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CBD HEMP PRODUCTION COSTS AND RETURNS FOR CONNECTICUT FARMERS IN 2020

Jeremy Jelliffe, Rigoberto A. Lopez, and Shuresh Ghimire

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About the Authors

All the authors are from the College of Agriculture, Health and Natural Resources at the University of Connecticut:

Jeremy Jelliffe is a Ph.D. Candidate in the Department of Agricultural and Resource Economics.

Rigoberto A. Lopez is the Richard DelFavero Professor of Agricultural and Resource Economics and coeditor of *Agribusiness: An International Journal*.

Shuresh Ghimire is an Assistant Extension Educator, Vegetable Specialist, based at the Tolland County Extension Office, Department of Extension.

For further information, contact Rigoberto.Lopez@uconn.edu

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EXECUTIVE SUMMARY

Introduction

Since its approval in the 2014 Federal Farm Bill under a pilot program, production of industrial hemp, particularly for cannabinoid (CBD) products, has skyrocketed. This trend has been largely driven by the potential for large profits from burgeoning consumer demand for CBD products. In Connecticut, hemp cultivation became legal for growers licensed by the Connecticut Department of Agriculture in May 2019. However, farmers need information on potential revenues, costs, and risks of producing hemp for CBD purposes to guide their investment decisions. This reports aims to provide such information for the first time to current and potential Connecticut farmers for 2020, the second year of hemp cultivation.

Methodology

Given the lack of historical data on production of CBD hemp in Connecticut, since summer 2019 was the first season, this study employed two complementary methods: (1) economic engineering by simulating the best practices involved in the farm production process for CBD hemp to estimate cost and revenues based on likely outputs and market prices; and (2) interviews with farmers in Connecticut, Massachusetts, and New York, as well as with experts in these states to validate assumptions and estimates. One key assumption is that markets work smoothly both on the input supply and the buyer sides, either of which could significantly constrain production or sale of the crop. Other technical details are found in the technical report.

Main Findings

For a representative farm of 10 acres that obtains 2,000 pounds of dry flowers with 9% CBD, as shown in Table 2, this study finds that for 2020 growing season:

- The total cost per acre is $19,189 or $9.59 per pound of dried hemp flower. About two-thirds of the total cost per acre ($12,619) is variable, meaning that it changes with the level of production, and one-third of it ($6,570) is fixed.
- At the prevailing local price of $1.25 and 9% CBD, total revenues are $22,500 per acre, leading to $9,881 in profits per acre, or $3,311 per acre net return over variable costs.
- Future profitability of CBD hemp production will on individual technical abilities of farmers (dry flower yield and CBD content of crop) as well as external market forces, predominately CBD prices.

Conclusion

Even though Connecticut is a late entrant in the CBD hemp production in farms, the crop is estimated to continue to be profitable in 2020, albeit not at levels discussed in policy circles which focused more on optimistic historical sales in other states. Because CBD hemp prices continue to decline as many states are rapidly expanding production and there is a possible further threat from CBD imports, policy challenges remain to ensure the long-term profitability and economic viability of CBD hemp production in Connecticut.

INTRODUCTION

Hemp cultivation is permitted in the 2014 federal Farm Bill under a pilot program allowing states to regulate production. Because hemp cultivation had been illegal for decades, there are limited resources available for prospective and current growers (Nemo 2019). As producers learn by doing, new information has become available to provide benchmarks for hemp operations. In this report, a representative enterprise budget is presented for high-value hemp production for cannabidiol (CBD) extraction. The information contained in in this report is based on consultation with agronomists, growers, and other industry experts.

We present costs of growing hemp in Connecticut for the CBD extraction industry. The budgets include additional columns labeled "Your Cost" for users to insert their own values in the tables. This design allows for current or prospective growers to compare their costs and returns against the representative budget.

We consider a *representative* farm that follows a set of general practices and techniques to produce hemp for CBD in Connecticut. The next section describes in detail the construction of the representative farm and the assumptions used to generate the enterprise budgets.

ASSUMPTIONS

Construction of the budgets presented in Tables 1–6 relies on the set of assumptions described in this section. Such assumptions are typical for cost-of-production and enterprise budgets, adapted from materials provided by extension services across several states (Hanchar 2019; Kime 2019; Shepard and Mark 2019a; 2019b; Cui and Smith 2019; Bolda et al. 2019). It is important to note that the values presented in this document are preliminary and serve as a guide for current and prospective growers. The use of conventional agricultural practices is seen as a first step in providing materials to growers, bearing in mind that additional materials under alternative technologies may be released in the future. Trade names and cultural practices used in this document do not constitute an endorsement or recommendation by the University of Connecticut, nor is criticism implied by omission of other similar items.

Based on conversations with growers, CBD hemp represents nearly 100% of total hemp acreage in Connecticut as of 2019. Cultural practices for CBD compared to grain or fiber hemp vary considerably, with some similarities found in pre-planting field preparation and post-harvest fieldwork.

Farm. The *representative* farm described in this study comprises 12 acres, of which 10 acres are planted with a single variety of CBD hemp at 5' plant by 6' row spacing, and 2 acres of land are used for roads and on-farm buildings. Hemp cultivation is done on well-drained land composed of loam to loamy clay soils with >3% organic matter, low sodium (Na) and magnesium (Mg), and Cation Exchange Capacity (CEC) from 12 to 20 (Smart and Ullrich 2019). Farming on other soil types and on compacted or poorly drained land may result in different costs.

PRODUCTION PRACTICES AND MATERIAL INPUTS

Connecticut hemp production is characterized by learning by doing, with first generation growers implementing alternative management practices to figure out what works best for their operation. Labeling restrictions have historically limited the use of pesticides and herbicides for hemp production, but recent changes in these guidelines have allowed for expanded use in the 2020 season. Based on conversations with experts and growers, we outline the general set of inputs and practices for hemp cultivation in the state.

Seedlings. CBD hemp is produced from transplanted seedlings grown in a greenhouse either on-farm or purchased from a specialty grower. We assume that the market price for purchased seedlings will decrease as the industry grows, with per plant prices currently estimated at $4, though availability is limited and most growers produce their own seedlings on-farm. In this study, a 30'x 60' heated greenhouse is used to produce seedlings for transplant. Certified feminized seed is planted in a growing medium in seedling trays. With a 5'x 6' spacing, a total of 1,452 seedlings are planted per acre, with and an additional 7% needed for replacement transplants, resulting in a total of 15,536 seedlings produced. The germination rate is assumed to be 92%, so 16,887 seeds are required to generate 15,536 seedlings. Seedlings are planted four to five weeks in advance of the transplanting date.

Land Preparation. A cover crop is planted on the 10-acre plot at the end of the previous growing season. Two soil samples are collected to test for pesticide residues and heavy metals, and to determine soil amendments and fertilization levels. Lime is applied to adjust the soil pH to around 6.5 to 15 PPM phosphorus (P), based on a modified Morgan test; potassium (K) within a range of 158-235 PPM; and Sulphur (S) availability to 10N:1S (Smart and Ullrich 2019). Recommended fertilizer rates can be found on test results from the UConn soil lab (www.soiltest.uconn.edu). The cover crop and soil amendments are disked twice, one to three weeks prior to planting. Rows are chisel plowed at a depth of 15" up to a week before planting. It is assumed that a well is included in the land rental and that the grower is responsible for installation and maintenance of pumps and irrigation lines. Single line drip tape is installed in each row to accommodate the 5' plant spacing. In areas of poor drainage, growers are advised to form raised beds to improve drainage. Plastic mulch is applied over the rows to control weed pressure and conserve soil moisture.

Transplanting. The ground is pre-irrigated before planting based on soil moisture content and weather conditions. A tractor-mounted transplanter makes holes in the plastic mulch and seedlings are inserted at 5' intervals. This activity requires three persons: a tractor operator, a transplanter operator, and one on the ground. The planting rate is one acre per hour. Replacement planting is done by hand over the course of the following month, for a total replanting rate of 7%.

Post-Planting Irrigation. Intensive irrigation is used during the month following transplanting; taking weather conditions into account, water is applied every other day. It is assumed that the water supply is adequate through the full growing season. Drip tape can be removed after plants are well established, about a month after transplanting.

Post-Planting Fertilization. This study assumes that fertilizer is applied throughout the growing season as needed. The budget includes 50 lb of nitrogen (N) applied by a custom operator.

Roguing. Male and hermaphroditic plants must be removed from the field prior to the release of pollen. It is possible to detect male flowers beginning at the pre-flower stage around the first week of August (<14 hours of daylight) for photoperiod sensitive cultivars. Careful examination of the entire 10-acre plot is done at a rate of three acres/hr and must be done every three to four days (~9x) during the month following pre-flower formation. For feminized seed, about 0.03% of plants produce male flowers; on average four to five male plants are expected on a 10-acre plot.

Pest Management. General guidelines for integrated pest management are available through UConn Extension (www.ipm.uconn.edu). As experts familiarize themselves with hemp-specific pest problems, additional information will be made available to growers.

Weeds. Pre-planting field preparation, disking, and the use of plastic mulch greatly reduce weed pressure in the field. It is recommended that a cover crop be maintained in the alleys between planting rows, which should be mowed on regular basis, as needed.

Vertebrates. Traps and fencing are used to control for vertebrates, such as deer, groundhogs, mice, moles, voles, and rats. An electric fence can be used to effectively control deer pressure. Signage and surveillance are recommended to minimize human trespassing.

Insects and mites. Control of damage is most important at early stages of plant establishment. Common insects include aphids, corn ear worm, European corn borer, Japanese beetle, spotted cucumber beetle (aka Southern corn root worm), tarnished plant bugs, and Western black flea beetle (Chartrand 2018). Insecticide may be used to control disease pressure as needed.

Diseases. Pathogenic soil microbes can be detrimental to plant establishment and development, and include the oomycete *Pythium* (seed rot and wilting) and fungal genera *Fusarium* (seed rot, wilting, and bud blight), and *Rhyizoctonia* (seed rot). *Sclerotinia sclerotiorum* (white mold), powdery mildew, and Botrytis (gray mold) negatively impact plant health and are most problematic in environments with poor air flow and high humidity (Bergstrom et al. 2019). A variety of leaf spots have been observed in hemp. including the following fungal genera: *Bipolaris, Boeremia (Phoma), Cercospora, Colletotrichum, Cristulariella, Leptosphaerulina, Phaeomycocentropora, Septoria,* and *Stagonospora* (Bergstrom et al. 2019). Fungicide is used to control disease pressure as needed.

Harvest. Timing of harvest is based on plant maturity, which is reached in early fall with particular attention to in-field mold formation, CBD, and d9-THC levels. The entire harvest process is completed over a two to three-week period and requires significant labor inputs. The duration of this period may lengthen significantly if additional labor is not available for removing flowers from dried plants, which is the most labor-intensive activity of the production cycle. Mechanization of the debudding process may become necessary as farm size increases because of limited availability of temporary labor.

Pre-Harvest Testing. Guidelines for required pre-harvest testing are available through the Connecticut Department of Agriculture (www.portal.ct.gov/DOAG). For the 10-acre single-variety plot, the regulation requires a 29-plant sample collected by a federal, state, local, or tribal law enforcement agency or another federal-, state-, or tribal-designated person. The entire crop

must be harvested within 15 days of the sampling date. Samples may be taken leading up to the official pre-harvest sample to assess CBD and d9-THC concentration. This study assumes that two to three samples are taken prior to official pre-harvest sampling.

Chopping. Hand harvesting is done by a team of 10 persons who chop and load plants onto a trailer for transportation to the drying facility. The 10-person team harvests the crop at a rate of five hrs/acre.

Drying. Plants are unloaded from trailers and dried in a leased indoor facility. We assume it takes five hours for a team of 10 persons to move plants from one acre into the drying facility. The facility is equipped with fans, dehumidification, and a heat source to maintain a drying humidity <60% at ~10°F above ambient temperature, not to exceed 80°F. Plants are dried to 8% moisture content over a period of 3 to 14 days (Darby 2019).

Debudding. Dried flower is removed at a rate of 175 hrs/acre planted. Final product is packed in plastic bags inside corrugated boxes that are palatized and wrapped for transportation.

Transportation. A box truck is rented to transport the final product to the buyer (e.g., processor).

Post-Harvest Cleanup. Plastic is removed from the fields at a rate of three hrs/acre. A custom operator is hired to plant a cover crop of winter rye. Non-flower plant debris are composted.

Yields. Average harvest is 2,000 pounds per acre of dried flower at 8% moisture content with 9% CBD content on a dry weight basis.

Returns. This study assumes an average price per pound of dried flower at $1.25 for each percentage point of CBD ($ / % CBD / lb).

Sales & Marketing. Marketing costs are estimated at 5% of gross revenue.

LABOR, EQUIPMENT, AND INTEREST

Labor. This study assumes temporary seasonal labor is available throughout the growing season. The wage rate is $13.00/hr for unskilled and $16.50/hr for skilled workers (USDA NASS 2019). Payroll overhead of 33% is added to the wage rate, such that labor expense is calculated as $17.29/hr for unskilled and $21.95/hr for skilled workers.

Interest on Operating Capital. This study uses an interest rate of 6.50% (Bolda et al. 2019).

Equipment Operating Costs. Fuel, lubrication, maintenance, and repairs are included in the budget for all machinery and equipment listed in Table 7. Red diesel fuel is purchased for on-farm equipment (e.g., tractors).

Pickup Truck. A company pickup truck is used for farm activities and is included in the budget.

Risk. The risk associated with hemp production is high due to factors related to production, environment, regulation, and markets. Crop insurance is available to hemp growers to mitigate some of the production and environmental risk. Regulatory risk stems primarily from potential shifts in the regulatory and legal frameworks guiding hemp production as well as the requirement of less than 0.3% d9-THC on a dry weight basis, which has become an important issue faced by early growers. If pre-harvest testing indicates a non-compliant crop, the farm faces a total loss as well as the additional cost of disposal services approved under current guidelines. Market risk associated with increased supply of CBD hemp from expanded production is likely to result in declining prices if demand does not increase accordingly (Sterns 2019). Yield, quality, and price variation are addressed in Tables 3 through 6.

CASH OVERHEAD

Property Taxes. This study assumes that property taxes are paid by the landlord and included in the rental rate. Differential tax assessment for agricultural land based on use value is allowed under Connecticut Public Act 490.

Insurance. Property and liability insurance are available to the farm and estimated based on average values for field crop production (USDA NASS 2019).

Office Expenses. Administration and office supplies, bookkeeping, accounting, utilities, and other miscellaneous expenses are included at an annual rate of $750 per acre (Bolda et al. 2019).

Land Rent. The land is leased at an annual rate of $167 per acre (USDA NASS 2019).

Connecticut Department of Consumer Protection Licensing and Fees. Growers pay a one-time $50 application fee and a licensing fee of $50 per acre every two years ($25/acre/year).

Connecticut Department of Agriculture Regulatory Requirements. Official pre-harvest testing is done at a rate of $151/hr and a testing fee of $95 by the UConn Center for Environmental Sciences and Engineering laboratory, Storrs, CT, which reports results directly to CT DoAG. If a second test is required, $50 is paid to CT DoAG in addition to the aforementioned testing costs.

Field Sanitation. A sanitation services company provides on farm portable toilets and washing stations. The cost includes two single units with nine months of servicing.

Farm Supervisor. Management of on-farm operations is done by a hired supervisor at a rate of $40,000 per year.

NON-CASH OVERHEAD

Capital Recovery Costs. Annual depreciation and interest expenses for equipment and other farm investments are calculated according to the following equation: ((Purchase Price – Salvage Value) x (Capital Recovery Factor)) + (Salvage Value x Interest Rate), where the Capital Recovery Factor

is taken from an amortization table value that corresponds to the effective interest rate; the salvage value is the remaining value of equipment at the end of its useful life, which is calculated using methods outlined by the American Society of Agricultural and Biological Engineers; and an interest rate of 6.50% is used to calculate capital recovery (Boehlje and Eidman 1984; AAEA 2000; Bolda et al. 2019).

Buildings. An 1,800 sq. ft. greenhouse and a 1,200 sq. ft. metal equipment shed are maintained.

Fuel Tank. A pickup truck-mounted 5-gallon fuel tank is used to deliver fuel to farm equipment.

Tools. This includes a general set of tools used on the farm for equipment maintenance and repair, and in the field during cultivation, harvest, and processing. The total value is estimated and does not reflect any specific inventory.

Irrigation System. An in-ground well maintained by the land owner is assumed to be included in the land rental cost. The grower is responsible for irrigation equipment, piping components, and drip tape to cover the 10-acres.

Equipment. Farm equipment is valued at 70% of the purchase price for new equipment to reflect a combination of used and new items. Table 7 includes annual ownership costs for equipment and other capital investments. These include operational costs, such as repairs, fuel, and lubrication, as well as overhead described in previous sections.

Table Values. Rounding may produce different totals than the sum of the rows.

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TABLE 1. CBD HEMP PRODUCTION COST PER ACRE IN CONNECTICUT

	Operation	Cash and Labor Costs Per Acre						
	Time (Hrs/A)	Labor Cost	Fuel	Lube & Repairs	Material Cost	Custom/ Rental	Total Cost	*Your Cost*
PRODUCTION COSTS								
SEEDLINGS:								
Potting medium (20 cu ft)	0	0	0	0	12.5	0	13	
Seed	1	17.29	0	0	1,678	0	1,695	
Fertilize (20-20-20)	0.1	1.73	0	0	1.5	0	3	
Heat and Electric	0	0	0	0	68.7	0	69	
Monitor seedlings	4	69.16	0	0	0	0	69	
Remove trays	0.2	3.46	0	0	0	0	3	
TOTAL SEEDLING COSTS							1,852	
CULTURAL:								
Cover Crop (1 per 2 crops)	0	0.00	0	0	0	75	75	
Soil Samples (2 per 10 acres)	0	0.00	0	0	0	84.8	85	
Disk 3X	0.84	14.52	13	5	0	0	33	
Chisel 2X	0.7	12.10	9	4	0	0	25	
Compost + Spread	0	0.00	0	0	125	50	175	
Pre-plant Fertilizer & Lime	0	0.00	0	0	155	30	185	
Install Drip System, Tape	3	51.87	33	17	1,525	0	1,627	
Plant: Lay Mulch	1.5	25.94	17	7	363	0	413	
Transplanting	0.75	12.97	8	3	0	0	24	
Replanting (7%)	3.25	56.19	0	0		0	56	
Irrigation	0	0.00	0	0	125	0	125	
Roguing	3	51.87	0	0	0	0	52	
Weeding (Cultivate/Mow)	1.5	25.94	22	12	0	0	60	
Fertilization (N 50 lb/ac)	0.75	12.97	12	5	23	0	53	
Vertebrate Trapping	1.5	25.94	0	0	0	0	26	
Spraying (disease/pests)	1.37	23.69	20	9	377	0	430	
Post-Harvest Cleanup	3	51.87	19	10	18	0	99	
Pickup: Business Use	1.71	29.57	15	6	0	0	51	
Testing (2x)	0.2	3.46	0	0	0	18	21	
TOTAL CULTURAL COSTS							3,614	
HARVEST:								
Official Testing	0.1	1.73	0	0	0	24	26	
Chop, Load & Haul	50	864.50	33	17	15	0	930	
Drying - Unload and Hang	50	864.50	0	75	50	0	990	
Debudding	175	3025.75	0	0	0	0	3,026	
Packaging	0.5	8.65	0	0	215	0	224	
Transportation	0.2	3.46	10	0	0	50	63	
Sales / Marketing	0	0.00	0	0	1,125	0	1,125	
TOTAL HARVEST COSTS							6,383	
Interest on Operating Capital							770	
TOTAL OPERATING COSTS							12,619	

TABLE 1 CONT'D. CBD HEMP PRODUCTION COST PER ACRE IN CONNECTICUT

	Operation	Cash and Labor Costs Per Acre						
	Time (Hrs/A)	Labor Cost	Fuel	Lube & Repairs	Material Cost	Custom/ Rental	Total Cost	*Your Cost*
CASH OVERHEAD:								
Office Expense							750	
Land Rent							167	
Liability Insurance							21	
Sanitation Fee							80	
Regulatory Programs							25	
Farm Supervisor							1,250	
Drying Facility Rent							2,000	
Investment Repairs							60	
TOTAL CASH OVERHEAD COSTS							4,353	
TOTAL CASH COSTS							16,972	
NON-CASH OVERHEAD:								
Greenhouse 30'x 60'							260	
Buildings 1,200 sq ft							195	
Fuel Tanks 1-50 gal							20	
Harvest Trailers 2-20'							7	
75 hp Pump and Filter							330	
Sprinkler Pipe							14	
Lateral Lines							16	
Miscellaneous Tools							30	
Equipment							1,345	
TOTAL NON-CASH COSTS							2,217	
TOTAL COSTS							19,189	

TABLE 2. SUMMARY OF CBD HEMP PRODUCTION COST AND RETURNS

Budget Items	**Value**
	--- $ per Acre ---
Value of Production	
Dry Hemp Flower ($1.25 / % CBD / lb)[1]	22,500
Costs of Production	
Variable Inputs	
Fertilizer & Lime	210
Seeds	1,678
Other Crop Inputs: Irrigation, Mulch, Spray, Custom, Etc.	4,321
Labor	5,259
Repair & Maintenance	170
Fuel	211
Interest on Operating Capital	776
Variable Costs Total	**12,619**
Fixed Inputs	
Buildings & Equipment	2,357
Land Charge	167
Drying Facility	2,000
Value of Operator Management	1,250
Administrative & Regulatory Expense	796
Fixed Costs Total	**6,570**
Total Costs	**19,189**
Net Returns	
Returns above Variable Costs	9,881
Returns above Total Costs	**3,311**

Note: [1]Yield assumed at 2,000 lb/acre and 9% CBD on a dry weight basis.

TABLE 3. CBD HEMP PRODUCTION COSTS AND RETURNS: SENSITIVITY TO YIELD

	YIELD (LB/ACRE)					
	500	1000	1,500	2,000	2,500	3,000
TOTAL VALUE OF PRODUCTION						
Dried Hemp Flower (9% CBD)	56,250	112,500	168,750	225,000	281,250	337,500
COST OF PRODUCTION/LB:						
VARIABLE COSTS/LB	25.24	12.62	8.41	6.31	5.05	4.21
FIXED COSTS/LB	13.14	6.57	4.38	3.29	2.63	2.19
TOTAL COST/LB	38.38	19.19	12.79	9.59	7.68	6.40
TOTAL COST OF PRODUCTION	191,891	191,891	191,891	191,891	191,891	191,891
NET RETURNS OVER VARIABLE COSTS	(69,937)	(13,687)	42,563	98,813	155,063	211,313
NET RETURNS OVER TOTAL COSTS	(135,641)	(79,391)	(23,141)	33,109	89,359	145,609

TABLE 4. SENSITIVITY ANALYSIS OF NET RETURNS WITH RESPECT TO YIELD AND PRICE OF HEMP AT 9% CBD CONTENT

Net Returns per Acre above **Operating Costs**

PRICE ($/ % /LB)	YIELD (LB/ACRE)					
CBD HEMP	500	1000	1500	2000	2500	3000
$0.50	($10,369)	($8,119)	($5,869)	($3,619)	($1,369)	$881
$1.00	($8,119)	($3,619)	$881	$5,381	$9,881	$14,381
$1.50	($5,869)	$881	$7,631	$14,381	$21,131	$27,881
$2.00	($3,619)	$5,381	$14,381	$23,381	$32,381	$41,381
$2.50	($1,369)	$9,881	$21,131	$32,381	$43,631	$54,881

Net Return per Acre above **Cash Costs**

PRICE ($/ % /LB)	YIELD (LB/ACRE)					
CBD HEMP	500	1000	1500	2000	2500	3000
$0.50	($14,722)	($12,472)	($10,222)	($7,972)	($5,722)	($3,472)
$1.00	($12,472)	($7,972)	($3,472)	$1,028	$5,528	$10,028
$1.50	($10,222)	($3,472)	$3,278	$10,028	$16,778	$23,528
$2.00	($7,972)	$1,028	$10,028	$19,028	$28,028	$37,028
$2.50	($5,722)	$5,528	$16,778	$28,028	$39,278	$50,528

Net Return per Acre above **Total Costs**

PRICE ($/ % /LB)	YIELD (LB/ACRE)					
CBD HEMP	500	1000	1500	2000	2500	3000
$0.50	($16,939)	($14,689)	($12,439)	($10,189)	($7,939)	($5,689)
$1.00	($14,689)	($10,189)	($5,689)	($1,189)	$3,311	$7,811
$1.50	($12,439)	($5,689)	$1,061	$7,811	$14,561	$21,311
$2.00	($10,189)	($1,189)	$7,811	$16,811	$25,811	$34,811
$2.50	($7,939)	$3,311	$14,561	$25,811	$37,061	$48,311

TABLE 5. SENSITIVITY ANALYSIS OF NET RETURNS WITH RESPECT TO YIELD AND QUALITY OF HEMP FOR A PRICE OF $1.25 / % CBD / LB

Net Return per Acre above **Operating Costs**

QUALITY (%)	YIELD (LB/ACRE)					
CBD HEMP	500	1000	1500	2000	2500	3000
4%	($10,119)	($7,619)	($5,119)	($2,619)	($119)	$2,381
6%	($8,869)	($5,119)	($1,369)	$2,381	$6,131	$9,881
8%	($7,619)	($2,619)	$2,381	$7,381	$12,381	$17,381
10%	($6,369)	($119)	$6,131	$12,381	$18,631	$24,881
12%	($5,119)	$2,381	$9,881	$17,381	$24,881	$32,381

Net Return per Acre above **Cash Costs** for Hemp

QUALITY (%)	YIELD (LB/ACRE)					
CBD HEMP	500	1000	1500	2000	2500	3000
4%	($14,472)	($11,972)	($9,472)	($6,972)	($4,472)	($1,972)
6%	($13,222)	($9,472)	($5,722)	($1,972)	$1,778	$5,528
8%	($11,972)	($6,972)	($1,972)	$3,028	$8,028	$13,028
10%	($10,722)	($4,472)	$1,778	$8,028	$14,278	$20,528
12%	($9,472)	($1,972)	$5,528	$13,028	$20,528	$28,028

Net Return per Acre above **Total Costs** for Hemp

QUALITY (%)	YIELD (LB/ACRE)					
CBD HEMP	500	1000	1500	2000	2500	3000
4%	($16,689)	($14,189)	($11,689)	($9,189)	($6,689)	($4,189)
6%	($15,439)	($11,689)	($7,939)	($4,189)	($439)	$3,311
8%	($14,189)	($9,189)	($4,189)	$811	$5,811	$10,811
10%	($12,939)	($6,689)	($439)	$5,811	$12,061	$18,311
12%	($11,689)	($4,189)	$3,311	$10,811	$18,311	$25,811

TABLE 6. SENSIVITY ANALYSIS OF NET RETURNS WITH RESPECT TO QUALITY AND PRICE VARIATION FOR A YIELD OF 2,000 LB/ACRE

Net Returns per Acre above **Operating Costs**

PRICE ($/ % /LB)	QUALITY (% / LB)					
CBD HEMP	4%	6%	8%	10%	12%	14%
$0.50	($8,619)	($6,619)	($4,619)	($2,619)	($619)	$1,381
$1.00	($4,619)	($619)	$3,381	$7,381	$11,381	$15,381
$1.50	($619)	$5,381	$11,381	$17,381	$23,381	$29,381
$2.00	$3,381	$11,381	$19,381	$27,381	$35,381	$43,381
$2.50	$7,381	$17,381	$27,381	$37,381	$47,381	$57,381

Net Returns per Acre above **Cash Costs**

PRICE ($/ % /LB)	QUALITY (% / LB)					
CBD HEMP	4%	6%	8%	10%	12%	14%
$0.50	($12,972)	($10,972)	($8,972)	($6,972)	($4,972)	($2,972)
$1.00	($8,972)	($4,972)	($972)	$3,028	$7,028	$11,028
$1.50	($4,972)	$1,028	$7,028	$13,028	$19,028	$25,028
$2.00	($972)	$7,028	$15,028	$23,028	$31,028	$39,028
$2.50	$3,028	$13,028	$23,028	$33,028	$43,028	$53,028

Net Returns per Acre above **Total Costs**

PRICE ($/ % /LB)	QUALITY (% / LB)					
CBD HEMP	4%	6%	8%	10%	12%	14%
$0.50	($15,189)	($13,189)	($11,189)	($9,189)	($7,189)	($5,189)
$1.00	($11,189)	($7,189)	($3,189)	$811	$4,811	$8,811
$1.50	($7,189)	($1,189)	$4,811	$10,811	$16,811	$22,811
$2.00	($3,189)	$4,811	$12,811	$20,811	$28,811	$36,811
$2.50	$811	$10,811	$20,811	$30,811	$40,811	$50,811

TABLE 7. FARM EQUIPMENT INVESTMENT AND OVERHEAD COSTS PER YEAR

ANNUAL EQUIPMENT COSTS

Yr.	Description	Price	Yrs. Life	Salvage Value	Capital Recovery	Cash Overhead		Total
						Insurance	Taxes	
20	75HP 4WD Tractor	58,000	20	7,500	5,071	28	292	5,390
20	Disc-offset 14'	16,000	20	850	1,430	8	82	1,520
20	Chisel 12’	12,000	20	625	1,073	6	62	1,141
20	Lstr/Shpr 3-48”R	5,000	15	475	512	3	29	544
20	Mulch Mchne 1-48”R	3,000	20	150	268	1	15	285
20	Transplanter 1-48”R	5,000	20	250	447	2	26	476
20	Drip Mchne 1-48”R	8,700	15	825	891	5	51	947
20	Sprayer w/ 20’ boom	3,700	5	1,200	680	4	39	722
20	Utility Trailer 10ft	3,000	20	150	268	1	15	285
20	Mower 4’	3,500	20	175	313	2	18	333
20	Truck 1 Ton	55,000	8	19,200	7,128	39	410	7,577
	TOTAL	172,900		31,400	18,082	99	1,040	19,221
	70% of New Cost[2]	121,030		21,980	12,657	70	728	13,455

Note: [2]To reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

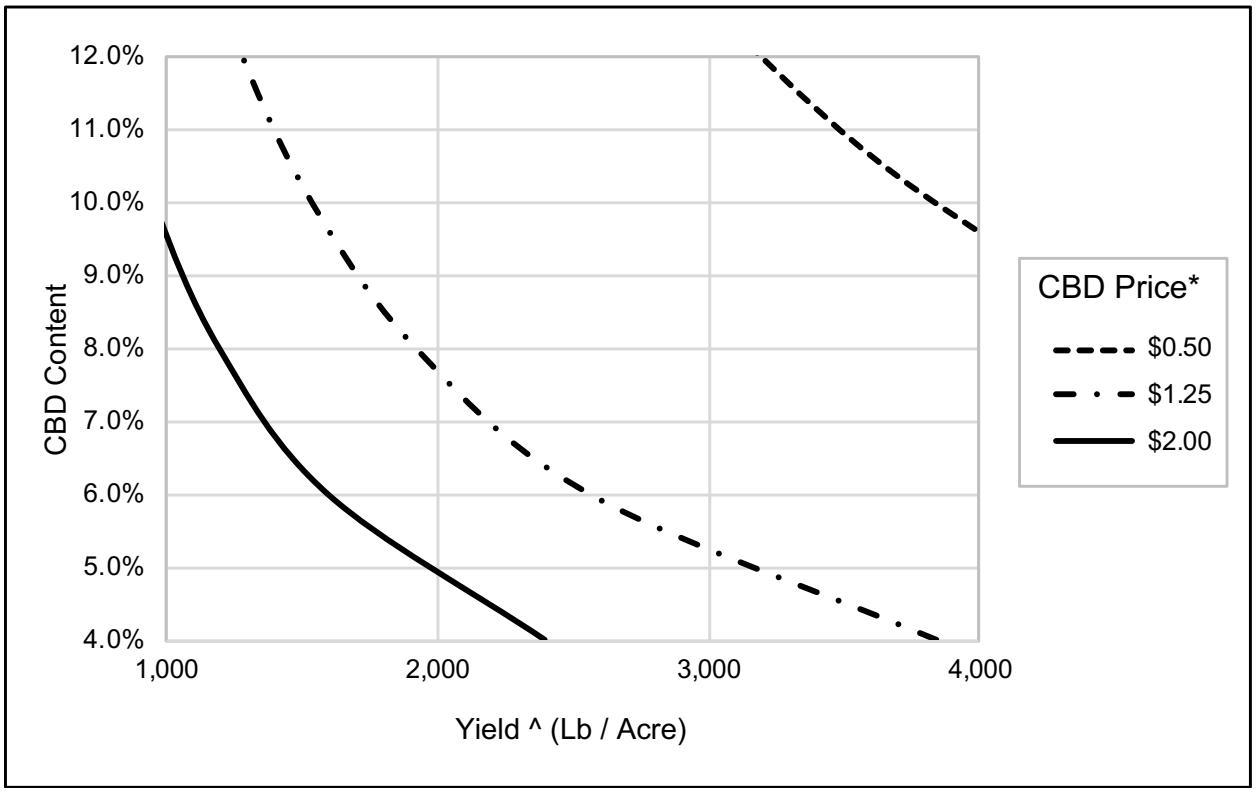
Description	Price	Yrs. Life	Salvage Value	Capital Recovery	Cash Overhead			Total
					Insurance	Taxes	Repairs	
Greenhouse[3] 30’x 60’	40,000	30	5,000	3,005	17	173	1,200	4,395
Buildings 1,200 sq ft	55,000	30	0	4,212	23	242	1,100	5,577
Electric fence	2,500	5	0	602	3	35	50	500
Fuel Tanks 1-50 gal	1,000	5	0	241	1	14	20	200
Harvest Trailers 2-20’	1,400	20	0	127	1	7	28	70
75 hp Pump and Filter	40,000	20	2,800	3,558	20	205	800	4,582
Sprinkler Pipe	13,500	15	6,700	1,159	6	67	270	1,502
Lateral Lines	8,000	5	0	1,925	11	111	160	2,206
Miscellaneous Tools	5,000	15	500	511	3	29	100	643
TOTAL INVESTMENT	166,400	145	15,000	15,339	84	882	3,728	19,675

Note: [3]Includes full greenhouse setup: site preparation, concrete slab, well and pump, galvanized house kit, door, plastic cover, tray tables/racks, irrigation system, seedling trays, heat source, electrical service, and installation. Repairs includes annual plastic replacement, 30% of trays replaced, and ordinary maintenance costs.

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Office Expense	10	acre	750	7,500
Land Rent	12	acre	167	2,004
Liability Insurance	12	acre	21	252
Sanitation Fee	10	acre	80	800
Regulatory Programs	10	acre	25	250
Farm Supervisor	10	acre	1,250	12,500
Drying Facility Rent	10	acre	1,000	10,000

FIGURE 1. BREAK-EVEN ANALYSIS: YIELD AND CBD CONTENT BY PRICE POINT



Note: The area to the right of the curve indicates a positive net return for the corresponding price; [4]Dry Flower at 8% moisture content, greater moisture content will reduce price for final product; [5]Pricing is in dollars per percentage point of CBD per pound of dry flower ($ / %CBD / lb). For example, at a price of $2.00, 100 lbs of 5% CBD flower is valued at $1,000.