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Preface

This report is a companion and follow-up to one released in 1991, **Effects of Including Alfalfa in Whole-Farm Plans: Comparison of Conventional, Ridge Till, and Alternative Farming Systems**, Economics Staff Paper 91-1 (SDSU Economics Department), by Clarence Mends and Thomas L. Dobbs. Research leading to this report was supported by the SDSU Agricultural Experiment Station and by U.S. Department of Agriculture LISA Grant LI-88-12.

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Introduction

A farming systems study conducted by South Dakota State University (SDSU) at the Northeast Research Station (near Watertown, SD) was aimed at comparing conventional, reduced tillage, and organic ("alternative") farming systems over the period 1986-1992. Farming Systems Study I (FSSI), which emphasized row crops, compared an Alternative system, which uses no chemical fertilizers or pesticides, to Conventional and Ridge Till rotation systems. Oats (which are harvested and also serve as a nurse crop for alfalfa), alfalfa harvested for hay, soybeans, and corn (in that order) were included in the 4-year Alternative rotation. The alfalfa was harvested for only one year (the year after underseeding in oats) in this system. Corn, soybeans, and spring wheat (in that order) were included in both the Conventional and Ridge Till 3-year rotations. Fertilizer and herbicides in the Conventional and Ridge Till systems were applied at rates recommended by the SDSU Plant Science Department.

A "normalized" version of the N.E. Research Station study was done prior to this report. This report took the Conventional and Ridge Till systems in FSSI from the "normalized" N.E. Research Station study and designed them to include alfalfa in

their rotations to make comparisons between a baseline system, where only the Alternative rotation includes alfalfa, and "designed" systems in which alfalfa is included in the Conventional and Ridge Till systems. This Normalized budget was derived by using "typical" machine operations from the 1986-1992 time period. Further explanation of the Normalized budget is found in Annex A.

Results

Relative Profitability of Systems in Baseline

Normalized results for Study I over the 7-year (1986-1992) period are shown in Annex Table A-1. Alfalfa is not included in the crop rotation for the Conventional and Ridge Till systems in the baseline analysis. Table 1 draws in part from the bottom portion of Annex Table A-1, and shows various cost and return measures for each system on a per acre basis. The first column, "direct costs other than labor", shows the cash operating expenses incurred for each system. "Gross income" figures are computed using yield figures in combination with farm program (e.g., deficiency payments) and current selling price information. The last three columns are different measures of net return or net income.

The Alternative system had the lowest direct cost and the highest gross income. It also had the best overall economic performance, with net returns over all costs except management of

$43/acre. This is 65 percent higher than the Conventional system and 377 percent higher than the Ridge Till system.

Table 1. Comparison of Baseline Systems vs. Designed Systems (with Alfalfa Included in the Conventional and Ridge Till Systems), Using the Normalized Budgets for 1986-1992.

System	Dollars/Acre				
	Direct Costs Other Than Labor	Gross Income	Net Income Over: All Costs Except Land, Labor, and Management	Net Income Over: All Costs Except Land and Management	Net Income Over: All Costs Except Management
Alternative					
Baseline	45	159	82	69	43
Conventional					
Baseline (w/o alfalfa)	63	157	62	52	26
Designed (w/ alfalfa)	59	173	83	71	45
Ridge Till					
Baseline (w/o alfalfa)	69	144	44	35	9
Designed (w/ alfalfa)	63	164	70	58	32

Relative Profitability of Systems With Alfalfa Included

During the 1986-1992 period, no alfalfa was included in the Conventional or Ridge Till systems under study at SDSU's Northeast Research Station. Two systems were designed to show how the inclusion of alfalfa in the Conventional and Ridge Till systems would affect their profitability. The baseline systems and the "designed" systems were based on 800 tillable acres. A 3-year corn-soybeans-spring wheat rotation along with alfalfa (overseeded with oats as a nurse crop) was used for the "designed" Conventional and Ridge Till systems. The number of acres devoted to alfalfa and alfalfa establishment in the designed system was calculated by taking the same number of

alfalfa acres as the baseline Alternative system (188 acres) and a quarter of the total alfalfa acres for alfalfa establishment (188/4 = 47 acres) and forcing these acres into the designed systems. The remaining acres were allocated to the other crops using average crop distribution percentages from 1986-1992. Fertilizer and herbicide rates for the corn, soybeans, and spring wheat in the "designed" Conventional and Ridge Till systems were the same as in the baseline system.

The baseline Alternative system from the Normalized study is compared with the "designed" Conventional and Ridge Till systems. The set of assumptions for the alfalfa crop in the "designed" systems differs from that of the baseline Alternative system, in respect to some cultural practices. The Alternative system in FSSI uses oats as a nurse crop. The oats are harvested as grain in the establishment year and alfalfa is harvested for only one year after the establishment year. For the "designed" Conventional and Ridge Till systems, the alfalfa was also assumed to be underseeded with oats in the rotation. It was assumed that in the alfalfa in the "designed" systems would have a 4-year stand following the seeding year, which is a more typical stand than the Alternative system. At the end of the fourth year of harvesting, the alfalfa was assumed to be turned under with one pass of a moldboard plow in the "designed" Conventional system and two passes with a chisel plow in the "designed" Ridge Till system. All costs to turn under the alfalfa in the designed systems were prorated over the 4-year period.

All of the establishment costs for the 4-year stand of alfalfa were allocated to the crop budget for oats, which is the nurse crop for alfalfa. The price of alfalfa was assumed to be $2.25/lb. Each system had an assumed alfalfa seeding rate of 9.5 lbs/acre. Both the price and the seeding rate are the same as those used in enterprise budgets for the Alternative system. Fertilizer rates that were used in this study for the designed Conventional and Ridge Till systems were taken from Mends and Dobbs (1991). We assumed phosphorus was applied annually at 45 lbs./acre and that potassium was applied at 125 lbs./acre. Alfalfa in both designed systems was assumed to have the same yield as the Alternative system in the Normalized budget for 1986-1992, which was 4.55 tons/acre.

Results comparing the Alternative system and the "designed" Conventional and Ridge Till systems show that including alfalfa in the crop rotations of the designed systems enhances the profitability of these systems (Table 1). The designed Conventional system becomes just slightly more profitable than the baseline Alternative system ($45/acre compared to $43/acre), based on net income over all costs except management. Even though the profitability of the Ridge Till system improves with the inclusion of alfalfa, it still is not as profitable ($32/acre) as the baseline Alternative system.

The figure that was used for the selling price of alfalfa was $53.29. This is slightly higher than the 20-year average, $48.28. A sensitivity analysis was performed to compare the

relative profitability of the baseline systems when the price received for alfalfa was decreased and increased by 20 percent. When the price received for alfalfa was decreased by 20 percent, the Alternative system was still $5/acre more profitable than the baseline Conventional system without alfalfa and $22/acre more profitable than the baseline Ridge Till system without alfalfa. Increasing the alfalfa price by 20 percent made the Alternative system $28/acre more profitable than the baseline Conventional system without alfalfa and $45/acre more profitable than the baseline Ridge Till system without alfalfa.

Our assumption that the alfalfa yield for the "designed" Conventional and Ridge Till systems will be the same as the Alternative system may not be correct, since the Conventional system and the Ridge Till system leave the alfalfa in for 4 years of harvesting and in the Alternative system the alfalfa crop is harvested for only 1 year. Thus, we probably have overstated the potential contribution of alfalfa to net returns in the Conventional and Ridge Till systems.

To study the possibility of lower yields in the Conventional and Ridge Till systems, we compared the baseline Alternative system to designed Conventional and Ridge Till systems that had alfalfa yields which were 10 percent and 20 percent lower than the alfalfa yield in the Alternative system. When alfalfa yields for the designed Conventional and Ridge Till systems were reduced by 10 percent, the Alternative system was $4/acre more profitable than the Conventional system and $17/acre more profitable than

the Ridge Till system. When alfalfa yields for the designed Conventional and Ridge Till systems were reduced by 20 percent, the Alternative system was $10/acre more profitable than the Conventional system and $22/acre more profitable than the Ridge Till system.

Conclusion

The results of this analysis show that alfalfa enhances the profitability of all systems. When it is included at the same yield level in the Conventional and Ridge Till systems, profitability is roughly the same in the Conventional system as in the Alternative system. However, one of the limitations of this analysis is the lack of actual agronomic data for the Conventional and Ridge Till systems that include alfalfa as part of the crop rotation.

The contribution of alfalfa to the profitability of any system is partially affected by the price received for alfalfa relative to the prices for other crops. Coefficients of variation (CVs) for crop prices in South Dakota from 1973-1992 were calculated for the crops included in this study. The coefficient of variation for the price received for alfalfa was .29. The CVs for corn, soybeans, wheat, and oats were .18, .14, .18, and .25, respectively. This indicates that the price for alfalfa may be slightly more volatile than the prices for grain crops and soybeans. In fact, the volatility of "gross prices" for corn, wheat, and oats would be even less than these CVs

indicate, because "gross prices" would also include government deficiency payments available to those crops but not to alfalfa. Thus, though alfalfa adds to the profitability of all the systems studied, there appears to be more price risk associated with that crop than with the grain and oilseed crops included in the systems studied.

Annex A

Description of the Normalized Budget

The Normalized budgets were generated to be representative of a "typical" year for the Northeast Research Station study. Many components of the Normalized budgets were based on averages from the 1986-1992 time period. Selling prices, deficiency payments, seeding rates, fertilizer application rates, and herbicide application rates were all averages over the 7-year 1986-1992 time period. Current (1992) prices were used for all inputs in the Normalized budgets. Storage, drying, overhead, interest, and labor charges were the same as those used in the 1992 N.E. Research Station Farming Systems study. Crop acreage distribution figures were taken from a machinery analysis by D. Becker and K. Koehne.[1] Each crop was computed as a percentage of 540 acres; then the percentage was applied to the 800 acres in the Normalized whole-farm budgets.

Table A-1 shows economic performance for two different analyses. The top portion of the table shows the **average** economic performance for FSSI from 1986-1992. The **bottom portion** of the table shows economic performance for the **Normalized** budgets. The two sets of whole-farm budgets have identical or nearly identical direct costs, but the Normalized budgets have

[1]This unpublished machinery analysis was compiled by former SDSU Economics Department Research Assistants David Becker and Kellie Koehne in 1992, and was revised to include 1986-1992 in the crop acreage averages.

slightly higher gross and net incomes for all of the systems.

Table A-1. Economic Performance of FSSI from 1986-1992.

System[a]	Dollars/Acre				
			Net Income Over		
	Direct Costs Other Than Labor	Gross Income	All Costs Except Land, Labor, and Management	All Costs Except Land and Management	All Costs Except Management
1986-1992 Average					
Farming Systems Study I					
1. Alternative (oats-alfalfa-soybeans-corn)	45	153	75	63	37
2. Conventional (corn-soybeans-s. wheat)	62	151	58	49	23
3. Ridge Till (corn-soybeans-s. wheat)	69	139	41	32	6
1986-1992 Normalized					
Farming Systems Study I					
1. Alternative (oats-alfalfa-soybeans-corn)	45	159	82	69	43
2. Conventional (corn-soybeans-s. wheat)	63	157	62	52	26
3. Ridge Till (corn-soybeans-s. wheat)	69	144	44	35	9

[a]Crops are shown in the order which they occur in each rotation.

Reference

Mends, C., and T.L. Dobbs. 1991. **Effects of Including Alfalfa in Whole-Farm Plans: Comparison of Conventional, Ridge Till, and Alternative Farming Systems.** SDSU Economics Staff Paper No. 91-1. Brookings, SD. April.