Economic Feasibility of Adopting Conservation Tillage in North Mississippi

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A key determinant of the private benefits of reducing soil loss by implementing soil conservation practices is the effect of current soil loss on future productivity within an individual farmer's planning horizon. The implementation of soil conservation practices is often a long-term phenomenon requiring sizable investments which do not yield short-term private benefits. Consequently short-run economic situations may dictate that farmers forego potentially feasible investments in soil conservation practices. The purpose of this study was to evaluate the economic feasibility of adopting soil conservation measures taking into consideration the productivity losses associated with erosion over time.

METHODS AND PROCEDURES

Panola county in North-central Mississippi is representative of soil types and erosion problems in north Mississippi. Soil Conservation Service personnel identified Loring and Granada soils as major erosive problem soils currently under intensive row crop production. Cultural practices and tillage systems utilized by farmers and those recommended for the area were identified for soybeans, the major row crop in the area. Based on this information, costs and returns budgets were developed for conventional, no-till, and min-till soybeans. Costs of production, excluding management and land charges, were estimated to be $147.39, $156.41, and $153.16 for conventional, no-till, and min-till soybean production systems using 8-row equipment [Mustafa].

Estimates of various topsoil depth – soybean yield combinations provided by SCS personnel enabled the estimation of topsoil depth-yield curves for Loring and Granada soils [Cook]. the dependent variable, soybean yields (Y), was estimated as a function of inches of topsoil depth (X) for each soil type as follows:

$$\text{Loring:} \quad Y = 7.23 + 1.14X$$
$$\text{Grenada:} \quad Y = 12.42 + .94X$$

Soil losses attributable to conventional, no-till, and min-till soybean production systems for Loring and Grenada soils were estimated with the Universal Soil Loss Equation [USDA, SCS]. These data and additional information on discount rates, soybean prices, yield penalties, and length of planning horizon were used as inputs in a

model that estimated and compared the present value of income streams associated with conventional, min-till, and no-till soybean production systems.

The model operates in the following manner for a hypothetical situation. Suppose a farmer has a realistic planning horizon of 20 years and wishes to determine which of two cultural practices, one being more erosive than the other, is desirable over time period specified. The model is designed to answer whether the producer should switch from the more erosive practice to the conservation system in the current time period. As a decision criterion the model calculates the net present value of the income stream for the conventional practice assuming that it is maintained to the end of the planning horizon. Secondly, assuming that the conservation practice is adopted in the current time period and maintained throughout the planning horizon, its net present value of the income stream is calculated. It would be feasible to adopt the conservation practice in the current period if its net present value exceeds that of the more erosive practice. If not, the more erosive practice is determined to be the economically feasible alternative and is maintained in the current year. The process is repeated for each successive year in the designated planning horizon to determine if changes in cultural practices should be made in any year during the planning horizon.

Assumptions and results in the model were varied to account for a lack of knowledge concerning certain variables and to provide a range of scenarios approximating real world situations. Two basic soybean cultural practices were compared: conventional and no-till. Planning horizons of 5, 20, 50, and 100 years were evaluated at discount rates of 5 and 10 percent. To account for uncertainty, yield penalties of 0 and 02 percent were attributed to the no-till system.

Conventionally tilled soybeans as opposed to no-till was the economically preferred choice for all situations evaluated on both Loring and Grenada soils when a 20 percent yield penalty was associated with no-till practices. The no-till system with a 0 percent yield penalty was feasible only for selected situations when a 50 or 100 year planning horizon was considered. These results indicate that the long-term benefits of no-till soybeans are insufficient to encourage farmers to switch from conventional tillage methods under normal circumstances.

SUBSIDIZED PRODUCTION PRACTICES

The preceding conclusion was based upon private costs and benefits attributable to erosion control measures. The effects of erosion, however, impact upon society as a whole and provide the basis for public assistance to encourage farmer adoption of conservation measures [Prato]. Given that society desires erosion reduction, financial inducements may be required to encourage farmer adoption.

The subsidy or cost-share level that would make the conservation tillage system as economically attractive as conventional tillage was estimated for Grenada and Loring soils of varying initial topsoil depths, planning horizons, yield penalties and discount rates. Since results for the two are comparable, discussion will be limited to Grenada

soils, Table 1. Figures in Table 1 indicate that a producer with an initial soil depth of 18 inches and a five year planning horizon would require a subsidy of $8.06 per acre for each year in the planning horizon to switch from conventional tillage to no-till in the current year if he expected no-till yields to be compable with conventional. Assuming a 20 percent no-till yield reduction an annual subsidy of $48.97 per acre would be required over the length of the planning horizon. Higher discount rates increase the subsidy required. As shown in Table 1, the required subsidies decrease as the length of planning horizon increases.

The data presented in Table 1 also indicate that if policy makers are looking for the most cost efficient means of reducing erosion to specified levels, something less restrictive than no-till may be desirable. For example, if over-all erosion limits could be met with min-till, the subsidy costs per ton of erosion reduced for the situation previously described could be reduced from 67 cents to 54 cents per ton.

IMPLICATIONS AND CONCLUSIONS

The results presented indicate that given current relative costs of production estimates for conservation and conventional tillage soybeans in north Mississippi and estimated long-term erosion productivity relationships, conservation tillage is not a feasible alternative to the more erosive conventional tillage practices. Estimated subsidy or cost share payments needed to encourage adoption of conservation practices can be substantial depending upon relative yield and cost of production differentials. Given zero yield penalties, the subsidies required are probably not out of line with current cost-share programs in existence. However, it is probably not reasonable to expect public support of subsidy programs of the magnitude implied by this research to encourage adoption of conservation tillage practices. Hence, further research designed to improve yields or reduce costs of conservation tillage systems is essential for farm adoption in north Mississippi.

REFERENCES

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Table 1. Annual subsidy requirements needed to switch from conventional tillage to minimum and no-till for selected discount rates, yield penalties, and planning horizons, Grenada Soils, Panola County, Mississippi[1]

Soil Depth	Planning Horizon	5% Discount Rate				10% Discount Rate			
		No-till Yield Penalty		Mn-till Yield Penalty		No-till Yield Penalty		Min-till Yield Penalty	
		0%	20%	0%	20%	0%	20%	0%	20%
(inches)	(years)	---------- Dollars/Acre ----------							
18	5	8.06 (.67)[2]	48.97 (4.08)	5.02 (.54)	45.89 (4.90)	8.10 (.68)	49.01 (4.08)	5.05 (.54)	45.94 (4.89)
	20	5.00 (.42)	45.79 (3.82)	2.62 (.28)	43.24 (4.61)	5.71 (.48)	46.53 (3.88)	3.18 (.34)	43.85 (4.66)
	50	1.27 (.11)	41.89 (3.49)	0 0	39.99 (4.27)	4.15 (.35)	44.90 (3.74)	1.96 (.21)	42.50 (4.52)
	100	0 0	39.76 (3.31)	0 0	39.22 (4.19)	3.93 (.33)	44.67 (3.72)	1.79 (.19)	42.31 (4.50)
12	5	7.58 (.43)	40.62 (2.28)	4.64 (.50)	37.62 (2.69)	7.65 (.43)	40.69 (2.29)	4.7 (.34)	37.68 (2.69)
	20	3.02 (.17)	35.86 (2.01)	1.08 (.12)	33.66 (2.40)	4.08 (.22)	36.97 (2.08)	1.9 (.14)	34.58 (2.47)
	50	0 0	30.06 (1.69)	0 0	28.82 (2.08)	1.75 (.10)	34.54 (1.94)	.06 0	32.55 (2.33)
	100	0 0	26.88 (1.51)	0 0	26.17 (1.87)	1.43 (.08)	34.21 (.92)	0 0	32.28 (2.31)

[1]Values were found by calculating the cost differential between conventional and conservation practices which make the present value differences of current year equal to zero.

[2]Values in parentheses represent the cost per ton of reducing erosion with this system.