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Estimating the Cost of Producing Container-Grown Landscape Plants with the Assistance of Computer Accounting Software[1]

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Abstract

Procedures and practices for a container nursery record keeping system were developed. The goal of developing this system was to allow for cost allocation to a given group of plants for pricing and planning purposes. To accomplish this, the economic engineering method was employed to develop a model nursery firm where the best proven practices of plant production were utilized. Enterprise budgets were updated and modified to estimate cost of production for container sized #1 woody landscape plants by five plant species. Job-cost accounting procedures were used to allocate annual fixed costs and general overhead expenses. Results revealed that fixed cost per plant represented approximately one-third of total cost per plant for each species and production method. Determination of per-plant costs in trials was important in determining whether the production of a species was profitable. This also aided in establishing selling prices.

Index words: job-cost accounting, per plant costs.

Significance to the Nursery Industry

The owner/manager of a nursery operation is a price-searcher, implying they have some control in determination of price for their commodity. Consequently, accurate allocation of costs among the different groups of plants is important in pricing decisions. Use of a record system that would facilitate cost allocation is developed in this study.

Introduction

Production of landscape plants in the United States offers a wide variety of production and marketing opportunities for farmers. Landscape horticultural crops have received increased interest as an alternative to traditional farm crops (6). In 1992, the U.S. Census of Agriculture (12) estimated there were more than 47,000 farms producing nursery and greenhouse crops, up twenty-seven percent from 1987. In 1993, the greenhouse/nursery industry accounted for eleven percent of total crop receipts in the United States, with receipts of approximately $9.3 billion.

In the United States, nurseries are required by the Internal Revenue Service to prepare an annual income statement. Many nurseries have microcomputers that assist with preparing the income statement, as well as with handling invoicing, accounts receivables, payroll, inventories, etc. However, relatively few nurseries have developed a system to estimate the costs of producing individual groups of plants.[5]

For the budgeting process to truly represent the firm, accurate information depicting the firm's production practices and costs is needed. To accurately price a group of plants, all costs incurred by the firm should be properly allocated among all respective groups of plants. In most segments of agriculture, farmers are considered to be price-takers, who have little control over prices received (2). The manager of a nursery operation, however, may not operate in a perfectly competitive market and may be a price-searcher. Many nursery producers operate in a market where there are few local sellers, but numerous buyers. Thus, the manager has some control in determination of price for their commodity. Consequently, accurate allocation of costs among the different groups of plants is important in pricing decisions (1).

An additional complication to calculating costs for nurseries is that production may be a multi-year process. For economic analyses and management decisions, accounting costs should be adjusted to include opportunity costs, which are defined as the cost of the next best alternative. For instance, if money is invested in a nursery, the opportunity cost would be the rate of return you could receive if you invested this money elsewhere. This full-cost information is needed to ascertain whether nursery production is economically feasible, to determine the most profitable mix of plants, as well as for purposes of pricing the plants. The objective of this study was to determine the procedures and practices for a record keeping system that would facilitate cost allocation to a given group of plants for pricing and planning purposes.

Materials and Methods

The objective of this study was achieved by using the following steps. First, the resource base (land, buildings, machinery, etc.) for a representative container nursery in Climatic Zones 7 and 8 was identified. Next, the variable cost of producing and selling container size #1 woody ornamental plants was estimated. A technique was then established by following cost accounting procedures for the allocation of fixed and overhead costs, as well as for direct variable expenses, to differing groups of plants. Finally, a microcomputer spreadsheet was developed to simulate the cost allocation procedure of a generalized job-cost accounting system.

The economic engineering, or 'synthesis' method, was employed to develop a model nursery firm where the best

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[5]A 'group of plants' includes plants of different varieties that are grown with the same cultural practices and have the same propagation and marketing times.

proven practices of plant production were utilized. Previous budgets by Hall et al. (5) were revised. The purpose of beginning the study by developing a 'model nursery' was to have information on a realistic nursery upon which the cost estimating technique could be applied. A 12-acre container nursery was used as the basis of illustration for how the system works.

To estimate the cost of production for container size #1 woody ornamental plants, enterprise budgets were developed for five plant species: azalea, Burford holly, crapemyrtle, Fraseri photinia, and Pfitzer juniper. For each species, two enterprise budgets were developed, one following the usual method (preferred timeliness of operations) and the other following the alternate method (delayed timeliness of operations).

To establish a technique for allocation of costs, a computerized general ledger accounting system was used to construct income statements a nursery would normally generate for tax purposes. These income statements were then modified to cover opportunity costs of resources used in production. All costs were allocated to groups of plants following established cost accounting procedures. The primary emphasis of the cost allocation procedure was placed on allocation of overhead. Job Order Cost Accounting was used for determining the cost of a manufacturing process. With the job cost method, direct labor and direct materials are recorded and allocated directly to a group of plants, with overhead allocated by a pre-determined method. Often for job costing, overhead is allocated as a percentage of direct labor expense (8).

A commercialized accounting software package (11) was used to approximate the type of accounting activity that would occur in an actual nursery operation. Use of commercial software helped to insure that this analysis represented the steps a nursery manager might follow, generated reports and listings that the nursery manager could have available, and followed accepted accounting practices (9). The nursery manager or crew leaders would be required to record the daily activities of employees. Daily records are then summarized into periodic reports to aid in allocating costs (7).

Several assumptions were necessary to facilitate this analysis. Individual nursery managers may modify these assumptions based on perceived market conditions. Market demand constraints placed a minimum and maximum on the number of plants that could be sold of each species (Table 1). This resulted in a minimum of 204,800 and a maximum of 396,800 plants of all species that could be marketed during a given year. For the initial cost allocation analysis, a total of 256,000 plants were produced (Table 1). Death and culling losses were considered at propagation and potting-out phases. The rates were varied by species, based on average losses for each species. Sufficient plants were propagated to provide for the desired number of mature plants. This initial mix of plants was adapted from Hall's (4) example with 2,700 hours of labor per month available to the nursery. Adjustments were necessary to Hall's optimal solution so that at least one batch of each species for each production method was included in the analysis. Given prices, number of plants being produced, and timing (Table 2), total expected sales revenue by quarter for the year was estimated. Total budgeted sales revenue for the year equaled $522,240.

For this research, production was assumed to remain constant from year to year. This assumption meant that the same number of azaleas produced by the usual (34,000 plants) and the alternate (12,800 plants) methods were sold each year, as well as for other species. The job-cost software, however, would accommodate changes in the plant mix marketed each year as each group of plants is treated as a separate job.

Table 1. Market demand constraints on the number of plants sold, initial cost allocation and prices.

Plant	Minimum	Maximum	Usual	Alternate	Total
Azalea	51,200	76,800	36,400	12,800	51,200
Burford holly	76,800	115,200	64,000	12,800	76,800
Crapemyrtle	12,800	76,800	12,800	25,600	38,400
Fraseri photinia	38,400	76,800	51,200	12,800	64,000
Pfitzer juniper	25,600	51,200	12,800	12,800	25,600
Totals	204,800	396,800			256,000

Empirical model: The model nursery consisted of twelve acres with eight acres of bed space. The other four acres were used for offices, roadways, sheds, working area, irrigation pond, plus area for future expansion. Land and buildings required a capital investment of $265,745 (Table 3). Capital investment in machinery and equipment totaled $90,130. Annual cost of ownership of capital assets included depreciation, interest, insurance and taxes. Depreciation was calculated using the straight-line method. In addition to the fixed costs of capital assets, operating expenses included general

Table 2. Estimated sales by quarter for a 12-acre nursery with 8 acres of bed space, 1990.

Crop	Plant	Date	Number of plants	Price ($)	Total revenue ($)
First quarter					
Usual	Azalea	Mar	28,800	2.00	57,600
Usual	Crapemyrtle	Mar	9,600	2.00	19,200
Usual	Juniper	Mar	9,600	2.10	20,160
Usual	Photinia	Mar	25,600	2.00	51,200
Subtotal			73,600		148,160
Second quarter					
Usual	Burford holly	Apr	32,000	2.10	67,200
Alternate	Crapemyrtle	May	25,600	2.00	51,200
Alternate	Juniper	Jun	12,800	2.10	26,880
Alternate	Photinia	Jun	12,800	2.00	25,600
Subtotal			83,200		170,880
Third quarter					
Subtotal			0		0
Fourth quarter					
Usual	Azalea	Oct	9,600	2.00	19,200
Alternate	Azalea	Oct	12,800	2.00	25,600
Usual	Burford holly	Oct	32,000	2.10	67,200
Alternate	Burford holly	Oct	12,800	2.10	26,880
Usual	Crape myrtle	Oct	3,200	2.00	6,400
Usual	Juniper	Nov	3,200	2.10	6,720
Usual	Photinia	Oct	25,600	2.00	51,200
Subtotal			99,200		203,200
Total			256,000		522,240

Table 3. Estimated capital requirements for a 12-acre nursery of container-grown plants with 8 acres of bed space, 1990.

Item	Description	Unit	#	Cost/unit	Salvage value	Useful life	Total cost
				dollars ($)			
Land		acre	12	2,000	0	—	24,000
Land improvements	pond, roads, etc.	acre	12	500	0	20	6,000
Buildings							
Office and restrooms	20' × 40'	sq.ft.	800	35	0	20	28,000
Potting and packing shed, storage	35' × 35'	sq.ft.	1,255	18	0	20	22,050
Concrete slab mixing area	35' × 50' × 4"	sq.ft.	1,750	2.50	0	20	4,375
Propagation greenhouses	20' × 96'	each	18	4,740	0	10	85,320
Machine storage shop	40' × 100'	sq.ft.	4,000	8	0	20	32,000
Winter greenhouses	21' × 96'	each	32	2,000	0	10	64,000
SUBTOTAL							265,745
Machinery and Equipment							
Tractor + front end loader	50 hp	each	1	17,500	4,000	10	17,500
Tractors	19 hp, Kubota	each	2	7,695	3,000	10	15,390
Trailers	4-wheel	each	3	1,000	480	10	3,000
Sprayer	Back-pack	each	1	130	0	10	130
Sprayer	Hydraulic piston	each	1	2,400	240	10	2,400
Sprayer	Airblast, 300 gal.	each	1	3,600	510	7	3,600
Truck	½ ton	each	1	12,800	500	10	12,800
Irrigation system	Pump, controls, PVC pipe, nozzles	—	1	17,000	1,000	20	17,000
Hand tools	Misc.	—	—	—	0	5	1,000
Mist system		each	12	600	600	10	7,200
Cyclone seeder	hand operated	each	1	30	0	20	30
Electric shears	hand operated	each	1	80	0	5	80
Office equipment	Misc.	—	—	—	0	5	10,000
SUBTOTAL							90,130
TOTAL LAND, BUILDINGS AND EQUIPMENT							355,975

overhead expenses. General overhead included items such as office salaries, supplies, utilities, and insurance on labor. General overhead expenses were estimated at $103,350 per year, or 65 percent of total annual fixed costs. Total annual cost of capital assets was estimated at $55,822.

Enterprise budgets detailing the direct variable expenses of the different plant species (Table 4) were developed to determine the variable cost per plant for each specie (3). Variable cost per plant ranged from a low of $1.04 for crapemyrtles, usual and alternate methods, to a high of $1.51 for Burford Holly, alternate method. The method for obtaining these data consists of having the crew chief responsible for using equipment, labor and materials record the activity for each day by each group of plants. Such an allocation allows all variable expenses in these categories to be attributed to a specific group of plants.

Budgets were sequenced by years and months for two harvest periods so the reader is able to follow the full production cycle. About 25 percent of the plants were scheduled for fall sales centered around October, with the remaining 75

Table 4. Estimated variable costs of producing selected container size #1 woody landscape plants, 12,800 plants, 1990.

Stage of production	Azalea	Burford holly	Crapemyrtle	Juniper	Photinia
	dollars				
Usual method:					
Propagation	3,739.94	4,795.30	3,675.55	4,730.49	3,729.02
Growing stage	7,513.97	10,854.43	7,353.55	9,000.41	7,707.56
Harvest stage	2,240.57	2,554.55	2,298.63	2,031.89	2,163.72
Total variable cost	13,494.48	18,204.28	13,327.73	15,762.79	13,600.30
Variable cost/plant	1.05	1.42	1.04	1.23	1.06
Alternate method:					
Propagation	4,326.19	4,778.64	3,298.88	3,891.93	3,357.89
Growing stage	9,571.68	9,571.68	11,253.40	7,978.28	10,007.89
Harvest stage	1,913.69	3,292.16	2,017.67	1,944.95	2,726.66
Total variable cost	15,811.56	19,324.2	13,294.83	15,844.77	14,163.92
Variable cost/plant	1.24	1.51	1.04	1.24	1.11

Table 5. Calculation of fixed costs and overhead allocation percentages for a 12-acre nursery with 8 acres of bed space, 1990.

Fixed costs and general overhead	Allocation	Annual	Qtr. 1	Qtr. 2	Qtr. 3	Qtr. 4
Total variable expenses						
Direct materials	$	137,314	19,783	70,575	36,362	10,594
Direct machinery	$	22,031	3,936	7,153	6,257	4,685
Direct labor	$	106,715	24,548	32,139	28,501	21,527
Total sq. ft. used:						
Prop. greenhouse	sq.ft.	123,200	28,000	36,400	29,400	29,400
Winter greenhouse	sq.ft.	137,000	68,500	0	0	68,500
Land	sq.ft	551,300	109,000	153,900	169,400	119,000
Yearly fixed cost and overhead		---------- dollars ($) ----------				
Land & improvements	sq. ft. used	2,700.00	675.00	675.00	675.00	675.00
Buildings:						
Office and restrooms	direct labor	3,640.00	910.00	910.00	910.00	910.00
Potting & packing shed, storage, concrete slab	direct materials	3,435.28	858.82	858.82	858.82	858.82
Propagation greenhouse	sq. ft. used	15,357.60	3,839.40	3,839.40	3,839.40	3,839.40
Machine shop	direct machinery	4,160.00	1,040.00	1,040.00	1,040.00	1,040.00
Winter greenhouse	sq. ft. used	11,520.00	5,760.00	0.00	0.00	5,760.00
Machinery and equipment	direct machinery	12,29.52	3,052.38	3,052.38	3,052.38	3,052.38
Office equipment	direct labor	2,800.00	700.00	700.00	700.00	700.00
General overhead	direct labor	103,354.00	25,838.50	25,838.50	25,838.50	25,838.50
% Direct materials	%	2.502	4.341	1.217	2.362	8.106
% Direct machinery and equipment	%	74.301	103.982	57.29	65.403	87.344
% Direct labor	%	102.886	111.817	85.405	96.308	127.58

scheduled for late winter or spring sales centered around March. Plants that reach maturity in the fall are ready for sale at that time. However, for this study, sales were allocated over several months resulting in some sales in every month.

The job-cost software setup determined what data were needed for the job-cost analysis. In this analysis master jobs were created for all plant varieties, all methods, so that the nursery manager could easily determine total investment to date in each variety of plant. For example, three different groups of azaleas, usual method, required production activity during the accounting year. Detailed cost codes were maintained for each job header containing the general ledger account to be debited, the overhead method and rate used for the cost code, estimated start and finish dates, estimated budget information by units and cost, actual information by units, cost for period-to-date (PTD) and job-to-date (JTD), plus other information (10). Estimated budget information in these records played an important role in report generation providing a standard with which to compare actual information with PTD and JTD figures.

For each cost code, a default general ledger account number was entered to be automatically debited when the cost occurred. These accounts were referred to as 'work-in-process' accounts and were set up as current assets. The credited accounts were either cash, accounts payable, inventory, or any other the transaction required (9). For these cost codes, the first seven were set up with a general ledger account number. Overhead, however, was treated as an indirect expense, which meant no general ledger distributions were generated.

Table 6. Allocation of fixed costs of producing container size #1 container grown plants by variety for a 12-acre nursery with 8 acres of bed space, 1990.

Crop	Allocated fixed cost	# of plants produced	Fixed cost per plant	Variable cost per plant	Total cost per plant	Fixed cost as a % of total cost
	($)	(no.)	($)	($)	($)	(%)
Usual						
Azalea	21,232.49	38,400	0.55	1.05	1.61	34
Burford holly	47,935.86	64,000	0.75	1.42	2.17	34
Crapemyrtle	6,957.70	12,800	0.54	1.04	1.57	34
Junipers	7,553.88	12,800	0.59	1.23	1.82	32
Photinias	27,851.00	51,200	0.54	1.06	1.61	34
Alternate						
Azaleas	8,187.45	12,800	0.64	1.24	1.87	34
Burford holly	10,560.71	12,800	0.83	1.51	2.33	35
Crapemyrtle	14,009.59	25,600	0.55	1.04	1.59	35
Junipers	7,662.53	12,800	0.60	1.24	1.84	33
Photinias	7,221.46	12,800	0.56	1.11	1.64	34
Total	159,172.69	256,000				

Table 7. Estimated per plant cost of production by differing plant mixes (holding output constant at 256,000 plants).

Crop	Original	1	2	3	4	5	6	7	8	9	10
	dollars ($)										
Usual											
Azalea	38,400	64,000	38,400	51,200	38,400	38,400	12,800	12,800	12,800	12,800	12,800
Burford holly	64,000	64,000	102,400	64,000	64,000	64,000	12,800	12,800	12,800	12,800	12,800
Crapemyrtle	12,800	12,800	12,800	25,600	12,800	12,800	12,800	12,800	12,800	12,800	12,800
Pfitzer juniper	12,800	12,800	12,800	12,800	38,400	12,800	12,800	12,800	12,800	12,800	12,800
Alternate											
Azalea	12,800	12,800	12,800	12,800	12,800	12,800	64,000	38,400	51,200	38,400	38,400
Burford holly	12,800	12,800	12,800	12,800	12,800	12,800	64,000	102,400	64,000	64,000	64,000
Crapemyrtle	25,600	12,800	12,800	12,800	12,800	12,800	12,800	12,800	25,600	12,800	12,800
Pfitzer juniper	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	38,400	12,800
Fraseri photinia	12,800	12,800	12,800	12,800	12,800	12,800	38,400	25,600	38,400	38,400	64,000
Total plants produced	256,000	256,000	256,000	256,000	256,000	256,000	256,000	256,000	256,000	256,000	256,000
	Total cost per plant ($)										
Usual											
Azalea	1.61	1.61	1.59	1.61	1.60	1.61	1.58	1.57	1.59	1.58	1.59
Burford holly	2.17	2.17	2.15	2.17	2.16	2.17	2.14	2.13	2.15	2.14	2.15
Crapemyrtle	1.58	1.58	1.57	1.58	1.58	1.58	1.56	1.55	1.57	1.56	1.57
Pfitzer juniper	1.82	1.82	1.81	1.82	1.81	1.82	1.79	1.78	1.80	1.79	1.80
Alternate											
Azalea	1.87	1.87	1.86	1.87	1.87	1.87	1.85	1.83	1.85	1.85	1.86
Burford holly	2.33	2.33	2.32	2.33	2.33	2.33	2.30	2.28	2.31	2.30	2.31
Crapemyrtle	1.59	1.59	1.57	1.59	1.58	1.59	1.56	1.55	1.57	1.56	1.57
Pfitzer juniper	1.84	1.84	1.82	1.84	1.83	1.84	1.81	1.80	1.81	1.81	1.82
Fraseri photinia	1.67	1.67	1.66	1.67	1.66	1.67	1.65	1.64	1.65	1.65	1.65
Net income	56,333	56,240	42,550	56,406	54,983	56,388	39,337	27,126	41,854	43,271	42,633

Allocation of overhead was based not only on direct labor expenses, but also on materials and machinery and equipment expenses. Referring to Table 3, there were several types of buildings used for different purposes, as well as general overhead and machinery and equipment costs each year. For each category of expense, an appropriate allocation method was determined. Table 5 lists fixed costs and general overhead expenses for the year, plus the allocation method used for each expense.

Office and supervisor salaries, plus related insurance, made up approximately 75 percent of general overhead. Although other general overhead expenses such as travel and advertising were not intuitively related to direct labor usage, neither were they related to direct materials or machinery. Since other overhead expenses made up a small proportion of total general overhead, allocating all of general overhead by direct labor would be the manager's best option.

Land, propagation greenhouses, and winter greenhouses were allocated based on square footage each crop used. Since allocation of these fixed costs was not based on a direct expense, the allocation had to be calculated separately and entered directly (not calculated) into the job-cost software. All costs for winter greenhouses were allocated in the first and fourth quarters since these facilities were not used during the second or third quarters (Table 5).

The nursery manager must develop estimates of variable and fixed costs, possibly from historical costs, to calculate allocation percentages for their operation. Thus, overhead allocated for the year in the job-cost software may not equal the amount reported on the yearly income statement. Periodic adjustments to allocated overhead may be necessary by the manager with either direct entries into the job-cost software using overhead detail cost codes or adjustments to overhead allocation percentages.

Results and Discussion

There were only moderate differences in estimated fixed costs per plant across varieties (Table 6). Allocated fixed costs represented slightly more than one-third of total estimated costs for azaleas, Burford hollies, crapemyrtles, and Fraseri photinia. Allocated fixed costs for Pfitzer juniper were 32 and 33 percent of total estimated costs for usual and alternate method, respectively, as this plant required no winter greenhouse protection.

Altering plant mix with total plant production held constant: Changes in plant mix would have an affect on allocation of fixed costs and general overhead to various production processes. Use of an electronic spreadsheet model allowed estimation of per plant cost of production due to changes in the plant mix being produced without recreating financial records for each mix of plants. By changing the number of plants being produced by plant variety for each production method (usual and alternate), fixed costs and general overhead were reallocated based on direct labor expenses for a group divided by total direct labor expense. For each job, allocation percentages were multiplied by direct labor costs to obtain overhead for that job based on labor expenses. The same procedure was followed for direct machinery and equipment, plus direct materials.

Finally, the simulation model spreadsheet calculated an estimated income statement by quarter and year given the plant mix. Labor, propagation greenhouse, and winter greenhouse requirements were also generated. The number of

greenhouses shown in Table 3 was based upon a total plant production of 256,000 plants given the plant mix used in the previous section. Thus, for this model, as the plant mix changed, the number of greenhouses was adjusted to accommodate the new plant mix that was being evaluated.

To examine changes in fixed cost allocation for a given total plant production, ten plant mix scenarios were analyzed. First, the alternative production method for each variety was kept at a minimum of 12,800 plants (one budgeted unit). The number of plants being produced by the usual method of production was adjusted so that a total of 256,000 plants were produced, each crop variety (usual and alternate added together) met market demand constraints, and each crop variety met the maximum market demand constraint in one plant mix scenario. The results of the ten plant mix scenarios were compared to the original plant mix analyzed in the previous section (Table 7). For plant mix scenarios one through five, there were none to only slight changes, $0.00 to $0.02, in per plant total cost from the original plant mix. The largest change in per plant total cost, $0.01 to $0.02, occurred when scenario two, the maximum number of Burford hollies, was produced.

For scenarios six through ten, the alternate method of production was primarily used and the usual method was held to 12,800 plants per variety. Per plant total costs changed from the original plant mix by as much as $0.01 to $0.05. For all scenarios, per plant total cost tended to be lower when the alternate method was primarily used versus the usual method. Scenario seven, with Burford hollies at the maximum market constraint, resulted in the lowest per plant cost of all scenarios.

The alternate method of production tended to lower per plant cost more than the usual method. This occurred although the alternate method of production received a larger per plant share of fixed costs than the usual method, generally because of longer growing periods. The fixed cost reduction arose from shifting from relatively lower variable costs associated with the usual method to higher variable costs associated with the alternate method. With more total dollars of variable costs involved, fixed cost per dollars of variable costs declined. Higher fixed costs arose from longer usage of land, propagation greenhouses and winter greenhouses for the alternate method, but the decrease in fixed costs associated with variable costs more than offset that arising from land and greenhouses.

However, net income decreased due to the change in plant mix (Table 7) because variable cost per plant was generally higher for the alternate method than for the usual method. For example, azaleas, usual method, have a per-plant variable cost of $1.05 compared to $1.24 for the alternate method. Thus, production was shifting to a relatively higher cost of production process.

Changes in plant mix involving azaleas, crapemyrtle, and Fraseri photinia, usual method of production, resulted in no change in total per-plant costs (scenarios one, three, and five of Table 7). With the alternate method, changes in the number of azaleas, crapemyrtles, and Fraseri photinias produced caused fixed cost to vary by $0.00 to $0.01 per plant (scenarios six, eight, and ten). Increases in the number produced of Pfitzer juniper and Burford holly and decreases in the number of the other three varieties resulted in lower per-plant total cost for reasons discussed above (scenarios two, four, seven, and nine).

Altering total plant production: The second step in this analysis was to examine how total fixed cost and general overhead allocation changed as total plant production changed. Market demand constraints required a minimum of 204,800 plants produced and bed space limitations allowed a maximum of 307,200 plants. For the initial plant mix, each variety was set at the market demand minimum. For each additional change in production, the total number of plants produced was increased by 12,800 plants. The variety of plant with the highest per-plant profit was increased by 12,800 plants; however, no variety could exceed its maximum market constraint. Per plant profit was determined by subtracting total cost per plant for the current output level from the sale price per plant given in Table 2. Labor was assumed to be non-constraining on production.

The number of plants by species and production method are shown in Table 8. As was expected, fixed cost per plant, and, therefore, total cost per plant, declined as output expanded (Table 9). At a production level of 204,800 plants, fixed cost comprised approximately 38 percent of total cost per plant. This percentage declined until, at an output level of 307,200 plants, fixed cost made up approximately 31 percent of total cost per plant.

This allocation of total fixed cost over a larger number of plants allowed Burford hollies, usual method, to just cover all costs with a sale price of $2.10 per plant when 294,400

Table 8. Number of plants by variety and production method with plant total varying.

Crop	1	2	3	4	5	6	7	8	9
	Number of plants								
Usual									
Azalea	38,400	38,400	38,400	38,400	38,400	51,200	51,200	64,000	64,000
Burford holly	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
Crapemyrtle	6,400	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800
Juniper	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	25,600
Photinia	25,600	25,600	25,600	38,400	51,200	51,200	64,000	64,000	64,000
Alternate									
Azalea	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800
Burford holly	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800
Crapemyrtle	6,400	12,800	25,600	25,600	25,600	25,600	25,600	25,600	25,600
Juniper	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800
Photinia	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800	12,800
Total	204,800	217,600	230,400	243,200	256,000	268,800	281,600	294,400	307,200

Table 9. Estimated changes in per plant cost and net income as total production increases.

Crop	1	2	3	4	5	6	7	8	9
	Fixed cost per plant ($)								
Usual									
Azalea	0.65	0.62	0.60	0.58	0.55	0.53	0.51	0.50	0.48
Burford holly	0.88	0.84	0.81	0.78	0.75	0.72	0.70	0.68	0.65
Crapemyrtle	0.64	0.61	0.59	0.57	0.54	0.52	0.51	0.49	0.47
Juniper	0.70	0.67	0.64	0.61	0.59	0.56	0.54	0.53	0.50
Photinia	0.64	0.61	0.59	0.57	0.54	0.52	0.50	0.49	0.47
Alternate									
Azalea	0.76	0.72	0.69	0.67	0.64	0.62	0.59	0.58	0.55
Burford holly	0.97	0.92	0.89	0.86	0.83	0.80	0.77	0.75	0.72
Crapemyrtle	0.64	0.61	0.59	0.57	0.55	0.53	0.51	0.49	0.48
Juniper	0.71	0.68	0.65	0.62	0.60	0.57	0.55	0.53	0.51
Photinia	0.66	0.63	0.61	0.59	0.56	0.54	0.53	0.51	0.49
	Total cost per plant ($)								
Usual									
Azalea	1.71	1.67	1.65	1.63	1.61	1.59	1.57	1.55	1.53
Burford holly	2.30	2.26	2.23	2.20	2.17	2.14	2.12	2.10	2.07
Crapemyrtle	1.68	1.65	1.63	1.61	1.58	1.56	1.55	1.53	1.51
Juniper	1.93	1.90	1.87	1.85	1.82	1.80	1.78	1.76	1.73
Photinia	1.70	1.68	1.65	1.63	1.61	1.58	1.57	1.55	1.53
Alternate									
Azalea	1.99	1.96	1.93	1.91	1.87	1.85	1.83	1.81	1.79
Burford holly	2.48	2.43	2.40	2.37	2.33	2.31	2.28	2.26	2.23
Crapemyrtle	1.68	1.65	1.63	1.61	1.59	1.57	1.55	1.53	1.51
Juniper	1.95	1.92	1.89	1.86	1.84	1.81	1.79	1.77	1.75
Photinia	1.77	1.74	1.72	1.69	1.67	1.65	1.63	1.62	1.60
Net income	12,099	23,668	34,400	45,187	56,333	67,719	78,56	89,398	100,515

plants were produced (Table 9). At 307,200 plants, Burford hollies, usual method, had a total cost of $2.07 per plant, allowing for a $0.03 profit. However, total cost for producing Burford hollies, alternate method, at any output level did not drop below the sale price of $2.10. Under different expansion scenario (Table 9) allowing more Burford hollies or Pfitzer junipers production, lower per-plant total cost resulted, but at the expense of net income.

Results revealed that fixed cost per plant represented approximately one-third of total cost per plant for each variety and production method. Fixed cost per plant for junipers, usual and alternate production method, was 32 and 33 percent, respectively, of total cost per plant. The fixed cost per plant for the other four varieties by production method ranged from 34 to 35 percent of total cost per plant. Junipers received a smaller share of fixed costs because no winter greenhousing was required. Burford holly, alternate and usual method of production, was the only variety in which the total cost per plant ($2.17 and $2.33, respectively) was greater than the established sale price of $2.10. This result emphasizes the importance of identifying and attributing fixed costs to groups of plants. Without allocation of fixed costs, the variable cost per plant may be below selling price, falsly leading the nursery owner to believe that a profit is made by selling that type of plant.

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