Risk Management Strategies for a Producer-Owned Peanut Shelling Cooperative

Robert J. Byrne
Department of Agricultural and Applied Economics
Conner Hall Rm 208
University of Georgia
Athens, Georgia 30602
rbyrne@agecon.uga.edu

Nathan B. Smith
Department of Agricultural and Applied Economics
University of Georgia
P. O. Box 1209
Tifton, GA 31793
nathans@uga.edu

Stanley M. Fletcher
National Center for Peanut Competitiveness
Department of Agricultural and Applied Economics
College of Agricultural and Environmental Sciences Griffin Campus
The University of Georgia
1109 Experiment Street
Griffin, GA 30223-1797
sfletch@griffin.uga.edu

Barry J. Barnett
Department of Agricultural and Applied Economics
University of Georgia
Conner Hall Rm 314-A
University of Georgia
Athens, Georgia 30602
bbarnett@agecon.uga.edu

Abstract: The 2002 Farm Bill altered the peanut program. Peanut producers have indicated interest in a New Generation Shelling Cooperative (NGSC). This study simulates inherent risks and potential risk management strategies for a NGSC. These strategies are ranked using various metrics to understand their impact on risk and return.

Introduction

The 2002 Farm Bill made some drastic changes to the peanut program. The major change was elimination of the two-price support system and poundage quota for peanuts. Peanuts are now treated like other major "program" crops with a system of direct support payments, contingent on historical production rather than current acreage. The new peanut program established a marketing loan program for all peanuts produced. 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 peanut CCC loan pool rate was $610/ton during previous peanut program under the 1996 Farm Bill. The current program under the 2002 Farm Bill dropped price support to $355/ton under the marketing loan program. Peanut farmers now face lower profit margins.

Concentration of peanut shellers has increased throughout the peanut industry over time (American Peanut Shellers Association). 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).

Another problem in the peanut industry is asymmetric information. 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). Access to

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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.

One alternative for peanut farmers in a concentrated market to enhance their profitability is to look to add value by forming a New Generation Cooperative (NGC). An NGC has specific membership and delivery rights that differ from traditional cooperatives. Most NGC's look to add economic value to a farmer's product, such as shelling peanuts. A New Generation Shelling Cooperative (NGSC) can give peanut farmers an alternative for marketing and additional source of income.

The appearance of 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). Three studies have been done on South Georgia Peanut Cooperatives and found positive results for a New Generation Shelling Cooperative. Ray et al. was the first study concerning acceptance of a Georgia peanut NGC. The results led to a feasibility study of a Southwest 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. 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. 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. Overall, the economic success of the NGC would have a positive effect in the Tift area.

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. A specific risk for an NGSC is throughput risk. 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).

Risk Management Tools

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 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, Group Risk Plan (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 is assumed to be located in the Southwest corner of Georgia in the counties Baker, Decatur, Early, Miller, Mitchell, and Seminole. The NGSC could use the GRP insurance for protection against county-wide losses and shortfalls in coop throughput. While federal crop insurance, specifically 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. Lastly, contracting ratios look at seasonal combinations of forward contracting with manufacturers. Contracting 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.

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 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 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 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.

Two types of data 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. 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.

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.

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 can take into consideration the "natural hedge" that takes place when low (high) production and high (low) prices are realized.

Empirical Model

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). 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).

The average yield for all cooperative members within a county is referred 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. 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 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.

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

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:

$$(2) \qquad SMY_x = Y_x^{RMA}\left(1 + P_x^{MY}\right).$$

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:

$$(3) \qquad TMT = \sum_{x=1}^{6}\left(MA_x\right)*\left(SMY_x\right).$$

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:

$$(4) \qquad COY_x^G = Y_x^{RMA} * YE_x$$

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. 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:

$$(5) \quad SF_x = \frac{\left(COY_x^G\right) - \left(SCOY_x\right)}{COY_x^G}.$$

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:

$$(6) \quad MAXPL_x = Y_x^{RMA} * MLR^{Peanut} * MAXSCALE .$$

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

$$(7) \quad IND_x^{Acre} = MAX\left[0, \left(\left(MAXPL_x\right) * \left(SCALE_x\right) * \left(SF_x\right)\right)\right]$$

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:

$$(8) \quad IND_x^{Total} = IND_x^{Acre} * MA_x .$$

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

$$(9) \quad GAMT_x = MAXPL_x * SCALE_x * MA_x$$

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

$$(10) \quad PM_x^{Total} = GAMT_x * BASEPM_x$$

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:

(11) $PM_x^{Acre} = \dfrac{\left(PM_x^{Total}\right)}{\left(MA_x\right)}$.

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:

(12) $OR_p^{out-turn} = SP_p^{out-turn} * CONT_p * PO^{out-turn} * TMT$

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:

(13) $TR^{PeanutSales} = \displaystyle\sum_{p=1}^{3} \sum_{out-turn=1}^{6} OR_p^{out-turn}$.

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:

(14) $TR^{NGSC} = TR^{PeanutSales} + \displaystyle\sum_{x=1}^{6} IND_x^{Total}$.

Total costs TC^{NGSC}, of the NGSC are determined as variable cost, VC^{NGSC}, plus fixed cost, FC^{NGSC}. Profit for the NGSC is determined before distribution of dividends and taxes (EBDT) and determined as total revenue minus total costs:

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

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 Excel was used to run simulations based upon the input data from NASS, RMA, and the USDA Federal-State Market News. The simulation performed 5,000 draws on the model. *@Risk* 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.

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 *Best Fit* program was used and it performs a series of goodness-of-fit tests on the input data to rank alternative distributions. The normal distribution was used, along with a mean and standard deviation. 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:

(16) $\quad$ *RiskNormal(µ, σ, RiskTruncate(Minimum, Maximum),*

$\quad\quad$ *RiskCorrmat(RMA_County_Correlation_2,2))*

where:

$\quad\quad\quad$ *RiskNormal* = @Risk normal distribution function

μ = mean

σ = standard deviation

RiskTruncate = @Risk truncate the distribution function

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

Methods of Evaluation

The ROA will be one method of determining the how the risk management strategies affect the financial performance of the cooperative. The return on assets 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.

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. In this study, VaR is used to evaluate the NGSC ROA. Closely related to Markowitz's mean-variance analysis, the Sharpe ratio is another investment ranking criterion that can be used to analyze investments. Sharpe explains that the Sharpe ratio could be used for discerning choices among mutually exclusive investments when borrowing or lending is possible (1994). 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).

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. 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 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.

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

recruiting quality members, GRP insurance, and contracting shelled peanuts, the model shows

that risk reduction is possible for the NGSC.

Adequate throughput is required for efficient operation of the NGSC and to produce a 60,000 ton target. A 5,000 draw Monte Carlo simulation of county yields versus member yields present possible outcomes of how quality members can reduce the variance of coop throughput. A county yield simulation represents the average farmer, and after five thousand draws, total cooperative throughput is between 69.459 and 169.7106 million pounds in 90% of the samples. The member yield simulation reduced the variance by 1.65 million pounds and also the acreage needed to produce the throughput target from 37,547 acres to 34,193 acres. This also means less acreage to insure and thereby reducing financial costs.

Contracting is essentially 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. 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, and 3) 40,30,30. The contract ratio of 40,30,30 proved to be the best among the three ratios and contained the highest ROA (16.32%), highest Sharpe's Ratio (.8121), and lowest FDSDRA (.2102). This could be explained by the data that contracting more in the production period can result in a higher profit for the NGSC. The ratio of 30,30,40 had the lowest VaR at 5% meaning that the NGSC could have an ROA of -7.93%.

Contracting provides some form of revenue protection but does not manage throughput risk. GRP insurance can be a method to manage throughput risk, and in combination with contracts the NGSC can effectively manage some revenue and throughput risk. The three contract ratios mentioned previously are used with GRP insurance of 90% coverage and scale ranging from 0.9 to 1.5. Table 1 shows the results of the simulation. The use of GRP insurance and contracting caused the ROA to range from a high of 16.54% with 90% coverage, 1.0 scale,

40,30,30 contract ratio to a low of 15.29% with 90% coverage, 1.5 scale, 30,40,30 contract ratio. This could be caused by lower prices that are received for contracts made in the harvest periods than in the production period and the increased cost of the higher GRP scale. The VaR ranges from a -0.78% ROA to a -3.2% ROA when using both contracts and GRP insurance. The use of the GRP insurance helps reduce the negative affect on the ROA when the throughput is decreased. GRP insurance minimizes the left tail of the ROA distribution and this minimized the total loss figure and also reducing the VaR figure. The scenario of 90% coverage, 1.4 scale, and 40,30,30 proved to rank first on all the metrics used to evaluate the model, while using no insurance and a contract ratio of 30,40,30 ranked least favorable.

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. 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.

Conclusion

The peanut industry is very important to the Georgia, especially in South Georgia. 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. With these looming problems on the horizon, peanut farmers can help minimize the variability of profit by planning, developing, and enacting risk management strategies.

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 ROA. 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. 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.

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 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.

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

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cooperative'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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Table 1. Rankings

Strategy	ROA	*rank_ROA*	VaR 5%	*rank_VaR*	Sharpe's Ratio	*rank_Sharpe*	FDSDRA	*rank_FDSDRA*
No insurance / Contract 30,30,40	16.11%	13	-7.93%	22	0.8073	23	0.2137	23
No insurance / Contract 30,40,30	15.40%	22	-8.33%	24	0.7750	24	0.2210	24
No insurance / Contract 40,30,30	16.32%	6	-7.98%	23	0.8122	22	0.2102	22
GRP .90, scale 0.9 / Contract 30,30,40	16.16%	11	-2.72%	16	0.9604	17	0.1708	16
GRP .90, scale 0.9 / Contract 30,40,30	15.46%	19	-2.93%	19	0.9273	21	0.1840	21
GRP .90, scale 0.9 / Contract 40,30,30	16.39%	3	-2.68%	15	0.9669	14	0.1723	18
GRP .90, scale 1.0 / Contract 30,30,40	16.31%	7	-2.99%	20	0.9634	16	0.1701	15
GRP .90, scale 1.0 / Contract 30,40,30	15.62%	17	-3.20%	21	0.9314	20	0.1767	20
GRP .90, scale 1.0 / Contract 40,30,30	16.54%	**1**	-2.73%	18	0.9722	13	0.1650	14
GRP .90, scale 1.1 / Contract 30,30,40	16.08%	14	-2.39%	12	0.9787	11	0.1623	10
GRP .90, scale 1.1 / Contract 30,40,30	15.40%	21	-2.72%	17	0.9469	18	0.1738	19
GRP .90, scale 1.1 / Contract 40,30,30	16.32%	5	-2.42%	13	0.9875	9	0.1621	9
GRP .90, scale 1.2 / Contract 30,30,40	16.02%	15	-2.33%	11	0.9783	12	0.1647	12
GRP .90, scale 1.2 / Contract 30,40,30	15.31%	23	-2.51%	14	0.9454	19	0.1715	17
GRP .90, scale 1.2 / Contract 40,30,30	16.24%	8	-2.01%	10	0.9879	8	0.1586	7
GRP .90, scale 1.3 / Contract 30,30,40	16.12%	12	-1.49%	7	1.0004	6	0.1571	6
GRP .90, scale 1.3 / Contract 30,40,30	15.41%	20	-1.70%	9	0.9662	15	0.1649	13
GRP .90, scale 1.3 / Contract 40,30,30	16.34%	4	-1.55%	8	1.0081	5	0.1533	5
GRP .90, scale 1.4 / Contract 30,30,40	16.19%	10	-0.97%	3	1.0317	3	0.1481	2
GRP .90, scale 1.4 / Contract 30,40,30	15.50%	18	-1.17%	5	0.9990	7	0.1602	8
GRP .90, scale 1.4 / Contract 40,30,30	16.42%	2	-0.78%	**1**	1.0422	**1**	0.1460	**1**
GRP .90, scale 1.5 / Contract 30,30,40	15.97%	16	-1.14%	4	1.0198	4	0.1531	4
GRP .90, scale 1.5 / Contract 30,40,30	15.29%	24	-1.39%	6	0.9868	10	0.1628	11
GRP .90, scale 1.5 / Contract 40,30,30	16.22%	9	-0.92%	2	1.0322	2	0.1483	3