Economic feasibility of producing olives for oil in the Sacramento Valley

by

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ABSTRACT

Extra virgin olive oil has become an important ingredient in the pantry of health-conscious consumers and foodies. This has increased the demand for olives that may be processed into extra virgin olive oil. There is, therefore, an opportunity to make investments in olive production to support this demand but it is important that it is assessed to be economically feasible. The purpose of this study is to determine the economic feasibility of high density olive orchard supplying processors of extra virgin olive oil in the Sacramento Valley. It also evaluated the sensitivity of this feasibility to oil prices, agronomic costs, and the debt-equity financing ratio.

The analysis utilized a combination of primary and secondary data from private farming enterprises and extension reports. In order to ensure a substantial cash flow and to provide sufficient time for the establishment of the orchard, the analyses were conducted over a period of ten years. Once in full production in Year 5, the average net profit for the base scenario was estimated at $1,243 per acre. In addition to the base scenario, the feasibility analyses were conducted under seven alternative scenarios focusing on different levels of oil prices, irrigation cost, pest management costs, and harvest costs as well as acreage and debt-equity financing ratio. The results were summarized using a matrix that showed the economic feasibility as measured by net present values under the different scenarios.

The results show that planting olives for extra virgin olive oil is economically feasible if the debt percentage to acreage ratio is kept below 0.15 to 0.20 percent when financing 40 percent or more of the operation. In the base scenario of the study, the net present value of the orchard was $150,648 at a discount rate of 5 percent and produced

$404,066 of net profit once full production was achieved in the fifth year. This study shows that the planting of olives for the production of extra virgin olive oil in the Sacramento Valley is economically feasible under certain production and market conditions. Under these feasible conditions, the results show that it can produce a substantial level of income for the owners.

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CHAPTER I: INTRODUCTION

The olive oil industry has experienced steady growth in recent years, both in domestic and international markets. The Sacramento Valley region in California has been identified as a suitable location for olive production due to its favorable climate and soil conditions. This has produced inherent opportunities for investors to consider developing olive orchards to support the olive oil production in the region. However, before investing in olive cultivation, it is necessary to evaluate the economic feasibility of producing olives for oil in this region. This research aims to explore the economics of olive production given the agronomic conditions in the Sacramento Valley.

Olive oil is considered one of the healthiest oils due to its high content of monounsaturated fatty acids and antioxidant compounds. The demand for olive oil has been increasing worldwide, particularly in the United States, which is the third-largest importer of olive oil after the European Union and Japan. California is the largest producer of olive oil in the United States, accounting for more than 99% of national production (USDA, 2022). Olives may be used for two main purposes: (i) Table olives, which are used as condiments and as ingredients in various dishes, such as pizza and salads; and (ii) Crushing olives, which are used to produce olive oil for the food, pharmaceutical, and cosmetic industries.

California has maintained between 30,000-40,000 bearing acres of olives since the 1980's with a vast majority of fruit being used for canning (USDA, 2023). However, from 2000 to 2015, the percentage of olives used for oil has increased from 4 percent to 15 percent (USDA, 2023). This was greatly fomented by the advent of high-density and super high-density orchard planting models which increased tree density from less than100 trees/acre to more than 600 trees/acre, producing higher yields and output and enabling more efficient, mechanical harvesting (Lazicki & Geisseler, 2016).

1.1 Research Questions and Objectives

The research was guided by two primary questions. First, is the production of olives for olive oil a feasible enterprise in the Sacramento Valley? Second, what financing structure will result in an acceptable economically feasible solution? These questions are important for two reasons:

(i) Agricultural land prices in California are probably one of the highest in the country. The most recent USDA farm real estate value by state shows that the average 2021 prices in California was above $8,400/acre (USDA, 2021). Since land is the largest investment cost for agricultural production, understanding the ability of the production to support the investment is critical.

(ii) There are numerous financing structures that may be employed for each situation to enhance the economic feasibility of an investment. Developing an appreciation of the alternatives could help an entrepreneur build the right relationships to position the project on a profitable and sustainable path.

Based on the foregoing questions, the overall objective of the research was to assess the economic feasibility of operating an olive orchard for oil production in the Sacramento Valley of California. The specific objectives are as follows:

1. Assess the financial benefits and cost of developing and operating an olive orchard for the production of olive oil.
2. Evaluate the effects of alternative oil prices on the economic feasibility of developing and operating an olive orchard for the production of olive oil.

3. Determine the impact of changes in input costs developing and operating an olive orchard for the production of olive oil. .
4. Determine the effects that alternative financing structures have on the economic feasibility of developing and operating an olive orchard for the production of olive oil.

1.2 Methods

This research used a mixed-methods approach, combining both qualitative and quantitative data collection and analyses. The primary data were collected through interviews with olive growers and industry experts. The secondary data were obtained from published reports, academic journals, government databases, and agricultural extension publications from institutions based in the Sacramento Valley. The economic feasibility of olive production was assessed using capital budgeting analysis. It employed the Net Present Value model. It also evaluated the base results under several price, cost, and financing scenarios to achieve the specified project objectives. These sensitivity analyses help to assess the robustness of the economic feasibility analysis.

1.3 Significance

This research will contribute to the understanding of the economic viability of olive production in the Sacramento Valley, providing insights for farmers, policymakers, and investors. The findings will also have broader implications for the agricultural industry in California and the United States, highlighting the potential for diversification and sustainability in the sector. Finally, this study will bridge the gap between academia and industry, fostering collaborations and knowledge-sharing for the benefit of all stakeholders.

CHAPTER II: LITERATURE REVIEW

2.1 Establishment and Cultural Practices

The majority of olive oil production in the Sacramento Valley over the past two decades has relied on super-high density plantings of olive trees. This density results in approximately 726 trees per acre with twelve feet between rows and five feet between trees (Danielle Lightle, 2016). This spacing can be increased or decreased by one to two feet depending on the cultural practices. Olive cultivars most commonly planted in the Sacramento Valley yield between 30 to 50 gallons of oil per ton of fruit and the generally accepted economic life of an olive tree is 25 years (Danielle Lightle, 2016). Water is delivered to the trees through a single or double-line drip irrigation system (Danielle Lightle, 2016). Depending on if the orchard is located within a water district and the strength of the water district, wells will need to be drilled to provide adequate water. Irrigation requirements and schedules will be discussed in a subsequent section.

In the same year as planting, the planting area is prepared by ripping down the tree rows at a depth of three feet to break up the compacted soil then disced twice to break up large clods. It is important to know that rows are oriented in a north to south pattern for optimal sunlight distribution. Berms are then pulled on the tree rows and the space between is disced and floated to allow vehicle access to the orchard for irrigation installation. Main, submain, lateral, and sublateral lines are installed below the ground with risers coming up from the sublateral lines at the end of each tree row. The addition of flush manifolds on the opposite end of the drip line to the riser adds cost but allows for entire sections of the irrigation system to be flushed as part of regular system maintenance. Once the system is fully connected, each zone/set is turned on to flush debris out of the underground lines then drip lines are stretched over the length of the tree rows and connected to the risers and flush manifolds. Each zone/set is tested again to ensure proper function and irrigate the ground before planting (Chavez, 2022).

In order to guarantee accurate and optimal orchard spacing, GPS is utilized to mark the position of each tree with a seven foot long by half inch bamboo pole. Trees are then planted on the leeward side of the bamboo pole from the prevailing wind. This practice ensures that young trees are not damaged by the bamboo when strong winds occur. At the end of each tree row, end posts are installed between which twelve gauge wire is strung. Metal t-posts are driven every 50 feet between the end posts, supporting the wire. Each bamboo pole is then clipped to the wire to provide training and stabilization for the tree. Trees are trained and pruned by hand for the first two years then mechanically skirted, hedged, and topped thereafter. Trees can begin to be mechanically harvested the third year after planting (Danielle Lightle, 2016).

2.2 Olive Oil Market Growth and Trajectory

To understand the olive oil market, one must understand the regions and climates in which olives are produced. Olive production typically occurs between 30° and 45° latitude in both the northern and southern hemispheres. The climate needs to have dry and hot summers with mild winters, not prone to freezing (D. Barranco, 2010). Olive oil makes up a relatively small sector of the world vegetable oil market which produced 212 million metric tons of oil in the 2021/2022 season. In the same season, there were 3.3 million metric tons of olive oil produced in the world with a value of $14 billion (USDA, 2022) The Mediterranean basin produces approximately 96 percent and consumes 72 percent of olive oil in the world (USDA, 2022). The United States has consistently produced 16,000 metric tons of olive oil for the past three years which is the most it has ever produced although approximately 63% of production is exported. That being said, the U.S. is the number one import destination for olive oil excluding trade between countries in the European Union. This is most likely due to the U.S. consumer preference for Italian olive oil brands (Bo Xiong, 2013).

One of the unique characteristics of the olive oil industry is oil quality, which impacts cultural practices, harvesting techniques, mill logistics, and the value of the oil. In 1979, Buron and Garcia Theresa determined that olive oil quality is, 'The set of oil properties or attributes that determines the level of consumer acceptance of the product for a certain purpose' (D. Barranco, 2010, 621). Under that definition, each gradient of properties or attributes of olive oil has a classification that helps the industry, and the consumer, to determine the best use of the oil. The main determinant of quality that is accepted the world over is oil acidity, which measures free fatty acid content present in the oil and is determined using oleic acid percentage (International Olive Council, 2022).

The International Olive Council (IOC) segregates olive oils into various categories based on acidity levels. The three most common, per IOC standards, are extra virgin, virgin, and ordinary virgin (International Olive Council, 2022). Standards set by the California Department of Food and Agriculture (CDFA) and adopted by the Olive Oil Commission of California (OOCC) require even higher standards to reach the categories of extra virgin and virgin (Agriculture, 2022). Table 2.1 shows the differentiation in standards between the IOC and OOCC.

Table 2.1: International (IOC) and California (OOCC) Olive Oil Quality Standards (Oleic Acid Percent)

Category	IOC	OOCC
Extra Virgin	≤ 0.8%	≤ 0.5%
Virgin	≤ 2.0%	≤ 1.0%
Crude	≤ 3.3%	> 1.0%

The United States market for olive oil, which tripled between the years of 1993 and 2013, was spurred on, in part, by expansive media coverage about the oil's positive health and culinary attributes and the increasing popularity of the Mediterranean diet (Bo Xiong, 2013). News articles containing references to the health attributes of olive oil increased from an annual average of 220 between 1990 and 1994 to an annual average of 513 between 2008 and 2012 (Bo Xiong, 2013). Earlier articles elicited a larger increase in demand for olive oil than later articles and the effects were primarily seen on demand for imported, EU olive oils rather than an increase in demand for domestically produced oil. The study by Bo Xiong also found that 100 more articles referencing olive oil would result in an approximate increase of $1.6 million over time. One of the indicators used to show the growth in popularity of the Mediterranean diet was per-capita imports of Italian style cheeses which increased 162% from 1990 to 2012 (Bo Xiong, 2013).

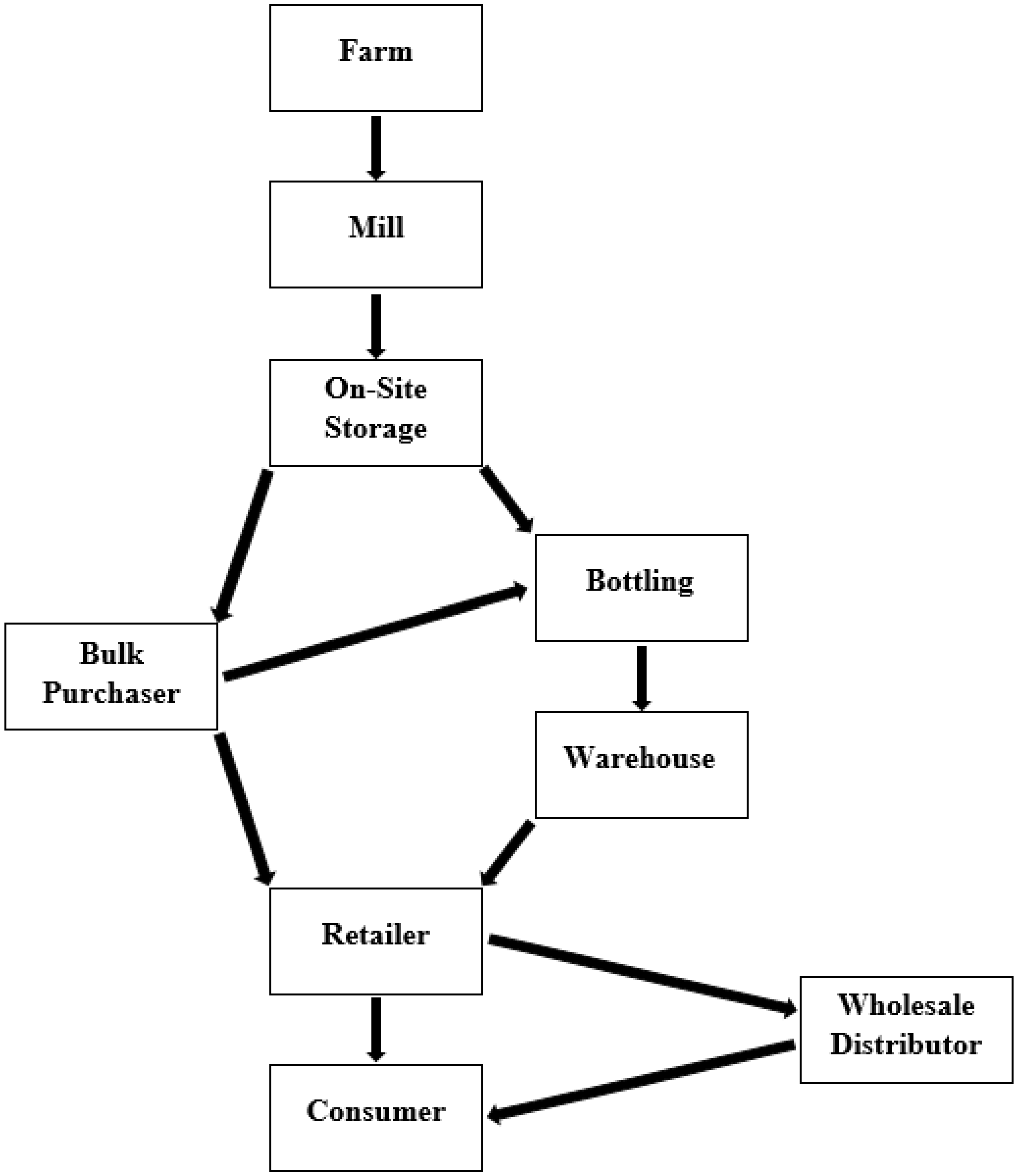
Research suggests that oils with varying characteristics and countries of origin are highly substitutable with an own price elasticity ranging from -0.4 to -1.4 thus denoting it as an inferior good. Virgin olive oil imported from the European Union, on the other hand, has an income elasticity greater than one, suggesting it is a luxury item and is income elastic (Bo Xiong, 2013).

In conclusion, the olive oil market has seen significant growth and trajectory in recent years. The quality of olive oil is a unique characteristic that shapes the industry, with acidity being the main determinant of quality. The United States market for olive oil has tripled between the years of 1993-2013, and media coverage about the oil's positive health and culinary attributes has spurred on its popularity. The growth in popularity of the Mediterranean diet has also contributed to the increasing demand for olive oil. Further research suggests that oils with varying characteristics and countries of origin are highly substitutable but imported virgin olive oil from the European Union is a luxury item and is income elastic. Overall, the olive oil market is a dynamic and evolving industry with various factors affecting its growth and trajectory. This leaves California producers of high quality, extra virgin olive oil with the obvious objective of marketing the product in a way that shows it is as good or better than its European competition.

2.3 Olive Oil Supply Chain

Californian olive oil reflects similar supply chain characteristics as those in Mediterranean countries. However, its relatively smaller market size has resulted in more vertical integration than in the Mediterranean market. For example, it is common in Mediterranean countries for olive growers to organize into cooperatives to increase bargaining power and reduce milling costs. In California, olive oil production is done primarily by private companies that contract with farmers for their fruit as well as grow their own fruit for milling. This, as well as the need for the mills to receive the fruit as soon as possible once it is harvested in order to maintain the quality of the oil, has resulted in a fairly simple supply chain, as demonstrated in Figure 2.1.

Figure 2.1: California Olive Oil Supply Chain



Author Developed, 2022

In the Sacramento Valley, there are three large olive oil mills, California Olive Ranch (COR), Corto Olive Co (Corto), and Boundary Bend Olives USA (BBO). Although the price per gallon net of milling costs is nearly the same for the three mills year to year, extraction efficiency varies between 80-90% across the three with BBO at the forefront

(Chavez, 2022). With oil price net of milling costs near $17.50 per gallon for the 2022 season, extraction efficiency plays a large roll in farm income (Chavez, 2022).

All three large mills are vertically integrated with large tank storage, bottling lines, and warehouse facilities on site. Certain buyers, such as food and cosmetic manufacturers, smaller olive oil companies, and restaurants opt to purchase different quality oils in bulk.

Having three large olive oil mills in the Sacramento Valley gives growers an opportunity to seek out strategically advantageous partnerships. In that pursuit though, growers must be concerned with how quickly the mill can process fruit received and how well they coordinate with in-field harvesting operations. Extraction efficiency also plays an important role in the selection of the mill a grower will contract to send their olives to.

CHAPTER III: ECONOMIC METHODS

In this chapter, we introduce and discuss the data and analytical methods used to determine the economic feasibility of an olive orchard for oil production in the Sacramento Valley. The chapter contains one section which presents the data and analytical methods used in the study.

3.1 Data and Analytical Methods

Data for the study were sourced from a combination of University of California – Davis Cost Study (UCDCS 2016) on olives planted specifically for olive oil, development budgets from an operating olive farm, and the author's own experience working and managing olive groves. All costs were adjusted for inflation to more accurately reflect current costs. All costs gathered from the UCDCS were further adjusted to reflect the costs as a manager would see them, rather than on a per acre basis. For example, any development or cultural cost which would be contracted as a piece rate job was changed from a cost per acre approach to a cost per unit approach.

Costs were organized into variable costs and fixed costs. Variable costs are costs that change with production while fixed costs are costs that, in the short run, do not change regardless of ongoing operations. Variable costs for this project included irrigation, pruning/training, pest management, fertilizer, maintenance, fuel, and harvest costs. Fixed costs included land, orchard establishment, equipment, property taxes, insurance, and vehicle registration costs. The land and orchard establishment costs and equipment acquisition expenses were grouped under what was termed development/startup costs and are described in Section 2.1 . Revenues were based on oil yield, acreage planted and oil price. Yields were based on the UCDCS reports, which aligns with the tree spacing and cultural practices that the anticipated farm would utilize. The price trend is based on the price of olive oil which increased at an average rate of two percent per year between the years 2011 and 2020. This trend is further supported by the market trend factors discussed in Section 2.2.

Once collected, adjusted, and averaged, costs and revenues were projected out ten years and the Net Present Value (NPV) function was used to determine viability at a five percent discount rate. The NPV allows us to analyze the difference in projected profitability between planting the olive orchard or using the funding to secure a financial vehicle that produces, in this circumstance, at least a five percent rate of return.

$$NPV = -C + \frac{R_1}{(1+d)} + \frac{R_2}{(1+d)^2} + \frac{R_3}{(1+D)^3} + \cdots + \frac{R_r}{(1+d)^r} = -C + \sum_{t=1}^{r} \frac{R_t}{(1+d)^t}$$

where R is net cashflow, calculated by subtracting gross revenue from expenses, d is the discount rate (5 percent), t is time, and C is the initial investment into the olive orchard.

The ten-year farm budget was stress tested by exposing three of the critical variable costs to price increases ranging from 0-25 percent. The variable costs exposed to these shocks were irrigation, pest management, and harvest. The cost of irrigation was chosen due to the increasing scarcity of water in the Sacramento Valley, which has resulted in decreases in water allocation as well as the legislative pressures, such as the Sustainable Groundwater Management Act (SGMA) that is limiting farmers access to groundwater. Pest management cost was chosen because it represents the possible increases in herbicides and pesticides costs as well as the potential increase in labor cost to mitigate mammalian pests such as deer, coyotes, and other vermin which can cause damage to the trees and irrigation system. Finally, harvest costs were chosen due to the limited access to custom harvest companies and olive harvesters in the Sacramento Valley. This limited supply of harvest equipment and the fact that the entire farm hinges upon a successful harvest means that a substantial increase in the cost of harvest is possible and needs to be planned for.

Ultimately, the data were used to determine ten-year net present values at various debt to equity ratios. While the production life of an olive orchard is 25 years, the NPV was calculated over ten years of cashflow. This was done for two reasons: (i) because the NPV in the first ten years is a strong indicator of the investment as a whole, and, (ii) because the reliability of revenue and cost projections begins to deteriorate significantly after ten years.

The size of the olive grove was iterated from 200 to 525 acres with debt to equity ratio iterations as the principal constraint on production. The sensitivity analyses and scenario analyses were performed using the scenario manager tool in Microsoft Excel®.

CHAPTER IV: ANALYSIS

This chapter presents the products of the various analyses performed which helped to determine the economic feasibility of an olive orchard in the Sacramento Valley of California. The chapter is organized into eight sections. Section 4.1 provides a high-level view of the scenarios presented in the subsequent chapters and the parameters surrounding the base scenario. Section 4.2 discusses the effects of olive oil price changes on net profits. Sections 4.3, 4.4, and 4.5 discuss the effects of shifts in the price of irrigation, pest management, and harvest costs, respectively, on net profit. Section 4.6 explores the effects that those same variables have on net present value. Finally, section 4.7 examines the relationship between debt financing and net present value for this specific investment. Table 4.1 gives a brief description of the five scenarios which were simulated in sections 4.1 through 4.5.

Table 4.1: Scenario Descriptions

Scenario	Description
Base	Starting with the most-plausible assumptions about the California olive oil and olive production market. See Table 4.2
Oil Price Increase	Oil price iterated at one-dollar intervals
Irrigation Price Increase	Irrigation cost increased in 5 percent increments up to 25 percent across price spectrum
Pest Management Price Increase	Pest management cost increased in 5 percent increments up to 25 percent across price spectrum
Harvest Price Increase	Harvest cost increased in 5 percent increments up to 25 percent across price spectrum

4.1 Base Scenario

The study encompassed five scenarios, including a base scenario. The base scenario assumes 325 planted acres, 50 percent debt financing, and a 5 percent interest rate. The oil yield per acre and price per gallon are presented in Table 4.2. The revenues and costs are also presented in Table 4.2. The financial analysis assumes a two percent per annum increase in olive oil prices. Based on the assumed output and prices, the revenues increased from $682,000 in Year 3 to nearly $1.5 million in Year 10.

Table 4.2: Base Scenario Cashflow (Revenues and Costs in $1,000)

Year	1	2	3	4	5	6	7	8	9	10
Gal/Acre	0	0	113	168	210	210	210	210	210	210
Price/Gal	$17.50	$18.21	$18.57	$18.94	$19.32	$19.71	$20.10	$20.50	$20.91	$21.33
Revenue	$0	$0	$682	$1,034	$1,319	$1,345	$1,372	$1,399	$1,427	$1,456
Variable Costs	$263	$263	$263	$263	$263	$263	$263	$263	$263	$263
Fixed Costs	$390	$390	$390	$390	$390	$390	$390	$390	$390	$390
Mortgage	$262	$262	$262	$262	$262	$262	262	$262	$262	$262
Net Profit	($915)	($915)	($233)	$120	$404	$430	$457	$485	$513	$541

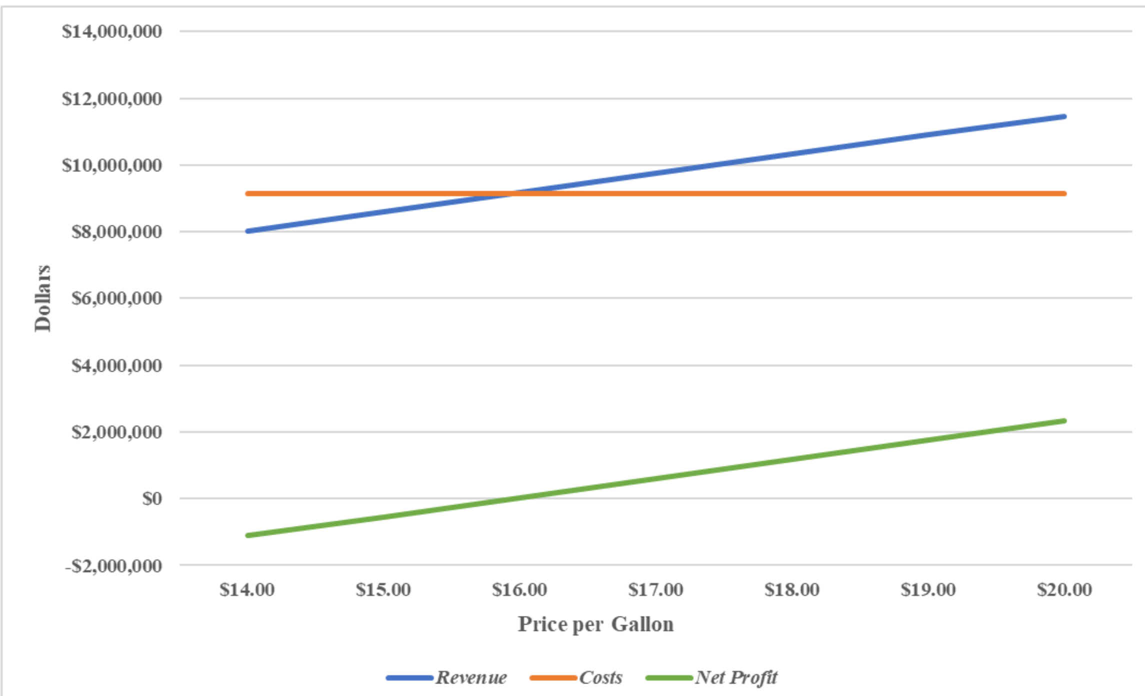
Table 4.2 shows cost under the base scenario fixed over the duration. The net profit (cash flow) increased from a negative of $915,000 to a positive $541,000 by the tenth year. Using a 5 percent discount rate, the net present value (NPV) under the base scenario was estimated at $150,648. This leads to the conclusion that the project is economically feasible under the base scenario. However, it is realized that prices and costs are hardly static. The results of the price effects on the foregoing results are presented in the next few sections.

4.2 Price Effect on Undiscounted Financials

The cashflow projections found that an average price of $13.41 per gallon of olive oil allowed the farm to break even once full production is achieved in year five given 325 acres of production, 70 percent debt financing, and a five percent interest rate.

Figure 4.1 shows the aggregate of a ten-year cashflow between the prices of $14.00 and $20.00 per gallon of extra virgin olive oil. Across this expanded time horizon, the breakeven price jumps to $16.00 per gallon compared to the annual breakeven of $13.41 per gallon. This is largely due to the lack of revenue in years one and two as well as diminished revenues in years three and four. Although there is not much managers can do to mitigate price risk in olives through traditional commodity hedging techniques, the use of forward contracts can greatly increase the stability of the operation's cashflow.

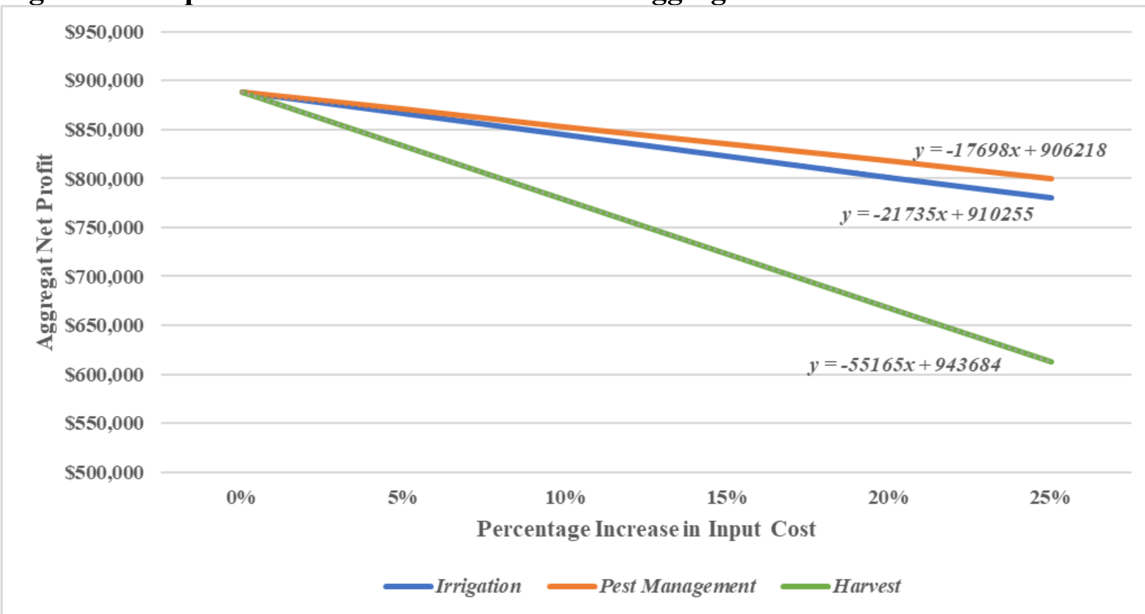
Figure 4.1: Undiscounted Total Revenue, Costs, and Net Profits at Alternative Olive Oil Prices



4.3 Input Cost Effect on Undiscounted Financials

For the study, the cost of the three most significant inputs was analyzed to determine their effect on the undiscounted cashflow over ten years, those inputs being irrigation, pest management, and harvest. This was done by finding the effect that incremental increases of five percent in the cost of the three inputs had on the ten-year aggregated net profits. When the analysis was performed, the other input costs were kept constant. The resultant data is represented in Figure 4.2.

Figure 4.2: Input Cost Effect on Undiscounted Aggregate Net Profits



For each percentage increase in irrigation, pest management, and harvest costs from the base, aggregate net profit decreases by $21,735, $17,698, and $55,165, respectively, on average, over the ten years. From a management perspective, this means that a significant amount of time should be devoted to managing harvest costs compared to time spent managing irrigation or pest management costs as those have less than half of the impact on net profits as harvest cost.

4.4 Irrigation Cost Effect on Annual Net Profits

Irrigation is a major cost in olive production in the Sacramento Valley. As a result, it was deemed prudent to explore the potential impact of alternative irrigation costs on a single year's cash flow. This was due to the erratic cost and availability of water in the Sacramento Valley. It is possible to have a year where water is relatively inexpensive to obtain and the next year need to purchase water at a premium to produce a crop. For this reason, it is vital for managers to understand the effect that irrigation costs can have on year-to-year profitability. Table 4.3 summarizes the average, annual net profit on the base acreage of 325 acres, the price changes as presented in Section 4.2, along with increasing irrigation cost at 5 percent increments from the base level cost. The table shows that the highest irrigation cost increase (25 percent above the base scenario cost) at the lowest oil price ($14/gallon) still produced a positive net profit for the year. This price shock was performed under the following assumptions: 325 acres of production, a five percent interest rate, and 50 percent debt financing.

Table 4.3: Irrigation Cost Effect on Annual Net Profit

Cost Increase	$14.00	$15.00	$16.00	$17.00	$18.00	$19.00	$20.00
Base	$40,880	$109,130	$177,380	$245,630	$313,880	$382,130	$450,380
5%	$38,706	$106,956	$175,206	$243,456	$311,706	$379,956	$448,206
10%	$36,533	$104,783	$173,033	$241,283	$309,533	$377,783	$446,033
15%	$34,359	$102,609	$170,859	$239,109	$307,359	$375,609	$443,859
20%	$32,186	$100,436	$168,686	$236,936	$305,186	$373,436	$441,686
25%	$30,012	$98,262	$166,512	$234,762	$303,012	$371,262	$439,512

As seen in Table 4.3, the situation in which rising irrigation costs would harm the farming operation the most is when the price per gallon of olive oil is low. In the event of the price dropping to $14.00 per gallon, a five percent increase in cost results in a reduction of 5.32 percent in net profit, while a 25 percent increase results in a 26.58 percent decrease in net profit from the base scenario results. On the opposite end of the price scale, at $20.00 per gallon, the same 5 percent and 25 percent increases in irrigation costs only result in a 0.48 percent and 2.42 percent decrease in net profits respectively. From a management perspective, this shows that, although important, managing irrigation costs need not be the primary focus of cost-saving efforts.

4.4 Pest Management Cost Effect on Annual Net Profit

The effect of increases in pest management costs was investigated by holding all other costs constant and increasing pest management costs by 5 percent increments from the base rate. The results are presented in Table 4.4. It shows the base scenario's annual net profit and the results emanating from the pest management cost changes.

Table 4.4: Pest Management Cost Effect on Annual Net Profit

Cost Increase	$14.00	$15.00	$16.00	$17.00	$18.00	$19.00	$20.00
Base	$40,880	$109,130	$177,380	$245,630	$313,880	$382,130	$450,380
5%	$39,110	$107,360	$175,610	$243,860	$312,110	$380,360	$448,610
10%	$37,340	$105,590	$173,840	$242,090	$310,340	$378,590	$446,840
15%	$35,570	$103,820	$172,070	$240,320	$308,570	$376,820	$445,070
20%	$33,800	$102,050	$170,300	$238,550	$306,800	$375,050	$443,300
25%	$32,031	$100,281	$168,531	$236,781	$305,031	$373,281	$441,531

Similarly to increases in irrigation costs, the pressures of rising pest management costs are felt more when olive oil prices are low. In the event of the price dropping to $14.00 per gallon, a five percent increase in pest management cost results in a 4.33 percent decrease in net profit while a 25 percent increase results in a 21.65 percent decrease in net profit. Conversely, when the price is at $20.00 per gallon, the reduction in net profit from the same price increases are 0.39 and 1.96 percent, respectively. This necessitates a decision that the farm manager has to make in a down market: to spray or not to spray for weeds. While weeds may rob the trees of water and nutrients, the benefits of weed removal may not be large enough to justify the cost. Farm managers could consider solutions such as tractor mounted weed removal mechanisms which can reduce the cost of weed management to the cost of tractor operation. However, like with irrigation costs, managers should not obsess over ensuring pest management costs are low as it would take a radical increase to eat away all net profits for the growing season.

4.5 Harvest Cost Effect on Annual Net Profit

This analysis was performed under the same circumstances as described in section 4.2 and 4.3. Irrigation and pest management cost increases were adjusted back down to zero. The results are displayed in Table 4.5

Table 4.5: Harvest Cost Effect on Annual Net Profit

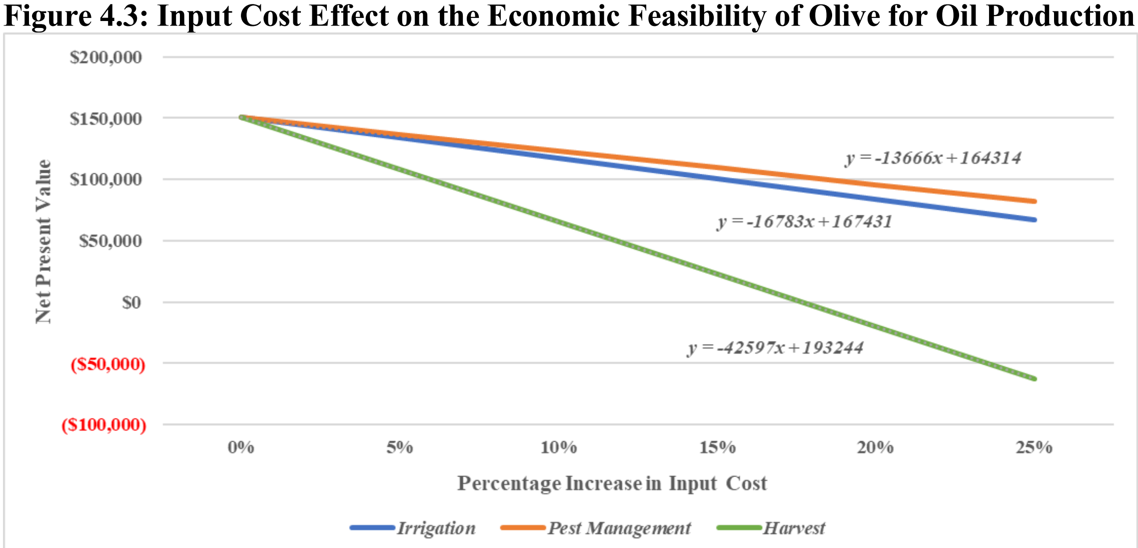
Cost Increase	$14.00	$15.00	$16.00	$17.00	$18.00	$19.00	$20.00
Base	$40,880	$109,130	$177,380	$245,630	$313,880	$382,130	$450,380
5%	$35,363	$103,613	$171,863	$240,113	$308,363	$376,613	$444,863
10%	$29,847	$98,097	$166,347	$234,597	$302,847	$371,097	$439,347
15%	$24,330	$92,580	$160,830	$229,080	$297,330	$365,580	$433,830
20%	$18,814	$87,064	$155,314	$223,564	$291,814	$360,064	$428,314
25%	$13,297	$81,547	$149,797	$218,047	$286,297	$354,547	$422,797

Similar to the previous price shocks, rising harvest costs are felt more acutely when oil prices are low. In a $14.00 per gallon market, a five percent increase in price results in a 13.49 percent decrease in net profit while a 25 percent increase in price produces a reduction of 67.47 percent from the base net profit. In a $20.00 per gallon market, these increases produce reductions of 1.22 and 6.12 percent, respectively, in net profit. For this reason, from a management perspective, reducing harvest cost should be of primary concern. While contracting out harvesting operations may eliminate the need to purchase equipment and manage harvest operations, it may also dig into the farms bottom line if the price rises significantly. Prudent farm managers can mitigate some of this risk by building strong relationships with custom harvest companies and contracting well in advance of harvest. Also, the farm manager should be on the lookout for strategic partnerships that may allow for investment in harvest equipment through a shared cost approach. Ultimately, once the operation has a manageable debt level and strong enough liquidity, the manager should look into the purchase of harvest equipment in order to reduce the risk of rising harvest costs.

4.6 Input Cost Effect on Economic Feasibility

The final analysis relating to the effects of price changes was performed by determining how those shifts can alter the NPV of the investment as a whole. Figure 4.3 illustrates the effects that price increases across the three variable costs can have on overall NPV. This scenario was performed with the following assumptions: a five percent discount rate, price per gallon of $17.50 with prices increasing at two percent per year, 325 acres of production, and 50 percent debt financing. For each percentage increase in irrigation, pest management, and harvest costs, NPV decreases by $16,783, $13,666, and $42,597, respectively, on average, over the ten years.

Figure 4.3: Input Cost Effect on the Economic Feasibility of Olive for Oil Production



To further drive home the need for managers to control harvest costs, Figure 4.3 shows how influential even modest price jumps can be on the NPV. Alarmingly, harvest costs, if increased past 18 percent, while holding all other factors constant, have the ability to push the NPV into the negative. For irrigation and pest management costs, it would take 45 and 55 percent increases, respectively, to produce the same effect.

Something that managers need to be aware of is that none of these variable costs are mutually exclusive. For example, the rising cost of labor affects both pest management and harvest costs. Likewise, if materials like plastics increase in price, this will be manifested in both irrigation and harvest costs due to the replacement parts required for both operations. This creates an environment where no single variable can be pinpointed as the cause of decreasing revenues. Rather, managers must assess these effects as a whole in order to make more prudent decisions.

4.7 Effect of Debt, Acreage, and Discount Rate on Economic Feasibility of Olives for Oil Production

Objective 5 of this study seeks to determine the amount of debt financing that can be supported by a certain amount of acreage while providing a positive NPV at a 5 percent discount rate and base scenario conditions (oil price of $17.50 per gallon with a two percent per year average increase). A secondary analysis of the effects of an alternative discount rate was also included. The results are shown in Tables 4.6 and 4.7. Figures shown in red are not feasible.

Table 4.6: Effects of Debt and Acreage on NPV With 5% Discount Rate (1,000)

	Debt Financing Percentage									
Acreage	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
225	($326)	($606)	($886)	($1,166)	($1,446)	($1,726)	($2,007)	($2,287)	($2,567)	($2,847)
250	$198	($113)	($425)	($736)	($1,047)	($1,358)	($1,670)	($1,981)	($2,292)	($2,603)
275	$722	$379	$37	($305)	($648)	($990)	($1,333)	($1,675)	($2,017)	($2,360)
300	$1,245	$872	$498	$125	($249)	($622)	($996)	($1,369)	($1,743)	($2,116)
325	$1,769	$1,364	$960	$555	$151	($254)	($659)	($1,063)	($1,468)	($1,872)
350	$2,293	$1,857	$1,421	$986	$550	$114	($322)	($757)	($1,193)	($1,629)
375	$2,817	$2,350	$1,883	$1,416	$949	$482	$15	($451)	($918)	($1,385)
400	$3,340	$2,842	$2,344	$1,846	$1,348	$850	$352	($146)	($644)	($1,142)
425	$3,864	$3,335	$2,806	$2,277	$1,748	$1,218	$689	$160	($369)	($898)
450	$4,388	$3,828	$3,267	$2,707	$2,147	$1,587	$1,026	$466	($94)	($654)
475	$4,911	$4,320	$3,729	$3,137	$2,546	$1,955	$1,363	$772	$181	($411)
500	$5,435	$4,813	$4,190	$3,568	$2,945	$2,323	$1,700	$1,078	$455	($167)
525	$5,959	$5,305	$4,652	$3,998	$3,345	$2,691	$2,037	$1,384	$730	$76

When comparing Tables 4.6 and 4.5, it is obvious that the increased discount rate has an effect on the feasibility of the investment. With the higher discount rate, the operation must be larger, beginning at 275 acres to achieve feasibility while the five percent rate can produce a feasible outcome at 250 acres. The management and decision-making power of these tables lies in determining the starting point for analysis. In both circumstances, further exploration would only be worthwhile if the debt, acreage, and discount rates available to the decision-maker produce a positive NPV.

Table 4.7: Effects of Debt and Acreage on NPV With 7.5% Discount Rate (1,000)

	Debt Financing Percentage									
Acreage	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
225	($528)	($852)	($1,176)	($1,500)	($1,824)	($2,149)	($2,473)	($2,797)	($3,121)	($3,445)
250	($89)	($449)	($809)	($1,169)	($1,529)	($1,890)	($2,250)	($2,610)	($2,970)	($3,330)
275	$350	($46)	($442)	($838)	($1,234)	($1,631)	($2,027)	($2,423)	($2,819)	($3,215)
300	$789	$357	($75)	($507)	($939)	($1,372)	($1,804)	($2,236)	($2,668)	($3,100)
325	$1,228	$760	$292	($176)	($644)	($1,113)	($1,581)	($2,049)	($2,517)	($2,985)
350	$1,667	$1,163	$659	$155	($349)	($854)	($1,358)	($1,862)	($2,366)	($2,870)
375	$2,106	$1,566	$1,026	$486	($54)	($594)	($1,135)	($1,675)	($2,215)	($2,755)
400	$2,545	$1,969	$1,393	$817	$241	($335)	($912)	($1,488)	($2,064)	($2,640)
425	$2,985	$2,372	$1,760	$1,148	$536	($76)	($689)	($1,301)	($1,913)	($2,525)
450	$3,424	$2,775	$2,127	$1,479	$831	$183	($466)	($1,114)	($1,762)	($2,410)
475	$3,863	$3,178	$2,494	$1,810	$1,126	$442	($243)	($927)	($1,611)	($2,295)
500	$4,302	$3,582	$2,861	$2,141	$1,421	$701	($20)	($740)	($1,460)	($2,180)
525	$4,741	$3,985	$3,228	$2,472	$1,716	$960	$203	($553)	($1,309)	($2,065)

The importance of the foregoing analysis is that it helps potential managers determine the appropriate level of financing necessary for an economically feasible solution given their available or anticipated production acreage. This creates an opportunity for investors to explore multiple financing options to increase their probability of producing economically feasible projects.

CHAPTER V: SUMMARY AND CONCLUSIONS

This thesis sought to bring a greater understanding on the economic feasibility of planting olives for the production of extra virgin olive oil in the Sacramento Valley. This was done in order to inform potential investors about whether the next steps are worth taking in pursuing the investment.

The results of the proforma cashflow analysis to determine profitability showed that the investment can produce consistent positive cashflow as long as the price of extra virgin olive oil stays above $15 per gallon, holding all other costs at their base scenario levels. The cashflow analysis also showed a net profits of $433 per acre at the 2022 price of $17.50 per gallon. The stress tests of the three most significant variable costs showed that significant increases in irrigation and pest management costs can be absorbed by the investment to produce positive cashflow and a positive net present value. However, harvest costs, when increased past 15 percent took a significant toll on cashflow and turned the net present value negative. Ultimately, this is a positive sign since, of the three variable costs that were assessed, harvest expense is the most easily controlled by management through the acquisition of a harvester.

Finally, the net present value assessment showed the importance of keeping a healthy balance between debt and equity financing. Debt financing can be tolerated at higher levels if there are also higher levels of acreage to produce more income. At acreage levels below 250 acres, the project becomes infeasible at debt financing levels below 50 percent. For this reason, it would be vital to the financial strength of the operation to increase equity financing and seek the remaining funds needed through debt financing.

This study is not a completely exhaustive compendium of the entire financial outlook of growing olives for olive oil production in the Sacramento Valley. One of the areas of further study that would greatly benefit these conclusions is price variability and projection analysis. This would allow for more informed pro forma cashflows to be built, thus increasing the risk assessment profile about the project. Additionally, an in-depth review of the potential for boutique or higher value oil is worth investigating. Such companies have gained popularity in the north and central coasts of California and have helped to popularize oils with flavor profiles beyond that of extra virgin olive oil. Ultimately, it is important to note that although studies, analyses, and tests can be performed to determine the feasibility of a farming operation, there is no guarantee of outcome. Farming comes with a litany of inherent risks that can affect agricultural investment. What such studies do is provide managers with an advanced knowledge about how to improve performance under uncertainty.

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