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THE COST OF SEEDLING PRODUCTION
IN TWO PADE SPONSORED NURSERIES

By

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INTRODUCTION

One of the important functions of the Agroforestry Outreach Project (AOP) is the production of forest tree seedlings for distribution to farmers. Since the project was evaluated in early 1986, and following through the project redesign, there have been numerous suggestions as to how seedling quality might be improved. These suggestions include using larger seedling containers, inoculating seedlings with mycorrhizae and *Rhizobium*, and increasing the time the seedlings spend in the nursery before planting.

Each of these alternatives has an associated change in production costs, usually an increase. It is useful for program managers to know the financial implications of each technical alternative. They may wish to weigh increased growth or survival against increased production costs. Even when the decision to change techniques is based on the desire to improve seedling quality despite increased costs, it is necessary to know whether nurseries will be able to continue producing seedlings for the same price.

The purpose of this paper is to examine the costs of producing forest tree seedlings in two AOP subsidized nurseries. These two nurseries, operated by the Eglise Emmanuel par la Foi in Saut D'Eau and the Assemblée Spirituelle des Baha'is de Liancourt, are nurseries established with the assistance of PADF as part of the Agroforestry Outreach Project. Both of these nurseries are small nurseries, producing about 40,000 seedlings for each of the two planting seasons. See Table 1.

Many nurseries do not keep complete records of all expenses incurred. However, PADF maintained virtually complete records for these two nurseries because PADF provided the supplies and equipment necessary and made cash advances for other expenses such as labor. These advances in cash and in kind were credited against future deliveries of seedlings to PADF. The actual establishment and maintenance costs of two nurseries are given below.

Saut D'Eau

The nursery at Saut D'Eau was established in late 1984 and early 1985. The first seedlings were produced for the Spring, 1985 season. The nursery has two shadehouses, one covered with plastic and the other covered with shadecloth. The shadehouse covered with shadecloth sits on a concrete slab. The nursery has a concrete block storage shed approximately 8m by 3.5m in size. Seedlings are watered with watering cans with water dipped from a

stream which runs through the nursery. Roottrainers 5's are held in wooden racks which rest on 10 inch concrete blocks. The nursery is located in a compound owned by the church and which is surrounded by a wall.

Liancourt

The Liancourt nursery first produced seedlings for the Spring, 1986 season. It has a simple wattle and mud storage shed. The nursery's two shadehouses are both covered with 73% shadecloth. The racks for the Roottrainer 5's are held by concrete blocks resting on the ground. Seedlings are watered with watering cans using water which flows into a 1.25m x 1.5m x 1.8m concrete reservoir which is gravity fed from an irrigation canal. The entire nursery is surrounded by a candelabre fence. A member of the church owns the land on which the nursery is located.

 Table 1. Seedling production for
 the selected nurseries.

Season	Nursery	
	Saut D'Eau	Liancourt
Spring 1985	28,900	0
Fall 1985	25,650	0
Spring 1986	39,950	40,168
Fall 1986	40,525	37,975

SEEDLING PRODUCTION COSTS

Table 2 gives a summary of all costs incurred by the Saut D'Eau nursery during the first two years of its existence. Table 3 gives similar data for the Liancourt nursery for the first year of its operation.

Table 2. Cost of producing seedlings at the Saut D'Eau nursery.

Fixed costs

Item	Fixed Costs	Estimated Life (seasons)	Seasonal Cost
Depot	800.00	20	40.00
Shadehouse	709.84	12	59.15
Shadecloth	272.70	6	45.45
Plastic	340.00	3	113.33
Racks	543.10	8	67.89
Equipment	78.95	4	19.74
Roottrainers	2126.00	5	425.20
Total	4870.59		770.76

Variable costs

Item	Variable Costs	Seasons	Seasonal Cost
Supplies			
Fertilizer	68.00	4	17.00
Mix	1915.50	4	478.88
Seed	72.83	4	18.21
Labor	3200.90	4	800.23
Total	5257.23		1314.31

Total costs

Item	Seasonal Cost	Cost Per Seedling (\$)	Percent Of Total
Depot	40.00	0.001	1.9
Shadehouse	59.15	0.001	2.8
Shadecloth	45.45	0.001	2.2
Plastic	113.33	0.003	5.4
Racks	67.89	0.002	3.3
Equipment	19.74	0.000	0.9
Roottrainers	425.20	0.010	20.4
Supplies			
Fertilizer	17.00	0.000	0.8
Mix	478.88	0.011	23.0
Seed	18.21	0.000	0.9
Labor	800.23	0.018	38.4
		0.048	100.0

Table 3. Cost of producing seedlings at the Liancourt nursery.

Fixed costs

Item	Fixed Costs	Estimated Life (seasons)	Seasonal Cost
Depot	830.00	20	41.50
Shadehouse	359.50	12	29.96
Shadecloth	298.00	6	49.67
Plastic	125.00	3	41.67
Racks	855.00	8	106.88
Equipment	6.00	4	1.50
Rootrainers	2079.00	5	415.80
Total	4552.50		686.97

Variable costs

Item	Variable Costs	Seasons	Seasonal Cost
Supplies			
Fertilizer	68.50	2	34.25
Mix	1420.00	3	473.33
Seed	30.80	2	15.40
Labor	1531.00	2	765.50
Total	3050.30		1288.48

Total costs

Item	Seasonal Cost	Cost Per Seedling (\$)	Percent Of Total
Depot	41.50	0.001	2.1
Shadehouse	29.96	0.001	1.5
Shadecloth	49.67	0.001	2.5
Plastic	41.67	0.001	2.1
Racks	106.88	0.003	5.4
Equipment	1.50	0.000	0.1
Rootrainers	415.80	0.011	21.0
Supplies			
Fertilizer	34.25	0.001	1.7
Mix	473.33	0.012	24.0
Seed	15.40	0.000	0.8
Labor	765.50	0.020	38.8
		0.051	100.0

OTHER COSTS

There are several costs which are not shown in the tables above. These include the costs of land, water, and fencing. The Saut D'Eau nursery is on land owned by the church. It was not purchased or rented but it does have a value which should be included as a cost. The nursery at Liancourt is located on land owned by one of the members of the Assemblée. No rent is charged but the use of the land has some value.

Each nursery uses water from a stream or an irrigation canal. Although the water is in some sense free, the value of the land is higher for having access to water than a similar piece of land without access to water.

The Saut D'Eau nursery is located on a compound surrounded by a stone wall. The Liancourt nursery is surrounded by a *candleabra* fence. The cost of constructing or establishing these fences is a valid expense to be charged against seedling production.

Two other significant costs are the cost of training nursery workers, which is borne by PADF, and sometimes the cost of management which is provided by other personnel within the PVO or by PADF.

There is one cost that is hidden in Tables 2 and 3. Some seedlings die, are not ready on schedule, or must be rejected and not used for some other reason. For instance, a nursery may have to incur the costs of producing 44,000 seedlings in order to have 40,000 high quality seedlings for distribution. The cost of producing the extra 4000 is included in the cost of the 40,000 seedlings actually distributed. These costs might be listed separately in an attempt to show that they too can be controlled and reduced through the use of higher quality seed, better scheduling of nursery activities, or closer management.

DISCUSSION

The cost breakdowns shown in Tables 2 and 3 for the two nurseries are quite similar. The three major costs of seedling production are for Rootainers (20.4% and 21.0%), soil mix (23.0% and 24.0%), and labor (38.4% and 38.8%). These three items account for between 81.8% and 83.8% of total production costs. In general, then, those decisions which affect containers, soil mix, or labor have the greatest influence on costs.

In 1982, Mark Webb estimated the costs of establishing and operating a nursery which could produce 100,000 seedlings per season. These costs are shown in Table 4. According to this estimate, seedlings could be produced for 4.3 cents each. Of total production costs, 75.1 % are for Rootainers, soil mix, and labor.

**Table 4. Cost of producing seedlings at
 the a typical PADF nursery.**

Fixed costs

Item	Fixed Costs	Estimated	
		Life (seasons)	Seasonal Cost
Depot	900.00	20	45.00
Potting shed	400.00	20	20.00
Greenhouse	600.00	12	50.00
Flats	1000.00	12	83.33
Rootainers	2400.00	5	480.00
Racks	2500.00	8	312.50
Trays	50.00	4	12.50
Sprayer	50.00	4	12.50
Reservoir	1500.00	20	75.00
Tools	800.00	4	200.00
Total	10200.00		1290.83

Variable costs

Item	Variable Costs	Seasons	Seasonal Cost
Supplies			
Fertilizer	160.00	1	160.00
Chemicals	50.00	1	50.00
Mix	750.00	1	750.00
Seed	50.00	1	50.00
Labor	4000.00	2	2000.00
Total	5010.00		3010.00

Using larger containers

It is generally accepted that, within certain limits, a larger container will produce seedlings which have a greater chance of surviving and a higher growth rate. With the change to a larger container is a concomitant increase in costs of seedling production. The increased costs are discussed below.

1. The larger containers cost more than the smaller containers. Rootainer 5's cost \$86.00 per case of 2500 whereas a case of Rootainer Deep 5's costs \$122.00. The increase in cost is 1.4 cents per container or, when Rootainers are depreciated over five seasons, 0.3 cents per seedling.

 Table 4 continued.

Total costs

Item	Seasonal Cost	Cost Per Seedling (\$)	Percent Of Total
Depot	45.00	0.0005	1.0
Potting shed	20.00	0.0002	0.4
Greenhouse	50.00	0.0005	1.2
Flats	83.33	0.0008	1.9
Rootrainers	480.00	0.0048	11.2
Racks	312.50	0.0031	7.3
Trays	12.50	0.0001	0.3
Sprayer	12.50	0.0001	0.3
Reservoir	75.00	0.0008	1.7
Tools	200.00	0.0020	4.7
Supplies			
Fertilizer	160.00	0.0016	3.7
Chemicals	50.00	0.0005	1.2
Mix	750.00	0.0075	17.4
Seed	50.00	0.0005	1.2
Labor	2000.00	0.0200	46.5
	4300.33	0.0430	100.0

2. The larger containers require more soil mix than the smaller containers. According to Pellek (1987), a Rootrainer Deep 5 requires 47% more soil mix than a Rootrainer 5. Since soil mix represents a cost of 1.1 or 1.2 cents per seedling, a change in container to Rootrainer Deep 5 will represent an increase of 0.5 cents per seedling due to increased costs of soil mix.

3. Larger containers may require either more racks or larger, more expensive racks, depending on the differences in size and shape. This would be the case if AOP were to change to Rootrainer 6's. However, serious consideration is only being given to Rootrainer Deep 5's which fit in the racks designed for Rootrainer 5's.

4. Additional shadehouses may be necessary. This would only be necessary if more or larger racks were needed. See the discussion above.

5. The seedlings of some species will have to stay in the nursery longer to form a good rootball. This may require additional labor for watering, weeding and other maintenance practices.

Thus, seedlings produced in Rootrainer Deep 5's will cost 0.8 cents more than seedlings produced in Rootrainer 5's. It is

assumed that there will be no costs associated with the change itself. As old Rootainers wear out they will be gradually replaced with the new size.

Inoculating seedlings

Numerous studies have shown that inoculating seedlings with *Frankia* or *Rhizobium* increases survival and growth rates. In many cases the inoculants have no significant effects on the seedlings. However, in no case does inoculation have any harmful effects. Do the increases in growth and survival justify the increased costs of seedling production?

Operation Double Harvest currently sells *Frankia* for inoculating *Casuarina* for \$50.00 a pound. One pound of *Frankia* is enough to inoculate 125,000 seedlings. The cost of inoculating *Casuarina* is then 4/100's of a cent per seedling.

In early 1987, the AOP purchased 100 bags of *Rhizobium* inoculant at a cost of \$3.50 a bag. There were additional expenditures for items such as air freight and telephone calls amounting to \$103.97. Thus each 100 gram bag of inoculum cost \$4.54. To inoculate one kilogram of *leucaena* seed requires 200 grams of inoculant and 60 ml of gum arabic - calcium carbonate solution for a total cost of \$9.56. If this kilogram of seed produces 16,000 healthy seedlings, the cost of inoculation is 6/100's of a cent per seedling.

In a typical nursery, 25% of all seedlings are of species which require inoculation and each will be inoculated with *Rhizobium* at a cost of 6/100's of a cent each. Seven percent of the seedlings are *Casuarina* and must be inoculated with *Frankia* at a cost of 4/100's of a cent each. The remaining 68% of the seedlings do not require inoculation.

All seedlings can be inoculated at a cost of under \$1100 per year. The per seedling cost is negligible. However, there is also the cost of inoculating seeds which will be sown directly in fields for the creation of hedgerows and contours. If 300 kilograms of seed will be used in 1987 for hedgerow creation, inoculation costs will increase by \$2868 for a total annual cost of \$3968.

Research on *Frankia* and *Rhizobium* should not be necessary if NIFTAL has indeed recommended the species of *Rhizobium* which are appropriate for the trees species AOP is producing. Rather than spending limited resources on determining whether it is beneficial to inoculate the seedlings, the seedlings should just be inoculated as a matter of course. Limited resources devoted to research can be better spent studying other topics such as mycorrhizae. This is not to say that the microsymbiont specialist who will be part of the research team should not work with *Rhizobium* and *Frankia* at all, merely that priority be given to studies which are likely to give greater returns.

However, it is not clear that the species of *Rhizobium* recommended by NifTAL are the best ones for the trees species planted by AOP. It may be that these are species of *Rhizobium* which nodulate but are not necessarily beneficial to the particular host species. Or, if they are beneficial species, they may not be the most beneficial. Again, NifTAL should be able to supply this information before AOP begins conducting its own research.

Future studies

The largest single expense in any nursery is likely to be for labor. If any studies of nursery costs are to be conducted, it would be best to start by studying labor allocation to different nursery tasks. Labor costs may be reduced in this way. A further advantage may be forthcoming if current managers begin to extend the time some seedlings spend in the nursery. Even now nursery schedules are difficult to follow, as new seedlings for Fall planting need to be started immediately after the Spring seedlings are distributed. If extended nursery schedules are adopted, scheduling will be much more important. By studying the time necessary to perform the various tasks, the nursery manager can better organize and schedule nursery activities.