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Center for Crop Diversification Fact Sheet
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High Tunnel Economics

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Introduction

Growing produce in high tunnels is a common practice among growers supplying vegetables and fruits for local and regional markets. High tunnels provide growers the ability to extend the season beyond what is normally possible in open field production systems. The physical barrier of a high tunnel can also provide pest and disease management advantages. High tunnels have increased in popularity with the expansion of local and regional food systems in Kentucky. Some agricultural policy and program initiatives, such as the High Tunnel System Initiative in the USDA-NRCS Environmental Quality Incentives Program (EQIP), have aided new high tunnel producers.

The cost of establishing a high tunnel is modest compared to an automated glass greenhouse. Various cost-share and grant programs may also make high tunnels attractive to produce and flower growers. However, even with potential offsets in establishment costs, high tunnels require annual investments to successfully grow crops and maintain the structure. Furthermore, high tunnels are labor-intensive and require good horticultural practices and thoughtful management.

Generating economic estimates for high tunnel profitability can be challenging as each farm's site is unique. High tunnel establishment and labor costs may vary greatly between farms and regions, resulting in variable profitability of high tunnel crops. This fact sheet outlines economic considerations for high tunnels in general terms. The principles here may be applied across crops and high tunnel designs, from smaller self-designed tunnels to large tunnels constructed by professional crews.

This fact sheet is best used as a resource to inform a grower's own cost and return estimates for growing crops in high tunnels. This is not a production guide. Consult other reliable resources to design and select a high tunnel structure and to make production decisions appropriate for each farm.

Yield and Price: The Keys to Maximizing Returns

- Higher yields of marketable produce per plant or per square foot, compared to field-grown production, are key to high tunnel profitability.
- High tunnel profitability is very sensitive to price. Premium selling prices for crops grown in high tunnels are key to sustaining profitable high tunnel production.

Some of the benefits of growing specialty crops in high tunnels are season extension (harvesting the crop before or after the traditional local open field growing season) and a higher percentage of marketable yields. However, there are upfront costs in order to reap these rewards. Most tomato varieties grown in a high tunnel, for example, require more labor on a plant-by-plant basis

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than tomatoes grown in the field. This is because of more production labor, especially harvest labor, as high tunnel tomatoes may yield more per plant.

Higher yields should provide the grower with a greater amount of marketable produce. This should translate to higher revenue on a plant-by-plant or space (per square foot or per acre) basis. Based on high tunnel production history in Kentucky and similar growing regions, high tunnel produce must also be sold at steady and premium prices to cover all the costs of production and to contribute toward the cost of the high tunnel itself.

A *sensitivity analysis* looks at how the changes in key enterprise variables would impact the overall profitability of an enterprise. Profits from fresh vegetables, fruit, and flowers are impacted by marketable yields and the prices at which those yields may be sold.

The table below illustrates the differences in returns from high tunnel tomatoes when sold at different prices and yields. The Cornell University interactive high tunnel budget tool (http://blogs.cornell.edu/hightunnels/economics/sample-budgets-spreadsheets/) was used to conduct this sensitivity analysis. Production assumptions and input prices were adjusted for a Central Kentucky production situation with 200 tomato plants grown in an unheated high tunnel. The budget assumed that 70 percent of the tomatoes would be sold at full retail price; 25 percent would be sold for $1 per pound; and 5 percent would be composted as culls.

The assumptions for retail prices were based on three-year average tomato prices reported from Kentucky farmers markets found on the CCD website at https://www.uky.edu/ccd/pricereports/KYFM.

Prices may not be constant throughout the season, especially if a high tunnel will bring products to market before the usual local season. For example, customers may be willing to pay a price premium if there are no tomatoes usually available during the first four weeks of a local farmers market. Consulting local and regional price reports can also indicate potential price trends.

The table reports returns to management, which includes a $550 annual depreciation cost for the high tunnel. Return to management is the return to the grower after all variable costs and fixed costs have been counted. This includes production input costs (the cost of plants, fertilizer, pest control products, etc.); harvest costs (hired labor, containers, transportation costs to market, selling expenses). These variable costs will change based upon the number of plants grown and the total yield; for example, it will take more labor hours to harvest and market 2,000 pounds of tomatoes than 1,600 pounds. The return to management also accounts for fixed costs, costs that do not change according to the quantity produced.

Another way to understand the return to management is as the amount a grower earns for his or her management, or the time that is not directly spent in growing and marketing the high tunnel crop. Successful high tunnel production involves pre-plant planning, developing a marketing plan and many other management activities that take time. If a grower has spent 40 hours in planning and managing high tunnel production, the return to management can be divided by 40 to estimate the hourly return. Using this assumption, a $1.50 retail price returns $3.83 per hour to management at a yield of 2,000 pounds. Return to management increases to $21.33 per hour at the $2.00 price, and a return of near-

Sample High Tunnel Sensitivity Analysis: Returns to Management*

Retail Price	1,600 lbs	1,800 lbs	2,000 lbs	2,200 lbs	2,400 lbs
1.5	-318	-83	153	388	623
1.75	-38	233	503	773	1043
2	243	548	853	1158	1463
2.25	523	863	1203	1543	1883
2.5	803	1178	1553	1928	2303

*Based on 200 tomato plants grown in an unheated high tunnel in Kentucky at various yields and prices; 70% sold at retail, 25% at $1/pound, 5% culls. Assumes annual fixed costs (including tunnel depreciation) of $550.

ly $39 per hour of management is estimated when the retail price is $2.50 per pound. Growers should develop yield and price projections for the high tunnel cropping system before starting high tunnel construction.

Understanding and Estimating High Tunnel Construction Costs

- Account for total construction costs of high tunnels, including potential "surprises" like site preparation and additional systems (heating/ventilation) expense.
- Estimate realistic construction labor costs.

One difficulty in estimating high tunnel profitability is that high tunnels can be as diverse as the farms that use them. For example, two farms could construct high tunnels of the same size and the same materials. But if extensive grading and drainage work are required at one site, construction costs could rise substantially. Similarly, if one farm were installing more heaters to use the high tunnel for growing transplants or off-season production, those heaters would also increase total construction costs.

Producers may also need to account for the cost of getting high tunnel materials to the farm. In some cases, freight costs can add a substantial percentage to high tunnel construction.

Here are questions to consider when estimating high tunnel construction costs:

- What will the raw materials cost?
- What site preparation work will be needed?
- What new systems equipment (ventilation, heating, irrigation) will need to be purchased?
- Will new equipment (like transplant production supplies) or machinery (bedding equipment, planting equipment, mulch layer) be needed?
- How much hired labor will be required for high tunnel construction?

High Tunnel Production Economics: Counting all Costs (including Labor!)

It has already been stated that the construction requirements for each high tunnel may be as unique as each individual farm. The same may be said for high tunnel production costs. The different types of crops, number of months the high tunnel is in use, crop rotations, soil fertility and even pest and disease management can all

result in production costs that can vary between seemingly identical high tunnels.

Labor costs may vary widely. Different crops and different production systems can involve very different labor costs. For example, the labor required to manage weeds by hand-weeding or hoeing in a high tunnel will likely be much greater than the labor needed to judiciously spray an approved herbicide over the same area. Different crops will also require different amounts of labor. The amount of labor needed for harvest on a per square foot basis will vary widely between lettuce and tomatoes, cucumbers and berries, flowers and culinary herbs.

Two areas of labor often unanticipated by producers new to high tunnel production are crop scouting and ventilation. The intensive cropping system and confined production space in a high tunnel means that producers must closely monitor crops and have someone nearby to ventilate the tunnel on sunny days.

Efficient use of space is another factor impacting high tunnel profitability. For example, the production area next to the high tunnel sidewalls is wetter and cooler during the winter months. This may limit production options; the producer may decide to keep winter production to a minimum in those areas. This can impact the overall profitability projection. A related concern is plant populations. Tighter plant spacing in high tunnels could increase yields but could lead to more pest and disease management challenges because of humidity.

Pest and disease management can also create unanticipated costs. Rodents and wildlife are attracted to the warmth of high tunnels during cooler months, and the costs of managing such pests should be accounted for

during the high tunnel budgeting process.

Crop rotations are another factor creating variability in high tunnel profitability estimates. If crop rotations are not followed, disease may limit productivity of certain crops. Once in the soil, many soilborne diseases can persist for years. Similarly, soil health concerns can also be a limiting factor. Productivity can also be impacted by accumulation of salts, which can result from covered soil not experiencing leaching from precipitation.

Season extension, a main benefit of high tunnel production, also raises economic considerations. Supplemental heat, needed to harvest some crops for early market windows, may add additional costs. Producers should determine whether early season price premiums will be great enough to cover any additional costs of production. Non-financial factors, like day length requirements for cold-season tomato production, could impact crop yields and financial returns. These types of questions are essential when projecting the economic feasibility of season extension.

Conclusion

The purpose of this publication is to assist growers in considering the economics of high tunnel production: how to plan and project the costs and returns of resources used to grow food and ornamental crops in high tunnels.

Developing a cost and return projection is a recommended exercise for any new farm enterprise. Producers considering high tunnel production should list the possible returns and expenses, thinking through what production challenges will occur from week to week.

Several interactive high tunnel budgets, which may be adjusted and changed to reflect the likely costs and returns in Kentucky production situations, are available from extension services in other states. Links to some of these are listed below.

References and Additional Reading

- Bullen, Gary. "High Tunnel Budgets" (NC State University, 2009) https://cefs.ncsu.edu/wp-content/uploads/hightunnelbudgets02172009.pdf?3106e7
- "Marketing and Economics." (Various publications and presentations) http://hightunnels.org/category/for-growers/marketing-economics/
- "Where's the Money in High Tunnel Production?" (Cornell University, 2008 newsletter article) https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/5/91/files/2016/04/where_is_the_money_shaw-opjr8a.pdf

Budgets

- Cornell Budgets (2009 season but in interactive spreadsheet for updating) http://blogs.cornell.edu/hightunnels/economics/sample-budgets-spreadsheets/
- Cornell High Tunnel Bramble Guide http://www.hort.cornell.edu/fruit/pdfs/high-tunnel-brambles.pdf
- "High Tunnel Production: The Basics for Success and Three Case Studies on Profitability" (University of Maryland, 2013) https://extension.umd.edu/sites/extension.umd.edu/files/_docs/publications/FS-957 High Tunnel production.pdf
- "Growing Under Cover: Guide to Polytunnel Options for Kansas Growers" (Kansas Rural Center, 2014) https://kansasruralcenter.org/growing-under-cover/
- Vegetable Production Budgets for a High Tunnel (Iowa State University Ag Decision Maker, 2013) https://www.extension.iastate.edu/agdm/crops/html/a1-23.html

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