ANALYSIS OF ALTERNATIVE PRODUCTION AND MARKETING STRATEGIES IN SOUTHWESTERN OKLAHOMA: A MOTAD APPROACH

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The importance of risk in production agriculture has received considerable attention in recent years and is well documented. Fluctuations in yields, prices and net returns are recognized by farm operators as facts of life and hazzards of the trade. Farm operators need not, and in fact do not, accept these fluctuations passively. Risk management, risk shifting, and risk reduction are topics of greater interest to farmers than risk bearing or risk acceptance.

The alternatives available for risk management by agricultural producers are different in different parts of the country and for different commodities. Principal crop and livestock activities in Southwestern Oklahoma are wheat, grain sorghum, cotton, and wheat pasture stocker cattle. Most crops are produced under dryland conditions, however, substantial acreages of cotton and grain sorghum are produced under irrigation. In addition, alfalfa, barley and oats are viable crop alternatives. Additional livestock alternatives include steers and heifers on grazeout wheat and summer stockers on native pasture.

Given the set of viable crop and livestock enterprise possibilities, a number of risk management alternatives are available to farm operators in the area. A sufficient number of production alternatives exist to permit diversification into several crop activities. A large number of combinations of acreages and enterprises are possible. In addition to the production alternatives, numerous marketing strategies are available. Stocker cattle, either steers or heifers, may be purchased in the fall to graze the winter wheat pasture until March, in which case a wheat crop is harvested in June, or the cattle may be retained for wheat grazeout. When the cattle are removed from the wheat pature, producers have the option of selling the cattle or retaining ownership until the cattle are ready for slaughter. Hedging opportunities also exist for the stocker cattle. Other risk management opportunities considered by many producers in the area include the purchase of crop insurance for wheat or participation in government farm programs which qualifies the farmer for deficiency and disaster payments. Opportunities to crop-share rather than cash rent cropland permit a sharing of the risk between tenant and landlord. Although the above strategies do not represent a complete enumeration of risk management possibilities in the area, they do represent a number of the alternatives considered by the producers.

The purpose of this study was to evaluate a number of the more important production, marketing, and risk management strategies available to farm operators in Southwestern Oklahoma. Specifically, the objectives were (1) to construct a model which would determine risk management alternatives available to producers in the area and (2) to evaluate the potential tradeoffs between expected income and variability of income under alternate assumptions regarding risk management strategies available to producers.

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MODEL DEVELOPMENT

In this analysis, an adaptation of Hazell's MOTAD (Minimization of Total Absolute Deviations) model was utilized. The MOTAD model may be solved by a linear programming algorithm and offers computational and cost advantages over quadratic programming. The objective of the MOTAD model was to minimize the summed total negative deviations over all years, subject to a set of linear resource constraints and to a constraint on expected gross margins. The model may be formulated as follows:

(1) Minimize Ld^-

(2) Subject to: $AX \leq B$

(3) $DX + Id^- \geq 0,$

(4) $C'X = \lambda,$

and

(5) $X, d^-, \lambda \geq 0$

where X represents an enterprise decision vector, A is a matrix of input parameters, B is a vector of resource availabilities, and C is a row vector of expected gross margins. D is a deviation matrix representing the difference between actual gross margins and expected gross margins in a particular year. The vector d^- represents the total negative deviations summed over all risky enterprises. The elements of d^- are summed over t years and multiplied by L, a row vector of ones, to give a measure of summed total negative deviations over t years. I is an identity matrix of the number of years in the study period. The scalar, λ, is used to parameterize the expected income constraint level. Figure 1 depicts the initial tableau of the model.

By parameterizing the income constraint, one can determine a set of risk efficient farm plans that trace out an efficiency frontier between expected gross margins and total negative deviations. There is no direct correspondence between this frontier and the expected value-variance (E-V) efficiency frontier obtained using quadratic programming. However, Ld^- can be converted into an estimate of standard deviation by multiplication by the constant K, which is calculated, based on the work of Hazell, Hazell and Scandizzo, Simmons and Pomareda, and Brink and McCarl as:

(6) $$K = \frac{2}{t} \sqrt{\frac{t \cdot \Pi}{2(t-1)}}$$

Where t = number of years in the series
Π is a mathematical constant and equals 3.14286

(7) Mean Absolute Deviation = $MAD = \frac{2}{t} \cdot Ld^-$

(8) Standard Deviation = $\sqrt{\frac{t \cdot \Pi}{2(t-1)}} \cdot MAD$

RESOURCES OR RESTRICTIONS	DECISION VARIABLES X_1	X_2	X_3	. . . . .	X_m	d_1^-	d_2^-	d_3^-	. . . . .	d_t^-	CONSTRAINTS
OBJECTIVE (TND)						1	1	1	. . . . .	1	MINIMIZE
RESOURCE 1	a_{11}	a_{12}	a_{13}	. . . . .	a_{1n}						$\leq B_1$
RESOURCE 2	a_{21}	a_{22}	a_{23}	. . . . .	a_{2n}						$\leq B_2$
RESOURCE 3	a_{31}	a_{32}	a_{33}	. . . . .	a_{3n}						$\leq B_3$
"	.	.	.	. . . . .	.						.
"	.	.	.	. . . . .	.						.
"	.	.	.	. . . . .	.						.
RESOURCE m	a_{m1}	a_{m2}	a_{m3}		a_{mn}						$\leq B_m$
YEAR 1	D_{11}	D_{12}	D_{13}		D_{1n}	1					≥ 0
YEAR 2	D_{21}	D_{22}	D_{23}		D_{2n}		1				≥ 0
YEAR 3	D_{31}	D_{32}	D_{33}		D_{3n}			1			≥ 0
"	.	.	.	. . . . .	.				.		.
"	.	.	.	. . . . .	.				.		.
"	.	.	.	. . . . .	.				.		.
YEAR t	D_{t1}	D_{t2}	D_{t3}	. . . . .	D_{tn}				.		≥ 0
INCOME	C_1	C_2	C_3	. . . . .	C_n					1	$= \lambda$

Figure 1. Initial Tableau for the MOTAD Model

Thus, the model can determine expected value-mean absolute deviation (E-A) farm plans as in MOTAD, or E-V plans as in Hazell and Scandizzo. Depending on the farm operator's preference for risk, he can select from the set of farm plans the one that will maximize his utility function.

RESOURCE SITUATIONS AND DATA REQUIREMENTS

Both dryland and irrigated farm situations were analyzed, but only the dryland farm operation is discussed in this paper. The dryland farm consisted of 1,200 acres of cropland and 300 acres of unimproved native pasture. A machinery and equipment complement was defined for the farm situation and cost and returns budgets were developed for each crop and livestock activity included in the model. Labor availability was estimated by period of the year (475 hours during January-March, 700 hours during April-June, 750 hours during July-September, and 575 hours during October-December). Hired labor and operating capital were assumed available at market wage and interest rates.

In addition to data on the resource situation and technical constraints, the model requires historical data on yields, prices and production costs for each crop and livestock enterprise. Crop yield data were obtained from published results of agronomy field plot experiments on crop varieties in southwestern Oklahoma. Annual yields for individual crops were computed on the basis of the average of the highest top-third yielding varieties that were tested each year. Experimental data were used in establishing annual yields because the resulting yield series were felt by extension personnel in the area to approximate the variability experienced by individual farmers. Aggregate yields for counties or the state were not used because they have been found to underestimate yield variability at the farm level (Freund; Eisgruber and Schuman).

Reliable yield data did not exist prior to 1954. Yields were available for different numbers of years for different crops. This study used yield series for the period 1965-1977, the longest period for which yield data were available for all crops (Table 1). The yield series were tested for trend using a simple linear regression equation. The fitted equation was used to adjust the alfalfa yield series, the only crop exhibiting trend values significant at the 5 percent level.

Crop and livestock prices used were current mid-month prices prevailing in Oklahoma and approximate those received by southwestern Oklahoma farmers. These prices were adjusted to the 1967 price level using the Index of Prices Paid by Farmers. Simple linear regression equations were used to test the adjusted price series for trend. Neither crop nor livestock prices had trend values significant at the 5 percent level.

Cost of production data for the different crop and livestock enterprises were not available for the entire 1965-1977 period. The 1977 crop and livestock budgets for southwestern Oklahoma were used to extrapolate variable costs of production for individual enterprises back to 1965 using the Index of Prices Paid by Farmers.

Estimated annual gross margins for each crop were calculated by multiplying actual annual yield per acre times the adjusted Oklahoma mid-month market price per unit and subtracting variable costs of production. This annual gross margin represents a return to land, labor, capital, overhead, risk and management. The resulting estimated gross margin series,

TABLE 1. Crop Yield Data Adjusted for Linear Trend, 1965-1977

Year	Crop Activities					
	Alfalfa	Barley	Oats	Wheat	Cotton Lint	Grain Sorghum
	(tons/ac.)	(bu./ac.)	(bu./ac.)	(bu./ac.)	(lbs./ac.)	(cwt./ac.)
1965	3.03	0.0	36.8	25.4	253.9	19.2
1966	4.64	58.8	77.8	38.7	0.0	20.4
1967	2.41	51.8	65.5	26.9	367.0	22.1
1968	2.93	0.0	0.0	0.0	135.0	24.6
1969	2.63	76.5	96.8	42.8	532.6	23.3
1970	4.51	59.8	52.0	28.9	316.3	19.8
1971	3.89	0.0	0.0	0.0	370.7	18.1
1972	3.01	8.0	18.6	2.3	142.0	22.4
1973	3.74	11.0	31.0	23.9	0.0	30.1
1974	3.29	50.9	61.8	43.2	202.0	21.1
1975	2.99	44.5	58.4	32.5	193.7	27.7
1976	3.31	49.7	99.8	37.9	215.5	18.2
1977	3.47	47.7	94.0	47.0	455.2	21.4
Mean	3.37	35.28	53.27	28.29	261.70	20.47
	0.64	26.14	33.07	14.97	152.01	6.19
Coeff. of Var.	0.19	0.74	0.62	0.53	0.58	0.30

which were expressed in 1967 dollars, were then inflated using the Index of Prices Paid by Farmers for Family Living Items to reflect 1977 dollars.

Data were not available to establish yield variability for the livestock activities. Buying and selling weights were assumed constant throughout the analysis. The gross margins series for the livestock enterprises were estimated in the same manner as for the crops.

Expected gross margins were calculated in several ways in the analysis. Initially, expected gross margins were calculated as the mean of the series of gross margins. Deviations were measured from the mean of the series. In subsequent analyses, expected gross margins were calculated as a three-year moving average of gross margins. Equally weighted and unequally weighted (.5, .3, and .2, respectively for the three previous years) moving averages were utilized. Deviations were measured as the difference between the actual and the average of the three previous years. Most of the weighted average analysis is reported elsewhere (Persaud and Mapp; Persaud).

ANALYSIS AND RESULTS

A number of risk management strategies were evaluated. The initial strategy consisted of evaluating the production and marketing alternatives available to the producer assuming that all crops were sold at harvest. That is, wheat was assumed sold in June and the mid-month wheat price for June was used in calculating gross receipts for the wheat activity. Barley and oats were assumed sold in June, grain sorghum in October and cotton in November. The second strategy evaluated assumed that the farmer could store his wheat and market it during any month of the crop year. The other crops were still assumed sold at harvest. The third strategy evaluated added the possibility of forward contracting a portion of the wheat production in March for delivery in June. The remainder of the wheat could be sold at harvest or marketed sequentially during the crop year. The fourth strategy evaluated added the possibilities of purchasing crop insurance for wheat and participating in the government farm program for wheat. The 1978 Wheat Farm Program was used in analyzing this alternative. The fifth alternative evaluated combined sequential marketing, forward contracting, wheat farm programs, and hail insurance as marketing and risk management alternatives. In addition, similar strategies were evaluated for an irrigated farm situation and under the assumption that variation is measured as deviations from a three-year weighted moving average.

ALTERNATIVE 1: SALE AT HARVEST

Initially, the farm plan was determined which maximized expected gross margins, subject to the set of resource constraints, using linear programming. The maximum expected gross margin determined in the linear programming solution was then specified as the gross margin constraint in the MOTAD model. The organization of production determined by MOTAD for this gross margin level was identical to the linear programming solution. The maximum expected gross margin for the sale at harvest alternative was $62,386 (Table 2), standard deviation was $38,319 and the coefficient of variation was 61.42 percent. The organization of production is specialized, consisting of 1,196 acres of grain sorghum, 4 acres of alfalfa, and summer stockers on the 300 acres of native pasture.

Table 2. Summary of Risk Efficient Farm Plans for the Sale at Harvest Alternative

		Expected Gross Margins			
Enterprise	Unit	$39,000	$54,000	$60,000	$62,386.02[a]
May Steers	head	116.27	18.36	-	-
Summer Steers	head	120.00	115.43	83.19	83.19
Native Pasture	acre	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.07	58.74	-	-
Alfalfa	acre	9.64	8.64	3.76	3.76
Cotton	acre	247.90	321.19	137.92	-
Grain Sorghum	acre	563.02	811.43	1,058.32	1,196.24
Idle Cropland	acre	7.37	-	-	-
Total Negative Deviations	$	69,272	103,898	153,469	190,895
Standard Deviation	$	13,905	20,856	30,806	38,319
Coefficient of Variation	%	35.65	38.62	51.34	61.42

[a]This is the farm plan maximizing gross margins.

The expected gross margin - total negative deviation frontier was traced out by parametrically varying the expected gross margin constraint from $60,000 to $15,000 in $3,000 decrements. Only a portion of the frontier is presented in Table 2. The risk efficient farm plan for $60,000 gross margins illustrates the potential for reducing gross margin variability through diversification. By reducing the acreage of grain sorghum and adding cotton, expected gross margins were reduced by $2,386 and standard deviation by about $7,500. The coefficient of variation declined from 61 to 51 percent. At the $54,000 gross margin level, grazeout wheat and stocker steers entered the solution and the coefficient of variation was further reduced to 38.6 percent. Between $54,000 and $39,000 in gross margins, the pattern of production changed little and relative variability declined only slightly.

ALTERNATIVE 2: SEQUENTIAL MARKETING

When wheat is harvested, the producer may sell immediately or place the wheat in storage for sale at a later time. If he stores wheat for later sale, he must realize a price increase sufficient to recover the cost of storage, shrinkage, damage, etc. In this analysis, the wheat was assumed stored at a local elevator rather than on the farm. Gross margins were adjusted to reflect storage costs, but no shrinkage or damage were assumed.

The risk efficient farm plans are summarized in Table 3. Adding sequential marketing permitted the producer to move to a higher efficiency frontier. The gross margin maximizing solution had expected returns of $69,361. The organization of production was specialized, consisting of 1,190 acres of wheat to be stored and sold in December and 366 wheat pasture stocker steers. The alfalfa, native pasture and summer stockers appear in all solutions. The coefficient of variation was 104 percent, considerably higher than under the sale at harvest alternative.

Three MOTAD solutions are presented for purposes of comparison. At the $63,000 gross margin level, the risk efficient farm plan became considerably more diversified. Wheat production declined to 375 acres and was stored for sale in September. Over 700 acres of grain sorghum entered the solution along with 111 acres of cotton. The standard deviation of gross margins was reduced from $72,000 to $36,000 while expected gross margins declined by only about $6,400. Thus, the coefficient of variation declined dramatically to 58 percent. At $54,000 gross margins level, the wheat selling activities dropped out of the solution and all wheat was grazed out by the May steers. At the $39,000 gross margin level, about 7 acres of cropland were left idle. The coefficient of variation was below 36 percent.

ALTERNATIVE 3: SEQUENTIAL MARKETING AND FORWARD CONTRACTING

In this alternative, the farm operator was assumed to consider forward contracting wheat production of up to 320 acres (about 10,000 bushels in an average year) with the local elevator operator. Forward contracting was included rather than hedging wheat in the future's market because the number of southwestern Oklahoma farm operators who forward contract far exceeds the number who utilize the future's market.

Table 3. Summary of Risk Efficient Farm Plans for the Sequential Marketing Alternative

		Expected Gross Margins			
Enterprise	Unit	$39,000	$54,000	$63,000	$69,361.34[a]
March Steers	head	-	-	124.94	365.55
May Steers	head	116.27	18.36	-	-
Summer Steers	head	120.00	115.43	82.14	79.86
Native Pasture	acre	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.06	58.74	-	-
Alfalfa	acre	9.64	8.64	5.84	10.35
Cotton	acre	247.90	321.19	111.08	-
Grain Sorghum	acre	563.02	811.43	708.26	-
September Wheat	acre	-	-	374.82	-
December Wheat	acre	-	-	-	1,189.65
Idle Cropland	acre	7.38	-	-	-
Total Negative Deviations	$	69,272	103,898	182,089	359,924
Standard Deviation	$	13,905	20,856	36,551	72,248
Coefficient of Variation	%	35.65	38.62	58.02	104.16

[a]This is the farm plan maximizing gross margins.

A summary of the sequential marketing and forward contracting solutions is presented in Table 4. The farm plan maximizing gross margins was the same as for the sequential marketing alternative. Thus, forward contracting did not offer an opportunity for increasing gross margins above that available under sequential marketing. Forward contracting did enter the MOTAD solution at the $66,000 gross margin level. The risk efficient farm plan included forward contracting the production from 179 acres of wheat, producing 435 acres of wheat to be stored for sale in December and about 5 acres of wheat to be sold in September. In the MOTAD solution, grain sorghum replaced about half of the wheat which appeared in the linear programming solution. The coefficient of variation was reduced from 104 to 72 to 39 percent as expected gross margins declined from $69,000 to $66,000 to $54,000. However, the introduction of forward contracting resulted in very little additional reduction in relative variability. The coefficient of variation at the $66,000 gross margin level declined from 72.76 for the sequential marketing alternative to 71.94 percent when both sequential marketing and forward contracting enter the solution.

ALTERNATIVE 4: HAIL INSURANCE AND WHEAT FARM PROGRAMS

One of the risk management options available to farm operators in the area is to purchase crop insurance. Purchase of hail insurance for wheat is practiced by a number of area farmers. Premiums for the insurance, which is provided by Production Credit Associations and insurance companies, depend on the amount of coverage and the probability of hail damage in the area surrounding the particular farm operation. Based on information provided by insurance companies in the area, a wheat farmer in the Altus, Oklahoma, area (about the center of the study area) is likely to suffer a loss of 20 to 30 percent of his crop in three to four years out of ten. The 1978 insurance rates were used to calculate premiums for the study period. The amount of coverage assumed was $40 per acre of wheat, and the premium was $11 per acre. These figures were extrapolated backwards using the Index of Prices Paid by Farmers to obtain coverages and premiums for the 1965-77 perod. Indemnities were calculated on the basis of 20 percent damage due to hail.

Participation in government farm programs represents an additional risk management option available to the producer. Participation in the 1978 Wheat Program was analyzed. Farmers participating in the program were required to set aside 20 percent of the harvested wheat acres to be eligible for deficiency and disaster payments. Cross compliance provisions of government program legislation were ignored in this preliminary analysis.

Deficiency payments were based on the difference between the established target price and the higher of the five month weighted U.S. average price received by all farmers, or the national loan rate. The established target price and national loan rate for the 1978 wheat crop were $3.40 and $2.25 per bushel for average quality wheat, respectively. If the U.S. weighted average market price received by farmers, as determined by the Secretary of Agriculture, was below the target price during the first five months of the marketing year (June through October), deficiency payments were made to eligible producers.

Table 4. Summary of Risk Efficient Farm Plans for the Sequential Marketing and Forward Contracting Alternative

Enterprise	Unit	Expected Gross Margins $39,000	$54,000	$66,000	$69,361.34[a]
March Steers	head	-	-	206.34	369.55
May Steers	head	116.27	18.36	-	-
Summer Steers	head	120.00	115.43	81.46	79.86
Native Pasture	acre	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.06	58.74	-	-
Alfalfa	acre	9.64	8.64	7.19	10.35
Cotton	acre	247.90	321.19	-	-
Grain Sorghum	acre	563.02	811.43	573.51	-
September Wheat	acre	-	-	5.42	-
December Wheat	acre	-	-	434.78	1,189.65
Contracted Wheat	acre	-	-	179.10	-
Idle Cropland	acre	7.38	-		-
Total Negative Deviations	$	69,272	103,898	236,521	359,924
Standard Deviation	$	13,905	20,856	47,477	72,248
Coefficient of Variation	%	35.65	38.62	71.94	104.16

[a]This is the farm plan maximizing gross margins.

Disaster payments were made to wheat producers who were prevented from planting wheat due to drought, flood, or other natural disaster or condition exogenous to the farmer. Payments were calculated by multiplying 75 percent of the established yield times one-third of the established price. Low yield payments were made if the farmer's yield was below 60 percent of the established yield. The payment rate for low yield was 50 percent of the target price, or $1.70 per bushel (U.S. Department of Agriculture).

To simplify the comparisons, the crop insurance and government program alternatives were considered with the sale at harvest crop activities. That is, the farm operator had the option of producing all crops for sale at harvest and, for wheat, could purchase crop insurance or participate in the wheat program. The results of the analysis are summarized in Table 5. The gross margin maximizing solution was the same as that obtained for the sale at harvest alternative. Thus, neither crop insurance nor wheat program participation increased expected gross margins. In addition, crop insurance failed to stabilize gross margins as much as wheat program participation and did not appear in the MOTAD solutions.

When the gross margin constraint was lowered to $60,000, the risk efficient farm plan included participation in the wheat program and production of 261 acres of wheat. The set aside requirement was calculated at 20 percent of the 261 acres of wheat in the solution. The addition of government program wheat, cotton, and stocker cattle to the solution reduced the coefficient of variation from 61.4 percent to 47.1 percent. Government program wheat remained in the MOTAD solutions until the gross margin constraint was reduced to $39,000.

ALTERNATIVE 5: SEQUENTIAL MARKETING, FORWARD CONTRACTING, WHEAT FARM PROGRAMS, AND HAIL INSURANCE

This alternative is a combination of the above alternatives. The farm plans determined under this alternative are presented in Table 6. The farm plan maximizing gross margins was identical to that derived under sequential marketing, and sequential marketing and forward contracting. The farm plan at the $66,000 gross margin level was identical to that obtained under sequential marketing and forward contracting. However, the risk efficient farm plan at the $63,000 gross margin level consisted of producing 83 acres of wheat to be stored for sale in December, 183 acres of contracted wheat, and about 102 acres of Farm Program wheat. At the $63,000 gross margin level, the standard deviation was reduced from $72,248 to $35,923 and the coefficient of variation was reduced from 104 to 57 percent. Adding the Wheat Farm Program and crop insurance options to the sequential marketing and forward contracting alternatives adds very little additional stability to the level of gross margins expected.

ADDITIONAL ANALYSIS

The above production, marketing, and risk management alternatives were evaluated for an irrigated farm operation. Irrigated cotton and grain sorghum had higher and more stable returns. Thus, irrigation represented an opportunity to both increase and stabilize expected gross margins. The results are discussed in detail by Persaud.

Table 5. Summary of Risk Efficient Farm Plans for the Wheat Farm Program and Wheat Hail Insurance Alternatives

		Expected Gross Margins			
Enterprise	Unit	$39,000	$54,000	$60,000	$62,386.02[a]
March Heifers	head	-	5.22	-	-
March Steers	head	-	17.00	86.90	-
May Steers	head	116.27	20.39	-	-
Summer Steers	head	120.00	118.78	82.46	83.19
Native Pasture	acre	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.06	65.25	-	-
Alfalfa	acre	9.64	9.76	5.21	3.76
Cotton	acre	247.90	290.86	95.95	-
Grain Sorghum	acre	563.02	756.33	785.99	1,196.24
Farm Program Wheat	acre	-	64.83	260.71	-
Set Aside	acre	-	12.97	52.14	-
Idle Cropland	acre	7.38	-	-	-
Total Negative Deviations	$	69,272	102,437	140,799	190,895
Standard Deviation	$	13,905	20,562	28,263	38,319
Coefficient of Variation	%	35.65	38.08	47.10	61.42

[a]This is the farm plan maximizing gross margins.

Table 6. Summary of Risk Efficient Farm Plans for the Sequential Marketing, Forward Contracting, Wheat Farm Programs, and Wheat Hail Insurance Alternative

		Expected Gross Margins					
Enterprise	Unit	$39,000	$54,000	$60,000	$63,000	$66,000	$69,361.34[a]
March Heifers	head	--	5.22	--	--	--	--
March Steers	head	--	17.00	86.90	122.31	206.43	396.55
May Steers	head	116.27	20.39	--	--	--	--
Summer Steers	head	120.00	118.78	82.46	82.16	81.46	79.86
Native Pasture	acre	300.00	300.00	300.00	300.00	300.00	300.00
Grazeout Wheat	acre	372.06	65.25	--	--	--	--
Alfalfa	acre	9.64	9.76	5.21	5.79	7.19	10.35
Cotton	acre	247.90	290.86	95.95	25.19	--	--
Grain Sorghum	acre	563.02	756.33	785.99	781.74	573.51	1,189.65
September Wheat	acre	--	--	--	--	5.42	--
December Wheat	acre	--	--	--	82.60	434.78	--
Contracted Wheat	acre	--	--	--	182.56	179.10	--
Farm Program Wheat	acre	--	64.83	260.71	101.77	--	--
Setaside	acre	--	12.97	52.14	20.35	--	--
Idle Cropland	acre	7.38	--	--	--	--	--
Total Negative Deviations	$	69,272	102,437	140,799	178,960	236,521	359,924
Standard Deviation	$	13,905	20,562	28,263	35,923	47,477	72,248
Coefficient of Variation	%	35.65	38.08	47.11	57.02	71.93	104.16

[a]This is the farm plan maximizing gross margins.

A number of alternatives were also evaluated using the weighted average procedure to determine expected gross margins and gross margin deviations. Risk efficient farm plans were quite different when the moving average approach was utilized. For example, under the sale at harvest alternative, wheat was the major crop in the gross margins maximizing solution (grain sorghum dominated the solution when variability was measured in terms of deviations from the mean of the series). As the expected gross margin was lowered, oats and grain sorghum entered the solutions (rather than wheat and cotton). For the sequential marketing and forward contracting alternative, the gross margins maximizing solution obtained using the weighted average procedure contained 873 acres of wheat stored for July sale, 320 acres of wheat forward contracted in March for June delivery, and wheat pasture stocker steers. The solution obtained using the conventional MOTAD approach contained 1,190 acres of wheat to be sold in December, 10 acres of alfalfa and March stocker steers. These results are discussed in more detail elsewhere (Persaud and Mapp). Research in this area is continuing (Persaud).

Summary and Conclusions

In this analysis, risk efficient farm plans have been determined for alternative production, marketing and risk management situations for farm operations in southwestern Oklahoma using a MOTAD approach. Results reveal the potential for increasing gross margins by storing wheat and marketing it sequentially during the crop year. Diversification, forward contracting and Wheat Farm Program participation were found to reduce gross margin variability for a given level of income. Crop insurance for wheat hail damage neither increased gross margins nor reduced variability when compared with government program participation.

Risk efficient farm plans were quite different when expected gross margins were defined as a moving average of the most recent three years and variability was measured in terms of deviations from the moving average. Research is continuing in this area.

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