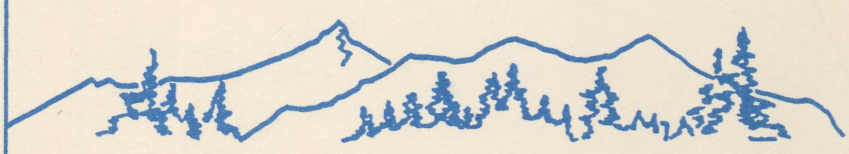
Papers of the 1991 Annual Meeting

Western Agricultural Economics Association



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be planted to any crop (excluding fruits and vegetables) with full base protection. In addition, irrigated payment acres are frozen at the greater of 1990 plantings or the previous three year average. Deficiency payments on eligible irrigated payment acres, above previous levels, are based on nonirrigated payment yields.

The number of potential program participation combinations suggest the use of mixed integer programming as the method of analysis. In addition, the influence of time on rotation selection and commodity base acreage makes the use of a multiyear framework attractive.

Hypothetical Farm Situation and Data

The hypothetical farming situation was based on 1987 Census of Agriculture statistics for Lincoln County, Nebraska, and consisted of 380 acres of tillable cropland, 260 acres of which can be irrigated using a center pivot irrigation system (two center pivots capable of irrigating 130 acres each). The farm was endowed with a 235 acre corn base and 72.5 acre wheat base. Deficiency payment yields were those typical for Lincoln County, Nebraska, for irrigated and nonirrigated cropland[1].

Crop yield data were derived from research at the University of Nebraska's West Central Research and Extension Center in North Platte, Nebraska. The research was conducted for the 1986 through 1990 crop years. Two rotations under both full irrigation and dryland (rainfed) conditions were replicated four times in a randomized complete block design within each water treatment. The two rotations were continuous corn and a winter wheat-corn-soybean rotation. Each phase of the rotation was present each year, and crop yields were the annual average yield of the four replications for each crop. Moisture during the growing season for 1986 and 1987 was near to slightly above normal, well above normal for 1988, and well below average for 1989 and 1990 (Schneekloth, et al.). Thus, a reasonable spectrum of moisture conditions was encountered.

Cost of production data include fertilizer costs as applied to the research plots. Cost data, other than fertilizer costs, were based on estimates by the University of Nebraska Extension Service (Jose, et al., 1986 - 1990). Cost data include only cash operating costs, with net returns being returns before any payment of fixed costs, taxes, unpaid family labor, or debt servicing.

Model Formulation

The dynamic mixed integer linear programming model for the 1985 FSA used four integer variables to determine program participation options: (a) in the corn program, (b) in the wheat program, (c) not in the corn program, (d) not in the wheat program. The model also included a center pivot integer[2]. Crop acreage base was determined within the model and was a function of the preceding five year average of plantings and considered plantings of each program crop, regardless of the participation option selected. Terminal values for each program crop were imposed as a cost element should plantings and considered plantings fall below the previous year's base. The terminal values reflected the value of lost CAB, based on government payments. For both participating and nonparticipating options, each phase of a crop rotation was represented as a separate activity within the model. Rotational constraints restricted the model to a specific path, determined by the previous year's crop. For example, rotational constraints allowed winter wheat only on acreage planted to soybeans in the previous year. Continuous corn could have been planted on any acreage devoted to corn the previous year, and soybeans could also

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[1] Personal discussion with T.K. Rogers, Lincoln County ASCS Director, January, 1991.

[2] The center pivot integer was used to test the model's sensitivity to various pivot start-up costs. The results of this sensitivity test are not discussed in this paper; however, the results did indicate that the model was insensitive to this parameter even with start-up costs as high as $10,000.

have been planted to any acreage which was in corn the previous year. Thus, rotational constraints allowed the model to shift rotations over time, but only in a consistent manner. The rotational constraints were also differentiated between full irrigation and dryland. To account for the eventuality of pivot shut-down, dryland rotational constraints were specified as acres in the irrigation rotation plus remaining dryland acres eligible for the rotation. Since present plantings are influenced by previous plantings, a set of initial conditions had to be imposed. The initial rotational endowment consisted of one pivot producing continuous corn, the second pivot producing continuous corn (25 percent) and winter wheat-corn-soybean (75 percent), and the dryland acres producing winter wheat-corn-soybean.

Reformulation of the model for the 1990 FACTA required an additional program participation variable, a change base integer. The change base integer could only be selected by exiting the program for both corn and wheat. The removal of cross compliance, with base restrictions, required that in the event of selected participation, additional base could not be added. Plantings could, however, exceed the crop acreage base. When participating, base could be maintained by payment acres plus ACR equalling 85 percent of CAB. Base could also be maintained by plantings and considered plantings equalling payment acres plus ACR and NFA when not participating in the program for any crop. Thus, base can be efficiently determined within the model through the participation option or the change base option; however, the removal of cross compliance made tracking base under selected participation options problematic. To reduce the problems, it was assumed that base could not be lost when selected participation was chosen, a heroic assumption indeed. However, results indicated that this assumption was not a problem. Flex acres were determined by the participation strategy, and tracking eligible flex acres essentially became identical to tracking base acres.

The programming models were solved by maximizing expected net returns under each farm bill. An expectations approach was used to introduce behavioral aspects into the model. This procedure also permitted the examination of income variability in terms of the standard deviation of actual net returns and the difference between expected returns and actual returns. Yield expectations were based on the five year mean yield for each crop according to irrigation practice. Price expectations were formulated by using the appropriate futures price for the contract month following harvest, taken just prior to any tillage operation. The futures price was then reduced by the appropriate basis to derive the expected harvest price. For corn and soybean, the futures price was taken on the last Wednesday in April with futures contract months of December and November, respectively. Winter wheat futures prices were taken the last Wednesday in September with a futures contract month of July.

Actual program provisions were used to simulate the entire history of 1985 FSA (1986 - 1990). The comparison between the 1985 and 1990 farm bills was accomplished by using actual market prices, 5 month national market prices, 12 month national market prices, and ending stocks to use ratios to develop loan rates, set-aside requirements, and deficiency payments for the 1990 FACTA during the same time period. Thus, the 1990 FACTA was simulated during 1986 to 1990. Target prices for corn and wheat were frozen at 1990 levels for each year of the 1990 FACTA model. The Conservation Use program, the Conservation Reserve Program, and Paid Land Diversions were not included in either model for simplicity and consistency reasons.

Results

Program participation, coupled with agronomic considerations, proved to be a potent motivator under both farm bills. Annual crop mix and program participation strategies are reflected in Table 1 for both farm programs. Under the 1985 FSA, program participation for both corn and wheat was selected each year. Participation under the 1990 FACTA was similar, with the exception of 1988 when wheat was a nonparticipating crop. Despite being out of the program in 1988, wheat plantings remained consistent with earlier years, indicating that the wheat program itself lacked attraction that year. While participation rates remained relatively similar under both programs, crop rotations did make some notable changes.

Under the 1985 FSA, the ending rotations were identical to the initial rotational endowments, lending support to the hypothesis that the 1985 farm bill was restrictive in locking-in current practices. While minor fluctuations in the rotation strategies were evident under the 1985 FSA, these fluctuations can be attributed to set-aside requirements. For example, in 1986 the corn set-aside requirement was 41

acres, and since the available dryland corn acreage was only 40 acres, an additional set-aside acre had to be found. The model chose to increase plantings of irrigated soybeans by one acre, rather than idle an acre under the center pivot. A similar result was evident in 1987, when corn set-aside requirements increased to 47 acres. Under the 1990 FACTA, with payment acres reduced, the model was able to take advantage of the irrigated winter wheat-corn-soybean rotation. The flex option per se was never utilized, plantings and considered plantings remain essentially the same for each crop, i.e. flexible corn acres were used for corn while flexible wheat acres were used for wheat. The shifts which did occur involved shifting dryland winter wheat-corn-soybean to irrigated winter wheat-corn-soybean, and simultaneously shifting irrigated continuous corn to dryland continuous corn. The model depended on the dryland continuous corn acreage for set-aside. The logic behind this shift was that since irrigated continuous corn acres were no longer necessary to maintain corn deficiency payments, these acres could shift to a higher value use. This result was evident since the solution for the 1990 FACTA was theoretically possible under the 1985 FSA, the only difference being program incentives. For illustrative purposes, final crop mixes under the center pivot irrigation system for both farm bills is shown in Figure 1.

Expected and actual returns under each farm program are shown in Table 2 along with actual returns under a nonparticipating strategy. While government deficiency payments are not specifically addressed in this paper, returns under each farm program from both crop enterprises and government payments are shown graphically in Figure 2. Returns under the 1985 FSA outperformed returns under the 1990 FACTA in three out of five years. Mean realized returns under each farm program for the five year period was $68,411 and $67,920 for the 1985 FSA and 1990 FACTA, respectively. Returns under the 1990 FACTA in 1986 and 1987 were enhanced primarily due to higher loan rates. The net effect of higher loan rates amounted to $4,586 in 1986 and $3,702 in 1987. Disallowing these higher loan rates caused the 1985 FSA to outperform the 1990 FACTA in four out of five years. The standard deviation in realized returns was $8,490 and $12,096 for the 1985 FSA and 1990 FACTA, respectively. Realized returns differed by approximately $500, a result suggesting that returns under either program were roughly comparative. However, the standard deviation of returns was considerably greater under the 1990 FACTA. This result tends to support the theory that increased flexibility would tend to increase the riskiness (as defined by variation in returns) of a farming operation. Returns under either farm program remained higher than a strategy of nonparticipation. However, the standard deviation of returns was higher when participating in the 1990 FACTA than when not participating. Drawing broader conclusions from these results must be tempered; however, since the hypothetical farming situation involved multiple base resources and cropping resources definable only within a narrow range of both producing area and production alternatives.

Another risk measure concerns the variability of predicted or expected returns with the returns actually received (McSweeny, Kenyon, and Kramer, 1987). Denoted as forecast error, this risk measure is predicted or expected returns minus actual returns. The forecast - realized return gap was narrower under the 1990 FACTA in four out of five years. The standard deviation of forecast error was $19,515 for the 1985 FSA and $18,611 for the 1990 FACTA, indicating that, *ceteris paribus*, decision-making under the 1990 FACTA had a slight forecasting advantage. However, without the ability to manufacture additional observations, it was impossible to arrive at a statistically significant conclusion regarding the models forecasting relationships.

Conclusions

Using 1986 to 1990 data, the 1985 FSA was compared with the 1990 FACTA through a dynamic mixed integer linear programming model. A hypothetical farming situation for southwestern Nebraska was utilized to examine farm level impacts under each farm program. The impacts of concern included crop mix/crop rotations, program participation, and returns to the cropping enterprise.

The results indicated that the flexibility provisions of the 1990 farm bill allowed for greater adoption of rotations, particularly on irrigated cropland when continuous cropping practices were no longer completely necessary to maintain high deficiency payments. Commodity participation in the 1990 farm program occurred in all five years for corn and in four out of five years for wheat. By comparison, commodity participation in the 1985 farm bill occurred in all five years for both corn and wheat. Returns

to the cropping enterprise were slightly reduced under the 1990 farm program, yet the variation in realized returns for the 1990 program was considerably higher. The 1990 farm bill offered a slight advantage in the prediction of returns, in which the difference between expected returns and actual returns was narrower in four out of five years when compared to expected and actual returns under the 1985 farm bill.

The impacts of each program on a farming situation is highly dependent on a number of variables. The initial conditions or endowments from the previous year, the availability and competitiveness of alternative crops and rotations, personal preferences, etc., can potentially influence the outcome of any particular solution. Additional research devoted to other potential farming situations would provide further insight into commodity program incentives at the micro level.

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Table 1. Annual Crop Mix/Rotation Strategies Under the 1985 Food Security Act and 1990 Food, Agriculture, Conservation, and Trade Act.

	1985 FOOD SECURITY ACT				1990 FOOD, AGRICULTURE, CONSERVATION, AND TRADE ACT			
Crop mix/ Rotation	Program Irrigated	Program Dryland	Nonprogram Irrigated	Nonprogram Dryland	Program Irrigated	Program Dryland	Nonprogram Irrigated	Nonprogram Dryland
1986								
CONT. CORN	161.5	0	0	0	120.5	0	15	0
CORN-W-S	32.5	0	0	0	32.5	0	0	20
WHEAT-C-S	32.5	24	0	0	32.5	14.5	0	11
SOYBEAN-W-C	0	0	33.5	39	0	0	59.5	13
Corn Set-aside	0	41			0	47		
Wheat Set-Aside	0	16			0	14.5		
1987								
CONT. CORN	154.5	0	0	0	125.5	0	0	0
CORN-W-S	32.5	1	0	0	27.5	0	5	30
WHEAT-C-S	33.5	19	0	0	47	0	11	0
SOYBEAN-W-C	0	0	39.5	33	0	0	42.5	30
Corn Set-aside	0	47			0	47		
Wheat Set-Aside	0	20			0	14.5		
1988								
CONT. CORN	154.5	0	0	0	93.5	0	22	0
CORN-W-S	33.5	0	0	0	59.5	0	0	13
WHEAT-C-S	39.5	13	0	0	0	0	42.5	30
SOYBEAN-W-C	0	0	32.5	40	0	0	42.5	30
Corn Set-aside	0	47			0	47		
Wheat Set-Aside	0	20			0	0		
1989								
CONT. CORN	155.5	0	0	0	132.5	0	0	0
CORN-W-S	39.5	0	0	0	37.5	0	5	30
WHEAT-C-S	32.5	33	0	0	32.5	22	10	1
SOYBEAN-W-C	0	0	32.5	40	0	0	42.5	30
Corn Set-aside	0	22.5			0	30		
Wheat Set-Aside	0	7			0	7		
1990								
CONT. CORN	162.5	0	0	0	127.5	0	5	0
CORN-W-S	32.5	0	0	0	42.5	0	0	30
WHEAT-C-S	32.5	36	0	0	32.5	22	10	1
SOYBEAN-W-C	0	0	32.5	40	0	0	42.5	30
Corn Set-aside	0	23.5			0	30		
Wheat Set-Aside	0	4			0	7		

Table 2. Annual Expected and Actual Realized Returns, 1985 Food Security Act, 1990 Food, Agriculture, Conservation, and Trade Act, and Actual Returns for Nonparticipating Strategy.

Year	1985 Food Security Act		Non-participation	1990 Food, Agriculture, Conservation, and Trade Act	
	Expected	Actual	Actual	Expected	Actual
	Dollars				
1986	$67,366	$74,695	$49,790	$74,129	$81,187
1987	70,359	76,684	58,583	71,281	76,736
1988	64,825	71,903	65,572	61,707	70,913
1989	87,354	56,284	40,167	80,409	51,884
1990	89,965	63,301	46,387	84,192	59,600
86-90 Mean	75,974	68,411	52,100	74,344	67,920
Stand. Dev.		8,490	10,049		12,096

Figure 1. Final Center Pivot Allocations

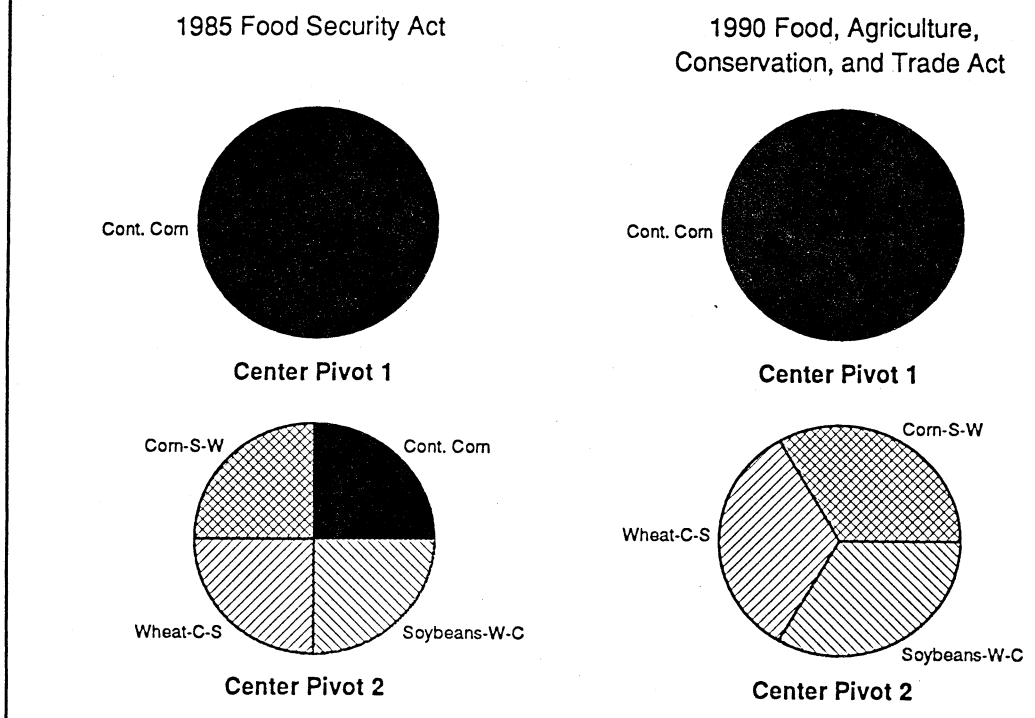

Figure 2. Annual Net Returns, 1985 Food Security Act vs. 1990 Food, Agriculture, Conservation, Trade Act