelihood of replanting and continuing forest rotations would seem to be quite slim. The pressure to use the land for immediate benefits will be too great. The worst that could possibly happen (and a phenomenon that has already been experienced by reforestation programs near city centers) is that the pressure for combustibles would become so great that precious wood forests would begin to be turned into firewood and charcoal. I would emphasize that this is not the normal pattern of events in the Haitian countryside; the Haitian peasant is highly protective of precious woods, but when population pressures reach a certain point, he will find that he has no control over what happens to his own land. Scavengers will move in, and what they can't move off by day, they will move off by night.

That moves us quite logically into the question of charcoal plantations. I want to clearly state my bias on this matter. After working for ten years in Haiti almost exclusively with precious hardwoods, I have

been moved to the conclusion that the only reasonable approach to reforestation in Haiti is with charcoal forests. I will give the following reasons for that conclusion:

1. It is presently estimated that 80% of the wood resources of Haiti are being consumed in the form of combustibles. This massive cutting of wood is presently turning the interior of the island into a desert. The only alternative presently in view to this rape of the land would seem to be a charcoal industry that would systematically plant and cut on an intensive scale. Such a program might finally produce charcoal at such a reasonable price that it would become uneconomical for the itinerant charcoal collector to continue scavenging over the interior in search of those last few scraps of wood.
2. While precious wood forests take many years to bring into production, a charcoal forest can be in production in four years. Since most of the land space in Haiti is owned by small peasant landholders, this is a critical point. The small landholder cannot wait for ten to fifteen years for a precious wood forest to mature. But with charcoal, he can garden the first year or two while the forest is being established, and then with only a two year lapse he can be in production.
3. Since the trees grow readily from the stump, the harvest is continuous for up to five or six cuttings (at four year intervals) without replanting. This makes a more or less permanent root system to continually protect the land surface from erosion.



4. The economics of charcoal production compare favorably with any other potential use of marginal mountainous land. Fast growing species such as Leucaena leucocephala and Cassia siamea should easily produce 500 sacks (eight ton) of charcoal per hectare per year. At the present price of \$1.60 per sack, this would mean a gross of \$800.00 per hectare per year. Considering the shortened time factor, this compares quite favorable with the production of precious hardwoods.
5. Charcoal production is a labor intensive industry. It can help to ease the unemployment crisis in areas where it is implemented. It is also a low level technology industry which means that it can be decentralized quite easily.

In conclusion, terms of national energy and resource priorities, workability for the small landholder, an effective land reclamation program, and a valid economic alternative to present use of mountainous land, I believe that charcoal production deserves high consideration.

APPENDIX B

The Costs and Benefits of Different Types of Nurseries

Ronald Smith

For all practical purposes, I would say that there are about five basic methods (with many variations) of getting from the seed to the planted forest. They are (1) bags, (2) Pots, (3) Root Trainers, (4) Bare-Root Planting, and (5) Direct Seeding. Each method has its strengths and its weaknesses, and one method may be applicable to certain circumstances while not to others. I will therefore take each method in turn and discuss its advantages and disadvantages. I will attempt to add to and summarize the discussion at the end of the report with a chart showing the cost breakdown of the different methods.

Plastic Bags

Growing nursery seedlings in plastic bags and moving them to the planting site with the soil and roots intact has become a standard forestry procedure over the last two decades. Using this system you can produce a healthy, vigorous eighteen to twenty four inch seedling that will compete well with the weeds, and that can be placed in the ground with little or no root damage. Since the bags are only used once and then thrown away, there is not the administrative hassle of moving containers back to the nursery site. I have found that the smallest size of plastic sack that will produce healthy and uniform nursery stock is about three inches in diameter,

and eight inches deep (capacity approximately one quart). The eight inches depth is sufficient to allow for the development of a straight tap-root, and the three inch diameter is the minimum space for the development of uniform leaves on all the plants. If this space is reduced by any significant margin, some plants will be crowded out while others take over. This means that you will end up with a lot of unusable plants in the nursery.

The main draw-back to the plastic bags is that they are expensive to handle. The trees with the balled earth intact weigh about two-and-one half pounds each, so a thousand plants is a heavy pick-up load. If the trees have to be carried any distance from the road to the planting site, the labor can become very expensive. (A man can comfortably carry 12 to 15 plants). In comparison to the small root trainers, the bags also take up a lot of nursery space, but in terms of the nursery operation they are really quite convenient, and I do not consider the space problem to be a great obstacle.

#### Plastic Pots

The use of the plastic pot is very similar to the use of the plastic bag. The main difference is that the pot is a reusable container. Since they cost about ten cents a piece as compared to one cent for the plastic bag, they must get ten uses with no loss or damage to compete with plastic bags. Beyond this improbability are all the problems of administration (counting pots!) and storage. In actual nursery use,

the pots are much more subject to the washing away of soil than plastic bags. Since the pots (at least the ones that I have had experience with) are not sufficiently deep to start with, this means that not infrequently the final product is a compacted two or three inch cake of soil with a taproot that curls around in several coils upon itself. While these trees may survive on the planting site, later in life they will be much more subject to wind damage and falling. The one plus of the plastic pot in the nursery is that they give a little more leaf space above the ground. While I am sure that a pot can be (and may already be) produced that will overcome the technical problems spoken of above, I am not yet convinced that they will ever be as economical or as convenient as plastic bags.

#### Root Trainers

Root trainers are plastic, reusable containers that come in various sizes. Some hold as much earth as the plastic bags that we were speaking of above, while others are quite small. Those that we will be referring to in this paper are the no. 5 and no. 6 root trainers. These are quite small, having an opening of about  $3/4" \times 1"$  and a depth of about four inches. Root trainers, as the name implies, are scientifically designed to form a superior root system on the young seedling. This is done through a series of vertical grooves in the plastic liners that stimulate continuous division and subdivision of the root hairs, thus forming a much more efficient nutrient collecting system. In what little experience

I have had with this system, the results are quite dramatic. A eucalyptus tree started in a root trainer and then transplanted to a plastic bag will attain a meter height in six weeks, while it takes three to four months to grow the same tree transplanted from the seed bed to the plastic sack.

There has recently been some success with projects in the mountainous areas of Haiti that have planted directly out into the field from the small root trainers. In the tropical lowlands I personally believe that these small whippy five and six inch plants are a bit small to compete with the lush tropical vegetation. If, however, planting patterns followed the gardening patterns (that is to say that the land was completely cleared and worked up), the more rapid growing species that are being talked about for charcoal production could probably be planted, and compete successfully with the incoming grass and weeds. The advantages would be that a Pick-up could carry about 8000 plants, and a worker could easily carry 100 plants out into the field. Digging holes (which is a necessity with the pots and bags) could be reduced to merely sticking a dibble into the soil to open it up, and placing the plant in the hole. The ease of planting would be quite comparable to the bare root method, and yet you would not disturb the roots in transplanting. The initial cost for root trainers and carrying cases is high, but they are reusable, and much more convenient to carry and store than the pots.

If you will refer to the chart comparing the cost of containers, you will see that the root trainer, in terms of cost, is not an unreasonable alternative to the other systems.

### Bare Root Planting

Bare root planting is not suitable to all species of trees, but since it is a possible alternative method for the faster growing charcoal species that we are dealing with, it is worth considering. Mr. Turkoz, the present Director of the United Nations forestry project in Limbe, Haiti, has much experience with this method (he bare-root planted over 2000 hectares of cassia siamea in the Upper Volta Region of Africa). He claims that the survival rate with this method is about 90%. The principle of the bare-root method is to get a healthy root stock. This is done by growing a plant about one meter in height. When the rains come, the plant is stubbed back to about six inches and dug out of the ground very carefully so as not to damage any more of the roots than necessary. The taproot is stubbed back, and the remaining stock is then placed in a basket in a moist medium (wet wood shavings or similar material) and transported to the planting site. The real plus for this system is the ease of transporting and planting. A pick-up truck can carry twenty or thirty thousand of the stubbed roots, and a man can carry three or four hundred through the field at once. The bare-root method has an advantage over direct seeding in areas where it is undesirable or

inconvenient to work up the soil before planting. It is my belief (as yet untested by experience) that this system may be hardier in terms of competing with weeds than the small seedling produced in the root trainer. The delicate part of the operation is that (1) the roots must be kept moist at all times until the stock is planted, and (2) the planting must be done immediately after a good rain (usually within 24 to 48 hours). Some care must also be exercised to make sure that the planters put the roots down straight into the soil rather than twisting or bending them.

#### Direct Seeding

The main advantage of direct seeding is cost. There are no nurseries, and no expensive transportation problems. The possibility of mechanizing and planting on a large scale is also one of the advantages of this method. In terms of the peasant farmer, the seed might actually be planted in his garden when it is being prepared. However, it should be remembered that these gardens must be weeded and it would be quite easy for a farmer to inadvertently destroy these very small seedlings in the process. Other weaknesses of this method are the high probability of failure due to unforeseen changes in the weather (unexpected dry periods) and the question of whether or not the plants will compete with the surrounding vegetation without being weeded (an expensive proposition). This method is highly recommended by Michael Bengé (USAID Agro-Forestry Consultant), and is definitely worth experimenting with.

COST PER 1,000 PLANTS FOR VARIOUS NURSERY CONTAINERS

Container Cost per Planting	Preparing Soil and Filling Containers	Nursery Maintenance	Transport.	Planting Clearing not Included	Total	Type of Container
\$10.00 *1	\$15.00	\$7.00	\$20.00	\$40.00	\$92.00	Plastic bag
\$15.00 *2	\$12.00	7.00	20.00	40.00	\$94.00	Pot
\$7.00 *3	\$3.00	3.00	3.00	12.00	\$25.00	Root Trainer
0	\$1.00	1.00	2.00	12.00	\$16.00	Bare Root

\*1 - One use only

\*2 - Six uses

\*3 - Six uses

The cost of direct seeding done on a mechanized scale with 2,500 plants per hectare is \$35.00 per 1,000 plants. This figure includes plowing and sub-soiling.

Note: If clearing of the land were to be included in the above chart, \$40.00 per thousand would be added to the cost of the work when trees are planted at a density of 2,500 per hectare.