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Costs of Producing Hydroponic Greenhouse Tomatoes and Cucumbers

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A greenhouse tomato and cucumber industry has been established recently in Idaho. These vegetables are being produced under a hydroponic, or soilless, system. This system provides water and nutrients to the plant roots through plastic bags or tubes which enclose the roots of the rows of plants. The tubes are placed on benches or troughs that have a slight grade. Gravity causes the nutrient solution to flow through the tubes. Holding tanks, pumps and hoses constantly recirculate the solution.

Since no soil anchors the plants, the hydroponic greenhouses have a support system that runs above the plant rows. Strings and clips attached to wires and the plants provide support. The plants grow from the trough, near floor level, up to the support wires that are within an arm's reach overhead.

Propane is the most common heat source for the greenhouses, but interest in using geothermal sources has increased because of spiraling fuel costs. To minimize heat costs, the greenhouses are not used during November and December. A typical grower will start the tomato plants in early January and begin picking in early spring. Harvest will continue through the end of October when the plants are removed. For cucumbers, the first crop is started in January. Picking begins 6 weeks later and continues for 8 to 10 weeks. The second crop is planted shortly thereafter, and the plants are removed when days become too short and cold.

Skilled Management

Hydroponic vegetable production is a risky business. Successful operators must have a knowledge of factors affecting plant growth and be skilled in observing and interpreting plant needs. Daily management is required. *Greenhouse Tomatoes, Lettuce and Cucumbers* by S. H. Wittwer and S. H. Honma, Michigan State University Press, 1979, is one of several good references that should help a manager's decision making.

Business management is also important to the success of a greenhouse vegetable operation. Some industry characteristics are:

- high initial investment
- high production and market risks
- escalating production costs
- increasing competition.

Successful businessmen calculate production costs to determine break-even prices, financing requirements and potential areas for cost cuts. This publication provides a basis for estimating production costs of hydroponic greenhouse tomatoes and cucumbers in Idaho. This information may be useful to those already in the business, those considering the business and lending institutions.

Typical Operation

Four experienced greenhouse growers provided data for the tomato and cucumber budget — Jean Baldwin of Pocatello, Bob Bartholomew of Teton, Carl Day of Rigby and Jim Hayward of St. Anthony. Data do not represent averages of these operations but are "typical" of successful operations. Many assumptions had to be made to complete the calculations for this "typical" operation:

1. Operation of four 30 × 124 foot greenhouses.
2. Steel-frame, inflated double poly greenhouse construction.
3. Propane heating.
4. 1-acre land requirement at $5,000 per acre.
5. Tomato plants in greenhouse for 10 months or two 4-month cucumber crops produced each year.
6. Family provides one-half of the labor requirement; remainder is met with minors at $3.00 per hour.
7. Life of nutrient bag and liner is two crops.
8. Pickup is used 8,000 miles per year for the production part of the operation. Cost is 20 cents per mile.
9. Total annual property taxes = $400.
10. Total general overhead expenses = $600.
11. 950 productive tomato plants per house.
12. 560 productive cucumber plants per house.

Table 1 lists assets that are needed for greenhouse production of tomatoes or cucumbers. Growers have paid, or will pay, more or less for any of the items on the list. However, growers in 1981 could expect to pay about these amounts if everything were purchased new. The expected life of each asset was estimated by experienced growers.

Tables 2 and 3 list the cultural operations and inputs required for hydroponic greenhouse tomato and cucumber production respectively. The total supplies cost $4,055 for tomatoes and $1,835 for cucumbers and are the actual cash outflows for producing the crops if the operator hires no labor, is debt-free and doesn't replace any equipment during the year.

However, many operators do hire labor. One-half of the total, or 690 hours for tomatoes and 232.5 hours for cucumbers per house, was considered typical. Most greenhouse laborers are minors hired at $3.00 per hour including benefits. Therefore, labor costs of $2,070 for tomatoes and $697.50 for cucumbers are included in the budgets.

Fixed costs are also included. They are costs that are incurred at a fixed annual rate regardless of what and how much are produced.

Depreciation is one of the fixed costs. As the greenhouse and equipment age, they lose value and usefulness and eventually must be replaced. The depreciation category accounts for the purchase costs of these assets spread over their useful lives. Depreciation is an accounting cost rather than a cash cost. Actual cash spent on replacing structures and equipment may be much higher or as low as zero in any particular year.

Real estate taxes are estimated to be $100 per greenhouse. The other fixed cost category — general overhead estimated at $150 — includes such things as insurance, office expenses, membership dues and accounting fees.

Table 1. Estimated capital investment per 30 × 124 foot greenhouse for a four-house operation.

Item	Replacement cost	Useful life	Annual depreciation*
		(years)	
Structure and fixtures			
Site preparation	$ 230	10	$ 20.70
Concrete foundation	690	10	62.10
Greenhouse frame	3,340	10	300.60
Electrical materials and installation	2,300	10	207.00
Heat, air and irrigation systems	3,450	10	310.50
Plant support wire system	1,040	10	93.60
Construction labor	2,300	10	207.00
Troughs and dike sticks	860	5	154.80
Plastic covers	600	3	200.00
Water pump, well and pressure storage	460	20	20.70
Equipment			
Tools, hoses, meters, etc.	580	5	104.40
Pesticide sprayer and respirator	210	5	37.80
Picking equipment	170	5	30.60
Generator (backup power)	350	10	31.50
Office equipment	100	10	9.00
Land (1 acre for 4 houses)	1,250	—	—
Totals	$17,930		$1,790.30

*Salvage value = 10%

The $8,165.30 for tomatoes and $3,552.65 for cucumbers cost figures cover cash expenses and depreciation only. Cost estimates were not made for interest on investment, family labor or management. Growers that borrow money, hire a manager or hire more than half the labor, of course, incur higher costs.

Table 2. Production costs per greenhouse (30 × 124 feet) for an eight-month hydroponic tomato crop.

Operation	Labor hours	Supplies	
		Name	Cost
Grow tube and house preparation	15	Tubes and liners	$ 100.00
Transplanting and support	25	Seedlings	330.00
Prune, train and lower	800	String, clips	45.00
Fertilize and irrigate	100	Fertilizer	750.00
Pest control	30	Chemicals	30.00
Picking	280	—	—
Remove plants	20	—	—
Pickup use	60	2,000 mi. @ $.20	400.00
Maintenance and miscellaneous	50	Parts	100.00
Utilities	—	Electricity	500.00
	—	Propane	1,800.00
Total hours	1,380		
Total supplies cost			$4,055.00
Hired labor (½ of total @ $3.00/hr.)			2,070.00
Fixed costs:			
Depreciation			1,790.30
Taxes			100.00
General overhead			150.00
			2,040.30
Total cost, excluding returns to capital investment, family labor and management			$8,165.30

Table 3. Production costs per greenhouse (30 × 124 feet) for a four-month hydroponic cucumber crop.

Operation	Labor hours	Supplies	
		Name	Cost
Grow tube and liner preparation	15	Tubes and liners	$ 100.00
Transplanting and support	25	Seedlings	280.00
Prune, train and lower	200	Strings, clips	35.00
Fertilize and irrigate	40	Fertilizer	250.00
Pest control	15	Chemicals	20.00
Picking	90	—	—
Remove plants	25	—	—
Pickup use	30	1,000 mi. @ $.20	200.00
Maintenance and miscellaneous	25	Parts	50.00
Utilities	—	Electricity	200.00
	—	Propane	700.00
Total hours	465		
Total supplies cost			$1,835.00
Hired labor (½ of total @ $3.00/hr)			697.50
Fixed costs:			
Depreciation			895.15
Taxes			50.00
General overhead			75.00
			1,020.15
Total cost, excluding returns to capital investment, family labor and management			$3,552.65

In addition to covering these budget costs, successful growers expect a return for the money they have invested and for the family's time spent in working and managing the operation. The actual return they get is whatever revenue remains after all expenses are paid. What an acceptable return is varies among growers, depending on what other opportunities there are for their money and time.

Returns to family inputs can be evaluated at different yields and prices. Individuals can then estimate the probabilities of getting acceptable returns and decide whether or not growing greenhouse tomatoes is worth the time, investment and risk. Unlike other farmers, however, greenhouse operators should not expect asset appreciation as part of their return. The main greenhouse assets, unlike farmland, depreciate rather than appreciate in value.

Tables 4 and 5 give some example return figures for different yields and prices for tomatoes and cucumbers respectively. Marketing costs, which are not in Tables 2 and 3, have been calculated for Tables 4 and 5. Growers are currently using three different marketing methods:

- Retail sales at the greenhouse.
- Wholesale sales to local grocery firms.
- Sales through growers' cooperatives.

The marketing costs in Tables 4 and 5 are for the sales to local groceries method, probably the most costly.

Break-even prices for different yields are given at the bottom of Tables 4 and 5. When growers receive prices above these levels, or if yields are higher, a positive return will result to capital, labor and management. Lower prices will result in negative returns. However, actual out-of-pocket expenses may still be covered in a particular year because depreciа-

tion is an accounting cost rather than an annual cash expense. Also, note that these figures are for one crop of cucumbers. Two crops per year are usually grown.

Since tomatoes and cucumbers are not storable commodities, growers need to sell them shortly after picking. In most years, tomato and cucumber prices will vary over a wide range during the picking period. They may be forced to sell below their break-even price during the summer when field-grown vegetables offer competition. Sufficient profits can be made during the remainder of the marketing season to make up for this loss.

Note that a particular grower's cost may be different from this budget, and opportunities exist to produce at a lower cost. The best opportunity is probably in reducing energy costs, which are 28 percent and 25 percent of the total costs for tomatoes and cucumbers respectively. This might be done by locating where electricity is cheaper, where the climate is warmer or where geothermal heat can be used. Production costs might also be reduced by building solar or more energy-efficient greenhouses.

Also, there may be potential for more profitable cropping patterns. For example, a tomato/cucumber rotation or combination in the same house or planting some other crop may make the grower more money than current practices.

Table 4. Returns to capital investment, family labor and management for different tomato yields and prices per 30 × 124 foot hydroponic greenhouse.

	Yield/house/10-month crop			
Price per box	**900 boxes**	**1,000 boxes**	**1,100 boxes**	**1,200 boxes**
(20 lb)				
$10.00	$ -902.30	$ -95.30	$ 711.70	$1,518.70
$11.00	-2.30	904.70	1,811.70	2,718.70
$12.00	897.70	1,904.70	2,911.70	3,918.70
$13.00	1,797.70	2,904.70	4,011.70	5,118.70
$14.00	2,697.70	3,904.70	5,111.70	6,318.70
Break-even price*	$ 11.00	$ 10.10	$ 9.35	$ 8.73

*Estimated costs are $8,165.30 per house for production and $1.93 per box for marketing. Marketing costs are: Labor 90 cents, transportation 38 cents and box 65 cents.

Table 5. Returns to capital investment, family labor and management for different cucumber yields and prices per 30 × 124 foot hydroponic greenhouse.

	Yield/house/4-month crop			
Price per box	**600 boxes**	**700 boxes**	**800 boxes**	**900 boxes**
(16 lb)				
$ 6.00	$-1,272.65	$ -892.65	$ -512.65	$ -132.65
$ 7.00	-672.65	-192.65	287.35	767.35
$ 8.00	-72.65	507.35	1,087.35	1,667.35
$ 9.00	527.35	1,207.35	1,887.35	2,557.35
$10.00	1,127.35	1,907.35	2,687.35	3,457.35
Break-even price*	$ 8.12	$ 7.28	$ 6.64	$ 6.15

*Costs are $3,552.65 per house for production and $2.20 per box for marketing. Marketing costs are: labor 90 cents, transportation 38 cents, plastic wrap 27 cents and box 65 cents.

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