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THE IMPACT OF LANDOWNERSHIP FACTORS  
ON SOIL CONSERVATION

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Paper prepared for the  
American Agricultural Economics Association  
Annual Meeting  
University of Illinois  
July 29, 1980

Although soil erosion has been a recognized problem in the United States since the 1930's, recent soil losses have generated additional concern. This concern has been prompted by reports that soil erosion losses are increasing, thus intensifying air and water pollution problems and reducing the productivity potential of cropland. These reports accompany evidence that suggests further productivity increases from fertilizers, seed technologies, energy, and pesticides are uncertain (Crosson). These productivity trends, coupled with irreversible losses of agricultural land to urban and other uses and the possibility of increased demands for U.S. agricultural products, make the issue of conserving soil quality increasingly important.

In response to these concerns, the Soil and Water Resources Conservation Act of 1977 (P.L. 95-192) requires a continuing appraisal of the soil and water resources of the nation and analyses of the effectiveness of ongoing conservation programs. A 1977 General Accounting Office report to Congress concluded, however, that effective conservation policies may require identifying and seeking out landowners whose lands have critical erosion problems. Hypotheses about the impact of landownership characteristics such as tenure, income, and owner attitudes on soil conservation have been investigated in studies since the 1940's. Events of the 1970's have renewed interest in these hypotheses and have suggested new ones. The attention focused on the changing structure of agriculture has led to the hypothesis that a larger, more corporate agricultural structure will have unfavorable consequences for soil conservation. The objectives of this paper are, first, to examine different organizational structures to determine if there are differences in average erosion rates among them, and second, to reexamine traditional hypotheses about landownership and

soil erosion from a broader perspective than previous studies. If significant differences can be identified among landownership groups, this information could be used to develop and implement more effective conservation policies.

#### Factors Affecting Soil Erosion

Soil management decisions at the farm level have been analyzed in the context of maximizing expected net income over a planning horizon. The rational individual calculates the income effects of a proposed conservation program over time and compares these effects to his/her expected income over time without conservation measures. Within this framework, individuals sharing similar erosion problems may reach different conservation investment decisions depending on individual time preference or discount rates and the length of their planning horizon. A lower discount rate and a longer planning horizon are thought to encourage conservation decisions by increasing the present value of expected net revenues and by allowing sufficient time to recoup conservation investments. Recent research has emphasized the importance of low discount rates and very long planning horizons in conservation management decisions (Seitz, et al.).

However, numerous economic variables as well as personal characteristics of the owner can affect the individual's choice of a discount rate and planning horizon. Individuals with low current incomes and inability to obtain capital for conservation investments may not be willing or able to forego income to maximize expected net returns over a longer time period. Similarly, individuals in an uncertain economic situation will be inclined to use short planning horizons because they are unable to predict future costs and prices. It also is possible that older farmers with no heirs operate under shorter planning horizons than younger ones.

Institutional factors can affect the choice of discount rate and planning horizons as well. Lack of knowledge or non-acceptance of conservation principles can lead to unfavorable conservation decisions even where there are economically favorable alternatives. Insecurity of tenure, particular leasing arrangements, absentee ownership, small operating units, high property taxes and a lack of credit facilities have all been hypothesized to be further institutional obstacles to conservation.

Recently, it has been hypothesized that changes in the ownership and control of agricultural land will have important repercussions for soil conservation. A larger, more corporate agriculture, it has been suggested, will lack a conservation ethic and will choose a planning horizon and discount rate designed to maximize current income at the expense of future soil quality (Bible).

Researchers have previously examined many of these hypotheses through studies in small, relatively homogeneous areas with similar soils, climate, and topography. By minimizing changes in physical characteristics, management and ownership differences, if they exist, are identified more readily. Both economic and institutional factors were found to influence soil conservation decisions. Higher incomes were found to be associated with higher degrees of soil conservation in areas of the Midwest (Anderson, et al., Heady and Allen). Tenure problems and owner resistance to conservation were found to be prevalent on high erosion farms in a series of studies conducted in Western Iowa since 1947 (Frey, Held and Timmons, Blase and Timmons, Hauser). Leasing arrangements, in particular, were examined by researchers and conservation practices under crop-share leases were found to reduce landlord's income (Jensen, et al.). However, because of the relatively small geographical areas studied, it is

sometimes difficult to determine how representative these studies may be. Also, a disproportionate number of these studies have been conducted in only one region, the Corn Belt.

In the following sections of this paper, the influence of the organizational structure of landownership units on soil erosion will be examined on a regional and national basis. In addition, the economic and institutional hypotheses about landownership and conservation explored in earlier studies will be reexamined from a regional perspective.

#### Data

Data for this analysis were obtained from a merger of the 1977 National Resource Inventories (NRI) conducted by SCS and the 1978 Landownership Survey undertaken by the Natural Resource Economics Division (NRED), ESCS, USDA (Lewis). The SCS NRI provided basic data reliable at the state level on land use, land quality, potential cropland, and erosion. The survey was a two-stage sample of 70,000 primary sampling units (PSU) of generally 160 acres. Within each PSU, three randomly selected points were inventoried. The SCS provided NRED the name and address of the owner of the first point in each sample PSU. Of the 70,000 points, names and addresses for private landowners were available for 52,000 points and slightly more than 37,000 completed landownership questionnaires were returned after follow-up procedures. For these 37,000 responses, additional land use information from the SCS NRI was available and utilized in this analysis.

Our initial analysis focused on key landownership variables hypothesized to influence soil erosion, including type of organizational structure, income and tenure characteristics. As income and other landownership data

were not available for the corporations in our sample, one model was formulated to test for differences in mean erosion rates on land owned by different organizational units, and another model was developed to analyze erosion differences among different income and tenure groups. Analyses at the national and farm production region levels were conducted, allowing a broader examination of earlier findings. However, many possibly relevant variables and interactions among variables were omitted from this analysis. A more comprehensive analysis is planned to look at additional relationships between landownership variables and soil erosion.

Rainfall erosion data for this analysis were estimated from the Universal Soil Loss Equation (Wischmeier and Smith). It is difficult to separate the influence of management and physical factors on erosion from the Universal Soil Loss Equation data as management practices are a reaction to a natural environment. Nevertheless, in an attempt to determine the relative importance of management and physical factors in erosion differences, means for management and physical factors within the Universal Soil Loss Equation were analyzed for ownership categories. Distributions of land with conservation measures of minimum tillage or residue practices in effect were examined as a management indicator, and prime farmland and erosion prone land (subclass e) distributions were evaluated as a measure of physical factors.

#### Soil Erosion Rates and Organizational Structure

Dummy variables were used in a regression model to test for differences in mean erosion rates on cultivated cropland acreage owned by different organizational units (Table 1). The model was weighted by the expanded acreage estimates associated with each observation to account for probability of selection and nonresponse in the survey data. F-statistics were used to test

Table 1. Erosion on Cultivated Cropland by Type of Landownership Organization

Organizational Structure <sup>a</sup>	National	Northeast	Lake	Southeast	Mountain
	tons/acre/year				
Nonfamily Corporation <sup>b</sup>	4.98 (9,242) <sup>c</sup>	4.53 (364)	3.29 (471)	5.14 (748)	1.39 (1,385)
Sole Proprietor	.03 <sup>d</sup> (147,548)	1.47 (3,936)	-.74 (15,933)	1.09 (7,499)	.21 (10,777)
Family Ownership	.32 (144,956)	.89 (6,596)	-.50 (20,796)	6.36* <sup>e</sup> (3,227)	.18 (11,787)
Partnership with Family Members	-.24 (40,111)	8.58* (1,210)	-1.02 (2,543)	2.87 (1,354)	1.60* (3,395)
Partnership with Nonfamily Members	-.34 (5,129)	-.89 (167)	6.50* (144)	-1.42 (290)	.63 (628)
Family Corporation	-.51 (15,469)	7.62* (281)	-.58 (869)	.28 (201)	1.62* (3,541)
Other (includes no pluralities & estates)	-.13 (14,001)	1.66 (231)	-2.17 (667)	.62 (386)	1.01 (851)
F	.79	5.69	2.57	3.82	4.24
Degrees of Freedom	11,263	666	1,282	490	833

Note:  $R^2$  statistics for this analysis were .1 or less.

<sup>a</sup>Determined by plurality of acres owned.

<sup>b</sup>Intercept.

<sup>c</sup>Numbers in parentheses are cultivated cropland acreage estimates for each category in thousands.

<sup>d</sup>Total soil loss for nonintercept categories can be calculated by adding soil loss from the non-family corporation categories.

<sup>e</sup>Asterisk denotes significance at the .05 level.



the hypothesis that no difference between mean rates of erosion exists on the acreage owned by these different types of landowners. Individual coefficients were examined with t-tests. Because nonfamily corporations were the excluded category in this analysis, a coefficient for a given category represents the difference between the mean rate of erosion for that category and nonfamily corporations.

The results of the structure analysis indicate that nationally there are no significant differences in mean soil losses between different types of ownership groups. Since the value of the F-statistic was below the critical F-value at the .05 level, we could not reject the hypothesis that mean soil losses between groups are equal. This conclusion applied to a majority of the farm production regions tested as well. However, for four of the ten regions in the U.S., F-values exceeded the critical value, indicating differences in mean rates of erosion between groups did exist. Significantly, in none of these regions were these differences the result of higher average rates of erosion by nonfamily corporations. In the Northeast, Mountain, and Lake regions, the data indicate that most of the reported differences in erosion rates among types of landowners can probably be attributed to physical rather than management factors. Landownership categories experiencing more erosion had higher percentages of land with conservation practices in effect, but also owned considerably higher percentages of erosion prone land.

The situation in the Southeast region appeared to be somewhat different. In this region family ownerships averaged 6.36 more tons/acre of soil loss annually than did nonfamily corporations. While distributions of physical factors appeared to be important, management practices also differed between the two groups. Almost 57 percent of land owned by nonfamily corporations

was operated using minimum tillage or residue practices. Only 36.4 percent of land owned by families had these practices in effect. The data also indicated that cultivated cropland owned by families in the Southeast is apparently more susceptible to erosion than land owned by nonfamily corporations. While 45 percent of corporately owned cultivated cropland had a designated erosion hazard, 54 percent of such family owned land had this classification.

Several explanations for the difference are possible. First, crops grown may differ between groups. Corporate influence in vegetable production is very strong in this region, so erosion differences may reflect more erosive crops, such as tobacco or peanuts, grown by family farmers. It is also possible that owner attitudes toward conservation differ between corporations and family cropland owners in this region. Another possible explanation is that family landowners in the Southeast are smaller, less affluent, and have more problems obtaining capital for conservation investments than their corporate counterparts. These factors would result in shorter planning horizons and higher discount rates for conservation investments by family groups. While income data are not available for the corporations in our sample, income effects will be tested on data for noncorporate landowners in the following section.

#### Erosion Differences Among Noncorporate Landowners

A second weighted regression model with dummy variables was formulated to examine mean soil erosion differences on cultivated cropland among income and tenure variables found to be important in previous studies. Leasing information was not available in sufficient detail to be included. A portion of this analysis, differences in mean erosion rates among income cate-

gories for full-owner-operators, is presented in Table 2. F-statistics were used to test the hypothesis that mean rates of erosion on cultivated cropland owned by different income groups are equal, while t-tests were used to examine individual coefficients. As the income category of \$0-\$2,999 was the excluded category in this analysis, each coefficient represents the difference between the mean soil loss for that category and the low income excluded category.

The results of our analyses do not indicate that significant differences in soil erosion rates exist between tenure groups at the national level or within most regions. Significant differences between tenure group erosion means were found in two regions, but only in the Northeast region were average erosion rates on cultivated cropland owned by full-landlords higher than erosion rates for full-owner operators. Similarly, mean levels of erosion on cultivated cropland did not differ significantly among net farm income categories nationally and for most regions. Only within the Southern Plains region were lower mean levels of erosion associated with higher net farm income categories.

Instead, the relationship between net farm income and mean levels of erosion appeared to depend on the tenure category of the landowner. For full owner-operators, those who operate only land that they own, higher income levels were associated with lower rates of erosion, nationally, and within five out of ten regions in the United States. Nationally, mean levels of erosion for landowners reporting net farm incomes between \$3,000-\$9,999, \$10,000-\$19,999, and \$20,000-\$49,999 were 1.34, 1.49, and 2.31 tons/acre less, respectively, than lower farm income landowners reporting \$0-\$2,999 as annual income. Net farm income greater than \$50,000 did not appear to result in significantly lower erosion rates. However,

Table 2. Rates of Erosion on Cultivated Cropland by Net Farm Income, Full-Owner-Operators

Net Farm Income	National	Northeast	Corn Belt	Delta	Mountain	Southern Plains
	tons/acre/year					
\$ 0 - \$2,999 <sup>a</sup>	5.62 <sup>b</sup> (8,189)	1.69 (379)	13.78 (1,476)	14.29 (103)	.45 (364)	6.19 (549)
Less than \$ 0	.07 <sup>c</sup> (12,434)	7.80** <sup>d</sup> (219)	-2.83 (2,354)	12.17* <sup>e</sup> (212)	2.07** (2,137)	-.41 (1,258)
\$3,000 - \$9,999	-1.34* (15,229)	2.36 (661)	-6.53** (3,413)	8.65 (134)	1.45* (1,554)	3.16* (668)
\$10,000 - \$19,999	-1.49* (8,591)	1.35 (365)	-6.57** (2,709)	-4.89 (62)	1.43 (610)	-4.34** (441)
\$20,000 - \$49,999	-2.31** (6,902)	4.30 (191)	-9.40** (1,925)	-8.84 (212)	1.01 (784)	-3.25* (932)
\$50,000 and over	1.35 (2,600)	.02 (95)	1.98 (647)	-9.02 (414)	.69 (199)	-3.31 (354)
F	3.41	2.65	3.82	2.97	1.98*	2.29
Degrees of Freedom	1609	90	399	46	155	90

Note: R<sup>2</sup> statistics for this analysis were .27 and less.

<sup>a</sup>Intercept.

<sup>b</sup>Numbers in parenthesis are cultivated cropland acreage estimates in thousands.

<sup>c</sup>Total soil loss for nonintercept categories can be obtained by adding soil loss from the net farm income category of \$ 0 - \$2,999.

<sup>d</sup>Asterisks denote significance at the .05 level.

<sup>e</sup>Asterisk denotes significance at the .01 level.

the acreage represented by this group is relatively small and therefore subject to more sample error. The Northeast, Corn Belt, Delta, Southern Plains, and Mountain regions displayed a similar trend to varying degrees. In the Corn Belt, for example, landowners with net farm incomes of \$20,000-\$49,999 averaged 9.4 tons/acre less erosion on cultivated cropland than did low income owners of \$0-\$2,999.

In the Northeast, Delta, and Mountain regions, full-owner operators who experienced net losses had the highest reported erosion rates. Since the excluded category in this analysis was net farm income of \$0-\$2,999, t-values for coefficients in these regions may not be significant, although differences between erosion rates for net farm losses and other categories are pronounced. For example, in the Delta, landowners with net losses averaged 26.4 tons/acre soil loss compared to 3.0 tons/acre by the highest income landowners in the region.

The association between net farm income and erosion was confined to full-owner operators. Off-farm income and total income variables were also tested for mean erosion differences within tenure groups and for all data, but no significant trends were detected.

The relationship between higher incomes and lower rates of erosion for owner-operators appears to result from a combination of less erosive land and more conservation practices. Nationally, only 40 percent of cultivated cropland owned by the most affluent landowners is classified as having an erosion hazard, while 59 percent of cultivated cropland owned by the lowest income group is labeled erosion prone. This trend can be found in most of the regions of the United States. In terms of management, 60 percent of cultivated cropland owned by landowners with net farm income greater than \$50,000 had minimum tillage or residue practices in effect, while 47 percent

of such land owned by those with net farm incomes of less than \$3,000 had these practices at the national level.

In the five regions for which significant differences in mean erosion rates between farm income categories occurred, distributions of physical and management characteristics reflected the national trend. However, in two regions with major erosion problems, Appalachia and the Southeast, mean rates of erosion for full-owner operators did not differ among income groups. Furthermore, examination of land quality and management data for these regions did not reveal a well-defined pattern. One possible explanation is that for some of the crops important to these regions, such as tobacco, recommended tillage practices are erosive and higher incomes alone may not result in improved management practices. Owner attitudes toward conservation may differ in these regions as well.

#### Conclusions

Further research is needed to address the issue of landownership impacts on soil conservation. As noted earlier, this analysis is a partial one. Additional analysis is underway to provide a more comprehensive analysis of landownership factors, including age and education, that might affect soil conservation decisions. Also, our analysis is based on cross-section data from 1977-78. However, many of the relevant questions about landownership and conservation refer to dynamics--what are the implications of a changing structure of agriculture for soil conservation? Hopefully, this analysis will provide a first step toward subsequent long-run research on these questions.

With these qualifications in mind, this analysis does provide some insight into landownership impacts on soil conservation. First, these

data indicate that corporations do not have higher average rates of erosion than other types of landowners. Nationally, and within most regions, there do not appear to be significant differences in mean rates of erosion on cropland owned by different types of organizational units. Furthermore, with the possible exception of the Southeast, no significant differences in mean rates of erosion between types of landowners were found to be principally due to management.

For noncorporate landowners, the results of this analysis are generally consistent with previous studies with respect to net farm income, although no significant differences between rates of erosion and tenure groups were found. However, net farm income was found to exert more influence within the full owner-operator tenure group than other tenure categories. It is possible that if additional information on the type and length of lease were tied to the erosion data, erosion differences among landlords would be evident. However, as a group, landlords do not automatically appear to have more soil losses than those who operate their own land or those who combine landlord, tenant, and owner-operator functions. Full landlords and part-owners do appear to have a different relationship between net farm income and erosion than full owner-operators. Thus, policies designed to encourage conservation through income incentives may not have similar effects in all tenure groups. Currently, our research indicates only 25 percent of cropland in the United States is owned by full-owner operators. Another 30 percent is owned by full-landlords, and the remainder is owned by those who are a combination of landlords, tenants, and owner-operators.

Finally, this analysis indicates regional differences do exist, at least with respect to income and tenure variables. Of five regions in the United States experiencing average rates of erosion on cultivated crop-

land above 5 tons/acre, income and tenure variables provided some explanation of erosion differences in the Northeast, Corn Belt, and Delta.

For the Appalachian and Southeastern regions, however, another model may be more appropriate. The characteristics of the types of crops grown in these regions as well as owner attitudes toward conservation may provide some explanations.



## Footnotes

Linda K. Lee is an assistant professor in the Department of Agricultural Economics, Oklahoma State University. Research for this paper was supported in part by the U.S. Department of Agriculture. This is Professional Paper No. 889 of the Oklahoma Agricultural Experiment Station. The author wishes to thank Marilyn G. Kletke for computational assistance.

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