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Economic Analysis of Fresh Green Bell Pepper (*Capsicum annuum*) Production under Shade Structures

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Fresh green bell pepper production is a major economic contributor to Florida's vegetable industry. The estimated value of cash receipts for peppers in 2011 was $247.5 million. This represents an increase in value from 2007 by 7.3%. Almost all of this value is from open field production. Methods for season extension using shade structures were developed and evaluated at the Suwannee Valley Agricultural Extension Center–UF/IFAS, Live Oak, FL. This season extension method may have potential in both small, diverse vegetable farms as well as larger commercial production. An increased amount of investment is in involved in growing peppers under shade structures, from both capital and management resources. To better assess risk and potential profitability of this new production system, a study of financial investment and potential is needed. Prospective profitability can be addressed through an enterprise budget - an itemized overview of costs incurred over a typical production cycle. Risk involved is addressed by analyzing cash flow in and out of the operation for a fixed interval of time. These two financial analyses of growing fresh green bell peppers under shade structures allow for a preliminary evaluation of investment and potential of this innovative growing system.

Florida's bell pepper (*Capsicum annuum* L.) industry is valued at $247.5 million, nearly all of which is produced in open field production in the winter months. With annual production of 15.7 million bushels of bell peppers, Florida is responsible for 46% of domestic bell pepper production (FASS, 2012); however, the hot summer climate in Florida limits production through the summer months. Modern fresh produce markets demand product year round, meaning during the summer months wholesale producers move production out of Florida. This can create even bigger challenges for small farmers without the ability to expand operations to multiple climates. Season extension has traditionally been targeted towards sustaining production through the coolest part of the year. Shade structures have been used by ornamental and cut flower industries to continue production through the summer in Florida. Over the past several years shade system production trials of green bell peppers have been conducted at Suwannee Valley Agricultural Extension Center near Live Oak, FL. The purpose of these trials has been to best evaluate the sustainability of producing green bell peppers under shade. While these trials have shown positive results in yields and inputs, the economic sustainability of producing peppers under shade structures must be evaluated. Additional economic concerns of producing peppers under shade include increased infrastructure and materials. Production under shade structures is atypical of open field production, in that the cultural practices are more similar to those found within greenhouse production. The plants are grown in 3-gal pots containing soilless media, and irrigated and fertilized using hydroponic principles (Hochmuth, 2007).

Growing any crop under shade, whether peppers, cut flowers or ornamentals, requires substantial investment. The two financial considerations most important when evaluating such an enterprise are profitability and cash flow. Profitability potential can be addressed through an enterprise budget, an itemized overview of cost incurred over a typical or average production cycle. The second consideration is addressed by analyzing cash flow in and out of the operation for a fixed interval of time. This is done by means of a cash flow budget.

Materials and Methods

An analysis of profitability can be best assessed by means of the values, gross return, net return above production cost, and net return above total cost. These three values are calculated using an enterprise budget (Table 1).

Every enterprise budget contains two types of costs: variable and fixed. Variable costs are those expenses incurred only if the production cycle is started. Examples of these costs are items like seed, fertilizer and media. Fixed costs are independent of production, meaning whether or not production is started the business will experience these costs. Examples of such fixed costs include depreciation, insurance, taxes, and interest. Fixed costs affect investments in property such as buildings as well as equipment items expected to last more than one season, which

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Table 1. Shade pepper enterprise budget.

General Information							
Production System		3gal pots/trellised		Crop Duration - weeks		33	
Number of Acres		1		Harvest Period - weeks		23	
				Miles to market		50	
Boxes Pepper/ Plant		0.4		Trips to market		46	
Plants per acre		10890		Labor Rate		$ 10.00	
Revenue		Yield-boxes		Price $/box		Total $	
		4356		$ 12.65		**$ 55,103.40**	
Costs			Unit	Quantity	Price	Value	Total $
Preharvest							
	Material Inputs		$	1	$ 14,794.77	$ 14,794.77	
	Energy		$	1	$ 171.60	$ 171.60	
	Labor		hrs	1090	$ 10.00	$ 10,900.00	
	Int. on Op Capital*		$	25866.37	5%	$ 1,293.32	
	Total Preharvest Variable Cost						**$ 27,159.69**
Harvest and Hauling							
	Labor		hrs	552	$ 10.00	$ 5,520.00	
	Vehicle**		mi	8940	$ 0.56	$ 5,006.40	
	Total Harvest/Hauling Cost						**$ 10,526.40**
Custom Packing and Marketing							
	Labor		Box	4356	$ 0.11	$ 479.16	
	Boxes, Foams & Labels		Box	4356	$ 0.76	$ 3,310.56	
	Marketing & Misc.		Box	4356	$ 0.80	$ 3,484.80	
	Total Packaging and Markeing Cost						**$ 7,274.52**
Cleanout			hrs	84	$ 10.00	$ 840.00	
							$ 840.00
Total Variable Cost							**$ 45,800.61**
Fixed Costs							
	Depreciation + Interest		$	1	$ 11,597.15	$ 11,597.15	
	Taxes & Insurance		$	1	$ 818.61	$ 818.61	
	Overhead			10%	$ 25,866.37	$ 2,586.64	
	Total Fixed						**$ 15,002.40**
Total Cost							**$ 60,803.01**
Returns Above Cash Costs							$ 9,302.79
Returns Above Total Costs							$ (5,699.61)
Breakeven Price to Cover Cash Costs							$ 10.51
Breakeven Price to Cover Total Costs							$ 13.96
*Interest on operating expenses charged at 10% for 6 months							
**Vehicle miles assumes 100 mile round trip to packinghouse 2 times/week for 30 weeks							
plus an additional 10 miles per day for other greenhouse needs							
Overhead costs are assumed to be equal to 10% of Operating Capital							

are referred to as durable goods. By including expected yield and price, the enterprise budget can be used to predict profitability of the operation. Enterprise budgets do not address whether the enterprise can produce a sufficient flow of funds to meet immediate cash obligations of the operation.

Cash flow analysis is used to determine whether the cash generated from operations (cash inflow/ revenue) is adequate to meet the cash outlays required to operate the enterprise (cash outflows/ expenses) over a given time interval. This is used to analyze the long term viability of the enterprise. Cash flow is often viewed with great importance by investors because it determines the operation's ability to return value to the financier. 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 shade production of green bell peppers for 1 acre of growing area are presented as an example in the following tables and discussed and analyzed in this paper.

Results and Discussion

Yield, market prices and gross revenue

The recent trials performed at UF/IFAS Suwannee Valley Agricultural Extension Center near Live Oak, FL have involved evaluation of the marketable yields of green bell peppers grown under shade structures. Marketable yields were dependent on variety, ranging from 1,967 boxes per acre to 4,375 boxes per acre (Hochmuth, 2007). These yields exceed what would be expected from standard open field production due to the extended season.

An ideal yield of 4,356 boxes per acre was used in the construction of the budget. The average yield per acre for open field grown systems is between 800 to 1,200 boxes per acre.

During the summer months most U.S. bell pepper production is moved north to states such as Georgia, Ohio, New Jersey, North Carolina, and Michigan. California is able to maintain production of marketable volumes of bell peppers year-round due to multiple climatic zones. The fresh bell pepper market is characterized as competitive, meaning that no one grower is large enough to influence the market price. This means that the price received by growers is due to factors that include consumer demand and supply from other parts of the country. The average price per box ranged from $12.40 to $12.90 during the summer months of 2012 (USDA–AMS). The price typically received by Florida growers through the winter was $14.70 to $15.80 per box. The expected price used in the enterprise budget was $12.65, which is representative of the national average price received at the Atlanta Terminal Market for the season targeted by shade growing practices; all prices being F.O.B. Shipping Point. This price is for commodity sale of the product; higher prices are available to producers who add value through marketing strategies. However, for the purpose of the economic analysis and budget, it is assumed that the product is being sold as a commodity.

With an expected yield of 4,356 boxes per acre and an expected price of $12.35 per box, the gross revenue of a pepper operation under shade structure is estimated to be $55,103 per acre. This translates to a value of $1.26 per sq. ft. for the production area. In order for the operation to be economically sustainable in the longer term, this return must be greater than the total cost (fixed cost + variable cost) for the enterprise.

Fixed Costs

Fixed costs (Table 2) for 1 acre of shade-grown peppers is equivalent to $60,253 before depreciation, interest, and taxes and insurance. These fixed costs can be divided further into investment costs, which includes items like buildings and site preparation, and durable goods, which are materials that will last longer than one growing season but do not represent a significant investment in property. Investment costs total $33,017 or 55% of fixed costs. After each cost is annualized, investment costs represent $4,522 annually, and durable goods cost $8,997 annually, meaning the total annualized fixed cost for the operation is $13,519. This was calculated assuming an interest rate of 10% on long-term capital used to fund much of these investments, and taxes and insurance accounting for 1.4% of the annualized cost. Depreciation was determined on a straight-line basis with an individual approach for each property or good, and usable life ranging from 20 years (shade structure) to 3 years (shade cloth and other durable goods).

The structures invested in include a 1 acre shade system: five sections, 10 ft high, 200 ft long, and 40 ft wide, with 40% shade cloth. Additional structures are a 10 × 10 ft shed to be used to house equipment and the fertilization/irrigation system. Fixed costs also include site preparation (grading and leveling) and covering the production area with ground cloth. The direct cost of labor for constructing the growing area and durables are also included. Durables (Table 3) include 3-gal pots, tubing, clips, and analytical equipment. Fixed costs overall equal $16,083 annually, with the addition of overhead of $2,564.

Variable costs

Fertilizer represents 34% of the pre-harvest cost associated with variable costs. Other preharvest costs include; media, fungicides and insecticides, transplant equipment, and energy. Overall pre-harvest costs not including labor total $14,966 (Table 4). Labor across the production cycle, including pre-harvest, harvest and handling, packing and marketing, and cleanout, represents 39% of variable costs. Labor is charged at $10.00 per hour and represents both a direct cost of paying employees and a loss of opportunity for unpaid family labor. Minimum wage in Florida is $7.76 per hour, but the price of agricultural labor is accepted to be higher, due to a shortage of skilled labor for agricultural operations. Other expenses associated with variable costs are fuel for delivery of product, packaging, and marketing. Variable costs equal $45,801.

Total cost. Total costs associated with the enterprise, both fixed and variable, are $60,803. This means that variable costs represent 75% of total expenses and fixed costs are responsible for the remaining 25%. Net return over variable cost [gross return – total variable cost] is equal to $9,303. This means that the

Table 2. Investment costs for shade pepper production.

					Annual Charge			
Construction			Original Cost	Life- Yrs	Depreciation	Interest**	Tax&Ins*	Annualized
Shade System	1 Acre		$ 13,500.00	20	$ 675.00	$ 675.00	$ 184.95	$ 1,534.95
Warehouse (10'x10')			$ 1,250.00	10	$ 125.00	$ 62.50	$ 17.13	$ 204.63
Site Preparation			$ 4,157.00	20	$ 207.85	$ 207.85	$ 56.95	$ 472.65
Ground Cover			$ 1,400.00	10	$ 140.00	$ 70.00	$ 19.18	$ 229.18
Irrigation/Fertigation System			$ 3,960.00	10	$ 396.00	$ 198.00	$ 54.25	$ 648.25
Plant Support System			$ 1,750.00	10	$ 175.00	$ 87.50	$ 23.98	$ 286.48
Labor (Const. + Equip. Install.)			$ 7,000.00	10	$ 700.00	$ 350.00	$ 95.90	$ 1,145.90
Total Construction Costs			**$ 33,017.00**		**$ 2,418.85**	**$ 1,650.85**	**$ 452.33**	**$ 4,522.03**
Durables								
Shade System			$ 8,276.40	5	$ 1,655.28	$ 413.82	$ 113.39	$ 2,182.49
Sprayer + Spray Mask			$ 1,590.00	5	$ 318.00	$ 79.50	$ 21.78	$ 419.28
Other Durable Goods			$ 16,869.50	4	$ 4,217.38	$ 843.48	$ 231.11	$ 5,291.96
Total Durables			**$ 26,735.90**		**$ 6,190.66**	**$ 1,336.80**	**$ 366.28**	**$ 7,893.73**
Total Greenhouse Investment + Durables			**$ 59,752.90**		**$ 8,609.51**	**$ 2,987.65**	**$ 818.61**	**$ 12,415.76**
Utility hookups (electric, gas & water)***			500					
Total Greenhouse Investment			**$ 60,252.90**					
*Taxes and Insurance Rate (%)		1.4%						
**Interest Rate (%) =		10%						
***Does not include cost of new well								

Table 3. Durable goods.

Materials		Unit	Quantity	Price	Total	Life-Yrs	Depreciation
Investments:							
	Shade System 40%	acre	1	$ 8,276.40	$ 8,276.40	5	$ 1,655.28
	Sprayer	each	2	$ 729.00	$ 1,458.00	5	$ 291.60
	Spray Mask	each	2	$ 66.00	$ 132.00	3	$ 44.00
Other:							
	Emmiter& Tubing	plant	10890	$ 0.35	$ 3,811.50	3	$ 1,270.50
	Thermometer	each	2	$ 31.50	$ 63.00	3	$ 21.00
	Timer	each	2	$ 200.00	$ 400.00	3	$ 133.33
	Clips	box	16	$ 50.00	$ 800.00	3	$ 266.67
	3 gal pots	each	10890	$ 1.00	$ 10,890.00	3	$ 3,630.00
	Tapener	each	1	$ 75.00	$ 75.00	5	$ 15.00
	Scale	each	1	$ 50.00	$ 50.00	3	$ 16.67
	Light Meter	each	1	$ 100.00	$ 100.00	5	$ 20.00
	pH/EC Meter	each	1	$ 100.00	$ 100.00	3	$ 33.33
	Harvest Bins	each	35	$ 12.00	$ 420.00	5	$ 84.00
	Tools	misc	1	$ 85.00	$ 85.00	3	$ 28.33
	Harvest Aids	each	1	$ 75.00	$ 75.00	5	$ 15.00
	Total				$ 26,735.90		$ 7,524.71

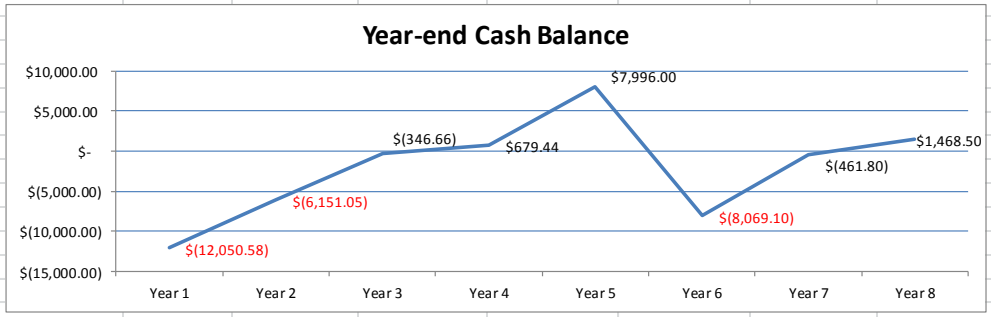
Table 4. Preharvest input prices.

Materials		Unit	Quantity	Price	Total
	Fertilizers				
	A mix 8-12-32	lbs	2100	$ 1.64	$ 3,444.00
	Magnesium Sulfate	lbs	385	$ 0.60	$ 231.00
	CaNO3	lbs	1980	$ 0.68	$ 1,346.40
	Sulfuric Acid	gal	35	$ 24.00	$ 840.00
	Insecticides				
	Soap	gal	6	$ 36.88	$ 221.28
	Neem	quart	15	$ 95.50	$ 1,432.50
	DiPel	lb	15	$ 5.95	$ 89.25
	Fungicides				
	Liquid Sulfur	quart	6	$ 7.95	$ 47.70
	Maneb	lbs	12	$ 8.99	$ 107.88
	Chlorothalonil	pints	9	$ 7.99	$ 71.91
	Media & Containers				
	Pine Bark	plant	10890	$ 0.50	$ 5,445.00
	Seed				
	23640	each	10890	$ 0.08	$ 871.20
	Transplant				
	Transplant Trays	each	55	$ 1.55	$ 85.25
	Germ Mix	bag	6	$ 15.60	$ 93.60
	Other				
	String	plant	10890	$ 0.02	$ 217.80
	Analytical Services& Repairs		1	$ 150.00	$ 150.00
	Other		1	$ 100.00	$ 100.00
Total Materials					**$ 14,794.77**
Energy					
	Electricity	kwh	1560	$ 0.11	$ 171.60
	LP Gas	gal	0	$ 1.55	$ -
Total Energy					**$ 171.60**

Table 5. Cash flow analysis.

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Beginning Cash Balance			$ (12,050.58)	$ (6,151.05)	$ (346.66)	$ 679.44	$ 7,996.00	$ (8,069.10)	$ (461.80)	$ (18,403.75)
Cash Inflows (Income):										
	Cash Receipts		$ 55,103.40	$ 56,756.50	$ 58,459.20	$ 60,212.97	$ 62,019.36	$ 63,879.94	$ 65,796.34	$ 422,227.72
	Financing	$ 48,202.32								$ 48,202.32
	Total Cash Inflows	$ 48,202.32	$ 55,103.40	$ 56,756.50	$ 58,459.20	$ 60,212.97	$ 62,019.36	$ 63,879.94	$ 65,796.34	$ 470,430.04
Available Cash Balance		$ 48,202.32	$ 43,052.82	$ 50,605.45	$ 58,112.53	$ 60,892.41	$ 70,015.36	$ 55,810.85	$ 65,334.54	
Cash Outflows (Expenses):										
	Production Cost Direct		$ 20,416.37	$ 21,028.86	$ 21,659.73	$ 22,309.52	$ 22,978.80	$ 23,668.17	$ 24,378.21	
	Harvest & Hauling		$ 7,766.40	$ 7,999.39	$ 8,239.37	$ 8,486.55	$ 8,741.15	$ 9,003.39	$ 9,273.49	
	Packing & Marketing		$ 7,274.52	$ 7,492.76	$ 7,717.54	$ 7,949.06	$ 8,187.54	$ 8,433.16	$ 8,686.16	
	Subtotal	$ -	$ 35,457.29	$ 36,521.01	$ 37,616.64	$ 38,745.14	$ 39,907.49	$ 41,104.72	$ 42,337.86	
Other Cash Outflows										
	Capital Investment	$ 60,252.90								$ 60,252.90
	Loan Payment Cap. Inv.		$ 9,382.24	$ 9,382.24	$ 9,382.24	$ 9,382.24	$ 9,382.24	$ 9,382.24	$ 9,382.24	$ 65,675.66
	Durable goods cost				$ 5,772.89		$ 23,882.62		$ 6,893.13	$ 36,548.64
	Taxes & Insurance		$ 818.61	$ 843.17	$ 868.47	$ 894.52	$ 921.36	$ 949.00	$ 977.47	$ 6,272.60
	Overhead		$ 3,545.73	$ 3,652.10	$ 3,761.66	$ 3,874.51	$ 3,990.75	$ 4,110.47	$ 4,233.79	$ 27,169.01
	Interest on Addit. Cap.			$ 553.59	$ 31.20			$ 726.22	$ 41.56	$ 1,352.57
	Subtotal	$ 60,252.90	$ 13,746.58	$ 14,431.11	$ 19,816.46	$ 14,151.27	$ 38,176.97	$ 15,167.93	$ 21,528.18	$ 197,271.39
	Total Cash Outflows	$ 60,252.90	$ 49,203.87	$ 50,952.11	$ 57,433.10	$ 52,896.41	$ 78,084.46	$ 56,272.64	$ 63,866.04	$ 468,961.54
Ending Cash Balance		$ (12,050.58)	$ (6,151.05)	$ (346.66)	$ 679.44	$ 7,996.00	$ (8,069.10)	$ (461.80)	$ 1,468.50	

	Assumptions	
	Loan Rate =	9%
	Price Inflation Factor	1.03
	Cost Inflation Factor	1.03
	Loan Period years =	7



operation is able to repay expenses related directly to production of the crop. This is important for the short term viability of the operation. Net return falls short of total cost [gross return – total cost] by $5,700. This demonstrates that gross revenue does not meet total costs each year. A large variety of options are at the disposal of the owner to decrease this loss and better meet total costs. These alternatives include: receiving higher prices through marketing and branding practices, obtaining long-term loans at a lower rate than 10%, and lowering variable costs through efficient practices. For a further analysis of the long-term viability of the operation, a cash flow assessment should be regarded.

Cash flow

The cash flow analysis (Table 5) was generated over an 8-year cycle to reconcile the cash flows past the term of the loan (7 years). Revenue is based on the assumptions made in the enterprise budget, which is based on production of 4,356 boxes of fruit sold at $12.65/box. Sales price of green bell pepper is assumed to rise over the 10-year period at a rate of 3% per year with costs rising at the same rate annually. A large amount of the labor cost in the budget is opportunity cost, therefore most labor expense is considered a non-cash cost. Thus, cash costs are total variable cost from the enterprise budget minus unpaid family labor, where unpaid family labor equals one-half pre-harvest labor plus one-half harvest and hauling plus all cleanout labor. Packing labor is included as a cost in the cash flow budget because it is assumed that packing is priced per box rather than per hour. A 7-year loan of $48,202, representing 80% of equipment and durable goods costs, is assumed. The cash flow budget indicates that, for this set of production conditions and in this marketing climate, additional annual cash infusions (operating loans) from financing would be required to sustain the enterprise for the first year of production. The projected cash flow will become positive after the first growing season. In the fourth year, a profit of $679 would be realized. The enterprise is expected to realize a negative cash flow of ($16,065) in year 6 due to the replacement of the shade cloth and other durable goods. Replacement of durable goods accounts for additional expenses at years 4, 6, and 8. Durable goods replacement would continue to be a significant drain on cash flow in the outlying years, but overall a profitable enterprise is still achieved. A positive ending cash balance can be used to reinvest in the operation, pay off additional long-term debt, and paying ownership. This is important because the ending cash balance is the only cash income provided for family/owner labor.

Conclusion

Overall the economic sustainability of bell peppers under shade structures is profitable, but with very tight margins when produced and sold as a commodity. The enterprise budget demonstrates that returns are very sensitive to both yield and price. The risk associated with this sensitivity can be mitigated through marketing to add additional value, resulting in higher gross returns. This need for additional marketing and value is the reason this growing system seems ideal for small or medium size farming operations that can capture more value within the

marketing chain. This can be done through direct marketing, additional processing, and branding. With as little as 20% higher prices (i.e., $15.18/ box), the enterprise of bell pepper production under shade structures seems both profitable and more appealing to risk-adverse producers.

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