8-2019

An Economic Contribution and Investment Analysis of the South Carolina Peach Industry

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AN ECONOMIC CONTRIBUTION AND INVESTMENT ANALYSIS OF THE SOUTH CAROLINA PEACH INDUSTRY

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Applied Economics and Statistics

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by
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August 2019

Accepted by:
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ABSTRACT

South Carolina (SC) is the second largest peach producing state in the United States, behind only California and ahead of Georgia. SC, however, is the largest fresh market peach producing state. In terms of production value, the peach industry consistently ranks in the top ten of agricultural products in SC. With a value of $71,546,000 in 2018, peaches are a major contributor to the SC agricultural economy.

This thesis is divided into two chapters focused on two economic questions related to the peach industry in South Carolina. The first chapter quantifies the contribution of the peach industry to SC's economy by performing an economic contribution analysis. Using data published by the USDA National Agricultural Statistics Service, an input-output model was chosen to conduct a regional economic analysis using the software program IMPLAN. Results from the model indicate that the SC peach industry has an economic contribution between $103,920,715 and $111,761,651.

The second chapter examines an investment decision for a 40-acre peach orchard in SC. The investment analysis used a Net Present Value (NPV) method paired with a Monte Carlo simulation to determine profitability. Peach enterprise budgets were constructed through interviews with peach producers and input from Clemson Cooperative Extension Service specialists and agents. Results from the analysis show positive NPVs when discount rates are below 6 percent for a 12-year time horizon and below 9 percent for a 15-year time horizon based on the assumptions made.

ACKNOWLEDGMENTS

I would like to thank everyone that has been responsible for aiding me to complete my Master of Science degree in Applied Economics and Statistics. I definitely could not have not done it without the help and wisdom of many involved parties.

First, I would like to thank my graduate committee. Thank you to Dr. Nathan Smith, who put his faith into me by bringing me on as a graduate research assistant. I greatly appreciate his countless hours and guidance throughout this process. Next, I would like to thank Dr. Michael Vassalos, who was a great professor to me as an undergraduate student and has always been there to offer me advice since my time as a graduate student. Third, thank you to Dr. Marzieh Motallebi, who was also always there to help me during my graduate studies. I am sincerely grateful to Dr. Smith, Dr. Vassalos, and Dr. Motallebi for giving me an unlimited resource of knowledge and expertise in the field of agricultural economics.

To continue, I would like to thank the Clemson University Peach Team for their advice on anything related to peaches for my research. Specifically, I would like to offer my gratitude to Clemson University Corporative Extension Agent Mr. Greg Henderson, who spent countless hours with me conveying the production practices of growing peaches in South Carolina.

Lastly, I want to thank my parents, who instilled in me the value of hard work and for always supporting me and offering me words of encouragement. Also, I would like to say thank you to all my friends and colleagues who have assisted me along the way.

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CHAPTER 1: AN ECONOMIC CONTRIBUTION ANALYSIS OF THE SOUTH CAROLINA PEACH INDUSTRY

Introduction: The United States Peach Industry

The majority of peach production in the United States (US) occurs in 20 states, with the top three producing states being California, South Carolina, and Georgia. Total peach production for the US has been on the decline for the last 14 years, dropping from 1,307,260 tons produced in 2004 to 696,650 tons in 2017 (USDA ERS, 2018) (Figure 1). In addition, per capita consumption of peaches in the US has been decreasing since the early 2000s (USDA ERS, 2018) (Figure 2). Different factors may have contributed to the decline in production and per capita consumption of peaches including drought, freezes, increase competition from tropical fruits, increases availability of out-of-season fruits, and inconsistent quality (Marini, 2019).

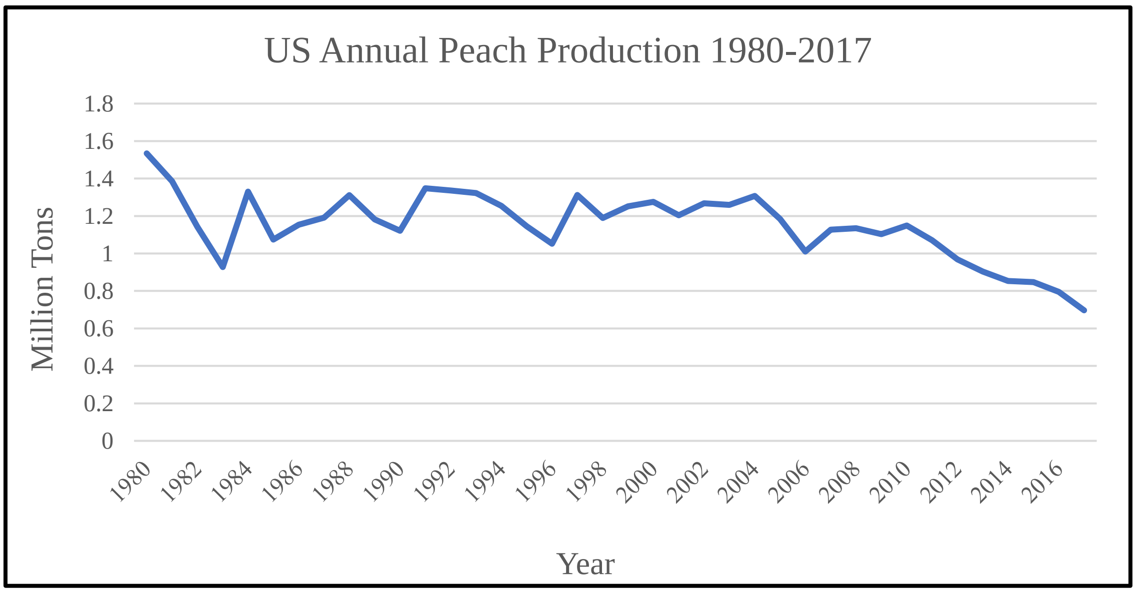

Figure 1: Annual Peach Production in the US from 1980-2017
Source: USDA Economic Research Service: "Fruit and Tree Nut Yearbook Tables"

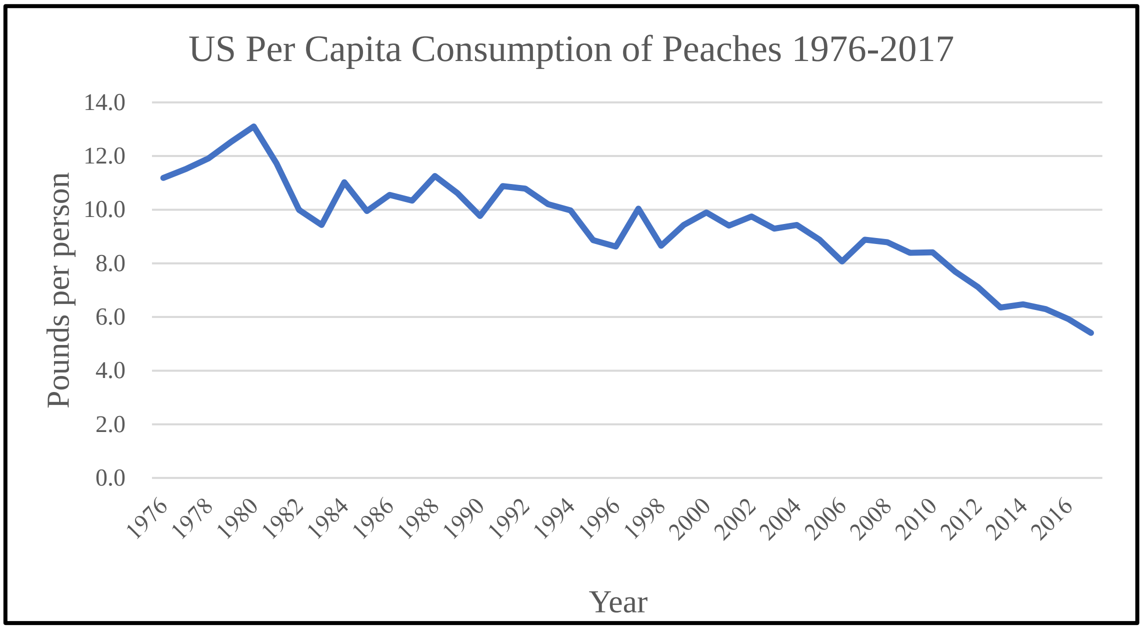

Figure 2: Per Capita Consumption of Peaches in the US from 1976-2017
Source: USDA Economic Research Service: "Fruit and Tree Nut Yearbook Tables"

The South Carolina Peach Industry

As mentioned above, South Carolina (SC) is second in peach production by state in the US behind only California and ahead of Georgia. As the leading state for peaches in the eastern United States, SC is sometimes referred to as the "Tastier Peach State" compared to its neighbors like Georgia (South Carolina Peach Council). A typical year for peaches in SC will rank the commodity 7th or 8th in production value of all agricultural products in the state according to the National Agricultural Statistics Service. As a part of the over $3 billion total agricultural production value in the state, the peach industry is a major contributor to the SC economy (USDA NASS 2017 Census of Agriculture). The industry traces its roots in the state to the mid-1800s and really became successful as more railroads were established in the South. For convenience, peach packing sheds would be placed near railways for easy loading to ship peaches all throughout the county (South Carolina Peach Council).

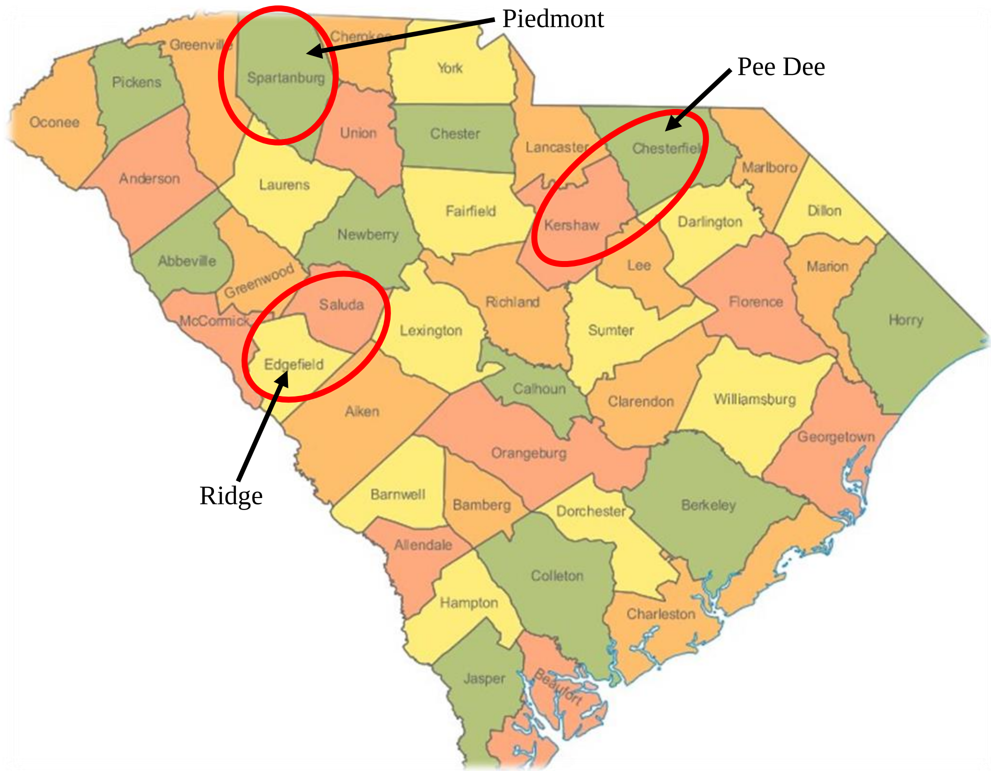

Figure 3: Map of Peach Regions in SC

Peaches in SC are grown in three main regions of the state (Figure 3). The first major region is the Ridge area, which is located towards the middle of the state between the Georgia state line and Columbia, SC. The Ridge produces the most peaches in the state by region. The counties that make up this area are Saluda, Edgefield, and parts of Aiken. Edgefield and Saluda counties are ranked first and second respectively in the state for peach production by county, in terms of acreage. (USDA NASS 2017 Census of Agriculture). Next, the Piedmont region in the northwestern part of the state is the second major region for SC peach production. Spartanburg and parts of Greenville counties comprise the production in this area. Furthermore, the Pee Dee region is the third prominent area for peaches, with production mainly taking place in Kershaw and Chesterfield counties.

In terms of production, peaches are harvested during the summer months of May through September in South Carolina. Like most fruit, peaches are best grown on higher ground to avoid low spots of cold air. Typically, peaches in the state begin to bloom in the spring months of March and April. A period of dormancy during the winter is required for the crop to grow. More specifically, a certain number of “chill hours” where temperatures are below 45°F are required for peaches during their dormant stage. The lower the number of chill hours relates to how early the peach crop will bloom once the weather begins to warm. Typically, peach trees in South Carolina require about 800-1,000 chill hours during dormancy (Clemson University). Peach production in SC has historically been located in the Ridge, Piedmont, and Pee Dee regions with rolling terrain and sufficient chill hours for peaches.

United States Department of Agriculture (USDA) National Agricultural Statistics Service’s (NASS) past Censuses of Agriculture show that peach acreage (bearing and non-bearing) in SC peaked at 40,093 in 1982. From 1982 to 2002, peach acres declined by a significant amount of 62.4 percent in the state. This major decline could be attributed to several factors, including changing weather patterns that caused late freezes, drought, and considerable real estate development across SC, particularly in Spartanburg and Greenville Counties along the I-85 corridor. However, peach acres have been on a slight increase from 2002 to 2017 as there were 17,566 acres in 2017 (Figure 4). In terms of bearing acres of peach trees, typically SC will have 13,000 to 14,000 acres per year.

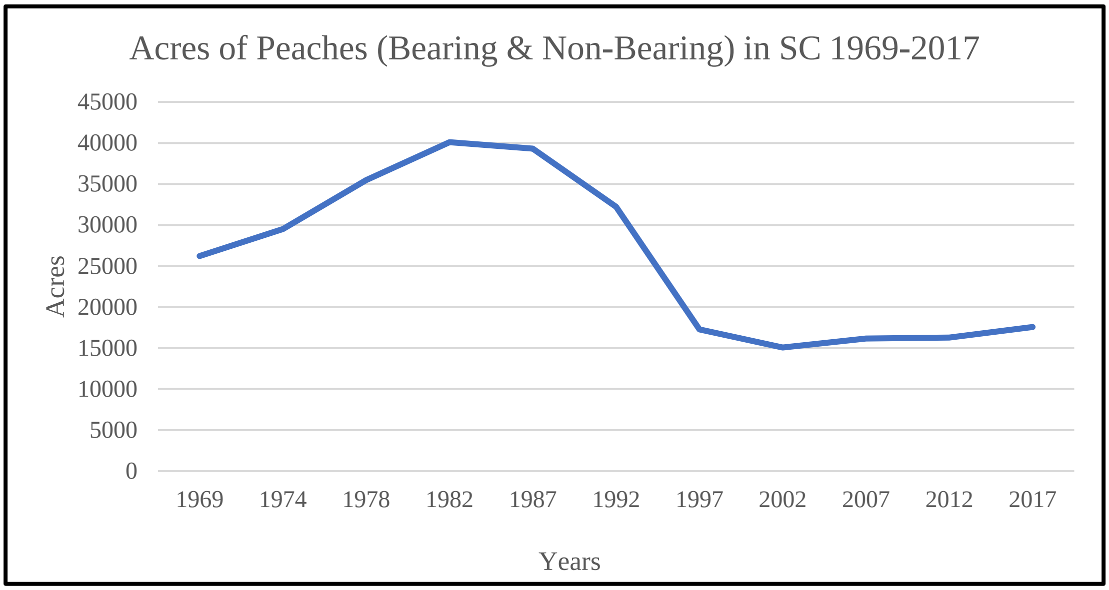

Figure 4: Total Bearing and Non-Bearing Acres of Peaches in SC from 1969-2017
Source: USDA NASS: Census of Agriculture

The yield of peaches for a typical year in South Carolina will generate an average of 63,588 tons with an average production value of $60,358,167 based on production data from the last decade (Figures 5 and 6). Since 2007, yield has tended to be somewhat volatile, as weather events have impacted the peach crop. The annual production in tons since 2007 has had a standard deviation of 28,188.65 and a coefficient of variation of 44 percent. Furthermore, in the same period, annual production value has had a standard deviation of $23,596,675.56 and a coefficient of variation of 39 percent. From years 2007 to 2018, yield peaked in 2010 when 110,000 tons were produced with a production value of $98,130,000. However, 2007 and 2017 saw peach yields drop to less than 13,000 tons produced with production values of less than $18,000,000 for both years. These well below average years were due to freezes that occurred after much of the peach trees had bloomed early because of unseasonably warm winters. Late freezes such as these can destroy up to 80 to 90 percent of a year's peach crop in SC.

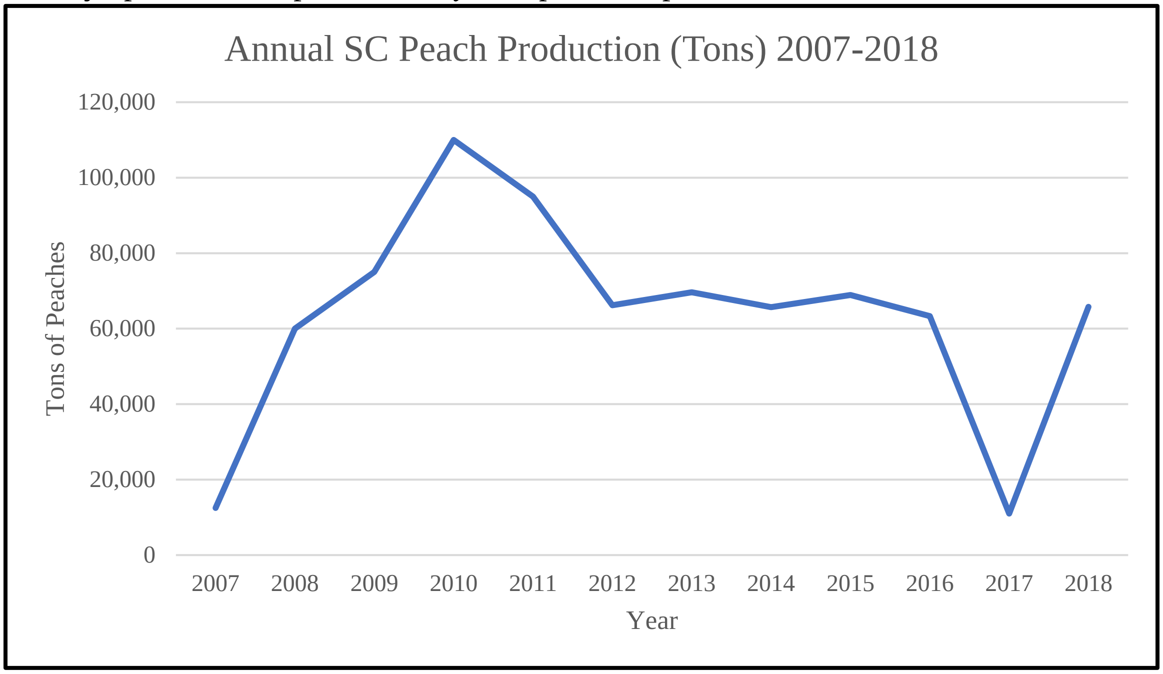

Figure 5: Annual Production (Tons) of Peaches in SC from 2007-2018
Source: USDA NASS Quick Stats Database

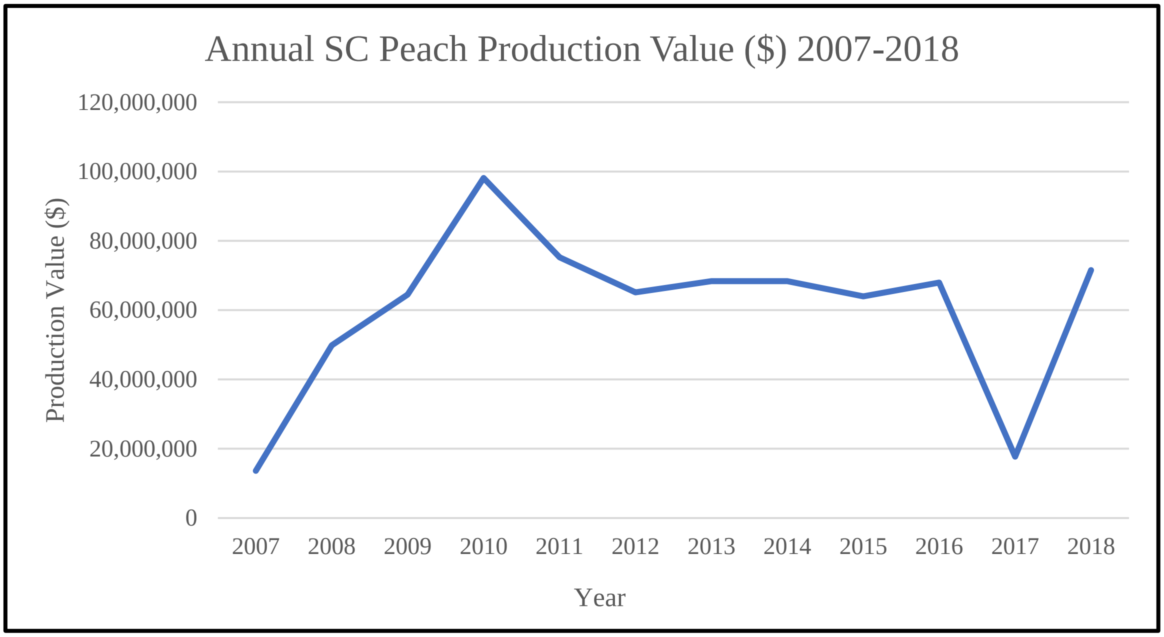

Figure 6: Annual Production Value ($) of Peaches in SC from 2007-2018
Source: USDA NASS Quick Stats Database

Peach production is labor intensive and thus a higher cost per acre enterprise. Hiring enough domestic labor has proved to be unachievable and inefficient according to personal communications with South Carolina peach producers. As a result, producers have had to turn to other means of hiring than the domestic workforce. An alternative workforce that producers in SC have recently utilized is migrant workers through the government administered H-2A guest worker program. The H-2A program was established by the Immigration and Nationality Act of 1952 and allows for migrant workers, mainly from Mexico, to enter the US on temporary work permits to work seasonal agricultural jobs. To take advantage of the program, agricultural producers must petition the U.S. Department of Labor (DOL) stating that there is a need for seasonal foreign workers by proving that the domestic labor market is insufficient and that hiring the migrant workers will not lower wages for domestic workers. The H-2A program does not come without additional costs, as farms employing the migrant workers must provide housing and transportation (Luckstead and Devadoss, 2019). In addition, wage rates for guest workers are based on the adverse effect wage rate (AEWR), which is "the minimum wage that will not adversely impact the employment opportunities for U.S. workers" (Luckstead and Devadoss, 2019). The AEWR is different in all states as it is based on each state's minimum wage rate. The AEWR for S.C. is $11.13 for 2019 (Office of Foreign Labor Certification, 2019).

The use of H-2A nationally has grown considerably and has become a vital resource for agricultural labor. The growth nationally is reflected in SC also, as the number of annual H-2A workers in the state has more than doubled since 2010. In 2018 there were 5,218 H-2A certified workers in SC, compared to 2,247 in 2010. Currently, SC is on track to employ even more migrant workers in 2019. The peach industry is a major user of the H-2A program. A total of 5,218 H-2A workers were certified to work in SC in 2018 with 1,761 certified to work in the peach industry, representing 33.7 percent. In recent years, the peach industry in SC accounted for 20 to 30 percent of the total number of H-2A workers annually (USDOL OFLC, 2019)(Figure 7).

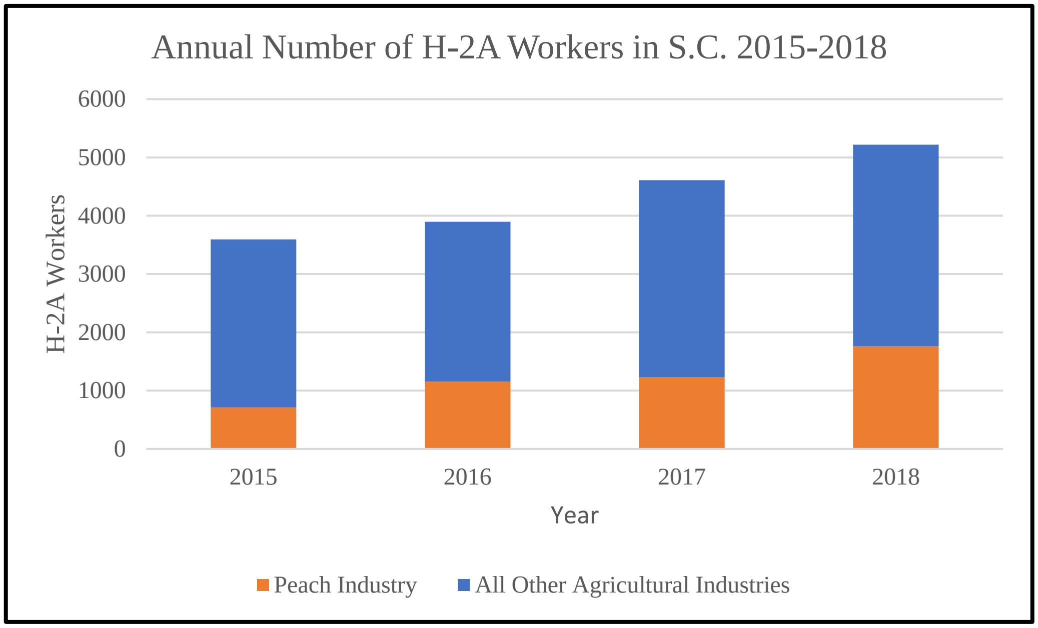

Figure 7: Annual Number of H-2A Workers in S.C.
Source: USDOL OFLC Annual Performance Reports

Objective

This chapter of the thesis presents an economic contribution analysis of the peach industry to the South Carolina economy. The purpose of conducting this analysis is to estimate the contribution of the peach industry to the state's economy. This chapter expands a previous economic impact analysis done by White *et al.* (2018) that examined the economic loss that occurred to the SC agricultural economy due to the 2017 freeze that destroyed much of the state's peach crop.

The model used for the analysis is an Input-Output (I-O) model based upon IMPLAN databases and software. Input-Output models characterize the linkages between different sectors of the economy and create an output multiplier to the overall regional economy. Production data for the model was obtained from USDA NASS and the Census of Agriculture.

Remaining sections of this chapter are as follows; a) Review of relevant literature on regional economic analysis, b) Model discussion on the I-O IMPLAN model used, c) Data discussion used to conduct the contribution analysis, d) Results of the IMPLAN model are reported, and e) Conclusion section discusses the results and suggests further research.

Literature Review

Several economic impact and contribution analyses for agricultural and natural resource industries in South Carolina (SC) have been published in recent years. A search of literature for economic impact and contribution of the peach industry did not reveal any published studies. The relevant literature reviewed in this section is useful for examining the methodology pertaining to economic impact and contribution analysis. Recent studies by London (2015), Hughes (2015), and Willis and Straka (2016) all focus on particular industries in SC to determine those industries' economic impact or contribution to the state's economy. London (2015) examined the agribusiness sector in the state, while Willis and Straka (2016) focus on the natural resources of SC, and Hughes (2015) analyzes the forestry industry. In addition, due to advanced economic modeling programs, such as the Input-Output (I-O) model IMPLAN, techniques on how to perform regional economic analysis has increased in the literature. Hughes (2003) and Watson *et al.* (2007) go in to detail on what goes into analyzing an economic event or sector and provide advice on potential setbacks that are involved with this type of analysis.

Input-output analysis was first developed by the research of 20th century economist Wassily Leontief. Leontief (1966) describes economies, whether referring to regional, national, or global, as a single system based on the classical economic theory of general interdependence. Next, it is the purpose of input-output analysis to measure the effects of the interdependence between sectors in the economy. The analysis focuses on the flow of goods and services through the economy. Leontief (1966) presents an example using the automobile industry. The final output is the automobile, but inputs such as, metals, rubber, glass, etc., are used to make the final product. The purchase of those inputs is dependent on the demand for automobiles, as more automobiles sold will result in more uses of metals, rubber, and glass. The premises of input-output analysis are that there is a fundamental relationship between an industry's output and input quantities and to reflect the structure of the economy (Leotief, 1966).

As the idea of input-output analysis came more prevalent, technology advances allowed for more systematic and accessible software programs that created I-O models. IMPLAN, short for Impact Analysis For Planning, was first created by the United States

Forest Service (USFS). The National Forest Management Act of 1976 tasked the USFS to create management plans for alternative land uses and how outputs from that land would impact local communities. The software program IMPLAN was created and then due to its success, was further developed by the University of Minnesota. Eventually, an independent corporation, the Minnesota IMPLAN Group (MIG, Inc.) was created to manage and sale IMPLAN products (IMPLAN Group, 2019).

Watson *et al.* (2007) attempts to explain the difference between economic contributions and economic impacts and why the difference is relevant in studying regional economics. First, the authors explain what regional economists do, such as providing consultations to local and state politicians on the possible effects of a policy change or a new industry entering the economy. Issues begin to arise with regional economic analysis due to researchers not understanding that there are unique differences in the terms “contribution,” “impact,” and “benefit.” The authors state that many times these terms are mistakenly used synonymously. Regional economists should pay close attention to their terminology in their analyses due to the differing meaning of the terms listed above. Each of the three techniques for analysis, “contribution,” “impact,” and “benefit,” are found using distinctly different processes and can all be useful when used appropriately (Watson *et al.*, 2007).

Economic contribution is defined by Watson *et al.* “as the gross changes in a region’s existing economy that can be attributed to a given industry, event, or policy” (Watson *et al.*, 2007). Descriptive in nature, contribution analysis examines how money is cycled through the regional economy based on the economic activity of the industry, event, or policy. In terms of the field of regional economics, contribution analysis is often the most common found, but it is usually mislabeled as an "economic impact." Economic models used for contribution analysis are constructed to find the linkages that exist between the outputs of sectors and how the output is attributed to particular inputs and value-added components. Next, derived from the linkages found in the economic model, the output multiplier is calculated, which attributes revenues in other sectors in the regional economy to the economic activity of the studied sector. The contribution of the studied industry to the regional economy is found by multiplying the industry's final production by the industry's output multiplier. Essentially, contribution analysis examines an industry, event, or policy to reveal how much of an effect the original study area has on the regional economy. The authors make a note that contribution analysis does not account for the fact that dollars spent in one sector of the economy by consumers are potentially taking away purchases in another sector (Watson *et al.*, 2007).

Next, Watson *et al.* (2007) begin to define the regional Gross Domestic Product (GDP), or value-added, component of regional economic analysis. When examining an individual industry, a regional GDP analysis will determine how much the industry's value-added component contributes to the region's total value-added. The authors state that this type of analysis will offer a more conservative evaluation for a particular industry than a contribution analysis because the value-added is only a subset of the entire contribution. Through regional I-O models, such as IMPLAN, regional GDP analysis can be done with the use of the value-added multiplier (Watson *et al.*, 2007).

As mentioned above, it is often the case that the terms “economic contribution” and “economic impact” are used interchangeably, when in fact they are different and perform differing analyses. Watson *et al.* (2007) define economic impact as an industry, event, or policy that results in “bringing new revenues into the region that would otherwise not occur in the region or keeping revenues in the region that would otherwise be lost to the region” (Watson *et al.*, 2007). Essentially, an economic impact analysis aims to measure the regional economy’s net changes based on the industry, event, or policy. Also, if an industry, event, or policy were withdrawn, an economic impact would examine how much economic activity would be lost from the regional economy. In terms of modeling for an economic impact analysis, a more elaborate approach than an I-O model may be required, such as the Computable General Equilibrium (CGE) model. In addition, a well performed impact study should aim to examine consumer’s behavior in the event that the individual industry is not in the regional economy. For example, if a new industry enters the region, then that new industry could potentially take away consumers from another industry. A true economic impact analysis will attempt to determine the net changes based on the fact that other industries in the region may suffer from a new industry entering the region. Examining the net changes in the regional economy is essentially the main difference in “economic contribution” and “economic impact,” as contribution attempts to find the gross changes (Watson *et al.*, 2007).

An economic benefit is entirely different than economic contribution and economic impact, even though often times benefit is used as a synonym for contribution and impact in regional economic analysis. Economic benefit analysis takes into account overall economic efficiency and social welfare measures, such as compensating variation (CV), equivalent variation (EV), and changes in consumer and producer surplus. For example, a new industry entering into the regional economy may cause other industries loss in revenues and consumers, which may in turn make the economic impact a negative to the region's economy. However, an economic benefit might occur if the consumers' utility has increased due to the new industry entering the region. Social welfare may increase in this region due to consumers having a large willingness to pay (WTP) for the new industry (Watson *et al.*, 2007).

Some of the literature goes more in depth of the methodology of regional economic analysis, such as Hughes (2003), instead of the terminology as seen in Watson *et al.* (2007). Comparatively, Hughes (2003) defines impact analysis as "effects of a positive or negative change in economic activity," which is similar to the definition provided by Watson *et al.* (2007). However, unlike Watson *et al.* (2007), Hughes (2003) does not specify whether the change in economic activity is a gross or net change. Hughes (2003) provides much more detail on using an I-O model and some of the limitations that can occur. Popularity in regional economic analysis and multiplier effects have increased mainly due to the software program IMPLAN, which provides users with a simple process of generating an I-O model. I-O models aim to determine the flow of products between sectors of the economy arriving to final uses, such as purchases by consumers. An important assumption of I-O models is the fixed-proportion production function, which states that "input use moves in lockstep fashion with production" (Hughes, 2003). Essentially, the assumption means that if a firm's output increases by a certain amount, then the inputs for the firm will also increase by the same amount. A completely elastic supply is used for this assumption, which means that demand shifts will only effect output quantity and will have no effect on price. The assumption for an elastic supply requires that firms have no barriers to entry or exit of markets and that all units of a particular input have the same quality (Hughes, 2003).

Hughes (2003) outlines several limitations of economic impact analysis and I-O models. First, feasibility of a project, especially profitability, is not considered when only using impact and multiplier analysis. A positive economic impact or a large multiplier for an industry does not necessarily mean that the industry will be profitable in the region. Because of this, it is favorable to supplement an impact study with a profitability or investment analysis. Also, investment may not be feasible to a region due to resource constraints, even though the studied industry is predicted to have a large multiplier effect. The major limitation of an I-O model is the elastic supply assumption where prices do not change. In most growing economies, price will change due to supply shifts, which is not accounted for in I-O models using multipliers. Similar to Watson *et al.* (2007), Hughes (2003) argues for using a CGE model for impact analysis, which is more complex and adjusts for price changes in the economy. It is important for regional economists to consider all options when determining if an I-O model will generate appropriate results in those situations (Hughes, 2003).

Recent literature regarding regional economic analysis for industries in South Carolina use the techniques outlined above by Watson *et al.* (2007) and Hughes (2003). All relevant literature studied for regional economic analysis used an I-O model, and more specifically the software program IMPLAN was used. London (2015), Hughes (2015), and Willis and Straka (2016) all propose similar explanations for their perspective I-O models. I-O models attempt to find the linkages between industries and consumer expenditures. The interdependency between sectors in the economy are found using I-O analysis.

Breaking down the effects of a studied industry into three categories is prevalent in the literature: direct effects, indirect effects, and induced effects. Direct effects are expenditures and economic activity that are attributed directly to the particular industry of interest. These direct effects are not the only way an industry contributes to the regional economy, as secondary effects can be examined as well. Indirect effects come from other sectors of the regional economy due to the activity in the industry of interest. For example, an indirect effect will occur when an agricultural producer purchases inputs for production. The activity generated from the producer move backward through the supply chain. Indirect effects introduce backward and forward linkages into regional economic analysis. Finally, induced effects are accounted for by employees of a certain industry using wages to purchase goods and services throughout the regional economy. Together, the sum of the direct, indirect, and induced effects create the total effect of an industry to the region. Using the total effect, the industry multiplier to other sectors of the economy can then be calculated.

The results of the three reviewed regional economic analyses for SC provide some overlap. Authors of each study provide impact or contribution analysis for the SC forestry industry. London (2015) used 29 sectors relating to forestry in the IMPLAN model, which estimated that the forestry industry had a total effect of $16.9 billion to the SC economy. Hughes (2015) based his analysis on London (2015), but added several more forestry related sectors, such as forest-based recreation, forest-based biofuel activity, and other forestry related industries. Using London's (2015) estimate of $16.9 billion, Hughes (2015) found that when adding in the additional forestry sectors listed above, the total effect of forestry to the SC economy was $18.573 billion. Willis and Straka (2016) use similar methodology to determine the effect of the forestry industry. Like London (2015), Willis and Straka (2016) use the 29 forestry related sectors in the IMPLAN model. The conclusions of Willis and Straka (2016) predict that the forestry sector has a total effect of $19.4 billion to the SC economy. The differences in figures from London (2015) and Willis and Straka (2016) could possibly be attributed to the analyses being performed in different years.

Furthermore, where the reviewed literature mainly differs is in the terminology the authors use in describing their analyses. London (2015) and Hughes (2015) both use the terminology of "impact" to title their studies. Willis and Straka (2016) choose to entitle their analysis as an "economic contribution." As Watson *et al.* (2007) noted, it is important to distinguish these two differing analyses. However, London (2015), Willis and Straka (2016), and Hughes (2015) all tend to use the terms interchangeably in their studies.

Model

An Input-Output (I-O) model was chosen to determine the economic contribution of the peach industry to the South Carolina economy. Input-Output analysis was performed due to familiarity of similar studies done for industries in SC using I-O models. In addition, I-O models are popular in regional economic analysis throughout the country because of the readily accessible software program IMPLAN, which has been refined and tested over the years, as well as being generally accepted by academics and industry.

Economic contribution analysis is becoming more and more popular to estimate the effect of an existing firm, sector, or industry to a regional economy. Contribution analysis differs from impact analysis in that an impact is determined by a change to the economy, such as the loss or gain of an industry or an event that increased or decreased economic activity. For example, in a similar study involving the SC peach industry, White *et al.* (2018) estimated the economic impact to the SC economy of the 2017 freeze that ruined much of the state's peach crop. This study differs slightly in that an event or change is not examined, but the contribution of the entire peach industry to the state's economy is estimated.

An I-O model shows the effect of activity in one industry on other sectors of the regional economy. The model is based on the dependencies of one industry to another, showing effects in total output, employment, labor compensation, and value added. Effects from the model are broken down into three categories to find the total effect. A direct effect is the economic activity tied to the particular industry being studied. Next, an indirect effect is attributed to other industries in relation to the direct effect of the initial industry, such as the purchase of inputs. Third, an induced effect is the household expenditure to employees based on the direct effect to the studied industry. The total effect calculated by the I-O model is the sum of all the direct effects, indirect effects, and induced effects.

For this study, the I-O model chosen was the IMPLAN model due to its ability to run on a regional basis. Models in IMPLAN are able to run for the entire state or can be run on a county-by-county basis. As mentioned above, IMPLAN separates the total economic effect into direct, indirect, and induced effects. Also, the model predicts multipliers from industries to the overall regional economy.

Data

The 2016 version of IMPLAN was used for the I-O model, which uses 2014 data to formulate a regional economic analysis using the state of South Carolina. Due to the data being from 2014, IMPLAN allows for dollar amounts to be converted into other years, in which case dollars were converted into 2019 values for this contribution analysis.

This version of IMPLAN separates the regional economy into 536 different sectors. The specific sector in IMPLAN examined for this study was the Fruit Farming sector, coded as (4) in IMPLAN. Through secondary data from IMPLAN, sector specific parameters are established based on national sector averages. Production functions, which include intermediate input and value-added expenditures, are based on national fruit farming averages. Allowing IMPLAN to run an I-O model based entirely on one specific commodity, in this case peaches, would require time consuming and extensive primary data collection from all involved producers and intermediaries in the SC peach industry. The resources required to collect the primary data were beyond the scope of this study. The established parameters for the Fruit Farming sector in IMPLAN were assumed to be adequate for this analysis based on that the SC peach industry should closely resemble how the overall national fruit sector operates (Schmit *et al.*, 2019).

Production data used to enter into IMPLAN was obtained from the USDA National Agricultural Statistics Service Quick Stats database (https://quickstats.nass.usda.gov/). Data on peach annual production values in SC was available for the 12-year period of 2007 to 2018. To determine the contribution of the peach industry to the state's economy, two scenarios were examined. First, the 2018 production value of $71,546,000 was entered as the starting point for IMPLAN to use in Scenario 1 due to 2018 being the latest full growing season to take place. The 2018 crop was representative of expected production and price was above average. Second, since the value of $71,546,000 could be considered higher than the historical norm, the median of the 12 reported years was used for Scenario 2. As mentioned previously, the spread of the production values in the last 12 years has been wide with a standard deviation of $23,596,675.56. Due to the disperse data, the median was determined to be a better indicator as opposed to the average. Also, the average could be considered biased as years 2007 and 2017, when late freezes occurred, would negatively bias the average value. The median of the 12 reported years was calculated as $66,526,500 and was used as the starting point for IMPLAN in Scenario 2.

Results

The two different scenarios as described in the previous section were run with the IMPLAN I-O model to reflect the most recent peach production in South Carolina and compare with a peach production estimate based on a longer run history that includes up and down years due to uncertainties involving weather. Results under Scenario 1 are shown in Table 1 below. Scenario 1, which used the production value of $71,546,000 from 2018, found that the total contribution of the peach industry to the state's economy is $111,761,651. This contribution includes all effects, direct, indirect, and induced. The indirect effect of adding 74 jobs and $2,884,344 in labor income generates an output of $6,349,628 to other industries in SC. The induced effect of 247 jobs estimates employees' household expenditure is $33,866,019 from the direct effects of the peach industry. Based on the results from IMPLAN, the total output multiplier for the peach industry in SC would be 1.56. In addition, it is estimated that the peach industry is responsible for a total of 1,926 jobs around the state and a total employee income of $55,961,752.

Impact Type	Employment (Jobs)	Labor Income ($)	Total Value Added ($)	Output ($)
Direct Effect	1,604	42,822,833	68,007,645	71,546,004
Indirect Effect	74	2,884,344	3,976,742	6,349,628
Induced Effect	247	10,254,575	18,711,881	33,866,019
Total Effect	1,926	55,961,752	90,696,267	111,761,651

Table 1: Economic Contribution of Peach Industry to SC from Scenario 1
Note: Scenario 1 uses the 2018 production value of $71,546,000

Next, Scenario 2 used the 12-year median of peach production value in SC, $66,526,500, to determine the economic contribution to the state. Results for Scenario 2 are reported in Table 2 shown below. With this scenario, it is estimated that a total effect of $103,920,715 is the contribution of the peach industry to SC. Based on these results the total output multiplier for the peach industry is 1.56, the same as Scenario 1. The multiplier did not change as the production functions and linkages were not changed, just the production value. Also, it is projected that the peach industry accounts for a total of 1,791 jobs and employee income of $52,035,607.

Impact Type	Employment (Jobs)	Labor Income ($)	Total Value Added ($)	Output ($)
Direct Effect	1,492	39,818,483	63,236,387	66,526,504
Indirect Effect	69	2,681,985	3,697,743	5,904,153
Induced Effect	230	9,535,138	17,399,099	31,490,058
Total Effect	1,791	52,035,607	84,333,229	103,920,715

Table 2: Economic Contribution of Peach Industry to SC from Scenario 2
Note: Scenario 2 uses the median of the 12-year production values of $66,526,500

Based on the two scenarios it is estimated that the peach industry in South Carolina has an annual economic contribution of $103,920,715 to $111,761,651 with an output multiplier of 1.56. A total output multiplier shows how dollars generated by an industry are cycled through the economy to the final output of the region. In this case, an output multiplier of 1.56 means that for every $1 that the SC peach industry generates, $1.56 is contributed to the entire SC economy. The output multiplier may be slightly high due to IMPLAN’s modeling techniques, but the value of 1.56 is similar to multipliers for most agricultural commodities in SC, as they are typically around 1.5 as reported by London (2015). In addition, the total job multiplier from both scenarios is estimated to be

1.2. Job multipliers work in the same fashion as the output multiplier, meaning that one job in the peach industry contributes 1.2 jobs to the SC economy.

These results are in line with the previous study by White *et al.* (2018) that examined the economic loss of the peach freeze in 2017 when 80 to 90 percent of the peach crop was lost. White *et al.* (2018) estimated that the economic impact to the state's economy from the loss in 2017 was $85,457,251 to $92,495,267 (White *et al.*, 2018). It makes sense that the results from the contribution analysis results in greater effects because a typical growing season is examined, not one that only produced 10 to 20 percent of peaches like in 2017.

A curious result from both scenarios is the total number of jobs estimated by the IMPLAN I-O model. Scenario 1 estimated 1,926 total jobs and Scenario 2 estimated 1,791 total jobs. According to the US Department of Labor, SC was certified for 1,761 H-2A workers to work in the peach industry in 2018. The majority of the H-2A workers likely were hired for field work, harvest, and working in packing sheds. The H-2A workers would be expected to be reflected in the direct jobs estimate. Thus, the model could be underestimating the total jobs and income contribution of peach production based on H-2A data.

Conclusion

Peach production and consumption in the United States has been declining over the last decade. South Carolina has experienced a similar trend, but peaches remain a vital industry in SC. As the second leading peach producing state in the country, SC peaches are important to the national supply of the fresh fruit market. Also, the peach industry is a major contributor to the state's agricultural industry and the overall economy. As a top ten commodity in the SC, the peach industry consistently has annual production values of over $60,000,000. Furthermore, as bearing and non-bearing acreage of peach trees has increased slightly over the last 15 years, it is possible that SC could increase total production.

The production of peaches results in a large direct economic contribution to the SC economy. As peaches leave the farms and are shipped to farmers markets, retail stores, and processors, dollars are generated through the state's economy. Using two scenarios of production values of SC peaches, IMPLAN I-O models estimate that the peach industry contributes between $103,920,715 to $111,761,651 to the SC economy. In addition, it is projected that the peach industry has an output multiplier to the state's economy of 1.56 and a job multiplier of 1.2.

Further research related to the economic contribution of the SC peach industry could include using other economic analysis models, such as a Computable General Equilibrium (CGE). Literature suggests the CGE model will be better able to determine the net effect the industry has on the state's economy. Another suggestion is to develop more detailed I-O models based on primary data. The reported contribution figures above may underestimate or not be totally indicative of the peach industry. A more detailed analysis using primary data from the SC peach industry could estimate the total effect more precisely. Primary data, including producer and labor numbers, packing sheds, processing facilities in SC, and SC peach production functions could be used to modify the IMPLAN model to more accurately reflect the peach industry instead of using IMPLAN's established parameters for the fruit farming sector. However, overall the purpose of this chapter of the thesis was to conduct an analysis in the absence of any publications found in the literature and to better understand the importance of the SC peach industry to the state and to the nation. Determining the economic contribution of the industry will give producers, consumers, and policy makers a better perspective on the significance of South Carolina peaches.

CHAPTER 2: AN INVESTMENT ANALYSIS OF A 40-ACRE PEACH ORCHARD IN SOUTH CAROLINA

Introduction

This chapter of the thesis focuses on an orchard investment decision of peach producers in South Carolina (SC). In order to examine this financial decision, production costs and revenues are estimated through the development of peach enterprise budgets. The budgets provide information on how the production process and specific inputs are used to produce peaches. Enterprise budgets are resources that producers use to help project their costs and expected profits when planning for a growing season. An investment analysis using a Net Present Value (NPV) method was presented for a 40-acre peach orchard in SC. An investment analysis was included to assess the financial feasibility of producing peaches in SC.

Enterprise budgets for agricultural commodities are found from many sources throughout the country, particularly land grant universities' Cooperative Extension Services. Specifically, Clemson University Cooperative Extension offers enterprise budgets for several commodities grown in the SC. However, even though SC is the second leading peach producing state in the US, peach enterprise budgets are currently not available through Clemson Cooperative Extension. The last peach enterprise budget developed by Clemson Extension was published in 2004. Also, the last peach enterprise budget developed in the largest peach production region of the Southeast was in 2007 by the University of Georgia. With SC and Georgia being two of the top three peach producing states in the US, it is important to establish an updated peach enterprise budget for producers in this region to use.

Peach enterprise budgets are somewhat different than other enterprise budgets for annual crops due to peach trees being perennial. Peaches grow on the tree year after year without any replanting for 15 years or more in commercial production. Also, there are different stages of maturity for a peach orchard as well as dozens or more varieties planted. Peach trees generally will not be harvested of fruit until year three and do not reach full maturity until years four to five. Since differing maturity stages bring about differing production practices, budgets are constructed for each year until full maturity is reached. Therefore, the peach enterprise budget includes budgets for year one or establishment, year two, year three, and year four. The establishment budget involves land preparation for an orchard and the planting of the peach trees. The year two budget mainly focuses on maintenance of the orchard. Year three of the orchard begins the yearly spray programs required for peach trees and will produce a smaller yield than mature trees. The year four budget is the budget that will be used for the duration of the orchard and conveys production practices used for trees at full maturity. Peach trees in SC will typically last for 12 to 15 years after planting so the year four budget can be used repeatedly until the end of the orchard life.

Objective

The objective of this chapter is to perform an investment analysis of a 40-acre peach orchard in SC using a Net Present Value (NPV) approach. NPV calculations are performed using total cost estimates derived from newly developed peach enterprise budgets. The purpose of this chapter is to help provide cost estimate information to current and future peach producers when planning to establish a new orchard.

The methodology chosen for this part of the study is a NPV approach to investment analysis. NPV is a financial tool to determine the value in the present term of an investment or project that has future costs and benefits. Since NPV accounts for the time value of money, future annual cash inflows and outflows for a peach orchard will be discounted to estimate if an orchard will be profitable. The NPV model is built using Microsoft Excel that includes a Monte Carlo simulation. Monte Carlo simulations change variables in an analysis to show how uncertainty can change the forecast of investments.

Sections of this chapter are as follows; a) Relevant literature on capital budgeting and investment analysis, b) A discussion on the financial methodology used, c) Data and assumptions, d) Results of the calculations of the NPV, and e) The chapter concludes with further research and discussion.

Literature Review

Capital investment evaluation methods have been prevalent in agricultural finance and management literature for the last several decades. Decisions regarding capital investments are especially essential to agricultural producers due to the fact that large initial investments are required to start the operation, but the benefits may not accrue to the producer for a number of years. Producers will not expect to receive all income and benefits right away from capital assets, such as land, machinery, and buildings.

Investment analysis or capital budgeting must be performed to evaluate the future income that stems from the initial capital investments.

Most relevant literature includes steps that should be taken when evaluating capital investment projects. For the most part the steps are basically the same across works, but some authors add additional steps and different ordering. Boehlje and Eidman (1984) and Lee *et al.* (1988) present a four-step method in evaluating capital investments. The first step is the same for both methods, but the remaining three steps differ somewhat. Boehlje and Eidman (1984) present their four-step method as follows:

1. Identify all possible profitable investment opportunities
2. Evaluate the economic profitability and financial feasibility of the various investment opportunities
3. Reevaluate the decision under different price and yield assumptions
4. Choose an alternative based on the economic and financial evaluation as well as other factors that would influence the investment decision (Boehlje and Eidman, 1984, p. 315)

Boehlje and Eidman (1984) also advise that collection of the appropriate data for the investment analysis is the most important part (Boehlje and Eidman, 1984, p. 315). Lee *et al.* (1988) provide a slightly different four step method:

1. Identify potentially profitable investment alternatives
2. Collect relevant data on capital outlays, costs, and returns
3. Use an appropriate method to analyze the data

4. Decide whether to accept or reject the investment or select the top ranking among mutually exclusive projects (Lee *et al.*, 1988, p. 70)

Olson (2011) presents a method of investment analysis in six steps, instead of four, but provides similar guidance:

1. Identify investment alternatives
2. Estimate receipts and costs in each year
3. Evaluate economic profitability
4. Evaluate financial feasibility
5. Conduct a sensitivity analysis
6. Select investment (Olson, 2011, pp. 373-374)

All three methods provide the same end result, but have different ways of getting there. It is important to note that Olson (2011) and Boehlje and Eidman (1984) include a step for a sensitivity analysis for the capital investment. Sensitivity analysis allows the decision maker to prepare for different scenarios than what is being estimated under the initial assumptions. Due to the investment analysis projecting future benefits and costs, changing the initial assumptions will give an idea as to what variables will affect the investment decision the most. Variables such as price, interest rates, production costs and quantities could all change the profitability and feasibility of the investment.

Since investment analysis evaluates present costs and future benefits, the time value of money must be considered, as a dollar received tomorrow does not equate to a dollar spent today. Levy and Sarnat (1990) present an investment with costs and benefits that are known with certainty as an example. Even though the present outlays and future cash flows are known, determining the feasibility of the investment still depends on the timing of such benefits. To continue, Levy and Sarnat (1990) consider an investment of $1,000 today that will return $1,100 one year later. The decision maker must consider if it is worth it to spend the $1,000 in the present in order to receive the future payment of $1,100. In making a decision, alternatives must be considered. The authors make the case of a 12 percent interest rate when depositing the $1,000 into the bank, which at the end of the year will make the value of the deposit $1,120 ($1000*1.12). Based on this alternative, the original investment would not be desirable because the deposit becomes greater than the return of the investment. If, on the other hand, the deposit will only generate 8 percent interest, the original proposed investment will be desired because the $1,100 return will exceed the value of the deposit of $1,080. Based on the example, it is important to consider all alternatives and the timing of a capital investment when making a decision (Levy and Sarnat, 1990, pp. 30-31).

Lee *et al.* (1988) offer a three-part explanation of why a dollar today is worth more than a dollar in the future. First, due to uncertainty, it is preferred to receive a dollar today instead of a dollar in the future. For example, if someone was offered the choice of $1,000 today or $1,000 one year from now, the money offered today would be the desirable choice because of the uncertainty of receiving the money in a year. Money in hand today is a for sure thing, while the possibility of receiving money one year from now is not. Next, similar to Levy and Sarnat (1990), Lee *et al.* (1988) use alternatives to explain the time value of money. It is possible that it is preferable to receive the $1,000 today, instead of a year from now, because it is needed to purchase something now. On the other hand, the money could be used to as an investment to earn interest or put into a savings account. The alternative uses of the money must be studied when considering the time value of money. Last, the concept of inflation is a determinant of the time value of money. Inflation causes money today to have less purchasing power in the future due to rising price levels in the economy (Lee *et al.*, 1988, pp. 58-59).

The literature presents several methods to evaluate capital investment projects. The best methods use the concept of time value of money to help the decision maker determine if an investment will be feasible. Most authors offer four ways to measure profitability of an investment:

1. Payback period
2. Simple Rate of Return (SRR)
3. Net Present Value (NPV)
4. Internal Rate of Return (IRR)

Olson (2011) presents the Modified Internal Rate of Return (MIRR) as fifth option.

Payback period is a tool that is often most common when referring to an investment because of its simplicity. Payback is described as the amount of time, usually years, that it takes for the investment's earnings to recover the original costs incurred. Boehlje and Eidman (1984), Lee *et al.* (1988), and Olson (2011) all make the case that close attention should be adhered to when using this method. Payback period has shortcomings due to it not accounting for economic profitability, as it is more a measure of liquidity than anything else. The method does not factor in the timing of cash flows, therefore revenues made after payback are not considered. In addition, as Boehlje and Eidman (1984) and Lee *et al.* (1988) explain, the payback method does not offer a logical basis when determining what is an acceptable result when using the method. Olson (2011) also outlines that payback period does not factor in the time value of money, as it is not discounted back to present terms. Based on these deficiencies, payback period method is not a reasonable tool when evaluating capital investments.

Simple Rate of Return (SRR) of an investment is a percentage that reflects the average annual net return divided by the initial investment outlay. Olson (2011) and Lee *et al.* (1988) offer an additional way of computing SRR that divides the average net return by the average investment amount. When determining if the SRR is acceptable, the decision maker would compare the SRR to some minimum rate of return on the investment. Compared to the payback period method, SRR is a superior method of evaluation, however SRR is not without its shortcomings either. As its name reflects, it is a simple calculation. The main issue is that the method does not factor in the time value of money. Furthermore, SRR ignores the timing of the yearly cash flows due to it considering the average of the net returns over the time horizon.

Based on the deficiencies of the payback method and SRR, the Net Present Value (NPV) method offers one of the best evaluations of an investment because it considers the time value of money. Boehlje and Eidman (1984) make the case for NPV because it factors in the opportunity cost of having funds tied into capital. In other words, NPV takes into account the alternative use of the initial funds tied to the capital. NPV uses a determined discount rate to show the present value of the future benefits of the investment. The method sums all discounted future cash flows minus the initial investment amount. The investment is considered acceptable when the NPV is positive, which indicates that the present value of the future returns is greater than the initial investment amount. For the case of an agricultural operation, the formula for NPV is adjusted somewhat due to having an initial investment cost, but also variable and fixed costs that will occur every year. In this case, the discounted future returns will be subtracted by the discounted future costs and the initial investment.

The Internal Rate of Return (IRR) is an additional method that factors in the time value of money. It is the discount rate that equates the NPV to zero. Or in other words, IRR is the rate that makes the present value of future returns equal to the initial investment cost. As Lee *et al.* (1988) note, the IRR and NPV are closely related and for the most part will yield the same results when evaluating an investment. Levy and Sarnat (1990) lay out a graphical example for NPV and IRR:

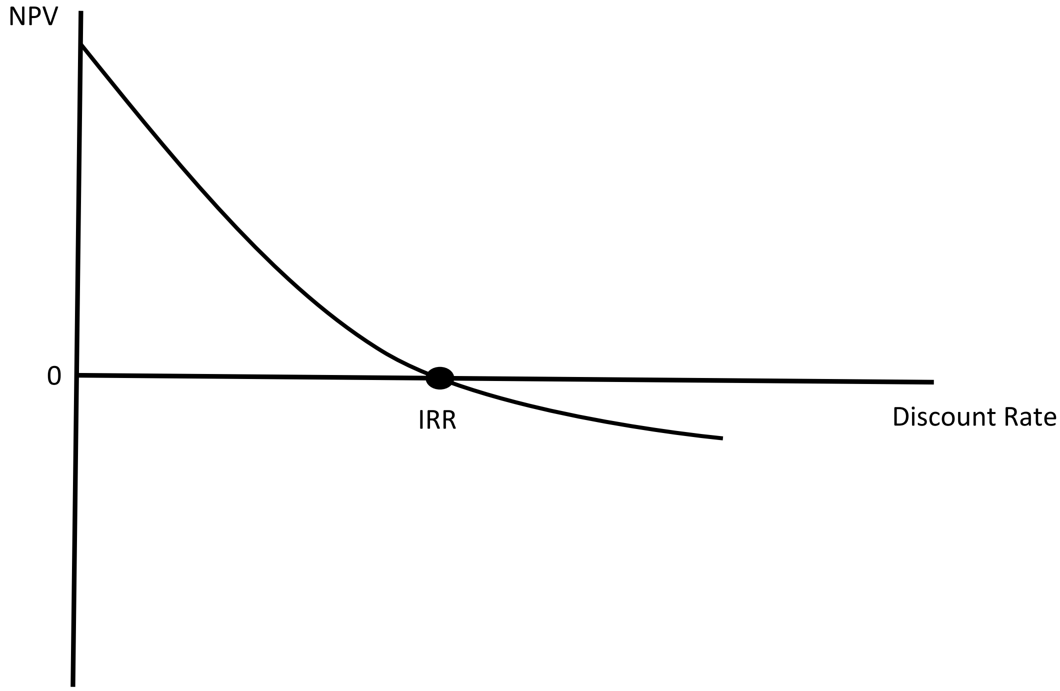

Figure 8: Graphical Representation of How the Discount Rate Effects NPV

As shown above, the NPV is on the vertical axis and the discount rate is on the horizontal axis. The NPV decreases as the discount rate increases and the IRR is the discount rate that equates the NPV to zero (Levy and Sarnat, 1990, pp. 38-39).

Moss (2013) outlines an approach to performing an investment analysis using the NPV method to examine the profitability of a citrus operation in Florida. First, the initial investment is broken down into land preparation, tree planting, and irrigation. Assuming a parcel of land that has not been in production, the land must be prepared and modified for orange tree planting. In the case of flatter land, rows or mounds must be formed for reduction of water damage to tree roots before planting. If the land is on a ridge, less land preparation is required. In either case however, retention ponds and other land improvements must be made. Moss (2013) advises to determine a per tree planting and land preparation costs. When planting the trees, decisions must be made on the type of tree and the density of the trees in the orchard. Also, a final component of land preparation is to set up irrigation to the orchard. A typical irrigation system for tree fruit farming uses micro-jets at the base of trees (Moss, 2013, p. 128).

Next, Moss (2013) considers the costs and returns of the citrus operation. Yield from an orange tree depends entirely on the maturity of the tree, as does all tree fruits. In this particular example, the production cycle for an orange tree reaches its peak around years 13-15 and will taper off after year 15, possibly even declining. To estimate variable costs, Moss (2013) uses enterprise budgets from the University of Florida's Extension Service. Enterprise budgets are provided by Land Grant universities to their individual states to best estimate costs of production for certain agricultural products. The most critical issue in extended NPV analyses is trying to project future prices of a commodity. In the citrus analysis, Moss (2013) explains that historical prices of citrus have been extremely volatile due to emergence of other countries, such as Brazil. The first price Moss (2013) uses is based on the average of the last five years, but it is historically high. Because of this Moss (2013) performs a sensitivity analysis showing what happens to the NPV calculation when the price received of oranges changes. It is found that a positive NPV occurs when the price is at or above $5.25 a box. Also, in the NPV calculation Moss (2013) uses a discount rate of 8%. Since this analysis involves several years in the future, it is important to account for inflation as variable costs and output prices could increase over time. With citrus and other tree fruits, the NPV calculation must factor in the declining yields an orchard will face over time (Moss, 2013, pp. 128-132).

Methodology

This thesis uses a Net Present Value (NPV) approach for the investment analysis of a 40-acre peach orchard. NPV was chosen because of it factoring in the time value of money and discounting future inflows into present terms. When examining peach trees, which can last up to 12 to 15 years in South Carolina, the time between planting and yields occurring several years into the future must be considered. Using a discount rate and NPV, it is possible to compare future revenues to the initial investment of the peach orchard. For this example, the NPV is formulized as:

$$(1)\ NPV = \sum_{t=1}^{N} \frac{NR_t}{(1+r)^t} - I$$

Where *NPV* is the net present value of the investment, in this case a 40-acre peach orchard, *N* is the lifetime of the peach orchard, NR_t is the annual net revenues generated from the orchard for the period *t* measured in years, *r* is the discount rate used, and *I* is the initial investment outlay required for the peach orchard.

When accessing the value of NPV, a good investment would have a NPV greater than zero. The higher the value of NPV, the more attractive the investment is. Due to the uncertainties that come with any agricultural commodity, a Monte Carlo simulation was included to include risk in the analysis. Monte Carlo simulations have become a popular method in dealing with conditions of risk and uncertainty when performing financial analysis. A Monte Carlo analysis uses simulations based on stochastic variables that affect the investment’s returns. The stochastic variables are based on a probability distribution, which creates random values from the distribution to show how the variables effect the NPV (Yeboah *et al*., 2013).

Data and Assumptions

To perform the investment analysis for a peach orchard in South Carolina, enterprise budgets were used to determine yearly production costs and revenues. As previously stated, peach enterprise budgets for SC were constructed due to Clemson Cooperative Extension not publishing an updated budget since 2004. Several peach producers around the state were consulted to learn updated production practices and to gather costs of production for peaches. In addition, peach specialists and extension agents from Clemson Extension were involved in the process to construct new budgets for SC peaches.

The enterprise budgets were constructed using the Mississippi State Budget Generator (MSBG), which is a software program offered through the Mississippi State Department of Agricultural Economics and Extension Service (https://www.agecon.msstate.edu/whatwedo/budgets/generator/index.php). The peach enterprise budgets use budgeting techniques consistent with recommendations in the American Agricultural Economics Association Commodity Cost of Returns and Estimation Handbook (2000). MSBG provides computerized calculation methods for time multipliers of tractor use, fuel multipliers, and labor multipliers. Tractor and machinery costs are based on engineering formulas and factors from the American Society of Agricultural and Biological Engineers Standards (2015).

The peach enterprise budgets and NPV calculations are based on several assumptions. First, the budget focuses on a 40-acre peach orchard with 145 tree density per acre. The orchard is arranged with a tree spacing of 19 feet by 16 feet. These orchard measurements and tree counts are consistent with current practices by peach producers in SC. In addition, the budgets are assumed to be based on a July Prince peach, which is a mid-season variety that is harvested in early to middle July. Revenues are determined using SC historical peach prices obtained through the USDA Agricultural Marketing Service and annual yield counts for SC peaches (https://www.ams.usda.gov/market-news/fruits-vegetables). Both price and yield data from 2008 to 2018 is used for the analysis.

The initial investment per acre is estimated to be $18,119.50. This figure includes land acquisition, land preparation, orchard establishment, and machinery, such as tractors and implements. The budget uses four tractors, a 185 horsepower, 100 horsepower, 85 horsepower, and a 45 horsepower. Several implements are required to prepare the land for an orchard, which are a levy plow, heavy disk plow, and a V ripper plow with emitters for fumigating. Next, a rotary mower, flail mower, and a seed drill are included for maintenance of the orchard. For the use of inputs in the production process, a nurse tank, orchard sprayer, pull type herbicide sprayer, and a fertilizer spreader are additional implements.

For the Monte Carlo simulation, the stochastic variables chosen were price and yield. Both price and yield are assumed to have a normal distribution. Weekly price data from the growing seasons of 2008 to 2018 were examined to calculate the average and standard deviation. Average peach price for SC was calculated as $0.55 per pound and a standard deviation of $0.18. Annual peach yield for SC for 2008 to 2018 was used to determine average yield per acre and standard deviation. The average annual peach yield was calculated as 12,500 pounds per acre, which equates to 250 bushels per acre, with a standard deviation of 3,092 pounds. Using the normal distribution and Microsoft Excel's random number function, prices and yield for the NPV analysis were generated based on the averages and standard deviations. The correlation between price and yield for years 2008 to 2018 was found to improve upon the model as well since these two variables are negatively related and not independent of each other. This correlation was used in the Excel model to further improve the NPV analysis.

Results

The correlation between historical prices and yield was calculated as -0.8664. This value was used in Excel where price and yield were randomly generated subject to the correlation coefficient for a 12-year time horizon. The Monte Carlo simulation performed 1000 iterations of the NPV based on the stochastic variables price and yield. An example of these calculations is shown in Table 3 below. Based on these parameters with a 10 percent discount rate and the Monte Carlo simulations, NPV is estimated to be negative. Table 4 shows the summary statistics of one Monte Carlo simulation. The main highlight is that in the 1000 iterations of NPV, the simulation returned 7.10 percent of positive NPVs. In other words, the majority of the time, 92.9 percent, NPV is estimated to be negative. The mean of NPV from the 1000 iterations is -$3,725.44 and a standard deviation of $2,571.66. The minimum NPV of the simulation is -$14,208.78 and the maximum NPV is $3,149.25.

Year	Yield (lbs)	Price	Costs	Revenue	Net Revenue	Discount Factor	Discounted Net Revenue	NPV per acre
1	0.00		$18,119.50	$0.00	-$18,119.50	1	-$18,119.50	-$3,314.68
2	0.00		$933.51	$0.00	-$933.51	1.1	-$848.65	
3	15040.99	$0.53	$3,075.60	$8,272.54	$5,196.94	1.21	$4,294.99	
4	13682.59	$0.55	$3,863.93	$7,557.48	$3,693.55	1.331	$2,775.02	
5	11211.18	$0.59	$3,863.93	$6,610.14	$2,746.21	1.4641	$1,875.70	
6	18589.62	$0.19	$3,863.93	$3,458.54	-$405.39	1.61051	-$251.71	
7	12103.28	$0.51	$3,863.93	$6,211.58	$2,347.65	1.771561	$1,325.19	
8	15907.27	$0.43	$3,863.93	$6,895.62	$3,031.69	1.9487171	$1,555.74	
9	13135.51	$0.50	$3,863.93	$6,605.94	$2,742.01	2.14358881	$1,279.17	
10	9443.15	$0.70	$3,863.93	$6,614.69	$2,750.76	2.357947691	$1,166.59	
11	13636.37	$0.51	$3,863.93	$7,003.43	$3,139.50	2.59374246	$1,210.41	
12	11378.67	$0.45	$3,863.93	$5,069.01	$1,205.08	2.853116706	$422.37	

Table 3: NPV calculations using price and yield as stochastic variables for a 12-year time horizon
Note: All values are reported as per acre

Number of Samples	1000
NPV Mean	-$3,725.44
NPV Std. Dev.	$2,571.66
Maximum	$3,149.25
Minimum	-$14,208.78
Probability of Positive NPV	7.10%

Table 4: Monte Carlo Results from Table 3 scenario of 12-year time horizon

An additional scenario was included that extended the orchard life to 15 years. For a discount rate of 10%, results in this scenario still estimate a negative NPV, but less negative than NPVs for a 12-year time horizon. Summary statistics from the Monte Carlo simulations for a 15-year orchard are shown in Table 5. The mean of NPV is -$1,656.08 and a standard deviation of $2,723.10. The minimum NPV is -$14,213.71 and the maximum is $5,980.52. There is a higher probability of a positive NPV, 27.60 percent, in a 15-year time horizon compared to the 12-year time horizon reported above.

Number of Samples	1000
NPV Mean	-$1,656.08
NPV Std. Dev.	$2,723.10
Maximum	$5,980.52
Minimum	-$14,213.71
Probability of Positive NPV	27.60%

Table 5: Monte Carlo results from a 15-year time horizon

It was important to include a sensitivity analysis that shows how the discount rate effects the NPV calculations. This analysis allows producers to examine all alternative options when deciding on establishing a peach orchard. The results of the sensitivity analysis are reported below in Table 6 for a 12-year orchard and in Table 7 for a 15-year orchard. Discount rates that are included range from three percent to 12 percent, increasing by increments of one percent. The means of the NPV and the probability of positive NPVs from the Monte Carlo simulation are reported. As expected the lowest discount rate produces the highest means of NPV and probability of a positive NPV. These values decrease as the discount rate increases to 12 percent. The NPV becomes negative between a discount rate five and six percent for a 12-year orchard and between a discount rate of eight and nine percent for a 15-year orchard.

Discount Rate	NPV Mean	Probability of Positive NPV
3%	$2,948.12	79.80%
4%	$1,847.67	70.00%
5%	$732.65	60.40%
6%	-$197.96	45.10%
7%	-$1,194.48	35.40%
8%	-$2,323.67	21.60%
9%	-$2,966.25	14.20%
10%	-$3,781.55	8.20%
11%	-$4,672.59	3.20%
12%	-$5,133.43	1.20%

Table 6: Sensitivity Analysis With Changing Discount Rates for 12-year Time Horizon

Discount Rate	NPV Mean	Probability of Positive NPV
3%	$8,304.07	97.40%
4%	$6,274.87	95.10%
5%	$4,638.24	91.70%
6%	$3,375.89	83.80%
7%	$1,947.99	75.30%
8%	$673.08	57.90%
9%	-$503.64	45.60%
10%	-$1,597.01	26.20%
11%	-$2,582.18	16.80%
12%	-$3,524.66	10.00%

Table 7: Sensitivity Analysis With Changing Discount Rates for 15-year Time Horizon

Conclusion

As one of the top commodities grown in South Carolina, it is important that enterprise budgets were made available to peach producers and the public. Enterprise budgets make decision making easier for agricultural producers by allowing them to estimate their expected costs and returns in preparation for a growing season. Along with the peach enterprise budgets, it is vital that producers have relevant information regarding investment opportunities when establishing their first orchard or adding additional ones to an existing farm.

Using Net Present Value (NPV) techniques best shows investment opportunities in a peach orchard because it allows future cash flows to be considered in present terms using a discount rate. There are lots of costs on the front side of the investment due to acquisition of land, land preparation, and the fact that the peach trees will not produce any yield until year three. Returns for peach producers really begin to increase in years four to eight when the peach trees reach full maturity. The latter years of the peach orchard will show some decline in yields, which results in the ending of the current orchard and the establishment of a new one.

Next, of course with any investment analysis there is risk involved, even more so when the investment is an agricultural commodity. Using the data available and assumptions previously stated, negative NPVs are estimated for peaches in SC when discount rates are over six percent for a 12-year orchard and over nine percent for a 15-year orchard. It is important to note that limitations exist for this analysis based on the assumptions. Price data represents the shipping point price for the Georgia and South Carolina region. The average price calculated could be lower or higher than a producer receives due to location or marketing differences. The costs estimated are based solely on a July Prince peach, which is a mid-maturity peach. Different costs and revenues would occur when other varieties that are early-maturities and late-maturities are included in an analysis. In the NPV simulation model, crop insurance indemnities are not included. In low yield years, crop insurance indemnities would be expected to offset some of the revenue loss. Next, the peach enterprise budget assumes high investment costs due to the establishment of the orchard. The budget assumes that land and new machinery must be acquired to establish the orchard. This assumption would not hold in the case of an existing peach farm that already has land and equipment when establishing new orchards. It should also be noted that data obtained is aggregated on the state level.

Further limitations are that it is difficult to predict future prices of peaches in the present time and that bad years caused by weather are an unknown when projecting yield. To help predict the uncertainty, revenues in this analysis are randomly generated based on a normal distribution for variables price and yield, but one or both variables may not be normally distributed. An expected yield (mean) of 12,500 pounds per acre is assumed in the analysis. The expected yield could be higher or lower than assumed. Also, the yield standard deviation is based on state level data, meaning an individual producer's variability could be higher or lower than that state. Results from this analysis are heavily influenced by the estimated correlation coefficient between price and yield for SC. The assumed correlation between price and yield may be higher than reality depending on how a producer markets peaches. Finding the true correlation for price and yield would present a better prediction of NPV. If the correlation coefficient used in this analysis is overestimated, NPV for peaches will become less negative as the correlation becomes less negative.

The purpose of this chapter of the thesis is to give peach producers in SC more information to plan for the production of peaches. Using peach enterprise budgets can be an excellent resource for producers to use. Whether the budgets are used as a template or a guideline, it is vital for producers to map out their costs and returns to better plan for the season. Furthermore, the investment analysis of a peach orchard can be used by existing peach producers and potential new producers by giving them an idea of the costs and returns associated with establishing a peach orchard. Using the NPV calculations, producers will be able to compare future revenues that will not occur for several years to the initial front-end costs of the investment. Further research for the SC peach industry should include cost estimates that include all early, mid, and late maturity varieties to better represent a peach farm that produces different varieties. Crop insurance indemnities should be further investigated to determine how revenue losses are offset when low yield years occur. In addition, it can be examined how peach producers can differentiate themselves in the market, such as organic production.

APPENDIX

Peach enterprise budgets for years one to four

Estimated costs per acre				
Peach Year 1 Establishment				
145 trees/acre 19' x 16' spacing				
ITEM	UNIT	PRICE ($)	QUANTITY	TOTAL ($)
DIRECT EXPENSES				
FERTILIZER				
Lime	lbs	$0.02	4000	$80.00
16-4-8	lb	$0.17	2.5	$0.43
HERBICIDE				
Chateau	oz	$5.31	8	$42.48
Firestorm	pt	$3.35	2	$6.70
NIS 80/20	fl oz	$0.12	6.1	$0.73
INSECTICIDE				
Lorsban	pt	$6.50	2	$13.00
ADJUVANT				
Field Clean Up	$	$350.00	1	$350.00
Telone II	gal	$20.00	17.5	$350.00
Buffers and Drains	$	$100.00	1	$100.00
Grass Seed	lb	$0.44	90	$39.60
Peach Trees	tree	$4.50	145	$652.50
Cartons	$	$0.18	145	$26.10
Dormant Oil	gal	$4.50	1	$4.50
OPERATOR LABOR				
Tractors	hour	$13.00	4.2414	$55.14
HAND LABOR				
Special Labor	hour	$12.96	22	$285.12
DIESEL FUEL				
Tractors	gal	$2.57	24.4587	$62.86
REPAIR & MAINTENANCE				
Implements	acre	$8.16	1	$8.16
Tractors	acre	$6.57	1	$6.57
INTEREST ON OP. CAP.	acre	$72.42	1	$72.42
TOTAL DIRECT EXPENSES				$2,156.31
FIXED EXPENSES				
Implements	acre	$46.37	1	$46.37
Tractors	acre	$54.59	1	$54.59
TOTAL FIXED EXPENSES				$100.96
TOTAL SPECIFIED EXPENSES				$2,257.27

Estimated costs per acre				
Peach Year 2				
145 trees/acre 19' x 16' spacing				
ITEM	UNIT	PRICE ($)	QUANTITY ($)	TOTAL ($)
DIRECT EXPENSES				
FERTILIZER				
16-4-8	lb	$0.17	2	$0.34
Nitrogen	lbs	$0.52	290	$150.80
FUNGICIDE				
Captan 80 WDG	lb	$2.90	2	$5.80
HERBICIDE				
Chateau	oz	$5.31	8	$42.48
Firestorm	pt	$3.35	2	$6.70
NIS 80/20	fl oz	$0.12	4	$0.48
Gramoxone	qt	$7.75	0.5	$3.88
INSECTICIDE				
Lorsban	pt	$6.50	3.5	$22.75
ADJUVANT				
Copper Spray	lb	$6.27	0.5	$3.14
Dormant Oil	gal	$4.50	1	$4.50
Air Compressor	acre	$25.00	1	$25.00
OPERATOR LABOR				
Tractors	hour	$13.00	1.5561	$20.23
PRUNING LABOR				
Special Labor	hour	$12.96	11.5	$149.04
HAND LABOR				
Special Labor	hour	$12.96	35	$453.60
DIESEL FUEL				
Tractors	gal	$2.57	5.6667	$14.56
REPAIR & MAINTENANCE				
Implements	acre	$5.08	1	$5.08
Tractors	acre	$1.76	1	$1.76
INTEREST ON OP. CAP.	acre	$36.23	1	$36.23
TOTAL DIRECT EXPENSES				$946.37
FIXED EXPENSES				
Implements	acre	$8.76	1	$8.76
Tractors	acre	$14.59	1	$14.59
TOTAL FIXED EXPENSES				$23.35
TOTAL SPECIFIED EXPENSES				$969.72

Estimated costs per acre				
Peach Year 3				
145 trees/acre 19’ x 16’ spacing				
ITEM	UNIT	PRICE ($)	QUANTITY	TOTAL ($)
DIRECT EXPENSES				
FERTILIZER				
Nitrogen	lbs	$0.52	90	$46.80
Potash 60% K20	lbs	$0.40	70	$28.00
Calcium Nitrate	lb	$0.29	30	$8.70
FUNGICIDE				
Captan 80 WDG	lb	$2.90	11.54	$33.47
Vangard	oz	$3.40	7	$23.80
Mycoshield	lb	$14.75	1.56	$23.01
Bravo Weather Stik	pt	$6.72	2.45	$16.46
Sulfur	lb	$0.45	21	$9.45
Pristine	oz	$2.85	7.35	$20.95
Merivon	fl oz	$5.59	4.2	$23.48
Inspire Super	fl oz	$1.44	12.6	$18.14
Indar	fl oz	$1.94	5.6	$10.86
HERBICIDE				
Chateau	oz	$5.31	2	$10.62
Firestorm	pt	$3.35	5	$16.75
NIS 80/20	fl oz	$0.12	13.5	$1.62
Karmex	lb	$6.35	1	$6.35
Sinbar	lb	$48.20	1	$48.20
Gramoxone	qt	$7.75	0.2	$1.55
Pindar	pt	$21.25	2	$42.50
INSECTICIDE				
Lorsban	pt	$6.50	7.7	$50.05
Agri-Mek	fl oz	$4.54	2.45	$11.12
Asana XL	fl oz	$0.57	15.4	$8.78
Imidan 70 WSB	lb	$11.50	8.75	$100.63
Baythroid XL	fl oz	$2.10	2.8	$5.88
Belay	fl oz	$1.48	4.2	$6.22
IRRIGATION				
Irrigation Install	$	$1,000.00	1	$1,000.00
ADJUVANT				
Dormant Oil	gal	$4.50	0.3	$1.35
Copper Spray	lb	$6.27	2.75	$17.24
Orchard Cleanup	$	$35.00	1	$35.00
OPERATOR LABOR				

Tractors	hour	$13.00	6.1061	$79.38
PRUNING LABOR				
Special Labor	hour	$12.96	17.7	$229.39
HAND LABOR				
Special Labor	hour	$12.96	39.11	$506.87
HARVEST LABOR				
Special Labor	hour	$12.96	20	$259.20
DIESEL FUEL				
Tractors	gal	$2.57	21.8254	$56.09
REPAIR & MAINTENANCE				
Implements	acre	$31.15	1	$31.15
Tractors	acre	$7.00	1	$7.00
INTEREST ON OP. CAP.	acre	$133.60	1	$133.60
TOTAL DIRECT EXPENSES				$2,929.66
FIXED EXPENSES				
Implements	acre	$88.19	1	$88.19
Tractors	acre	$57.72	1	$57.72
TOTAL FIXED EXPENSES				$145.91
TOTAL SPECIFIED EXPENSES				$3,075.57

Estimated costs per acre				
Peach Year 4				
145 Trees/acre 19' x 16' spacing				
ITEM	UNIT	PRICE ($)	QUANTITY	TOTAL ($)
DIRECT EXPENSES				
FERTILIZER				
Lime	lbs	$0.02	500	$10.00
Nitrogen	lbs	$0.52	90	$46.80
Potash 60% K20	lbs	$0.40	70	$28.00
Calcium Nitrate	lb	$0.29	30	$8.70
FUNGICIDE				
Captan 80 WDG	lb	$2.90	16.5	$47.85
Vangard	oz	$3.40	10	$34.00
Mycoshield	lb	$14.75	2.25	$33.19
Bravo Weather Stik	pt	$6.72	3.5	$23.52
Sulfur	lb	$0.45	30	$13.50
Pristine	oz	$2.85	10.5	$29.93
Merivon	fl oz	$5.59	6	$33.54
Inspire Super	fl oz	$1.44	18	$25.92
Indar	fl oz	$1.94	8	$15.52
HERBICIDE				
2,4-D amine	qt	$3.44	1	$3.44
Rely	oz	$0.50	32	$16.00
Matrix	oz	$10.95	2	$21.90
Alion	oz	$9.95	1	$9.95
Firestorm	pt	$3.35	3	$10.05
NIS 80/20	fl oz	$0.12	9.6	$1.15
Gramoxone	qt	$7.75	0.2	$1.55
Pindar	pt	$21.25	1	$21.25
INSECTICIDE				
Lorsban	pt	$6.50	11	$71.50
Agri-Mek	fl oz	$4.54	3.5	$15.89
Asana XL	fl oz	$0.57	22	$12.54
Imidan 70 WSB	lb	$11.50	12.5	$143.75
Baythroid XL	fl oz	$2.10	4	$8.40
Belay	fl oz	$1.48	6	$8.88
ADJUVANT				
Dormant Oil	gal	$4.50	2	$9.00
Crop Insurance	$	$700.00	1	$700.00
Copper Spray	lb	$6.27	4.5	$28.22
Orchard Cleanup	$	$35.00	2	$70.00

OPERATOR LABOR				
Special Labor	hour	$13.00	3.5	$45.50
Tractors	hour	$13.00	8.0896	$105.16
PRUNING LABOR				
Special Labor	hour	$12.96	27.2	$352.51
HAND LABOR				
Special Labor	hour	$12.96	59.11	$766.07
HARVEST LABOR				
Special Labor	hour	$12.96	48	$622.08
DIESEL FUEL				
Tractors	gal	$2.57	27.3661	$70.33
REPAIR & MAINTENANCE				
Implements	acre	$40.38	1	$40.38
Tractors	acre	$8.65	1	$8.65
INTEREST ON OP. CAP.	acre	$152.69	1	$152.69
TOTAL DIRECT EXPENSES				$3,667.31
FIXED EXPENSES				
Implements	acre	$125.07	1	$125.07
Tractors	acre	$71.53	1	$71.53
TOTAL FIXED EXPENSES				$196.60
TOTAL SPECIFIED EXPENSES				$3,863.91

**Note: The mention in the above budgets of any commercial product does not imply an endorsement over other products not named nor does the omission imply they are not satisfactory.*

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