A Cash Marketing Strategy For Slaughter Cattle

With the Aid Of Technical Analysis

A CASH MARKETING STRATEGY FOR SLAUGHTER CATTLE WITH THE AID OF TECHNICAL ANALYSIS

by

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Violent fluctuations in cattle prices have caused a drastic increase in the risk faced by cattlemen in the U.S. during the past decade. During a five-month period in 1979, the Omaha weekly average cash price for 900-1100 pound Choice steers dropped from $77 per hundredweight on April 21 to $58.28 per hundredweight by September 22. The total change in price was $29.26 per hundredweight or roughly $500 per head and, since 1972, there have been sixteen occasions when the weekly average price has changed at least $10 per hundredweight within a six-month period.

Sharp fluctuations in price cause producers to face significant market risks. While the assumption of risks can result in higher levels of profits, poor management of the risks may court financial ruin. Producers have had available to them several methods of managing their market risks. Some have elected to diversify their operations so as to spread the risks. Some have turned to the futures markets to hedge their production. Others have shunned these alternatives in favor of cash forward contracts. For yet another group, none of the foregoing represents a viable alternative. Capital restrictions may preclude the use of adequate diversification; the magnitude and type of production as well as lack of understanding of the futures markets may prevent the use of the hedging route. Forward contracts can be time-consuming when all value dimensions need to be negotiated but, moreover, result virtually in an irreversible decision.

All things considered, the producer's best means of managing market risk turns on the acquisition of adequate, timely information permitting crucial decisions to be made at important turns in the cash market price. Unfortunately, the time required to keep abreast of and analyze the myriad of fundamental factors influencing price can be burdensome in terms of time as well as the cost of procuring the relevant information.

Objectives

The primary goal of this report is to provide a set of objective rules for determining when to buy and sell fed cattle on the cash markets. Specifically, the objectives are: 1) to develop a set of moving averages using average cash prices over the past decade that would maximize returns to producers and, 2) to determine if an optimized set of moving averages used in conjunction with a

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Relative Strength Index would further increase profits and reduce profit variability compared to a fixed period strategy of marketing cattle.

Data and Procedures

Technical tools of analysis have been applied sucessfully in analysing futures prices but have not been tested as to usefulness in the cash markets. When applied to the futures market, combinations of technical tools have provided more reliable trades than any other single tool. Using different technical tools simultaneously to yield more reliable trades is called "The Principle of Coincidence." Most losses associated with moving averages systems are the result of "whipsaw effects" produced primarily in trendless markets. The Relative Strength Index works best in trendless markets. Hence, applying the Principle of Coincidence, a combination of the Relative Strength Index along with an optimized set of moving averages can be expected to improve profitability.

The data used in this study covered Omaha Choice 2-4, 900-1100 pound steers; Omaha Choice 2-4, 900-1100 pound heifers; and Texas Panhandle Choice 2-4, 900-1100 pound steers. The data were extracted form the USDA publication Livestock Meat and Wool for the time period 1972 through 1982. This time period was selected to assure that the analysis would encompass a full cattle price cycle. The optimization was evaluated in terms of the profits generated from the buy and sell signals triggered by the crossing of alternative sets of moving averages.

A Relative Strength Index was calculated using the same data set. The Relative Strength (RSI) value was used as a confirming device. A buy position was entered whenever the RSI fell to a value below 30 if the moving averages had not already indicated a buy signal. No sell signal was honored whenever the RSI had a value below 40 and an automatic sell was generated whenever the RSI produced a value above 90 if the moving averages had not already produced a sell signal earlier. Fifteen weeks were used in the calculation of the RSI value and, therefore, no signals were honored until after the 15th week of 1972. To ensure that the moving averages program would represent a more realistic marketing strategy and that the cattle would weigh between 900-1100 pounds, sell signals were honored only between the 17th and 25th week after the initial buy signal appeared.

Results

The results are presented in three parts. First, the results of optimization of the moving averages are presented for each of the three markets. Second, the results of varying the penetration rule with respect to the most profitable moving average set are presented. Third, the results of combining the most profitable moving average set and penetration rule with the RSI are presented and, finally, the results of the combined moving averages and RSI strategy are compared to a strategy of marketing cattle on 21-week intervals.

Moving Averages

A major assumption made concerning the moving averages was that the weekly average price of the week which generated the signal could be attained during the next week. For instance, if the end of one week generated a buy signal at a weekly average price of $65 per cwt., then it was assumed that the range of prices in the succeeding week would include $65 per cwt. and the actual trade would take place in the second week. Of course, in some weeks a trader would have prices move in his favor and in some weeks the opposite effect would be experienced. However, over the time span studies it was assumed that these effects would average out and the assumption would hold.

Table 1 provides the profits associated with selected sets of moving averages for Omaha steers. Systems involving two averages and three averages were tested. For systems involving two averages, the first number represents the shorter of the two averages. The second number represents the longer of the two averages. For the systems with three averages, the first

TABLE 1

MOVING AVERAGES RESULTS FOR OMAHA SLAUGHTER STEERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Number of Consecutive Losses
----------------Dollars Per Hundredweight-----------------						
1-2w*		107.53	147.27	40.71	6.01	15
2-8		73.59	88.16	14.57	4.26	3
2-7		71.62	88.68	17.06	4.36	4
3-7		62.13	83.09	20.96	5.90	4
1-3-5w	.09	56.42	74.69	18.27	8.97	3
3-10		55.42	69.13	13.71	6.64	3
3-4-6	.07	54.40	76.28	21.88	8.22	4
4-8		45.83	69.52	23.69	7.48	3
3-4-8		45.82	69.25	23.43	7.08	3
4-8	.04	44.49	73.82	29.33	7.28	3
3-4-8w		39.75	68.92	29.17	8.73	4
3-4-7w		35.94	68.46	32.52	9.08	4
4-8w	.05	35.90	67.47	31.57	8.46	5
3w-4w-14	.06	30.51	54.10	23.59	10.55	3

*"w" denotes linearly weighted moving average.

number is the shorter of the averages, the second number is the intermediate length average and the third number is the longest of the averages. A number with a "w" to its right indicates a linearly weighted average.

For the two average systems, a buy signal is posted whenever the short average crosses the long average from below. For some of these systems the crossing must be by the amount indicated by the penetration rule. The 4-8 week system, for example, indicates a buy signal if the 4-week average crosses the 8-week average from below by $0.04 per cwt. or more. Sell signals are generated when the short average crosses the long average from above.

For the three average systems, a buy signal is produced whenever the intermediate length average crosses the longest average from below (by the amount of the penetration rule, if required) *and* the shorter average is above the intermediate average. Sell signals occur when the intermediate average crosses the longest average (by the amount of the penetration rule when warranted) *and* the shortest average is below the intermediate average.

For the Omaha slaughter steers the 1-2w system was clearly superior to all the other combinations tested in terms of the gross and net profit. Although the 1-2w set of averages had a clearly superior track record in terms of profitability, it ranked low in terms of producing the largest number of consecutive loses which could be important to financially weak firms.

Table 2 provides the results for Omaha slaughter heifers. The notation in this table follows the same format as in the preceding table. The 1-2w set of averages was clearly superior to the other sets of averages tested in terms of profitability as was the case for Omaha steers. However, the margin of superiority was not as great. Paralleling the situation with respect to the Omaha steers, the 1-2w system suffers from possessing the greatest number of consecutive losses.

Table 3 provides the results for Texas slaughter steers. Once again, the 1-2w system of moving averages produced profits clearly superior to those produced by any of the other sets of averages tested. The system may be faulted for possessing the largest number of consecutive losses. However, the losses tended to be small since this system turned in the smallest dollar value for the largest number of consecutive losses.

Penetration Rules

The profits yielded by the 1-2w system of moving averages were registered without the use of a penetration rule. Penetration rules serve as additional filtering devices and have the potential of reducing the number of "whipsaw" trades and thereby increasing total profits and reducing losses. The penetration rules associated with several of the systems reported above were included because they had been found to be useful in optimizing the set of averages in an application to the futures markets.

TABLE 2

MOVING AVERAGES RESULTS FOR OMAHA SLAUGHTER HEIFERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Number of Consecutive Losses
		---------------Dollars Per Hundredweight-----------------				
1-2w*		91.14	137.65	46.51	7.52	16
2-7		76.47	88.68	12.21	3.17	2
2-8		71.05	87.55	16.50	3.07	3
3-7		66.86	84.80	17.94	4.72	3
3-10		56.85	71.81	14.96	8.87	2
3-4-6		50.97	72.26	21.29	5.73	4
1-3-5w	.09	49.72	74.63	24.91	5.91	4
4-8		49.39	73.14	23.75	6.97	3
3-4-8		49.27	71.25	21.98	6.97	3
4-8	.04	49.14	69.73	20.59	6.97	3
4-8w	.05	44.31	71.03	26.72	11.13	2
3w-4w-14	.06	40.45	51.55	11.10	5.88	1
3-4-7w		38.60	61.42	22.82	10.53	4
3-4-8w		34.57	60.36	25.79	11.13	3

*"w" denotes linearly weighted moving average.

Table 4 shows the results of testing a variety of penetration rules to the 1-2w set of averages applied to the Omaha slaughter steers. This work was done in an effort to more precisely locate the point of maximum profits. In this case profits were increased by nearly $12 per hundredweight by the use of a $0.10 per hundredweight rule. The number of consecutive losses was also reduced and the dollar value of the consecutive losses was also reduced.

Table 5 gives the results of testing several penetration rules in conjunction with the 1-2w set of averages applied to Omaha slaughter heifers. The results parallel those obtained for Omaha steers. The profits were increased by more than $9 per hundredweight through the use of a $0.10 per hundredweight penetration rule. In addition, the number of consecutive losses was reduced as was the dollar value of such losses.

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TABLE 3

MOVING AVERAGES RESULTS FOR TEXAS SLAUGHTER STEERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Number of Consecutive Losses
			-Dollars Per Hundredweight-			
1-2w*		143.49	173.69	30.20	4.35	12
2-7		68.75	97.42	28.67	6.53	6
2-8		56.26	88.36	32.10	8.35	5
3-4-6	.07	47.64	82.64	35.00	13.10	4
3-7		44.45	85.06	40.61	11.29	5
3-4-8		34.53	74.36	39.83	12.13	4
3-10		33.39	66.78	34.65	11.58	2
1-3-5w	.09	29.95	72.02	42.07	11.96	5
4-8		24.07	74.45	50.38	14.66	5
4-8	.04	23.11	74.20	51.09	14.66	5
3w-4w-14	.06	20.57	54.88	34.31	15.70	3
3-4-8w		15.74	74.61	58.87	19.66	6
3-4-7w		8.34	66.94	58.60	18.13	5
4-8w	.05	5.30	72.39	67.09	19.43	5

*"w" denotes linearly weighted moving average.

TABLE 4

THE 1-2w MOVING AVERAGES RESULTS WITH VARIOUS PENETRATION RULES FOR OMAHA SLAUGHTER STEERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Number of Consecutive Losses
			-Dollars Per Hundredweight-			
1-2w		107.53	147.24	40.71	6.01	15
1-2w	.05	112.14	145.87	33.73	4.30	12
1-2w	.10	119.37	148.20	28.83	4.30	9
1-2w	.15	106.88	132.03	25.15	3.37	7

TABLE 5

THE 1-2w MOVING AVERAGES RESULTS WITH VARIOUS PENETRATION RULES FOR OMAHA SLAUGHTER HEIFERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Number of Consecutive Losses
		----------------Dollars Per Hundredweight-----------------				
1-2w		91.26	137.65	46.39	7.52	15
1-2w	.05	93.94	130.02	36.08	5.98	11
1-2w	.10	100.94	131.12	30.18	5.45	10
1-2w	.15	98.78	125.44	26.66	4.41	7

Table 6 gives consideration to the results of testing several penetration rules used in conjunction with the 1-2w set of moving averages applied to Texas slaughter steers. In this case, a $0.05 per hundred weight penetration rule improved profits per hundredweight by almost $7 per hundredweight. Moreover, as was the experience with Omaha steers and Omaha heifers, the number of consecutive losses was reduced along with the dollar value of the losses.

TABLE 6

THE 1-2w MOVING AVERAGES RESULTS WITH VARIOUS PENETRATION RULES FOR TEXAS SLAUGHTER STEERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Number of Consecutive Losses
		----------------Dollars Per Hundredweight-----------------				
1-2w		143.49	173.69	30.20	4.35	12
1-2w	.05	150.10	174.01	23.91	3.85	8
1-2w	.10	134.04	161.15	27.11	3.40	5
1-2w	.15	132.85	158.05	25.20	4.90	5

Moving Averages Combined with RSI

In this portion of the analysis the optimum set of moving averages along with penetration rules were combined with the Relative Strength Index in an effort to further reduce losses and increase profits. Table 7 provides evidence that significant improvement in profits are achieved with the introduction of the RSI. Even without the use of a penetration rule, profits were improved more than three and one-half times for Omaha slaughter steers. When a penetration rule of $0.15 per hundredweight was incorporated, profits were increased by more than five-fold. A sharp decline in the number of consecutive losses was also recorded.

Table 8 reveals a marked improvement in profits for Omaha heifers through the introduction of the RSI into the set of trading rules. Here profits were multiplied more than four-fold compared to the use of the the moving averages without the penetration rule. When the moving averages were used in conjunction with both a penetration rule of $0.10 per hundredweight and the RSI, profits were increased by more than 550 percent. In this case too, the number of consecutive losses was drastically reduced.

Similar results were obtained for Texas steers. Profits for Texas steers were increased by more than 350 percent by the introduction of the RSI but without the penetration rule. When the moving average system was used along with the RSI and a penetration rule of $0.15 per hundredweight, profits were improved by more than five-fold. Here also, the number of consecutive losses were reduced dramatically.

Comparison with a 21-Week Strategy

Table 9 presents the results of following a strategy of marketing finished cattle on an average of every 21 weeks. The average feeding period for slaughter cattle since 1972 has been approximately 145 days. Depending upon the weather, rations used and the initial weights of the cattle, the feeding period would vary. From the foregoing, a marketing strategy of buying, feeding, and selling slaughter cattle in 21 weeks was assumed as a possible marketing plan. While some cattlemen might only feed cattle for 90 days in some instances while others might feed as long as 200 days, a 145 day feeding period would not represent any particular feeding operation. Since there is no compelling logic for the use of any specific feeding period, the 21 week period was adopted for purposes of analysis.

Over the period from 1972-1982, profits varied little among the three markets. Omaha Choice Steers averaged the smallest amount of profits and Texas steers averaged the highest profits. Omaha heifers averaged nearly $31 per head more than the Omaha steers while Texas steers averaged nearly $48 per head more than Omaha steers. The number of consecutive losses from following a 21 week marketing strategy were small in all three markets.

Table 10 shows a comparison of the 21 week strategy with the technical strategies over the period December 25, 1982 - April 7, 1984 for Omaha slaughter steers. The 21 week strategy produced the poorest results. Net profit was only $86.50 per head and $28.83 per pen fed. It should be pointed

TABLE 7

**MOVING AVERAGE AND RELATIVE STRENGTH INDEX
MARKETING STRATEGY RESULTS FOR OMAHA
SLAUGHTER STEERS, 1972-1982**

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Average[1] Net Profit/ Pen	Number of Consecutive Losses
	$/cwt	--------------Dollars Per Hundredweight-----------------					
1-2w* with RSI		396.20	886.90	490.70	66.10	16.51	1
1-2w with RSI	.05	206.70	870.80	664.10	143.20	7.95	2
1-2w with RSI	.10	539.00	1066.40	527.40	126.60	22.46	2
1-2w with RSI	.15	559.00	834.50	275.50	61.40	25.41	2

*"w" denotes linearly weighted moving average.

[1]Average net profit per pen is calculated by dividing the net profit by the number of pens.

TABLE 8

MOVING AVERAGE AND RELATIVE STRENGTH INDEX MARKETING STRATEGY RESULTS FOR OMAHA SLAUGHTER HEIFERS, 1972-1982

Moving Averages	Penetration Rule	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Average[1] Net Profit/ Pen	Number of Consecutive Losses
	$/cwt	--------------Dollars Per Hundredweight-----------------					
1-2w* with RSI		392.70	793.90	401.20	132.80	15.10	2
1-2w with RSI	.05	379.00	901.80	522.80	195.90	15.79	2
1-2w with RSI	.10	515.90	965.40	449.50	143.20	23.45	2
1-2w with RSI	.15	497.80	866.80	369.00	91.70	24.89	1

*"w" denotes linearly weighted moving average.

[1]Average net profit per pen is calculated by dividing the net profit by the number of pens.

TABLE 9

TWENTY-ONE WEEK MARKETING STRATEGY RESULTS
FOR SLAUGHTER CATTLE, 1972-1982

Market	Net Profit	Gross Profit	Gross Losses	Sum of Largest Set of Consecutive Losses	Average[1] Net Profit/ Pen	Number of Consecutive Losses	Number of Pens
	-----------------------Dollars Per Head------------------------						
Omaha Choice 2-4 900-1100 lb. Steers	200.10	889.30	689.20	204.80	7.41	3	27
Omaha Choice 2-4 900-1100 lb. Heifers	230.90	880.40	649.50	188.20	8.55	2	27
Texas Choice 2-4 900-1100 lb. Steers	247.90	904.80	656.90	174.90	9.18	2	27

[1]Average net profit per pen is calculated by dividing the net profit by the number of pens.

TABLE 10

MARKETING STRATEGIES RESULTS FOR
OMAHA SLAUGHTER STEERS,
DECEMBER 15, 1982 - APRIL 7, 1984

Strategy	Net Profit	Gross Profit	Gross Losses	Largest Loss	Average[1] Net Profit/Pen
	--------------------------------Dollars Per Head--------------------------				
21-week	86.50	164.00	77.50	77.50	28.83
1-2* with RSI	93.50	182.50	89.00	89.00	31.17
1-2w(05) with RSI	93.50	182.50	89.00	89.00	31.17
1-2w(10) with RSI	149.50	149.50	0	0	74.75
1-2w(15) with RSI	142.00	142.00	0	0	71.00

*"w" denotes linearly weighted moving average

[1]Average net profit per pen is calculated by dividing the net profit by the number of pens.

out that net profits as used here are not net in the usual sense. Both fixed and variable expenses were omitted from the analysis because they were assumed to be the same regardless of the marketing strategy employed. Thus, the term net reflects the difference between profitable transactions and unprofitable ones. While these profits are not poor in themselves they fail to measure up to the profits associated with the technical strategies. The most profitable strategy was the 1-2w moving averages with a $0.10 penetration rule and the RSI.

The results of the analysis for Omaha heifers over the period December 25, 1982 - April 7, 1984 are presented in Table 11. For the heifers the 21-week strategy was not the worst but it only exceeded the profits from two of the technical strategies by $3 per head. The most profitable strategies were the 1-2w moving averages combined with the RSI and either a $0.10 or a $0.15 penetration rule. Each of these latter two strategies produced the same degree of profitability. Of credit to the 21-week strategy is the fact that is produced a smaller figure for the largest loss than did the technical strategies over the test period.

TABLE 11

MARKETING STRATEGIES RESULTS FOR OMAHA SLAUGHTER HEIFERS, DECEMBER 15, 1982 - APRIL 7, 1984

Strategy	Net Profit	Gross Profit	Gross Losses	Largest Loss	Average[1] Net Profit/Pen
	----------------------------Dollars Per Head----------------------------				
21-week	86.70	164.70	78.00	78.00	28.90
1-2* with RSI	83.70	168.20	84.50	84.50	27.90
1-2w(05) with RSI	83.70	168.20	84.50	84.50	27.90
1-2w(10) with RSI	104.70	189.20	84.50	84.50	34.90
1-2w(15) with RSI	104.70	189.20	84.50	84.50	34.90

*"w" denotes linearly weighted moving average

[1]Average net profit per pen is calculated by dividing the net profit by the number of pens.

For the Texas steers, all of the technical strategies were superior to the 21-week marketing strategy (Table 12). The 1-2w set of moving averages combined with the RSI and a $0.15 penetration rule yielded the largest profit per head. The 21-week marketing system produced a profit of $85.40 per head. No losses were encountered with the most profitable system over the test period.

Summary and Conclusions

Since the early 1970's, cattlemen have been plagued with extremely volatile cattle prices. The past decade has seen the exit of many cattlemen from livestock production because of the inability to cope with the highly capital-intensive operations of the cattle industry. Many of those leaving the industry may have lacked the necessary skills for the successful marketing of their livestock. Marketing skills are equally important to the cattleman as are the technical skills such as breeding and feeding.

TABLE 12

MARKETING STRATEGIES RESULTS FOR
TEXAS SLAUGHTER STEERS,
DECEMBER 15, 1982 - APRIL 7, 1984

Strategy	Net Profit	Gross Profit	Gross Losses	Largest Loss	Average[1] Net Profit/Pen
	-----------------------------Dollars Per Head--------------------------				
21-week	85.40	165.90	80.50	80.50	28.47
1-2* with RSI	130.60	213.60	83.00	83.00	43.53
1-2w(05) with RSI	130.60	213.60	83.00	83.00	43.53
1-2w(10) with RSI	111.80	213.60	101.80	101.80	37.27
1-2w(15) with RSI	147.00	147.00	0	0	73.50

*"w" denotes linearly weighted moving average

[1] Average net profit per pen is calculated by dividing the net profit by the number of pens.

In an effort to aid producers with their marketing problems, a marketing strategy based on a combination of the technical tools of analysis was developed. Such tools have previously been found to be successful in the futures markets. An array of moving averages was tested against data comprised of the weekly average prices of Omaha slaughter steers, Omaha slaughter heifers, and Texas slaughter steers over the time span from 1972-1982. Efforts were made to improve on the profitability of the marketing system by incorporating penetration rules and through the use of a combination of the moving averages and the Relative Strength Index. To establish a basis for comparison, a strategy of marketing cattle at 21-week intervals -- the average length of feeding period -- was included in the analysis.

Of the sets of moving averages tested, a one-week average and a two-week set of linearly weighted averages was found to be most profitable. When a penetration rule and the Relative Strength Index were added to the

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marketing strategy, profits were increased significantly. When the marketing strategy was tested with data outside the time span used to optimize the moving averages, the technical strategy proved to be superior to a strategy of marketing cattle over 21-week intervals. Incorporation of the Relative Strength Index magnified profits several-fold in each of the three markets investigated. In addition, the number of consecutive losses was reduced sharply by the addition of the penetration rule and the use of the Relative Strength Index. The principal conclusion of this work is that the technical tools of analysis found to be useful to traders in the stock and futures markets can be useful in developing cash marketing strategies. The results should be of particular interest to those producers who cannot avail themselves, for whatever reasons, of the traditional methods of managing risk.

Suggestions for Additional Research

The results of this study are rudimentary and merely demonstrate the potential for the application of the tools of technical analysis to cash market analysis The principle of coincidence needs to be explored using more than two tools of analysis. Optimization over other time spans needs to be explored with attention devoted to the differential effects, if any, that may exist among uptrending markets, downtrending markets, and trendless markets. A more detailed analysis of the slaughter cattle markets seems warranted on the basis of these preliminary results as well as an investigation of these techniques as applied to other markets such as stocker-feeder cattle, cow-calf operations, and other livestock and grain markets.
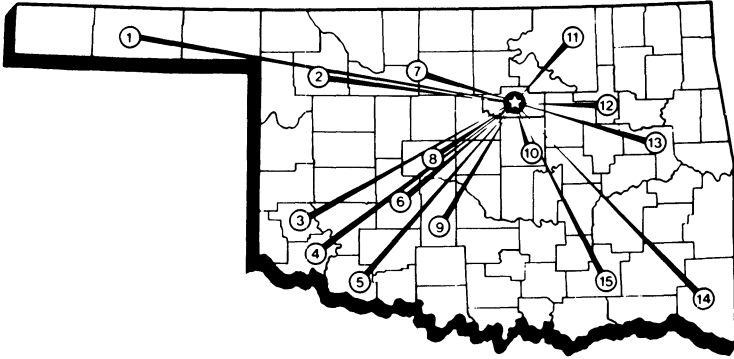
OKLAHOMA

AGRICULTURAL EXPERIMENT STATION

System Covers the State

* Main Station—*Stillwater, Perkins and Lake Carl Blackwell*
1. Panhandle Research Station — *Goodwell*
2. Southern Great Plains Field Station — *Woodward*
3. Sandyland Research Station — *Mangum*
4. Irrigation Research Station — *Altus*
5. Southwest Agronomy Research Station — *Tipton*
6. Caddo Research Station — *Ft. Cobb*
7. North Central Research Station — *Lahoma*
8. Southwestern Livestock and Forage Research
    Station — *El Reno*
9. South Central Research Station — *Chickasha*
10. Pecan Research Station — *Sparks*
11. Pawhuska Research Station— *Pawhuska*
12. Vegetable Research Station — *Bixby*
13. Eastern Research Station — *Haskell*
14. Kiamichi Field Station — *Idabel*
15. Southeastern Oklahoma Agricultural Research and
    Extension Center — *Lane*

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