THE FEASIBILITY OF ESTABLISHING AN APPLE ORCHARD IN THE KANSAS CITY, MISSOURI REGION

MSA 699 RESEARCH PROJECT

Submitted in Partial Fulfillment of the Requirements
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Submitted by:

Submitted To:

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Monitor

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EXECUTIVE SUMMARY

Apples are an important crop for the United States as the World’s second largest exporter of fresh apples and processed apple products. All 50 states grow apples, 36 states grow apples commercially. Missouri was ranked 20th in the nation for apple production in 2001.

The purpose of this study is to determine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. The decision criterion was determined by the break-even point. To proceed with establishing a commercial apple orchard, without the benefit of value added products, it must demonstrate the ability to break-even within the first 5 years of expected apple production or sooner.

The data collection methods utilized, were on-line open source and scholarly research through two libraries. The data collected was from USDA, IRS, Missouri department of agriculture, Missouri Secretary of State, census results, scholarly trade journals, articles, and white papers retrieved from various sites and reports. The researcher analyzed secondary data and personal observations to form opinions and develop conclusions. Data analysis will be based on opinions formed by the researcher, opinions of experts in quantitative orchard agriculture, statistics presented in the secondary data, scholarly journals, and preexisting survey data on the establishment of orchard operations.

The research uncovered numerous challenges and variables to include site selection, soil management, tree selection, planting and seasonal care, herb and pest management, marketing, historical yield and price range, permanent and seasonal employees, post-harvest care, legal establishment, and other considerations. Each consideration required deliberate planning as much as two years prior. Many other variables are uncontrollable such as weather and market fluctuations. Orchardists require a thorough knowledge of pomology for successful operations.
Research data supports socioeconomic value for apple orchards operated as family farms in their respective communities. These benefits were an unintended discovery that supports the continued effort to maintain a strong family farm structure within the United States.

The ecological characteristics exist in the Kansas City, Missouri, region to grow apple orchards. The demand for fresh apples and apple products within the research area exceeds the supply by more than 2 to 1 ratio. This study provides data on the feasibility of establishing an apple orchard with the purchase of land, equipment, trees, cost per acre, and sales projections bases on historical averages.

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This project would not be possible without the love, patience, and commitment of many loved ones and dear friends. My wife, and our three children, have encouraged me and endured the challenges throughout this project and my career. My parents, who have endured challenges throughout my life, have endeavored to encourage me, provided timely guidance, and most importantly lifted me up in their daily prayers. To the many friends that have supported my family and me in so many ways, I am ever grateful and humbled by your endless acts of kindness.
CHAPTER 1: DEFINITION OF THE PROBLEM

Introduction

The feasibility of establishing an apple orchard in the Kansas City, Missouri, region is unknown. The researcher intended to explore variables in production, management, marketing, and profitability. Exploring these areas defined the feasibility of establishing an apple orchard.

Family farming has been around for centuries. Through the advancement in technology, a family farm has been able to grow in size. Technology improvements coincided with population migration from rural to urban living. These events have led to an increased size of farms and the large agribusiness firms (Gray, 2012). Due to the large agribusiness firms and government subsistence system that encourages larger farming entities the market structure creates a cost-price squeeze for mid-size farms (Gray, 2012). The cost-price squeeze is generated when large operations use their advantage to gain more competitive pricing for inputs and gain higher returns for outputs. Conversely small operations do not have the same leverage, therefore costs for inputs is higher and returns for outputs is lower creating the cost-price squeeze.

The researcher believes in the social and entrepreneurial benefits of the family farming. The researcher grew up in a farming community working various jobs associated with family farming, and attended college where undergraduate studies led to a Bachelor of Science in Quantitative Agricultural Economics. Next, the researcher joined the Army as an officer. Opportunities to work the challenges of enabling and facilitating the development of sustainable agricultural practices in a free market economy in Iraq were undertaken. Practical experience and the desire to operate a farm inspired this research project.
Ownership builds bonds and mutual obligations to form a type of social capital (Hassebrook, 1999). Social capital is the bonds formed between an entity and the community in which it operates. Economists call this corporate social responsibility or the obligation a business has to act accordingly for the benefit of the community. Social capital is gained through positive action within the community and strengthens the society, benefiting our children and generations to come. Entrepreneurial endeavors require dedication and hard work to succeed. The lessons learned through dedication, sacrifice, and commitments made by the farm family are the same traits that enable young people to grow into productive members of society.

The researcher's objective is to examine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. Apple orchards are present in the vicinity, but have steadily declined over the last decade. Research included best rootstock, cultivars, orchard floor management, natural pesticide and herbicide methods, multiple marketing strategies, financing strategies, cash flow management, and profitability.

**Problem Statement**

The feasibility of establishing an apple orchard in the Kansas City, Missouri, region is unknown. An apple market does exist in the area with access within 250 miles to eight cities with a range in population of 127,000 to 415,000 (United States Census Bureau, 2013). Apple orchards are in production in Missouri and Kansas. USDA statistics indicate a declining number of apple orchards and a declining level of apple production throughout Missouri. This presents a potential supply and demand problem within the apple market.
Purpose of the Study

The purpose of this study is to determine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. The 5th year, on average, is when apple trees begin baring fruit for sale. The study will determine current market demand, the supply of apples to meet market demand, marketing and advertising strategies, legal organizational structure, profitability, and the feasibility of establishing an orchard in the Kansas City, Mo. region.

Research Questions

Research Question 1: What is the current market demand for apples grown in the Kansas City, Missouri, region?

Research Question 2: What is the supply of apples grown in the Kansas City, Missouri, region?

Research Question 3: What is the most advantageous legal organization of an apple orchard in the Kansas City, Missouri, region?

Research Question 4: What is the profitability of establishing an apple orchard in the Kansas City, Missouri, region?

Research Question 5: What is the feasibility of establishing an apple orchard in the Kansas City, Missouri, region?

Definition of Terms

Apple eau-de-vie: A traditional alcoholic beverage produced in France by distillation of fermented apple juice (hard cider), eau-de-vie means water of life (Hang & Woodams, 2010).
Cation Exchange Capacity: The relative ability of soils to store one particular group of nutrients, such as calcium and magnesium (Agronomy Guide, Purdue University).

Commercial Family Farms: A farm with gross sales more than $250,000 and sub classified as a large family farm (gross sales between $250,000 and $499,999) or as a Very large family farm (gross sales of $500,000 or more) (Hoppe & Banker, 2010).

Community Supported Agriculture (CSA): Refers to direct marketing programs associated with farmers' markets, roadside stands, 'pick-your-own', and sales through internet or mail order.

Cost-price Squeeze: A market structure that results in purchasing inputs at high costs, while selling outputs at less-than-sustainable prices.

Cover crop: A crop (grass, flowers, other) deliberately grown on ground beneath the trees (orchard floor) with the purpose of providing natural herbicides and pesticides to protect the orchard.

Cultivar: Apple tree variety selected for desirable characteristics based on climate, location, soil type, and the marketability of the apple produced originating and persistent under cultivation.

Fallow: Land that has been plowed and harrowed and has been left unseeded for one or more growing seasons.

Intermediate Family Farms: have three sub classifications, Farming-occupation farms. Family farms (whose operators report farming as their major occupation), Low-
sales farms (Gross sales less than $100,000), and High-sales farms (Gross sales between $100,000 and $249,999) (Hoppe & Banker, 2010).

**Nonfamily Farms:** They are any farm where the operator and persons related to the operator do not own a majority of the business (Hoppe, et al., 2010).

**Orchard Floor:** The ground beneath the apple trees.

**Organic Matter:** The matter consisting of dead and decomposing plant and animal parts.

**Pollinator:** An agent (i.e. an insect) that pollinates flowers, one that pollinates, or pollinizer (Merriam-webster.com).

**Pomology:** The science of apple growing.

**Rhizodeposition:** Represents the loss of organic materials from roots as they grow through the soil (Scandellari, Ventura, Gioacchini, Vittori Antisari, & Tagliavini, 2010).

**Rootstock:** Apple tree variety selected based on healthy root system consisting of a root or a piece of root.

**Rural-residence Family Farms:** have two sub classifications, retirement farms (Small farms whose operators report they are retired) and residential/lifestyle farms (Small farms whose operators report a major occupation other than farming) (Hoppe, et al., 2010).

**Small Family Farm:** Two classifications reside under Small Family farm, *Rural-residence family farms* or *Intermediate family farms* (Hoppe, et al., 2010).

**Wholesaling:** Marketing crop to anyone other than the standard consumer.
**Decision Criteria**

The decision criterion was dictated by the break-even point. To proceed with establishing a commercial apple orchard, without the benefit of value added products, it must demonstrate the ability to break-even within the first 5 years of expected apple production or sooner.

**Assumptions**

It is assumed that funds are available and adequate (from loans, investors, or personal investment) to run day-to-day operations for the first five years of expected apple production. The researcher next assumed the orchard established would perform at historical averages, receiving historical prices, and the inputs would cost historical averages.

**Limitations**

1. Financial resources provided through investors will limit the flexibility of operations and the ability to engage rapidly in multiple venue operations.

2. Due to logistics of travel and time, research is limited to computer research.

3. A limited populous of individuals exists to survey within the Leavenworth County area, which have experience establishing or operating an apple orchard.

**Summary**

The feasibility of establishing an apple orchard in the Kansas City, Missouri, region is unknown. The size of the apple orchard and methods researched are consistent with the family farm label. Many challenges to establishing an apple orchard exist. Research to determine the best practices for overcoming the challenges will determine the break-even point and answer the question of feasibility. The literature available through scholarly and peer reviewed sources, Department of Agriculture, Department of Commerce, and Small Business Administration is
more than sufficient to determine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region.
CHAPTER 2: LITERATURE REVIEW

Introduction

The researcher's objective was to examine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. Apple Orchards are not native to North America; they are native only in China. Europeans imported Apple trees during the Colonial years. This is an important fact due to the sensitivity that orchards have to the climate, soil type, pests, and general treatment. Commercial orchards are not feasible in every area of the United States. Orchards are prevalent enough to make the United States the world’s second leading exporter of apples behind China (FAOSTAT, http://faostat.fao.org/site/339/default.aspx, 21APR13). The researcher explored the complexities of establishing an apple orchard.

The researcher did not include specifics of financing the establishment of an apple orchard. Many options of financing exist through agricultural lending institutions, venture capitalists, and provisions in H.R. 6124 (Food, Conservation, and Energy Act for 2008 also known as the Farm Bill of 2008) (The Senate and House of Representatives of the United States of America, 2008). H.R. 6124 was set to expire 31 December 2012; the American Taxpayer Relief Act of 2012 extended provisions to 30 September 2013 (The Senate of the United States, 2012). An article published in Farm Futures on 30 April 30, 2013 suggested the current political climate in the U.S. Senate to pass a new farm bill that modifies the federally subsidized funding as likely. The ever-changing political climate and the purpose to focus the research on the feasibility of establishing an apple orchard allowed the researcher to focus beyond the financing.

Literature was researched to define the history of apple orchards in the United States and the Kansas City, Missouri, region. The history provided data of successful orchard operations
including the environmental conditions and market conditions. The historical yield rates by
cultivar and planting strategy were included. Average apple consumption per person was
included to determine demand, and supply availability compared to the demand.

Marketing strategies researched identified trends and best strategies. This included
research in expenses associated with different strategies. Expenses ranged from labor, fertilizer,
equipment, fuel, transportation, supplies, and other considerations. These factors aided in
determining the feasibility and profitability of establishing an apple orchard in the Kansas City,
Missouri, region. Literature presented includes site selection, soil management, tree selection,
planting and seasonal care, herb and pest management, marketing, historical yield and price
range, permanent and seasonal employees, post-harvest care, legal establishment, and other
considerations.

Site Selection

Site selection is a critical aspect of any agricultural endeavor. Fruit trees are generally
sensitive, requiring detailed planning to ensure the selection of a viable location, and proper
preparation for planting (Penn State: College of Agricultural Sciences, 2012). Typical apple
flavor develops during ripening while temperature directly affects the production of certain
compounds (Dixon & Hewett, 2000). The growing season, average temperatures, annual rainfall,
and frost-free periods are some consideration when selecting a site to establish an apple orchard.
Fruit quality is affected by climate, soil conditions, tree characteristics, and orchard operational
practices (Aggelopoulou, et al., 2010).

Ideal sites are located on rolling or elevated land, allowing cold air to drain (Penn State:
College of Agricultural Sciences, 2012). Southern facing slopes warm up quicker in the spring,
while northern facing slopes warm up quicker in the fall. Based on the variety of trees in the orchard, southern or northern slopes are advantageous. Soil drainage is critical for orchard survival. Poorly drained soil causes root problems for trees in orchard operations. Soil ingredients include mineral elements, pore space, organic matter, and other items consisting of living organisms (fungi, bacteria, nematodes) (Penn State: College of Agricultural Sciences, 2012). The Kansas City, Missouri, region researched indicated the mean annual precipitation is 33 to 41 inches, the mean annual air temperature is 50 to 55 degrees Fahrenheit, and the frost-free period is 177 to 220 days. The characteristics of 20% to 30% of the region are zero to 9% slope with soil classification as farmland, prime farmland, and prime farmland if drained (USDA Natural Resource Conservation Service, 2013).

Prior use of the land is important to consider as various herbicides and pesticides can linger and ultimately damage apple trees. Different crops of other vegetation will affect the pH and fertility of the site differently. These are important considerations when planning a suitable site. An orchard plan must include soil preparation and management.

**Soil Preparation and Management**

The site selection process should minimize soil preparation and management to the extent possible. Soil characteristics are critical for healthy trees and successful orchard operations. Characteristics that effect the planning of an orchard include; soil texture (% sand, % silt, % clay), cation exchange capacity (CEC), pH, nitrate nitrogen (NO₃-N), ammonium nitrogen (NH₄-N), phosphorous (P), exchangeable calcium (Ca), exchangeable sodium (Na), exchangeable potassium (K), exchangeable magnesium (Mg), available iron (Fe), available zinc (Zn), available manganese (Mn), available copper (Cu), boron (B), and organic matter.
concentrations (Aggelopoulou, Pateras, Fountas, Gemtos, & Nanos, 2010). The level of consideration given to these potential characteristics is dependent on the variety of trees selected for planting. Another consideration is soil carbon that plays a pivotal role in many soil functions. Soil sequestration enhances the soil quality and various ecosystem services (Deurer, et al., 2012). Soil mapping is available through USDA Natural Resource Conservation Service in most areas of the United States to include the Kansas City, Missouri, region. Soil sampling and testing is available through various agricultural consulting services. Understanding the soil characteristics and requirements for a successful orchard facilitate effective soil preparation and management decisions.

Prior land use will determine the extent of rhizodeposition. Rhizodeposition affects the density and activity of microorganisms, therefore affecting the availability of nutrients to the roots, specifically as it relates the nitrogen levels (Scandellari, Ventura, Gioacchini, Vittori Antisari, & Tagliavini, 2010). Preferably, the orchard site is fallow or row cropped for at least two years prior to planting (Penn State: College of Agricultural Sciences, 2012). These techniques decrease the prevalence of persistent perennial weeds that will compete for water and nutrients. Herbicides and insecticides used in row cropping during the two years prior to planting require careful selection. Many common corn and wheat herbicides can persist and damage subsequent crops (Penn State: College of Agricultural Sciences, 2012).

Soil management in an orchard is broken down into two distinct areas: the area between the tree rows and the area directly underneath the trees also call row middle management (Penn State: College of Agricultural Sciences, 2012). A technique for row middle management is growing a ground cover. Ground covers offer several benefits that include adding nutrients and
combating specific pests, while increase the work to maintain the cover at acceptable levels and decreasing yield (Tworkoski & Glenn, 2012). Different grasses affect the soil differently: shallow rooted grasses deplete less moisture than deep-rooted sods, while some compete for nitrogen like tall fescue (Tworkoski & Glenn, 2012). Research supports hard fescue, chewings fescue, creeping red fescue, and slow growing, turf-type perennial ryegrass as row middle management due to their ability to minimize weeds, add nitrogen and other nutrients to the soil, and for minimizing soil erosion (Penn State: College of Agricultural Sciences, 2012). Applying 20 to 40 pounds of nitrogen per acre at the establishment of a cover crop is recommended (Penn State: College of Agricultural Sciences, 2012).

The methods of soil preparation and management, conventional or organic, need to be decided following site selection, before tree planting. Conventional methods require additional equipment and the handling of various herbicides and pesticides. Organic methods are more environmentally friendly and generally support sustainable agriculture better than conventional methods. Ground covers can add required nutrients with the benefit of limiting certain pests, while adding work to maintain the cover at acceptable levels that do not compete for water and nutrients with the trees.

**Tree Selection**

Growers consider multiple variables when selecting a variety of trees time of bloom, pollen viability, vigor, time of harvest, days of growth, storage viability, and characteristics at harvest. Consideration of these variables is critical to selecting varieties that offer the greatest probability for sustained profitability. The cultivar market is changing with varieties introduced from Europe, New Zealand, and Japan and the retraction of government restriction on the sale of
specific trees (Penn State: College of Agricultural Sciences, 2012). The demand in the U.S. has shifted from the traditional Red Delicious variety to newer varieties, such as Fuji and Gala (United States International Trade Commission: Agriculture and Fisheries Division, 2010).

Research indicated the common varieties of apple trees grown in the Kansas City, Missouri, region, the Golden Delicious responded with greater trunk diameter, tree height, and higher biomass than other varieties under drought stress (Liu, Cheng, Ma, Zou, & Liang, 2012). Increased resistance to drought conditions improves an orchardist’s ability to maintain a sustainable environmentally friendly operation.

Tree selection usually occurs 2 years prior to planting (Penn State: College of Agricultural Sciences, 2012). Fruit production varies based on selected rootstock. Generally, trees bear fruit in year 3 or 4, but it can vary as widely as year 2 to 7. Many nurseries that feature commercial sales of fruit trees and rootstock were located during research. Careful planning during tree selection is critical for a sustainable and profitable orchard operation.

**Pest Management (Weed, Insect, and Fungi)**

Many applications are available to address deficiencies in soil nutrients, persistent weeds, or fungal issues. Conversely, biodiversity options exist for the producer inclined to grow organically. Natural weed and insect suppression techniques were tested successfully on specific weeds and insects in profitable orchards (Brown, 2012). Pesticides control pests, but also reduce natural predatory enemies. Compost mulch can reduce weeds, competition from various pests and increase nutrients, with the risk of creating a natural habitat for various fungi that can damage or kill trees (Brown, 2012). Research indicates that damage by trunk and branch disease and pests on apple trees were considerably higher in biological systems, reducing the vitality of
apple trees (Borovinova, Petrova, & Maneva, 2012). Organic methods manage ecosystems in a generally more sustainable manner with risks specifically to profitability and sustainability.

Research has shown that weed management with grass beneath fruit trees is less inhibitive to tree growth and yield in mature orchards (Tworkoski & Glenn, 2012). Orchard operators establishing new orchards must consider the fragility of new trees when planning ground cover management practices. Research has shown that apple trees grown in mowed sod were nearly 25% smaller than trees grown under an herbicide program 6 years after planting (Penn State: College of Agricultural Sciences, 2012). Other methods still in the testing phase include grazing hogs, planting clover, and applying various woodchips to the orchard floor. Orchard pests of weeds, insects, and fungi continue to be managed with chemicals. Organic orchardists are still working to develop the methods and techniques that will make organic systems economically and ecologically sustainable (Hinman & Ames, 2011). The manner of pest control, including any organic methods, needs to be complementary to the variety of trees selected.

**Planting and Seasonal Care**

The variety of trees chosen assists with determining the density of planting. Density planning requires many consideration including soil characteristics, climate, tree varieties, and expected yields throughout the life of the tree. Trees planted more densely with expected yields in year 4 require a different plan for marketing, labor, storage, and other inputs than an orchard less densely populated with trees that won’t bear fruit until the 6th year. Early forecasting of fruit production is important for market planning, labor planning, storage requirements, and other inputs required (Wulfsohn, Zamora, Tellez, Lagos, & Garcia-Finana, 2010). The density of
planting also effects seasonal considerations including pruning and value added efforts to enhance the quality of the fruit.

Trees per acre is calculated by multiplying the in-row spacing by the between-row spacing and dividing that number by the number of square feet in an acre (43,560 sq. ft.) (See Table 1) (Penn State: College of Agricultural Sciences, 2012). Growers must consider what the soil and available moisture can support. More trees does not necessarily equate to more production. An approach is orchard meadows, used more prevalently in Europe than the U.S. This method minimizes the number of trees per acre while increasing the lifetime of the orchard. Orchard meadows lifetime is usually between 50 to 80 years (Schonhart, Schauppenlehner, Schmid, & Muhar, 2011). Meadow orchards offer the ability to grow foliage and other diverse crops in the orchard with the risk of creating natural habitats for various pests, as previously discussed.

Current wide spread practice is for growers to guess likely production based on visual inspections and historical knowledge with the range of error between 15% and 40% (Wulfsohn, Zamora, Tellez, Lagos, & Garcia-Finana, 2010). Predictions of the Florida citrus crops have achieved errors of 5% to 8% (Wulfsohn, et al., 2010). Other fruit growing industries have

<table>
<thead>
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<th>Table 1. Number of trees per acre at various tree spacings.</th>
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<td>8  1,815 1,361 1,039 967 877 777 690</td>
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<tr>
<td>9  1,013 1,210 968 806 691 605 537</td>
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<td>10 1,452 1,089 871 726 622 544 484 435</td>
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<td>11 1,320 990 792 660 565 495 440 396 360</td>
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<td>12 1,210 976 726 605 518 453 403 363 330 302</td>
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<td>13 1,116 838 670 558 478 418 372 335 304 279 257</td>
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<td>20 726 545 414 363 311 272 242 217 198 181 167 155 145 136 128 121 114 108</td>
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</tbody>
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Source: Penn State: College of Agricultural Sciences, 2012
developed effective methods of forecasting yield. Vineyards regularly forecast with error between 10% and 15% (Wulfsohn, et al., 2010). Fruit size and quality predictive analysis is more difficult with no available industry standard. A method to regulate the quality of the fruit and facilitate efficient harvesting is to prune trees.

The pruning technique for fruit trees is mechanical. Mechanical pruning is conducted with two techniques, heading and thinning cuts (Fumey, Lauri, Guedon, Godin, & Costes, 2011). Two primary pruning periods are during dormancy (winter) or during growing season (summer) with tree responses to pruning depending on timing and tree variety (Fumey, et al., 2011). Research expectantly concluded that pruning promoted growth while limiting the trunk size resulting in increased quality yield (Fumey, et al., 2011).

Another seasonal care technique is applying commercially developed reflective materials to the ground. Research indicates that up to a 9% increase of well-colored fruit is expected when using reflective ground covers (Meinhold, Damerow, & Blanke, 2011). Reflective ground covers are only used for 4 to 6 weeks near the end of the growing season. The use of these covers did not affect internal fruit quality or sugar (Meinhold, et al., 2011). Reflective covers can be used for up to 10 seasons depending on the quality initially purchased and care used during application and retrieval. The cost of apply commercially developed reflective ground covers is in the purchase price, labor to spread the cover, and labor to retrieve it 2 to 3 days prior to harvest.

**Labor Force (Permanent and Seasonal)**

Few scholarly studies specifically address farm labor, particularly orchard labor. Orchards require a myriad of abilities from management skills, pruning and care knowledge, pest
identification, and physical ability to climb ladders while harvesting apples repetitively. Planning is critical in order to estimate accurately labor requirements. The variety of trees selected, density of planting, style of pruning, availability of equipment, intended uses of the product, and financial resources available are all variables that affect the labor decisions. Labor availability is a critical aspect; orchard meadows are a method that requires less labor due to decreased tree density (Schonhart, Schauppenlehner, Schmid, & Muhar, 2011). Numerous articles in newspapers from the State of Washington have detailed the labor challenges orchards growers face due to a declining migrate work force. Migrant work forces have been used for generations and due to the current political interest in immigration reform, the issue has grown beyond the academic and economic aspects. The researcher deliberately avoided the political issue as it is outside the scope of this research.

The potential labor force for orchard production is possibly more limited in Missouri than in other states with larger orchard production. The primary reason is the reluctance to accept wages that are affordable to the orchardist. This is illustrated in several news publications during the 2012 harvest in Washington State. One publication, The Wall Street Journal, reported by Joel Millman, described how the bumper crop in Washington could lose up to 25% due to lack of a labor force. Unemployment in Missourri (as of 4 May 2013) is 6.7% or about 52,000 people according to the Missouri Department of Labor. The portion of that population that is between 22 and 64 years of age is 48,589 people. The population that claims some form of agriculture as their industry is 409. It is likely that personnel from other industries possess the required talents for orchard work, such industries may include construction (9,912 unemployed), transportation and warehouse (2,266 unemployed), or manufacturing (5,530 unemployed). The unemployment
rates may not be enough to find a capable labor force willing to accept the wages that keep the orchard profitable. Labor decisions are partially driven by spring projection of harvest yield.

**Historical Yield and Price (Not Adjusted)**

Orchards, like other agricultural entities are subject to severe fluctuation in yield and price that are affected by weather, supply, demand, pests, and other variables. Research indicates in 2012 Missouri produced 1,600 acres of apples, yielding 21,900 pounds per acre (approximately 521.4 bushels per acre), receiving $0.471 per pound, equaling $10,314.90 per acre (USDA National Agricultural Statistics Services, 2013). Apple statistics in 2011 were reported for 1,800 acres of production, yielding 8,330 pounds an acre (approximately 198.3 bushels per acre), receiving $0.313 per pound, equaling $2,607.29 per acre (USDA National Agricultural Statistics Services, 2013). Missouri statewide statistics for 2009 and 2010 were 1,800 acres each, yielding 10,300 and 18,300 pounds per acre (approximately 245.3 and 435.7 bushels per acre), receiving $0.266, and $0.301 per pound, equaling $2,739.80 and $5,508.30 per acre (USDA National Agricultural Statistics Services, 2013). The national average price per pound in 2009 was $0.231 and 2010 was $0.241 indicating Missouri beat the national average in years where data for both state and national are available (USDA: National Agricultural Statistics Service, 2012). The average statewide yield over the 4 years was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). The average statewide price per acre was $5,292.57. Historical data for non-bearing acres in production was not available for the 2009 to 2012 years. Previous year data from 2001 to 2007 indicated that approximately 10% of planted acres would not bear fruit based on the numerous variables that can affect apple orchards (USDA Natural Resource Conservation Service, 2013).
Improvements in efficiency and production are sought throughout the orchard operation. Several products are available that claim to assist the business owner in these pursuits. Research has demonstrated that AgProfit™, an online software program, designed to assist farmers assess economic risks associated with adoption of new technologies or production practices (Julian & Seavert, 2011). Research indicated using AgProfit™ as a planning tool, a change in production practice from traditional pruning to using a raised platform could reduce pruning and training cost by up to 40% (Julian, et al., 2011). Traditional pruning by hand with ladders is estimated to require 110 hours per acre at $13 per hour or $1,430 per acre (Julian, et al., 2011). Regardless of the methods or techniques chosen to manage the orchard variables throughout the growing season and postharvest, planning must be conducted months or years in advance.

**Postharvest Care**

The first consideration postharvest is apple storage. Inevitably, apples will need to be stored for at least a limited amount of time. Limited or short-term storage consisting of a week or less is unlikely to affect the product. Controlled atmosphere storage (refrigeration) for a month or several months possesses several challenges, including the loss of acceptable apple flavor and aroma (Dixon & Hewett, 2000). Over 300 volatile compounds have been measured in the aroma profile of apples that can be affected in controlled atmospheres (Dixon, et al., 2000). Treatments are available to sustain the quality of the fruit. Research has demonstrated that in combination with post-harvest 1-methylcyclopropene (1-MCP) treatment will help maintain fruit firmness during long-term storage (DeEll & Ehsani-Moghaddam, 2012). Secondary benefits can be realized with treatments for long-term storage such as increased total antioxidant activity.
(Hoang, Golding, & Wilkes, 2011). Treatments will react differently based on the variety of fruit and the conditions in storage.

Postharvest land management and orchard management practices are applied. This is the time to apply herbicides, fungicides, copper compounds, and other inputs to improve the efficiency and productivity of the orchard (Penn State: College of Agricultural Sciences, 2012). Dead or failing trees may be removed and replaced. Winter pruning and other farm maintenance activities are accomplished. Planning for the postharvest season is important to set the conditions for a productive orchard operation in the spring.

**Legal Establishment**

Establishing an apple orchard will require the establishment of legal status under Missouri State and Federal law. The scope of this research is on small to mid-sized orchard operations that can be managed as a sole proprietorship. The researcher focused on Family Farm, Limited Liability Company, and Uniformed Limited Partnership law. According to a white paper written by William D. Heffernan, Ph.D. and Mary K. Hendrickson, Ph.D. in 2002, in the 1970’s consensus among economists defined the family farm as a farm production unit in which the farm family provided most of the labor, management, and capital. The researcher was unable to find a present day consensus on the definition of family farm amongst economists. Missouri revised statutes chapter 347 Limited Liability Companies (LLC), section 347.057 governs the liability of individuals that are member, managers, or both. In a LLC, a member or manager is not liable solely for being associated with the LLC. Missouri revised statutes chapter 359 describes liability under a Uniform Limited Partnership for full partners to be the same as the Uniform Partnership law. The Uniform Partnership law in chapter 358 describes liability for
partners (owners) as full financial liability for all action taken under the name of the partnership. A small family farm generally has more access to credit than an urban business due to a more varied community of lenders and various rural programs, such as USDA’s Business and Industry Guaranteed Loan Program (Briggeman & Akers, The credit advantage of farm and rural small business ownership, 2010). Family farms account for 98% of U.S. farms in 2007 (Hoppe, et al., 2010). Family farm types are dependent on the value of gross sales (see Figure 10). The preponderance of agriculture production, 84% of the value of production, is performed by 12% of farms consisting of large-scale family farms and nonfamily farms (Hoppe, et al., 2010).

Marketing

Orchard marketing is an important function for a successful operation. Producers can market any combination of direct to consumer, direct to retailers and/or restaurants, and wholesale (Hardesty & Leff, 2009). An important marketing consideration is consumption rates, in 2008, approximately 16.9 pounds of fresh apples were consumed per capita (United States International Trade Commission: Agriculture and Fisheries Division, 2010). Marketing for distribution direct to consumers, or direct-market agriculture, is conducted through community-supported agriculture (CSA). Direct-market agriculture can support farmer-consumer relations, educational, and community elements (McIlvaine-Newsad, Merrett, Maakestad, & McLaughlin, 2008). The steady growth of socioeconomic relationships has contributed to the quality of life in rural communities above that seen in urban communities (McIlvaine-Newsad, et al., 2008). The socioeconomic relationships fostered through CSA come at the cost of packing and storage, transportation, and selling and administration for the producer (Hardesty, et al., 2009). Producers receive higher prices through CSA venues as compensation to the cost they incur when direct
marketing their product (Hardesty, et al., 2009). CSA activity can support marketing activities for direct to retailers and/or restaurants by providing a common meeting place to network with potential customers.

Other marketing activities can take on forms that are more creative. Inspired individuals can lead efforts that bring growers together from various places in the world, as was the case when growers from New York’s Hudson valley met with growers from Percheron, France (Leaf, 2012). The exchange offered growers the opportunity to network and share ideas. The effort organized growers, and then they traveled to the other country for tours and sampling of the various raw and refined products to include American cider and French hard cider (Leaf, 2012). Orchardist may market in conjunction with national apple month, a 3-month promotional window from September to November, which was expanded in 1996. Other marketing in more traditional forms can be conducted based on the intent and purpose of the orchard operation.

Other Considerations

Orchards in Missouri attract deer. A consideration for orchardist in Missouri would be a deer fence. The U.S. experiences an average of $100 million dollars in damaged crops from deer (VerCauteren, Lavelle, & Hygnstrom, 2006). Fencing costs range from less than $2 to more than $20 per meter, with efficacy rates between 60% and 99% (VerCauteren, Lavelle, & Hygnstrom, 2006). A cost-benefit analysis is required to determine feasibility and long-term sustainability for the investment. Deer fences are just one of many products to consider with the multitude of variables in orchard operations.
Previous Research Studies

The University of Vermont produced an information paper on the extension and research for the commercial tree fruit grower in Vermont and beyond. The team name is the UVM Apple Team; Dr. Lorraine Berkett served as the lead faculty member, Terence Bradshaw served as the research technician, and Marlys Eddy working on graduate studies. This paper provides suggestions for websites, economics, site selection, soil preparation, cultivar and rootstock selection, and planting considerations.

The, “Crop Profile for Apple in Missouri,” published on-line by IPM (Integrated Pest Management) and sponsored by USDA, National Institute of Food and Agriculture (Nov. 2001) provides information on yield, production rank, acres in orchards, product uses, insect, disease, and weed pests specific to Missouri. Four key insects pest are codling moth, mites, San Jose scale, and plum curculio. The key diseases are apple scab, fire blight, cedar apple rust, and powdery mildew. Flyspeck and sooty blotch are secondary diseases that affect fruit quality if not managed. Annual and perennial weeds (grasses and broadleaves) must be managed to reduce competition for water and nutrients, and to remove overwintering sites for insects and diseases.

Missouri ranked 20th in the nation with commercial apple production reaching 46 million pounds in 1999 that was valued at $8.11 million. Approximately 3,500 acres are in apple orchard production. All apples produced in Missouri are for fresh market or juice with the majority of the crop marketed through wholesale channels and sold locally. The state’s largest producer manages about 500 acres with several growers managing 50 to 150 acres located in southwest and central Missouri bordering the Missouri River. Varieties common to Missouri include Golden Delicious, Jonathan, Red Delicious, Gala, Fugi, Red Rome, Ozark Gold, Earligold,
Idared, Cortland, Empire, Winesap, Jonalicious, Rome Beauty, Lurared, Blushing Golden, Granny Smith, Freedom, and Braeburn.

According to the apple facts published by the University of Illinois Extension, apples are grown commercially in 36 states with all 50 states growing apples. The average size orchard in the United States is 50 acres. Apples are the second most valuable fruit in the United States with oranges as the first. Apples ripen 6 to 10 times faster at room temperature than if they are refrigerated. In 2005, United States consumers ate an average of 46.1 pounds of fresh apples and processed apple products, 36% of apples were processed into apple products; 18.6% of this is for juice and cider, 2% was dried, 2.5% was frozen, 12.2% was canned and 0.7% was fresh slices. Other uses were the making of baby food, apple butter or jelly and vinegar. Fresh apples consumed in 2005 equated to 63% of the apple crop. Nearly one out of every four apples harvested in the United States is exported.

**Summary**

Apple orchards are complex operations that require detailed long-term planning for successful operations. Many considerations related to production need to be addressed early and readdressed regularly throughout the production cycle. Literature presented included site selection, soil management, tree selection, planting and seasonal care, herb and pest management, marketing, historical yield and price range, permanent and seasonal employees, post-harvest care, legal establishment, and other considerations.

Site selection needs to account for climate variables, including temperature, weather patterns, and expected frosts. These variables in conjunction with soil characteristics will influence success or failure in growing and sustaining viable apple trees. The most important soil
characteristic is soil drainage. Poorly drained soil will foster an ecological environment that will destroy the orchard. Many soil characteristics involving nutrients are managed with general or site specific plans. Some common characteristics that are managed with site specific plans include, pH, nitrate nitrogen (NO3-N), ammonium nitrogen (NH4-N), phosphorous (P), exchangeable magnesium (Mg), available iron (Fe), available zinc (Zn), available manganese (Mn), and organic matter concentrations (Aggelopoulou, et. al., 2010). Two distinct areas define soil management: the area between the tree rows and the area directly underneath the trees also call row middle management (Penn State: College of Agricultural Sciences, 2012). Multiple soil management methods consisting of conventional chemicals, organic, or a combination are in practice throughout Missouri. The specific plan and ratio of chemical and organic are dependent on site selection and tree selection.

Tree selection requires the consideration of multiple variables including time of bloom, pollen viability, vigor, time of harvest, days of growth, storage viability, and characteristics at harvest. Consideration of these variables is critical to selecting varieties that offer the greatest probability for sustained profitability. Tree selection usually occurs 2 years prior to planting (Penn State: College of Agricultural Sciences, 2012). Generally, trees bear fruit in year 3 or 4, but it can vary as widely as year 2 to 7. Focused planning during tree selection will minimize negative effects of variables such as pest, while cultivating a sustainable and profitable orchard operation.

Numerous applications are available to address deficiencies in soil nutrients, persistent weeds, or fungal issues. Conversely, biodiversity options exist for the producer inclined to grow organically. Pesticides control pests, but also reduce natural predatory enemies. Compost mulch
can reduce weeds, competition from various pests and increase nutrients, with the risk of creating a natural habitat for various fungi that can damage or kill trees (Brown, 2012). Tree selection is a critical aspect of the type and style of pest management. Research has shown that weed management with grass beneath fruit trees is less inhibitive to tree growth and yield in mature orchards (Tworkoski, et. al., 2012). Orchard pests of weeds, insects, and fungi continue to be managed with chemicals. The manner of pest control, including any organic methods, needs to be complementary to the variety of trees selected.

The variety of trees chosen assists with determining the density of planting. Density planning requires many consideration including soil characteristics, climate, tree varieties, and expected yields throughout the life of the tree. Early forecasting of fruit production is important for market planning, labor planning, storage requirements, and other inputs required (Wulfsohn, et. al., 2010). Growers must consider what the soil and available moisture can support. More trees does not necessarily equate to more production. Pruning is conducted with two techniques, heading and thinning cuts during the summer and/or winter months (Fumey, et. al., 2011). Other seasonal considerations include effective crop estimates and commercial applications to improve fruit quality. These and other season considerations are labor intensive, planning is the key to maintaining a feasible and sustainable operation.

Orchards require a myriad of abilities from management skills, pruning and care knowledge, pest identification, and physical ability to climb ladders while harvesting apples repetitively. Planning is critical in order to estimate accurately labor requirements. The variety of trees selected, density of planting, style of pruning, availability of equipment, intended uses of the product, and financial resources available are all variables that affect the labor decisions.
Missouri had a 6.7% unemployment rate on 4 May 2013, or about 52,000, of which 409-claimed agriculture as their industry. Training may be required for both permanent and season labor. Planning is critical as seasonal labor and seasonal care practices will be driven by harvest forecasts.

Orchards, like other agricultural entities, are subject to severe fluctuation in yield and price that are affected by weather, supply, demand, pests, and other variables. Missouri orchardists outperformed the national average in 2009 and 2010 for price per pound and price per acre. The average statewide price per acre was $5,292.57. Data indicated that an average of 10% of the crop is lost each year. Orchardists considering implementing new practices or technology have the aide of many online software programs, designed to assist farmers assess economic risks and maintain sustainability to maximize financial returns.

Postharvest care includes storage, pruning, and soil management. Long-term storage requires consideration for the fruit quality and techniques to maintain the quality. Winter pruning is conducted with site specific and general soil management practices.

Legal establishment is primarily for managing risks and realizing tax advantages. Family farms file documents to incorporate in order to manage risks to personal assets. Establishing a family run orchard under a Limited Liability Company legal structure is a feasible method to manage personal financial risks.

Producers market through direct to consumer, direct to retailers and/or restaurants, and wholesale (Hardesty, et. al., 2009). Direct-market agriculture can support farmer-consumer relations, educational, and community elements (McIlvaine-Newsad, et. al., 2008). The socioeconomic relationships fostered through CSA come at the cost of packing and storage,
transportation, and selling and administration for the producer (Hardesty, et al., 2009). CSA activity can support marketing activities for direct to retailers and/or restaurants by providing a common meeting place to network with potential customers. Other creative strategies have been successful in establishing international relationship to learn varying techniques and market products.

Other considerations involve value added products, such as managing loss from the deer population. The considerations throughout an orchard operation require careful and detailed planning. Successful orchardists manage variables and maintain costs at feasible levels in a complex operation year around.
CHAPTER 3: RESEARCH METHODOLOGY

The Problem Restated

The feasibility of establishing an apple orchard in the Kansas City, Missouri, region is unknown. An apple market does exist in the area with access within 250 miles to eight cities with a range in population of 127,000 to 415,000 (United States Census Bureau, 2013). Apple orchards are in production in Missouri and Kansas. USDA statistics indicate a declining number of apple orchards and a declining level of apple production throughout Missouri. The declining production presents a potential supply and demand problem within the apple market.

Population and Sample

Quantitative research with empirical evaluation of the data was the nature and design for this feasibility study. Quantitative research is the numerical representation of observation or events to describe and explain the activity. Secondary data was the primary data source for this research. Scholarly journals, articles, textbooks, government statistics, preexisting research from government and university agricultural extensions, and media were used to analyze and quantify the variables for establishing an apple orchard. The secondary data was analyzed to determine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. The research data collected was from a date span of 1999 to 2013.

Data Collection Methods

The data collection methods utilized was on-line open source and scholarly research through two libraries. The data collected was from USDA, IRS, Missouri department of agriculture, Missouri Secretary of State, census results, scholarly trade journals, articles, and white papers retrieved from various sites and reports. The data collected for this feasibility study
examined the variables to establish an apple orchard in the Kansas City, Missouri, region. The researcher collected data from a date span of December 2012 to May 2013.

**Variables and Measures**

Unique to this study are the numerous variables including weather, pests, marketing, employment, and inherent risks. Weather effects on crop yields prevent even production from year to year. Irrigation is a means to minimize the risks associate with drought, though few methods exist to mitigate damaging winds, floods, irregular frosts, and other damaging weather patterns.

Pests are any biological organism that harms the orchard. Pests include fungi, animals, various insects, and disruptive plant life. Many natural and chemical remedies exist to minimize pest damage, many with the complex traits that will unintentionally harm other parts of the orchard environment.

Employment on an apple orchard is characterized as permanent and seasonal. Employment levels vary from year to year based on the projected yield and the actual yield at harvest. The skills required to perform successfully in an orchard operation include management skills, pruning and care knowledge, pest identification, and physical ability during harvest to climb ladders repetitively. Permanent employees require, at a minimum, knowledge in all areas and proficiency in at least one area. Seasonal employees may be hired specifically for harvest requiring physical abilities and basic orchard knowledge. Depending on the skills and availability of the permanent labor, seasonal employees may be hired to prune the orchard or other tasks.
Marketing fruit can be conducted through community-supported agriculture (CSA) or direct to the consumer, direct to retailers and/or restaurants, and wholesale (Hardesty & Leff, 2009). The diverse marketing is unique to this study because of the complexity, compounded with the uncertainty of the harvest year-to-year.

Apple orchard risks are derived through the complex interconnected environment including weather, pests, and marketing strategies. Other variables that add to the risk include foreign and local market production causing irregular price fluctuation. The inherent risks associated with orchard operations are vast and numerous, typically they are outside the orchardists ability to exert influence the risks.

**Data Analysis Methods**

The researcher will analyze secondary data and personal observations to form opinions and develop conclusions. Data analysis will be based on opinions formed by the researcher, opinions of experts in quantitative orchard agriculture, statistics presented in the secondary data, scholarly journals, and preexisting survey data on the establishment of orchard operations.

**Research Questions**

The following research questions are addressed in this study:

1. What is the current market demand for apples grown in the Kansas City, Missouri, region?
2. What is the supply of apples grown in Kansas City, Missouri, region?
3. What is the most advantageous legal organization of an apple orchard in the Kansas City, Missouri, region?
4. What is the profitability of establishing an apple orchard in the Kansas City, Missouri, region?

5. What is the feasibility of establishing an apple orchard in the Kansas City, Missouri, region?
CHAPTER 4: DATA ANALYSIS

Introduction

The study focused on the feasibility of establishing an apple orchard in the Kansas City, Missouri, region given a complex series of variables. Variables to consider when establishing an apple orchard include site selection, soil management, pest management, tree selection, planting and seasonal care, labor, yields and market price, postharvest care, and legal establishment. Apple orchards exist in the Kansas City region and throughout the state of Missouri. Agricultural statistics from Missouri indicate a declining number of orchards and a declining level of production over the past 10 years. The variety of marketing techniques used by the existing Missouri orchards span the three categories of community-supported agriculture (CSA) or direct to the consumer, direct to retailers and/or restaurants, and wholesale. A variety of the production and management methods are in use in the target area that will enable effective study to determine the best practices. The study will use government statistics and scholarly resources to determine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. The feasibility will be determined by the ability for the orchard to break-even.

Data Presentation and Analysis

Chapter 2 discussed several variables to consider when establishing an apple orchard including site selection, soil management, tree selection, pest management, planting and seasonal care, labor, yields and market price, postharvest care, legal establishment, and marketing. Site selection is the first critical decision with fruit trees generally sensitive, requiring detailed planning to ensure the selection of a viable location, and proper preparation for planting (Penn State: College of Agricultural Sciences, 2012). The location needs to have the proper range of
temperature for proper flavor development (Dixon & Hewett, 2000). The quality of fruit is influenced by the climate and soil conditions (Aggelopoulou, et al., 2010). Sites located on rolling or elevated terrain allow cold air to drain (Penn State: College of Agricultural Sciences, 2012). Kansas City, Missouri, experiences 33 to 41 inches of rain, a mean annual temperature of 50 to 55 degrees Fahrenheit, and a frost-free period of 177 to 220 days with 20% to 30% of the land 0 to 9% slope and classified as a form of farmland (USDA Natural Resource Conservation Service, 2013). These site selection characteristics support the upward trend for the ratio of agriculture land price to earnings from the land. The Ratio has increased annually by an average of 0.16% from 1960 to 2008 (see figure 2) (Briggeman, Gunderson, & Gloy, 2009). Good site selection assists with soil management, but active practices must be emplaced to sustain orchard operations.
Soil preparation and management is a balance between art and science. Internal soil drainage is the most important consideration for orchard establishment (Penn State: College of Agricultural Sciences, 2012). The critical characteristics that effect orchard planning include; soil texture (% sand, % silt, % clay), cation exchange capacity (CEC), pH, nitrate nitrogen (NO3-N), ammonium nitrogen (NH4-N), phosphorous (P), exchangeable calcium (Ca), exchangeable sodium (Na), exchangeable potassium (K), exchangeable magnesium (Mg), available iron (Fe), available zinc (Zn), available manganese (Mn), available copper (Cu), boron (B), and organic matter concentrations (Aggelopoulou, et al., 2010). Prior land use will determine the extent of rhizodeposition. Rhizodeposition affects the density and activity of microorganisms, therefore affecting the availability of nutrients to the roots, specifically as it relates to the nitrogen levels (Scandellari, et al., 2010). Soil management in an orchard is broken down into two distinct areas:
the area between the tree rows and the area directly underneath the trees, also called row middle management (Penn State: College of Agricultural Sciences, 2012). Site-specific soil management, including site-specific fertilization programs, can improve profitability with accurate knowledge of soil characteristics and tree requirements (Aggelopoulou, et al., 2010).

Tree selection requires knowledge of soil characteristics to understand the varieties that are economically supported and market trends to be able to sell the production at harvest. The common varieties grown in Kansas City, Missouri, region include Golden Delicious, Jonathan, Red Delicious, Gala, Fugi, Red Rome, Ozark Gold, Earligold, Idared, Cortland, Empire, Winesap, Jonalicious, Rome Beauty, Lurared, Blushing Golden, Granny Smith, Freedom, and Braeburn according to the Crop Profile for Apple in Missouri.

Source: U.S. Apple Association at www.usapple.org

Figure 1 Fuji
Figure 2 Gala
Figure 3 Golden Delicious
Figure 4 Granny Smith
Figure 5 Idared
Figure 6 Jonathan
Figure 7 Red Delicious
Figure 8 Rome Beauty

Source: U.S. Apple Association at www.usapple.org
nt varieties like Golden Delicious improve an orchardist’s ability to maintain a sustainable and environmentally friendly operation. Tree selection and purchase usually occurs 2 years prior to planting with fruit production varying based on rootstock, generally bearing fruit in years 3 or 4 (Penn State: College of Agricultural Sciences, 2012). Selection criteria should consider the hardiness to local pests.

Pest management requires understanding of the most critical vulnerabilities of the orchard. Many organic and chemical methods exist to manage weeds, insects, and fungi. Grass planted on the orchard floor to manage weeds and fungi can be both positive and negative depending on the most critical orchard requirements. Compost mulch can reduce weeds, competition from various pests, and increase nutrients with the risk of creating a natural habitat for various fungi that can damage or kill trees (Brown, 2012). Research indicates that damage by trunk and branch disease and pests on apple trees were considerably higher in biological systems, reducing the vitality of apple trees (Borovinova, et al., 2012). Organic orchardists are still working to develop the methods and techniques that will make organic systems economically and ecologically sustainable (Hinman, et al., 2011). The manner of pest control, including organic methods, need to be complementary to the variety of trees selected.

Planting density and seasonal care affects early forecasting of fruit production that is important for market planning, labor planning, storage requirements, and other inputs required (Wulfsohn, et al., 2010). The density of planting also effects seasonal considerations including pruning and value added efforts to enhance the quality of the fruit. Tree density is tied to soil characteristics (nutrients available to support tree density) and site-specific soil management. More trees do not automatically equate to higher yield or higher quality. Seasonal care includes
forecasting yield for market planning, current practice is based on visual inspections and historical knowledge with the range of error between 15% and 40% (Wulfsohn, et al., 2010). The estimates must be predictive of fruit size and quality and a method to regulate quality is mechanical pruning. Mechanical pruning is conducted with two techniques, heading and thinning cuts (Fumey, et al., 2011). Two primary pruning periods are during dormancy (winter) or during growing season (summer) with tree responses to pruning dependent on timing and tree variety (Fumey, et al., 2011). Planting and seasonal care require skilled labor with knowledge of orchard practices and physical stamina.

Labor serving an orchard is comprised of permanent and seasonal. A form of permanent labor is family labor. An advantage of a small family farm is the operator and family provides the preponderance of labor (Calus & Huylenbroeck, 2010). Due to the complexity of orchard operations, permanent and seasonal labor must have knowledge of the operations and practices. Lack of seasonal labor can occur due to numerous reasons to include political, better opportunities, and wage demands. Orchard wages must remain competitive with a fluctuating market that varies historically in yield and price.

Historical yields and price fluctuate based on many variables including weather, supply, demand, pests, and other variables. In 2011, the average farm size in Missouri was 271 acres (U.S. Department of Agriculture: National Agriculture Statistics Service, 2011). Missouri’s largest orchard producer manages about 500 acres with several growers managing 50 to 150 acres located in southwest and central Missouri bordering the Missouri River. In 2012, Missouri produced 1,600 acres of apples, yielding 21,900 pounds per acre (approximately 521.4 bushels per acre), receiving $0.471 per pound, equaling $10,314.90 per acre (USDA National
Agricultural Statistics Services, 2013). Apple statistics in 2011 were reported for 1,800 acres of production, yielding 8,330 pounds an acre (approximately 198.3 bushels per acre), receiving $0.313 per pound, equaling $2,607.29 per acre (USDA National Agricultural Statistics Services, 2013). Missouri statewide statistics for 2009 and 2010 were 1,800 acres each, yielding 10,300 and 18,300 pounds per acre (approximately 245.3 and 435.7 bushels per acre), receiving $0.266, and $0.301 per pound, equaling $2,739.80 and $5,508.30 per acre (USDA National Agricultural Statistics Services, 2013). The national average price per pound in 2009 was $0.231 and 2010 was $0.241 indicating Missouri beat the national average in years where data for both state and national are available (USDA: National Agricultural Statistics Service, 2012). The average statewide yield over the four years was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). The average statewide price per acre was $5,292.57. Yields and prices are sustained through continuous care postharvest.

Postharvest activities include storage, pest management, soil management, and tree management. Controlled atmosphere storage (refrigeration) for a month or several months possesses several challenges, including the loss of acceptable apple flavor and aroma (Dixon, et al., 2000). Research has demonstrated that in combination with post-harvest 1-methylcyclopropene (1-MCP) treatment will help maintain fruit firmness during long-term storage (DeEll & Ehsani-Moghaddam, 2012). This is the time to apply herbicides, fungicides, copper compounds, and other inputs to improve the efficiency and productivity of the orchard (Penn State: College of Agricultural Sciences, 2012). Dead or failing trees are removed and replaced. Winter pruning, estimated to require 110 hours per acre at $13 per hour or $1,430 per
acre is accomplished (Julian, et al., 2011). Postharvest planning is important for success in the spring and dependent on labor availability.

Legal establishment of the orchard operation can take multiple forms for legal, liability, tax, and availability of credit reasons. Missouri revised statues chapter 347 Limited Liability Companies (LLC), section 347.057 governs the liability of individuals that are member, managers, or both. In a LLC, a member or manager is not liable solely for being associated with the LLC. Missouri revised statutes chapter 359 describes liability under a Uniform Limited Partnership for full partners to be the same as the Uniform Partnership law. The Uniform Partnership law in chapter 358 describes liability for partners (owners) as full financial liability for all action taken under the name of the partnership. A small family farm generally has more access to credit than an urban business due to a more varied community of lenders and various rural programs, such as USDA’s Business and Industry Guaranteed Loan Program (Briggeman, et. al., 2010). Defined legal establishment and access to credit in conjunction with the overarching orchard plan will improve the effectiveness of marketing strategies.

Orchard marketing can be any combination of direct to consumer, direct to retailers and/or restaurants, and wholesale (Hardesty & Leff, 2009). Marketing strategies are influenced by the average apple and apple product consumption of 46.1 pounds in 2005, according to the University of Illinois apple facts. In 2008, approximately 16.9 pounds of fresh apples were consumed per capita (United States International Trade Commission: Agriculture and Fisheries Division, 2010). Marketing for distribution direct to consumers, or direct-market agriculture, is conducted through community-supported agriculture (CSA) which supports the growth of socioeconomic relations. Direct-market agriculture can support farmer-consumer relations,
educational, and community elements (McIlvaine-Newsad, et al., 2008). The socioeconomic relationships fostered through CSA come at the financial cost of packing and storage, transportation, and selling and administration for the producer (Hardesty, et al., 2009). Producers receive higher prices through CSA venues as compensation to the cost they incur when direct marketing their product (Hardesty, et al., 2009).

**Research Question Analysis**

Chapter 3 outlined the data collection methods as quantitative research with empirical evaluation of the data collected from USDA, IRS, Missouri department of agriculture, Missouri Secretary of State, census results, scholarly trade journals, articles, and white papers. The sources were used to address the objectives of this feasibility study. Chapter 4 will address and analyze five research questions.

**Research Question 1:** What is the current market demand for apples grown in the Kansas City, Missouri, region?

The market for apples is thoroughly interconnected and integrated domestically nationwide and augmented with imports (see Figure 11). The average consumption of apples and apple products is 46.1 pounds according to the University of Illinois apple facts. Approximately 16.9 pounds are consumed fresh per capita (United States International Trade Commission: Agriculture and Fisheries Division, 2010). The common varieties grown in the Kansas City, Missouri, region include Golden Delicious, Jonathan, Red Delicious, Gala, Fugi, Red Rome, Ozark Gold, Earligold, Idared, Cortland, Empire, Winesap, Jonalicious, Rome Beauty, Lurared, Blushing Golden, Granny Smith, Freedom, and Braeburn according to the Crop Profile for Apple in Missouri. The demand in the U.S. has shifted from the traditional Red Delicious variety to
newer varieties, such as Fuji and Gala (United States International Trade Commission: Agriculture and Fisheries Division, 2010).

The Kansas City, Missouri, region has a large population of 463,000 citizens (US Census Bureau). Access to expand into St. Louis and Columbia, Missouri (population 318,000 and 130,000), Topeka and Wichita, Kansas (population 128,000 and 384,000), Lincoln and Omaha, Nebraska (population 262,000, 415,000), and Des Moines and Cedar Rapids, Iowa (population 206,000 and 127,000) all are within 250 miles and direct access via interstate roadways. The approximate total population within a 250-mile radius is 2,433,000 citizens. The approximate average consumption of fresh apples in this area is 41,117,700 pounds, approximate average consumption of processed apple products is 71,043,600 pounds, total apple, and apple product consumption is estimated at 112,161,300 pounds.
Table 3. U.S. apple distribution system

![Apple Distribution System Diagram]

Source: United States International Trade Commission: Agriculture and Fisheries Division, 2010

Table 4. U.S. Fresh apple apparent consumption

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<th>Years</th>
<th>Production utilized in the fresh market (1,000 mt)</th>
<th>Imports (1,000 mt)</th>
<th>Exports (1,000 mt)</th>
<th>Total utilization</th>
<th>Per capita consumption (Kilograms)</th>
<th>Import penetration (Percent)</th>
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</tr>
<tr>
<td>2001</td>
<td>2,843.3</td>
<td>157.1</td>
<td>714.9</td>
<td>2,285.5</td>
<td>8.08</td>
<td>6.9</td>
</tr>
<tr>
<td>2002</td>
<td>2,440.0</td>
<td>170.4</td>
<td>598.1</td>
<td>2,008.3</td>
<td>7.02</td>
<td>8.5</td>
</tr>
<tr>
<td>2003</td>
<td>2,473.6</td>
<td>168.8</td>
<td>546.2</td>
<td>2,144.2</td>
<td>7.32</td>
<td>8.8</td>
</tr>
<tr>
<td>2004</td>
<td>3,002.3</td>
<td>207.4</td>
<td>491.1</td>
<td>2,718.8</td>
<td>9.31</td>
<td>7.6</td>
</tr>
<tr>
<td>2005</td>
<td>2,765.5</td>
<td>122.8</td>
<td>685.4</td>
<td>2,202.9</td>
<td>7.47</td>
<td>5.6</td>
</tr>
<tr>
<td>2006</td>
<td>2,861.5</td>
<td>156.7</td>
<td>640.7</td>
<td>2,388.5</td>
<td>7.95</td>
<td>6.6</td>
</tr>
<tr>
<td>2007</td>
<td>2,756.6</td>
<td>206.6</td>
<td>663.5</td>
<td>2,290.7</td>
<td>7.64</td>
<td>9.0</td>
</tr>
<tr>
<td>2008</td>
<td>2,859.4</td>
<td>165.3</td>
<td>712.5</td>
<td>2,312.2</td>
<td>7.68</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Source: United States International Trade Commission: Agriculture and Fisheries Division, 2010

**STATUS**
The research data supports that a large market demand for fresh apples and processed apple products currently exists in the Kansas City, Missouri, region.

The research data supports that the common varieties of apples grown in the Kansas City, Missouri, region are marketable and currently demanded by the consumers.

**Research Question 2: What is the supply of apples grown in the Kansas City, Missouri, region?**

Research indicates in 2012 Missouri produced 1,600 acres of apples, yielding 21,900 pounds per acre (approximately 521.4 bushels per acre), for an estimated total of 35,040,000 pounds (USDA National Agricultural Statistics Services, 2013). Apple statistics in 2011 were reported for 1,800 acres of production, yielding 8,330 pounds an acre (approximately 198.3 bushels per acre) (USDA National Agricultural Statistics Services, 2013). Missouri statewide statistics for 2009 and 2010 were 1,800 acres each, yielding 10,300, and 18,300 pounds per acre (approximately 245.3 and 435.7 bushels per acre) (USDA National Agricultural Statistics Services, 2013). The average statewide yield over the 4 years was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). Data from 2001 to 2007 indicated that approximately 10% of planted acres would not bear fruit based on the numerous variables that can affect apple orchards (USDA Natural Resource Conservation Service, 2013; Hoppe & Banker, 2010).

Research indicated that 36 states produce apples commercially with five states producing the preponderance of the apple crop (United States International Trade Commission: Agriculture and Fisheries Division, 2010) (see Table 5 and 6).
Table 5. U.S. fresh apple production, bearing acreage, and yields by state, 1998 to 2003 average, 2004-08

<table>
<thead>
<tr>
<th>State</th>
<th>1998-2003 average</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Production (1,000 mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington</td>
<td>2446.2</td>
<td>2789.6</td>
<td>2585.5</td>
<td>2517.5</td>
<td>2358.7</td>
<td>2830.9</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>459.4</td>
<td>580.6</td>
<td>474.0</td>
<td>571.5</td>
<td>594.2</td>
<td>567.0</td>
<td></td>
</tr>
<tr>
<td>Michigan</td>
<td>402.3</td>
<td>331.1</td>
<td>344.7</td>
<td>399.2</td>
<td>349.3</td>
<td>272.2</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>203.2</td>
<td>183.7</td>
<td>228.8</td>
<td>213.2</td>
<td>213.2</td>
<td>199.6</td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>284.8</td>
<td>161.0</td>
<td>161.0</td>
<td>181.0</td>
<td>156.5</td>
<td>163.3</td>
<td></td>
</tr>
<tr>
<td>All other</td>
<td>712.9</td>
<td>676.8</td>
<td>592.8</td>
<td>593.5</td>
<td>451.1</td>
<td>588.4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4508.7</td>
<td>4722.9</td>
<td>4384.9</td>
<td>4455.9</td>
<td>4122.9</td>
<td>4431.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
<th>Bearing acreage (1,000 acres)</th>
<th>Yield (mt/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington</td>
<td>168.8</td>
<td>154.0</td>
</tr>
<tr>
<td>New York</td>
<td>48.2</td>
<td>45.0</td>
</tr>
<tr>
<td>Michigan</td>
<td>46.9</td>
<td>40.0</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>22.3</td>
<td>21.0</td>
</tr>
<tr>
<td>California</td>
<td>31.0</td>
<td>26.0</td>
</tr>
<tr>
<td>All other</td>
<td>114.1</td>
<td>93.3</td>
</tr>
<tr>
<td>Total</td>
<td>427.4</td>
<td>381.9</td>
</tr>
</tbody>
</table>

Source: United States International Trade Commission: Agriculture and Fisheries Division, 2010

Table 6. U.S. apple production by state

The national level of production for the varieties most prevalently grown in the Kansas City, Missouri, region indicate a potential market gap for Missouri orchardists (see table 7). The common varieties grown in Kansas City, Missouri, region that are most commonly grown nationally are Red Delicious, Gala, Golden Delicious, Granny Smith, Fuji, Rome Beauty, Red
Rome, Empire, Braeburn, Idared, Jonathan, and Cortland (United States International Trade Commission: Agriculture and Fisheries Division, 2010).

Table 7. U.S. apple production by variety (1,000 42-lb units), 2004-08

<table>
<thead>
<tr>
<th>Varieties</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Delicious</td>
<td>63,232</td>
<td>58,350</td>
<td>69,578</td>
<td>64,968</td>
<td>61,101</td>
<td>53,692</td>
</tr>
<tr>
<td>Gala</td>
<td>18,810</td>
<td>20,634</td>
<td>25,807</td>
<td>23,975</td>
<td>28,904</td>
<td>28,519</td>
</tr>
<tr>
<td>Golden Delicious</td>
<td>27,766</td>
<td>28,317</td>
<td>31,810</td>
<td>30,014</td>
<td>28,283</td>
<td>24,835</td>
</tr>
<tr>
<td>Granny Smith</td>
<td>19,265</td>
<td>18,101</td>
<td>21,884</td>
<td>20,531</td>
<td>22,314</td>
<td>23,021</td>
</tr>
<tr>
<td>Fuji</td>
<td>20,357</td>
<td>15,332</td>
<td>22,570</td>
<td>21,000</td>
<td>20,218</td>
<td>18,164</td>
</tr>
<tr>
<td>McIntosh</td>
<td>7,866</td>
<td>11,057</td>
<td>12,019</td>
<td>9,913</td>
<td>10,065</td>
<td>10,138</td>
</tr>
<tr>
<td>Rome</td>
<td>7,970</td>
<td>10,183</td>
<td>10,463</td>
<td>9,822</td>
<td>8,428</td>
<td>7,082</td>
</tr>
<tr>
<td>Empire</td>
<td>2,820</td>
<td>4,498</td>
<td>4,965</td>
<td>4,281</td>
<td>6,553</td>
<td>6,473</td>
</tr>
<tr>
<td>Braeburn</td>
<td>3,056</td>
<td>2,955</td>
<td>5,337</td>
<td>4,945</td>
<td>4,330</td>
<td>5,024</td>
</tr>
<tr>
<td>Idared</td>
<td>3,225</td>
<td>5,165</td>
<td>4,964</td>
<td>4,677</td>
<td>4,838</td>
<td>4,670</td>
</tr>
<tr>
<td>York</td>
<td>3,724</td>
<td>4,186</td>
<td>4,066</td>
<td>4,395</td>
<td>4,090</td>
<td>3,857</td>
</tr>
<tr>
<td>Jonathan</td>
<td>3,607</td>
<td>4,679</td>
<td>4,553</td>
<td>4,483</td>
<td>4,527</td>
<td>3,504</td>
</tr>
<tr>
<td>Cripps Pink</td>
<td>1,448</td>
<td>1,096</td>
<td>3,602</td>
<td>3,342</td>
<td>2,915</td>
<td>3,322</td>
</tr>
<tr>
<td>Cortland</td>
<td>1,761</td>
<td>2,474</td>
<td>2,775</td>
<td>2,298</td>
<td>2,665</td>
<td>2,743</td>
</tr>
<tr>
<td>Cameo</td>
<td>1,005</td>
<td>1,303</td>
<td>2,236</td>
<td>2,071</td>
<td>1,969</td>
<td>1,882</td>
</tr>
<tr>
<td>Jonagold</td>
<td>1,388</td>
<td>1,347</td>
<td>1,860</td>
<td>1,723</td>
<td>1,601</td>
<td>1,588</td>
</tr>
<tr>
<td>Northern Spy</td>
<td>1,121</td>
<td>1,088</td>
<td>1,714</td>
<td>1,712</td>
<td>1,225</td>
<td>1,225</td>
</tr>
<tr>
<td>Stayman</td>
<td>1,267</td>
<td>1,394</td>
<td>1,395</td>
<td>1,429</td>
<td>1,410</td>
<td>1,123</td>
</tr>
<tr>
<td>R.I. Greening</td>
<td>1,267</td>
<td>1,086</td>
<td>2,260</td>
<td>1,912</td>
<td>1,092</td>
<td>1,106</td>
</tr>
<tr>
<td>Newtown</td>
<td>1,310</td>
<td>1,103</td>
<td>1,099</td>
<td>1,032</td>
<td>1,016</td>
<td>974</td>
</tr>
<tr>
<td>All others</td>
<td>10,667</td>
<td>14,082</td>
<td>13,599</td>
<td>12,546</td>
<td>18,847</td>
<td>18,524</td>
</tr>
<tr>
<td>Total</td>
<td>202,950</td>
<td>209,360</td>
<td>248,586</td>
<td>231,069</td>
<td>236,469</td>
<td>201,064</td>
</tr>
</tbody>
</table>

Source: United States International Trade Commission: Agriculture and Fisheries Division, 2010

**STATUS**

Research data supports the supply of apples produced in Missouri falls well short of apple demand. Current estimated total demand is 112,161,300 pounds of fresh and processed apples. Current estimated production is 35,040,000 pounds of fresh and processed apples. This level of supply satisfies approximately 31.2% of the market demand.

**Research Question 3:** What is the most advantageous legal organization of an apple orchard in the Kansas City, Missouri, region?

Missouri revised statues chapter 347 Limited Liability Companies (LLC), section 347.057 governs the liability of individuals that are member, managers, or both. In a LLC, a
A small family farm generally has more access to credit than an urban business due to a more varied community of lenders and various rural programs, such as USDA’s Business and Industry Guaranteed Loan Program (Briggeman, et al., 2010). Family farms account for 98% of
U.S. farms in 2007 (Hoppe, et al., 2010). Family farm types are dependent on the value of gross sales (see Figure 10).

**Figure 10: Farm Types, 2007**

<table>
<thead>
<tr>
<th>Small family farms (gross farm sales less than $250,000)</th>
<th>Large-scale family farms (gross farm sales of $250,000 or more)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Retirement farms.</strong> Small farms whose operators report they are retired, although they continue to farm on a small scale. These operations sell enough farm products (at least $1,000 worth) to qualify as farms under the current farm definition.</td>
<td></td>
</tr>
<tr>
<td><strong>Residential/lifestyle farms.</strong> Small farms whose operators report a major occupation other than farming. The category also includes a small number of farms—8 percent of the group in 2007—whose operators are not in the labor force.</td>
<td></td>
</tr>
<tr>
<td><strong>Farming-occupation farms.</strong> Small family farms whose operators report farming as their major occupation.</td>
<td></td>
</tr>
<tr>
<td>• Low-sales farms. Gross sales less than $100,000.</td>
<td></td>
</tr>
<tr>
<td>• Medium-sales farms. Gross sales between $100,000 and $249,999.</td>
<td></td>
</tr>
<tr>
<td><strong>Large family farms.</strong> Farms with gross sales between $250,000 and $499,999.</td>
<td></td>
</tr>
<tr>
<td><strong>Very large family farms.</strong> Farms with gross sales of $500,000 or more.</td>
<td></td>
</tr>
<tr>
<td><strong>Nonfamily farms</strong></td>
<td></td>
</tr>
<tr>
<td>Nonfamily farms. Any farm where the operator and persons related to the operator do not own a majority of the business.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Hoppe, et al., 2010

**STATUS**

Research supports a family farms filing to incorporate to manage risk to personal assets. Further research supports establishing a family run orchard under a Limited Liability Company legal structure.

**Research Question 4:** What is the profitability of establishing an apple orchard in the Kansas City, Missouri, region?

Missouri orchardists received $0.471 per pound in 2012, equaling $10,314.90 per acre (USDA National Agricultural Statistics Services, 2013). In 2011, 1,800 Missouri acres yielded 8,330 pounds an acre (approximately 198.3 bushels per acre), receiving $0.313 per pound, equaling $2,607.29 per acre (USDA National Agricultural Statistics Services, 2013). Statewide statistics for 2009 and 2010 were 1,800 acres each, yielding 10,300 and 18,300 pounds per acre
(approximately 245.3 and 435.7 bushels per acre), receiving $0.266, and $0.301 per pound, equaling $2,739.80 and $5,508.30 per acre (USDA National Agricultural Statistics Services, 2013). The national price per pound average in 2009 was $0.231 and in 2010 was $0.241, indicating Missouri beat the national average (USDA: National Agricultural Statistics Service, 2012). The average statewide yield over the four years, 2009 to 2012, was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). The average statewide price per acre over the same time was $5,292.57, or approximately $0.36 per pound of apples.

The researcher determined the cost per tree is approximately $7.00 based on prices published by Stark Bros. Nurseries in Louisiana, MO. High density orchards consist of 500 trees per acre or more and are most prevalent in the United States (Penn State: College of Agricultural Sciences, 2012). The average size orchard in the United States is 50 acres. Tree density (500) multiplied by number of acres (50), multiplied by cost per tree ($7) equals $175,000 initial investment in trees. The 2012 average cost of farmland in Missouri is $2,900 as reported by University of Missouri agriculture extension. The average farm size (50 acres) multiplied by the average cost of farmland ($2,900) in Missouri equals $145,000 to purchase land. The initial investment in trees and land is approximately $320,000. Average cost per acre to maintain an apple orchard in non-bearing year at $4,000 to $5,000 and increasing during bearing years, according to the University of Minnesota Fruit site. This study estimates average cost per acres at $4,500 during nonbearing years and increasing by 5% for the first bearing year, year 3, and remaining constant from year 3 through year 10. This study assumes trees are planted at 2 years of age requiring only 2 years of nonbearing care before transitioning into bearing years. Labor was assumed to be captured in the price per acre average with the 5% increase accounting for
additional labor during bearing years. The first year of bearing was estimated at 70% of the average price per acre for 50 acres equaling $185,315 in sales and then at 100% each of the following years equaling $264,735. No increase in production was figured in this study (see table 8 and 9). The same methodology was used to calculate total profits for 10 different sized orchards, size measured in acreage. No consideration was given to advantages gained in labor and equipment through increased land and production. Furthermore, the researcher did not consider bulk-pricing break points when purchasing trees or the likely decreased price per acre realized when purchasing tracts measuring in the hundreds of acres (see Table 10).

Table 8. Break Even Analysis Inputs

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Purchase</td>
<td>($145,000)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tree Purchase</td>
<td>($175,000)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cost Per Acre</td>
<td>($225,000)</td>
<td>($225,000)</td>
<td>($236,250)</td>
<td>($236,250)</td>
<td>($236,250)</td>
<td>($236,250)</td>
<td>($236,250)</td>
<td>($236,250)</td>
<td>($236,250)</td>
<td>($236,250)</td>
</tr>
<tr>
<td>Equipment Purchase</td>
<td>$100,000</td>
<td>$25,000</td>
<td>$25,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Annual Profit/(Loss)</td>
<td>($645,000)</td>
<td>($645,000)</td>
<td>($971,001)</td>
<td>($942,625)</td>
<td>($914,253)</td>
<td>($885,875)</td>
<td>($857,496)</td>
<td>($829,118)</td>
<td>($800,739)</td>
<td>($772,361)</td>
</tr>
</tbody>
</table>
Table 9. Break Even Analysis

Break Even Analysis 50 Acres

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Profit/(Loss)</th>
<th>Total Profit/(Loss) - 50 Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$(76,010)</td>
<td>$(76,010)</td>
</tr>
<tr>
<td>1</td>
<td>$(250,000)</td>
<td>$(250,000)</td>
</tr>
<tr>
<td>2</td>
<td>$(645,000)</td>
<td>$(645,000)</td>
</tr>
<tr>
<td>3</td>
<td>$(895,000)</td>
<td>$(895,000)</td>
</tr>
<tr>
<td>4</td>
<td>$(942,632)</td>
<td>$(942,632)</td>
</tr>
<tr>
<td>5</td>
<td>$(914,253)</td>
<td>$(914,253)</td>
</tr>
<tr>
<td>6</td>
<td>$(857,496)</td>
<td>$(857,496)</td>
</tr>
<tr>
<td>7</td>
<td>$(829,118)</td>
<td>$(829,118)</td>
</tr>
<tr>
<td>8</td>
<td>$(800,739)</td>
<td>$(772,361)</td>
</tr>
</tbody>
</table>
Table 10. Total Profit / (Loss) Comparison of 10 different size orchards over 10 years
STATUS

Research does not support the feasibility of an apple orchard in the Kansas City, Missouri, region to be able to break-even by the 7th year after planting, which is the 5th year of apple production. Further calculations comparing orchard sizes ranging from 30 acres to 300 acres confirmed that commercially producing apples without a value added product in Missouri would fail to meet the break-even point by the 7th year after planting, which is the 5th year of apple production. These calculations do not consider advantages gained in labor and equipment through increased land and production. The calculations also do not consider bulk-pricing break points that could be realized in the purchasing of trees or the likely decreased price per acre realized when purchasing tracts measuring in the hundreds of acres.

Research Question 5: What is the feasibility of establishing an apple orchard in the Kansas City, Missouri, region?

Research indicated the Kansas City, Missouri, region has a mean annual precipitation is 33 to 41 inches, the mean annual air temperature is 50 to 55 degrees Fahrenheit, and the frost-free period is 177 to 220 days. The characteristics of 20% to 30% of the region are zero to 9% slope with soil classification as farmland, prime farmland, and prime farmland if drained (USDA Natural Resource Conservation Service, 2013). Ideal sites are located on rolling or elevated land, allowing cold air to drain (Penn State: College of Agricultural Sciences, 2012). Missouri has a strong agriculture base throughout the state as indicated by the 2011 state agriculture overview measuring all field and miscellaneous crop production at $5,766,795,000.
Dozens of nurseries are located throughout the U.S. to provide specific rootstock and variety to fit the planning of an orchard. Many applications are available to address deficiencies in soil nutrients, persistent weeds, or fungal issues. Conversely, biodiversity options exist for the producer inclined to grow organically. Natural weed and insect suppression techniques were tested successfully on specific weeds and insects in profitable orchards (Brown, 2012). The variety of trees chosen assists with determining the density of planting. Density planning requires many consideration including soil characteristics, climate, tree varieties, and expected yields throughout the life of the tree.

The number of unemployed individuals looking for work is sufficient to fill the requirements for an orchard, about 52,000 people according to the Missouri department of labor. Finding employees willing to work at the wages that keep the orchard competitive is the challenge. Numerous articles in newspapers from the State of Washington have detailed the labor challenges orchards growers face due to a declining migrate work force. Knowledgeable labor is required for postharvest land management and orchard management practices. This is the time to apply herbicides, fungicides, copper compounds, and other inputs to improve the efficiency and productivity of the orchard (Penn State: College of Agricultural Sciences, 2012). Dead or failing trees may be removed and replaced. Winter pruning and other farm maintenance activities are accomplished. Planning for the postharvest season is important to set the conditions for a productive orchard operation in the spring.

**STATUS**

Research supports that Missouri has the necessary soil characteristics, climate, and labor for orchard operations to be feasible.
Research also supports ample nurseries are available to purchase rootstocks and varieties of choice to best fit a feasible and profitable orchard plan in the Kansas City, Missouri, region.

Data Analysis Summary

Agricultural statistics from Missouri indicate a declining number of orchards and a declining level of production over the past 10 years. Current estimated total demand is 112,161,300 pounds of fresh and processed apples. Missouri orchardists are producing an estimated 35,040,000 pounds of fresh and processed apples. This level of supply satisfies approximately 31.2% of the market demand.

Common apple varieties and demand in the Kansas City, Missouri, region were established through research data. The demand in the U.S. has shifted from traditional Red Delicious to newer varieties, such as Fuji and Gala, both varieties are common in Missouri (United States International Trade Commission: Agriculture and Fisheries Division, 2010). The common varieties grown in Kansas City, Missouri, region that are most commonly grown nationally are Red Delicious, Gala, Golden Delicious, Granny Smith, Fuji, Rome Beauty, Red Rome, Empire, Braeburn, Idared, Jonathan, and Cortland (United States International Trade Commission: Agriculture and Fisheries Division, 2010). Ample nurseries are available to produce and deliver the particular rootstock and cultivar required for the orchard plan.

The research data identified the climate and soil characteristics required for successful apple orchards and determined that the Kansas City, Missouri, region possess the required characteristics. Historical yields and prices from Missouri Orchards indicate the ability to make a profit when variables and risks are effectively managed. Research indicates that a variety of
management techniques exist and current Missouri Orchards are effectively managing the variables and risks to achieve sales prices higher than the national average.

Orchard marketing is a combination of CSA, direct to retailers and/or restaurants, and wholesale (Hardesty & Leff, 2009). Most Missouri orchards incorporate all three methods to improve profitability.

Missouri orchardists received $0.266 and $0.301 per pound in 2009 and 2010 respectively (USDA National Agricultural Statistics Services, 2013). The national average price per pound in 2009 was $0.231 and 2010 was $0.241 indicating Missouri beat the national average in years where data for both state and national are available (USDA: National Agricultural Statistics Service, 2012). The average statewide yield from 2009 to 2012 was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). The average statewide price per acre was $5,292.57, or approximately $0.36 per pound of apples.

Research supports family farms filing to incorporate to manage risk to personal assets. Further research supports establishing a family run orchard under a Limited Liability Company legal structure.

Based on research an apple orchard commercially producing only apples with no value added products in the Kansas City, Missouri, region is not feasible. Data indicates the establishment of an orchard will not break even by the 7th year after planting, which is the 5th year of apple production. These calculations do not consider unforeseen market fluctuations such as natural disasters, extreme price increases of farm inputs, or bumper crops earning higher than expected prices. This study does not consider the owners annual salary, advantages gained in labor and equipment through increased land and production, or bulk-pricing break points, and
decreased price per acre realized when purchasing tracts measuring in the hundreds of acres. An apple orchard run as a family farm is a good way to build socioeconomic relationships in a community while providing a healthy service to the community and beyond.
CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This chapter will summarize the research problem, data collection methods, and reiterate the results of the research detailed throughout the four previous chapters. Specific recommendations will be provided to assist agricultural entrepreneurs in establishing a profitable and sustainable orchard operation.

The purpose of this study is to determine the feasibility of establishing an apple orchard in the Kansas City, Missouri, region. On average, the 5th year is when apple trees begin to bear fruit for sale. Orchards typically plant 2-year old trees and experience two nonbearing years. The study determined current market demand, the supply of apples to meet market demand, marketing and advertising strategies, legal organizational structure, profitability, and the feasibility of establishing an orchard in the Kansas City, Mo. region.

Chapter 1 defined the research problem, the purpose of the study, provided definitions, limitations to the study, and presented five research questions for this feasibility study:

1. What is the current market demand for apples grown in the Kansas City, Missouri, region?

2. What is the supply of apples grown in Kansas City, Missouri, region?

3. What is the most advantageous legal organization of an apple orchard in the Kansas City, Missouri, region?

4. What is the profitability of establishing an apple orchard in the Kansas City, Missouri, region?
5. What is the feasibility of establishing an apple orchard in the Kansas City, Missouri, region?

Chapter 2 discussed secondary literature sources on 11 aspects of establishing and running a profitable and sustainable apple orchard. Scholarly research indicated that tree selection, site selection, and soil management are the three most crucial aspects to plan and manage for a successful orchard operation. Numerous other variables were highlighted with most noting that deliberate planning, months or years in advance, is critical to the decision-making and sustainability of orchard operations. Research determined that apple orchards experience uncontrollable variables, such as severe weather patterns and extreme market fluctuations. Missouri orchardists are able to manage their operations and produce apple varieties demanded by local and national markets while receiving higher prices than the national average.

Chapter 3 outlined the methodology for this feasibility study. Quantitative research with empirical evaluation of the data was the nature and design for the study. The researcher analyzed secondary data and personal observations to form opinions and develop conclusions. Secondary data was the primary data source for this research. Scholarly journals, articles, textbooks, government statistics, preexisting research from government and university agricultural extensions, and media were used to analyze and quantify the variables for establishing an apple orchard.

Chapter 4 correlated the data presentation and data analysis for the secondary research sources through the five research questions. The research data supports that a large market demand for fresh apples and processed apple products currently exists in the Kansas City, Missouri, region. The research data supports that the common varieties of apples grown in the
Kansas City, Missouri, region are marketable and currently demanded by the consumers. Data results indicate the supply of apples produced in Missouri falls well short of apple demand. Research supports family farms filing to incorporate as an LLC to manage risk to personal assets. Data analysis indicates it is not feasible to establish an apple orchard in the Kansas City, Missouri, region and to break even by the 7th year after planting, which is the 5th year of apple production. Based on the feasibility criteria, Missouri has the necessary soil characteristics, climate, labor for orchard operations, and nurseries for apple orchards. The following conclusions further define the data outcomes based on the five research questions.

Conclusions

The five research questions presented in Chapter 1 for this feasibility study are concluded in this section. The researcher concludes that the limitations listed in chapter 1 had little or no impact on this research project. The research process conducted for this feasibility study was sufficient to determine the break-even point. The researcher believes the process would have been enhanced through discussions with active orchardists and on the ground study of active orchard operations. A more thorough understanding of all aspects of apple orchards would have been the result of personal interaction.

Research Question 1: What is the current market demand for apples grown in the Kansas City, Missouri, region?

Based on the population of major cities within 250 miles of the Kansas City, Missouri, region and national average apple consumption, the demand is approximately 41 million pounds of fresh apples and approximately 71 million pounds of processed apple products for a total estimated demand of 112 million pounds. Common varieties grown in the Kansas City, Missouri,
region include Golden Delicious, Jonathan, Red Delicious, Gala, Fugi, Red Rome, Ozark Gold, Earligold, Idared, Cortland, Empire, Winesap, Jonalicious, Rome Beauty, Lurared, Blushing Golden, Granny Smith, Freedom, and Braeburn. Demand has shifted in the U.S. from Red Delicious to newer varieties, such as Fuji and Gala; both varieties are prevalent in the research area. A large market demand for fresh apples and processed apple products exists for the common varieties of apples locally grown in the Kansas City, Missouri, region.

**Research Question 2: What is the supply of apples grown in Kansas City, Missouri, region?**

In 2012 Missouri produced 1,600 acres of apples, yielding 21,900 pounds per acre (approximately 521.4 bushels per acre), for an estimated total of 35 million pounds and the highest yield of the four years (2009 to 2012) referenced in this feasibility study. The average statewide yield over the four years was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). Estimated demand is 112 million pounds of fresh and processed apples. Estimated supply of locally grown apples is 35 million pounds of fresh and processed apples or approximately 31.2% of the market demand.

**Research Question 3: What is the most advantageous legal organization of an apple orchard in the Kansas City, Missouri, region?**

Agricultural endeavors are inherently risky due to the numerous uncontrollable variables that effect production and operations. Maintaining a family farm status offers advantages from the Farm Bill and with access to credit through a variety of lending institutions. Incorporating the family farm as a LLC offers legal protection of personal finances, thereby limiting risks. The researcher believes a family farm, LLC is the most advantageous legal organization of an apple orchard.
Research Question 4: What is the profitability of establishing an apple orchard in the Kansas City, Missouri, region?

Missouri orchardists received $0.471 per pound in 2012, equaling $10,314.90 per acre, the highest price per pound and total per acre of the four years (2009 to 2012) referenced in this feasibility study. The average statewide yield over the four years was 14,707.5 pounds per acre (approximately 350.2 bushels per acre). The average statewide price per acre over the same period was $5,292.57, or approximately $0.36 per pound of apples. Missouri orchards beat the national average in price per pound in each of the four years. Cost to establish an orchard were estimated at $7 per 2-year old tree for 25,000 trees ($175,000), on 50 acres costing an average of $2,900 per acre ($145,000), with the purchase of $100,000 of equipment for an initial investment of $420,000. Estimated cost per acre in the nonbearing years was $4,500, increasing during bearing years. Additional equipment costs were figured for two purchases of $25,000 each. Labor was assumed to be captured in the price per acre. Debt before the first year of production totaled $895,000. Based on average yields and price per pound $264,735 was estimated for annual returns except for the first year, which was estimated at 70% of annual returns or $185,315. The same methodology and average costs were calculated for orchards ranging in size from 30 to 300 acres with the same result in each case. These calculations do not consider advantages gained from labor and equipment through the increase in size and production, nor does this study consider price-break points earned on bulk orders and decreased price per acre when purchasing tracts with hundreds of acres.
In conclusion, a commercial apple orchard without any value added products in the Kansas City, Missouri, region will not break even by the 7th year after planting, which is the 5th year of apple production and fails the decision criteria.

**Research Question 5: What is the feasibility of establishing an apple orchard in the Kansas City, Missouri, region?**

Research supports that Missouri has the necessary soil characteristics, climate, and labor for orchard operations to be feasible. Research also supports ample nurseries are available to purchase rootstocks and varieties of choice to best fit a feasible and profitable orchard plan in the Kansas City, Missouri, region. The break-even point does not support the feasibility of establishing an apple orchard without any value added products in the research area. In the form of this feasibility study, it is not feasible to establish an apple orchard in the Kansas City, Missouri, region.

**Recommendations**

**Recommendations for research question 1:**

The researcher recommends joining professional network groups and building relationships with various agricultural entities. The types of professional networks may include restaurant owners, grocery stores, and food processing operations. The agricultural entities include local cooperatives, CSA activities, and horticultural groups. The network area should cover, at a minimum, the population defined in the market plan. The network should facilitate planning for value added products such as apple butter, apple cider, or apple eau-de-vie and the continued growth of knowledge in pomology.

**Recommendations for research question 2:**
The researcher recommends establishing an orchard that is capable to produce sufficient quantity for demand for fresh and value added apple products to increase profitability.

The second recommendation is to grow a diverse crop of no less than three varieties. Careful planning to ensure proper pollination is required. The additional varieties will aide in hedging risks from year to year.

**Recommendations for research question 3:**

The researcher recommends incorporating a family farm structure as an LLC to manage risk to personal assets. Managing risk by breaking the family farm into separate LLC and then incorporating all of the separate corporations, into one LLC further establishes risk management of personal assets.

**Recommendations for research question 4:**

The researcher recommends diversifying the crop into no less than three varieties grown to maximize the profitability and manage risks. Missouri has experienced higher price per pound in the 2009 to 2012 growing season than the national average, however, this is not indicative of future performance. The average returns from 2009 to 2012 were not enough to establish an apple orchard that would break-even by the 7th year after planting and the 5th year of apple production.

The researcher also recommends diversifying the uses of the yield into the form of value added products such as apple butter, apple cider, or apple eau-de-vie.

**Recommendations for research question 5:**

The researcher recommends apple orchard entrepreneurs develop a business plan based on niche market or markets to satisfy a portion of the unrealized market demand in the research
area. Essential components of the plan include; site selection, tree selection, understanding pomology, orchard management, debt and cash flow management, marketing networks, and networks to share knowledge.

**Future Research Recommendations**

This feasibility study did not consider the viability of diversifying an apple operation into value added products. Numerous apple by-products are produced and consumed every year, the specific demand and supply availability for the Kansas City, Missouri, region is unknown and should be researched.

Research did not address the feasibility of diversifying into other products such as grapes, peaches, nuts, or berries to manage risk and facilitate profitability. These products are all grown in the Kansas City, Missouri, region. The specific demand and supply availability is unknown and should be researched.

The researcher recommends further study be conducted on the current effectiveness and efficiency of CSA and marketing techniques, correlating how current technological trends such as social media can improve the effectiveness and efficiency to minimize costs and improve profitability.
REFERENCES


Washington, D.C.: USDA.
