

A Profitability and Cash Flow Analysis of Typical Greenhouse Production in North Florida Using Tomato as an Example

John Smith, Tim Hewitt, Robert Hochmuth and George Hochmuth

Introduction

Growing crops in a greenhouse environment requires a substantial investment in capital and management resources. The two financial considerations regarding any such enterprise are profitability and cash flow. Profitability potential can be addressed through an enterprise budget, which is an itemization of costs incurred over a typical or average production cycle. The second consideration is addressed by analyzing cash flows in and out of the enterprise for a fixed interval of time, that is, through a cash flow budget.

Greenhouse enterprise budgets contain two types of costs, variable and fixed.

Variable costs are those costs incurred only if the production cycle is started. Seeds, fertilizer and perlite bags are examples of such costs. Fixed costs occur whether or not there is production. Property taxes, insurance, depreciation and interest on investment such as buildings and equipment are examples of fixed costs and must be accounted for even if there is no production. An enterprise budget can be used to estimate the profitability of an enterprise by including sales revenue and net returns. Net returns will be expressed as gross margin and net income. Gross margin is expressed as revenue minus variable cost and net income is revenue minus all costs. Enterprise budgets do not address whether the enterprise can produce a sufficient flow of funds to meet the cash obligations of the enterprise.

Cash flow analysis is used to determine whether the cash generated from operations (cash inflow) will be adequate to meet the cash outlays required to operate the enterprise (cash outflow) over a given time interval. Unpaid family labor is charged to the enterprise as an expense because it represents the loss of opportunity for the family member to work elsewhere and earn income. Consequently, while not a cash outlay, it should be charged as an opportunity cost to the enterprise. Both enterprise and cash flow budgets for greenhouse tomato production for one greenhouse are presented as an example in the following tables and discussed and analyzed in this paper. While this discussion uses tomato as a crop example, the principles discussed are applicable to other crops such as pepper, cucumber and eggplant. This particular example was chosen to illustrate several important aspects of greenhouse production and marketing that affect profitability such as market price, yield and labor.

Investment Cost and Enterprise Description

The greenhouse used in this analysis is a 30 ft. X120 ft aluminum frame Quonset style structure covered with inflated double polyethylene (PE) film and can be purchased in kit form. The kit typically contains frame, PE covering, heating, ventilation and circulation equipment and shade systems as well as controls for managing the greenhouse environmental climate. Cooling systems are usually priced separately. An equipment list for construction of the greenhouse as well as a list of durable goods required to operate the greenhouse is shown in Table 1. It was

assumed that contract labor was used to construct the greenhouse. Straight-line depreciation (original investment/life-years) is used on all items. The depreciation period for each item is shown in Table 1. An interest charge of 9% is made to the average investment (half the initial cost) of each item. Taxes and insurance are assumed to be 1.25% of the original investment.

Enterprise Budget

An enterprise budget for greenhouse tomatoes along with its assumptions is presented in Table 2. The number of plants used in the enterprise budget is based on recommendations found in the Florida Vegetable Production Guide Volume 3. The assumptions used, based on these recommendations and this size greenhouse are:

- Row length = 110 ft.
- Number of twin Rows = 5
- 15 in. spacing between plants.
- Plants/twin row = $2 \times 110 \times 12 / 15 = 176$
- Total plants = $176 \times 5 = 880$
- Sales Price = \$0.90/lb.

The 20 lb. plant yield assumed in the enterprise budget is based on UF-IFAS research and extension experience. Other research centers such as Mississippi State University and North Carolina State University project yields of 20-25 lbs./plant. Projected revenue for the enterprise, assuming 880 plants, 20 lbs. of fruit per plant and a selling price of \$0.90/lb. is \$15,840. Several aspects about this budget are noteworthy. First, returns are negative, both for cash costs (\$1,053) and total costs (\$6,274), indicating that the enterprise will not generate sufficient revenue from operations to be profitable or to return anything to the grower for his investment. Also noteworthy is that harvesting, hauling, packing and marketing comprise 39 % of total costs. Hauling cost is especially significant due to the high mileage and time required to haul produce to the packing location. The size of the hauling cost makes it desirable to locate the greenhouse near a packing plant or for the producer to pack and market tomatoes for himself.

Fixed cost is substantial, representing 22.8% of the total cost. Fixed cost can be mitigated by efficiency improvements, such as more fruit production per plant or more plants per square foot and larger greenhouses. Such changes would improve net returns by increasing revenue with relatively small increases in production costs. For example, increasing the yield from 20 to 25 lbs. would increase revenue by \$3,960. A yield increase of 5lbs. would principally increase harvest, packing and marketing costs by \$1,162, leaving an additional return to labor and management of \$2,798. The example illustrates how some variable costs such as heating and cooling are minimally affected by changes in yield. The costs of heating and cooling the greenhouse are more related to other factors such as ambient temperature and greenhouse size than pounds of fruit produced per plant. Increasing the number of greenhouses would also lower some fixed costs such as pollinators, sprayers and pH equipment that could be used in the additional greenhouses.

Labor, insurance, and taxes are significant costs. Greenhouse labor (pre-harvest, harvest and cleanout) charged at \$5.25 an hour represents 18.6% of the variable cost. Pre-harvest costs represent 49% of the total variable cost. Insurance and taxes are cash fixed costs that will vary by location and tax rates. Factors such as proximity to fire stations, building codes and construction costs will determine insurance rates. Tax rates are a function of local millage rates.

Breakeven price is a summary value for an enterprise budget. The breakeven price is the selling price, expressed as a unit of output, required to cover variable costs or full costs. The breakeven price to cover variable costs in this illustration is \$0.96/lb. and to cover full costs is \$1.26/lb. The differences between breakeven prices and the projected selling price of \$0.90/lb. indicate the degree to which the illustrated enterprise is not profitable and cannot meet variable costs.

Cash Flow

The cash flow analysis (Table 3) was generated over an eleven-year cycle to reconcile the cash flows to the satisfaction of the longest loan (10 years). Revenue is based on the assumptions made in the enterprise budget, which produced 17,600 lbs. of fruit sold at \$0.90/lb. Sales price of tomato is assumed to rise over the 11-year period at a rate of 5 percent per year with costs rising at 3 percent annually. Labor costs are considered a non-cash cost and are not included in the cash flow budget. Thus, cash costs are total variable cost from the enterprise budget minus unpaid family labor, where unpaid family labor equals pre-harvest labor plus harvest and hauling labor plus cleanout labor. Packing labor is included as a cost in the cash flow budget because it is assumed that packing will be performed off site at a packinghouse. A 7-year loan of \$21,692, representing 80% of equipment and durables goods costs, was assumed. The cash flow budget indicates that, for this set of production conditions and in this marketing climate, additional annual cash infusions from financing would be required to sustain the enterprise annually for the first eight years. The projected cash flow would not become positive until the ninth year when the capital investment loan has been satisfied. In the ninth year when the loan has been satisfied, a positive cash flow of \$2,831 (Beginning Cash Balance Year10 minus Beginning Cash Balance Year9) would be realized. The enterprise would also have a positive cash flow in the tenth year but less than year 9 due to scheduled replacement of certain durable goods. Durable goods replacement would continue to be a significant drain on cash flow in the outlying years.

Sensitivity Analysis

Enterprise returns and cash flows are particularly sensitive to changes in yields, prices, and finance cost. Each is more carefully considered below.

Yield Effects

Table 4 is a summary of the effect of yield and price. Because there is minimal change in pre-harvest, hauling and fixed costs relating to a 10% increase in yield from 20 to 22 lbs. per plant, the cash cost breakeven price declines from \$0.96 to \$0.90. Cash flow is positive in the ninth year for the enterprise that starts with a 7-year loan. A 22 lb. plant yield projects to a positive net cash balance of \$5,631 at

the end of the eleventh year (11 Year Cash Balance) compared to a net of **(\$14,389)** for the same period with a 20-lb./plant yield.

Price Effect

Because there are no related cost changes, price has the greatest effect on greenhouse profitability. Table 4 shows the effect of increasing prices from \$0.90 to \$1.00/lb. The enterprise realizes a net cash balance increase of nearly \$31,000 over the 11-year cycle. Cash flow would be positive in year 2 at a price of \$1.00/lb. compared to Year 9 for a \$0.90/lb. price. Table 4 also shows the combined effects of higher prices and greater yields. The 11-year net cash balance for a \$1.00/lb. fruit price with a yield of 22 lbs./plant is \$26,887, which is substantially greater than the base budget illustration shown in Table 4 of **(\$14,389)** for the \$0.90/lb. and 20lb./plant illustration.

Cost of Finance and Cash Balance

Loan payments for three different principals (80, 60, and 50% of total investment), three different loan periods (5, 7, and 10 years) and two different interest rates (9 and 12%) are shown in Table 5. Longer duration loans will reduce the annual loan payments but cause an increase in the total loan payments and loan costs to the enterprise. To illustrate this, compare the loan payments for a \$21,692 loan at 9% for the 5 and 10-year loan periods. For the first five years, the annual payment for a 5-year loan is \$5,577 annually compared to an annual payment of \$3,380 for a 10-year loan, or a reduction in annual cash flow burden of \$2,197 per year. Over the life of the loans however, the 5-year loan will cost \$27,884 (5×5577) versus \$33,800 (10×3380) for the 10-year loan. The effect of interest rate should also be considered. For this particular \$21,692 loan taken for a length of 7 years, it costs approximately \$443/year more for a 12% loan than one at 9%.

Cash balance at the end of each year should also be analyzed. In this particular illustration, cash balances are increasingly negative for the first several years, indicating a need to add cash from outside sources. The effect of financing a loan for 5, 7, and 10 years at 9% on year-end cash balance is shown in Table 6 and Figure 1. Five-year loans require significantly more cash additions from outside sources in years 1 through 5 than the 10-year loan. In year 11, when all loans have been satisfied the net cash balance is the same. This indicates there is no cash penalty for using the 10-year loan. The benefit is that less cash from outside sources has to be added in the early years, when the enterprise is in its startup phase. The effect of interest rate should also be considered. For this particular loan of \$21,692 for 7 years, it costs \$443/year more for a 12% loan than one at 9% (Table 5).

Summary and Concluding Remarks

This enterprise budget illustration indicates a lack of profitability of this greenhouse tomato enterprise using these particular assumptions regarding cost, price, plant density and plant yields. The sensitivity analysis addresses the various factors that had the greatest effect on profitability of the enterprise. Pricing has the greatest impact on enterprise profitability followed by yield. These factors can increase revenue with a minimal increase in production costs.

A cash flow analysis (7-year greenhouse loan) for the enterprise budget illustrated, indicated that additional cash infusions would be required for

approximately 8 years before revenue from the enterprise could cover all costs. Structuring debt properly to conserve cash during the early years of the enterprise, in this instance, could be critical to the success or failure of the enterprise.

It is important to recognize that small positive changes in price and yield can significantly improve cash flows and gross margins to the enterprise. A grower selling his fruit for \$1.00/lb. and having a yield of 22 lb. of fruit /plant would have a positive cash flow of \$26,887 over an 11-year cycle compared to cash of (\$14,389) for the base case of \$0.90/lb. price and 20-lb/plant yield.

Each grower should evaluate his particular unique situation and circumstances and perform the necessary due diligence to address the following questions before proceeding with the enterprise.

- How will you market the product?
- Can you get a higher market price?
- Can you improve on the plant yields?
- Will you require additional capital investment?
- Will you custom package or pack your own product?
- Is a packinghouse nearby?
- Do you have sufficient family labor?

The answers to these questions and others unique to his circumstances should aid the grower in making the proper enterprise decisions for his particular situation.

Table 1. Greenhouse Investment Costs for Tomato Production

Construction	Original Cost	Life-Yrs.	-----Annual Charge-----			
			Depreciation	Interest**	Tax&Ins.*	Annualized
Greenhouse Frame(30X120)	5880	20	294	265	74	632
Warehouse(10'X10')	900	10	90	41	11	142
Site Preparation + Inflation Kit	620	10	62	28	8	98
Ground Cover	560	7	80	25	7	112
Irrigation/Fertigation System	1700	7	243	77	21	341
LP Gas Heating System	1600	10	160	72	20	252
Plant Support System	750	10	75	34	9	118
Backup Generator + Electrical	1450	10	145	65	18	228
Labor (Const. + Equip. Install.)	7000	10	700	315	88	1103
Total Construction Costs	\$20,460		\$1,849	\$921	\$256	\$3,025
Durables						
Plastic	500	4	125	23	6	154
Shade System	540	3	180	24	7	211
Cooling Pads (35)	1470	3	490	66	18	575
Pump & Plumbing	680	5	136	31	9	175
Cooling Fans + Environmental Control	1790	5	358	81	22	461
Sprayer + Spray Mask	575	5	115	26	7	148
Other Durable Goods	1100	5	220	50	14	283
Total Durables	6655		1624	300	83	2007
Total Greenhouse Investment + Durables	\$27,115		\$3,473	\$1,221	\$339	\$5,032
Utility hook-ups(electrical, gas & water)***	500					
Total Greenhouse Investment	\$27,615					

* Taxes and Ins Rate % = 1.3

** Interest Rate (%) = 9

***Does not include cost of new well

Table 2. Greenhouse Tomato Enterprise Budget**General Information**

Production System	Perlite Bags	Crop Duration - weeks	42
Number of Greenhouses	1	Harvest Period-weeks	30
Dimensions	30' X 120'	Miles to packinghouse	50
Lbs. Tomatoes/Plant	20	Trips to packinghouse	60

Revenue	Yield-lbs.	Price \$/lb.	Total \$
	17,600	0.90	15,840

Costs	Unit	Quantity	Price	Value	Totals \$
Pre-harvest					
Material Inputs	\$	1	3,200	3,200	
Energy + Repairs	\$	1	3,290	3,290	
Labor	hrs.	281	5.25	1,475	
Int. on Op. Capital*	\$	7,965	0.05	398	
Total Pre-harvest Variable Cost					8,364
Harvest & Hauling					
Labor	hrs.	288	5.25	1,512	
Vehicle**	mi.	8,940	0.34	3,040	
Total Harvest/Hauling Cost					4,552
Custom Packing & Marketing	lbs.	17,600	0.226	3,978	
Total Packaging and Marketing Cost					3,978
Cleanout		36	5.25	189	
					189
Total Variable Cost					17,082
Fixed Costs					
Depreciation + Interest	\$	1	4,693	4,693	
Taxes & Ins.	\$	1	339	339	
Total Fixed					5,032
Total Cost					22,114
Returns Above Cash Costs					(1,053)
Returns Above Total Costs					(6,274)
Breakeven Price to cover cash costs					0.96
Breakeven Price to cover total costs					1.26

* Interest on operating expenses charged at 10% for 6 months.

** Vehicle miles assume 100 mile round trip to packing house 2 times/week for 30 weeks plus an additional 10 miles per day for other greenhouse needs.

Table 4. The Effect of Changes in Yield and Price on Break-even Costs and Cash Balance after 11 years.

Num.Plants	Yield lbs./plant	Price	B/E Cash	11 Yr. Cash Balance
880	20	0.90	0.96	(\$14,389)
880	22	0.90	0.90	\$5,631
880	20	1.00	0.96	\$14,450
880	22	1.00	0.90	\$26,887

Assumptions:

1. Loan Period - 7 years
2. Loan Rate - 9%

Table 5. Annual Loan Payments for Various Loan Periods and Amounts for Different Interest Rates

% GH Financed	Principal (\$)	9 % Interest			12 % Interest			
		Loan Period - Years			Loan Period - Years			
		5	7	10	5	7	10	
		-----\$/Year-----				-----\$/Year-----		
80	21,692	(\$5,576)	(\$4,310)	(\$3,380)	21,692	(\$6,018)	(\$4,753)	(\$3,839)
60	16,269	(\$4,183)	(\$3,232)	(\$2,535)	16,269	(\$4,513)	(\$3,565)	(\$2,879)
50	13,558	(\$3,486)	(\$2,694)	(\$2,113)	13,558	(\$3,761)	(\$2,971)	(\$2,399)

Table 6. Cash Flow Sensitivity for a Greenhouse with 880 Plants Yielding 20 lbs. Fruit/plant with a loan of 80% of the Greenhouse Construction + Durable Goods Costs (\$21,692) at 9% for Three Separate Loan Periods.

Loan Period Years	Cash Balance at the End of the Year										
	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10	Year11
5	(\$4,520)	(\$7,957)	(\$11,707)	(\$17,558)	(\$21,839)	(\$26,480)	(\$26,797)	(\$24,175)	(\$21,344)	(\$19,601)	(\$14,389)
7	(\$4,520)	(\$6,690)	(\$9,060)	(\$13,406)	(\$16,046)	(\$18,899)	(\$22,843)	(\$24,175)	(\$21,344)	(\$19,601)	(\$14,389)
10	(\$4,520)	(\$5,760)	(\$7,116)	(\$10,357)	(\$11,793)	(\$13,333)	(\$15,846)	(\$15,619)	(\$15,399)	(\$16,500)	(\$14,389)

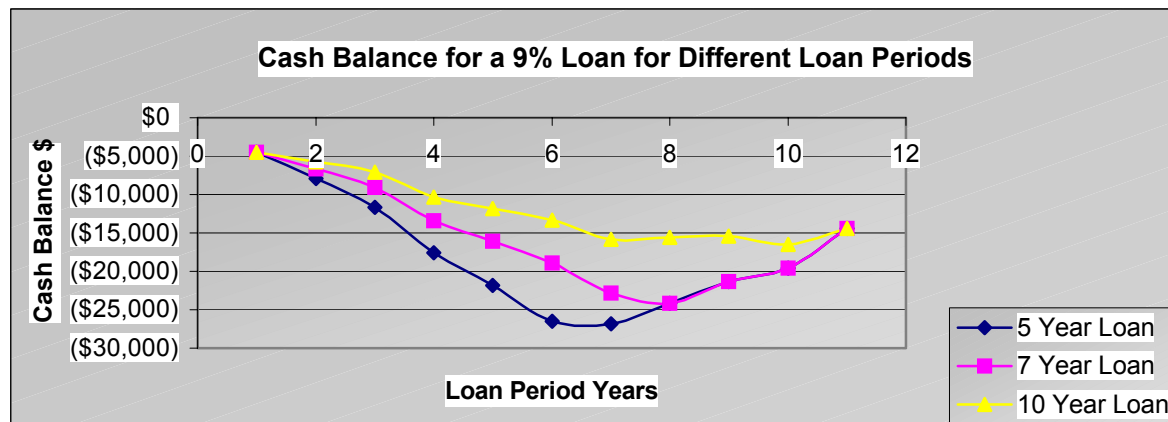


Fig. 1