RISK MANAGEMENT STRATEGIES FOR A PRODUCER OWNED SHELLING COOPERATIVE

by

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(Under the Direction of Stanley Fletcher)

ABSTRACT

Peanut producers have faced several new changes under the past 2002 Farm Bill. Due to these changes, and continual increasing concentration of the peanut industry beyond the farm gate, peanut producers have a lack of market power. Peanut producers can form a New Generation Shelling Cooperative (NGSC) to increase market power and capture some of the value beyond the farm gate. When forming a NGSC, individual farmer-member risks are joined together in the cooperative, thereby increasing an individual farmer's risk rather than diversifying the farmer's portfolio. This study identifies various sources of risk, discusses risk management tools, and develops risk management plans for the NGSC. Finally, the risk management plans are tested under a Monte Carlo simulation and measured and ranked with VaR, Sharpe's Ratio, and a stochastic dominance measure to understand their worth.

INDEX WORDS: Peanuts, New Generation Cooperatives, Risk Management, Monte Carlo, Value-at-Risk, Sharpe's Ratio, Stochastic Dominance.

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DEDICATION

I would like to dedicate this thesis to my grandmother for encouraging me to try different things in life. I never will forget her telling me to be open minded in life and try new things. I have to also thank God everyday that he gave me a brain and that I can undertake work such as this. Thanks Jesus!

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CHAPTER 1

INTRODUCTION

Agriculture businesses face many uncertainties. Most risk in agricultural production is linked to uncontrollable weather conditions (Fleisher). Since the risk in agriculture is so great, the federal government has historically participated in crop insurance programs since private insurance cannot fully meet the demands for highly correlated risks. Economic circumstances of agriculture insurance have led to programs in which premiums are subsidized by the government. About the same time in the late 1930's the peanut program was established to support peanut production. The federal peanut program has controlled peanut supply through acreage and poundage allotments over time and supported peanut prices.

The 2002 Farm Bill made some drastic changes to the peanut program. Some of the changes included deletion of the two-price support system and the quota system. Peanuts are now treated like other major "program" crops with a system of direct support payments, contingent on historical production rather than current acreage. This program allows marketing loan provisions to all peanut farmers, and farmers do not have to own or rent quota rights to produce peanuts for domestic consumption.

Peanut farmers are now facing a lower marketing loan rate under the 2002 peanut program. The marketing loan rate was $610/ton during previous peanut program under the 1996 Farm Bill. The current program under the 2002 Farm Bill dropped the marketing loan rate to $355/ton. Peanut farmers now face lower profit margins. Peanut farmers can enhance their profitability by forming a New Generation Cooperative (NGC). An NGC has specific membership and delivery rights, and can add economic value to a farmer's product, such as shelling peanuts. Peanut farmers can form a New Generation Shelling Cooperative (NGSC) to shell peanuts. NGSCs can give farmers an additional source of income and marketing alternatives. Also, an NGSC can be a response to market concentration. Concentration of peanut shellers has increased throughout the peanut industry over time (American Peanut Shellers Association)

Overview of the Peanut Industry

The major world exporters of peanuts are China, Argentina, and the United States. U.S. peanut exports represent about 10 percent of total world production and 25 percent of world trade (USA Peanuts). The state of Georgia leads the country in peanut exports, contributing 30 percent to the total amount of peanut exports and over $90 million to the value of U.S. exports (USA Peanuts). European countries purchase about 60 percent of U.S. raw peanut exports (Economic Research Service). Processed peanuts and specialty peanuts make up 25 percent of the total U.S. value of peanut exports. Peanuts produced above the amount needed for domestic edible consumption and the export market are crushed for oil and peanut meal.

United States production of peanuts was 3,320 million pounds in the year 2002, down 22 percent from 2001 according to the USDA Situation and Outlook yearbook. A major cause for this shortfall was drought that hit the Southeast. Peanut production was up in 2003 to 4,144 million pounds with improved weather. It is estimated that peanut production in the U.S. is valued at $1 billion for the 2003 annual crop value (USDA). Southeast production for 2003 increased 45 percent compared to 2002. Georgia produced 1,863 million pounds of peanuts in 2003 and was the leading producer in the US with almost 45 percent of total US production.

Georgia also set a record high for yield per acre (3,450 lbs/ac) in 2003 according to the USDA crop report.

The 2002 Census of Agriculture shows 3,290 Georgia farms harvested 1.17 billion pounds of peanuts in 79 counties (NASS). Compared to the 1997 Census, the number of farms had decreased 32 percent over the five year period from 1997 to 2002. The amount of Georgia acreage in peanut production went from 520,283 acres in 1997 to 467,712 acres in 2002, resulting in a 10 percent drop of acreage in peanut production.

Peanuts grow in a light-textured, well-drained soil and require 120 to 150 days to mature, depending on the variety (Schaub 1989). Peanuts are grown in three regions of the United States: the Southeast, the Southwest, and the Virginia- North Carolina region. The Southeast region includes the states of South Carolina, Georgia, Florida, and Alabama. The Southwest region includes the states of Texas, Oklahoma, and New Mexico, while the last region includes the states of Virginia and North Carolina. Four types of peanuts are grown in the United States: Runners, Spanish, Virginia, and Valencia. The Runner variety is typically grown in Georgia and the other Southeastern states.

After peanuts are harvested, cured, and picked they are delivered to a buying point or shelling plant and are regarded as farmer stock peanuts (USA Peanuts). Farmer stock peanuts are then graded and inspected to determine the quality. Loan values are calculated from USDA price support schedules (USA Peanuts).

Peanuts fall into one of three grades called segregation one (I), two (II), or three (III). Segregation I peanuts are suitable for edible use market. Segregation II and III peanuts are used for the oil and peanut meal market. Peanuts found to have aflatoxin levels above acceptable levels automatically become segregation III peanuts. Farmer stock peanuts either are shelled or stored for shelling at a later date. Processing removes the kernel from the shell and is termed shelling. The shelled peanuts are cleaned and sorted according to size into market grades.

Four major food products are produced by peanut manufacturers: peanut butter, snack peanuts, peanut candies, and in-shell peanuts. The March 2004 USDA stocks and processing report indicates the percentage breakdown for the four peanut product types in the U.S. are 45 percent, 23 percent, 21 percent, and 9 percent, respectively. The runner peanut variety is typically used in the production of peanut butter and is the most common peanut type used in the peanut industry. About 20 percent of runners are also used in the production of candy and snack peanuts (Ray). In-shell peanuts are commonly Virginia type peanuts. Virginia peanuts make up approximately 50 to 60 percent of peanuts used in snack peanuts and cocktail nuts (Sanford). Spanish peanuts are used in the manufacturing of peanut butter, snack peanuts, and candy. Valencia type peanuts are unique due to having three or four kernels per shell and are used in snack peanuts.

Peanut shellers purchase, process, and sell shelled peanuts to processors, manufacturers, and the export market. Shellers are usually located in peanut producing regions near the supply source. Peanut processors and manufacturers are usually located in major consuming regions where food products are produced from peanuts, such as candies, peanut butter, and snacks (So).

Peanut farmers are not typically involved in any value-added process (i.e. shelling) of their peanuts once the peanuts leave the farm. After the peanuts are harvested in the fall, farmers deliver the peanuts to shellers or buying points that are located throughout the growing areas. Buying points are typically owned and operated by shellers or independent dealers (Fletcher). Peanut farmers receive the current market price or the loan rate for their peanut crop, unless they have a marketing contract that specifies a fixed price. The government sets the loan rate price each year for each peanut type based upon a national loan rate of $355 per ton. The farmer is then paid according to the quantity and quality of his peanuts.

The Peanut Program

The first peanut program was started with passage of the Agriculture Adjustment Act in 1930 due to economic conditions of the Great Depression (McGill). In 1934, Congress established a program to control the domestic supply of peanuts and also secure peanut farmers' income. The major focus of this peanut program was controlling acreage allotments and having a price support program. Some problems with pre 2002 programs included an increased cost to the government as well as an excess supply of peanuts. In addition, exports of peanuts were hampered due to the support prices that would exceed the current world market level.

The peanut program was revamped in the late 1970s so that it served as a supply management program and a two level price support system. The price system assigned prices to two "types" of peanuts. "Quota" peanuts were first quality peanuts that would meet the domestic edible U.S. demand and poundage set by the USDA. Quotas were determined among farms based on production history. "Additional" peanuts were all other grades of peanuts and peanuts in excess of the national quota limit. The support level prices assigned to quota peanuts and additionals were determined by the government and the additionals price was set lower than quota peanuts to ensure no or minimum losses for the Commodity Credit Corporation (CCC) when peanuts were sold or disposed (Economic Research Service). Additionals peanuts were usually produced and sold for export and crushing, but may also have been be used for the U.S. edible market through the "buyback" provision or CCC resale when quota supply wais short of demand (Shurley, et al.). Peanuts that were deemed buybacks are additional peanuts which were allowed to be bought and used in meeting the quota level when there were not enough quota peanuts to meet the national poundage. Buybacks were made possible through a provision which allowed first handlers to use additional peanuts as quota peanuts with permission of the farmer. The first handler was required to pay the contracted additionals price to the farmer and a premium for the permission. Then the first handler paid the difference between the quota price and the contracted additionals price to the CCC.

A government-sponsored cooperative grower association in each of the three major U.S. production areas supervised government peanut programs (Dubman). The major functions of these associations include: supervision of CCC warehousing, resale of CCC loan peanuts to shellers, drawing drafts on CCC to pay farmers for loan peanuts, and to operate a pool that distributed any gains from operations to farmers (Miller).

The 1981 Agriculture and Food Act changed the program by removing the acreage allotment system, but kept the dual-price system (Dubman). Another expansion of this act allowed peanut exports to be competitive with world prices. This act also had the special buyback provision which allowed additionals to be used in the domestic market. The additionals peanut market gave any farmer the opportunity to grow and market additionals for export at the world market price (Dubman). Few changes were made to the peanut program until the early 1990s when NAFTA eliminated import quotas, which helped maintain the status of the U.S. domestic peanut program. By 2008, all tariffs for Mexican-origin peanuts will end and the peanuts will be allowed to enter the U.S. freely (NAFTA). President Clinton signed the Federal Agriculture Improvement and Reform (FAIR) Act of 1996 which imposed several changes to the peanut program existing at that time. This act lowered and fixed the quota price to $610 per ton for 7 years until 2002. Congress also eliminated the minimum poundage quota floor, the price escalator provision, and undermarketing carryover for peanuts. The elimination of the carryover stopped a farmer's right to carry over unused quota to next season, but he could have sold or leased out his unused quota to another farmer in the same state across county lines. The program was designed to be of no cost to the government and farmers were assessed the cost of any program losses. The act also reduced disaster payment benefits. Farmers, under this act, could also lose support benefits if they sold their crop to the government for two consecutive years rather than take a contract with a commercial buyer offering a minimum of support price. Due to the changes from the 1996 Act, it was obvious that the peanut program was moving towards a more open and competitive market with less government policy influence. Chen and Fletcher (1997) concluded that the peanut industry may be better in the long run with less government intervention and open trade, but in the short run, many peanut farmers would not be able to survive the impact without some type of assistance.

The 2002 Farm Bill made major changes to the peanut program. The bill eliminated the two-price support system and the marketing quota system (USDA). Currently peanuts are treated like other major "program" crops such as cotton and grains and have a system of a direct support payments contingent on historical, not current acreage. Peanut farmers are offered marketing assistance loans, loan deficiency payments, counter-cyclical payments, and direct payments. Also, peanut quota holders were compensated for the elimination of the peanut quota system through a buy-out program of eligible quota owned (USDA). All farmers with a past history of producing peanuts during the years 1998-2001, whether a quota holder or not, are eligible for fixed direct payments and counter-cyclical payments based on an established target price (USDA).

The 2002 Farm Bill has four major provisions for peanuts. One provision is the market assistance loan available to all farmers choosing to produce peanuts. The marketing assistance loan rate is fixed at $355 per ton for the length of the farm bill. Farmers can now market their peanut crop for domestic edible consumption without any penalties under the new peanut policy (Economic Research Service). Farmers can enroll in the marketing loan program for up to nine months and then repay the loan at a rate that is the lesser of (1) $355 per ton plus interest or (2) a USDA determined repayment rate designed to minimize loan forfeiture, government-owned stocks, and storage costs. The farmers can opt for a loan deficiency payment (LDP) instead of the marketing loan. The LDP would be at a payment rate equal to the difference between the loan rate and loan repayment rate (Economic Research Service).

The second provision is similar to the production flexibility contract payments made available to grain and cotton farmers in the 1996 Farm Act, peanut farmers receive $36 per ton of eligible historical production during the base (1998-2001) period as “fixed, decoupled” payment. Eligible production equals the product of base-period yields (with provisions for unusual crop losses) and 85 percent of base-period acres planted to peanuts. The payments are considered fixed and decoupled because they are made regardless of current prices or as long as the production area stays in an approved agriculture use (Economic Research Service).

A third provision is a countercyclical payment (CCP) made to farmers with a base acreage and allows them to obtain financial assistance when market prices are below a fixed target price of $495 per ton. Payments are based on the difference between the target price and the higher of 1) the twelve month national average market price for peanuts plus a $36 per ton fixed decoupled payment or 2) the marketing assistance loan rate plus the $36 per ton fixed decoupled payment. Payments are 85 percent of base (1998-2001) peanut production as long as the area stays in an approved agriculture use (Economic Research Service). A CCP for a farm is calculated in two steps:

(1.1) *Payment rate* = [(*target price*) – (*direct payment rate*) – (*higher of peanut market price or loan rate*)]

(1.2) *CCP = 0.85* x (*base acres*) x (*payment yield*) x (*payment rate*)

The fourth provision is the quota buyout program compensating for loss of quota asset value for quota owners. Payments are received in five annual installments of $220 per ton ($0.11 per lb.) during the fiscal years 2002 through 2006, and based on the quota owners' 2001 quota. Alternatively, quota owners could choose to receive the buyout in a lump sum payment of $1100 per ton ($0.55 per /lb.) in lieu of the five annual installments. Continued eligibility for compensation payments would remain with the established quota owner regardless of future interest in the farm or whether the person continues to produce peanuts (Economic Research Service).

Peanut Shellers

Over time there has been a decline in the number of Georgia peanut shellers. During the 1980 to 1981 growing season, there were a total of thirty-nine active shelling plants that were members of the American Peanut Shellers Association (APSA). Ten years later, in the 1990 to 1991 growing season, the number had reduced to twenty-two active shelling plants that were APSA members. The number of active shellers had declined to eight for the 2003 growing season (American Peanut Shellers Association.).

Shellers need peanuts to shell, therefore shellers face a throughput risk based upon peanut production. Acquiring peanuts from farmers is considered the most outstanding risk faced by shellers and contracting with farmers potentially reduces risk (Dubman). Due to the current nature of peanut contracts, farmers are not obligated to deliver contracted peanuts. A non-delivery clause exists in a peanut contract and a sheller bears all risk associated with the contract

(Dubman). This started before 1981 when peanut contracts were required to be on CCC Form 1005 which favored farmers and did not require delivery of the contract. Farmers can claim an act of nature or an act of God when weather or nature disrupts a farmer's peanut crop for non-delivery of a contract. This non-delivery clause has been in effect for a long period of time and a risk-averse farmer would prefer to sign a contract that does not require delivery. This is an attractive feature in a contract and if one sheller offers a non-delivery contract, other shellers must follow or risk loss of business. Shellers have an unforeseen risk of throughput shortfall and that could be potentially a disaster for their business. They are left vulnerable since they are required to make good on any forward contracts of shelled peanuts, whereas peanut farmers can default on a forward contract with the sheller.

Shellers make contracts with farmers to ensure a sufficient supply of peanuts to shell. The typical peanut contract is based upon poundage, intended acreage to plant, and intended yield per acre. Intended irrigated acres are noted on a contract to purchase farmer stock peanuts, and a clause that guarantees the farmer will plant not less than ninety percent of the intended acreage. The farmer must certify in writing the actual acreage planted no later than August 1st of applicable crop year. Even if a farmer guarantees this in a contract, there is still the risk that the yield may not be met. Beginning in 2002, shellers introduced "option contracts" for the purchase of peanuts in order to exercise the exclusive right to buy a farmer's peanuts or not. Some option contracts are based solely on poundage, while others have a poundage basis, acreage planted, and average yield per acre. The farmer's stock peanuts are placed in storage under a marketing assistance loan and the sheller can exercise the option until the market loan maturity date.

Farmers' stock peanuts are an uncertain input supply for a peanut sheller. Weather, specifically rainfall and temperature, is a common cause of variation in production over the production seasons. A drought, such as 1980 or 1990, could reduce the total peanut crop production by a significant amount and impose negative effects (USDA). Peanut shellers have limited choices of risk management tools for throughput risk. Contracting with farmers that produce irrigated peanuts is one way to reduce throughput risk, but it does not eliminate all factors that could affect that risk. Over the years, new and improved peanut varieties have been introduced that have brought increased yields. Peanut yields have plateaued in the late 1980's and early 1990's after a decrease from the 1970's. Yields have recently trended up since 2000. Figure 1.1 shows Georgia's peanut acreage production from 1973 to 2003 and Figure 1.2 shows Georgia's average peanut yield from 1973 to 2003.

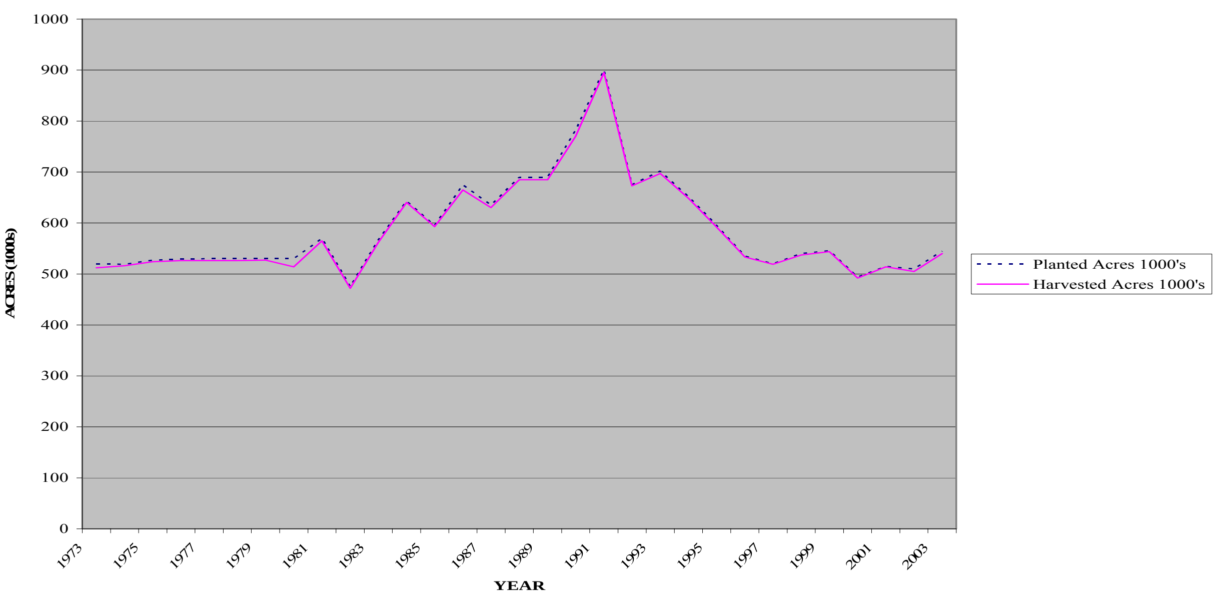


Figure 1.1 Georgia's peanut acreage production from 1973 to 2003

Price risk is another area of concern for peanut shellers, both the purchase of farmers' stock peanuts and pricing of shelled peanuts. Without a futures market or some form of hedging instrument for price risk, handlers in the peanut industry are exposed to possible extreme swings in peanut prices. Extreme price movements can financially harm firms that are totally exposed without some form of protection. These exposed firms may be unable to handle price risk and experience disastrous financial losses.

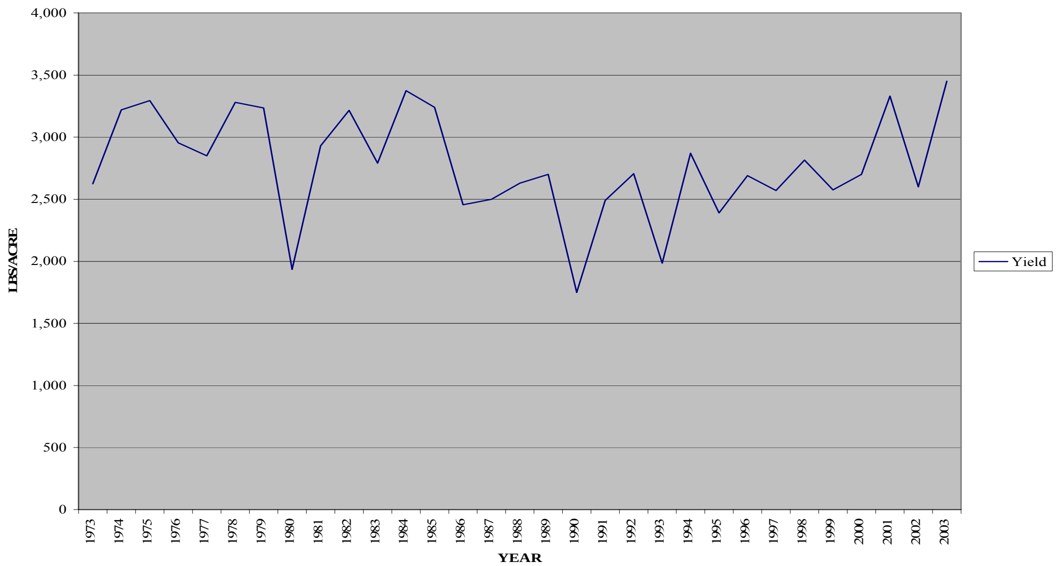


Figure 1.2 Georgia's peanut yields from 1973 to 2003

Price information for purchase of farmers' stock peanuts is somewhat simplified by the market loan rate with the current peanut program. It does not eliminate all price risk associated with purchase of farmers' stock peanuts. A year of low peanut production could cause an increase in the price required to purchase farmers' stock peanuts. Shellers typically know what they will have to pay for farmer's stock peanuts based upon the marketing loan rate.

Pricing for shelled peanuts in the domestic market is simplified by the current market loan rate. Shellers know what they pay for farmers' stock peanuts and the shelling costs involved, and therefore shellers know the minimum price that will cover costs. Shelled peanut buyers typically know the range of prices that they must pay for shelled peanuts (assuming a normal production year). Pricing information is not easy for the exporting market. Shellers must have information on the entire world peanut market in order to operate competitively (Dubman). All the pricing information a sheller can obtain will help with export price risk since there is no world-wide price reporting or a peanut futures contract. It is a continuous process to gather world prices with negotiations and discovering prices are very challenging for shellers (Smith, 1984).

Problems in the Peanut Industry

Current problems in the peanut industry are (1) asymmetric information, (2) decreased marketing loan rate, and (3) concentration of peanut shellers. Nicholson describes asymmetric information as an imbalance of knowledge between two parties when entering into an economic or business transaction (1998). This can be compared to adverse selection as one party can act in its favor since market information is not readily available to both parties. Currently there is no futures market or exchange for buying and selling peanuts domestically or in the world market. Since there is no open market, price discovery remains difficult and buyers and sellers must depend upon a network of contacts to obtain information (Smith, 1984). Access to pricing information is easier for shellers than individual farmers since shellers have the resources to obtain this information. However, access to price information is critical to the farmer as well as the sheller. An efficient market could be achieved if both sellers and buyers of peanuts had equal access to price information.

A second problem in the industry is the decreased marketing loan rate due to the change in the peanut program. The marketing loan rate decreased from $610/ton under the 1996 peanut program down to $355/ton under the current peanut program. Farmers receive lower prices for their peanut crop under the current program. Peanuts are less profitable for many farmers due to the change in margin.

The third problem in the peanut industry is the concentration of shellers. Two shellers controlled around 80% of the Georgia peanut shelling market in 2003 (Fletcher). This leaves farmers at a disadvantage due to the big market players. Peanut farmers lack market power and marketing opportunities due to this concentration beyond the farm gate. Non-farm sectors of the peanut industry have consolidated over time to increase their efficiency (Ray).

A new generation sheller cooperative (NGSC) is a possible alternative to help peanut farmers with the above mentioned problems in the peanut industry. An NGSC can help farmers by adding value to their crop through shelling and capture some extra profit by providing peanut farmers with marketing opportunities. While an NGSC may be an alternative for farmers, it does face various risks. There is limited information on managing risk for a cooperative, specifically a peanut shelling cooperative. Lastly, while an NGSC does face risk, it can be a profitable second source of income for members by adding value and increasing marketing opportunities with proper management.

Objectives

Throughput risk and marketing risks are specific risks an NGSC will face. The objective of this research is to compare and rank several alternative risk management techniques according to their ability to provide risk reduction for the NGSC. Specifically this research will:

1. Identify the sources of risk for an NGSC, particularly throughput risk and marketing risks.
2. Identify risk management tools and strategies for an NGSC.
3. Illustrate the risk management tools and strategies on an NGSC by simulations and rank them according to how they affect the financial performance of the NGSC.

The structure of the study follows: Chapter Two reviews New Generation Cooperatives (NGC), identifies various risks associated with a peanut shelling cooperative, and then discusses selected risk management tools. Chapter Three discusses the data and simulation model used for this study as well as a variety evaluation techniques of metrics, specifically, Value-at-Risk (VaR), Sharpe's Ratio, and stochastic dominance. Chapter Four discusses the results of the simulation and rank the effectiveness of the risk management strategies. If there is strong agreement among the rankings implied by these evaluation measures, it will help indicate the worth of one risk management strategy over another. Finally, Chapter Five provides the conclusion of this study and a brief summary.

CHAPTER 2

NEW GENERATION COOPERATIVES AND RISK MANAGEMENT STRATAGIES

The appearance of new generation cooperatives (NGCs) in value-added agriculture has sparked interest among farmers and farm organizations to study and develop businesses solely owned by farmers (Thomas). Specifically, NGCs produce their own value-added product, i.e., shelled peanuts. In many cases, farmer-members finance the construction of the facility and contract most or all of their entire crop to the cooperative (Thomas).

Changes in the agriculture sector have encouraged farmers to seek alternatives to restore prosperity to their livelihood (Thomas). Farm Bill program revisions, the ever-changing global market, the decrease in the number of farmers, and economic stress have all caused concern among farmers. Farmers are concerned with their economic outlook with these changes and NGCs may have potential for increasing financial returns.

New Generation Cooperatives

New generation cooperatives represent the most recent development in cooperatives. The main objective of NGCs is value-added processing (Waner). NGCs differ from traditional cooperatives by the following characteristics: (1) restricted or closed memberships with specific delivery rights based upon the amount of shares owned by the member, (2) typically require higher level of initial equity investment, (3) transferability of delivery shares, and (4) the opportunity for appreciation or depreciation in the value of delivery shares (Thomas).

The first characteristic of an NGC is delivery rights. Delivery rights shares for an NGC typically obligates the farmer to deliver a specific amount of farm product to the cooperative each year (Thomas). For example, one equity share (delivery right) may give the farmer the obligation to produce and deliver one ton of farmers' stock peanuts to the cooperative each year. Basically, this delivery right functions as a two-way contract between the farmer-member and the cooperative. The farmer is obligated to deliver the product and the cooperative is obligated to accept the product (Thomas). Delivery rights ensure farmers a market for their product and also assures the cooperative of a stable source of throughput. This is, in effect, a risk management strategy for the NGC. If a farmer-member cannot meet the quantity or quality standards, alternative arrangements made by either the farmer or the cooperative are made in order to fulfill the delivery requirements. The farmer would be responsible for the expense of the additional input needed to fulfill the contract.

A second characteristic is the NGC must determine the processing capacity it can handle. The number of stock shares giving delivery rights is determined by the processing objectives. The price of each share of stock (delivery right) is usually set by dividing the total amount of equity capital that the cooperative needs to finance the operation by the processing capacity of the cooperative facilities. For example, if a cooperative needed $10 million in equity capital, and could process 50,000 tons per year, then $10 million divided by 50,000 tons would equal $200 per share of delivery right. The shares that allocate delivery rights are different from membership shares. Each farmer-member holds one membership share, but can hold more than one delivery rights share (Thomas). The privileges with a membership share are voting rights, and each member has one vote in the cooperative affairs. The cost of a membership share is usually nominal when compared to a delivery rights share.

A third characteristic is once a new generation cooperative has sold all of its delivery rights, no more memberships are sold unless the business decides to expand. New membership in the NGC can only be allowed if an existing member wants to sell some if his delivery rights to another farmer. The sale of delivery rights shares typically requires the approval from the board of directors before they occur. The value at which the delivery rights shares are sold are negotiated between the member and farmer that is buying. The value of the shares can fluctuate with the overall performance of the NGC, therefore a gain or loss could be had with the sale of delivery rights shares.

Finally, since delivery rights are present in new generation cooperatives, a higher level of initial equity investment is required from farmers than most traditional cooperatives. NGCs typically raise between 30 to 50 percent of their total capital requirements from the sale of equity shares (Harris et al.). Farmers usually have a minimum level of delivery rights that must be purchased from the NGC for membership. Since the members invest a significant amount into the NGC and are committed to deliver product, farmer-members tend to stay more involved and dedicated in a NGC than in an traditional cooperative.

Other important differences between traditional cooperatives and NGCs worth noting are the activities relating to income or profit distributions to members. A patron cash dividend is common in many traditional cooperatives. Part of the dividend is paid in cash and the other part is retained for equity investment by the member (Coltrain, 2000a). The cash dividend is usually around 20 to 35 percent for a traditional cooperative versus 65 to 85 percent cash dividend rate for NGCs (Coltrain, 2000a). This is made possible since the member has invested equity to obtain delivery rights. Traditional cooperatives distribute lower dividend amounts because a higher percentage of income is retained to invest in financial assets and replace equity. NGCs have a larger portion of initial equity from direct investment when the cooperative is established. Therefore, NGCs invest less of members' profit distributions back into the cooperative. Another method of profit distribution is pooling. Pooling is a common method for NGCs to set and pay the price for the input products that members deliver. Pooling is based upon marketing agreements. Once the pool has been marketed, a net margin price is determined. An initial payment is made at the delivery time of the product, and profits are delayed conditioned upon the close of the pool and the final margin (Coltrain, 2000a).

An NGCs focus is adding value to a member's product. Adding value by definition is "to economically add value to a product by changing its current place, time, and form characteristics to characteristics more preferred in the marketplace" (Coltrain, 2000b). New Generation Cooperatives are usually formed by members that are seeking additional profits through value-added enterprises (Waner). Some reasons that have stimulated the establishment of NGCs are: (1) low prices for commodities, (2) attempt to capture more value from crops, (3) free trade and globalization of markets, (4) vertical integration of production, (5) declining farm supports, (6) increasing cost of technology, and (7) tax advantages of a NGCs. When successful, NGCs can provide a secondary source of income to its members. Also, an NGC can possibly provide a positive return on investment and increase a member's stock value. Due to the recent major changes in the peanut program, NGCs can provide an important opportunity for farmers looking to increase the value of their peanuts beyond the farm gate. The peanut-program appears to be heading to a more market oriented program (Fletcher). Lastly, a NGC can be a mechanism for farmers to respond to market oriented program and by adding value to a farmer's commodities, farm income can be enhanced by use of this strategy (Coltrain, 2000b).

Review of South Georgia Peanut Cooperative Studies

Three previous studies have focused on a South Georgia Peanut shelling cooperative, specifically a new generation shelling cooperative. Ray et al. (2001) was the first study concerning acceptance of a Georgia peanut NGC. The results led to a feasibility study of a South Georgia peanut NGC (Hancock et al.). The feasibility study for a South Georgia Peanut cooperative was conducted by the National Center for Peanut Competitiveness (NCPC) with the goal of forming a value-added cooperative that would allow farmer-members to have a larger share of the consumer peanut dollar. The motivation for this study was brought about by three main factors: (1) farm income for peanut farmers has declined steadily over the last three years, (2) future of current peanut program is questionable, and (3) the first buyers market (i.e., shellers) has become continually concentrated over the last decade (NCPC). According to Hancock et al., segments of the peanut industry have integrated to increase efficiency except for farmers and a lack of market power and pricing information have put farmers at a disadvantage.

The first study by Ray et al. investigated the acceptance among peanut farmers in Georgia for a new generation cooperative. Among the peanut farmers in Georgia, 66 percent were dissatisfied with the number of buyers available, and 74 percent in Southwest Georgia were open to starting a new generation peanut cooperative. From a statistical standpoint, larger farmers were statistically more likely to want a peanut NGC than smaller farmers. Those larger farmers produced more than 250 acres, irrigated at least 50 percent of their peanuts, and were located in Southwest Georgia. At the time of the study, two firms dominated the first buyer market of farmers' stock peanuts by at least 80% or more in Georgia (Ray et al.). The study proposed that an NGC would add value to a farmer's crop, in this case shelling farmer stock peanuts. The study identified larger farmers should be targeted for starting a new generation shelling cooperative in Georgia and determined that the ideal location of the NGC should be located near the target members (Southwest Georgia).

The second study by Hancock et al. conducted a benefit-cost analysis on a new generation peanut cooperative in Southwest Georgia based on the previous study by Ray et al. Major assumptions of the analysis were: (1) no peanut program, (2) new coop facilities and equipment, (3) conservative (overestimated costs and under estimated revenue) cost estimates, (4) coop throughput of 69,000 tons of farmer stock peanuts per year, and (5) no cold storage facility would be purchased by the cooperative. The results showed benefit-cost ratios that ranged from 1.91 to 1.42 over a ten year period. While this study showed positive economic results for forming a NGC, other factors such as farmer cooperation, management decisions, and practices just to name a few, would play into the success of the cooperative.

Another feasibility study was conducted by the Center for Agribusiness and Economics on a farmer-owned peanut shelling plant in the Tift area of Georgia (Smith et al.). The study looked at the Tift area for a possible peanut shelling and marketing operation through a new generation cooperative. Four alternatives were considered: (1) renovating an existing seed shelling facility, (2) constructing a new shelling facility including new storage, (3) constructing a new facility and utilizing existing commercial storage, and (4) purchasing an existing shelling facility. The study proposed a contingency plan to have only members who grew irrigated peanuts, thereby helping to ensure consistent throughput and help avoid production shortfalls in any given year. Total capital cost ranged from $20.24 million for a new facility and storage to $7.49 million for an existing ($4 million purchase price) facility and commercial storage. The study used the $355 marketing loan price under the 2002 Farm Bill for purchase price of peanuts, and also estimated shelled peanut prices under the new loan program using historical shelled prices. The estimated net returns to shelling ranged from $30 to $46 per ton.

The feasibility study included a survey of peanut buyers and found buyers were satisfied with current suppliers and 68% of 44 buyers surveyed would consider purchasing from a farmer-owned cooperative. Another interesting fact is that the survey showed some buyers purchased peanuts on a daily to monthly basis. Being able to deliver product in a consistent and timely manner would be critical to an NGC. Cold storage would be a necessity for the storage of peanuts in order to have them ready for timely delivery. Overall, the economic success of the NGC would have a positive effect in the Tift area.

Identifying Risks for an NGSC

Every agribusiness firm has to deal with some level of risk that could lead to variability of income. Major sources of variability are throughput and price uncertainty, especially for a new generation peanut shelling cooperative. Total reduction of risk is usually not possible, nor wise, as it may eliminate high profit potential (Zeuli). Agribusinesses must develop means for determining acceptable risk levels.

A problem that farmers could experience with being members of an agriculture cooperative is that they are doubly exposed to economic losses due to catastrophic events (Zeuli). Zeuli explains that farmer-members commonly do not fully understand the risk associated with their equity invested in a cooperative. Some solutions Zeuli suggests to manage catastrophic risk with traditional cooperatives and new generation cooperatives are use of capital market innovations and insurance. Capital market innovations attempt to cover systemic risk exposure, such as weather derivatives. While these products may be beneficial in reducing risk, the costs may deter the use of risk management tools unless one can show that the risk-return trade-off is profitable. These risk management tools may have the ability to reduce the double risk exposure that farmer-members face with being a member of a cooperative (Zeuli).

This study attempts to identify risks for an NGSC and classifies the risks into two areas. The two areas are throughput risk and marketing risk. Throughput risk is concerned with production input and output. Marketing risk is associated with prices paid for farmers' stock peanuts (input) and prices received for shelled peanuts (output). The areas are broken down to analyze the risks that are faced in each realm. The objective is to look at the various risks an NGSC faces in those two areas and determine which ones can be mitigated with available risk management tools.

An NGSC needs farmers' stock peanuts to shell in order to operate. Throughput is shelled peanuts (output) relative to the amount of farmers' stock peanuts (input). An NGSC is concerned with the amount of throughput because lower production (throughput) can mean lower profit if prices are held constant. Also, a decreased throughput can cause problems if contracts are made to deliver a set amount of shelled peanuts and the NGSC cannot meet the contracted amount due to decreased throughput amount.

Throughput risk is identified in this study to include production quantity risks and quality risks. Quantity and quality issues can be affected by events such as weather, disease, pests, bio-terrorism, and on-farm management. These issues can all affect the input side of production or throughput. Risks faced in production output include bio-terrorism, plant malfunction, shelling out-turns, loss of storage (storage capacity), and warehouse management which includes drying, peanut handling/cleaning, and transportation. These production output risk issues are faced beyond the farm gate and until the peanuts leave the hands of the NGSC.

Marketing for the NGSC involves prices paid for farmers' stock peanuts and prices received from selling shelled peanuts. Marketing input risks could also deal with cold storage and handling costs. The 2002 Farm Bill provides for reimbursement of handling and storage costs for farmer's stock peanuts enrolled in the marketing loan program. Continuation of this provision is uncertain for the next farm bill because of the cost of the program. This is an example of policy risk that affects the price paid for farmer's stock peanuts for an NGSC. The loan rate level is another example of risk. Both government policy and market demand can be considered as causes of risk faced on the input side.

Marketing output risks are associated with the price at which shelled peanuts are sold and cold storage costs for unsold shelled peanuts. Price risk can be attributed to variables such as demand, the season in which peanuts are contracted, and the total U.S. supply. Fluctuations in total U.S production can cause fluctuations in peanut prices. For example, if an NGSC makes a contract in August for delivery of shelled peanuts in September and the total U.S. peanut production is below average, the contracted price may reflect lower price than the current market price. Cold storage risk is associated with any production of shelled peanuts that are not immediately shipped out, and any storage cost that could arise from this.

The reward for risk-taking is profit, and profit can vary by the risk that is taken (Hardaker et al.). Risk can positively or negatively affect profit. Given a choice between a risky action with an uncertain expected return, and another action with a certain expected return of equal value, the risk averse individual will always chose the certain expected return. A risk averse individual will be willing to trade off some expected return for a reduction in risk. The acceptable trade-off rate depends upon how risk averse the individual is. Examples in agriculture of risk aversion can be found in farmer's actions such as purchase of insurance or crop diversification (Hardaker et al.).

Previous Risk Management Studies for Cooperatives

Agriculture cooperatives operate in a risky environment. As mentioned in the previous section, a major concern of agriculture processing firms such as peanut shellers is input supply or throughput supply. Zeuli and Skees argue that throughput risk is the highest frequency risk that a field crop processing firm faces (2000). The issue of managing throughput risk has been difficult to address because solutions to the problem have previously not been feasible (Zeuli). Contingent claim products are now available in the capital market and can be used to hedge against throughput risk. GRP insurance (area yield) contracts and weather indexes are examples of contingent claim products. Zeuli and Skees considered alternative risk-sharing instruments for a cooperative and how the instruments can improve risk reduction for their farmer-members. They considered that a cooperative can hedge its own risk with capital market innovations and can offer insurance to its members to cover a member's independent risk. The results from this strategy showed a reduction in variation in revenue per acre when a member's yield correlates well with their county yield.

Manfredo et al. point out that many cooperatives take a path of risk accommodation by holding internal capital reserves rather than using an active risk management plan (2003). This can be financially burdening to the cooperative if a major loss occurs. Manfredo et al. examined the financial effects of different risk management practices for agriculture cooperatives. Specifically, they examined how the risk management tools affect the distribution of return on assets. They claimed that a lack of understanding of the risks and rewards of alternative risk management tools are a common reason cooperatives have not adapted them to their active risk management. They studied how different risk management tools effect grain cooperatives' financial performance by using evaluation procedures of value-at-risk (VaR), Sharpe's Ratio, and stochastic dominance. The tools evaluated were put options, futures, swaps, and insurance. The results supported the use of exchange traded option contracts and futures markets. Over-the-counter revenue swaps were not favored due to the possible counterparty risk akin with these contracts. Also, at times the metrics used did not provide similar rankings. Specifically VaR (Value-at-Risk) was inconsistent for certain risk management strategies. Lastly, the study was meant to provide helpful information to cooperative managers on risk management tools and strategies for their business. Use of these risk management tools can decrease cooperative managers' reliance on internal capital reserves and decrease cooperative member ownership risk.

Possible NGC Risk Management Tools

Risk management tools that an NGC could possibly utilize are (1) federal crop insurance, (2) yield hedge, (3) weather derivatives, (4) contracts, (5) revenue swaps, and (6) catastrophic insurance. Four of the management tools; yield hedge, weather derivatives, revenue swaps, and catastrophic insurance, are not readily or currently available for the peanut industry. These tools could be considered for future use if they become available. Federal crop insurance and price contracts are possible risk management tools for an NGSC. While federal crop insurance, specifically Group Risk Plan (GRP) insurance, is not available to cooperative businesses, it is assumed that a change in policy would allow farmer-owned cooperatives to use GRP insurance.

Federal Crop Insurance

The current federal crop insurance plans offered for peanuts are Actual Production History (APH), and Group Risk Plan (GRP). APH for peanuts was first offered in 2002. Prior to 2002 it was similar to a dollar program under the old peanut quota system. APH policies insure farmers against individual yield losses due to natural causes such as drought. A farmer can select the percentage amount of coverage for crop yield he wishes to insure, ranging from 50 to 75 percent (in some areas up to 85 percent) of their APH yield. The farmer also selects the percent of the predicted price he wants to insure ranging between 55 and 100 percent of the crop price established annually by the Risk Management Agency (RMA) of the USDA. If the harvest yield is less than the yield guarantee insured, the farmer is paid an indemnity based on the difference. Indemnities are calculated by multiplying this difference by the insured percentage of the established price selected when crop insurance was purchased.

GRP is an area-based yield insurance and it makes indemnity payments based on shortfalls in county yields. County yields are estimated by the National Agriculture Statistical Service (NASS) of USDA to determine a forecasted yield. Farmers are allowed to scale the amount of protection they purchase from 90% up to 150% of the forecasted yield times the expected price. Farmers can choose to insure from 70% up to 90% of county yield (RMA). The design of an area yield policy is not like traditional multiple-peril or named-peril crop insurance, but rather it is an option on an index. Area yield policies are similar to put options on a futures contract because they have an association with basis risk. Basis risk happens when the insurance contract significantly mismatches the actual losses that occurred (Skees and Barnett, 1991a). Farmers can experience farm-level yield losses when area yield shortfalls are not sufficient to trigger an indemnity payment under an area yield policy. Decreasing the chances of such an event is an important objective when formulating an area yield policy. When a county yield for the insured crop falls below a certain trigger, the indemnity is paid out. Payments are not based on a farmer's individual loss, but rather the percentage difference between county forecasted yield and actual county yield.

Yield Hedge

Working off the idea of crop insurance and option markets, another tool that the NGSC could possibly use is a yield hedge. This hedge includes the use of the GRP insurance. The idea is for each farmer-member to purchase GRP insurance for the crop year and then sign the coverage payments over to the NGC. This plan could help ensure protection from numerous unfulfilled contracts that are made with the NGC and also the systemic risk of individual crop insurance offerings (Zeuli and Skees).

Koch Industries was the first to introduce the yield hedge in 1997 and the hedge is only being used in private, limited areas of the market (Zeuli and Skees). The hedge is specific on a field by field basis, which protects against independent risk when farmer-members do not correlate with the county yield. Zeuli (1999) also describes this yield hedge as an NGC offering individual APH policies, and thereby eliminating the correlated, cataclysmic nature of yield risk, and leaving an NGC to manage the losses of farmers. Under this policy, the farmer is financially reimbursed in a low crop yield year and pays no premium, and in a good year pays a share of the crop. The NGC receives indemnity payments when yields are under an insured level, reducing the financial stress of the NGC and farmer-member when purchasing raw product elsewhere.

Weather Derivatives

Derivatives have emerged throughout the insurance and risk management market over the past several years. Weather derivatives are fairly new to the market when compared with other tools and insurance. Weather derivatives are among the most innovative of markets for hedging financial risks (Dischel, 2002). In the past, other derivatives have been stock prices, exchange rates, and interest rates, to name a few. The U.S. energy sector has been a major player in the weather derivative market and according to a survey by PricewaterhouseCoopers, more than US

$75 billion of weather risk has been transferred in weather risk markets since 1997. William Daley, former U.S. Secretary of Commerce, stated that, "Weather is big business, it is not just an environmental issue, it is a major economic factor - - one-seventh of our economy, about $1 trillion a year, is weather sensitive."

In the agriculture sector, limited use has been made of weather derivatives. AGROASEMEX, the state agriculture reinsurance company in Mexico, began using weather derivatives and found that the derivatives offered protection at a cheaper cost and covered smaller risk exposures than reinsurance. Weather events that are covered are rainfall amounts, critical day covers, growing degree day covers (GDD), cooling degree day covers (CDD), heating degree day covers (HDD), high winds, and multiple triggers or combinations of these. Weather derivatives could potentially play an important role for an NGC in hedging against yield losses. For example, high amounts of rainfall during harvest time could lower the amount of peanuts an NGC receives on the input production side. An NGC must be able to identify and investigate the possible uses of weather derivatives that cause or increase losses. The frequency, severity, and spatial-correlation of the triggering event must be determined after identification of the source of risk, time, and duration when the losses occur (Dishel). Careful and thoughtful planning on use of weather derivatives could help offset some of the risk that the NGC faces.

Contracts

Contracts are an important part of an NGC on both the input and output side. Farmer-members are required to buy delivery shares in order to deliver to the NGC and are obligated to deliver that amount of product. If a member is unable to deliver, one remedy is for the member to buy product elsewhere in order to meet the contracted delivery amount. Alternatively, the NGC could buy the product and then charge the member for the undelivered balance. Contracts can help ensure the NGC of a consistent amount of throughput and reduce the risk of the NGC looking for enough input product.

The NGC can contract with buyers of shelled peanut products throughout the marketing year. This can ensure the price the NGC will get for its products and eliminate some financial risks. Using forward contracts with manufactures can guarantee the price the NGC will receive for its product in the future and through different seasons of the year.

Swaps

Swap contracts are another type of derivative that can used to hedge financial risk. These over-the-counter contracts are similar to a forward contract and have payoffs over a period of time. With a swap contract, the two parties that enter a swap contract have nearly exact opposite economic interests. Therefore, it is natural that the parties enter into an agreement to offset each other's losses in the event of price volatility or yield variability (Manfredo et al.). A problem with swaps is counter-party risk. Counter-party risk occurs when the other party in an agreement defaults.

One strategy that Manfredo et al. presents is a revenue swap. This swap is between a cooperative and the end-user of the commodity. The cooperative and the end-user agree upon a set amount of product and price. The amount of the commodity that is agreed upon is set at the average cooperative throughput and the price is set at the long-run average price. This creates the benchmark value for revenue. The cooperative's revenue as well as the and the end-user's cost is locked with this revenue swap. This can help an NGC by locking in a price that will be received for the shelled peanuts and eliminate price variability in the future.

Catastrophic Insurance

Other strategies the NGC can potentially utilize for catastrophic losses are cat-bonds and the Catastrophe Risk Exchange (CATEX). These products are useful for major disasters or problems that do not have standard insurance contracts. CATEX started in 1996 and was formed as an internet based business-to-business exchange for many different risk management products. It is the world's largest online business-to-business exchange for commercial insurance and reinsurance (CATEX). CATEX uses an online platform for businesses to post particular insurance needs to an international community of insurers and re-insurers while CATEX remains the neutral intermediary between the insurer and insured. It also allows reinsurance companies to post selling needs and insurance companies to re-sell catastrophic risk exposures (Anderson).

Cat-bonds came about when the reinsurance market for catastrophic risks tightened during the 1990s (Anderson). Cat-bonds provide coverage for specific exposures of catastrophic events, such as hurricanes and other weather-related events. The cat-bond will pay out when a disaster triggers a set level, or a physical level that measures the magnitude of the event. An NGC could benefit from cat-bonds if the coop acted as an insurer to its farmer-members. The cat-bond would serve as reinsurance for the NGC, and could be used when a specific event occurred. For example, the NGC could have a policy written to cover a hailstorm caused a 90% yield loss of its farmer-members' peanut crop. This event would cause the cat-bond to kick-in and payout the insurance. This would help the NGC financially cope with such a loss.

Tools used for this Study

Some risk management tools that are used frequently in the agriculture industry are federal crop insurance, futures markets, and options markets. There is no current futures or options market for peanuts. Other risk management tools for an NGSC could be management practices such as training and updating technology, as these can play a role in managing risks.

The previous sections talked about certain risk management tools. They are GRP insurance, yield hedge, weather derivatives, contracts, swaps, and catastrophic insurance. The transaction costs, counter-party risk, data-availability issues, complex pricing issues, and the ability to acquire a provider for some of these strategies may not be feasible for the peanut industry. The specific risk management tools for managing throughput and marketing risks that this study will use are recruiting irrigated farmer-members with average yields 10% higher than the county expected yield, GRP insurance, contracts for marketing output, as well as combinations of these strategies. Recruiting quality farmer-members with irrigated production can help ensure the NGSC with consistent throughput.

The NGSC could use the GRP insurance for protection against county-wide losses and shortfalls in coop throughput. This could protect the NGSC when counties that contain member farms have a county-wide decrease in peanut yields. There is also a correlation between county yield and member yield risk. GRP has low transaction costs since the federal government currently offers insurance, and it is readily accessible and available for peanut farmers. Lastly, contract ratios will function like forward contracts. Contract ratios will be determined by the season and the amount (percentage) in order to lock in a price contract with a buyer for shelled peanuts.

CHAPTER 3

MODEL DEVELOPMENT

Conceptual Framework

New generation shelling cooperative managers must determine whether to follow a strategy of risk neutrality or risk aversion. This study will assume a strategy of risk aversion for the NGSC since there is a high correlation of risk associated with a loss on the farm and a loss in the NGSC. Typically when making investments, investors can diversify a portfolio by investing in several areas and spreading the risk of loss among different and un-correlated sectors. Farmers do not really diversify when investing in cooperative since the chance of a loss on the farm could also mean a loss at the same time for a cooperative. When an individual has a choice between a risky action with an uncertain expected return and another choice with a lower return that is a certainty, the risk-averse individual may chose the certain outcome even if it is a lower wealth amount (Williams, Jr. et al). Risk reduction consumes resources and an individual's risk aversion can be explained by the expected utility theory. An individual's aversion to risk implies that his decisions are based upon both expected return and the level of uncertainty that is associated with the expected return. A risk-averse individual will choose the outcome that has the least uncertainty when faced with many choices with equivalent returns. Risk-neutral individuals select the choice with the greatest net return, regardless of the risk involved. The reward for risk is profit, likewise risk can affect the variability in income. A risk-averse individual will choose the outcome with the least amount of variability, and a risk-neutral individual will choose the outcome with the highest profit (revenue).

Economists rely upon the expected utility theory to model decision making under risky choices. Consider when NGSC management has a decision problem which has various states of nature T_y with $y = 1,2,\ldots,n$, a set of possible actions A_c with $c = 1,2,\ldots,m$, a set of monetary outcomes D_{yc} linked with the cth action choice in the yth state of nature, and a discrete probability density function $\pi(T_y)$ indicating the likelihood of occurrence for the various states of nature, with $0 \leq \pi(T_y) \leq 1$, and $\sum_{y=1}^{n} \pi(T_y) = 1$. The expected utility of one of many action choice, such as action choice 1, would be calculated as follows:

(3.1) $$EU_{c=1}\left(D_{yc}\right) = \sum_{y=1}^{n} U\left(D_{y1}\right)\pi\left(T_y\right).$$

Profit maximization by a firm implies risk neutrality (Anderson et al.). When firms pursue the route of maximizing profit, managers want to choose the strategies that maximize the value of the firm's shares.

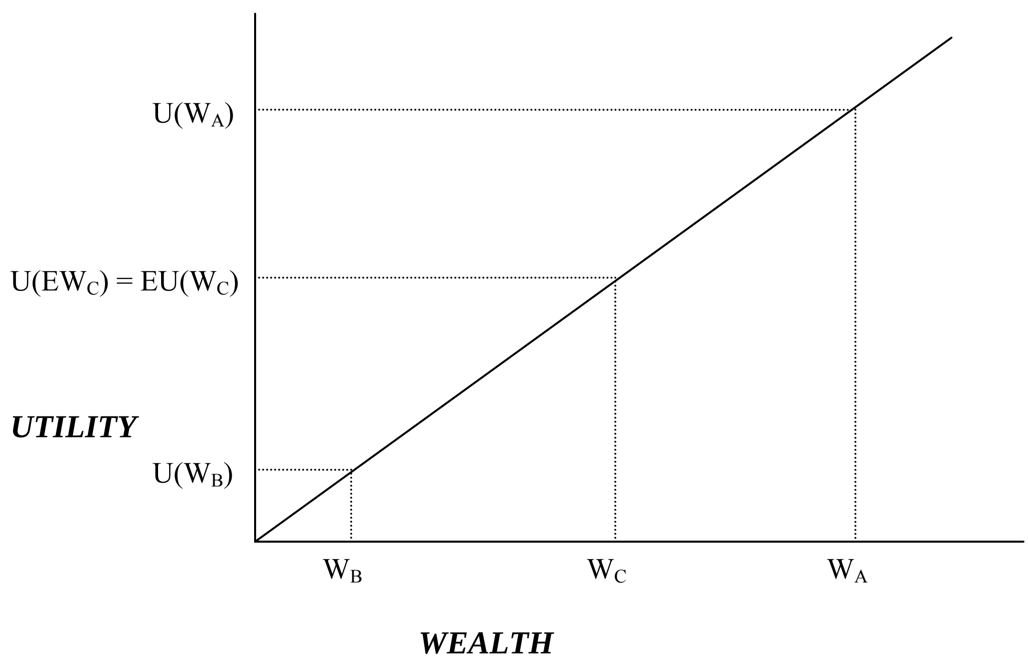


Figure 3.1 Utility as a function of wealth – Constant marginal utility

As shown in figure 3.1 the utility curve is linear signifying risk neutrality. Figure 3.1 has the following properties: 1) utility is an increasing function of wealth, U` > 0; and, 2) marginal utility is a constant function of wealth U`` = 0. The individual, or NGSC management would be apathetic between the risky choice and the certain expected return. Management would choose the plan that allows profit maximization, $U(EW_C) = EU(W_C)$. The management would be concerned only with the risks that affect the value of the firm's shares and not concerned with reducing the variance of the firm.

The decision to purchase insurance or risk management tools is just one of many possible economic decisions which management can make under risky and uncertain conditions. The utility function in figure 3.2 shows characteristics of a risk-averse decision maker. Figure 3.2 has the following properties: 1) utility is an increasing function of wealth, $U' > 0$; and, 2) marginal utility is a decreasing function of wealth, $U'' < 0$.

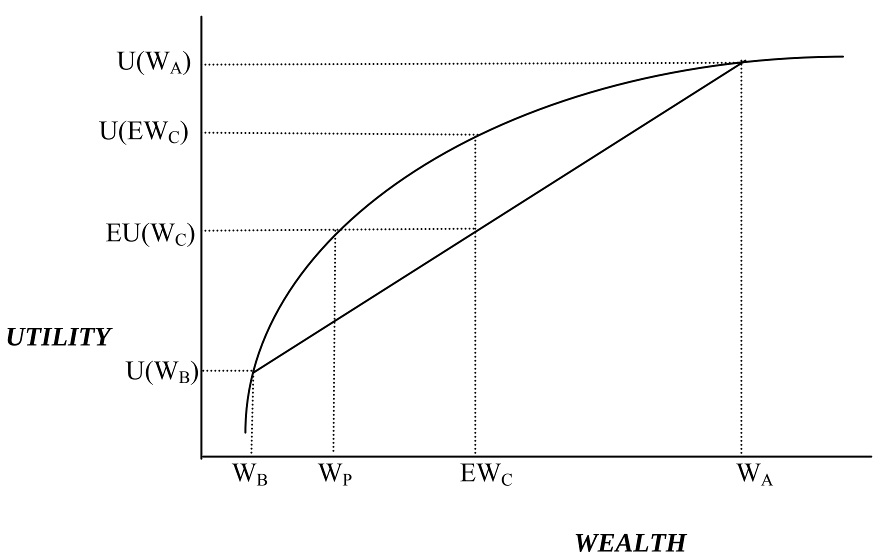


Figure 3.2: Utility as a function of wealth – Decreasing marginal utility

A risk-averse individual, or NGSC management, prefers less risk to more risk

(Williams, Jr. et al). This "risk aversion" means that the individual is willing to allot a share of wealth to an activity that is solely meant to reduce risk. Suppose that figure 3.2 represents NGSC management whose wealth is W_A and faces the risk of a loss that reduces wealth to W_B. The utility function assigns utility $U(W_A)$ to wealth amount W_A and utility $U(W_B)$ to wealth W_B. The effects of risk aversion are shown by the concave downward utility function in figure 3.2. The concave downward shape represents marginal utility of wealth. The marginal utility of wealth declines as the level of wealth increases. Basically, an additional dollar to a billionaire is less important than to a graduate student living on beans and rice. Therefore the size of a loss has disproportionate impacts on utility. A large loss does not compare to a small loss. The points on $[W_A, U(W_A)]$ and $[W_B, U(W_B)]$ represent expected values of situations whose outcomes are wealth amounts W_A and W_B. The likelihood of the outcomes are directly proportional to the distances between the expected values and the endpoints of the line. As shown in figure 3.2, the point EW_C represents the expected wealth of one situation. The probability of loss, where the outcome is wealth W_B, is $(W_A\text{-}EW_C)/(W_A\text{-}W_B)$, though the probability of no loss, resulting in W_A is the complement $(EW_C\text{-}W_B)/(W_A\text{-}W_B)$. Finally, the expected loss is calculated as $W_A\text{-}EW_C$.

The expected utility of the NGSC management that faces the risk of loss is $EU(W_C)$, and management would be willing to pay for an insurance policy providing complete coverage of loss as long as the cost of the policy would result in utility of at least $EU(W_C)$. This premium, represented in figure 3.2 would be $W_A – W_P$, where the ending wealth W_P adds an increase to utility $EU(W_C)$. The risk premium is the difference between this largest premium and the expected value of the loss $EW_C\text{-}W_P$. The risk premium represents the maximum amount the

NGSC management would be willing to pay for a policy to cover the loss and the expected value of the loss itself.

Empirical Model

A common method of estimating probability distributions for risky outcomes is through the use of simulation procedures, since realistic probability distributions of uncertain future outcomes cannot be made (Harrington and Niehaus). Stochastic simulation is used to show how selected risk management tools affect the financial performance of the NGSC. @*Risk* add-in for Excel is used to perform Monte Carlo simulations in Excel to draw observations from designated distributions (i.e yield distributions). A later section will discuss more on @*Risk*.

The following sections will discuss the empirical model that was used for the simulation purposes of the NGSC. Yields and prices were simulated to estimate values for throughput and shelled peanut prices. The throughput and prices are used to estimate revenue and the income statement of the NGSC, followed by metrics to evaluate the return on assets (ROA).

Member Throughput

The average yield for all cooperative members within a county is refered to as members yield. Member yields for Baker, Decatur, Early, Miller, Mitchell, and Seminole counties were simulated to get a total throughput estimate for the NGSC. See appendix Table A.1 for the member values for each county. The simulated total throughput, *ST*, equals the total member production from the six counties. The target throughput, *TT*, of the NGSC is 120,000,000 lbs. The target amount was based upon shelling 18 tons per hour and operating two eight hour shifts for five days a week and forty-two weeks of shelling per year. The target throughput was divided among the counties by a calculated percentage so the amount of member production acres MA_x could be determined for each county *x*. The formula for member production acres is as follows.

$$(3.2) \qquad MA_x = \frac{(TT)\circ(COT_x)}{Y_x^{RMA}\left(1+P_x^{MY}\right)}$$

where:

COT_x = percent of total throughput *TT* for which county *x* is responsible

P_x^{MY} = Percentage amount by which members average yield is above the RMA expected yield for county *x*

Y_x^{RMA} = RMA expected yield for county *x*

The mean yield SMY_x for members in county *x* used for the simulation was determined as RMA expected county yield times percentage increase in member yields:

$$(3.3) \qquad SMY_x = Y_x^{RMA}\left(1+P_x^{MY}\right).$$

The total member production (throughput), *TMT*, for the NGSC is then determined as the sum of the products of member acres times simulated mean of member yields in each county:

$$(3.4) \qquad TMT = \sum_{x=1}^{6}\left(MA_x\right)*\left(SMY_x\right).$$

GRP Insurance

GRP insurance is modeled by making county yield a stochastic variable. A simulation of the county yield creates a distribution of indemnities paid based upon shortfalls simulated for each county. Note that the GRP indemnity payment was based on a county level yield, and not a member yield. The RMA FCI-35 county actuary tables contain the trigger yield for each county at the respective percentage of coverage from 70% up to 90%. The yield guarantee, COY_x^G, for county *x* is calculated as:

(3.5) $COY_x^G = Y_x^{RMA} * YE_x$

where:

$YE_x =$ Yield election, the percentage coverage for county x.

GRP indemnities are triggered when the actual county yield falls below the yield guarantee chosen by the farmer. The amount of the indemnity is calculated as a percent shortfall rather than bushel or pound shortfall as with APH policies. Actual county yield variable is a stochastic variable in the model. Yields are simulated for each county and the RMA expected county yield Y_x^{RMA} is used for the mean of the distribution for the simulated yield $SCOY_x$ for county x. The percentage yield shortfall is calculated as follows:

(3.6) $$SF_x = \frac{\left(COY_x^G\right) - \left(SCOY_x\right)}{COY_x^G}.$$

The maximum protection level $MAXPL_x$ per acre for county x is calculated the RMA county expected yield times the marketing loan rate MLR^{Peanut} in pounds ($0.1775) for peanuts times the maximum scale $MAXSCALE$ amount (1.5) as follows:

(3.7) $MAXPL_x = Y_x^{RMA} * MLR^{Peanut} * MAXSCALE$.

The indemnity per acre IND_x^{Acre} for county x is then calculated as follows:

(3.8) $IND_x^{Acre} = MAX\left[0, \left(\left(MAXPL_x\right) * \left(SCALE_x\right) * \left(SF_x\right)\right)\right]$

where:

$SCALE_x =$ GRP scale amount for county x, from 0.9 up to 1.5.

The total indemnity IND_x^{Total} for county x is determined by the amount of indemnity per acre for county x multiplied by the amount of member acreage in production for county x and is figured as follows:

(3.9) $IND_x^{Total} = IND_x^{Acre} \circ MA_x$.

The guaranteed amount $GAMT_x$ for county *x* is figured as:

(3.10) $GAMT_x = MAXPL_x \circ SCALE_x \circ MA_x$

and the premium PM_x^{Total} total for the GRP insurance coverage for county *x* is calculated as:

(3.11) $PM_x^{Total} = GAMT_x \circ BASEPM_x$

where:

$BASEPM_x =$ Base premium rate for county *x* from RMA premium calc website (www.rma.usda.gov).

The premium per acre PM_x^{Acre} for county *x* is determined from:

(3.12) $PM_x^{Acre} = \frac{\left(PM_x^{Total}\right)}{\left(MA_x\right)}$.

Peanut Sales Revenue

Total revenue, $TR^{PeanutSales}$, from peanut sales is calculated as the sum of the sale of each out-turn in all periods. The price of each out-turn is simulated in the three marketing periods. The revenue of each shelling out-turn, $OR_p^{out-turn}$, where *out-turn* represents Jumbo, Medium, # 1's, U.S. Splits, Oil-stock, or Hulls, for period *p* is calculated as:

(3.13) $OR_p^{out-turn} = SP_p^{out-turn} \circ CONT_p \circ PO^{out-turn} \circ TMT$

where:

$SP_p^{out-turn} =$ Simulated price of shelling *out-turn* during period *p*

$CONT_p =$ Contracted percentage amount for period *p*

$PO^{out-turn} =$ Percent of *out-turn* in one ton of shelled peanuts

$TMT =$ Total member throughput (production) for the NGSC

The total peanut sales revenue is then calculated as:

$$(3.14)\quad TR^{PeanutSales} = \sum_{p=1}^{3} \sum_{out-turn=1}^{6} OR_{p}^{out-turn} .$$

Income Statement

All formulas mentioned previously contribute to the final income of the NGSC. The total revenue of the NGSC, TR^{NGSC}, is determined from both sales revenue of shelled peanuts and indemnity payments and determined by the following formula:

$$(3.15)\quad TR^{NGSC} = TR^{PeanutSales} + \sum_{x=1}^{6} IND_{x}^{Total} .$$

The NGSC has both variable costs VC^{NGSC} and fixed costs FC^{NGSC} which are calculated as follows:

$$(3.16)\quad VC^{NGSC} = \left(FARMERSTOCK^{Peanut}\right) + \left(STORAGEFEE^{Peanut}\right) + \left(HANDLINGFEE^{Peanut}\right) + (TRANSPORT^{Peanut}) + (GRADEFEE^{Peanut}) + \left(SHRINK^{Peanut}\right) + \left(D^{Labor}\right) + \left(UTILTIY^{Cost}\right) + \left(RPM^{Cost}\right) + \left(MISC^{Cost}\right) + \left(WC^{Int}\right)$$

where:

$FARMERSTOCK^{Peanut} =$ Cost of farmers' stock peanuts

$STORAGEFEE^{Peanut} =$ Storage fees associated with peanuts

$HANDLINGFEE^{Peanut} =$ Handling fees of peanuts

$TRANSPORT^{Peanut} =$ Transportation fees

$GRADEFEE^{Peanut} =$ Grading fees

$SHRINK^{Peanut} =$ Shrinkage of peanuts

$D^{Labor} =$ Direct labor costs, administration costs included here

$UTILITY^{Cost}$ = Utilities costs: natural gas, fuel, electricity, water, sewer, etc.

RPM^{Cost} = Repairs and maintenance costs

$MISC^{Cost}$ = Miscellaneous costs

WC^{Int} = Interest on working capital

Fixed costs are as follows:

$$(3.17)\quad FC^{NGSC} = \left(\sum_{x=1}^{6} PM_{x}^{Total}\right) + \left(DP^{Start}\right) + \left(DP^{Equipment}\right)$$

where:

DP^{Start} = Depreciation on building/start-up costs of the NGSC

$DP^{Equipment}$ = Depreciation on plant equipment

Total costs TC^{NGSC} of the NGSC are determined as:

$$(3.18)\quad TC^{NGSC} = \left(VC^{NGSC}\right) + \left(FC^{NGSC}\right)$$

Profit for the NGSC $\left(\pi^{NGSC}\right)$ is determined before distribution of dividends and taxes (EBDT) and determined as total revenue minus total costs:

$$(3.19)\quad \pi^{NGSC} = \left(TR^{NGSC}\right) - \left(TC^{NGSC}\right)$$

Data

Various sources of data are needed for the completion of this research. The NASS website (www.nass.usda.gov) is used for acquiring county level yield data, and the RMA supplied the farm level yield data. Farm level data is needed since the NGSC is made up of individual peanut farmers and it was felt that this data would be a better representation than only county yields. The price data was retrieved from Peanut Market Summary from the Federal-State Market News Service (USDA).

Yield Data

The yield data that is used for this study are NASS county yields, NASS county production, Risk Management Agency (RMA) APH farm yield data, and the 2003 RMA county actuarial table FCI-35 coverage and rates. Data is from the six Southwest Georgia counties, Baker, Decatur, Early, Miller, Mitchell, and Seminole. The NASS county yield data spans the time period of 1981 – 2003. The NASS county yield data was de-trended to account for changes in technology. The base year used for de-trending the NASS county yield data was 2003. A linear regression was run on each county yield history and the yields were adjusted to reflect the year 2003. Next, the standard deviation from each county was found. This standard deviation was used for defining the probability distribution for both simulated county and simulated member yields. The mean that was used for the simulation of the county and member yields came from the RMA FCI-35 tables. The tables listed the RMA expected county yield for the respective county.

The correlation relationships between the counties and members yields were calculated from the NASS and RMA data. The RMA APH data was used for this purpose because it contained farm level data which was assumed to represent the members of the NGSC. Three yield correlations were used for the simulation model: correlation between county yields, member yields, and county and member yields. The yield correlations represent the years of 1992 – 2002 corresponding to the RMA APH data. The correlation coefficients are given in the correlation matrix found in appendix table A.1.

The RMA data consists of farms that participated in APH insurance program in 2002 and were chosen from six Southwest Georgia counties, Baker, Decatur, Early, Miller, Mitchell, and Seminole. The observations consisted of 213 farms with a minimum of six years of data up to eleven years. All observations were from irrigated peanut farms and units. All acreage was insured irrigated in 2002, but the complete yield history may have not been irrigated. Limitations with the RMA database allows only for identification of farms irrigated in 2002. All farms were insured as irrigated in 2002, but previous years may contain non-irrigated peanut acreage.

The RMA farm level APH data spans the time period from 1992 – 2002, and reflects an unbalanced panel as some farms did not have a complete eleven years of irrigated peanut production. Also, the number of irrigated peanut farm observations was not equal across the different counties. Specifically, the observations were: 19 from Baker County, 24 from Seminole County, 31 from Early County, 43 from Decatur County, 46 from Mitchell County, and 50 from Miller County. Table 3.1 shows summary statistics for the RMA APH data.

Table 3.1: RMA APH farm level data for irrigated farms 1992 to 2002*.

	Baker	Decatur	Early	Miller	Mitchell	Seminole
Minimum (lbs/ac)	489	891	174	33	365	87
Maximum (lbs/ac)	5,968	6,002	6,689	6,565	5,990	5,707
Mean (lbs/ac)	3,706	3,797	3,500	3,519	3,559	3,424
Mode (lbs/ac)	3,655	3,990	3,498	3,455	3,125	4,480
Median (lbs/ac)	3,894	3,853	3,510	3,567	3,632	3,446
Std. Deviation	1,079	904	926	892	955	930
Variance	1,157,080	815,090	853,362	794,515	910,258	860,523
Skewness	-0.8	-0.3	-0.3	-0.4	-0.5	-0.5
Kurtosis	3.8	3.1	4.3	4.5	3.4	3.9
Number of Observations	19	43	31	50	46	24
RMA expected county yield for 2003 (lbs/ac)	3,297.0	3,471.6	2,875.0	3,241.0	3,299.0	2,974.0

*Note: RMA data is from irrigated farms that use APH insurance in the respective counties.

GRP Data

Two sources were needed for the GRP modeling of this study. NASS county yields (1981-2003) and RMA FCI-35 2003 county actuarial tables provide data necessary for simulating GRP insurance indemnities. The RMA expected county yield was used for the mean of the yield distribution for simulation of GRP insurance. NASS county yields were de-trended as mentioned previously under the yield data section to adjust for a base year and provide the standard deviation for each county.

The 2003 RMA FCI-35 county actuarial tables provide the necessary information for determining base premium rates for the GRP insurance program for peanuts in each of the six counties. The RMA FCI-35 county actuarial table provides information on county expected yield, and also the trigger yields at 70%, 75%, 80%, 85%, and 90% GRP coverage levels. Once this information is known, the guaranteed amount, premium, subsidy, total premium, and premium per acre are calculated for each county's proposed peanut production that would feed the NGSC.

Price Data

The price data that is used for the model is Federal State Market News Service/USDA/AMS/Fruit and Vegetable Division's monthly average F.O.B. prices for cleaned and shelled runner peanuts from 1992 to 2002. Since the time period includes three different peanut policies, the price data was normalized to 2002 prices. The prices were also sorted to three marketing periods: 1) Production –February to August; 2) Harvest – September to November; and 3) Post – December to May. These time periods were created for marketing and contracting purposes. The shelled peanut prices include Jumbos, Mediums, Number 1's, and Splits. Oil stock peanuts and peanut hulls were not simulated due to limited data availability. It is assumed these two omitted prices are less important for determining sheller revenue.

Normalization of price data is necessary for several reasons. Normalization accounts for changes in inflation and technology. It can also account for different peanut policies that were in place previous to the 2002 Farm Bill and adjust the price accordingly. These peanut policies are part of Farm Bills in 1990, 1996, and 2002. Since the data has four shelling out-turns and three marketing periods, normalization of prices had to be figured for each shelling outturn under each marketing period. The percentage change in averages from one year to the next was found and then multiplied by the base year of the 2002 out-turn average for the respective period. The normalized price was calculated and the standard deviation was determined from the normalized prices. Table 3.2 shows the price normalization process for the post shelled peanut period.

Table 3.2:: Illustration of Price Normalization*.

Post_Runners Jumbo	Dec	Jan	Feb	Mar	Apr	May	AVG	Change	Change x 2002 *AVG*
1992	65	64.875	64.25	63.875	63	62.375	63.90		
1993	71.875	71	69.5	69	68	66.25	69.27	8.41%	45.35
1994	63.75	63	63	62	61	59	61.96	-10.56%	37.42
1995	63.5				68.5		66.00	6.52%	44.56
1996	61	61			60	60.75	60.69	-8.05%	38.47
1997	63.5	63	62	61	61	60	61.75	1.75%	42.57
1998	60	60					60.00	-2.83%	40.65
1999	60.5	60.5	60	59.5	61.5		60.40	0.67%	42.11
2000	64			62	62	60	62.00	2.65%	42.94
2001	59	59	59	59	59	61	59.33	-4.30%	40.03
2002	42	42.25	42.25	42	41.5	41	41.83	0.00%	41.83

*Note: Prices are for shelled jumbo runner peanuts during the post period from the Peanut Marketing Summary. Prices are reported in cents per pound.

The model also used the correlation relationships between prices and periods for each out-turn, as well as correlation between each period out-turn price and county production. The normalized price data was used for correlation between prices and county production. Correlation coefficients between member production and prices was assumed to be the same as the correlation coefficients of the county production and price since an individual farmer's production does not influence prices as much an entire county's production. Correlation brings some reality to the modeling process. Rather than assuming independence between variables, correlation can take into consideration the "natural hedge" that takes place when low (high) production and high (low) prices are realized. The appendix (Table A.1) contains the correlation matrix for production, prices, and periods. Prices are positively correlated in the same period. Harvest and post period prices are negatively correlated with county production.

Stochastic Simulation Using @RISK

The model used in this study was created for a Monte Carlo simulation to simulate county yields, NGSC's member yields, and prices of shelled peanuts. Specifically, *@RISK* add-in for Microsoft Excel was used to run simulations based upon the input data from NASS, RMA, and the USDA Federal-State Market News. This software was useful in simulating the variability in both coop throughput and price received for shelled peanuts, as well as county level yields for GRP insurance indemnity evaluation.

@RISK uses Monte Carlo simulation and allows stochastic variables to be specified throughout the model. *@RISK* contains a function called *BestFit* that fits data to distributions. *BestFit* performs goodness-of-fit tests and shows distributions it fails to reject. The function *BestFit* was used and failed to reject the normal distribution for yield and price data. Normal distribution was then used for the input distributions. *@RISK* has the capability to correlate input distributions (variables) within the model. This leads to realistic variables such as a simulated yield of 4,000lbs in Miller County would not be possible with a simulated yield of 500lbs in Decatur County. *@RISK* can also check if the matrix is positive semi-definite. *@RISK* can generate the closest valid matrix if the entered matrix is invalid. The coefficients entered in the matrix used for the model was determined by *@RISK*. The matrix used for the model was corrected by *@RISK* so it would be positive semi-definite.

An example of the stochastic simulation is illustrated below to describe how *@RISK* works. Simulation of the county yields was done by choosing an *@Risk* distribution, inputs, and outputs. The normal distribution was used, along with a mean and standard deviation. The minimum and maximum are optional, and can be used for truncating the distribution. Since the normal distribution is assumed and it is possible for this distribution to pick negative numbers, the minimum was set at 1 lb/acre and the maximum set at 6,000 lbs/acre Also, the county correlations were factored into in the model, and @Risk calculates this before running simulations. Below is an example of the @Risk equation that was used for the Baker county yield simulation cell:

(3.20) *RiskNormal(μ, σ, RiskTruncate(Minimum, Maximum), RiskCorrmat(RMA_County_Correlation_2,2))*

where:

RiskNormal = @Risk normal distribution function

μ = mean

σ = standard deviation

RiskTruncate = @Risk truncate the distribution function

RiskCorrmat = @Risk correlation function (cell/worksheet reference).

Income Statement

The simulated information from the model helps determine inputs for the NGSC income statement. Therefore an income statement is needed as part of the model. An income statement in an Excel worksheet is based upon the income statement from the Tift Area Peanut Growers Cooperative, Inc. business plan and the Manfredo et al. study. This study on NGSCs focuses on profit before distribution and taxes (EBDT). Items that affected the income on the income statement were the simulation of the county yields, the price received for the shelled peanut, as well as the amount of indemnities paid from the GRP insurance. Specifically, the income includes the shelling out-turns: Jumbos, Mediums, # 1's, U.S. Splits, Oil Stock, and Hulls. The Oil Stock and Hull price was fixed and was not simulated due to limited data. The shelled peanut contract varied by the percentage amount to contract and period in which to contract. The GRP insurance premium was fixed cost on the income statement. While the cost of insurance was fixed, the amount of the premium depended upon the specified amount of coverage and scale, as well as the amount of acreage that was covered. This amount of protection will be discussed further in chapter four, along with the level and scale at which GRP insurance was used in the modeling. Once the GRP information, member information, and price information was simulated and fed into the income statement, the risk management strategies were measured by four methods, described in the following section, 1) expected return only – return on assests (ROA), 2) VaR, 3) Sharpe Ratio, and 4) first degree stochastic dominance with a risk free asset (FDSDRA). These metrics provide a solid method of ranking the different risk management strategies involved in this study.

The simulation process for this study consisted of 5,000 iterations which is adequate to provide enough random selections from the input distributions for obtaining a substantial and steady distribution of ROA. This is beneficial since historical data can only show risk with respect to movements in the past. Using 5,000 simulation runs allows a broad scenario analysis to be performed to further explain the riskiness of certain markets. The ROA has exposure to swings in yields and prices from input distributions. The next section discusses the evaluation techniques of the different risk management tools.

Methods of Evaluation

The return on assets (ROA) will be one method of determining the how the risk management strategies affect the financial performance of the cooperative. The return on assests will be calculated before distribution of patronage dividends and taxes. Profitability of the NGSC can be measured with ROA, and is a common method to examine the financial condition and performance of a firm.

VaR

Value-at-Risk (VaR) summarizes the worst loss or outcome over a certain period with a given confidence level (Jorion). It measures the variation in value of an asset on a specific target date or range. VaR is part of the latest generation of risk management tools and can combine a price-yield relationship with the probability of an adverse market movement.

When considering valuation and risk management methods, the two have several similar characteristics, but there are some notable differences. Valuation techniques require more precision and operate in a risk neutral world; risk management methods provide rough estimates of downside risk and deal with actual distribution (Jorion). This information for risk management purposes, and along with knowledge of derivatives can help explain why VaR is a "standard benchmark" for measuring financial risks (Jorion). VaR is not a treatment for all risks due to limitations, but rather a tool that can be used to give an educated estimate market risk.

VaR can be defined mathematically as

(3.21) $VAR_{Xp} = Q_x(p),$

where VAR_{Xp} is the value at risk under strategy X and cumulative probability level p, $Q_x(p)$ is the quantile function of strategy X evaluated at cumulative probability level p. The quantile function of strategy X is defined as the inverse of the cumulative distribution function associated with the returns to strategy X in equation (3.21):

(3.22) $Q_x(p) = F_x(a)^{-1},$

where $F_x(a)$ is the cumulative distribution function associated with the returns to strategy *X*, which is defined in equation (3.22), and *a* is a monetary return level;

$$(3.23) \quad F_x(a) = \Pr(x \leq a),$$

where *Pr* denotes the probability that the monetary returns (*x*) to strategy *X* are less than or equal to some level *a* (Gloy and Baker).

In this study, VaR is used to evaluate the NGSC ROA. By specifying a probability in the cumulative return distribution (CDF), a manager of the NGSC can make decisions upon the different returns under several scenarios. For example, when applying VaR at the 10% level, a VaR of 1,000 indicates there is a 10% probability of receiving gross returns less than $1,000, or a 90% chance of receiving returns higher than $1,000. Therefore, the VaR can be used to rank strategies by choosing a specific probability level in the CDF and ranking the strategies according to there worth.

VaR is useful for focusing on a specific probability level. According to Gloy and Baker, most agriculture risk management situations do not have a clear economic justification for such a selection of probability level at which VaR_{Xp} is judged. A more solid objective is to measure strategies according to their ability to produce or not produce some benchmark level. This benchmark level is a risk-free return, and has two important key reasons. First, it allows the idea of opportunity cost with the investment analysis. Secondly, it can logically keep separate investment decisions from risk preferences (Gloy and Baker).

Sharpe's Ratio

Closely related to Markowitz's mean-variance analysis, the Sharpe ratio is another investment ranking criterion that can be used to analyze investments. Sharpe (1994) explains that the Sharpe ratio could be used for discerning choices among mutually exclusive investments when borrowing or lending is possible. According to Sharpe (1994), if there are *t* states of nature with equal probability of happening, the mean difference in returns between asset *i* and the risk-free asset is given by:

$$(3.24)\quad \mu_i = \frac{\sum_{j=1}^{t} \tilde{R}_{ij}}{t} - R_f \ , \ \forall i = 1,2,...,t,$$

where $\tilde{R}_{ij}$ is the random return to asset *i* in state *j*, and R_f is the fixed return to the risk-free asset. The population standard deviation of the return for asset *i*, σ_i, is specified as follows:

$$(3.25)\quad \sigma_i = \sqrt{\frac{\sum_{j=1}^{t} [(\tilde{R}_{ij} - R_f) - \mu_i]^2}{t}} \ , \ \forall i = 1,2,...,t.$$

The Sharpe ratio for asset *i* is then given by the equation in (3.25).

$$(3.26)\quad S_i = \frac{\mu_i}{\sigma_i} \ .$$

With a set of mutually exclusive investment alternatives that differ by only the first two moments, every expected utility-maximizing decision maker with the ability to borrow or lend will invest in the alternative with the largest Sharpe ratio (Sharpe). The Sharpe ratio is a simple, powerful tool for comparison criteria, but it still has the down-fall of the mean-variance approach. That is, the Sharpe ratio assumes only the first two moments characterize the distributions (Manfredo et. al.). In addition to being connected to the expected utility, the Sharpe ratio resembles the coefficient of variation, with that the main difference of the return on the risk-free asset has been subtracted from the returns to the risky asset (Sharpe). Sharpe also describes how the Sharpe ratio and *t*-statistic are related when the *t*-statistic is used to determine the probability that the difference between returns to the risky asset and returns to the risk-free asset is zero.

The Sharpe ratio considers the opportunity cost of borrowing and lending, and under certain assumptions identifies the expected utility-maximizing strategy. However, the mean-variance model used to generate the Sharpe ratio relies upon several seemingly strong assumptions. The most obviously violated assumption is the requirement that the distributions being compared differ only by their first two moments. This is potentially important in a risk management context because one purpose of using risk management strategies, such as options, is to modify the skewness of the return distribution. Rather than adopting the assumptions of the mean-variance model, economists frequently employ the various stochastic dominance criteria when evaluating alternatives involving risk (Gloy and Baker).

Stochastic Dominance

Using stochastic dominance criteria can provide a relevant ranking over a broader range of assumptions (Manfredo et. al.). Gloy and Baker describe how under very general assumptions, the ordinary stochastic dominance (SD) risk-efficiency criteria identifies groups of methods that will have expected utility-maximizing strategies for various classes of decision makers. By assuming that the manager can borrow or lend at the risk-free rate, the quantity of the efficient sets can be minimized (Gloy and Baker). Levy and Kroll explain stochastic dominance with a risk-free asset (SDRA) criteria, and incorporated the idea of financial leverage in the ordinary SD framework (1978). This study will use the first degree stochastic dominance criteria which includes the ability to lend or borrow at the risk-free rate (FDSDRA).

The conditions that are necessary for first degree SDRA are:

(3.27) $Nfsdra_X = F_{X_s}(r)$

where the probability returned, *Nfsdra*$_x$, is the cumulative distribution of strategy X_s (s = 1,2,3…S), $F_{X_s}(v)$, is judged at the risk-free return, r. The outcome v is the result from strategy s chosen. The smallest value of *Nfsdra* is preferred.

This criterion for FDSDRA is similar to VaR, although VaR has no economic rational for a specific evaluation point. Since FDSDRA uses the risk-free return in its rational, it provides an opportunity cost for different strategies. The best strategy would be the plan that has the smallest probability of achieving the risk-free rate (Gloy and Baker).

The use of these different metrics can be explained for several reasons. First, managers of NGSC must understand the cost of the risk that they face. Some measures based on statistical notations of a distribution of returns have significance to some managers (i.e. mean-variance efficiency), while others are concerned with the probability of a loss (Manfredo et. al.). Secondly, some measures are much simpler to calculate and therefore easier to provide an explanation of the larger picture for management and members of a NGSC. Lastly, if the rankings of the different metrics have strong agreements among each other for specific risk-management strategies, then one can make decisions on the weight of one risk-management strategy over others that are presented in this study.

CHAPTER 4

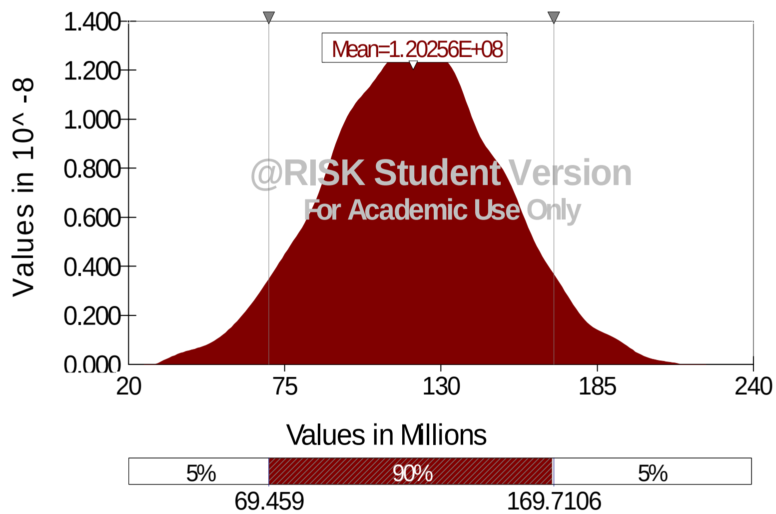
ANALYSIS OF RESULTS

Model analysis illustrates how risk management tools effect the income statement, specifically ROA before distribution of dividends and taxes. Effectiveness of risk management tools is related to rankings according to the metrics of VaR, Sharpe Ratio, and FDSDRA. Strategies presented below show possible outcomes for NGSC efficiency in reducing financial losses due to variability in throughput and shelled peanuts peanut prices. Through the use of management, GRP insurance, and contracting shelled peanuts, the model shows that risk reduction is possible for the NGSC.

The model uses NASS county yield data, RMA APH farm-level data, and shelled peanut price data. Model simulations are based upon historical county yields and shelled peanut prices. Member data represents an array of participant in the NGSC. Member data consists of a mean yield that is 10 percent higher than the RMA county expected yield. This is part of the risk management plan to acquire quality members. Since the model has six counties feeding into the NGSC, counties were divided by a percentage amount that would represent the amount of production for the coop. Baker, Early, Seminole, and Mitchell counties each are 15% responsible for supplying the coop, while Miller and Decatur counties are responsible for 20%. Miller county is assumed as a central location for the NGSC. Miller and Decatur are assumed responsible for more percentage of the NGSC's throughput, since these two counties have the highest amount of irrigated peanut production according to the 2002 USDA Census. The model performs scenario runs based upon alternative GRP coverage, scale factor, and price contract ratios. The following sections discuss the results from the model.

Throughput

Adequate throughput is required for efficient operation of the NGSC. A 5,000 draw Monte Carlo simulation of county yields shows possible outcomes of the six counties total production that would supply into the NGSC. Figure 4.1 presents outcome and related statistics.

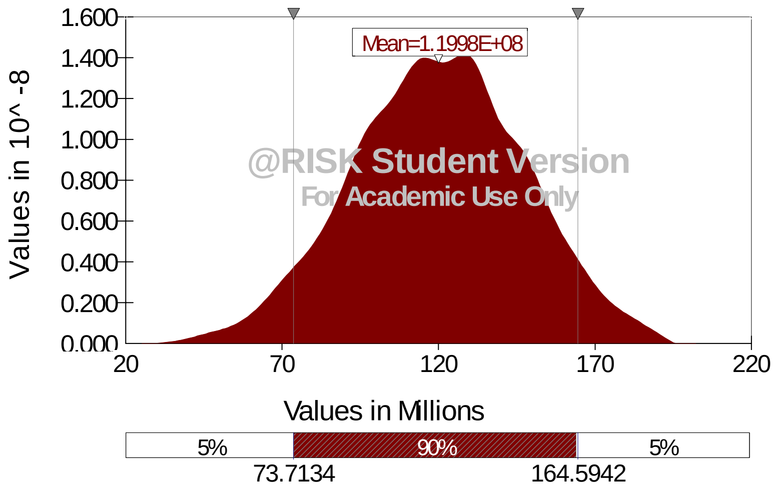


Minimum	2.49E+07
Mean	1.20E+08
Maximum	2.24E+08
Std Dev	3.05E+07
Variance	9.28E+14

Figure 4.1: Distribution of County Throughput

As shown above, the mean throughput into the coop is close to 120,000,000 pounds of farmers' stock peanuts. Figure 4.1 is based upon each county having mean yields equal to the RMA's county expected yield. After five thousand simulations, total production is between 69.459 and 169.7106 million pounds in 90% of the samples. RMA expected county yield comes from the RMA FCI-35 county actuary table and is what the agency uses for determining insurance rates. Figure 4.1 shows the results of a NGSC recruiting members that have yields equal to the county average.

As an alternative membership structure for a NGSC, an assumption of recruiting members having average yields that are 10% above the RMA's county expected yield is evaluated. Total NGSC acreage in production decreases to 34,193 acres from 37,547 acres[1]. The NGSC is assumed to employ a strategy of seeking members with irrigated peanuts to reduce their input risk of throughput. Figure 4.2 shows the simulation results for total NGSC production.



Minimum	2.47E+07
Mean	1.20E+08
Maximum	2.03E+08
Std Dev	2.76E+07
Variance	7.63E+14

Figure 4.2: Distribution of Member Throughput

Figure 4.2 shows a variance that is less than Figure 4.1, a 1.65 million reduction. While means are similar, the 90% range of where the total production falls narrows some. The main result that Figure 4.2 displays is that the area outside 90% of the distribution has decreased. While all county simulated yield distributions were truncated with the reported minimum and maximum yield, member distribution was truncated from one lb/ac to six thousand lb/ac for each county. This corresponds to some member potentially having yields near zero.

GRP

Currently GRP insurance coverage is available to individual farmers. It is assumed that GRP coverage would be made available to producer owned cooperatives such as the NGSC that is modeled in this study. GRP coverage in this study was assumed not to include the subsidy that

[1] The 37,547 acres comes from the RMA data figure on how many total acres are needed to produce the 120 million pounds of throughput from the respective counties at the determined percentage amount from each county.

is available to farmers. The cost of GRP insurance is the full amount of the premium and has no government subsidies. If government policy changes and the premium subsidy is allowed for a NGSC, then it will reduce the total cost of the premium.

Several scenarios of the GRP coverage were tested on the model. Since GRP can be applied at a coverage level of 70%, 75%, 80%, 85%, or 90%, and a scale from 0.9 up to 1.5, there was a need to determine a coverage level for the NGSC that would reduce risk. Table 4.1 shows results of the metrics used to evaluate some of the different risk management strategies using GRP insurance. See appendix, Table A.3, for an outline of the explanations of the following tables in chapter four.

Table 4.1: Simulation of GRP insurance on member data*.

Data	County**	Member	Member
GRP Coverage	0%	0%	90%
GRP scale	0	0	1.5
Contract (p1,p2,p3)	30,30,40	30,30,40	30,30,40
Statistics on ROA			
Mean	15.99%	16.25%	16.12%
StdDev	15.95%	14.74%	11.40%
Variance	2.54%	2.17%	1.30%
Min	-51.23%	-37.88%	-16.23%
Max	78.21%	68.65%	63.63%
Coefficient of Variation	0.9976	0.9071	0.7077
Metrics on ROA			
VaR @ 5%	-10.46%	-7.97%	-0.79%
VaR @ 1%	-22.21%	-19.20%	-6.59%
Sharpe's Ratio (risk-free rate = 4.3%)	0.7328	0.8108	1.0361
FDSDRA	0.2283	0.2042	0.1455

*Note: This simulation run is with no insurance and the best possible GRP coverage and scale. One note to make is the fact that the ROA shown in all of this study is before distributions and taxes and is higher than after distribution and taxes; this applies to all tables.
**County data is used for the base run and no risk management tools are used.

Table 4.1 contains a base run of the model. The base run is the county yield data with the contract ratio of 30,30,40 and no GRP insurance. The other runs are part of different risk management strategies. As shown in Table 4.1, member data no insurance and a contract ratio of

30,30,40 shows that the VaR at 5% for the ROA is a -7.97%. This means that there is a five percent chance that the ROA will be less than -7.97%. County data with no risk management involved has a VaR at 5% of -10.46% ROA. By adding GRP with the highest coverage and scale to the member data and using the contract ratio of 30,30,40 the VaR at 5% for the ROA decreases to -0.79%. The use of the highest GRP coverage and scale gives an example of the difference of no insurance compared to the best insurance coverage. The use of GRP insurance can decrease the downside of risk, as shown in Table 4.1. GRP insurance helped minimize the loss that the NGSC could face at the 5% level. Also, having quality members reduces the VaR as well as insurance.

Risk management strategies cannot be looked upon solely to create shareholder wealth. Other metrics that are shown in Table 4.1 are Sharpe's Ratio and FDSDRA. The Sharpe's Ratio is the average ROA less the return from a risk-free asset over the standard deviation of ROA. The return on the risk-free asset (4.3%) is the average 3-month T-bill rate from 1980-2001 according to the Federal Reserve Bank of Chicago. Strategies that produce the highest Sharpe's Ratio are preferred. The most preferred Sharpe's Ratio in Table 4.1 is the run of member data with GRP insurance and contract ratio of 30,30,40 (1.0361), while the least preferred is the county data with a contract ratio of 30,30,40 (.7328). The density of ROA is evaluated at the risk-free rate of 4.3% with FDSDRA. This metric returns the cumulative probability of returning the ROA less or equal to the risk-free rate. Strategies are ranked from the most preferred (lowest value) to least preferred (highest value). Simply put, the best strategy according to FDSDRA is the strategy that returns the smallest probability of returning at least the risk-free rate. The FDSDRA rank in Table 4.1 shows the run with insurance and contract ratio of 30,30,40 as the best possible strategy (0.1455). These results on the use of GRP insurance show that if the

NGSC wants to reduce some of its risk, GRP insurance is a possible method to reduce some profit variance for the cooperative.

Contracts

While a NGSC must be concerned with the total amount of throughput, it must also be concerned with locking into some contracts to ensure prices it will receive for its shelled peanuts. Essentially this is a forward contract the NGSC has with a manufacture or peanut broker. A marketing year for a sheller is defined as February to May of the following year for one season of peanuts and a total of sixteen months. This time period is consistent with the Peanut Marketing Summary published by the Federal-State Marketing News Service of Thomasville, Georgia (USDA).

Several contract scenarios were applied to the model and simulated on member data. Specifically the contract ratios used are 1) 30 percent ,30 percent,40 percent, 2) 30,40,30, 3) 40,30,30, 4) 10, 40, 50, 5) 20,30,50, and 6) 60,10,30. The ratios varied the amount contracted during each period. Table 4.2 shows some of the results of the contract ratios run.

Table 4.2 shows the lowest VaR at 5% is the contract ratio of 40,30,30 (-7.87%) and the highest is the contract ratio of 30,40,30 (-8.24%). This could mean that contracting more in period one (pre-harvest) could offer higher prices. This is also indicated by the ROA mean as well. The Sharpe Ratio concurs that the contract ratio of 40,30,30 is the best plan in Table 4.2. However, the FDSDRA ranks the contract ratio of 30,30,40 as the best possible plan in Table 4.2. This could mean that the distribution of the ROA is shifted to the right for the contract ratio of 30,30,40.

Table 4.2: Simulation of Contract Ratios*.

Data	Member	Member	Member
GRP Coverage	0%	0%	0%
GRP scale	0	0	0
Contract (p1,p2,p3)	30,30,40	30,40,30	40,30,30
Statistics on ROA			
Mean	16.25%	15.55%	16.47%
StdDev	14.74%	14.41%	14.89%
Variance	2.17%	2.08%	2.22%
Min	-37.88%	-38.67%	-39.27%
Max	68.65%	67.10%	70.30%
Coefficient of Variation	0.9071	0.9266	0.9039
Metrics on ROA			
VaR @ 5%	-7.97%	-8.24%	-7.87%
VaR @ 1%	-19.20%	-19.38%	-19.34%
Sharpe's Ratio (risk-free rate = 4.3%)	0.8108	0.7808	0.8175
FDSDRA	0.2042	0.2142	0.2048

*Note: The simulation of contract ratios with member data was to illustrate the use of different contract ratios and how it affects the income statement.

An interesting result in Table 4.2 is the contract ratio of 30,40,30. This ratio contracts the most in the harvest period time, and has the lowest ROA mean, and the metrics rank the strategy least preferred in Table 4.2. This could be a result of the prices having lower average (historical) price during the harvest time than in other periods.

GRP and Contract

After runs with different GRP coverage or contract ratios, question arose about how the ROA would be affected by both different levels of GRP and contract ratios. Table 4.3 shows some examples of different levels of GRP insurance and different contract ratios. The GRP levels and contract ratios were randomly chosen to show various possible combinations.

Table 4.3 reveals different returns on assets when using various GRP coverage, scale, and contract ratios. The mean ROA differs from a low of 14.90% to a high of 18.25%. According to an industry expert, a typical contracting ratio is 30% during production period, 30% during harvest period, and 40% during post period. Due to the price information on shelled peanuts, it

Table 4.3: Different levels of GRP Insurance and Contract Ratio

Data	Member	Member	Member	Member
GRP Coverage	90%	85%	90%	80%
GRP scale	1.5	0.9	1.5	1.5
Contract (p1,p2,p3)	10,40,50	10,40,50	60,10,30	60,10,30
Statistics on ROA				
Mean	15.00%	14.90%	18.25%	17.80%
StdDev	11.19%	12.70%	12.66%	14.35%
Variance	1.25%	1.61%	1.60%	2.06%
Min	-17.65%	-24.48%	-16.58%	-29.32%
Max	64.46%	63.60%	73.49%	76.49%
Coefficient of Variation	0.7464	0.8523	0.6938	0.8062
Metrics on ROA				
VaR @ 5%	-1.80%	-4.97%	-0.38%	-4.65%
VaR @ 1%	-7.52%	-11.14%	-6.01%	-11.67%
Sharpe's Ratio (risk-free rate = 4.3%)	0.9556	0.8348	1.1016	0.9409
FDSDRA	0.1666	0.2152	0.1221	0.1777

is apparent from the results that contracting more in period one can result in a higher ROA, therefore leading the NGSC to more profit. Although the results from the model and data show this, this could be a downfall when the NGSC follows the practice of contracting a large percentage in the production period (first marketing period) and has a large shortfall in throughput. The NGSC must be concerned about relations with their customers and buyers of shelled peanuts. With other shellers in the market, a shelled peanut buyer may not be inclined to make purchases in the future when a NGSC fails to deliver on a contract.

Table 4.3 gives some ideas on different scenarios that could be applied to a NGSC risk management plan. The scenario of 90%, 1.5 GRP insurance and 60,10,30 contract ratio provides the best ROA, FDSDRA, VaR at 5%, and Sharpe’s Ratio. Again, a firm must think about the trade-off between risk and return and understand the firm’s goals and plans. Once an acceptable level of risk has been determined, then these various scenarios can be reviewed for possible consideration.

Yield shock

Yield variability is another aspect of profit and risk for a NGSC. An assumed scenario is that Seminole County experiences a weather event that causes a 20% decrease in average yield for members in that county and that the NGSC was unable to obtain compensating throughput from an outside source. Yields in othe NGSC counties are assumed to achieve expected levels and not affected by the weather event. Table 4.4 shows the outcome of the shock on Seminole County yield.

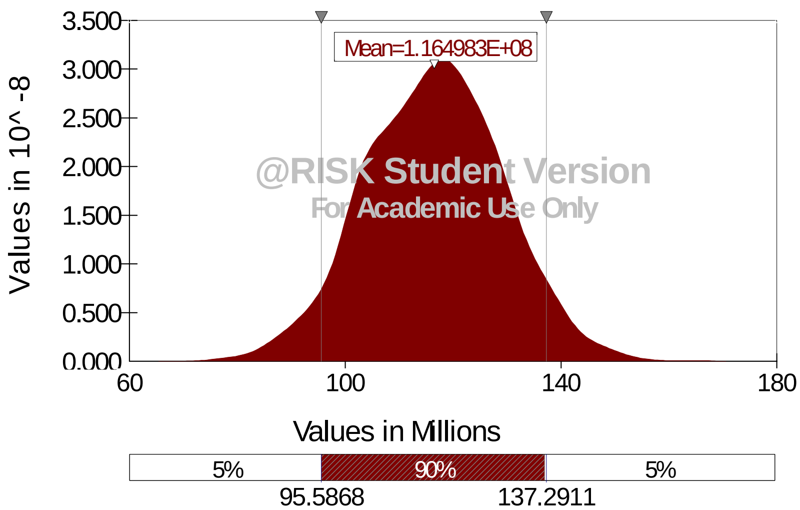
As shown in Table 4.4, a decrease in Seminole County's yield caused a decrease in the ROA compared to previous simulation results. The total amount of loss is reduced with GRP insurance. The VaR @ 5% with insurance for the 30,30,40 contract shows a reduction in risk (-5.58% ROA) when compared to the same contract without insurance (-12.67%).

Table 4.4: Shock on Seminole County Yield*.

Data	Member	Member	Member
GPR Coverage	0%	90%	90%
GRP scale	0	1.5	1.5
Contract (p1,p2,p3)	30,30,40	30,30,40	60,10,30
Statistics on ROA			
Mean	11.95%	11.84%	13.86%
StdDev	14.74%	11.68%	12.69%
Variance	2.17%	1.36%	1.61%
Min	-48.88%	-20.26%	-19.36%
Max	65.49%	62.20%	69.49%
Coefficient of Variation	1.2332	0.9867	0.9156
Metrics on ROA			
VaR @ 5%	-12.67%	-5.58%	-4.90%
VaR @ 1%	-21.83%	-11.26%	-10.95%
Sharpe's Ratio (risk-free rate = 4.3%)	0.5192	0.6453	0.7535
FDSDRA	0.2958	0.2687	0.2359

*Note: Seminole County yield was 20% below the normal member level and all other counties held constant.

A weather event is possible for a NGSC to experience (i.e. hurricane), but it is possible for the NGSC to reduce the total loss, as in this example. The Sharpe Ratio and FDSDRA concur that the use of insurance is a better plan that the use of none. The effect of this yield loss is shown in Figure 4.3. This figure shows the total member production (throughput) of the six counties. The production amount decreased roughly by 350,000 pounds from the NGSC's target throughput of 120 million pounds.



Minimum	6.52E+07
Mean	1.16E+08
Maximum	1.71E+08
Std Dev	1.28E+07
Variance	1.63E+14

Figure 4.3: Total Throughput with Seminole Yield Decrease.

Conclusion of Results

The rankings of the various risk management strategies (insurance and contracts) are located in Table 4.5. This is a table based upon the number ranking of each evaluation method. Each table contains the strategies used in this study and the rankings of the respective evaluation metrics. Overall the metrics rank the strategy of contracting 60,10,30 with GRP of 90% coverage at a 1.5 scale as better than other strategies presented.

One interesting observation about contract ratios is that the higher contracted amounts in the production period usually have a higher ranking among the metrics than lower contracted amounts. This could be an indicator that prices are more favorable in the beginning of a marketing year. Specifically, the contract ratio of 10,40,50 appears to rank the lowest by the metrics, differing only by use or non-use of GRP. Also, the data that is available for shelled peanut prices has some limitations. The prices reported are average monthly prices and some shelling out-turns do not have a complete year of reported prices. Also the correlation between the production period price and county peanut production is not as strong as in the other periods of harvest and post. The production period may not have a strong influence on the price of a shelled peanut since actual production figures are usually determined during harvest time. Usually shelled peanut prices are partly based upon the amount of U.S. peanut production, and for example, usually shelled peanut prices increase in a low production year.

Another observation is the ranking by VaR, Sharpe's Ratio, and FDSDRA on use of the highest GRP coverage and scale. The top three strategies, according to these three metrics, all have GRP coverage at 90% and scale of 1.5. This may indicate that a NGSC could minimize the risk faced with the highest GRP insurance possible. Also, since this GRP coverage is at 90%, it may have a higher possibility of triggering than a lower coverage amount. GRP insurance seems to prove its worth as a risk management tool when used at or near the maximum coverage level. The FDSDRA rankings from all of the risk management strategies show that use of GRP at 90% coverage and 1.5 scale is better than no insurance and the same contract ratio (see appendix). Sharpe's Ratio ranks the use of GRP insurance 85% coverage and 1.5 scale and higher coverage[2] better than no use of insurance. Only one strategy that uses this exact GRP insurance coverage and scale falls below rank. Specifically the strategy that has a contract ratio of 10,40,50. This could be the result that this ratio has more probability to contract lower prices during high production periods.

These results show that risk management and reduction of specific risks, i.e. throughput, is possible with active use of the risk management tools used for this model. The model results

[2] Higher coverage meaning the next level of coverage at 90% and scale of 0.9.

are from historical data, therefore, these results are based solely upon the outcomes that have happened in the past. Future outcomes are possible that this model did not cover. What is possible are management of the risks covered in this study by use of contracting, GRP insurance, and recruiting quality members.

Table 4.5: Ranking of Results*

ID	*GRP* Coverage	Scale	*Contract Period* P1	P2	P3	ROA	*rank_ROA*	VaR @ 5%	*rank_VaR*	Sharpe Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
1	0%	0	30%	30%	40%	0.1625	11	-0.0797	38	0.8108	38	0.2042	28
2	0%	0	30%	40%	30%	0.1555	28	-0.0824	40	0.7808	41	0.2142	37
3	0%	0	40%	30%	30%	0.1647	8	-0.0787	37	0.8175	36	0.2048	30
4	0%	0	10%	40%	50%	0.1485	40	-0.0835	42	0.7551	42	0.2194	40
5	0%	0	20%	30%	50%	0.1577	26	-0.0831	41	0.7969	40	0.2057	32
6	0%	0	60%	10%	30%	0.1806	5	-0.0813	39	0.8740	26	0.1855	21
7	90%	1.5	30%	30%	40%	0.1612	16	-0.0079	2	1.0361	3	0.1455	3
8	90%	1.5	30%	40%	30%	0.1542	31	-0.0115	4	1.0017	7	0.1522	5
9	90%	1.5	40%	30%	30%	0.1634	10	-0.0080	3	1.0460	2	0.1415	2
10	90%	1.5	10%	40%	50%	0.1500	36	-0.0180	6	0.9556	9	0.1666	8
11	90%	1.5	20%	30%	50%	0.1593	21	-0.0134	5	1.0070	5	0.1500	4
12	90%	1.5	60%	10%	30%	0.1825	1	-0.0038	1	1.1016	1	0.1221	1
13	90%	0.9	30%	30%	40%	0.1596	18	-0.0324	14	0.9305	17	0.1775	15
14	90%	0.9	30%	40%	30%	0.1524	34	-0.0346	19	0.8968	22	0.1870	23
15	90%	0.9	40%	30%	30%	0.1619	15	-0.0316	13	0.9389	14	0.1754	14
16	90%	0.9	10%	40%	50%	0.1493	37	-0.0446	22	0.8648	29	0.2000	24
17	90%	0.9	20%	30%	50%	0.1586	22	-0.0406	21	0.9119	19	0.1853	17
18	90%	0.9	60%	10%	30%	0.1818	2	-0.0325	15	1.0036	6	0.1592	6
19	85%	1.5	30%	30%	40%	0.1595	19	-0.0292	10	0.9337	15	0.1749	13
20	85%	1.5	30%	40%	30%	0.1527	32	-0.0327	16	0.9020	20	0.1853	19
21	85%	1.5	40%	30%	30%	0.1619	14	-0.0300	11	0.9428	11	0.1730	10

* ID represents the order in which the risk management strategies were run.

Table 4.5: Ranking of Results (cont'd).

ID	*GRP* Coverage	Scale	*Contract Period* P1	P2	P3	ROA	*rank_ROA*	VaR @ 5%	*rank_VaR*	Sharpe Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
22	85%	1.5	10%	40%	50%	0.1471	41	-0.0339	18	0.8714	27	0.2018	26
23	85%	1.5	20%	30%	50%	0.1563	27	-0.0291	8	0.9206	18	0.1867	22
24	85%	1.5	60%	10%	30%	0.1795	6	-0.0200	7	1.0140	4	0.1599	7
25	85%	0.9	30%	30%	40%	0.1595	20	-0.0292	9	0.9337	16	0.1749	12
26	85%	0.9	30%	40%	30%	0.1527	33	-0.0327	17	0.9020	21	0.1853	20
27	85%	0.9	40%	30%	30%	0.1619	13	-0.0300	12	0.9428	12	0.1730	11
28	85%	0.9	10%	40%	50%	0.1490	39	-0.0497	25	0.8348	34	0.2152	39
29	85%	0.9	20%	30%	50%	0.1583	24	-0.0452	23	0.8809	24	0.2020	27
30	85%	0.9	60%	10%	30%	0.1812	4	-0.0379	20	0.9700	8	0.1696	9
31	80%	1.5	30%	30%	40%	0.1582	25	-0.0543	31	0.8577	31	0.2056	31
32	80%	1.5	30%	40%	30%	0.1510	35	-0.0561	35	0.8241	35	0.2149	38
33	80%	1.5	40%	30%	30%	0.1604	17	-0.0540	30	0.8649	28	0.2043	29
34	80%	1.5	10%	40%	50%	0.1454	42	-0.0548	33	0.8085	39	0.2205	42
35	80%	1.5	20%	30%	50%	0.1547	30	-0.0511	27	0.8550	32	0.2066	34
36	80%	1.5	60%	10%	30%	0.1780	7	-0.0465	24	0.9409	13	0.1777	16
37	80%	0.9	30%	30%	40%	0.1624	12	-0.0531	29	0.8743	25	0.2063	33
38	80%	0.9	30%	40%	30%	0.1554	29	-0.0562	36	0.8423	33	0.2116	36
39	80%	0.9	40%	30%	30%	0.1647	9	-0.0545	32	0.8817	23	0.2007	25
40	80%	0.9	10%	40%	50%	0.1493	38	-0.0552	34	0.8153	37	0.2204	41
41	80%	0.9	20%	30%	50%	0.1585	23	-0.0519	28	0.8593	30	0.2068	35
42	80%	0.9	60%	10%	30%	0.1815	3	-0.0507	26	0.9429	10	0.1853	18

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

The peanut industry is very important to the Georgia, especially in South Georgia. Georgia is the major producer of peanuts in the United States. Recent changes in the 2002 Farm Bill have changed the peanut program significantly, most specifically the decrease in the marketing loan rate. Some concern over the loss of price supports and other features of the 2002 peanut program has grown among peanut producers. Also, issues such as free trade and increasing concentration of sectors of the peanut industry, especially peanut shellers, are causes of concern. The lack of market power and pricing information leaves peanut producers at the bottom of the chain. Factors mentioned above as well as weather can all have negative effects on a peanut farmer’s income. With these looming problems on the horizon, peanut farmers can help minimize the variability of profit by planning, developing, and enacting risk management strategies.

This research was inspired by the recent changes in the peanut policy and suggests how Georgia peanut farmers can respond to these changes. One possible solution is for Georgia farmers to form a New Generation Shelling Cooperative (NGSC). The formation of an NGSC would give farmers a chance to add value to their crop of peanuts by shelling and possible further processing. This could strengthen their marketing power by joining forces to market their production and purchasing inputs. U.S. agriculture cooperatives are responsible for selling billions of dollars of farm output and input supplies per year (USDA).

An NGSC can be a profit enhancing mechanism for peanut farmers, but it can also doubly expose farmer-members to losses due to the high correlation of a loss in the cooperative and on the farm. The throughput risk is considered a major risk the NGSC faces. Without peanuts to shell, the NGSC would not operate. Many cooperatives have not kept pace with investor owned-competitors when it comes to active risk management. Rather, cooperatives have taken a position of risk accommodation by holding onto capital reserves (Manfredo et al.). Possible lack of understanding and knowledge of the risk and rewards of both traditional and alternative risk management tools and how they ultimately affect the financial performance of the cooperative has hampered active risk management.

The objective of this research was to look at specific risk management tools and which tools have potential use for an NGSC as well as how they effect the distribution of the NGSC's return on assets (ROA). First, identification of risks that an NGSC could face was reviewed. Several risk management tools and how they could be used by an NGSC were discussed. Next, ready-to-use tools and tools which require some development to work for an NGSC were discussed. The following risk management tools were chosen: limiting membership to irrigated members with yields that average 10% above county yields; seasonal marketing strategies (contracts with manufacturers); and Group Risk Plan (GRP) insurance. The recruitment of quality members for the NGSC is specifically for the purpose of helping the cooperative to reduce throughput risk. Forward contracting provide the NGSC with some certainty on a price received for a specified amount of shelled peanuts. GRP insurance will help in reduction of the magnitude a loss that an NGSC could face during a yield shortfall.

These specific risk management tools were chosen to determine how they affect the distribution of ROA. The ROA was measured at earnings before patronage distribution and taxes (EBDT). While several other risk management tools were possible choices, issues such as transaction costs, counter-party risk, data-availability issues, and complex pricing issues hampered the modeling of them. Specifically, tools such as a yield hedge, weather derivatives, revenue swaps, and catastrophic insurance would require further study to understand their use or benefit for an NGSC.

A Monte Carlo simulation was used to run simulations on the model developed to show how the risk management strategies affected the bottom line of the NGSC's income statement. The model simulates county yields, member yields, and shelled peanut prices as stochastic variables to estimate earnings and ROA. The stochastic simulation was performed with the *@RISK* add-in for Excel and 5,000 iterations were performed on each risk management scenario. *@RISK* can perform Monte Carlo simulations in Excel with the ability to correlate input distributions. Several risk management scenarios were simulated at different levels of GRP coverage, scale, and price contracting ratios.

The model tested scenarios without any risk management, various combinations of just contracting, various combinations of just GRP insurance, and various combinations of contracts and GRP insurance. The evaluation of the different risk management strategies used various metrics, including metrics that focus on downside risk (Value-at-Risk) as well as traditional mean-variance efficiency (Sharpe's Ratio; stochastic dominance). The strategies were then ranked according to the respective metrics. Overall, the use of contracting and GRP insurance at 90% coverage proved to be worthwhile. GRP insurance minimizes the left tail of the ROA distribution and this minimized the total loss figure. The contract ratios are set up so the NGSC can contract a percentage amount of total throughput during each the three periods in a marketing year: production, harvest, and post harvest period. The contract ratios proved to be most beneficial when the majority of the throughput was contracted in the production period. The higher rankings for contracting a majority in the production period could be caused by the correlation with county production.

A study done by Manfredo et al. used simulation methods to see how traditional and innovate risk management practices affect the financial performance for agriculture grain merchandising cooperatives (2003). The risk management tools used in this study are futures, put options, revenue swap, and GRP insurance. They are applied to a corn, wheat, and soybean merchandising cooperative. When comparing the Manfredo et al. study and this study, the use of GRP appears to help the NGSC more than a grain merchandising cooperative. This could result from the quality of the NGSC membership, and since the NGSC is adding value by shelling the profit margin is not as small as a grain merchandising cooperative.

Further research in this area of risk management for shelling cooperatives should look into modeling other risk management tools and how they can be applied to an NGSC. Other risk management tools could provide cooperative management with other choices that fit within the co-op's knowledge base or risk preferences. Also, optimization of the contract ratio and use of GRP coverage and scale is another area that could lead to more efficient use of these tools. All this information could lead to educating cooperatives on better risk management practices.

This study was conducted with monthly average shelled peanut price data and RMA APH farm-level data. A question remains on the length of reported price data available and if it accurately represents the price market for shelled peanuts. Another uncertainty is if the RMA APH farm-level data accurately represents the members of an NGSC, or if the data set contains farmers that are not quality growers.

One key point that needs to be made is that GRP insurance is available to individual farmers, and not to businesses. Hopefully, this study proves that GRP is worthwhile to farmer-owned cooperatives, and future policy could change this to allow GRP insurance for farmer-owned businesses. Given that cooperatives are important in American agriculture, this research provides critical information to NGSC managers concerning risk management that may prove useful in their organizations. By using the risk management tools mentioned in this study, and as well as other risk management tools, cooperative managers can focus on using external capital for productive purposes, reduce ownership risk faced by farmer-members, reduce cost of capital, and possibly expand in both membership and the market.

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Appendices

Table A.1: Correlation Matrix of Yield* and Prices**

		County						Member						Production				Harvest				Post			
		Baker	Decatur	Early	Miller	Mitchell	Seminole	Baker	Decatur	Early	Miller	Mitchell	Seminole	Jumbo	Mediums	No. 1's	US Splits	Jumbo	Mediums	No. 1's	US Splits	Jumbo	Mediums	No. 1's	US Splits
County	Baker	1																							
	Decatur	0.6426	1																						
	Early	0.6071	0.6200	1																					
	Miller	0.5783	0.7029	0.6336	1																				
	Mitchell	0.5087	0.6486	0.5879	0.7467	1																			
	Seminole	0.5076	0.7509	0.5754	0.7056	0.6820	1																		
Member	Baker	0.4898	0.2375	0.3580	0.2471	0.1925	0.0857	1																	
	Decatur	0.6754	0.7585	0.6382	0.6913	0.6559	0.7141	0.3390	1																
	Early	0.6173	0.6865	0.7221	0.6912	0.6682	0.6662	0.2703	0.6861	1															
	Miller	0.5261	0.5653	0.5706	0.6594	0.6386	0.5235	0.5347	0.5964	0.5658	1														
	Mitchell	0.5203	0.7153	0.6203	0.7376	0.7512	0.7516	0.1664	0.6920	0.6999	0.6067	1													
	Seminole	0.5077	0.6900	0.5881	0.6537	0.6678	0.6725	0.2357	0.6766	0.6749	0.6056	0.6908	1												
Production	Jumbo	0.2037	0.2095	0.0878	0.0603	0.1120	0.0748	0.2037	0.2095	0.0878	0.0603	0.1120	0.0748	1											
	Mediums	0.1534	0.0074	0.1486	-0.0749	0.0483	-0.1817	0.1534	0.0074	0.1486	-0.0749	0.0483	-0.1817	0.5298	1										
	No. 1's	-0.2224	-0.1706	0.0585	-0.0724	-0.1120	-0.1787	-0.2224	-0.1706	0.0585	-0.0724	-0.1120	-0.1787	0.4247	0.4247	1									
	US Splits	0.1567	0.2295	0.1995	0.3932	0.2303	0.3148	0.1567	0.2295	0.1995	0.3932	0.2303	0.3148	0.4926	0.1802	0.3937	1								
Harvest	Jumbo	-0.4036	-0.3801	-0.6788	-0.4829	-0.3966	-0.5068	-0.4036	-0.3801	-0.6788	-0.4829	-0.3966	-0.5068	-0.1854	-0.0065	-0.1536	-0.2641	1							
	Mediums	-0.4484	-0.5479	-0.5914	-0.5695	-0.4195	-0.5549	-0.4484	-0.5479	-0.5914	-0.5695	-0.4195	-0.5549	0.0583	0.1277	0.1182	-0.3015	0.5506	1						
	No. 1's	-0.5072	-0.4604	-0.5702	-0.4800	-0.3025	-0.4623	-0.5072	-0.4604	-0.5702	-0.4800	-0.3025	-0.4623	-0.1117	0.0743	0.0798	-0.4041	0.5727	0.7066	1					
	US Splits	-0.3615	-0.3756	-0.6555	-0.3906	-0.3503	-0.4475	-0.3615	-0.3756	-0.6555	-0.3906	-0.3503	-0.4475	-0.1831	-0.0641	-0.0750	-0.1397	0.7406	0.4715	0.4904	1				
Post	Jumbo	-0.2617	-0.4578	-0.5302	-0.2962	-0.2703	-0.3523	-0.2617	-0.4578	-0.5302	-0.2962	-0.2703	-0.3523	-0.3477	-0.2866	-0.1877	-0.2337	0.6057	0.4526	0.4256	0.6787	1			
	Mediums	-0.2272	-0.3719	-0.4022	-0.0577	-0.1890	-0.1996	-0.2272	-0.3719	-0.4022	-0.0577	-0.1890	-0.1996	-0.3250	-0.4185	-0.0559	-0.1391	0.3538	0.3130	0.2966	0.5088	0.6918	1		
	No. 1's	-0.0921	-0.3715	-0.3329	-0.1140	-0.1123	-0.1910	-0.0921	-0.3715	-0.3329	-0.1140	-0.1123	-0.1910	-0.2868	-0.2908	-0.0731	-0.1225	0.3680	0.2874	0.2577	0.5325	0.7053	0.7540	1	
	US Splits	-0.1129	-0.3612	-0.3148	-0.1080	-0.1724	-0.1647	-0.1129	-0.3612	-0.3148	-0.1080	-0.1724	-0.1647	-0.2713	-0.3971	-0.0687	-0.0351	0.2792	0.2220	0.1386	0.4553	0.6647	0.7567	0.7544	1

*Note that the correlation of county yield uses NASS county yields and member yield uses RMA APH data.

**Note that the coefficient for prices is from the correlation between prices and county production. Correlation between prices and members production was assumed to be the same as the correlation between prices and county production.

Table A.2: Income Statement for NGSC

Income:	Assumed %	Pounds	Unit Price	**Total $**	**$/FSE Ton**
Jumbos	16.99%	19,980,240	$ 0.4193	$ 8,377,715	$ 139.63
Mediums	33.27%	39,125,520	0.4005	15,669,771	261.16
# 1's	7.28%	8,561,280	0.3800	3,253,286	54.22
US Splits	12.71%	14,946,960	0.3918	5,856,219	97.60
Oil Stocks	6.65%	7,820,400	0.1200	938,448	15.64
Hulls	23.10%	27,165,600	0.0500	1,358,280	22.64
Total	100%	117,600,000		**$ 35,453,719**	**$ 590.90**
		58,800	**<= Shelled Tons Sold**		
Direct Costs:	Lbs or Tons	Cost/Lb or Tons			
Peanuts	120,000,000	$ 0.1900		$ 22,800,000	$ 380.00
Storage (Tons)	54,432	40.17		2,186,407	36.44
Handling Fee	120,000,000	0.02		2,400,000	40.00
Transportation (Ton)	60,000	2.30		138,000	2.30
Grading Fee (Ton)	60,000	5.25		315,000	5.25
Shrink	3,600,000	0.30		1,063,612	17.73
Total				$ 28,903,018	$ 481.72
Direct Labor:					
Administration				$ 205,000	$ 3.42
Total Direct Labor				921,600	15.36
Benefits	30%	Administration		61,500	1.03
Total Labor Costs				$ 1,188,100	$ 19.80
Other Direct Costs:					
Electricity				$ 168,000	$ 2.80
Natural Gas				8,000	0.13
Fuel				3,600	0.06
Water		$1.30	1,000 gallon	24,375	0.41
Sewer		$0.60	1,000 gallon	11,543	0.19
Repairs & Maintenance				118,458	1.97
Miscellaneous Costs				100,500	1.68
Interest on Working Capital		10%	$ 632,493	63,249	1.05
Total of Other Direct Costs				$ 497,726	$ 8.30
Total Direct Cost				**$ 30,588,844**	**$ 509.81**
Fixed Costs:					
Insurance				$ 96,292	$ 1.60
Depreciation - Building/Start Up Costs				207,378	3.46
Depreciation - Plant Equipment				529,471	8.82
Interest on Investment - Building/Start Up Costs		10%		400,812	6.68
Interest on Investment - Plant Equipment		10%		296,146	4.94
GRP Insurance*				fixed	fixed
Total Fixed Costs				**$ 1,530,100**	**$ 25.50**
Total Cost				**$ 32,118,944**	**$ 535.32**
Efficiency				91%	
Profit				**$ 3,334,775**	**$ 55.58**

*GRP premium is a fixed cost based upon coverage and scale amount.

Table A.3 Description of results tables.

Data	*describes which data source was used
GRP Coverage	*amount of GRP coverage used 70% up to 90%, this figures the yield trigger
GRP scale	*amount of GRP scale used, from 0.9 to 1.5
Contract (p1,p2,p3)	*% amount contracted in periods(p1=production, p2=harvest, p3=post)
Statistics on ROA	*section shows the results of the Return on Assets from the Income Statement, expressed in percentage form
Mean	*shows the mean of return on assets from the simulation in percentage form.
StdDev	*shows the standard deviation of ROA from the simulation.
Variance	*shows the variance of ROA from the simulation.
Minimum	*shows the minimum ROA from the simulation.
Maximum	*shows the maximum ROA from the simulation.
Coefficient of Variation	*shows the CV of ROA, which is StdDev/Mean, and measures relative risk.
Metrics on ROA	*section shows the evaluation procedures used to measure the different strategies.
VaR 5%	*Value at Risk, measures the 5% probability, shows the exposure of risk. Expresses an exact ROA number.
Sharpe's Ratio (risk-free rate = 4.3%)	*is a direct measure of reward to risk and helps find the best possible strategy(largest number indicates best strategy) Expressed in percentage form.
FDSDRA	*first degree stochastic dominance with a risk free asset - returns the cumulative probability of returning the ROA less or equal to the risk-free rate (4.3%).(smallest number prefered) Expressed in percentage form.

Table A.4: Rankings of Strategies by ROA*

ID	*GRP* Coverage	Scale	*Contract Period* P1	P2	P3	ROA	*rank_ROA*	VaR @ 5%	*rank_VaR*	Sharpe Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
12	90%	1.5	60%	10%	30%	0.1825	1	-0.0038	1	1.1016	1	0.1221	1
18	90%	0.9	60%	10%	30%	0.1818	2	-0.0325	15	1.0036	6	0.1592	6
42	80%	0.9	60%	10%	30%	0.1815	3	-0.0507	26	0.9429	10	0.1853	18
30	85%	0.9	60%	10%	30%	0.1812	4	-0.0379	20	0.9700	8	0.1696	9
6	0%	0	60%	10%	30%	0.1806	5	-0.0813	39	0.8740	26	0.1855	21
24	85%	1.5	60%	10%	30%	0.1795	6	-0.0200	7	1.0140	4	0.1599	7
36	80%	1.5	60%	10%	30%	0.1780	7	-0.0465	24	0.9409	13	0.1777	16
3	0%	0	40%	30%	30%	0.1647	8	-0.0787	37	0.8175	36	0.2048	30
39	80%	0.9	40%	30%	30%	0.1646	9	-0.0545	32	0.8817	23	0.2007	25
9	90%	1.5	40%	30%	30%	0.1634	10	-0.0080	3	1.0460	2	0.1415	2
1	0%	0	30%	30%	40%	0.1625	11	-0.0797	38	0.8108	38	0.2042	28
37	80%	0.9	30%	30%	40%	0.1624	12	-0.0531	29	0.8743	25	0.2063	33
27	85%	0.9	40%	30%	30%	0.1619	13	-0.0300	12	0.9428	12	0.1730	11
21	85%	1.5	40%	30%	30%	0.1619	14	-0.0300	11	0.9428	11	0.1730	10
15	90%	0.9	40%	30%	30%	0.1619	15	-0.0316	13	0.9389	14	0.1754	14
7	90%	1.5	30%	30%	40%	0.1612	16	-0.0079	2	1.0361	3	0.1455	3
33	80%	1.5	40%	30%	30%	0.1604	17	-0.0540	30	0.8649	28	0.2043	29
13	90%	0.9	30%	30%	40%	0.1596	18	-0.0324	14	0.9305	17	0.1775	15
19	85%	1.5	30%	30%	40%	0.1595	19	-0.0292	10	0.9337	15	0.1749	13
25	85%	0.9	30%	30%	40%	0.1595	20	-0.0292	9	0.9337	16	0.1749	12
11	90%	1.5	20%	30%	50%	0.1593	21	-0.0134	5	1.0070	5	0.1500	4

*ROA is measured before patronage distribution and taxes (EBDT).

Table A.4: Rankings of Strategies by ROA (cont'd)

ID	*GRP* Coverage	Scale	*Contract Period* P1	P2	P3	ROA	*rank_ROA*	VaR @ 5%	*rank_VaR*	Sharpe Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
17	90%	0.9	20%	30%	50%	0.1586	22	-0.0406	21	0.9119	19	0.1853	17
41	80%	0.9	20%	30%	50%	0.1585	23	-0.0519	28	0.8593	30	0.2068	35
29	85%	0.9	20%	30%	50%	0.1583	24	-0.0452	23	0.8809	24	0.2020	27
31	80%	1.5	30%	30%	40%	0.1582	25	-0.0543	31	0.8577	31	0.2056	31
5	0%	0	20%	30%	50%	0.1577	26	-0.0831	41	0.7969	40	0.2057	32
23	85%	1.5	20%	30%	50%	0.1563	27	-0.0291	8	0.9206	18	0.1867	22
2	0%	0	30%	40%	30%	0.1555	28	-0.0824	40	0.7808	41	0.2142	37
38	80%	0.9	30%	40%	30%	0.1554	29	-0.0562	36	0.8423	33	0.2116	36
35	80%	1.5	20%	30%	50%	0.1547	30	-0.0511	27	0.8550	32	0.2066	34
8	90%	1.5	30%	40%	30%	0.1542	31	-0.0115	4	1.0017	7	0.1522	5
20	85%	1.5	30%	40%	30%	0.1527	32	-0.0327	16	0.9020	20	0.1853	19
26	85%	0.9	30%	40%	30%	0.1527	33	-0.0327	17	0.9020	21	0.1853	20
14	90%	0.9	30%	40%	30%	0.1524	34	-0.0346	19	0.8968	22	0.1870	23
32	80%	1.5	30%	40%	30%	0.1510	35	-0.0561	35	0.8241	35	0.2149	38
10	90%	1.5	10%	40%	50%	0.1500	36	-0.0180	6	0.9556	9	0.1666	8
16	90%	0.9	10%	40%	50%	0.1493	37	-0.0446	22	0.8648	29	0.2000	24
40	80%	0.9	10%	40%	50%	0.1493	38	-0.0552	34	0.8153	37	0.2204	41
28	85%	0.9	10%	40%	50%	0.1490	39	-0.0497	25	0.8348	34	0.2152	39
4	0%	0	10%	40%	50%	0.1485	40	-0.0835	42	0.7551	42	0.2194	40
22	85%	1.5	10%	40%	50%	0.1471	41	-0.0339	18	0.8714	27	0.2018	26
34	80%	1.5	10%	40%	50%	0.1454	42	-0.0548	33	0.8085	39	0.2205	42

Table A.5: Rankings of Strategies by VaR*

ID	*GRP* Coverage	Scale	*Contract Period* P1	P2	P3	ROA	*rank_ROA*	VaR @ 5%	*rank_VaR*	Sharpe Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
12	90%	1.5	60%	10%	30%	0.1825	1	-0.0038	1	1.1016	1	0.1221	1
7	90%	1.5	30%	30%	40%	0.1612	16	-0.0079	2	1.0361	3	0.1455	3
9	90%	1.5	40%	30%	30%	0.1634	10	-0.0080	3	1.0460	2	0.1415	2
8	90%	1.5	30%	40%	30%	0.1542	31	-0.0115	4	1.0017	7	0.1522	5
11	90%	1.5	20%	30%	50%	0.1593	21	-0.0134	5	1.0070	5	0.1500	4
10	90%	1.5	10%	40%	50%	0.1500	36	-0.0180	6	0.9556	9	0.1666	8
24	85%	1.5	60%	10%	30%	0.1795	6	-0.0200	7	1.0140	4	0.1599	7
23	85%	1.5	20%	30%	50%	0.1563	27	-0.0291	8	0.9206	18	0.1867	22
25	85%	0.9	30%	30%	40%	0.1595	20	-0.0292	9	0.9337	16	0.1749	12
19	85%	1.5	30%	30%	40%	0.1595	19	-0.0292	10	0.9337	15	0.1749	13
21	85%	1.5	40%	30%	30%	0.1619	14	-0.0300	11	0.9428	11	0.1730	10
27	85%	0.9	40%	30%	30%	0.1619	13	-0.0300	12	0.9428	12	0.1730	11
15	90%	0.9	40%	30%	30%	0.1619	15	-0.0316	13	0.9389	14	0.1754	14
13	90%	0.9	30%	30%	40%	0.1596	18	-0.0324	14	0.9305	17	0.1775	15
18	90%	0.9	60%	10%	30%	0.1818	2	-0.0325	15	1.0036	6	0.1592	6
20	85%	1.5	30%	40%	30%	0.1527	32	-0.0327	16	0.9020	20	0.1853	19
26	85%	0.9	30%	40%	30%	0.1527	33	-0.0327	17	0.9020	21	0.1853	20
22	85%	1.5	10%	40%	50%	0.1471	41	-0.0339	18	0.8714	27	0.2018	26
14	90%	0.9	30%	40%	30%	0.1524	34	-0.0346	19	0.8968	22	0.1870	23
30	85%	0.9	60%	10%	30%	0.1812	4	-0.0379	20	0.9700	8	0.1696	9
17	90%	0.9	20%	30%	50%	0.1586	22	-0.0406	21	0.9119	19	0.1853	17

*Value-at-Risk (VaR) summarizes the worst loss or outcome over a certain period with a given confidence level (in this case 5%).

Table A.5: Rankings of Strategies by VaR (cont'd)

ID	*GRP* Coverage	Scale	*Contract Period* P1	P2	P3	ROA	*rank_ROA*	VaR @ 5%	*rank_VaR*	Sharpe Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
16	90%	0.9	10%	40%	50%	0.1493	37	-0.0446	22	0.8648	29	0.2000	24
29	85%	0.9	20%	30%	50%	0.1583	24	-0.0452	23	0.8809	24	0.2020	27
36	80%	1.5	60%	10%	30%	0.1780	7	-0.0465	24	0.9409	13	0.1777	16
28	85%	0.9	10%	40%	50%	0.1490	39	-0.0497	25	0.8348	34	0.2152	39
42	80%	0.9	60%	10%	30%	0.1815	3	-0.0507	26	0.9429	10	0.1853	18
35	80%	1.5	20%	30%	50%	0.1547	30	-0.0511	27	0.8550	32	0.2066	34
41	80%	0.9	20%	30%	50%	0.1585	23	-0.0519	28	0.8593	30	0.2068	35
37	80%	0.9	30%	30%	40%	0.1624	12	-0.0531	29	0.8743	25	0.2063	33
33	80%	1.5	40%	30%	30%	0.1604	17	-0.0540	30	0.8649	28	0.2043	29
31	80%	1.5	30%	30%	40%	0.1582	25	-0.0543	31	0.8577	31	0.2056	31
39	80%	0.9	40%	30%	30%	0.1647	9	-0.0545	32	0.8817	23	0.2007	25
34	80%	1.5	10%	40%	50%	0.1454	42	-0.0548	33	0.8085	39	0.2205	42
40	80%	0.9	10%	40%	50%	0.1493	38	-0.0552	34	0.8153	37	0.2204	41
32	80%	1.5	30%	40%	30%	0.1510	35	-0.0561	35	0.8241	35	0.2149	38
38	80%	0.9	30%	40%	30%	0.1554	29	-0.0562	36	0.8423	33	0.2116	36
3	0%	0	40%	30%	30%	0.1647	8	-0.0787	37	0.8175	36	0.2048	30
1	0%	0	30%	30%	40%	0.1625	11	-0.0797	38	0.8108	38	0.2042	28
6	0%	0	60%	10%	30%	0.1806	5	-0.0813	39	0.8740	26	0.1855	21
2	0%	0	30%	40%	30%	0.1555	28	-0.0824	40	0.7808	41	0.2142	37
5	0%	0	20%	30%	50%	0.1577	26	-0.0831	41	0.7969	40	0.2057	32
4	0%	0	10%	40%	50%	0.1485	40	-0.0835	42	0.7551	42	0.2194	40

Table A.6: Rankings of Strategies by Sharpe's Ratio*

	GRP		*Contract Period*										
ID	**Coverage**	**Scale**	**P1**	**P2**	**P3**	**ROA**	***rank_ROA***	**VaR @ 5%**	***rank_VaR***	**Sharpe Ratio**	***rank_Sharpe***	**FDSDRA**	***rank_FDSDRA***
12	90%	1.5	60%	10%	30%	0.1825	1	-0.0038	1	1.1016	1	0.1221	1
9	90%	1.5	40%	30%	30%	0.1634	10	-0.0080	3	1.0460	2	0.1415	2
7	90%	1.5	30%	30%	40%	0.1612	16	-0.0079	2	1.0361	3	0.1455	3
24	85%	1.5	60%	10%	30%	0.1795	6	-0.0200	7	1.0140	4	0.1599	7
11	90%	1.5	20%	30%	50%	0.1593	21	-0.0134	5	1.0070	5	0.1500	4
18	90%	0.9	60%	10%	30%	0.1818	2	-0.0325	15	1.0036	6	0.1592	6
8	90%	1.5	30%	40%	30%	0.1542	31	-0.0115	4	1.0017	7	0.1522	5
30	85%	0.9	60%	10%	30%	0.1812	4	-0.0379	20	0.9700	8	0.1696	9
10	90%	1.5	10%	40%	50%	0.1500	36	-0.0180	6	0.9556	9	0.1666	8
42	80%	0.9	60%	10%	30%	0.1815	3	-0.0507	26	0.9429	10	0.1853	18
21	85%	1.5	40%	30%	30%	0.1619	14	-0.0300	11	0.9428	11	0.1730	10
27	85%	0.9	40%	30%	30%	0.1619	13	-0.0300	12	0.9428	12	0.1730	11
36	80%	1.5	60%	10%	30%	0.1780	7	-0.0465	24	0.9409	13	0.1777	16
15	90%	0.9	40%	30%	30%	0.1619	15	-0.0316	13	0.9389	14	0.1754	14
19	85%	1.5	30%	30%	40%	0.1595	19	-0.0292	10	0.9337	15	0.1749	13
25	85%	0.9	30%	30%	40%	0.1595	20	-0.0292	9	0.9337	16	0.1749	12
13	90%	0.9	30%	30%	40%	0.1596	18	-0.0324	14	0.9305	17	0.1775	15
23	85%	1.5	20%	30%	50%	0.1563	27	-0.0291	8	0.9206	18	0.1867	22
17	90%	0.9	20%	30%	50%	0.1586	22	-0.0406	21	0.9119	19	0.1853	17
20	85%	1.5	30%	40%	30%	0.1527	32	-0.0327	16	0.9020	20	0.1853	19
26	85%	0.9	30%	40%	30%	0.1527	33	-0.0327	17	0.9020	21	0.1853	20

* The Sharpe's Ratio is the average ROA less the return from a risk-free asset over the standard deviation of ROA.

Table A.6: Rankings of Strategies by Sharpe's Ratio (cont'd)

	GRP		*Contract Period*										
ID	**Coverage**	**Scale**	**P1**	**P2**	**P3**	**ROA**	***rank_ROA***	**VaR @ 5%**	***rank_VaR***	**Sharpe Ratio**	***rank_Sharpe***	**FDSDRA**	***rank_FDSDRA***
14	90%	0.9	30%	40%	30%	0.1524	34	-0.0346	19	0.8968	22	0.1870	23
39	80%	0.9	40%	30%	30%	0.1647	9	-0.0545	32	0.8817	23	0.2007	25
29	85%	0.9	20%	30%	50%	0.1583	24	-0.0452	23	0.8809	24	0.2020	27
37	80%	0.9	30%	30%	40%	0.1624	12	-0.0531	29	0.8743	25	0.2063	33
6	0%	0	60%	10%	30%	0.1806	5	-0.0813	39	0.8740	26	0.1855	21
22	85%	1.5	10%	40%	50%	0.1471	41	-0.0339	18	0.8714	27	0.2018	26
33	80%	1.5	40%	30%	30%	0.1604	17	-0.0540	30	0.8649	28	0.2043	29
16	90%	0.9	10%	40%	50%	0.1493	37	-0.0446	22	0.8648	29	0.2000	24
41	80%	0.9	20%	30%	50%	0.1585	23	-0.0519	28	0.8593	30	0.2068	35
31	80%	1.5	30%	30%	40%	0.1582	25	-0.0543	31	0.8577	31	0.2056	31
35	80%	1.5	20%	30%	50%	0.1547	30	-0.0511	27	0.8550	32	0.2066	34
38	80%	0.9	30%	40%	30%	0.1554	29	-0.0562	36	0.8423	33	0.2116	36
28	85%	0.9	10%	40%	50%	0.1490	39	-0.0497	25	0.8348	34	0.2152	39
32	80%	1.5	30%	40%	30%	0.1510	35	-0.0561	35	0.8241	35	0.2149	38
3	0%	0	40%	30%	30%	0.1647	8	-0.0787	37	0.8175	36	0.2048	30
40	80%	0.9	10%	40%	50%	0.1493	38	-0.0552	34	0.8153	37	0.2204	41
1	0%	0	30%	30%	40%	0.1625	11	-0.0797	38	0.8108	38	0.2042	28
34	80%	1.5	10%	40%	50%	0.1454	42	-0.0548	33	0.8085	39	0.2205	42
5	0%	0	20%	30%	50%	0.1577	26	-0.0831	41	0.7969	40	0.2057	32
2	0%	0	30%	40%	30%	0.1555	28	-0.0824	40	0.7808	41	0.2142	37
4	0%	0	10%	40%	50%	0.1485	40	-0.0835	42	0.7551	42	0.2194	40

Table A.7: Rankings of Strategies by FDSDRA*

	GRP		*Contract Period*										
ID	**Coverage**	**Scale**	**P1**	**P2**	**P3**	**ROA**	***rank_ROA***	**VaR @ 5%**	***rank_VaR***	**Sharpe Ratio**	***rank_Sharpe***	**FDSDRA**	***rank_FDSDRA***
12	90%	1.5	60%	10%	30%	0.1825	1	-0.0038	1	1.1016	1	0.1221	1
9	90%	1.5	40%	30%	30%	0.1634	10	-0.0080	3	1.0460	2	0.1415	2
7	90%	1.5	30%	30%	40%	0.1612	16	-0.0079	2	1.0361	3	0.1455	3
11	90%	1.5	20%	30%	50%	0.1593	21	-0.0134	5	1.0070	5	0.1500	4
8	90%	1.5	30%	40%	30%	0.1542	31	-0.0115	4	1.0017	7	0.1522	5
18	90%	0.9	60%	10%	30%	0.1818	2	-0.0325	15	1.0036	6	0.1592	6
24	85%	1.5	60%	10%	30%	0.1795	6	-0.0200	7	1.0140	4	0.1599	7
10	90%	1.5	10%	40%	50%	0.1500	36	-0.0180	6	0.9556	9	0.1666	8
30	85%	0.9	60%	10%	30%	0.1812	4	-0.0379	20	0.9700	8	0.1696	9
21	85%	1.5	40%	30%	30%	0.1619	14	-0.0300	11	0.9428	11	0.1730	10
27	85%	0.9	40%	30%	30%	0.1619	13	-0.0300	12	0.9428	12	0.1730	11
25	85%	0.9	30%	30%	40%	0.1595	20	-0.0292	9	0.9337	16	0.1749	12
19	85%	1.5	30%	30%	40%	0.1595	19	-0.0292	10	0.9337	15	0.1749	13
15	90%	0.9	40%	30%	30%	0.1619	15	-0.0316	13	0.9389	14	0.1754	14
13	90%	0.9	30%	30%	40%	0.1596	18	-0.0324	14	0.9305	17	0.1775	15
36	80%	1.5	60%	10%	30%	0.1780	7	-0.0465	24	0.9409	13	0.1777	16
17	90%	0.9	20%	30%	50%	0.1586	22	-0.0406	21	0.9119	19	0.1853	17
42	80%	0.9	60%	10%	30%	0.1815	3	-0.0507	26	0.9429	10	0.1853	18
20	85%	1.5	30%	40%	30%	0.1527	32	-0.0327	16	0.9020	20	0.1853	19
26	85%	0.9	30%	40%	30%	0.1527	33	-0.0327	17	0.9020	21	0.1853	20
6	0%	0	60%	10%	30%	0.1806	5	-0.0813	39	0.8740	26	0.1855	21

*FDSDRA returns the cumulative probability of returning the ROA less or equal to the risk-free rate (4.3%).

Table A.7: Rankings of Strategies by FDSDRA (cont'd)

	GRP		*Contract Period*										
ID	**Coverage**	**Scale**	**P1**	**P2**	**P3**	**ROA**	***rank_ROA***	**VaR @ 5%**	***rank_VaR***	**Sharpe Ratio**	***rank_Sharpe***	**FDSDRA**	***rank_FDSDRA***
23	85%	1.5	20%	30%	50%	0.1563	27	-0.0291	8	0.9206	18	0.1867	22
14	90%	0.9	30%	40%	30%	0.1524	34	-0.0346	19	0.8968	22	0.1870	23
16	90%	0.9	10%	40%	50%	0.1493	37	-0.0446	22	0.8648	29	0.2000	24
39	80%	0.9	40%	30%	30%	0.1647	9	-0.0545	32	0.8817	23	0.2007	25
22	85%	1.5	10%	40%	50%	0.1471	41	-0.0339	18	0.8714	27	0.2018	26
29	85%	0.9	20%	30%	50%	0.1583	24	-0.0452	23	0.8809	24	0.2020	27
1	0%	0	30%	30%	40%	0.1625	11	-0.0797	38	0.8108	38	0.2042	28
33	80%	1.5	40%	30%	30%	0.1604	17	-0.0540	30	0.8649	28	0.2043	29
3	0%	0	40%	30%	30%	0.1647	8	-0.0787	37	0.8175	36	0.2048	30
31	80%	1.5	30%	30%	40%	0.1582	25	-0.0543	31	0.8577	31	0.2056	31
5	0%	0	20%	30%	50%	0.1577	26	-0.0831	41	0.7969	40	0.2057	32
37	80%	0.9	30%	30%	40%	0.1624	12	-0.0531	29	0.8743	25	0.2063	33
35	80%	1.5	20%	30%	50%	0.1547	30	-0.0511	27	0.8550	32	0.2066	34
41	80%	0.9	20%	30%	50%	0.1585	23	-0.0519	28	0.8593	30	0.2068	35
38	80%	0.9	30%	40%	30%	0.1554	29	-0.0562	36	0.8423	33	0.2116	36
2	0%	0	30%	40%	30%	0.1555	28	-0.0824	40	0.7808	41	0.2142	37
32	80%	1.5	30%	40%	30%	0.1510	35	-0.0561	35	0.8241	35	0.2149	38
28	85%	0.9	10%	40%	50%	0.1490	39	-0.0497	25	0.8348	34	0.2152	39
4	0%	0	10%	40%	50%	0.1485	40	-0.0835	42	0.7551	42	0.2194	40
40	80%	0.9	10%	40%	50%	0.1493	38	-0.0552	34	0.8153	37	0.2204	41
34	80%	1.5	10%	40%	50%	0.1454	42	-0.0548	33	0.8085	39	0.2205	42

Table A.8: County and Member yield, standard deviation, and acreage for model.

	Baker Co.		**Decatur Co.**	
	COUNTY	MEMBERS	COUNTY	MEMBERS
County lbs/ac	3297	3626.7	3471.6	3818.76
Std Dev lbs/ac	429.77	429.77	424.69	424.69
Min lbs/ac	1	1	1	1
Max lbs/ac	4963	6000	5355.7	6000
% to Coop*	15%	15%	20%	20%
Ac from Co.	5459	4963	6913	6285
	Early Co.		**Miller Co.**	
	COUNTY	MEMBERS	COUNTY	MEMBERS
County lbs/ac	2875	3162.5	3241	3565.1
Std Dev lbs/ac	459.13	459.13	524.27	524.27
Min lbs/ac	1	1	1	1
Max lbs/ac	4136	6000	4938	6000
% to Coop*	15%	15%	20%	20%
Ac from Co.	6261	5692	7405	6732
	Mitchell Co.		**Seminole Co.**	
	COUNTY	MEMBERS	COUNTY	MEMBERS
County lbs/ac	3299	3628.9	2974	2676.6
Std Dev lbs/ac	406.07	406.07	574.3	574.3
Min lbs/ac	1	1	1	1
Max lbs/ac	4798	6000	5108	6000
% to Coop*	15%	15%	15%	15%
Ac from Co.	5456	4960	6052	5502

*Percentage to co-op is the percentage amount of throughput that the county supports the NGSC with.