Greenhouse Vegetable Production Economic Considerations, Marketing, and Financing

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In the U.S., tomatoes are only exceeded by potatoes in economic importance. Among fresh vegetable products, annual per capita consumption of fresh tomatoes is only exceeded by lettuce and potatoes. Consumption of fresh tomatoes has remained fairly constant at around 12.8 pounds for the past 10 years as compared to the consumption of processed tomatoes in the form of ketchup and sauces which has increased. These growth characteristics only take into account commercial production and do not include the increasing popularity of home gardens. Tomatoes are the most popular backyard garden crop and possibly account for the leveling off of the per capita consumption of fresh tomatoes during the past ten years.

The greenhouse tomato industry in the south central portion of the U.S. reached a peak in the late 1960's and thereafter declined rapidly as tomato growers switched to other crops. There is, however, a renewed interest in the industry. Perhaps the biggest influence, in this area, has been aggressive promotions by greenhouse manufacturers and exaggerated claims made by advertisers as to the profitability of a greenhouse operation. For example, a recent economic study by a new farm cooperative in South Texas outlined a plan to construct 43 greenhouses to produce tomatoes. The study included an excellent economic analysis of alternative farm operations and concluded that a greenhouse enterprise would provide the highest return for their investment. The conclusions were based primarily on economic data obtained from a greenhouse manufacturing company. The plan called for three plantings at a density of 1.4 ft2 (.13M2) per plant and an estimated yield of 30 lbs (13.5 kgs) per plant space per year under the worst case and a yield of 46-50 lbs (21-23 kgs) per plant space under the best case. They showed an economic analysis where each house would yield $10,660 in pre-tax earnings and an 89% return on their investment. A survey of the industry indicates yields of around 20-32 lbs (9-14.5 kgs) per plant space per year, but it takes 4 ft2 (.37 M2) of greenhouse space to achieve these yields. A south central U.S. wide yield average would more closely approximate 16-30 lbs (7-14 kgs) per plant space per year with a 4 ft2 (9.37M2) plant density. Obviously, there is a gross divergence of views of the economic advantage of entering the greenhouse tomato industry. Yields are directly related to the availability of sunlight and crowding decreases rather than increases yields/unit.

A greenhouse tomato operation appeals to retirees and other families looking for a part-time source of income. Many of these individuals have limited agricultural background, but are attracted because of the potential revenue, minimal work claims and cookbook approach that many greenhouse manufacturers preach. Many families, with spare time on their hands, see a greenhouse as an opportunity to more fully utilize their time.

Interviews with commercial greenhouse growers reveal an entirely different economic outlook. Greenhouse tomato production is hard, risky business. Growers claim that economic rewards are not as lucrative as they are in other related agricultural ventures such as the greenhouse foliage industry. Rising fuel costs present a major problem to growers. The lack of marketing experience and the high degree of skill necessary to successfully grow above the break-even point under intensified greenhouse conditions are other problems. Due to these and other factors, many new greenhouse vegetable growers are not successful.

Objectives of the Study

This study was conducted to analyze the economic situation of the greenhouse tomato industry in the south central portion of the U.S. from the individual producer's point of view. The size, type, and cost of a greenhouse structure was reviewed to identify the typical operation and to determine the cost of construction and operation per unit of measure. The cost, yield, and price data was analyzed to determine the profitability of a typical operation. Over 60 growers from as far away as Canada and the Caribbean Islands responded to an intensive survey designed to analyze these factors.

The data collected was statistically analyzed and converted to an economic profile of a typical greenhouse module. A 30' x 96' (9.1M x 29.3M) greenhouse structure of 2880 square feet (268 M2) was selected as representing the most common economic module in terms of unit size most often used to expand an existing operation or used by potential entrants as a planning unit for entry into the greenhouse vegetable industry.

Market Evaluation

The fresh vegetable market in the U.S., with particular emphasis in the south central portion of the U.S., was reviewed to determine the price and relative availability of field grown tomatoes during the 8.5 month greenhouse tomato production period from mid-October through June. This price and availability analysis was compared to the cost of producing greenhouse tomatoes during the winter period to see if the greenhouse product could be economically marketed during this period.

Detailed Findings

Market Patterns

The greenhouse vegetable industry in the U.S. revolves around the production and marketing patterns of field grown vegetables. Greenhouse production concentrates on the winter months when quantity and quality of field grown tomatoes are scarce and prices are high.

Average wholesale prices for field grown tomatoes sold in the Houston and Dallas vegetable markets are shown in Chart 1. A ten year average was used to confirm the two periods of high prices, a winter high from November through January and a spring high from mid-March through early June. The mid-winter (Feb. - Mar.) price slump appears to correspond to the peak production period in Mexico when large volumes of tomatoes flood the U.S. markets. The summer (July-Oct) price decrease is due to competition from high quality grown tomatoes in Texas, California and backyard gardeners. Insert Chart 1 here!!

The mid-winter price slump for field grown tomatoes also coincides with the period of lowest production for greenhouse growers due to short day length (low light) conditions. Respondents to questionnaires indicated that they did not experience any difficulty selling greenhouse tomatoes during the mid-winter price decline. They continued to receive the premium price because their output correspondingly decreased during the period. This characteristic would perhaps not hold true if the greenhouse tomato industry grew substantially so as to create a surplus of lush quality tomatoes during the peak competition periods from...
A one crop production system was compared to a two crop system where old plants are replaced with fresh plants during mid-winter. Total crop yields between one versus two crop systems did not differ statistically but the wholesale price peaks for field grown tomatoes clearly favors a two crop system. Many greenhouse growers, particularly those growing in the more cloudy areas in the Gulf Coast, favor the two crop system since they are then able to gain more efficient production from fresh spring plants and avoid the production problems associated with the short, cloudy, humid days of mid-winter.

These market fluctuation patterns do not appear to be present in European markets. This is probably due to the large distance to fresh product production centers and the shortage of high quality produce during a substantial portion of the year. Although some growers in the colder parts of the U.S. grow on a year-round basis, most greenhouse growers concentrate their production to the winter months discussed above the south central part of the U.S.

In Canada, Alaska and northern Europe, the production cycle concentrates on the summer months from April through November. Yield data from these areas should exceed the yield data indicated in this paper since growers depend on more sunshine during the summer months.

**Estimated Construction Cost for Basic Greenhouse Module**

A wide variety of greenhouse designs, materials, construction and production methods are available. A basic set of assumptions was made relative to the greenhouse, production methods and financing. This basic set of assumptions was heavily influenced by the response to the initial survey. Sixty-five percent of the respondents were using houses with double layers of ultraviolet protected plastic over either high carbon steep pipes or aluminum frames. Fifteen percent were using fiberglass over a wood frame. The remainder were using glass houses or a combination of thin wall tubing, wood, single layer plastic and fiberglass. In Europe, most houses are covered with glass. Europeans continue to prefer glass due to its permanency, but many new houses are being covered with double layered plastic panels.

Very few new commercial operations are being established with glass houses since construction costs often exceed $30/ft² ($323/M²) for structure alone. A substantial number of the over 200 acres of glass houses in the Ohio area are being covered with a double layer of plastic to provide insulation and conserve heat. Insulation blankets and other insulation devices are being installed in most of the remaining glass houses in order to reduce heating costs.

A comparative analysis of construction costs was conducted separately. It was found that the double layer plastic with ultraviolet light protection treatment over a metal frame (steel pipe or aluminum) was both the least expensive and most durable in the long run. As a result, the base set of assumptions used in this study was:

**Type of Greenhouse**

A quonset-type greenhouse of approximately 2880 ft² (268M²), constructed of galvanized metal tubing anchored in concrete and covered with a double layer of polyethylene film was selected as the economic unit to form the basis of the analysis. Adequate equipment for heating, cooling, and ventilation were considered an essential part of the greenhouse facility.

**Estimate of Construction Costs**

The survey disclosed that construction costs to establish a complete economic unit, to include required equipment, varied from $5,500 by a Louisiana grower, to over $70,000 for a completely automated unit in Canada. Turn key construction costs by competent greenhouse construction contractors were substantially higher than construction costs by an owner/operator who supervised construction and used subcontractors.

The average construction costs varied from $1.90 to over $30/ft² ($20.90-$323/M²). These expenses did not include the cost of land.

The costs shown in Table 1 include the range of costs since construction costs were highly variable. A weighted average cost of $6/ft² ($20.90-$323M²) was extrapolated from the survey using the basic assumption that a new entrant to the industry would supervise contractors of major components and use hired labor for the finishing touches.

**Table 1. Greenhouse Construction Costs**

<table>
<thead>
<tr>
<th>$/ft²</th>
<th>$/M²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>$4.00-$30.00</td>
</tr>
<tr>
<td>Recent</td>
<td>$5.00</td>
</tr>
</tbody>
</table>

*A a weighted average of the range was calculated from a recent survey of greenhouse construction costs.

The construction of a complete greenhouse includes:

- Site Preparation
- Structure
- Heating/Cooling Equipment
- Thermostats and Controls
- Irrigation System
- Nutrient Tank or Injector System
- Growing System

**Fuel Used**

Natural gas was assumed as the fuel used for heating and electricity used for lighting, operating fans, pumps and other small equipment. If LP gas is used, construction costs are basically the same, however, a separate fuel tank will be needed if one is not already available on the site. The additional costs of a fuel
storage tank should be added to the initial cost requirements and variable costs should be increased by approximately fifteen percent.

**Planting System**

One crop of 730 plants per year was assumed grown in sand troughs. A yield comparison was made between one crop versus a two crop system. The difference in yields was not statistically significant. The overall annual production costs of both systems were very similar except that new transplants are needed on January 1 under a two crop system. As a result, a one crop system was used as the basis for the study. A two crop system would achieve similar results, and some growers prefer fresh spring plants to help capitalize on the spring market peak.

**Feeding System**

Water, liquid fertilizer and micronutrients would be supplied by an automatic time control device.

**Growth Media**

Plastic lined beds filled with coarse washed sand was used as the growth media. A substantial number of respondents indicated that they are growing in plastic bags, pots or troughs using a variety of growth media such as gravel, peat-lite mix, rice hulls, pine bark, cedar shavings, and other growth media. Houses built earlier were growing in a whole floor of sand, but new houses were installing sand troughs or growing in a modified nutrient film technique. A whole floor of coarse washed sand is the preferred method if sand is available at a reasonable price.

Only routine general maintenance and repairs were assumed normal with the major maintenance expense coming from replacing the polyethylene glazing every two years.

**Estimate of Capital Requirement**

The initial investment for an operational greenhouse as described above, together with all the major components necessary to initiate operations, is estimated at $18,788 as shown in Table 2. This table also shows that $1,500 will be needed to purchase equipment. The equipment would include a sprayer, dissolved solids meter, scales, timers and miscellaneous small tools.

**Table 2. Estimate of Capital Requirements for Initial Construction for a 30’x 96’ (9.1M x 29.3M) Greenhouse**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per FT²</th>
<th>Per M²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse (2880FT² x $6/FT²)</td>
<td>$17,288</td>
<td>$ 6.00</td>
<td>$ 64.37</td>
</tr>
<tr>
<td>Other Equipment</td>
<td>$  1,500</td>
<td>$.52</td>
<td>5.59</td>
</tr>
<tr>
<td>Total Capital Required</td>
<td>$18,788</td>
<td>$ 6.52</td>
<td>$69.96</td>
</tr>
<tr>
<td>30% Down Payment</td>
<td>($ 5,638)</td>
<td>($1.96)</td>
<td>($21.00)</td>
</tr>
<tr>
<td>70% Loan</td>
<td>$13,150</td>
<td>$4.57</td>
<td>$48.96</td>
</tr>
</tbody>
</table>

This equipment could support a larger greenhouse operation. Equity capital requirements necessary to initiate financing are highly variable and depend on the loan agency, securities provided, borrower’s credit rating, and the relationship between the borrower and the lending agency. Small operators with good credit ratings can usually obtain 60-80% loans, however, lending agencies are reluctant to finance large operations. Financing with equity or venture capital appears as the most viable means of financing large operations.

The summary of the capital requirements shown in Table 2 assumes a 70% loan. A grower contemplating to establish a greenhouse would need approximately $1.96/ft² ($21/M²) to obtain a 70% loan of $4.57/ft² ($48.96/M²).

**Estimate of Annual Production Costs**

Total annual production costs include fixed and variable expenses. Since cost data collected from the survey was associated with a wide variety of greenhouse sizes, the information was converted to a basic cost per/ft² (M²) of greenhouse space and then projected for the 2880 ft² (268 M²) model selected for the comparative analysis. A summary of annual production costs is shown in Table 3.

**Table 3. Estimate of Annual Production Costs**

<table>
<thead>
<tr>
<th></th>
<th>(268 M²) Per FT²</th>
<th>Per M²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Costs</td>
<td>(268 M²)</td>
<td>$ .57</td>
</tr>
<tr>
<td>Interest Expense</td>
<td>$1,644</td>
<td>$.57</td>
</tr>
<tr>
<td>Depreciation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse (5 year)</td>
<td>$3,957</td>
<td>$1.38</td>
</tr>
<tr>
<td>Equipment (3 year)</td>
<td>$ 40</td>
<td>$.01</td>
</tr>
<tr>
<td>Taxes</td>
<td>$ 200</td>
<td>$.07</td>
</tr>
<tr>
<td>Insurance</td>
<td>$5,841</td>
<td>$2.03</td>
</tr>
<tr>
<td>Total Fixed Costs</td>
<td>$5,427</td>
<td>$1.90*</td>
</tr>
<tr>
<td>Variable Expenses</td>
<td>$11,313</td>
<td>$3.92</td>
</tr>
</tbody>
</table>

Hydroponic Vegetable Production | Aggie Horticulture http://aggie-horticulture.tamu.edu/greenhouse/hydroponics/economics.html
Variable expenses ranged from $1-$3/ft² ($10.76-$32.28/M²)

Fixed Costs

Interest expense was calculated at 12.5% on a five year note for the $13,150 shown in Table 2 as assumed borrowed on a 70% loan. Depreciation was calculated on 5 and 3 year straight line basis for the greenhouse and the equipment respectively. Taxes and insurance costs were extrapolated directly from survey data.

Variable Costs

Variable cost included operating expenses associated with the payment for purchase of:
- Repairs
- Marketing
- Fertilizer
- Other chemicals
- Insecticides
- Transportation
- Fungicides
- Labor
- Utilities
- Miscellaneous supplies

Labor Requirements

Respondents indicated that utilities and labor expenses comprised over 60% of the variable operating costs. Labor requirements varied from 8-28 hours per week per greenhouse module. The larger operations were more labor efficient since crews can specialize in specific functions. An average of the more efficient labor requirements were used to calculate the labor expense. The cost estimate is based on 75% of the required labor consisting of hired labor and 25% provided by the owner/operator.

The larger more efficient operators indicated that a greenhouse operation consumes approximately 3 men/acre (7.4 men/Ha) to operate/maintain the greenhouse and an additional man is needed to package and ship, for a total of 4 men/acre (9.9 men/Ha).

Cost per Plant Space

The cost shown in Table 3 can be projected to reflect costs per plant space. The total overhead costs will approximate $8.00 fixed and $7.50 variable for a total cost of $15.50 per year per plant space with a plant density of 3.95 ft² (.37 M²) per plant.

Estimated Annual Entrepreneurial Profits

The yield and price projections shown in Table 4 are based on the data provided by respondents. Average yields of 20 lbs of U.S. No. 1 and 2, and an additional 7 lbs of salable culls, for a total of 27 lbs of salable tomatoes per plant space were reported. Growers were receiving $.80/lb ($1.76/kg) during the 1984-1985 season with salable culls selling at half price. The income statement shows gross income of $13,724 ($4.77/ft²; $51.10/M²) and net income of $2,411 ($.84/ft²; $8.98/M²). In addition, respondents indicated that prices received on direct sales approached and often exceeded wholesale prices due to high demand for high quality but deformed tomatoes, which could be obtained by direct customers at less than retail prices.

Break Even Costs

The only true measure of risk is to compare break even costs to produce a commodity to the price expected from the sale of the product. Table 5 provides a summary of break even costs. If the total fixed and variable costs of $11,313 are divided by the total production of 19,710 lbs (8940 kgs) determine break even production costs of $57/lb ($1.27/kg) or $.77/lb ($1.71/kg) if only the total production of U.S. No. 1 and 2 is used to calculate break even costs.

Cash Flow Analysis

Table 6 provides a cash flow projection. The total revenue from tomato sales used in this comparison is the same income calculations as shown in the income statement in Table 4. An analysis of sources and used of funds provides a potential producer a better idea of the actual operating cash generated from an operation. Many new businesses are able to show a net profit but often run into problems by not having the cash on hand to actually pay bills.

A cash flow projection is different to a profitability analysis in that only cash inflow/outflow is taken into consideration. Non-cash outlays such as depreciation is not considered.

The cash flow projection appears more attractive than the profitability estimate and shows that sufficient cash would be available to service debt. If yields, however, dropped to below 16 lbs (7.3 kgs) per plant space, it would be difficult to generate sufficient funds to service debt even if the product is sold for $.80/lb ($1.76/kg).

Break Even Analysis

Table 7 shows break even yields at various levels required to recapture total annual production costs. The table shows the minimum number of pounds or kilograms of tomatoes which must be produced to cover fixed and variable costs. For example, if the average sale price for greenhouse tomatoes is $80/lb ($1.76/kg), a grower must produce and sell 19.4 lbs (8.8 kgs) to cover the total costs before any profit can be realized. This table again emphasizes that unless yields in excess of 20 lbs (9.1 kgs) per plant space can be produced and sold for at least $.80/lb ($1.76 kg), the potential entrant should be discouraged from entering the greenhouse production industry.

Estimated Returns to Labor Management
The net returns indicated on the estimated income statement and cash flow projections shown in Table 5 and 6 are low but may not appear unattractive to some operators. When risk and opportunity costs of the investments are introduced and the potential yield levels are varied, we identify a new dimension for a prospective investor. Tables 8 and 9 analyze the investment in a greenhouse venture from a profitability and cash flow point of view and Table 10 summarizes the profitability analysis on a per ft2 (M2) of greenhouse space basis. The profitability analyses (Tables 8 and 10) use risk and opportunity costs to equate the profitability of the investment. The opportunity cost calculation subtracts from income the revenue which would be generated by seeking other investments for the average amount of capital which would be tied up in a greenhouse production enterprise. The risk calculation measures the amount of additional monetary gains expected for the higher investment risk associated with a greenhouse investment. Risk factors of 3% are common for normal agricultural production operation. A risk factor of 5% was chosen because a greenhouse venture carries higher risk and an operator should seek higher compensation. Please note that the lowest yield level considered in this analysis is 20 lbs (9.1 kgs) per plant space since lower yields fall below the break even level. Note also that interest expense was not included when calculating income and the net income is divided by the average hours of annual management labor per greenhouse module. We can see that a grower must produce more than 20 lbs (9.1 kgs) per plant space in order to exceed minimum wage compensation.

The hourly wage compensation in the cash flow analysis in Table 9 increases to $10.64/hr since expenses do not include non-cash outlays, such as a depreciation deduction. It should also be noted, however, that the hourly requirements per module were increased to 14 hours/unit/week instead of 11 hours/unit/week which would be required under the assumptions made initially. This adjustment was made only in the hourly calculations since it is difficult to achieve higher labor efficiency in small one unit operations. The 5 hours provided by the owner/operator would comprise approximately 36% of the total labor requirement.

The net income estimate in the profitability analysis in Table 8 can be used to establish investment parameters. For example, if an owner/operator requires approximately $50,000 in annual income he should plan to establish the equivalent of approximately 14 greenhouse modules, assuming that he is able to produce at least 25 lbs (11.3 kgs) per plant space, and can sell the product for at least $.80/lb ($1.76/kg). The number of required modules drops to less than 10 units with the same assumptions if the grower reviews the investment from a cash flow point of view as shown in Table 9.

The same comparisons may be made by using Table 10. Under the same assumptions as above, a grower could generate approximately $52,700 in annual income from a one acre greenhouse complex.

**Comparative Analysis and Marketing Implications**

The purpose of this section is to provide a comparative analysis of greenhouse and field grown tomato production costs during the winter season. The basic premise is that a greenhouse vegetable production operation will probably not form into a viable enterprise unless it is able to compete with field growers in price or provide such a superior quality product that it in effect enters a new premium market category and direct competition is not as important. Greenhouse vegetable growers remain at a competitive disadvantage from a cost of production point of view. Successful greenhouse growers in the U.S. concentrate their production strategy on marketing since a premium price is a necessary ingredient for adequate profits.

**Cost Comparison of Field and Greenhouse Produced Tomatoes**

Economic theory indicates that the long run price of any commodity produced in a competitive industry is equal to the average cost of production. This suggests that the critical measurements are the differences between the costs of producing greenhouse and field grown vegetables and in the prices received for the respective products.

Production and marketing costs for Florida growers average $.255/lb ($0.562/kg) plus approximately $.045/lb ($0.099/kg) transportation costs (Ft. Pierce to Dallas) for a total grower delivery cost of $.304/lb ($0.661/kg). Costs for Mexican tomato production was even less. Production costs average $.205/lb ($0.452/kg) plus $.031/lb ($0.062/kg). This data is supported by the average wholesale price of approximately $.30-$0.40/lb ($0.661-$0.881/kg) for field grown tomatoes shown in Chart 2. Production costs for greenhouse tomatoes, on the other hand, averaged over $.57/lb ($1.27/kg) assuming a yield of 27 lbs (12.3 kgs) per plant space, as indicated in Table 6.

The substantial increases in energy costs during the 1970s and 1980s has had a devastating effect on greenhouse production costs. Energy costs more than doubled greenhouse production costs whereas transportation costs added only approximately $.025/lb ($0.055/kg) in delivery costs during the same period.

**Economic Implications of Cost Comparisons**

These rough calculations indicate that greenhouse tomato growers need a $.17-$0.27/lb ($0.37-$0.60/kg) price premium to remain competitive with field producers. Actual differences may be greater. Greenhouse packing, marketing, and transportation costs in most situations may be greater for greenhouse tomatoes than for field grown items. Real production cost differences between field and greenhouse tomatoes may be $.30/lb ($0.66/kg) or more for some operations.

The obvious conclusion from this comparison is that greenhouse tomatoes compete at a substantial competitive disadvantage. They must have a price premium to achieve economic survival yet their profit margin is equal to or below that of field grown tomatoes. Their main advantages are: 1) freshness since they are grown close to retail centers and picked ripe; and 2) higher quality since they are grown in a highly controlled environment. These two advantages encourage a demand for a higher price, but also characterizes them with a high elasticity of demand and with a high degree of vulnerability to product substitution. Therefore, it appears that the purchase of greenhouse vegetables is directly proportional to the product price and the level of disposable income of the consumer.

The precise elasticity of demand for specific greenhouse produce varies over a range of economic conditions. The nature of demand at retail for greenhouse vegetables varies with season and price. During the winter and early spring, total supplies are lowest and prices are highest. As the season progresses, through late spring, summer and early fall, supplies increase and prices decrease. Thus, the demand for greenhouse vegetables tends to be more elastic in the summer and more inelastic during the winter.

In the final market analysis, the real key to marketing success is the availability, visual appearance and quality of available substitutes. Up to a point, the retail price of tomatoes produced in a greenhouse is not as critical on their demand as the price, visual appearance and quality of available field grown tomatoes. Our surveys of growers indicated that attractive greenhouse tomatoes would sell at twice the price or more of field grown competitors if the field
grown product was unattractive or mushy. Greenhouse growers experienced problems in moving their products at a 20% price premium if the field grown counterpart was attractive and of sufficiently high quality. The key marketing evaluation to be made is, therefore, what is the visual appearance, price and quality of available competitors. If supply is scarce, quality questionable, and prices high, a grower should not experience too many marketing problems if he aggressively follows basic promotional themes.

Financial

Greenhouse ventures are considered high risk investments by lending institutions. Lenders are reluctant to finance large operations. Smaller operations carry higher probability of obtaining financial support from a lending institution, than larger operations. An excellent relationship between the client and the financial institution is normally an essential requirement in obtaining financing. If a loan is available, most lending institutions are reluctant to provide more than a 50%-80% of the capital requirement. As a result, the use of equity or venture capital is the most common means of financing greenhouse operations. Although the following discussion concentrates on the necessary requirements to obtain financing from a lending institution, the basic requirements remain the same if venture capital is solicited from investors.

People who plan to approach a lender for credit should demonstrate their ability to use and manage money wisely. It is important to understand certain basic principles of borrowing and lending in order to compete successfully with other business and individuals for available loan funds. Lenders normally consider loan purpose in terms of its effect on the profitability of the business. Ideally, a sound loan is one which enables the borrower to increase his income by an amount significantly greater than the amount needed to repay the loan. The loan purpose also determines the length of the repayment period.

Consideration should be given to how the lender decides whether the loan will be made and for what amount. A lender who provides a loan that is either insufficient or in excess of the amount needed may cause serious problems for the borrower. The following questions are often asked by lenders in a loan analysis:

1. How much is to be borrowed?
2. When will the money be needed?
3. What is it going to be used for?
4. How will it affect the borrowerís financial position?
5. When will it be repaid?
6. How will it be repaid?
7. How will the loan be repaid if the first repayment plan fails?

In evaluating a loan request, a lender weighs the strong and weak factors in the request to assess the borrowerís ability to repay the loan. To do this, the lender attempts to:

- Obtain correct, adequate, and complete information,
- Compile the information in a useful way,
- Weigh the strengths and weaknesses of each credit factor,
- Consider the strengths and weaknesses of all credit factors in relation to each other and as a whole,
- Analyze the probable performance of the loan, and
- Make the loan decision based on technical knowledge, the institutions loan policy, and previous experience.

A detailed portfolio must be prepared containing pro-forma statements, balance sheets, cash flow projections, and reference letters. The financial statements should be clear and contain at least as much economic details as shown in this paper. If the income tax treatment of greenhouse investments is favorable to investors, these facts should be highlighted in the portfolio. Sources of information, labor, equipment, and supplies must be clearly listed as well as market outlets and marketing plants. Keep in mind that lenders look for possible and probable causes of failure when reviewing all loans and in particular, loans in support of high risk operations, such as a greenhouse venture. Include in your portfolio contingency plans for emergencies such as a power failure during a rain or snow storm.

Lenders are looking for a high degree of assurance that the operation will be successful and therefore profitable for you, the lender, and the community. Carefully review your portfolio from the lenders point of view and insure that you have documented all alternatives which might cause you concern if you were the lender.

Conclusions

General Observation

Although the greenhouse vegetable industry is again expanding, the competitive position of firms remain at a disadvantage. Increased competition from alternate supply sources and increased greenhouse production costs under a relatively elastic demand situation appears to be the cause of the competitive disadvantage. The intensity of greenhouse culture is unlike anything else in crop production. It requires substantial managerial skills, patience, and hard work from a grower. Opportunities do exist for someone willing to devote the time to establish marketing channels and manage the many facets of the business. It is a scientific, demanding, and intensive form of agriculture. Sales outlets and production costs are important considerations. With field grown tomato production costs averaging $2.25-$3.55/lb ($5.50-$7.75/kg), compared to over $5.75/lb ($12.75/kg) for greenhouse tomatoes, promoters and prospective operators should carefully evaluate the market before investing in the business.

Some general implications from the analysis of the basic 2880 ft2 (268 M2) module used in this report were:

1. Construction costs ranged from $2-$30/ft2 ($43-$323/M2) of floor space, but a substantial number of excellent units are being built for $6/ft2 ($64.58/M2). It would be wise for prospective entrant to shop around before buying.
2. Since operating costs are relatively inflexible, the financial success of greenhouse tomato production is highly dependent on yields and market prices. This means the need for gross returns of approximately $4/ft2 ($42/M2) to come out even, or a minimum average production of 19.4 lbs (8.8 kgs) per plant space if the market price averages $8.00/lb ($1.76/kg). If a grower wants compensation for risk, opportunity costs, and management labor, he will need to produce approximately 20.5 lbs (9.3 kgs) per plant space to provide labor returns that approach minimum wage, assuming again
3. A viable marketing program is an absolute since a premium price is essential to economic survival. 
4. Greenhouse tomato production is labor intensive. If located in a high labor cost area, returns from greenhouse tomato production would be marginal if adequate labor was not available at wage rates which approximate minimum wage and substantial amount of hired labor was necessary. 
5. Fuel costs represent almost 40% of production costs. The uncertainty of future prices necessitate an aggressive program to conserve fuel or the use of solar energy to keep this expense at a manageable level.

If profits appear feasible, a carefully prepared study with pro-forma cash flow and financial statements that indicate a potential profit will be required to attract investment capital. There is no better method for securing funding since lending institutions have shown reluctance to finance greenhouse ventures. A potential entrant to the industry must not delude himself into forecasting a profit when the facts do not bear this out. The present situation appears full of risk and uncertainty. The present economic situation must be stabilized before greenhouse vegetable situation can be properly evaluated.

Economics of Production

One of the primary factors contributing to the weakened economic position of the greenhouse vegetable industry has been the disproportionate cost/price situation during recent years. Production costs have continued to increase steadily, while farm prices for greenhouse vegetables have remained relatively unchanged. The quantity and quality of field grown tomatoes during the winter months has increased substantially during the past few years. Consequently, growers have tried to maintain net returns by minimizing production costs and increasing yields. This objective sounds familiar since it is the object of almost all agricultural ventures. Greenhouse vegetable producers have had to switch from glass houses to the more economical polyethylene construction materials. More work is needed to cut production costs since greenhouse tomatoes are highly vulnerable to product substitution at the retail prices.

Demand for Greenhouse Vegetables

Although the demand for greenhouse vegetables has been increasing over the years, such increases are primarily a function of population expansion, not increased per capita consumption. This trend will likely continue, as greenhouse vegetables are characterized by a relatively elastic demand curve with a high potential to remain on the shelf if the price is too high or if similar quality substitutes are available.

Recommendations

Managerial Considerations

Each situation must be evaluated separately. If profits from greenhouse vegetables do not appear feasible, there are alternative crops which may be profitable, e.g., bedding or foliage plants and flowers. Any particular operation may hold surprises each situation is unique.

A manager should maintain close contact with research agencies and the industry to take advantage of the most efficient growing techniques. Researchers recognize that the only way that greenhouse vegetable growers will be formed into a viable industry is to increase efficiency to the point where greenhouse vegetables compete with field grown vegetables imported from the microclimatic winter growing areas. They visualize that as the price of fuel increases, it will be far cheaper to grow fresh fruit at a close proximity to a population center and eliminate long distance transportation costs if we reduce the greenhouse dependence on fossil fuels for heat. To accomplish this objective, solar energy and other fuel conservation techniques must be incorporated into future production systems. The growing systems must be redesigned to increase efficiency, yields and reduce costs. A wise manager would begin by taking these essential steps into account in forecasting future operations.

Profit Maximization and Space Utilization

A typical greenhouse tomato production operation only utilizes approximately 60% of the floor space of a greenhouse during the preparation phase and it takes 90-120 days from seed to first harvest. Substantial greenhouse space is available in sufficiently long periods of time to intercrop short duration ornamental plants. Intercropping and/or diversification into the following crops may be an economically viable alternative:

- Lettuce
- Cucumbers
- Bedding plants
- Foliage plants
- Seasonal crops
- Ornamental tomato baskets
- Custom growing for flower or specialty shop
- Production of Oriental vegetables provides a wide new horizon of expectations

Marketing

Marketing the crop is the area in which most greenhouse operators fail. A thorough understanding of the marketing channels available is a necessity when promoting any form of greenhouse operation. Among the usual option are wholesalers, retailers, roadside or farm stands, and door-to-door routes.

Produce wholesalers complain that in order to handle a product, a steady supply must be available. Individual greenhouse tomato growers frequently cannot guarantee this; thus, wholesalers may not want to add the item to their inventories. Therefore, growers should visit several wholesalers before assuming any wholesaler will buy the crop.

Small producers might well consider selling direct to retailers. Surveying produce managers in local supermarkets is highly recommended for those choosing this option. Marketing through local stores has the advantages of not requiring distant delivery, and smaller quantities are usually preferred by the store.

Direct selling to the public is a frequently chosen method. In considering this method, sales costs should be considered, both in real terms, and in lost opportunity time for other endeavors.
A combination of sales outlets can also be employed. Whichever is chosen, the additional costs of selling must be considered. These include transportation, time and any storage required.

Taken from a paper "Greenhouse Vegetable Production Economic Considerations, Marketing, and Financing" presented and published in the proceedings of the "Hydroponics Worldwide: State Of The Art In Soilless Crop Production" conference by the International Center for Specials Studies, In Hawaii during December 1985. The paper was completely reviewed in 1991, found to be still current and retained unchanged. Since then, it has been reviewed several times. Whereas some of the values (input costs and output value) are up about 15 percent as compared to the last complete review in 1991, the production systems and financial relationships are not so far out of date.

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