Economically Feasible Crop Production Alternatives to Peanuts in Southwestern Oklahoma

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Abstract: Changes in the U.S. peanut program have resulted in drastically decreased planted acres and forced many peanut producers in the Southwest to consider alternative crops. This study examined the economic risk associated with producing peanuts and common alternatives to peanuts. Seedless watermelon is an alternative for risk preferring farmers whereas, irrigated peanut is the best choice for risk averse farmers.

Key Words: Feasibility, Peanuts, Government Payments, simulation, risk efficiency

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Introduction

Peanuts are an important cash generating traditional crop in Oklahoma. Peanuts rank 7th in value among Oklahoma agricultural commodities and Oklahoma ranks 6th among peanut producing states with 4.63 percent of US peanut Production (Oklahoma Agricultural Statistics, 2003).

The Farm Security and Rural Investment Act of May 2002 (2002 Farm Bill) brought about historic changes in the US approach to regulating peanut markets. Before 2002, peanuts had been among a small group of US commodities regulated by marketing quotas. The quota system was established during the great depression to support and stabilize growers' incomes through supply limitation and price supports (Dohlman et al.).

Under the quota system, supply controls assured peanut quota holders of receiving high support prices. Those quota peanuts could be sold for the domestic food use market. Peanuts produced beyond the quota limits could be sold at a lower price to the crush market or could be exported. Non-quota peanuts were called "additionals". Producers who were quota owners had the right to rent their quotas. Under the 1996 Farm Bill, these quota peanuts were priced up to $610 per ton. Producers who did not have quota rights were assured only $132 per ton in 2001/2002 (Chvosta et al., 2003).

The 2002 Farm Bill terminated this supply limiting marketing quota system for peanuts. The new peanut policy implied that all peanut producers, whether quota holders or non-quota holders are eligible for the same kinds of government payments that are available for the mainstream commodity crops such as grains, cotton and oilseeds. The 2002 Farm Bill includes three provisions for peanut growers: direct fixed payments, counter cyclical payments and marketing assistance loans.

US peanut growers are a small but geographically concentrated group of farmers. Due to the crop's soil and climatic requirements, peanuts are produced only in 9 states. These states fall in one of three regions: The Southeast (Georgia, Alabama, Florida and South Carolina), the Southwest (Texas, Oklahoma and New Mexico) and Mid-Atlantic (Virginia and North Carolina).

The passage of the 2002 Farm Bill eliminated the support price policy and peanut prices are as low as half the support price prior to the 2002 Farm Bill. Due to the fall in price, these peanut growing areas experienced large declines in the acreage. According to the USDA, National Agricultural Statistical Service data base, after the 2002 Farm Bill, US peanut planted acreage declined 12 percent from 2001 to 1.36 million acres and was the smallest since 1982. The decline in planted acres in the year 2003, compared with year 2001, was steep in Virginia (55 percent), Oklahoma (54 percent) and Texas (35 percent).

Oklahoma peanut planted acres dramatically dropped in the 2003 planting season to the lowest level since 1928. The drop in planted acres caused reduced production and hence the value of production. Oklahoma peanut production decreased to 98 million pounds in 2003 from 198 million pounds in 2001, more than a 50 percent decrease in production. Similarly, the value of production decreased to 18.7 million dollars in 2003 from 54.2 million dollars in 2001, more than a 65 percent decrease.

Oklahoma peanut production is not as profitable as it was prior to the 2002 Farm Bill. The change forced many Oklahoma farmers to abandon peanut production and look for alternative crops. Many farmers have expressed an interest in switching to alternative enterprises. However, due to inadequate knowledge about the future consequences of the new alternatives, farmers are having difficulty in crop choice decisions. At this time it is very important to carefully examine the profitability of peanuts relative to alternatives. The overall objective of this research endeavor is to increase the ability of Southwestern Oklahoma peanut producers to make more informed decisions related to changes in the farm operations. The specific objective is to determine risk efficient crop alternatives to peanuts in Southwestern Oklahoma.

Historical Overview of U.S. Peanut Policy

Most of the U.S. commodity programs originated with the Agricultural Adjustment Act of 1933 (Dohlman et al.). The peanut program was in effect when peanuts were designated as a basic commodity in 1934. Under this Act, peanut producers were mandated payments in return for taking land out of production. In 1937, the Regional Grower's Association was formed. It purchased specified quantities of peanuts from registered participants at support prices set by the government. However, this program was unsuccessful because it could not sustain high prices and non-participant growers expanded acreage planted to peanuts (Rucker and Thurman).

Failure of this voluntary acreage reduction led to the establishment of a mandatory program in 1941. Individual acreage allotments were set and penalties were applied to those who would produce on additional lands. However, during World War II, these penalties were not applied. As a result the U.S. peanut acreage increased to 3.4 million acres during the 1943-48 period, up from 1.9 million acres in 1941 (Chvosta et al., 2003).

After World War II, the Agricultural Act of 1949 established support prices for peanuts between 75 to 90 percent of the then current levels. Payments of support prices were made only if acreage allotments and marketing quotas were approved by peanut growers. Periodical approval of such allotments and quotas were made and this program was in effect until 1978. During this period new peanut varieties were introduced and new production technologies were employed which led to increases in per-acre yield. The rate of growth of production was higher than the rate of growth of consumption. Thus, government purchases and the treasury costs of the peanut program increased substantially (Chvosta et al., 2001). Due to the large program costs in the 1970s, the peanut program was amended by the Food and Agricultural Act of 1977. According to this new program (1978-81), producers received the support prices only on quota peanuts and this time the quota was set annually in poundage terms to meet the market demand (Borges).

In 1982, the acreage allotment was abandoned. Under this new program anyone could grow peanuts but only those growers who had poundage quotas would receive the edible support price. During 1986-90 program periods, one of the most noticeable changes was in the distribution of profits from association pools. Previously separate quota pools and additional pools were merged and profits from additional pools were used to offset losses from quota pools (Rucker and Thurman).

The 1990 Farm Act legislated a minimum national poundage quota and support price escalator that raised the peanut loan rate based on estimated increases in production cost. The loan rate for quota peanuts was set at $ 678 per ton and the national minimum quota was set at 1.35 million tons. The peanut program came under substantial pressure after the approval of NAFTA and GATT. The peanut program was blamed for creating barriers to trade and unfairly protecting peanut producers from international competition. This pressure led to the Federal Agricultural Improvement and Reform Act of 1996 (Chvosta et al., 2003).

The 1996 FAIR Act made some important adjustment in the previous Act. Basic feature of the 1996 FAIR Act is planting flexibility. Support price was reduced by 10 percent to $610 per ton from $678 per ton. This was the first instance that the nominal price of peanuts was lowered in the history of the U.S. peanut program. The annual effective quota was reduced from 1.47 million tons for the 1995 crop year to 1.15 million tons for the 1996 crop year. The 2002 Farm Bill terminated the existing supply limiting marketing quota system and replaced it with marketing assistance loan program. All farmers are eligible for the loan rate for the current production regardless of whether or not they qualify as historic peanut producers under previous programs.

Policy Change and its Impact on Peanut Producers

Farm policy programs have changed substantially from their origins. The basic direction of change has been a shift from annual acreage supply controls, combined with price supports above market clearing levels, to less supply intervention and more direct income support (Pease et al.). Chvosta et al., 2003 have shown that in the aggregate U.S. farmers would lose $712 per farm per year under the 2002 Farm Bill if they continue to grow peanuts. They further estimated that Oklahoma quota peanut producers would lose $4,759 per farm per year which is the highest among other peanut producing states.

Pease et al. have reported that the 2002 Farm Bill has substantially decreased the annual net returns of the Virginia peanut producers. Their estimate shows that under the 2002 Farm Bill peanut enterprise would barely cover its variable cost of production. Smith and Bullen showed that there is net increase in farm income for Georgia and North Carolina farms under the 2002

Farm Bill compared with the FAIR Act of 1996. The Increase in the net return is due to government payments.

To summarize the existing literatures, there are mixed results. Therefore, it is very difficult to generalize the results over wider spatial extent. Which makes it necessary to focus on a particular area to infer the situation of that particular area. One important thing to notice is that, all of these analyses are based on the average estimates. Since crop production is a risky business we have to take into account the risk associated with it.

Methodology

Typical enterprise budgets for peanuts, cotton, soybeans and watermelons that are specific to Caddo County, Oklahoma are constructed to generate net returns. Two budgets are prepared for peanuts, cotton and soybeans; one for dry land and one for irrigated conditions. Two budgets are also prepared for watermelons; one for seedless watermelons and one for seeded watermelons. Both seeded and seedless watermelons are grown under irrigated conditions. This provides eight enterprise budgets as alternatives to determine the most profitable enterprise and to rank the associated risk of each alternative. Average farm acres in our model are fixed at 310 acres per farm because Caddo County has an average farm size of 310 acres according to the 2002 Census of Agriculture. The budgets assume no economies of size.

State level average annual producer price of cotton and soybeans for a period of 10 years (1995-2004) were obtained from the National Agriculture Statistics Service of the United States Department of Agriculture (NASS/USDA). However, the peanut price from 1995-2004 cannot be used because of the changes in the price support program mandated by the 2002 Farm Bill. Therefore, weekly national market price for peanuts from 2002 (September) to 2004 (December) was obtained from the Farm Service Agency (FSA) of USDA. These weekly prices were converted into average annual prices using simple averages. FSA reports different prices for four different types of peanuts. This study utilizes the price of the runners since more than 70 percent of the total peanuts produced in Caddo County are runners.

Seedless and seeded watermelon prices were obtained from the Dallas Terminal Market reported by USDA's Agricultural Marketing Service (AMS/USDA). These prices are wholesale prices. Producer received prices are extrapolated from Dallas terminal wholesale price data assuming transportation and packaging cost margins of 30 percent. However, the actual margin will vary by an unknown amount depending upon the supply and demand situation in the Dallas terminal market (Wathen et al.).

Irrigated and non-irrigated yield of peanuts and cotton for Caddo County were obtained from NASS/USDA. There is no separate yield of soybeans for irrigated and non-irrigated condition reported for Caddo County or even the state of Oklahoma. Therefore, the irrigated and non-irrigated yield of soybeans from Northern High Plain region of Texas is used assuming that this yield closely resembles Southwestern Oklahoma yields. The Northern High Plains region of Texas is geographically close to Southwestern Oklahoma.

Watermelon yield for both seeded and seedless variety is obtained from Wes Watkins Agricultural Research and Extension Center, Lane, Oklahoma. According to the information provided by the Lane Agriculture Center scientists, yield for both the seedless and seeded watermelon can be assumed to be the same when irrigated. But the producer received price for these two types of watermelons can be different.

Peanuts, cotton and soybeans are program crops and the farmers growing these crops will receive payments from the government. Payments are made based on the base acres established on the farm during the crop year 2002. Base acres cannot exceed the farm's cropland acreage. Once the farmers enroll in the payment program, they are eligible for the payment through the policy period (2002-2007) even though they did not grow that crop in a particular year. Farmers can still receive payments although they choose to grow different crop in the peanut base. However, the crop alternative should be a program crop or pasture. Watermelons are non program crops.

There are three types of payments implemented by the 2002 Farm Bill: the Direct Fixed Payments (DP), Counter Cyclical Payments (CCP) and Loan Deficiency Payment (LDP). There were no LDPs in 2003 and 2004 as the market price exceeded the loan rate. Therefore, we assume LDPs to be zero while preparing budgets. DP for peanut base is calculated as:

(1) $$DP = DPR * PY * BA * 0.85$$

where *DPR* is the direct payment rate that is constant ($36/ton) and established by the 2002 Farm Bill. *PY* is payment yield and *BA* is base acres. *PY* is determined by FSA. PY for Caddo County was set to be 3210 pounds per acre through the policy period (2002-2007). Base acre may vary greatly among different farmers. However, our budget model assumes it to be 310 acres. CCP is calculated as:

(2) $$CCP = \{TP - DPR - \max(\Pr, MLR)\} * PY * BA * 0.85$$

where *TP* is the target price established by the 2002 Farm Bill ($495/ton), *DPR* is the direct payment rate as in equation (1). Max (Pr, *MLR*) is either market prices (Pr) or the Marketing Assistance Loan Rate (MLR) whichever is higher. MLR is set to be $355 per ton by the 2002 Farm Bill. *PY* and *BA* are payment yield and base acres respectively as in equation (1). The number 0.85 in equation (1) and (2) indicate that only 85 percent of the base acres are eligible for the government payments.

Costs associated with producing peanuts, cotton, soybeans and watermelons were obtained from different several sources including Oklahoma State University fact sheets, OSU budgets software and the cucurbit manual published by Lane Agriculture Center. These costs are representative of average costs for farms in Caddo County. Larger and smaller farms may have lower or higher costs per acre. All of the machinery costs are based on custom hired machines (Doye et al.) and the irrigation estimates are based on central pivot sprinkler system.

Net returns are calculated for each crop alternative as:

$$NR_i = (P_i * Y_i) - (VC_i + FC_i) + DP_i + CCP_i \quad (3)$$

where:

NR_i is the net returns for i^{th} alternative.

P_i is the price of i^{th} commodity

Y_i is the yield of i^{th} commodity

VC_i is the variable cost of i^{th} commodity

FC_i is the fixed cost of i^{th} commodity

DP_i is the direct fixed payment for i^{th} commodity

CCP_i is the counter cyclical payment for i^{th} commodity

Stochastic simulation is defined as a tool for addressing "what if…" questions about a real economic system in a non-destructive manner (Richardson, 2005). Net return for each crop production alternative is considered as the key output variable. To simulate net returns one or more of the input variables of the model (exogenous variables) should be considered stochastic. Our study considers average annual crop yield, price received by farmers and the custom machinery rates as stochastic. We used a GRKS distribution to simulate these variables. Gray, Richardson, Klose and Schumann developed the GRKS distribution to simulate subjective probability distributions based on minimal input data. Parameters used for GRKS distributions are minimum, mean and maximum of the stochastic variables.

Enterprise budgets that include one or more stochastic variables are called stochastic budgets. Net returns estimated from these budgets are simulated for 200 iterations generating 200 possible net returns for each crop production alternative. Simulation was done using the SIMETAR© simulation package developed by Richardson, Schumann and Feldman in the Department of Agricultural Economics at Texas A&M University. These iterated net returns are used in stochastic efficiency analysis to rank the preferred production alternatives.

Risk efficient crop production alternatives were identified using Stochastic Efficiency with Respect to a Function (SERF) criteria for a range of risk attitudes. SERF analysis relies on the assumption that decision makers have an expected utility function, U(x), which is increasing and twice differentiable with respect to x. SERF uses a range of Risk Aversion Coefficients (RACs). SERF involves comparison of cumulative probability distributions of simulated net returns for each crop alternative.

SERF analysis is done assuming a negative exponential utility function for which Absolute Risk Aversion Coefficient (ARAC) range is set to be -0.1 and +0.1. SERF uses Certainty Equivalents (CE) to rank risky alternatives. Certainty equivalent value shows the amount of money that the decision maker would have to be paid to be indifferent between the particular scenario and a no risk investment. We also estimated confidence premiums for each alternative. Confidence premium indicates how much a decision maker has to be paid to switch from the preferred strategy.

RAC where the preference changes is called Break Even Risk Aversion Coefficient (McCarl 1988). The BRAC method was used to identify risk preference intervals reflecting unique preference rankings. BRAC for each pair of risky alternatives is identified. Richardson, Schumann and Feldmann suggest that BRACs are the same as the RACs where the CE line crosses in the SERF chart. Using McCarls BRAC procedure we can calculate the actual range of RACs where one alternative is preferred and the range over which another alternative is preferred.

Results and Discussion

Our analysis starts with the interpretation of the average net returns generated from the deterministic enterprise budgets. The mean analysis indicates that growing seedless watermelon is the most profitable alternative with the net returns of $ 893.87 per acre followed by seeded watermelon ($ 674.39 per acre) and irrigated peanuts ($ 288.98 per acre) respectively (Table 1). Despite the change in the commodity program policy by the 2002 Farm Bill, irrigated peanuts are still more profitable compared to other program crops like cotton and soybeans. Direct fixed payments and counter cyclical payments for peanut base were estimated to be $49.11 per acre and $133.24 per acre respectively.

Government payments have significant contribution to net farm income. For farmers growing irrigated peanuts, the government payment constitutes 63 percent of the net return. Highest percentage net return from government payment is for dry land cotton, 183 percent. DCP payments, average net returns and percent contribution of government payment to net return is shown in Table 1. Note that watermelons are not included in the government program crops and farmers will gain no government payments for growing watermelons.

Simulated net returns provide us the opportunity to conduct the risk efficiency analysis. Mean simulated net returns were found to be the highest for seedless watermelon ($ 1353.66 per acre) followed by seeded watermelons ($853.47 per acre) and irrigated peanuts ($ 276.34 per acre) respectively. However, the standard deviation for seedless watermelon was found to be the highest (1835.95) followed by seeded watermelon (899.96) and irrigated cotton (106.586) (Table 2).

Stochastic efficiency analysis utilizes simulated net returns distribution to rank crop production alternatives in terms of Absolute Risk Aversion Coefficient (ARAC). Preferences ranking of different crop alternatives under different ARAC are shown in Table 3. Each column in the table shows the range of upper and lower risk aversion coefficient within which the preference prevails. Seedless watermelon production is ranked first in the risk aversion coefficient as high as 0.000613. The ARAC can be interpreted as the percentage change in marginal utility per unit change in the net revenue. The change in the marginal utility can be positive, zero or negative based on the risk averse, risk neutral or risk preferring nature of the farmers respectively.

The seedless watermelon production dropped rapidly in the rankings as the ARAC increased, suggesting that a rough knowledge of risk preferences may be of significant importance in identifying preferred production alternatives. Seedless watermelon production can be worse case for the farmers having ARAC higher than 0.002280. Preference ranking based on generalized stochastic dominance indicate that irrigated peanuts can be stable alternative and is ranked high throughout the range of the ARAC.

Confidence Premium (CP) results are shown in Table 4-6 assuming ARAC of -0.01 for risk preferring farmer (Table 4), -0.0001 to 0.0001 for risk neutral farmer (Table 5) and 0.01 for risk averse farmer (Table 6). CP indicates the relative conviction that a farmer has to a particular alternative ranking.

The result shows that the risk preferring farmer will have to be paid $ 5390.13 per acre to accept seeded watermelon production (second best) over seedless watermelon (best alternative). Similarly, risk preferring farmer will have to be paid $8305.07 per acre to accept irrigated peanut production (third best) over seedless watermelon (best alternative). Risk neutral farmer has to be paid $ 640.92 per acre to accept seeded watermelon production and he has to be paid $1259.27 per acre to accept irrigated peanuts production over seedless watermelon.

However, irrigated peanuts production is the best alternative and seedless watermelon production is the worst for a risk averse farmer with ARAC of 0.01. He has to be paid $ 73.99 per acre to accept dry land soybean production (second best) over irrigated peanuts. However, the risk averse farmer has to be paid as high as $ 2349.27 per acre to accept seedless watermelon (worse) over irrigated peanut production. This finding shows the importance of risk analysis for making crop production choices for crops with highly variable net returns.

Pair wise comparison of simulated cumulative distribution functions (CDFs) of eight crop production alternatives are also provided in Table 7. There are two possible outcomes: either one alternative dominates the other or dominance can not be determined. If one crop alternative dominate the other through the entire range of given ARACs, then either alternative in the column dominates alternative in the row (CDR) or alternative in the row dominates alternative in the column (RDC). However, if the CDFs have an intersection then either column dominates row (BRAC with asterisk) or the row dominates column (BRAC without asterisk) above that intersection. BRAC is the ARAC at which risk preference changes between a pair of production choices. In other word, each BRAC is a reference point that separates the farmers by their risk attitudes.

Conclusion

This study examined the economic risks associated with producing peanuts and common alternatives to peanuts in Southwestern Oklahoma. A total of eight different enterprises were generated for analysis. Enterprise budgets were made stochastic to provide more information. Results indicate that seedless watermelon production is a highly probable alternative to irrigated peanuts if producers are willing to accept the risk associated with the perishable nature of the horticultural crops. The seedless watermelon production dropped rapidly in the rankings as the ARAC increased, suggesting that the rough knowledge of the risk attitude has significant importance in identifying preference ranking. Preference rankings indicated that the irrigated peanut production is a highly viable choice for risk averse farmers.

Government payments play a significant roll in the sustainability of the farms in Southwestern Okalahoma. Only irrigated peanuts and dry land soybeans were found to be profitable without including government payments. This study only considered eight alternatives. Further research can utilize several other alternatives to determine the profitability and risk associated with them. Another research focus could be to determine different management strategies such as use of different levels of inputs, time of planting, use of own machinery so that precise information can be generated and disseminated to the farmers.

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Table1: DCP Payments, Net Returns and Percent Contribution of Government Payment on Net Returns for Crop Alternatives in Caddo County using Baseline Costs and Prices

Commodity	DCP Payment[1] ($/Acre)	Mean Net Return ($/Acre)	Percent Net Return from Government Payment
Irrigated Peanuts	182.35	288.98	63.10
Dry land Peanuts	182.35	148.51	122.77
Irrigated Cotton	182.35	122.61	148.72
Dry land Cotton	182.35	99.52	183.23
Irrigated Soybeans	182.35	166.84	109.29
Dry land Soybeans	182.35	205.80	88.60
Seedless Watermelon	0.00	893.87	0.00
Seeded Watermelon	0.00	674.39	0.00

Note: watermelons are not program crops and are not eligible for government payment
[1]DCP Payments = Sum of Direct fixed payment and counter cyclical payments.

Table 2: Summary Statistics of Simulated Average Net Returns generated from Stochastic Budgets ($/Acre)

Commodity	Mean	Std. Dev.	Minimum	Maximum
Irrigated Peanuts	276.34	35.006	174.53	358.20
Dry Land Peanuts	133.24	84.920	-107.75	325.92
Irrigated Cotton	120.90	106.586	-130.77	404.47
Dry land Cotton	105.45	53.346	2.08	291.69
Irrigated Soybeans	168.99	37.319	85.83	279.10
Dry land Soybeans	200.93	31.723	120.74	296.26
Seedless Watermelon	1353.66	1835.954	-2602.86	9117.04
Seeded Watermelon	853.47	899.96	-868.47	3678.78

Table 3: Preference Rankings of Crop Production Alternatives in terms of Absolute Risk Aversion Coefficient

	Absolute Risk Aversion Coefficient											
Lower	-0.1000	-0.0704	-0.0428	-0.0320	-0.0154	-0.0152	-0.0094	-0.0051	0.000614	0.001105	0.001216	0.001265
Upper	-0.0705	-0.0429	-0.0320	-0.0154	-0.0153	-0.0094	-0.0052	0.000613	0.001104	0.001215	0.001264	0.001324
Ranking												
PNI	4	4	3	3	3	3	3	3	3	2	2	2
PND	5	5	5	6	6	7	7	6	6	6	6	6
CNI	3	3	4	4	5	5	6	7	7	7	7	7
CND	7	8	8	8	8	8	8	8	8	8	8	8
SBI	8	7	7	7	7	6	5	5	5	5	5	4
SBD	6	6	6	5	4	4	4	4	4	4	3	3
WMS	1	1	1	1	1	1	1	1	2	3	4	5
WMD	2	2	2	2	2	2	2	2	1	1	1	1

	Absolute Risk Aversion Coefficient										
Lower	0.0001324	0.001347	0.001361	0.002281	0.002770	0.002998	0.003343	0.003494	0.003502	0.003734	0.01042
Upper	0.001346	0.001360	0.002280	0.002769	0.002997	0.003342	0.003493	0.003501	0.003733	0.010410	0.10000
Ranking											
PNI	2	2	2	1	1	1	1	1	1	1	1
PND	5	5	5	5	5	5	4	4	4	4	5
CNI	7	6	6	6	6	6	6	5	5	6	6
CND	8	8	7	7	7	7	7	7	6	5	4
SBI	4	4	4	4	4	3	3	3	3	3	3
SBD	3	3	3	3	2	2	2	2	2	2	2
WMS	6	7	8	8	8	8	8	8	8	8	8
WMD	1	1	1	2	3	4	5	6	7	7	7

Where, PNI = Irrigated Peanuts, PND = Dry land Peanuts, CNI = Irrigated Cotton, CND= Dry land Cotton,
SBI = Irrigated Soybeans, SBD = Dry Land Soybeans, WMS = Seedless Watermelon, WMD = Seeded Watermelon.

Table 4: Confidence Premium ($/Acre) for Risk Preferring Farmer with -0.01 ARAC

	WMS	WMD	PNI	SBD	CNI	SBI	PND
WMS	-						
WMD	5390.13	-					
PNI	8305.07	2914.94	-				
SBD	8381.23	2991.10	76.16	-			
CNI	8407.94	3017.80	102.86	26.71	-		
SBI	8410.91	3020.78	105.84	29.68	2.97	-	
PND	8421.36	3031.23	116.29	40.13	13.43	10.45	-
CND	8465.15	3075.02	160.08	83.92	57.21	54.24	43.79

Note: Crops in the column are dominant over crops in the row.

Table 5: Confidence Premium ($/Acre) for Risk Neutral Farmer with -0.0001 to 0.0001 ARAC

	WMS	WMD	PNI	SBD	SBI	PND	CNI
WMS	-						
WMD	640.92	-					
PNI	1259.27	618.35	-				
SBD	1334.69	693.77	75.42	-			
SBI	1336.61	725.69	107.34	31.92	-		
PND	1402.08	761.16	142.81	67.39	35.47	-	
CNI	1412.21	773.29	154.94	79.52	47.60	12.13	-
CND	1430.09	789.17	170.82	95.39	63.47	28.01	15.87

Note: Crops in the column are dominant over crops in the row.

Table 6: Confidence Premium ($/Acre) for Risk Averse Farmer with 0.01 ARAC

	PNI	**SBD**	**SBI**	**PND**	**CND**	**CNI**	**WMD**
PNI	-						
SBD	73.99	-					
SBI	107.54	33.55	-				
PND	175.35	101.36	67.81	-			
CND	176.80	102.81	69.26	1.45	-		
CNI	200.35	126.36	92.81	25.00	23.55	-	
WMD	647.11	573.12	539.56	471.75	470.31	446.76	-
WMS	2349.03	2275.04	2241.49	2173.68	2172.23	2148.68	1701.93

Note: Crops in the column are dominant over crops in the row.

Table 7: Break Even Risk Aversion Coefficient from Pair-wise Comparison of Crop Production Choices

	PNI	**PND**	**CNI**	**CND**	**SBI**	**SBD**	**WMS**
PNI							
PND	CDR						
CNI	-0.0428	-0.0051					
CND	CDR	0.01042*	0.003734*				
SBI	CDR	-0.0152*	-0.0094*	-0.0704*			
SBD	CDR	-0.0320*	-0.0154*	RDC	RDC		
WMS	0.001105	0.001324	0.001347	0.00136	0.00127	0.001216	
WMD	0.002281	0.003343	0.003494	0.00350	0.00299	0.002770	0.00061*

CDR = alternative in the column dominates alternative in the row
RDC = alternative in the row dominates alternative in the column
* indicates that row alternative dominates column alternative above this BRAC
BRAC without * indicate that column alternative dominate row alternative above this BRAC