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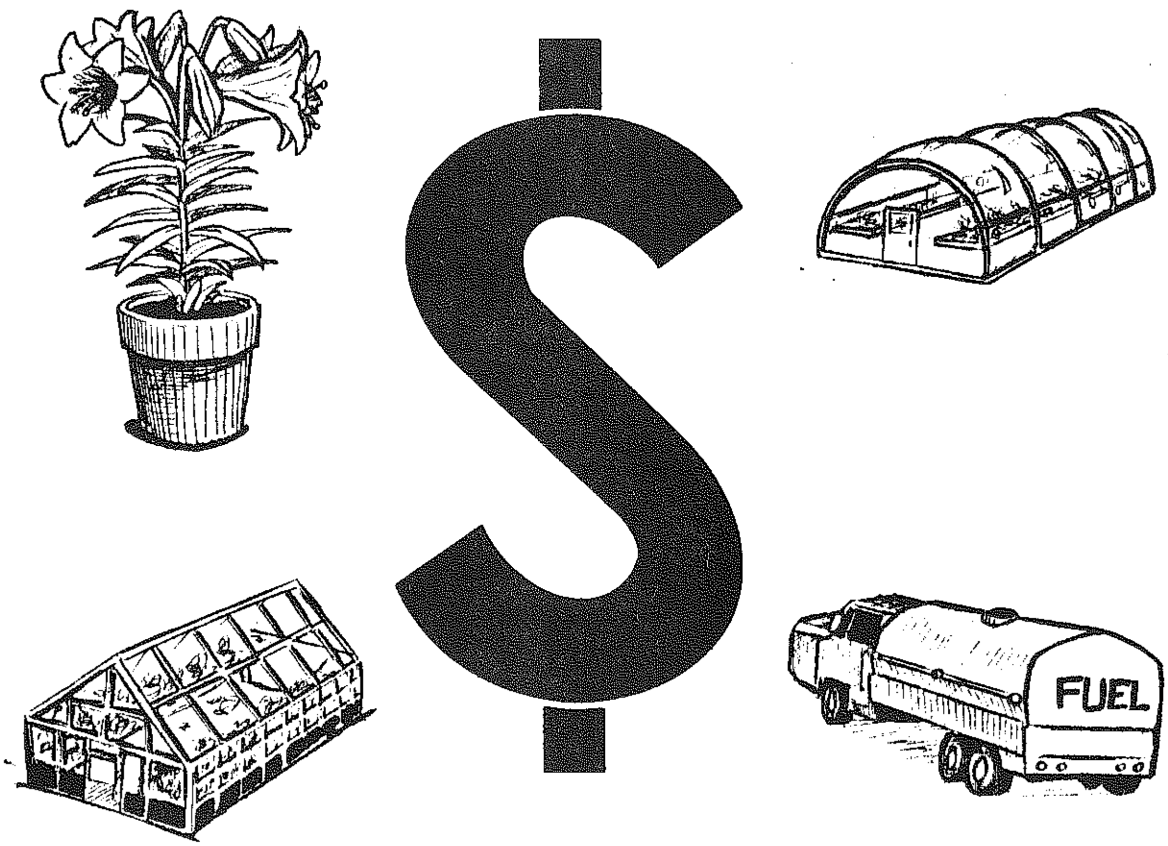
AN ECONOMIC ANALYSIS OF NEW YORK GREENHOUSE ENTERPRISES



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An Economic Analysis of New York Greenhouse Enterprises

by

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Introduction and Purpose

Greenhouse floriculture crops provide an important economic contribution to New York State, accounting for over $40 million in wholesale value for major crops in 1980[1]. Due to skyrocketing energy prices, greenhouse heating costs have increased as a proportion of total costs resulting in declining profits for potted plant production. Consequently, the production of those crops which maximize profits is now more crucial than ever for the continued survival of greenhouse growers. Potential gains in efficiency and profitability are not automatically identifiable. A grower will commonly rely upon experience and intuition to make rational decisions on the management of the greenhouse operation. The general goal of improved management calls for the utilization of all relevant tools and decision aids.

The purpose of this publication is to present enterprise budgets for five important greenhouse crops in New York State - poinsettias, lilies, chrysanthemums, geraniums, and hydrangeas - in order to assist growers in comparing alternative crop enterprises in their own operations. Enterprise analysis is a management tool which can be used to organize and plan the production of a combination of crops. Enterprise budgets for each crop include the major inputs to which costs are assigned according to the requirement for each input in the production of each crop. The systematic

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[1] Floriculture Crops, Crop Reporting Board, ESCS, USDA, March 1981.

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examination of the cost components and relative profitability among enterprises contributes to better business management.

Methodology and Format

Several approaches were used to develop crop enterprise budgets. First, the economic engineering method was used to estimate the costs of certain inputs, (e.g., fertilizer) by taking the crop production requirement for that input per pot as determined through research and extension publications. Input prices for these inputs were obtained from a supplier's catalogue. Results obtained from this method often yielded cost estimates much higher than realized in actual production and had to be scaled down accordingly to reflect common practices. The engineering method was also used to compute fuel requirements. The second method involved the use of a questionnaire whereby individual growers provided cost data on their operations. The third method, the growers' panel, consisted of the review of the questionnaire in the presence of the local extension agent, the authors of this study, and a panel of growers, who determined by concensus the amounts and costs of certain inputs. Each method was applied where the nature of the input cost in question favored its use. Two different panels were used, consisting of three growers from Erie County, two growers from Monroe County, one grower from Orleans County, and one grower from Seneca County.

The data sought included growing practices and costs of production in order to formulate a cost analysis. The crops analyzed in the study are described as follows:

Poinsettias: 6 in. azalea pot, pinched, 17 week growing period, 3 spacings, market - Christmas.

Lilies: 6 in. standard pot, 5 blooms, 18 week growing period, 3 spacings, market - Easter.

Chrysanthemums: 6.5 in. azalea pot, 13 weeks growing period, 2 spacings, market - Mother's Day.

Geraniums: 4.5 in. standard pot, rooted cutting, 9 week growing period, 2 spacings, market - Memorial Day.

Hydrangeas: 7.5 in. standard pot, 2-3 blooms, 12 week growing period (to finish), 2 spacings, market - Memorial Day.

The temperature regime assumed for all crops was 70 degrees day, 60 degrees night.

For purposes of coming up with a "typical" cost situation which growers could use as a guide in making production decisions, it was necessary to make assumptions concerning the size and type of operation. Based on preliminary discussions with faculty from the Cornell University Department of Floriculture and Ornamental Horticulture, and with extension agents having program responsibility in floriculture, a greenhouse operation of 20,000 square feet was selected as "typical" for a grower who is the sole manager but also furnishes some labor. Returns, costs, and profits for each crop were compiled from the data available and organized into crop enterprise budgets.

The study used several sources of data. A number of publications of the Department of Floriculture and Ornamental Horticulture, Cornell University, contributed valuable background information on the growing practices and fertilizer needs of individual crops. The questionnaire submitted by growers yielded cost data. Information on growing practices as well as other relevant facts were provided by growers on the growers' panel. Greenhouse manufacturers submitted estimated of basic material and labor costs for a new structure. Commercial greenhouse suppliers furnished input cost data through their catalogues. Finally Dr. Langhans of the Department of Floriculture and Ornamental Horticulture, Cornell University, reviewed the budgets and many of his suggestions were incorporated into the final results.

The format for crop enterprise budgets provide for four general categories:

RETURNS

COSTS

PROFIT PER POT

PROFIT PER SQUARE FOOT WEEK

RETURNS represent the consensus of the growers' panel for wholesale prices during the 1980-1981 season (Table 1). These prices were later adjusted to reflect shrinkage, i.e., plants which died or were of too poor quality to sell through normal market channels.

COSTS are divided into three subcategories under which associated component costs were included:

1) Direct Costs
   - Rooted cutting
   - Pot
   - Fertilizer
   - Growth retardant
   - Media
   - Pesticide
   - Shipping container
2) Indirect Variable Costs
   - Labor
   - Fuel
   - Cash expenses
3) Fixed Costs
   - Insurance and taxes
   - Depreciation and interest

Table 1. Product Prices and Input Costs

PRICES			
Potted Plants	Dollars	Potted Plants	Dollars
Poinsettias	$4.00	Chrysanthemums	$3.50
Lilies	$3.50	Hydrangeas	$5.50
Geraniums	$1.00		

COSTS			
Fertilizer	Dollars	Media	Dollars
15 - 0 - 15 (lb.)	$ .66	Metro - Mix (cu.ft.)	$2.33
15 - 15 - 15 (lb.)	.66	Pro Mix C (cu.ft.)	1.66
20 - 20 - 20 (lb.)	.66	Commercially prepared media (cu.ft.)	2.00
15 - 30 - 15 (lb.)	.74		
Potassium Nitrate (lb.)	.55		
Calcium Nitrate (lb.)	.54	Labor	
		Hourly	4.50
Growth Retardant		Capital	
A - Rest (qt.)	36.85	Long-term interest rate (real rate + risk premium)	9%
Cycocel (qt.)	27.90		
B-Nine SP (lb.)	26.75		
Pesticides		Heating Costs	
Kelthane (lb.)	4.15	#2 Fuel Oil (gal.)	$1.00
Lesan (lb.)	10.90	Gas (100 cu. ft.)	.40
Benlate (lb.)	14.95		
Karathane (lb.)	3.65		

Each of these cost subcategories included itemized costs assigned to that subcategory. Direct Costs include those variable costs which can be attributed directly to a particular pot. Direct cost data for the rooted cutting, pot, and shipping container were collected from the growers' panel. Cost figures for fertilizer, growth retardant, media, and pesticide were constructed using the economic engineering approach. Actual calculated costs for fertilizer, growth retardant, and pecticide were adjusted to be consistent across crops and to reflect real practices. These variable inputs are not a large proportion of total growing costs. Input prices for direct cost items as well as for indirect variable costs are shown in Table 1.

Indirect Variable Costs include labor, fuel, and certain cash expenses. An annual average expenditure for labor was calculated from estimates submitted by four growers. Due to the small sample size, this average labor bill cannot be considered "statiscally significant"; however, a review of relevant studies on greenhouse operations confirmed the validity of our estimate. It is difficult to estimate the labor cost for a family run operation. Also, it was difficult to assign labor costs to particular crops since some crops are more labor intensive than others. The labor cost per pot was calculated by multiplying the ft^2/week labor cost times the space requirement in square foot weeks (SFW's) necessary to produce one pot. The labor charge was computed at $.047/SFW. The fuel bill was similarly calculated except that SFW costs varied according to changing monthly fuel needs, spacing requirements, and the months in which each particular crop is grown. Fuel requirements and space requirements for the respective crops are shown in Tables 2-6. (Fuel requirements and costs by month for glass and plastic houses, for oil and natural gas and for varying temperature and prices are shown in the Appendix.) Indirect costs were computed at $.016/SFW (Table 7).

Table 2. Fuel and Space Requirements, Poinsettias (Christmas)

Growing Period & Spacing				(1)	(2)	(3)	(2÷3)
Month	No. of Days	Spacing	SFW's in Prod.	Gal. per ft^2 floor	Gal. per ft^2 bench	No. pots/ ft^2 bench	Gal. per pot
August	14	6x6		.009	.014	4.00	.003
September	14	6x6	1.00	.015	.023	4.00	.006
	16	10x10		.018	.027	1.44	.019
October	5	10x10	2.10	.012	.018	1.44	.013
	26	13.5x13.5		.065	.098	.79	.124
November	30	13.5x13.5		.135	.203	.79	.256
December	14	13.5x13.5	12.66	.092	.138	.79	.175
	119	(17 weeks)	15.76				.596 gal. per pot

Table 3. Fuel and Space Requirements, Chrysanthemums (Mother's Day)

Growing Period & Spacing				(1)	(2)	(3)	(2÷3)
Month	No. of Days	Spacing	SFW's in Prod.	Gal. per ft^2 floor	Gal. per ft^2 bench	No. pots/ ft^2 bench	Gal. per pot
February	23	7.5x7.5		.163	.245	2.56	.096
March	5	7.5x7.5	1.56	.028	.042	2.56	.016
	26	14x14		.144	.216	.735	.294
April	30	14x14		.106	.159	.735	.216
May	7	14x14	12.24	.012	.018	.735	.024
	91	(13 weeks)	13.80				.646 gal. per pot

Table 4. Fuel and Space Requirements, Geraniums (Memorial Day)

Growing Period & Spacing				(1)	(2)	(3)	(2÷3)
Month	No. of Days	Spacing	SFW's in Prod.	Gal. per ft^2 floor	Gal. per ft^2 bench	No. pots/ ft^2 bench	Gal. per pot
March	14	4.5x4.5		.078	.117	7.11	.016
April	21	4.5x4.5	.70	.074	.111	7.11	.016
	9	7x7		.032	.048	2.94	.016
May	19	7x7	1.16	.033	.050	2.94	.017
	63 (9 weeks)		1.86				.065 gal. per pot

Table 5. Fuel and Space Requirements, Hydrangeas (Mother's Day)

Growing Period & Spacing				(1)	(2)	(3)	(2÷3)
Month	No. of Days	Spacing	SFW's in Prod.	Gal. per ft^2 floor	Gal. per ft^2 bench	No. pots/ ft^2 bench	Gal. per pot
February	14	8x8		.099	.149	2.25	.066
March	7	8x8	1.32	.039	.059	2.25	.026
	24	18x18		.133	.200	.444	.450
April	30	18x18		.106	.159	.444	.358
May	9	18x18	20.25	.012	.018	.444	.041
	84 (12 weeks)		21.57				.941 gal. per pot

Table 6. Fuel and Space Requirements, Lilies (Easter)

Growing Period & Spacing				(1)	(2)	(3)	(2÷3)
Month	No. of Days	Spacing	SFW's in Prod.	Gal. per ft^2 floor	Gal. per ft^2 bench	No. pots/ ft^2 bench	Gal. per pot
December	31	6x6		.203	.305	4.00	.076
January	11	6x6	1.50	.079	.119	4.00	.030
	20	8x8		.144	.216	2.25	.054
February	22	8x8	2.64	.156	.234	2.25	.104
	6	10x10		.042	.063	1.44	.044
March	31	10x10		.172	.258	1.44	.179
April	5	10x10	4.20	.018	.027	1.44	.019
	126	(18 weeks)	8.34				.506 gal. per pot

Table 7. Overhead: Indirect Cash Expenses and Fixed Costs

Indirect Variable Costs (excluding fuel and labor)

Cash Expenses	Costs/ft^2 floor/year		Costs/ft^2 bench/year
Accounting	$ .022		$ .033
Legal	.010		.015
Office expenses	.058		.087
Advertising	.016		.024
Freight expenses	.010		.015
Telephone	.019		.029
Business travel	.012		.018
Dues and subscriptions	.014		.021
Water and sewer	.034		.050
Electricity	.070		.105
Vehicle expenses	.187		.281
Repairs	.059		.089
Miscellaneous	.000		.000
TOTAL	$ .511	x 1.5 =	$ .767 ÷ 48 wks. = $.016/SFW

Fixed Costs: Taxes and Insurance; Depreciation and Interest (Plastic House)

Fixed Costs	Cost/ft^2 floor/year	Costs/ft^2 bench/year	Cost/SFW
Taxes	$ .24	$ .36	$.0075
Insurance	.11	.17	.0035
Depreciation	.69	1.04	.022
Interest	.24	.36	.007

Fixed costs, the final cost subcategory, were classified into two component items. First, taxes and insurance represent those fixed costs as derived from the questionnaire; second, depreciation and interest[2] (on buildings and equipment) represent those costs associated with owning buildings and equipment based on the estimated new cost of a gutter connected plastic greenhouse. Investment costs and the associated annual fixed costs are shown in Table 8 for both plastic and glass houses. The type of plastic greenhouse considered in this study was based on a supplier's estimate for four gutter connected aluminum frames, each consisting of three 17'x 96' houses covered with a double layer of plastic. The estimate used for glass was specified for three 42'x 165' gutter connected all aluminum and glass greenhouses. However, only the cost of plastic ranges was included in the enterprise analyses.

PROFIT PER POT AND PROFIT PER SQUARE FOOT were residual calculations based on the relative returns and costs for each crop. These represent returns to management; all other costs, including capital costs and owner and family labor are accounted for.

The results of this study are presented in terms of SFW bench area in production. SFW is a very important concept in greenhouse cost accounting. Since approximately two-thirds of the total floor space, or range, of a greenhouse operation is typically bench space actually in production, cost data per floor space was converted into bench space by multiplying 1.5 times the floor space (the same as dividing by two-thirds). In order to account for periods between production cycles, costs incurred annually were converted into weekly costs by dividing the annual costs by 48 weeks. This has the effect of increasing costs to account for nonproductive time during which indirect costs and fixed costs are still being incurred.

[2] An interest rate of nine percent was used. The rate reflects a real rate of interest of four percent and a risk premium of five percent.

Table 8. Investment and Annual Fixed Costs For Plastic and Glass Greenhouses (20,000 ft^2)

	(1) New Cost[a] (dollars)	(2) Life in Years	(3) Depreciation (St.-line)	(4) Interest	(3 & 4) Total Annual Cost
			- PLASTIC -		
Frame	48,500	10	4,850	2,183	7,033
Plastic	7,250	2	3,625	326	3,951
Heating & ventilation	30,000	10	3,000	1,350	4,350
Other[b]	22,500	10	2,250	1,013	3,263
TOTAL COST	108,250		13,725	4,872	18,597
Cost/ft^2 floor	5.41		.69	.24	.93
Cost/ft^2 bench	8.12		1.04	.36	1.40
Cost/SFW bench	.17		.022	.007	.029
			- GLASS -		
Frame	170,500	20	8,525	7,673	16,198
Glass	41,800	20	2,090	1,881	3,971
Heating & ventilation	58,650	10	5,865	2,639	8,504
Other[b]	22,500	10	2,250	1,013	3,263
TOTAL COST	293,450		18,730	13,206	31,936
Cost/ft^2 floor	14.65		.94	.66	1.60
Cost/ft^2 bench	21.975		1.41	.99	2.40
Cost/SFW bench	.46		.029	.021	.050

a/ The estimated labor charge of $15,000 was allocated to new cost in the following proportions:

Frame 60%	= $ 9,000
Plastic 15%	= 2,250
Heating & ventilation 25%	= 3,750
	$15,000

The total labor bill of $100,000 was allocated to new cost in the following proportions:

Frame 58%	= $ 58,000
Plastic 22%	= 22,000
Heating & ventilation 20%	= 20,000
	$100,000

b/ Includes site preparation, electrical connections, watering system, CO^2 generators, fuel tanks, doors, benches, and tools.

To calculate profit per SFW, the profit per pot was divided by the square foot weeks necessary to produce on pot. SFW's are calculated by multiplying the spacing requirement for one pot per square foot times the number of weeks of production at that spacing. The spacing of the crop increases in area as the growth of the plant progresses. The SFW's in production are calculated for each period of growth at a particular spacing and the total SFW per pot is the sum of SFW at each spacing. The SFW computations for the respective crops are shown in Tables 2-6. For example, SFW's in production per pot for geraniums is as follows:

1st SPACING: 4.5 in. x 4.5 in. for five weeks. Therefore

$$.14\ ft^2/pot \times 5\ weeks = .70\ SFW's\ in\ production/pot$$

2nd SPACING: 7 in. x 7 in. for four weeks. Therefore,

$$.29\ ft^2/pot \times 4\ weeks = 1.16\ SFW's\ in\ production/pot$$

TOTAL SFW's in production = .70 + 1.16 = 1.86

Results

The results of this analysis are shown in Table 9. Returns are shown net of shrinkage. Costs are summarized by components. Profit per pot was greatest for poinsettias, which had a return of $.53 per pot, while hydrangeas had a loss of $.83 per pot.

However, it is not only profit per pot which is significant. Profit per SFW is the most important indicator of profit. It is a measure which takes account of the space occupied by the plant, as well as the time it takes to grow the plant until marketing. By this measure, geraniums were the most profitable crop. Although profit per pot was only $.16, profit per SFW was highest at $.086 due to the limited space and the relatively short production cycle required by the crop. Geraniums had the further cost

Table 9. Enterprise Budgets, Five Potted Plants, 1981

	Poinsettias	Lilies	Chrysanthemums	Geraniums	Hydrangeas
RETURNS					
Price	$4.00	$3.50	$3.50	$1.00	$5.50
Shrinkage[a]	- .40	- .53	- .35	- .05	- .55
Net	$3.60	$2.97	$3.15	$ .95	$4.95
COSTS					
1) Direct Costs					
Rooted cutting/bulb	$ .40	$ .80	$ .50	$ .37	$1.85
Pot[b]	.12	.14	.14	.05	.24
Fertilizer	.02	.02	.02	.01	.03
Growth retardant	.02	.02	.01	.01	.03
Media[c]	.13	.14	.15	.04	.22
Pesticide	.02	.02	.02	.01	.03
Shipping container	.16	.21	.16	.03	.21
Total Direct Costs	$ .87	$1.35	$1.00	$ .52	$2.61
2) Indirect Variable Costs					
Labor[d]	.73	.47	.65	.10	1.01
Fuel	.60	.51	.65	.07	.94
Cash expenses	.25	.13	.22	.03	.35
Total Indirect Variable Costs	$1.58	$1.11	$1.52	$ .20	$2.30
3) Fixed Costs					
Insurance & taxes[e]	.17	.09	.15	.02	.24
Depreciation & interest[f]	.45	.24	.40	.05	.63
Total Fixed Costs	$ .62	$ .33	$ .55	$ .07	$ .87
TOTAL COSTS	$3.07	$2.79	$3.07	$ .79	$5.78
PROFIT PER POT	$ .53	$ .18	$ .08	$ .16	-$ .83
PROFIT PER SQUARE FT. WEEK[g]	$ .034	$ .021	$ .006	$ .086	-$ .038

(footnotes next page)

Table 9 footnotes:

a/ Shrinkage represents the proportion of total production lost by death, reduced quality, or unsalable plants. The shrinkage rate is 15% for lilies, 5% for geraniums, and 10% for all others.

b/ For hydrangeas, includes cost of stake.

c/

Crop	Pot Size	Media cost/cu. ft.	No. pots per cu. ft. media
Poinsettias	6 in. Azalea	$2.00	16
Lilies	6 in. Standard	2.00	14
Chrysan.	6.5 in. Azalea	2.00	13
Geraniums	4.5 in. Standard	2.00	48
Hydrangeas	7.5 in. Standard	2.00	8

d/ Annual labor bill approximately $30,000 at average wage rate of $4.50 per hour. To assign labor costs:

$30,000 ÷ 20,000 ft^2 range = $1.50/ft^2 floor ÷ 2/3 (bench efficiency) = $2.25/ft^2 bench

$2.25/ft^2 bench ÷ 48 = $.046875/SFW bench x SFW's in production = labor cost/pot

An additional $.08/pot labor charge was assigned to lilies.

e/ Taxes and insurance calculated from average expenditures of several growers in Western New York.

f/ Interest calculated at a real rate of 9%.

g/ Profit per pot ÷ SFW's in production = profit per square foot week.

advantage of a production cycle in months of relatively low fuel requirements.

It should be remembered that the results for the different crops are not directly comparable since they represent different marketing and production cycles. For example, lilies had a profit per SFW of only $.021; however, lilies are grown during the months of proportionately high fuel requirements (December through April). Thus, lilies are probably a very profitable crop considering the season in which they are grown. Chrysanthemums grown during those same months as lilies would show negative profit due to fuel costs greater than in Table 9 for chrysanthemums sold at Mother's Day. This example illustrates that profit/SFW cannot be interpreted without reference to the alternatives at that particular production cycle. On the other hand, chrysanthemums grown in the summer months would show a greater profit, assuming a market exists, due to lower fuel costs.

Suggestions for and Limitations of Use

The crop enterprise budgets can be used as decision aids for production planning. The objective of this study was not to furnish actual cost figures representative of a particular group of growers. The average production costs for any agricultural enterprise are difficult to calculate and are highly variable due to widely varying production practices and management techniques. In fact, because of factors such as inadequate record keeping, inexperience with cost calculation methods, and the absence of published guides, many growers themselves have a less than perfect idea of their own costs.

It should be emphasized that the costs and returns computed in this study were not intended to approximate costs incurred in a real operation. Rather, the intent is to help growers construct budgets for their own operations. The budgets as based on the particular data base and methods employed here reflect above average management, new plastic houses and new associated equipment. Thus, the returns to management do not represent those of any particular grower, nor are they representative of the average commercial grower. As shown in Table 8, fixed costs for new glass houses were $.05 per SFW. Glass would be more costly in terms of energy consumption as well.

The construction of enterprise budgets can behelpful to growers in at least three ways. First, it can facilitate pricing decisions. Second, it can assist in the selection of enterprises and production planning in general. Third, it provides benchmark data against which individual operations can be compared.

Summary

The results of the enterprise budgets indicated that geraniums and poinsettias were the most profitable of the crops and production cycles studied. This conclusion is consistent with USDA statistics which show that geraniums and poinsettias respectively are the most widely grown crops in New York State in terms of the number of producers and area in production (see Table 10). Only hydrangeas showed a loss per plant in this analysis - a finding borne out by its limited production throughout the state and its declining relative importance. It must be emphasized that while the results may coincide well with the general situation of the industry, the budgets are not necessarily representative estimates of production costs and profits of typical growers. Growers should construct budgets for their own operation as a base for their decision making.

Table 10. Numbers of Producers, Production Area, and Sales for Selected Floriculture Crops, New York State, 1976-80.

Crop	No. of Producers					Area in Production 1,000 sq. ft.					Value of Sales of Wholesale $ Million $				
	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
Geraniums	318	356	359	345	323	1,524	1,922	2,135	1,841	2,021	2.99	3.21	3.78	4.01	5.11
Poinsettias	206	231	232	231	221	1,162	1,587	1,926	1,785	2,048	2.05	2,80	3.73	3.37	4.41
Chrysanthemums	177	187	199	189	190	764	826	959	966	1,065	1.87	2.62	3.22	2.31	2.87
Lilies	142	162	163	158	141	230	288	296	264	286	.63	.95	.99	.93	1.13
Hydrangeas	46	53	56	37	41	195	179	207	134	215	.32	.42	.62	.39	.56

Source: New York Crop Reporting Service, USDA, E.R.S., New York Agricultural Statistics, 1980.

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APPENDIX

(1) The total area covered in the Pellerin study was broken down into the type of operation as follows:

60% glass

31% plastic

9% fiberglass

(2) Based on U-factor data, glass houses were assumed to require 1.5 times the energy required by plastic; fiberglass 1.25 times that of plastic.

(3) The Pellerin study recorded an average yearly consumption of 1.63 gallons of no. 2 fuel oil per square foot and 220 cu. ft. of natural gas per ft^2. Consumption per square foot was adjusted by using weights derived from (1) and (2):

x_1 = the annual fuel requirement for plastic

$$.31x_1 + .60x_1(1.5) + .90x_1(1.25) = 1.63 \text{ gal/ft}^2$$

$$1.3225x_1 = 1.63 \text{ gal/ft}^2$$

$$x_1 = 1.2325 \text{ gal/ft}^2$$

The annual fuel requirement for glass = 1.2325 x 1.5 = 1.849 gal/ft^2. Fuel requirements using natural gas were similarly calculated.

(4) Allocation of annual usage on a monthly basis was determined by taking the monthly average degree days for Ithaca, New York and weighting accordingly. The greenhouse environment assumed was 70° day/60° night.

Annual Fuel Oil Requirements by Month and by Volume (gallon/ft^2) for Glass and Plastic Houses

Month	% of Annual Fuel Requirement by Month	GLASS GROWING TEMPERATURES 70° day / 60° nite	65° day / 55° nite	60° day / 50° nite
January	18.1	.335	.291	.247
February	16.1	.298	.256	.215
March	14.0	.259	.215	.157
April	8.6	.159	.108	.059
May	4.4	.081		
June	1.4	.026		
July	.3	.005		
August	.7	.013		
September	2.7	.050		
October	6.3	.116	.051	
November	10.9	.202	.149	.096
December	16.5	.305	.256	.208
ANNUAL TOTAL	100.0	1.849 gal/ft^2	1.326 gal/ft^2	.982 gal/ft^2

Month	% of Annual Fuel Requirement by Month	PLASTIC 70° day / 60° nite	65° day / 55° nite	60° day / 50° nite
January	18.1	.223	.194	.165
February	16.1	.198	.170	.143
March	14.0	.172	.143	.104
April	8.6	.106	.072	.040
May	4.4	.054		
June	1.4	.017		
July	.3	.004		
August	.7	.009		
September	2.7	.033		
October	6.3	.077	.034	
November	10.9	.134	.099	.063
December	16.5	.203	.171	.138
ANNUAL TOTAL	100.0	1.23 gal/ft^2	.883 gal/ft^2	.653 gal/ft^2

Fuel Oil Heating Costs for Plastic and Glass Greenhouses
at Different Prices Under Different Temperature Conditions

	GLASS @ $.90/gallon			PLASTIC @ $.90/gallon		
	70°D / 60°N	65°D / 55°N	60°D / 50°N	70°D / 60°N	65°D / 55°N	60°D / 50°N
Janaury	.302	.262	.222	.201	.175	.149
February	.268	.230	.194	.178	.153	.129
March	.233	.194	.141	.155	.129	.094
April	.143	.097	.053	.095	.065	.036
May	.073			.049		
June	.023			.015		
July	.005			.004		
August	.012			.008		
September	.045			.030		
October	.104	.046		.069	.031	
November	.182	.132	.086	.121	.089	.057
December	.275	.230	.187	.183	.154	.124
TOTAL	$1.665	$1.191	$ .883	$1.108	$ .796	$ .589
	@ $1.00/gallon			@ $1.00/gallon		
January	.335	.291	.247	.223	.194	.165
February	.298	.256	.215	.198	.170	.143
March	.259	.215	.157	.172	.143	.104
April	.159	.108	.059	.106	.072	.040
May	.081			.054		
June	.026			.017		
July	.005			.004		
August	.013			.009		
September	.050			.033		
October	.116	.051		.077	.034	
November	.202	.149	.096	.134	.099	.063
December	.305	.256	.208	.203	.171	.138
TOTAL	$1.849	$1.326	$ .982	$1.23	$ .883	$ .653

Fuel Oil Heating Costs for Plastic and Glass Greenhouses at Different Prices Under Different Temperature Conditions

	GLASS @ $1.10/gallon			PLASTIC @ $1.10/gallon		
	70°D 60°N	65°D 55°N	60°D 50°N	70°D 60°N	65°D 55°N	60°D 50°N
January	.369	.320	.272	.245	.213	.182
February	.328	.282	.234	.218	.187	.157
March	.285	.237	.173	.189	.157	.114
April	.175	.119	.065	.117	.079	.044
May	.089			.059		
June	.029			.019		
July	.006			.004		
August	.014			.010		
September	.055			.036		
October	.128	.056		.085	.037	
November	.222	.164	.106	.147	.109	.069
December	.336	.282	.229	.223	.188	.152
TOTAL	$2.036	$1.46	$1.079	$1.352	$ .97	$ .718
	@ $1.20/gallon			@ $1.20/gallon		
January	.402	.349	.296	.268	.233	.198
February	.358	.307	.258	.238	.204	.172
March	.311	.258	.188	.206	.172	.125
April	.191	.130	.071	.127	.085	.048
May	.097			.065		
June	.031			.020		
July	.006			.005		
August	.016			.011		
September	.06			.040		
October	.139	.061		.092	.041	
November	.242	.179	.115	.161	.119	.076
December	.366	.307	.250	.244	.205	.166
TOTAL	$2.219	$1.591	$1.178	$1.477	$1.059	$ .785

Fuel Oil Heating Costs for Plastic and Glass Greenhouses
at Different Prices Under Different Temperature Conditions

	GLASS @ $1.30/gallon			PLASTIC @ $1.30/gallon		
	70°D / 60°N	65°D / 55°N	60°D / 50°N	70°D / 60°N	65°D / 55°N	60°D / 50°N
January	.436	.378	.321	.290	.252	.215
February	.388	.333	.279	.257	.221	.186
March	.336	.279	.204	.224	.186	.135
April	.207	.140	.077	.138	.094	.052
May	.105			.070		
June	.034			.022		
July	.007			.005		
August	.017			.012		
September	.065			.043		
October	.151	.066		.100	.044	
November	.263	.194	.125	.174	.129	.083
December	.397	.333	.270	.264	.222	.180
TOTAL	$2.407	$1.723	$1.276	$1.599	$1.148	$ .851

Annual Natural Gas Requirements by Month and by Volume (cu.ft/ft^2) for Glass and Plastic Houses

Month	% of Annual Fuel Requirement by Month	GLASS GROWING TEMPERATURES: 70° day / 60° nite	65° day / 55° nite	60° day / 50° nite
January	18.1	45.25	39.4	33.49
February	16.1	40.25	34.6	29.06
March	14.0	35.0	29.05	21.2
April	8.6	21.5	14.62	8.04
May	4.4	11.0		
June	1.4	3.5		
July	.3	.75		
August	.7	1.75		
September	2.7	6.75		
October	6.3	15.75	6.93	
November	10.9	27.25	20.17	12.91
December	16.5	41.25	34.65	27.68
TOTAL	100.0	250	179.42	132.38
			PLASTIC	
January	18.1	30.05	26.14	22.22
February	16.1	26.73	22.99	19.31
March	14.0	23.24	19.29	14.08
April	8.6	14.28	9.71	5.34
May	4.4	7.30		
June	1.4	2.32		
July	.3	.50		
August	.7	1.16		
September	2.7	4.48		
October	6.3	10.46	4.6	
November	10.9	18.09	13.39	8.57
December	16.5	27.39	23.01	18.64
TOTAL	100.0	166	119.13	88.16

Natural Gas Heating Costs for Plastic and Glass Greenhouses at Different Prices Under Different Temperature Conditions (per ft^2)

	GLASS @ $.004/cu.ft			PLASTIC @ $.004/cu.ft		
	70°D / 60°N	65°D / 55°N	60°D / 50°N	70°D / 60°N	65°D / 55°N	60°D / 50°N
January	.181	.158	.134	.12	.105	.089
February	.161	.138	.116	.107	.092	.077
March	.14	.116	.085	.093	.077	.056
April	.086	.058	.032	.057	.039	.021
May	.044			.029		
June	.014			.009		
July	.003			.002		
August	.007			.005		
September	.027			.018		
October	.063	.028		.042	.018	
November	.109	.081	.052	.072	.054	.034
December	.165	.139	.111	.110	.092	.075
TOTAL	$1.0	$ .718	$ .53	$ .664	$ .477	$ .352
	@ $.005/cu.ft			@ $.005/cu.ft		
January	.226	.197	.167	.150	.131	.111
February	.201	.173	.145	.134	.115	.097
March	.175	.145	.106	.116	.096	.070
April	.108	.073	.040	.071	.049	.027
May	.055			.037		
June	.018			.012		
July	.004			.003		
August	.009			.006		
September	.034			.022		
October	.079	.035		.052	.023	
November	.136	.101	.065	.090	.067	.043
December	.206	.173	.138	.137	.115	.093
TOTAL	$1.251	$ .897	$ .661	$ .83	$ .596	$ .441

Natural Gas Heating Costs for Plastic and Glass Greenhouses at Different Prices Under Different Temperature Conditions (Per ft^2)

	GLASS @ $.006/cu.ft			PLASTIC @ $.006/cu.ft		
	70°D 60°N	65°D 55°N	60°D 50°N	70°D 60°N	65°D 55°N	60°D 50°N
January	.272	.236	.201	.18	.157	.133
February	.242	.208	.174	.16	.138	.116
March	.21	.174	.127	.139	.116	.084
April	.129	.088	.048	.086	.058	.032
May	.066			.044		
June	.021			.014		
July	.005			.003		
August	.011			.007		
September	.041			.027		
October	.095	.042		.063	.028	
November	.164	.121	.077	.109	.080	.051
December	.248	.208	.166	.164	.138	.112
TOTAL	$1.504	$1.077	$ .793	$ .996	$ .715	$ .528
	@ $.007/cu.ft			@ $.007/cu.ft		
January	.317	.276	.234	.210	.183	.156
February	.282	.242	.203	.187	.161	.135
March	.245	.203	.148	.163	.135	.099
April	.150	.102	.056	.10	.068	.037
May	.077			.051		
June	.025			.016		
July	.005			.004		
August	.012			.008		
September	.047			.031		
October	.110	.049		.073	.032	
November	.191	.141	.090	.127	.094	.060
December	.289	.242	.194	.192	.161	.130
TOTAL	$1.75	$1.255	$ .925	$1.162	$ .834	$ .617