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Targeting Erosion Control

Economic Impact of the Conservation Targeting Program: Daviess and Harrison Counties, Missouri

A Report from a National Research Project

Research on targeting

U.S. DEPARTMENT OF AGRICULTURE PROJECT PERSONNEL

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Economic Impact of the Conservation Targeting Program: Daviess and Harrison Counties, Missouri, by Daryll D. Raitt. U.S. Department of Agriculture. Economic Research Service Staff Report No. AGES850903.

ABSTRACT

The economic impacts of the conservation targeting program are analyzed for Harrison and Daviess counties, Missouri. Long-term soil productivity losses associated with erosion are estimated using a productivity index model. Physical losses in productivity are translated into economic losses and evaluated as present values. The present value of alternative conservation practices to farmers and society is estimated as well as the net present value of the conservation targeting program.

Key Words: Conservation targeting program, long-term soil productivity, present value of erosion loss, net present value of conservation.

ACKNOWLEDGMENT

The author appreciates the typing assistance from the Department of Agricultural Economics, University of Missouri-Columbia.

1301 New York Ave., N.W.
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July 1986

PREFACE

A national program to target conservation efforts on critical resource problem areas was launched by the U.S. Department of Agriculture (USDA) in 1981. The decision to pursue this policy option for achieving conservation goals came about because of concerns expressed by Congress, the conservation agencies of USDA, others in the executive branch, and the public at large. The concerns focused on the observation that resource problems were concentrated in limited geographic areas, but that USDA conservation efforts were spread rather widely and uniformly throughout the agricultural areas.

Targeting was a central thrust of planning under the Resources Conservation Act passed by Congress in 1979 (RCA), and was seen as a way to increase effectiveness of public expenditures on conservation. The key agencies in designing and implementing the program are the Soil Conservation Service (SCS) and the Agricultural Stabilization and Conservation Service (ASCS).

The Agricultural Research Service (ARS) and the Economic Research Service (ERS) of USDA designed and carried out research on targeting in close cooperation with SCS and ASCS at the national, state, and county levels. The objectives of the research were to: (1) analyze the delivery system used in implementing the targeting program, (2) analyze factors associated with farmers' adoption of erosion control practices and identify characteristics of farmers most likely to respond to future conservation programs, and (3) analyze the impacts of the targeting program on farm income and long-term productivity.

The researchers did not address the question of whether the Federal Government should spend more or less on conservation efforts, or indeed whether it should spend any at all. Rather the research proceeded from the premise that because of public interest, constituent demand, and support from both Congress and the executive branch, USDA will continue to spend several hundred million dollars each year on conservation. Thus, the research question is whether greater payoff can be obtained from public investments through targeting of erosion control programs.

SCS and ASCS targeted resources for controlling water and wind erosion on cropland and rangeland, water conservation, and salinity problems. The research addresses programs for controlling water erosion on cropland only. Water erosion on cropland is the problem with the highest priority on USDA's agenda, and the one to which the largest proportion of targeted funds and personnel is devoted.

The researchers recognized that there is not a single "national" conservation problem, but rather problems of very different physiographic and socioeconomic areas across the country. Different approaches to program design and execution may be necessary. So the decision was made to study the targeting program in detail in one state in each of the four major water erosion areas that USDA targeted starting in 1981: Alabama in the Coastal Plains; Missouri in the Corn Belt; Tennessee in the Mississippi Valley Uplands; and Washington in the Palouse area of the Pacific Northwest.

The general approach was to start with the objectives of the targeting program; to see how these objectives were translated into an operating program in the field; and then to trace through the impacts of the program on farmers' adoption of erosion control practices, farm incomes, and other impacts.

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SUMMARY

Daviess and Harrison counties were designated as highly erosive counties and targeted for additional conservation funds. Average annual erosion exceeds 5 tons per acre on about 65 percent of the land in Daviess county and about 54 percent of the land in Harrison county. Row and grain crops account for 62 percent of the land and 90 percent of the erosion in Daviess county and 43 percent of the land and 84 percent of the erosion in Harrison county.

Historically, the majority of cost-sharing funds have been used to construct water control and terrace systems. More recently, the percentage of funds for water impoundments has decreased but terraces remain the mainstay of the cost-sharing program. In general, funds have been targeted to the most erosive soils in the counties, but not to the most efficient practices.

An analysis of the long-term economic impacts of conservation practices adopted as a result of the federal cost-sharing program for the years 1981-83 indicates that benefits exceeded costs in Daviess county but costs exceeded benefits in Harrison county. The present value of net benefits in Daviess county were $5.40 to society and $1.46 million to farmers. These benefits accrued due to the large net benefits resulting from conservation tillage which more than compensated for the net losses from the single practices of terracing or the combined practices of terracing and contour farming.

The Harrison county conservation program resulted in a long-term net loss of about $0.25 million to society and a $0.51-million loss to farmers. The net impacts of the program were negative in this county because of the high investments in structural measures to the exclusion of low-cost practices such as conservation tillage. This does not imply that conservation tillage was not adopted in the county. Rather, it indicates that conservation tillage was not reported as an integral part of the conservation plans adopted by farmers receiving cost-sharing.

The inference that can be drawn from the economic analysis of conservation practices applied in the two counties is that the conservation program should be centered around conservation tillage. It is the single practice with the highest net returns to both society and farmers in the short run as well as the long run. As a minimum, conservation tillage should be a prerequisite to cost-sharing for less efficient practices such as terracing. With conservation tillage as the first increment for reducing erosion, other practices designed to supplement this practice might be less costly.

The recent development of models specifying the relationship between soil productivity and levels of depletion provides the means for quantifying the long-term cost of erosion and the long-term benefits of various conservation practices. Further development and use of this methodology should be a high priority. This methodology can be used to target conservation funds on the basis of economic criteria which may be quite different than the physical measures of erosion now being used.

ECONOMIC IMPACT OF THE

CONSERVATION TARGETING PROGRAM

Daviess and Harrison Counties, Missouri

by
Daryll D. Raitt

INTRODUCTION

The goal of the conservation targeting program is to reduce erosion in designated highly erosive counties by the most practical and efficient means. The major objectives of this study are to quantify the long-term onsite effects of erosion, indicate the extent to which the targeting goal is being accomplished, and suggest changes which may accomplish the targeting goal more efficiently. This report is for the two counties selected in Missouri: Daviess and Harrison (map 1). Specific objectives are:

1. Explore the usefulness of the newly created 1982 National Resources Inventory (NRI) and the Conservation Reporting and Evaluation System (CRES) sets of data for evaluating the erosion problem.

2. Explore the usefulness of the Productivity Index (PI) developed by Clarence Scrivner, Department of Agronomy, University of Missouri, for quantifying the effects of erosion on crop yields.

3. Develop the methodology for using the above data sets as well as others for quantifying the onsite economic effects of soil erosion.

4. Quantify the reduction in erosion and long-term economic effects of alternative conservation practices or sets of practices.

5. Assess the long-term onsite economic effects of erosion reduction accomplished by the targeting program.

6. Suggest changes in data collection which would enhance the evaluation of conservation programs.

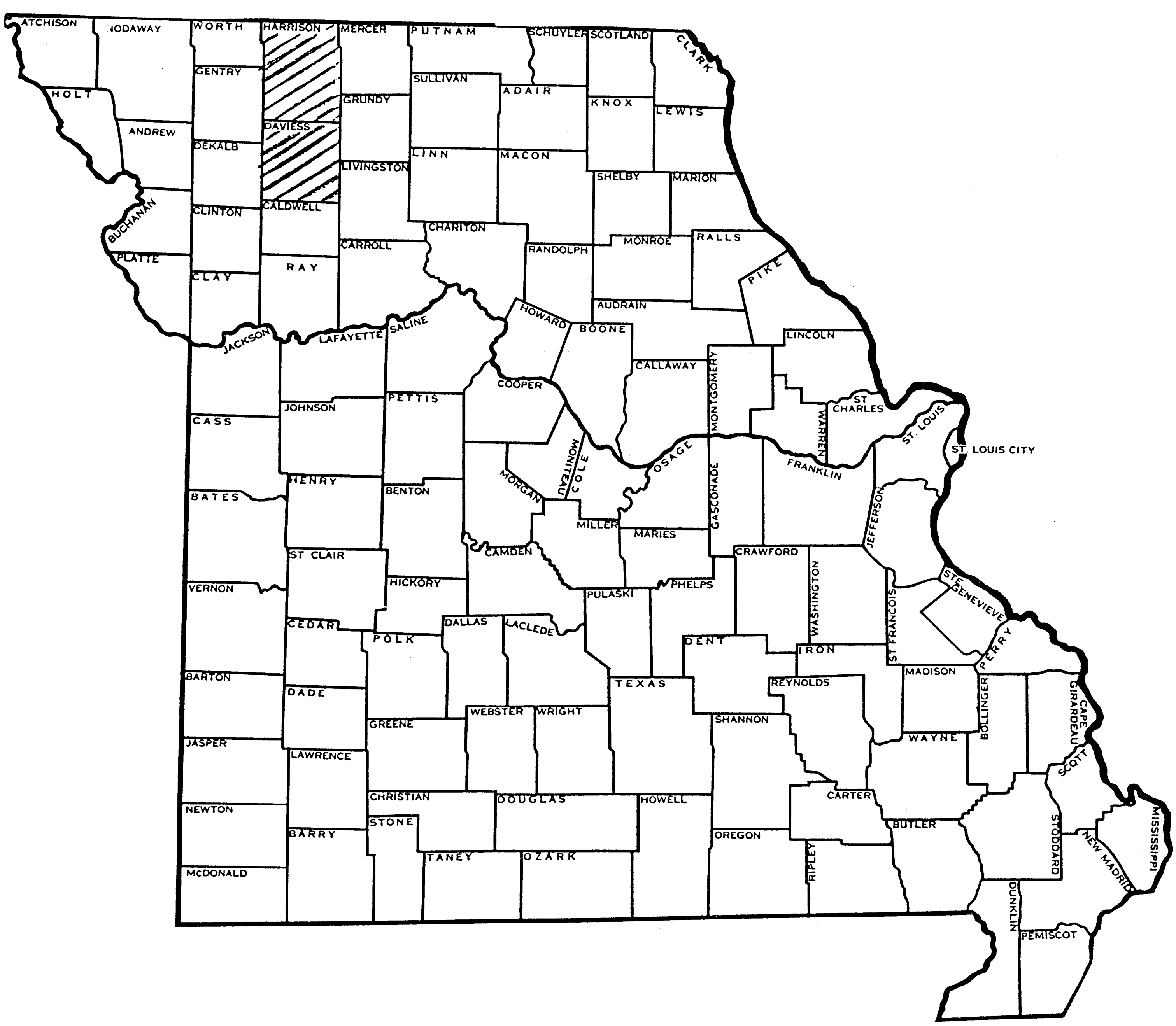
7. Suggest changes in the targeting program based on the study results.

THE SOIL EROSION PROBLEM

Under present conditions, average annual erosion in Daviess county is 3.3 million tons or 9.6 tons per acre. In Harrison county, 4.0 million tons erode at an annual rate of 8.9 tons per acre. While the amount of erosion occurring is useful in quantifying the relative magnitude of soil movement in an area, it is not a sufficient measure of the problem. The erosion problem is manifested by the physical and economic effects caused by this erosion. These effects should be the focus of any analysis of the soil erosion problem.

Basic to the analysis is an understanding of the soil erosion process, how it is estimated, and the relative importance of the underlying factors causing

Map 1. Location of Daviess and Harrison Counties, Missouri



erosion. The approach of this study was to analyze the contribution the underlying factors have on erosion, estimate the economic effect of this erosion, and evaluate the economic potential for reducing erosion by changing the underlying factors associated with various conservation practices.

Measurement of Soil Erosion

Water erosion occurs when soil particles are detached from the soil mass and transported to another location (1). (Underscored numerals in parentheses refer to items in References section.) Erosion occurs in three forms: sheet erosion whereby a fairly uniform layer of soil from the land surface is removed by water; rill erosion in which numerous small shallow channels are formed; and gully erosion where water accumulates in narrow channels. Gullies frequently remove soil from this area to considerable depths. The major detachment of soil is by sheet and rill erosion which is estimated by the Universal Soil Loss Equation (USLE). The formula is: A = RKLSCP. Soil loss, A, in tons per acre is a function of six major factors: R, rainfall intensity; K, a soil erodibility factor; L, slope length; S, slope steepness; C, vegetative cover and management; and P, a conservation support factor (2).

Values for the USLE equation were available for the two target counties from the recently completed 1982 National Resources Inventory (NRI). This data set, based on a sample statistically reliable sample at the country level, was used to quantify and analyze the erosion problem. A comparison of the land use and soils statistics with other sources indicated that NRI provided reasonable estimates of these two measures (see app. A).

Land Uses and Soil Groups

Two of the major determinants of soil erosion are the slope of the land, S, and the amount of vegetative cover (C). The vegetative cover is largely a function of land use and the slope is related to the soil and its position on the landscape. In order to consider the importance of these two factors, we partitioned the data set into four soil groups and seven land uses.

Soil group 1, representing the alluvial bottomlands, is the least erosive. Flooding and internal drainage are more predominate problems on this soil group. Soil groups 2, 3, and 4 are progressively more erosive upland soils. Soil group 2 generally occurs at the crest of a hill and groups 3 and 4 occur on the side slopes (fig. 1). Soil groups 2, 3, and 4 generally correspond to the SCS land capability classes II, III, and IV (See app. tables 16 and 17).

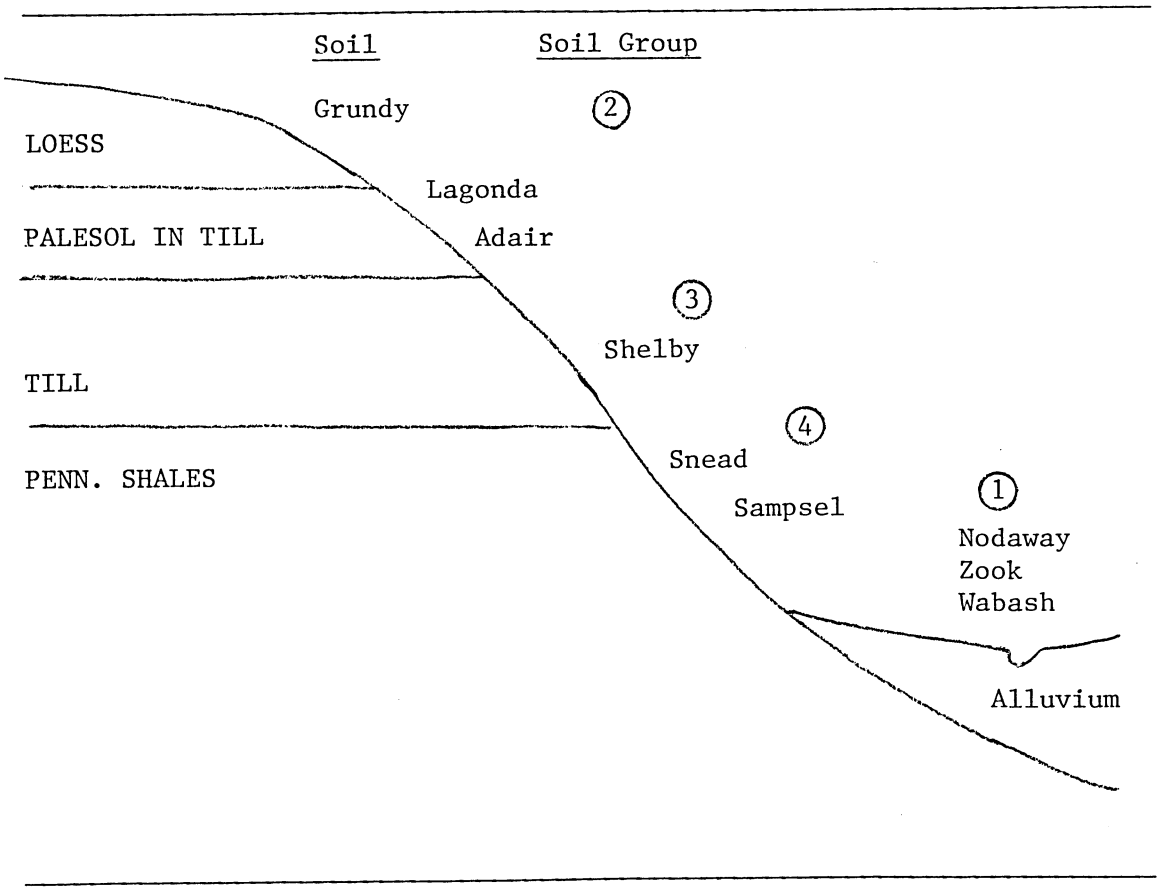
Land use was aggregated into four types of row and grain crops subject to annual tillage and three land uses not subject to annual tillage (tables 1 and 2). The cross-reference of seven land uses by four soil groups provided the basic inventory needed to quantify the erosion problem and solutions. Erosion rates were computed by soil groups, land uses, and conservation practices (see app. B for detailed data).

Erosion Distribution

If erosion rates are distributed normally about the mean, partitioning of data into more detailed sets is of less importance. As figure 2 illustrates, the distribution of erosion rates is skewed to the right in both counties resulting in a much higher percentage of land below the mean values than above. One result of these skewed distributions is that a higher percentage of land would need treatment in Harrison county (45 percent) to meet an erosion standard of 5 tons than in Daviess county (35 percent). This is just the opposite of what mean values alone would indicate.

One of the obvious reasons for the skewed erosion distributions for all land is the amount of land subject to tillage. Row and grain crops, the most erosive land uses, comprise 62 percent of the agricultural land in Daviess

Figure 1. Hillside profile of major soils by soil groups, Daviess and Harrison Counties



Source: Clarence Scrivner, Department of Agronomy, University of Missouri, Columbia.

county but contribute 90 percent of the erosion (table 3). In comparison, Harrison county intensively crops 43 percent of the land which contribute 84 percent of the erosion. Although a lower proportion of the land in Harrison county is cropped, the average erosion rate on this land is higher. The distributions of erosion rates for row and grain crops are presented in figure 3. Note that these distributions are still skewed to the left, although to a lesser degree than all land. Additional factors obviously cause the skewed distributions. These factors are largely related to attributes of the soils.

The partitioning of row and grain crops into the four soil groups previously described results in a further reduction of skewness in erosion rates (figs. 4 and 5). The remaining skewness can be attributed to other USLE factors and interaction between USLE factors. The percentage of row and grain land meeting tolerance rates of erosion can be read directly from these figures. Note that almost all of the land in soil group 1 meets the tolerance level of 5 tons per acre while less than 10 percent of the land in soil groups 2 through 4 is under the tolerance level of 3 tons per acre. The soil loss tolerance is

Table 1. Annual Sheet and Rill Erosion by Land Use and Soil Group, Daviess County, 1982

Land Use	Soil Group 1	2	3	4	Total
Total Area:	<---------------	1000 Acres	--------------->		
Corn & Sorghum	19.0	12.0	11.5	0.5	43.0
Soybeans	41.0	35.5	43.0	10.0	129.5
Wheat & Oats	4.0	8.5	14.0	3.0	29.5
Other Crops	1.5	2.0	4.0	.5	8.0
Row & Grain	65.5	58.0	72.5	14.0	210.0
Hay	2.0	6.0	11.0	1.5	20.5
Pasture	17.5	13.0	42.1	14.5	87.1
Forest	5.5	2.0	8.0	8.5	24.0
Total	90.5	79.0	133.6	38.5	341.6
Annual Erosion:	<---------------	1000 Tons	--------------->		
Corn & Sorghum	62.5	156.9	258.9	8.3	486.6
Soybeans	146.0	484.6	1022.2	302.4	1955.2
Wheat & Oats	12.0	85.0	211.7	100.3	409.0
Other Crops	3.5	20.7	69.6	9.6	103.4
Row & Grain	224.0	747.2	1562.4	420.6	2954.2
Hay	2.2	5.4	31.0	1.7	40.3
Pasture	13.0	30.7	83.3	123.8	250.8
Forest	.8	.4	10.3	24.1	35.6
Total	240.0	783.7	1687.0	570.2	3280.9
Annual Erosion Per Acre:	<---------------	Tons	--------------->		
Corn & Sorghum	3.3	13.1	22.6	16.5	11.3
Soybeans	3.6	13.7	23.8	30.1	15.1
Wheat & Oats	3.0	10.0	15.1	33.3	13.8
Other Crops	2.4	10.5	17.4	19.2	12.9
Row & Grain	3.4	13.0	21.6	30.0	14.1
Hay	1.1	.9	2.8	1.1	2.0
Pasture	.7	2.4	2.0	8.5	2.9
Forest	.1	.2	1.3	2.8	1.5
Total	2.6	10.0	12.6	14.8	9.6

defined as "the maximum level of soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely" (2).

The importance of land use and soils in determining erosion rates is summarized in table 4. Harrison county has more land in the more erosive soil groups 3 and 4 but a lower portion of land in row and grain crops in

Table 2. Annual Sheet and Rill Erosion by Land Use and Soil Groups, Harrison County, 1982

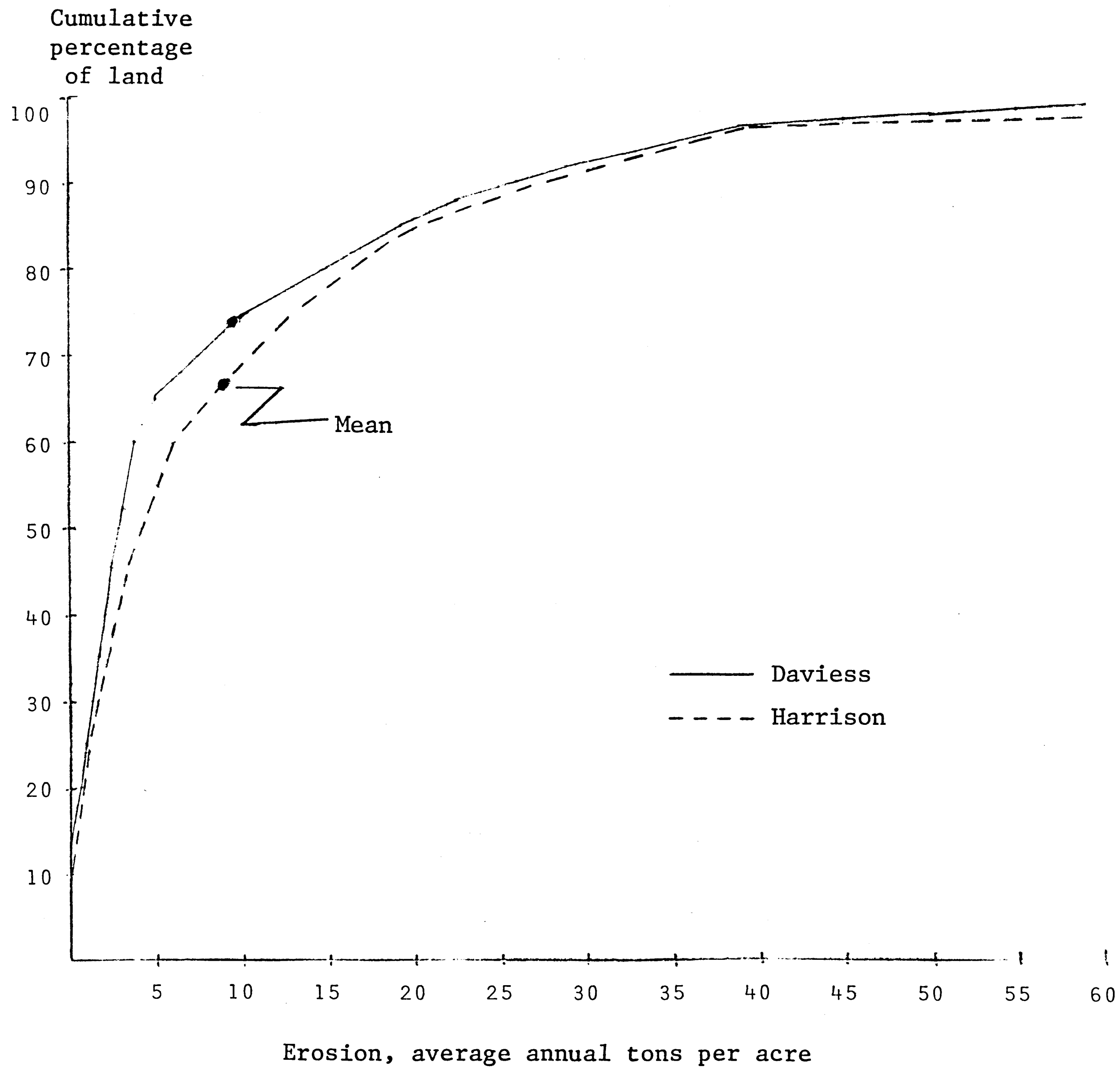
Land Use	Soil Group 1	2	3	4	Total
Total Area:	<--------------		1000 Acres	-------------->	
Corn & Sorghum	25.6	7.0	19.2	4.5	56.3
Soybeans	32.0	12.8	33.3	11.0	89.1
Wheat & Oats	.6	2.5	21.8	4.5	29.4
Other Crops	2.6	.7	6.4	2.5	12.2
Row & Grain	60.8	23.0	80.7	22.5	187.0
Hay	5.8	7.0	33.9	17.3	64.0
Pasture	30.7	6.4	67.8	61.3	166.2
Forest	7.1	0	5.9	14.0	27.0
Total	104.4	36.4	188.3	115.1	444.2
Annual Erosion:	<--------------		1000 Tons	--------------->	
Corn & Sorghum	74.5	83.0	496.3	211.5	865.3
Soybeans	109.3	154.3	937.5	377.9	1579.0
Wheat & Oats	2.1	24.5	349.1	202.4	578.1
Other Crops	4.5	1.3	166.7	104.4	276.9
Row & Grain	190.4	263.1	1949.6	896.2	3299.3
Hay	1.7	9.5	69.8	94.4	175.4
Pasture	7.7	5.2	126.1	311.6	450.6
Forest	.3	0	2.6	36.5	39.4
Total	200.1	277.8	2148.1	1338.7	3964.7
Annual Erosion Per Acre:	<----------------		Tons	------------------>	
Corn & Sorghum	2.9	11.8	25.8	47.1	15.4
Soybeans	3.4	12.1	28.1	34.6	17.7
Wheat & Oats	3.3	9.6	16.0	45.1	19.6
Other Crops	1.7	2.0	26.0	41.2	22.7
Row & Grain	3.1	11.4	24.1	39.9	17.6
Hay	.3	1.4	2.0	5.5	2.7
Pasture	.3	.8	1.9	5.1	2.7
Forest	.1	0	.4	2.6	1.5
Total	1.9	7.6	11.4	11.6	8.9

all soil classes. The percentage of land in row and grain crops decreases as the erosiveness increases from soil group 2 to 4 in both counties.

Relationship Between USLE Factors and Erosion

The average USLE factor values and the resulting erosion rates for the

Figure 2: Cumulative percentage of all land by erosion rates, Daviess and Harrison counties, 1982



major land uses are presented in table 5. Since the USLE is multiplicative, the larger the factor value, the higher erosion. The rainfall factor, R, was excluded because it is a constant, 200, for both counties.

The comparative values of average factors between land uses and counties give a general indication of the importance of each factor in explaining differences in erosion. For example, the higher average K factor for Daviess county indicates that the inherent erosiveness of soils is slightly higher in this county. The variation in this factor among land uses in both counties, however, is small, indicating that the K factor is relatively insignificant in explaining differences in erosion.

Table 3. Summary of Erosion and Acreage Distribution by Major Land Use, Daviess and Harrison Counties, 1982

Land Use	Daviess County			Harrison County		
	Erosion	Total Area	Proportion Eroding	Erosion	Total Area	Proportion Eroding
	Tons/Ac	<-Percent->		Tons/Ac	<--Percent-->	
Corn & Sorghum	11.3	13	15	14.6	13	22
Soybeans	15.1	38	60	17.7	20	40
Wheat & Oats	13.8	9	12	19.6	7	15
Other Cropland	12.9	2	3	22.8	3	7
Total Row & Grain	14.1	62	90	17.4	43	84
Hayland	2.0	6	1	2.7	14	4
Pastureland	2.9	25	8	3.1	37	11
Forestland	1.5	7	1	1.5	6	1
Total	9.6	100	100	8.9	100	100

An average P factor of less than 1.00 indicates the presence of contour farming since the P value for each acre contour farmed is from 0.5 to 0.6. The high P factors for both counties indicate that contour farming is not widely used.

The potential erosion is greater in Harrison county because of the higher average slopes, S, and length of slopes, L. The factor which results in average erosion being lower in Harrison county despite the fact that the potential erosion is greater is the lower cover or C factor. This reflects the lower proportion of land in crops subject to tillage.

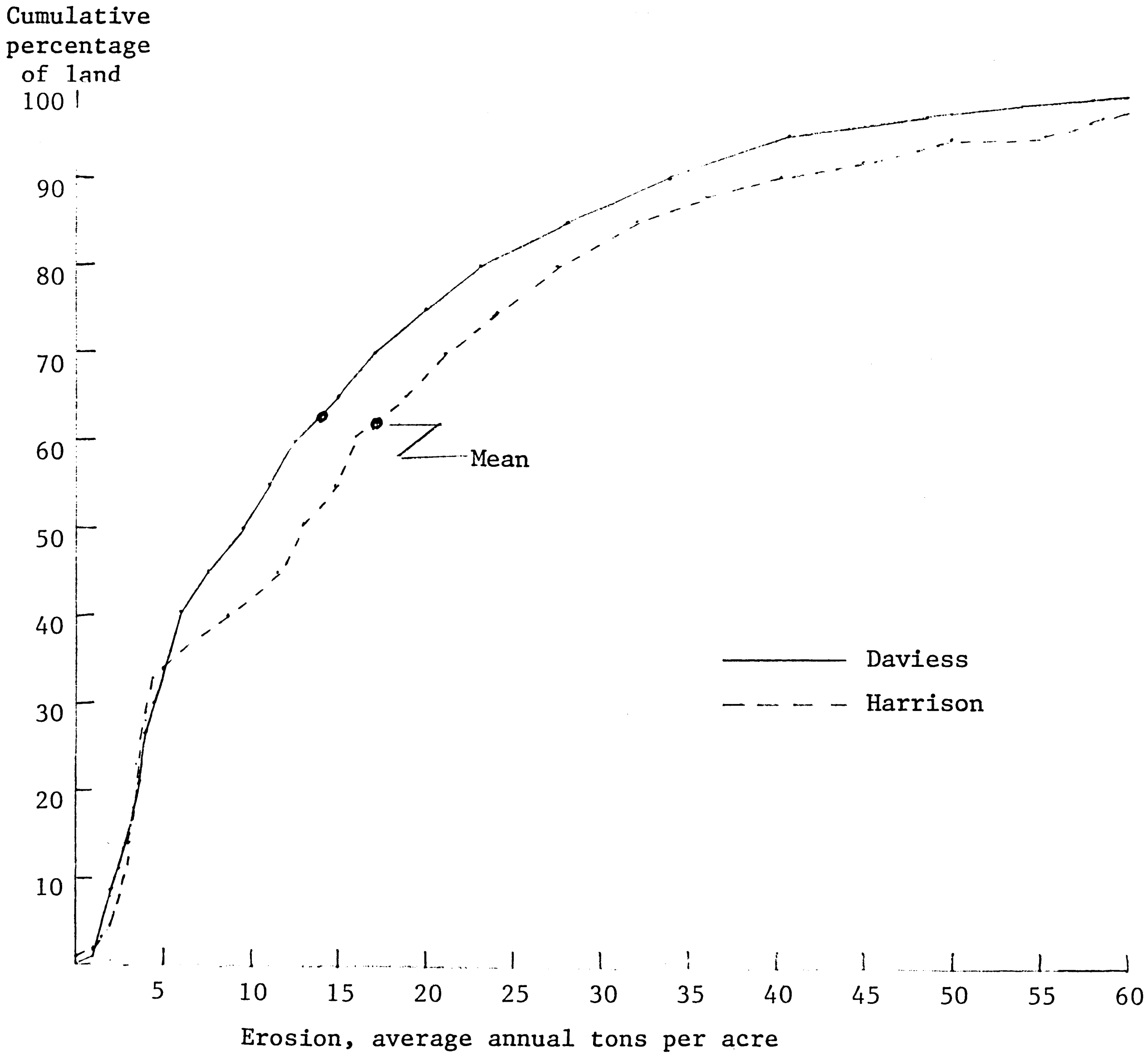
The high erosion on row and grain crops is due to the high average C factors (0.24 and 0.17) compared with permanent vegetation with C values of from 0.01 to 0.04. The potential erosion is in fact lower on row and grain land than on land with permanent vegetation. Because of lower average slopes, average erosion on hayland pasture and forest land ranges from 1.5 to 3.1 tons per acre compared with 14.1 and 17.4 tons per acre for row and grain land. Because of the low erosion on land in permanent cover, the remaining analysis focuses on row and grain cropland.

The average USLE factor values and erosion rates for row and grain crops partitioned by soil groups are presented in table 6. The major factor resulting in differences in erosion between soil groups is the slope factor.

POTENTIAL CONSERVATION MEASURES

Of the six factors used to estimate erosion, only P, L, and C are subject

Figure 3: Cumulative percentage of row and grain crops by erosion rates, Daviess and Harrison counties, 1982



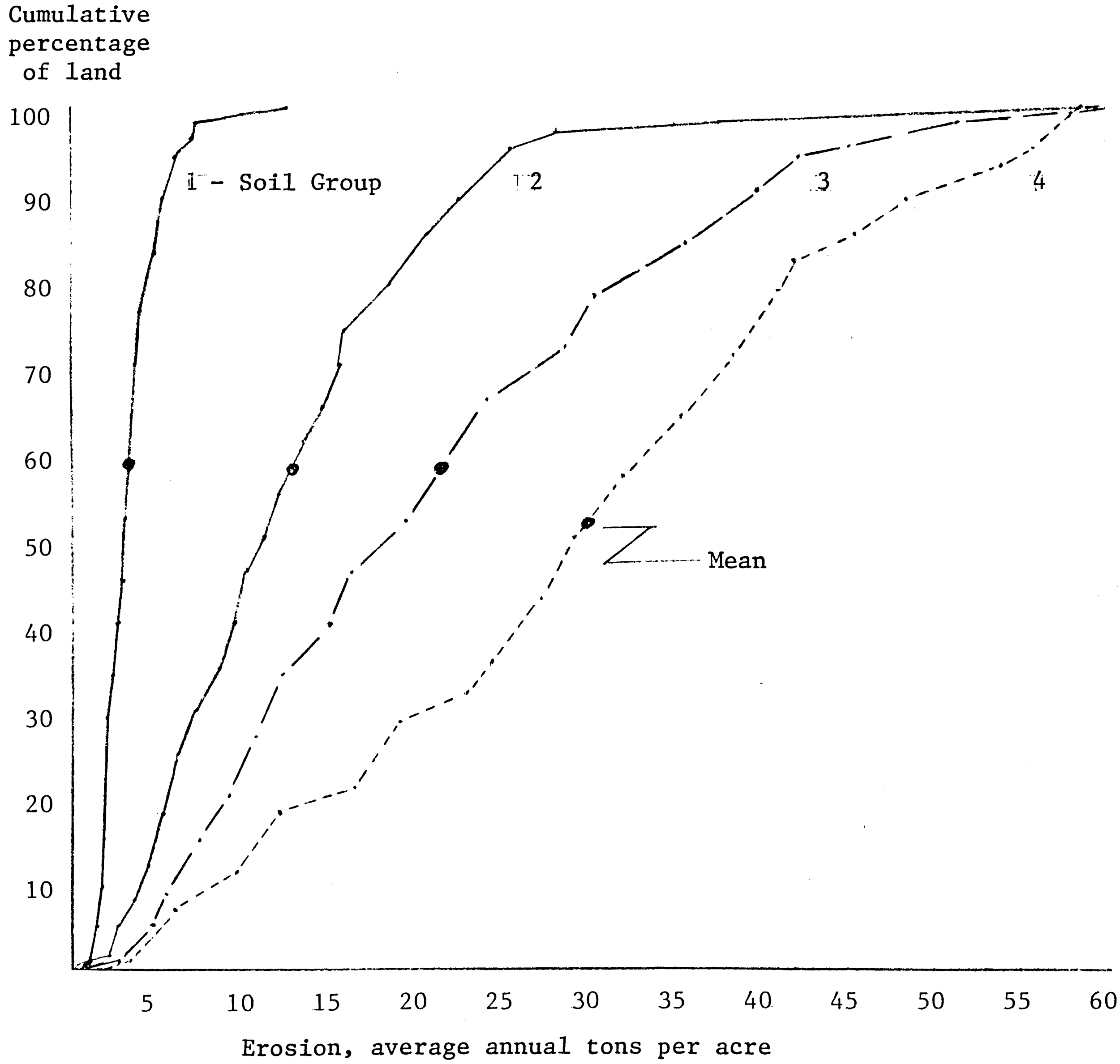
to change by management. Each conservation measure affects erosion through at least one of these factors. The conservation measures can be better understood if discussed in terms of these factor values.

Cover Factor, C

The greatest potential for reducing erosion is by changing the cover or C factor. In general, C factors ranging from 0.01 to 0.05 represent land in perennial vegetation. Figure 6 vividly illustrates those lands. Also illustrated is the higher proportion of land in permanent cover in Harrison county which results in a lower average C factor for all land and consequently lower average erosion.

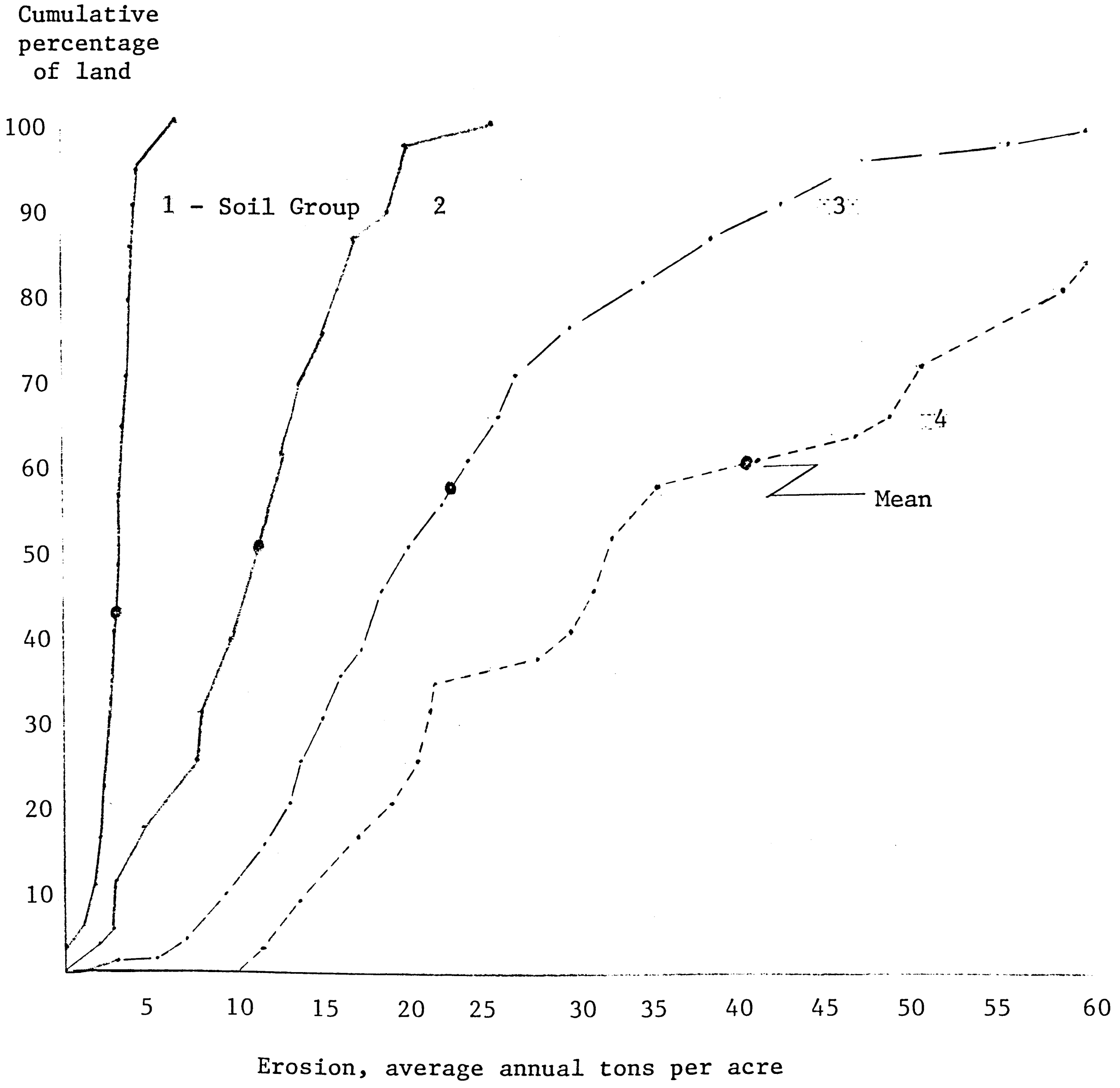
The higher C factors are associated with row and grain land. The distri-

Figure 4: Cumulative percentage of row and grain crops by erosion rates and soil groups, Daviess county



bution of C factors on this land is skewed to the left indicating a larger proportion of C factors in the higher range (fig. 7). The range in C factors for corn and soybeans by four types of tillage is illustrated in figure 7 as an indication of the type of tillage presently used. About 80 percent of the row and grain land in both counties has C factors greater than 0.3 indicating the prevalence of plowing or its equivalent. Since the distribution is based on NRI field observations of cover, these data should be a better indication of the type of tillage being practiced then other estimates of reduced tillage. Basic C factors for specific types of tillage practices on the major crops are indicated in table 7. A full range of C factors between these values are possible for various rotations.

Figure 5: Cumulative percentage of row and grain crops by erosion rates and soil groups, Harrison county



The potential for reducing erosion by increasing cover on the four soil types is illustrated in figure 8. The upper end point of each function represents fall plowing. The difference between these values and present values represents the extent to which reduced tillage is currently being practiced. The point estimates for minimum tillage represent tillage operations which result in 30-percent cover. The variance in these values for the four soil types is due to differences in crop combinations and rotations.

Although almost all of the land in soil group 1, the alluvial soils, is plowed as indicated by the high C factor, the average erosion rate on this land is well below the tolerance level of 5 tons per acre. The tolerance level

Table 4. Summary of Erosion and Acreage Distribution by Soil Resource Groups, Daviess and Harrison Counties, 1982

Soil Group	Total Acres: Distribution	Total Acres: Erosion	Row & Grain Crops: Portion of Soil Group	Row & Grain Crops: Erosion
	Percent	Tons/Ac	Percent	Tons/Ac
Daviess County:				
1	27	2.6	72	3.4
2	23	10.0	73	12.9
3	39	12.6	54	21.6
4	11	14.8	36	29.9
Total or Average	100	9.6	62	14.1
Harrison County:				
1	24	1.9	58	3.1
2	8	7.6	63	11.4
3	42	11.4	43	24.1
4	26	11.6	20	39.3
Total or Average	100	8.9	43	17.4

Table 5. Summary of USLE Factor Averages by Major Land Uses, Daviess and Harrison Counties, 1982

County and Land Use	USLE Factors: C	K	P	S	L	Average Annual Erosion1/
	<---------		Value		--------->	Tons/Acre
Daviess County:						
Row and Grain	0.38	0.35	0.97	3.8	201	14.1
Hayland	.04	.35	1.00	4.7	166	2.0
Pasture	.04	.33	1.00	6.1	212	2.9
Forest	.01	.32	1.00	8.3	168	1.5
Total	.24	.34	.96	4.8	199	9.6
Harrison County:						
Row and Grain	.37	.33	.95	4.8	200	17.4
Hayland	.03	.32	.98	7.4	260	2.7
Pasture	.03	.30	1.00	8.4	212	3.1
Forest	.01	.30	1.00	9.5	222	1.5
Total	.17	.31	.98	6.8	214	8.9

1/ Computed by aggregating individual sample point data from NRI. Computation of erosion using average values presented may be different.

Table 6. Summary of USLE Factors Average for Row and Grain Crops by Soil Groups, Daviess and Harrison Counties, 1982

County and Soil Group	C	K	P	S	L	Average Annual Erosion1/
	USLE Factors					
	<--------- Value --------->					Tons/Acre
Daviess County:						
1	0.40	0.33	0.99	1.0	140	3.4
2	.38	.37	.90	3.7	227	12.9
3	.36	.33	.91	5.7	237	21.6
4	.36	.34	.83	8.1	192	29.9
Total	.38	.35	.97	3.8	201	14.1
Harrison County:						
1	.42	.31	.99	.9	113	3.1
2	.37	.37	.94	3.3	281	11.4
3	.35	.33	.94	6.7	234	24.1
4	.34	.31	.90	10.5	229	39.9
Total	.37	.33	.95	4.8	199	17.6

1/ Computed by aggregating individual sample point data from NRI. Computation of erosion using average values presented may be different.

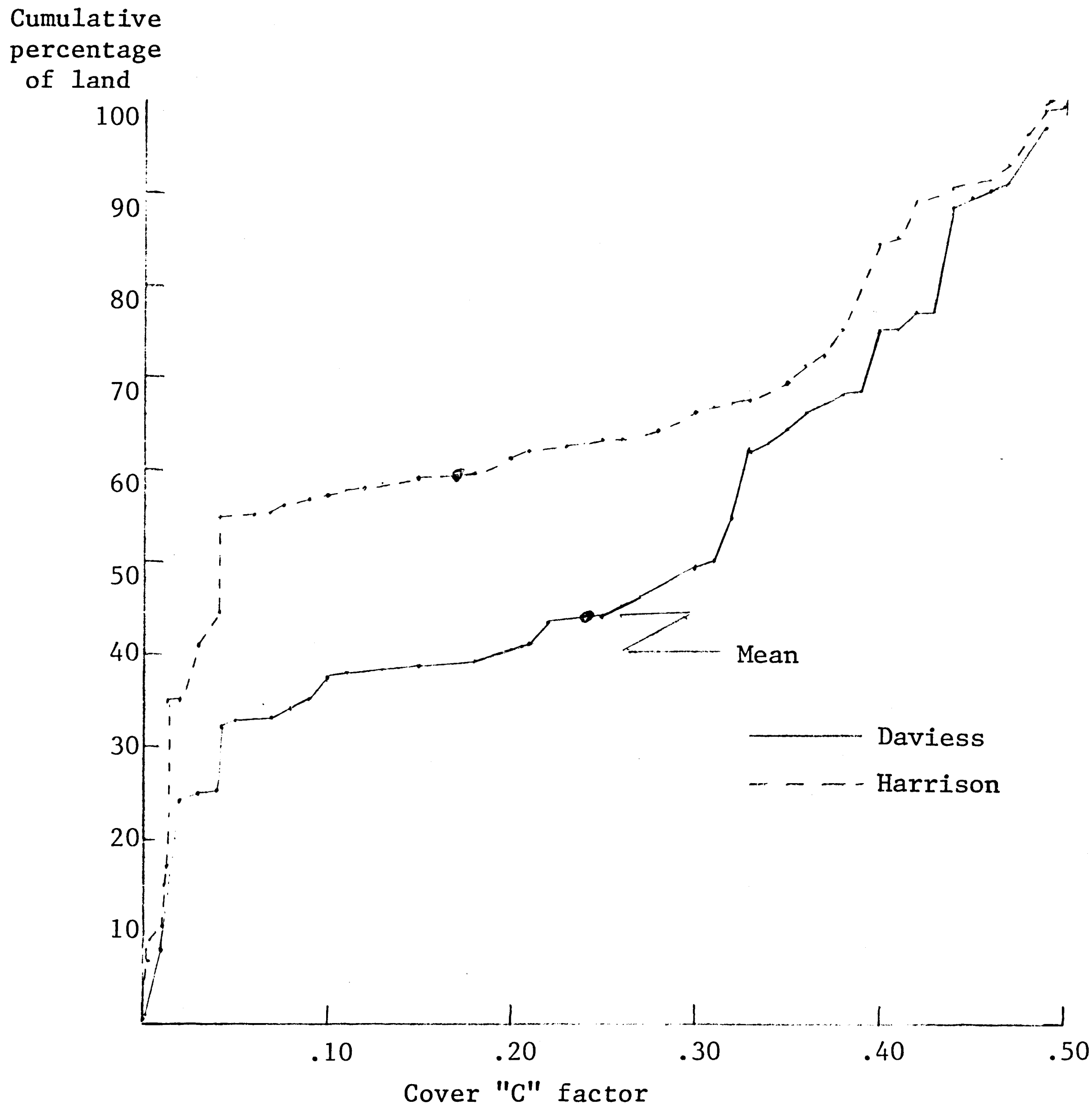
of 3 tons per acre for the three upland soil groups would require C factors of from about 0.02 to 0.09. Zero tillage would permit meeting the tolerance level on soil group 2. However, the C factors necessary for meeting the tolerance levels on soil groups 3 and 4 could only be attained by including a sod-type crop in the rotation or changing the land use to permanent vegetation.

The large difference in erosion reduction possible by reducing cover between soil groups is due to the progressively greater slopes. Consequently, the average erosion reduction possible from practicing zero tillage on soil group 4 is about three times as great as on soil group 2. Thus, if tons of soil reduction was the main criteria for targeting erosion control practices, the steepest soils would merit priority.

Conservation Support Factor, P

The management practice used in the area which is represented by the P factor is contour farming. The amount of erosion reduction possible with contour farming is 50 percent or less depending on the slope and vegetative cover. Average P values and estimated reductions in erosion possible for row and grain crops presently grown are shown in table 8. The percentage reductions possible as indicated in this table are somewhat less than that indicated by the P value because contour farming is presently practiced on 15 percent of the land in Daviess and 9 percent in Harrison county.

Figure 6: Cumulative percentage of all land by cover factor, Daviess and Harrison counties, 1982

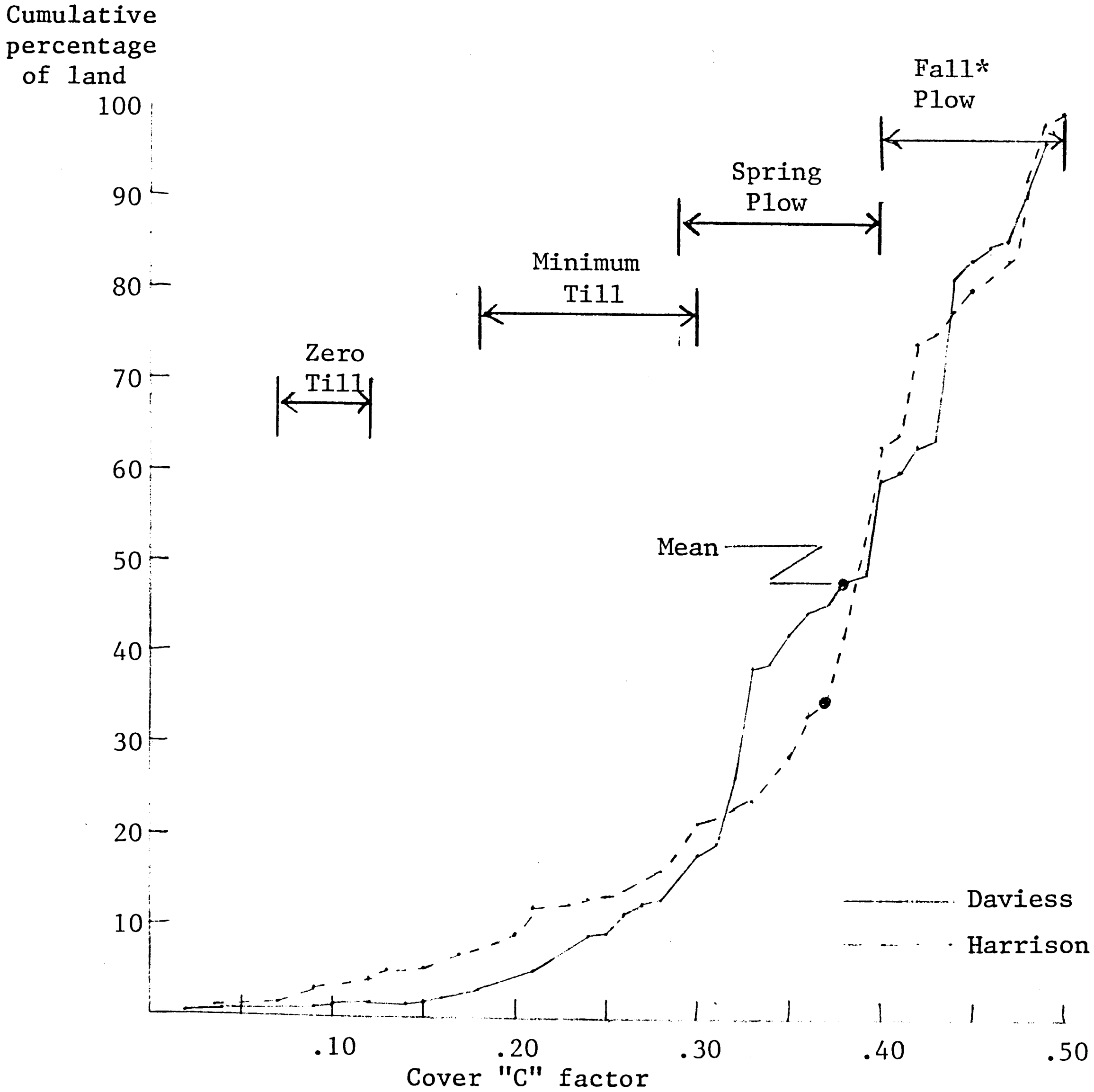


Slope Length Factor, L

The conservation practice associated with the length of slope factor, L, is terracing. About 9,300 acres or 4 percent of the row and grain land in Daviess county and 6,400 acres or 3 percent of this land in Harrison county is terraced. Most of the terraced land is also contour-farmed.

Terracing is most effective when applied to land with long slopes. These long slopes are broken into smaller segments by spacing terraces about 120 feet apart. Using this average spacing, land with slope lengths of less than 120 feet could be categorized as not suitable for terracing. In practice, slope lengths for a particular field vary, and some areas with shorter slopes may also be terraced. However, terracing is practiced mainly on fields with the

Figure 7: Cumulative percentage of row and grain crops by cover factor, Daviess and Harrison counties, 1982



* Ranges for corn-soybean combinations

longer slope lengths. For purposes of analysis, two categories of slope lengths were considered, land with slope lengths greater than 120 feet and land with slope lengths greater than 200 feet.

The distribution of slope lengths for row and grain crops indicates that about 64 percent of this land in both counties has slope lengths greater than 120 feet (fig. 9). The percentage of this land with slope lengths greater than 200 feet is 30 percent for Harrison county and 40 percent for Daviess county.

The potential for reducing erosion by the combined practices of terracing and contour farming is shown in table 9. Contrary to what might be expected,

Table 7. Basic "C" Factors for Alternative Land Uses and Type of Tillage Operations 1/

Crop	Fall Plow	Spring Plow	Minimum2/ Tillage	Zero Tillage
	Type of Tillage			
	<------------- "C" Factor ------------->			
Corn:				
After Corn	0.36	0.29	0.18	0.03
After Beans	.42	.36	.30	.12
Soybeans:				
After Soybeans	.48	.41	.35	.12
After Corn	.40	.33	.17	.03
Continuous Wheat	.19	--	.07	.03

1/ Source: John McCarthy, 4/16/84, SCS State Office, Columbia, Missouri.

2/ Assumes 30-percent cover.

the average erosion reduction (13 tons per acre) for areas with slope lengths greater than 120 feet in Daviess county is the same as for areas with slope lengths greater than 200 feet. This results because of the interaction between slope length and slope in soil groups 3 and 4. As slope lengths increase, slope decreases. This relationship demonstrates the value of the NRI point sample data. If only mean values for the soil groups rather than point sample data were available, there would be no basis for partitioning data by length of slopes and reflecting these interactions. Interactions are less important in Harrison county. The average erosion reduction possible from contour farming and terracing increases from 15.7 tons per acre for areas with slopes greater than 120 feet to 19.6 tons per acre for the longer slope area.

The middle soil groups, 2 and 3, account for about three-fourths of the land with a potential for terracing for both slope length categories. The average potential for erosion reduction by terracing and contour farming on even the longer slopes in soil group 1 is less than 3 tons per acre. Terracing is not generally recommended by conservationists for this soil group.

LONG-TERM ECONOMIC IMPACTS OF SOIL EROSION

Knowing the present underlying source and amount of erosion and the potential reduction possible with alternative conservation measures is a necessary but not sufficient condition for estimating erosion impacts. The major onsite effect of soil erosion is the reduced crop productivity which usually occurs as the soil is depleted. To estimate this impact, one must establish the physical relationship between crop yields and level of soil depletion. These relationships can then be translated into economic effects.

Figure 8: Relationship between average "C" factor and average erosion by soil groups for row or grain crops, Daviess and Harrison counties, 1982

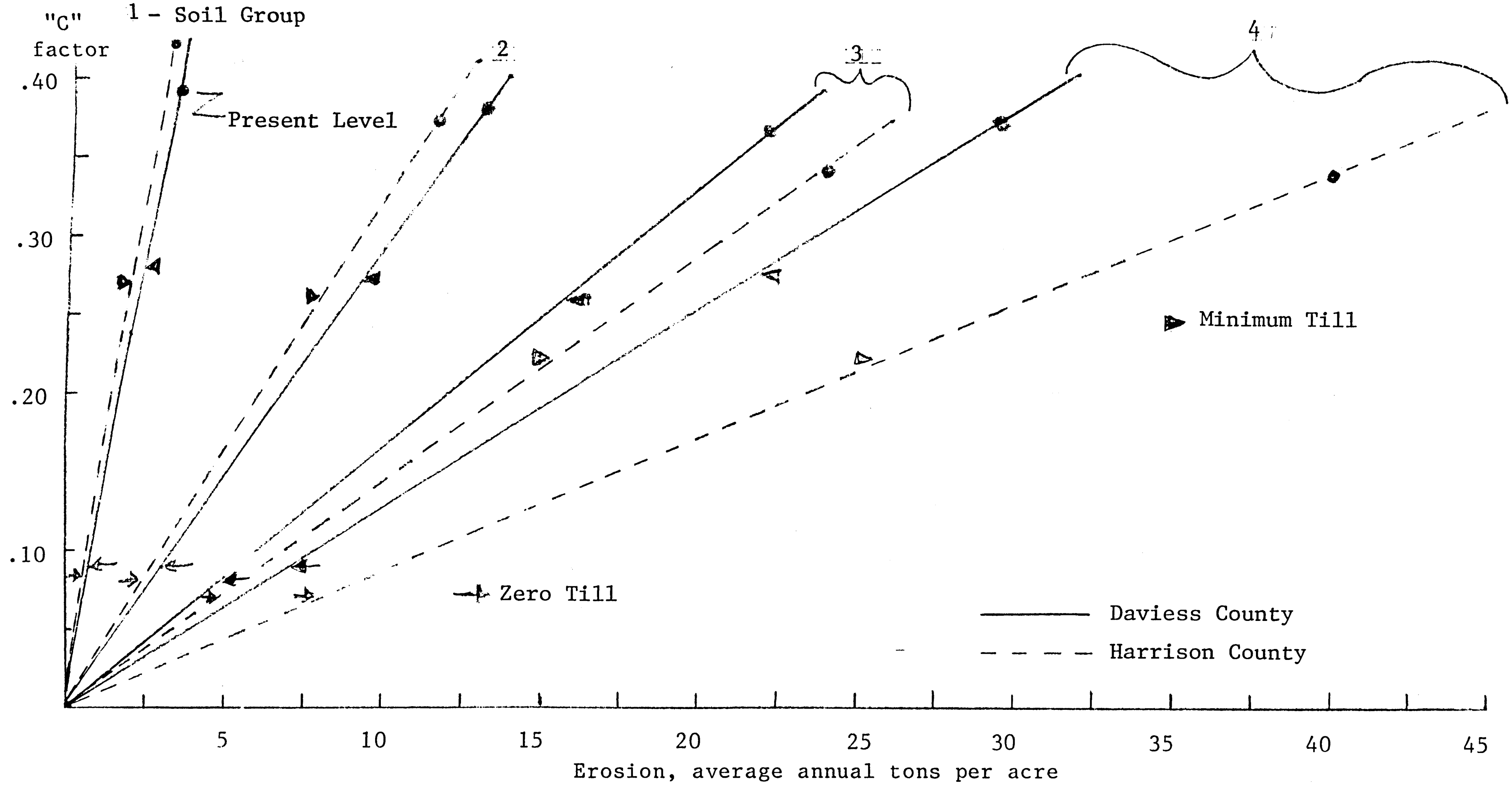


Table 8. Potential Average Erosion Reduction by Changing the P Factor with Contour Farming, Daviess and Harrison Counties, 1982

Soil Group	Average Erosion Present	Average Erosion With Contour	P Factor	Erosion Reduction
	<--- Tons/Ac.	--->	Value	Percent
Daviess County:				
1	3.4	1.7	0.5	50
2	12.9	7.2	.5	44
3	21.6	11.9	.5	45
4	29.9	21.8	.6	27
Average	14.1	8.1	.5	43
Harrison County:				
1	3.1	1.6	.5	50
2	11.4	6.1	.5	46
3	24.1	12.6	.5	48
4	39.3	26.7	.6	32
Average	17.6	9.9	.5	44

Soil Depth and Productivity

The relationship between soil depth and soil productivity was estimated by a model recently developed by Clarence Scrivner of the Agronomy Department, University of Missouri-Columbia (3). Dr. Scrivner provided the basic soils data and assisted in using the model to estimate the effects of erosion on the four soil groups. The model simulates the effects of the remaining soil profile on plant growth as incremental amounts of soil are removed by soil erosion. The effects, as measured by a productivity index, were simulated for 4-inch incremental layers of soil up to 20 inches (figs. 10 and 11). This model does not consider the mixing of soil layers by mechanical tillage. These graphs illustrate the wide variance in basic productivity depending on the soil and level of depletion. As expected, productivity decreases on the upland soils groups 2, 3, and 4 as erosion occurs. In contrast, the productivity of soil group 1, the alluvial soils, increases with the removal of some soil layers. Because of flooding hazards, the basic productivity of these soils as estimated by the model was reduced by from 12 to 28 percent (see app. C).

Effects of Erosion on Income

The productivity indices were used as a basis for estimating current yields and gross incomes per acre for the major row and grain crops in each

Table 9. Potential Erosion With and Without Contouring and Terracing for Row and Grain Crops, Daviess and Harrison Counties, 1982

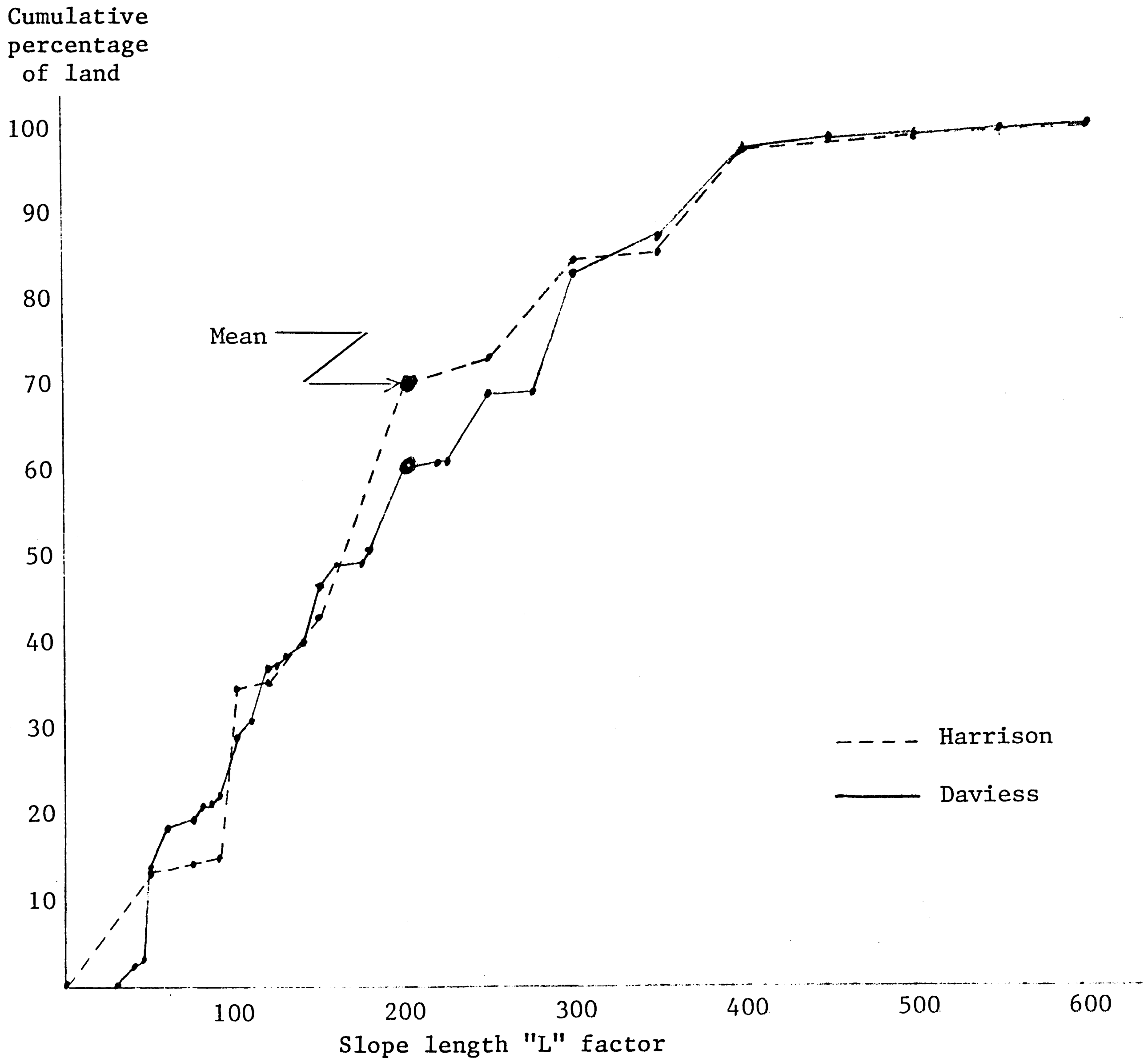
Item	Unit	Soil Group 1	2	3	4	Total or Average
Daviess County:						
L > 120 Feet	1000 Ac	20.5	43.5	57.5	10.0	131.5
Erosion Without1/	Tons/Ac	4.2	16.0	25.7	38.9	20.2
Erosion With1/	Tons/Ac	1.6	5.8	8.6	16.8	7.2
Difference	Tons/Ac	2.6	10.2	17.1	22.1	13.0
L > 200 Feet	1000 Ac	13.5	28.0	37.0	5.0	83.5
Erosion Without	Tons/Ac	4.4	17.4	24.6	29.8	19.2
Erosion With	Tons/Ac	1.5	5.8	7.5	11.9	6.2
Difference	Tons/Ac	2.9	11.6	17.1	17.9	13.0
Harrison County:						
L > 120 Feet	1000 Ac	16.0	20.5	65.9	17.3	119.7
Erosion Without	Tons/Ac	3.1	12.3	26.8	50.1	24.5
Erosion With	Tons/Ac	1.4	4.2	9.0	20.0	8.8
Difference	Tons/Ac	1.7	8.1	17.3	30.1	15.7
L > 200 Feet	1000 Ac	4.5	12.8	28.8	9.6	55.7
Erosion Without	Tons/Ac	2.7	13.0	30.4	53.8	28.5
Erosion With	Tons/Ac	1.1	4.1	8.8	19.5	8.9
Difference	Tons/Ac	1.6	8.9	21.6	34.3	19.6

1/ With and without contour farming and terracing.

soil group. Average crop yields and prices for the 1979-83 period were used to reflect average current conditions. Gross incomes were estimated for each 4-inch layer of soil by soil resource groups (see app. C for methodology).

The transformation of crop yields into dollars permits estimating the value of each inch of soil removed. The loss in income per acre inch of soil loss is presented in table 10. The value of the loss in productivity due to erosion varies from 0 to $7.74 per acre inch eroded depending on the upland soil and level of depletion. The negative values for soil group 1 reflects gains in productivity and income for these layers of soil.

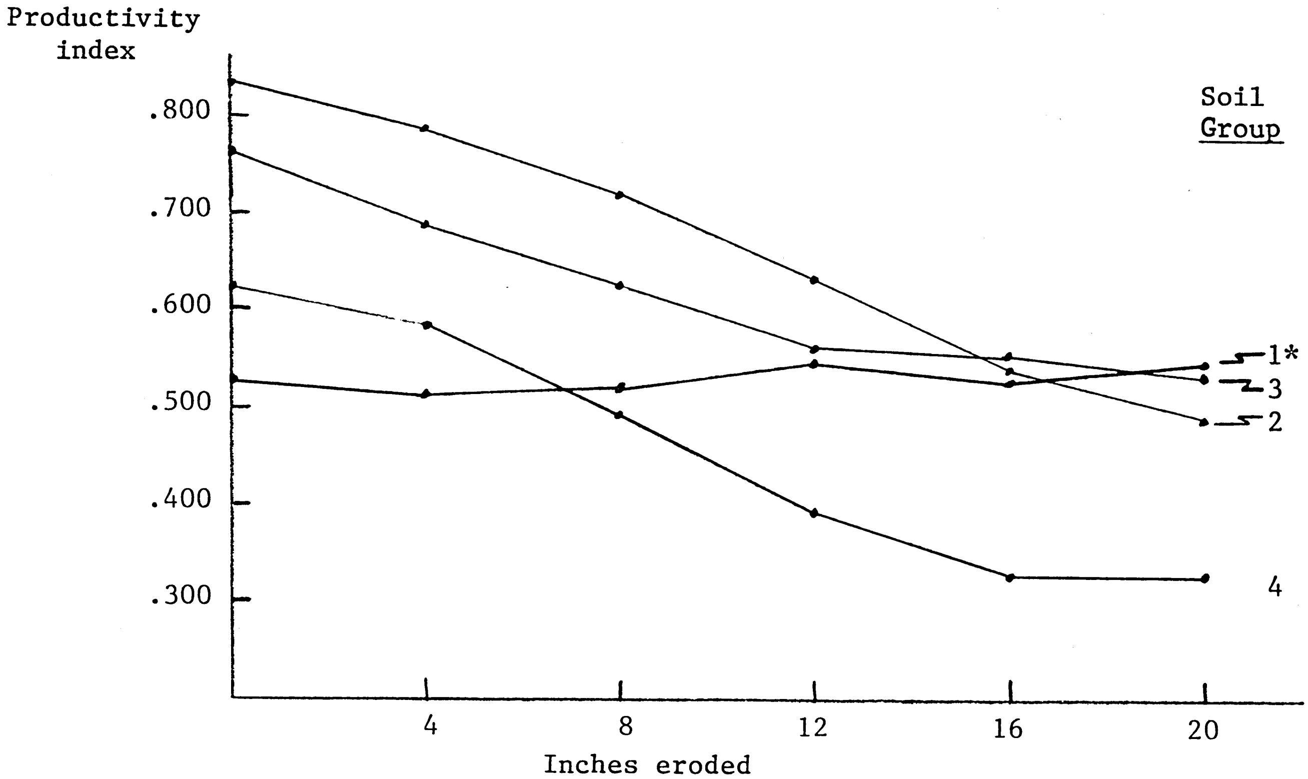
Figure 9: Cumulative percentage of row and grain crops by erosion rates, Daviess and Harrison counties, 1982



Although the losses for a particular soil group are different for the two counties, the weighted average losses for all soils are almost the same. A generalized loss function for all soils decreases at a more rapid rate after 4 inches are eroded, then continuously decreases at a lower rate after 8 inches are eroded.

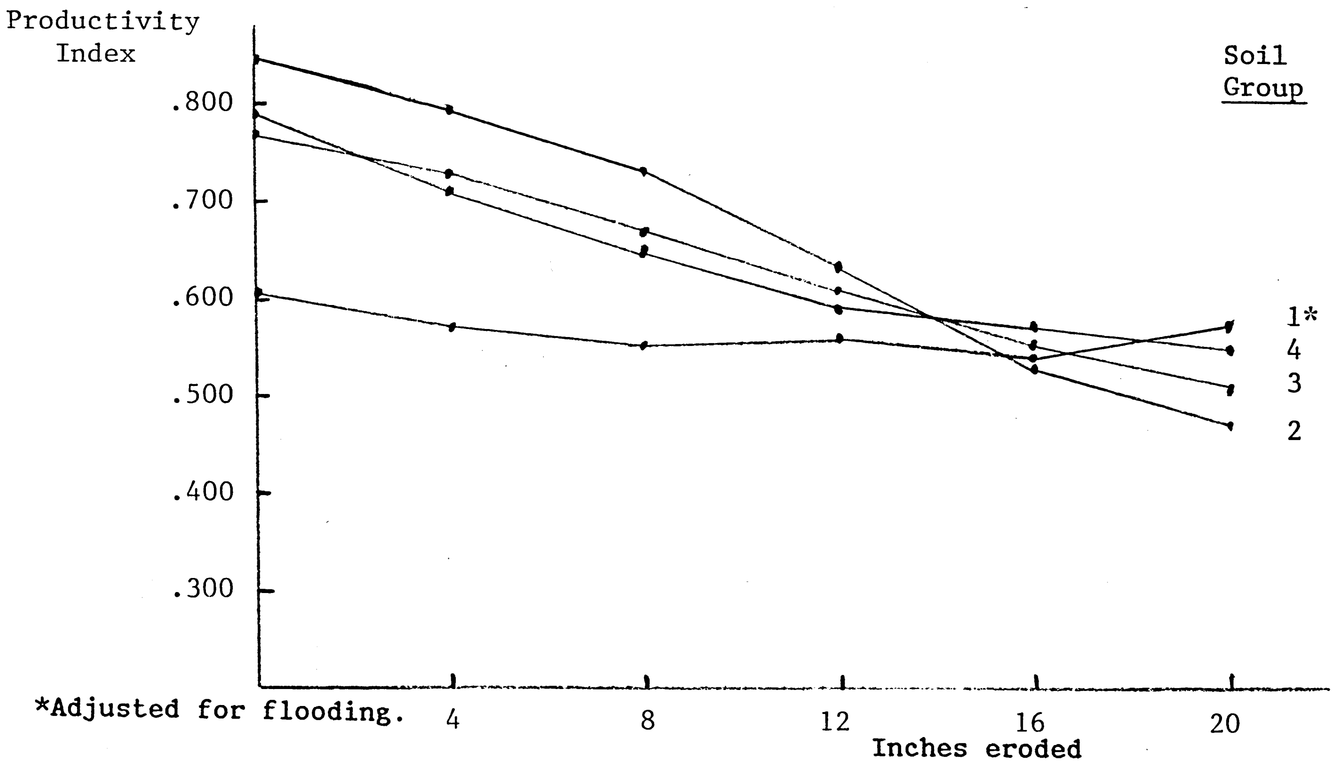
Given these values, the average annual losses in income due to the reduced productivity associated with present rates of soil erosion can be estimated. The annual loss in income for present rates of erosion varies from 0 to $1.45 per acre depending on the soil, soil layer, and rate of erosion (table 11). The low annual values are one reason for the lack of concern for erosion by many in the short run. However, because these losses are accumulative, they

Figure 10. Relationship between productivity index and inches of soil eroded by soil groups, Daviess county



*Adjusted for flooding

Figure 11. Relationship between productivity index and inches of soil eroded by soil groups, Harrison county



*Adjusted for flooding.

Table 10. Average Loss in Income Per Acre Inch of Soil Eroded, Row and Grain Land, Daviess and Harrison Counties

Soil Group	Inches of Soil Eroded 0-4	4-8	8-12	12-16	16-20
	<-- Loss in Dollars Per Acre Inch1/ -->				
Daviess County:					
1	1.01	0.16	-2.87	1.47	-0.78
2	3.46	5.01	6.04	7.15	3.54
3	5.40	4.32	4.75	.07	2.30
4	2.70	6.22	6.91	4.70	0
Weighted Average	3.36	3.40	2.99	2.78	1.56
Harrison County:					
1	2.18	1.95	-.83	1.05	-1.95
2	3.52	4.71	6.61	7.74	3.73
3	3.39	3.78	4.04	3.00	3.39
4	5.00	4.20	4.53	.40	2.26
Weighted Average	3.24	3.40	2.96	2.66	1.69

1/ Undiscounted.

Table 11. Average Annual Loss in Income Per Acre at Present Erosion Rates, Row and Grain Land, Daviess and Harrison Counties

Soil Group	Present Erosion Rate	Inches of Soil Eroded 0-4	4-8	8-12	12-16	16-20
	Tons/Ac	Annual Loss, Dollars Per Acre 1/				
Daviess County:						
1	3.4	0.02	0	-0.07	0.03	-0.01
2	12.9	.32	.45	.54	.64	.32
3	21.6	.78	.65	.72	.01	.35
4	29.9	.79	1.30	1.45	.98	0
Weighted Average	14.1	.38	.34	.30	.27	.15
Harrison County:						
1	3.1	.05	.04	-.02	.02	-.04
2	11.4	.28	.38	.53	.62	.30
3	24.1	.57	.64	.68	.51	.57
4	39.9	1.40	1.17	1.26	.11	.63
Weighted Average	17.4	.39	.41	.36	.32	.21

1/ Undiscounted.

Table 12. Present Loss in Income Due to Past Erosion, Daviess and Harrison Counties, 1982

Soil Group	Soil Dist.	Present Annual Erosion	Inches Eroded	Loss Per Inch Eroded	Total Loss
	Percent	Tons/Ac	Inch/Ac	<--- $/Acre	--->
Daviess County:					
1	31	3.4	2.3	0.93	2.17
2	28	12.9	3.8	3.51	13.16
3	34	21.6	4.9	5.21	35.35
4	7	29.9	5.8	3.79	21.85
Total or Average	100	14.1	3.8	3.88	14.90
Harrison County:					
1	33	3.1	2.1	2.10	4.50
2	12	11.4	2.3	3.41	7.88
3	43	24.1	4.3	3.42	14.60
4	12	39.9	8.7	4.57	39.60
Total or Average	100	17.4	3.9	3.59	13.90

can be significant in the long run, especially for those soils with high erosion and soil profiles resulting in rapidly declining productivity.

The long-term impact of past erosion on current income is shown in table 12. On the average, net income from row and grain crops is about $14 to $15 per acre lower in 1982 because of past erosion. This varies from a low of about $2 per acre for the alluvial soil where erosion is minimal to about $40 per acre for soil group 4 in Harrison county where an average of about 9 inches of soil has been eroded.

The long-term accumulative economic loss in productivity due to erosion is shown in figures 12 and 15. These functions reflect economic losses associated with the removal of 4-inch incremental layers of soil if the present rate of erosion occurred for a period of 100 years. The 4-inch increments are indicated by the line segments between the connecting points. These functions reflect the full soil profile starting with an uneroded soil. Note that at current erosion rates, in a period of 100 years, five or more increments of 4-inch layers or 20 inches or more of soil would erode in soil group 4 in both counties. In 76 years, the annual loss in income per acre due to reduced productivity would reach a level of $82 in Daviess county. In Harrison county, the annual loss would reach a level of $64 per acre in about 70 years. Losses on the other two upland soils, groups 2 and 3, are somewhat less because of lower erosion rates.

Present Value of Productivity Loss

The accumulated loss in annual income as represented by the areas under the curves is significant over long periods of time. For example, the 100-year

Figure 12. Loss in income per acre by years, row and grain crops eroding at present rates, Daviess county

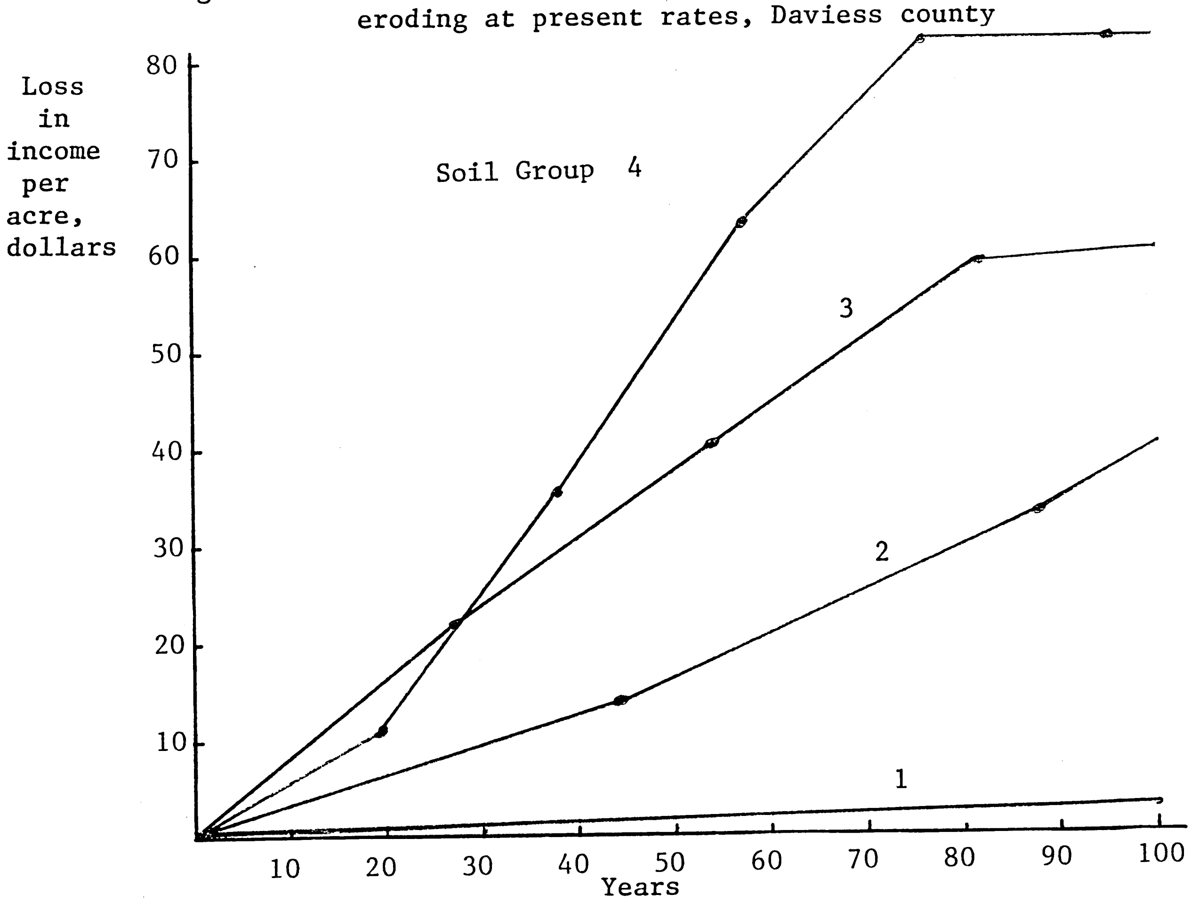


Figure 13. Present value of income loss by years, row and grain crops eroding at present rates, 12-percent discount rate, Daviess county

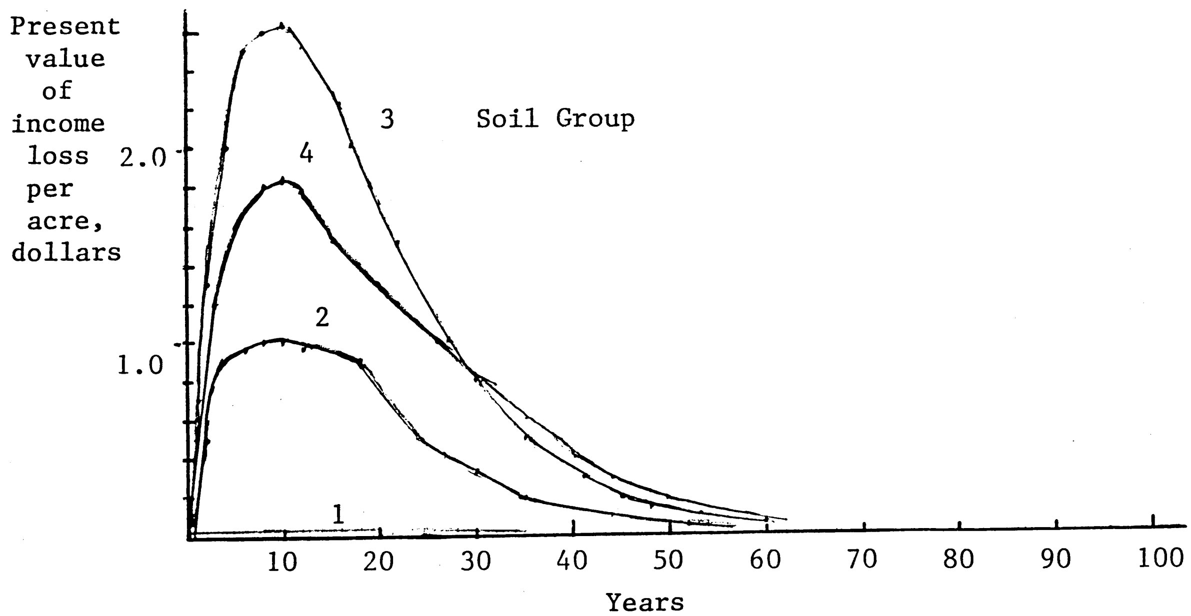


Figure 14. Loss in income per acre by years, row and grain crops eroding at present rates, Harrison county

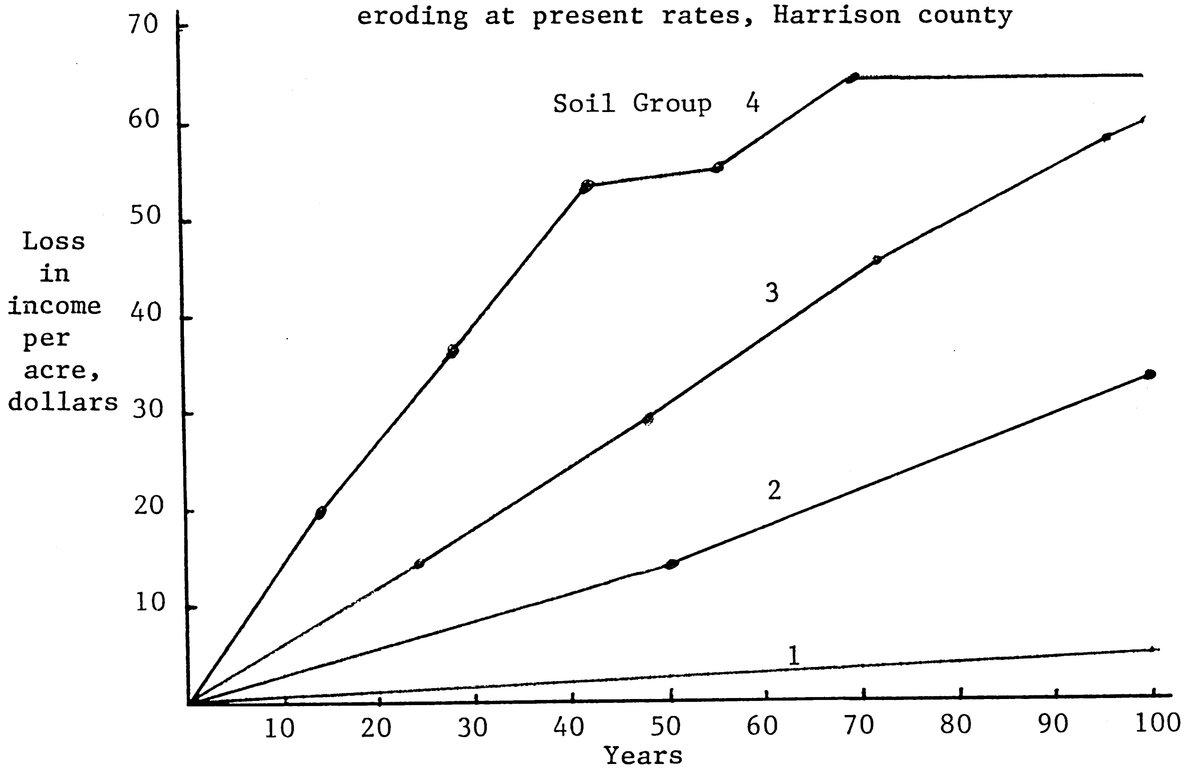


Figure 15. Present value of income loss by years, row and grain crops eroding at present rates, 12-percent discount rate, Harrison county

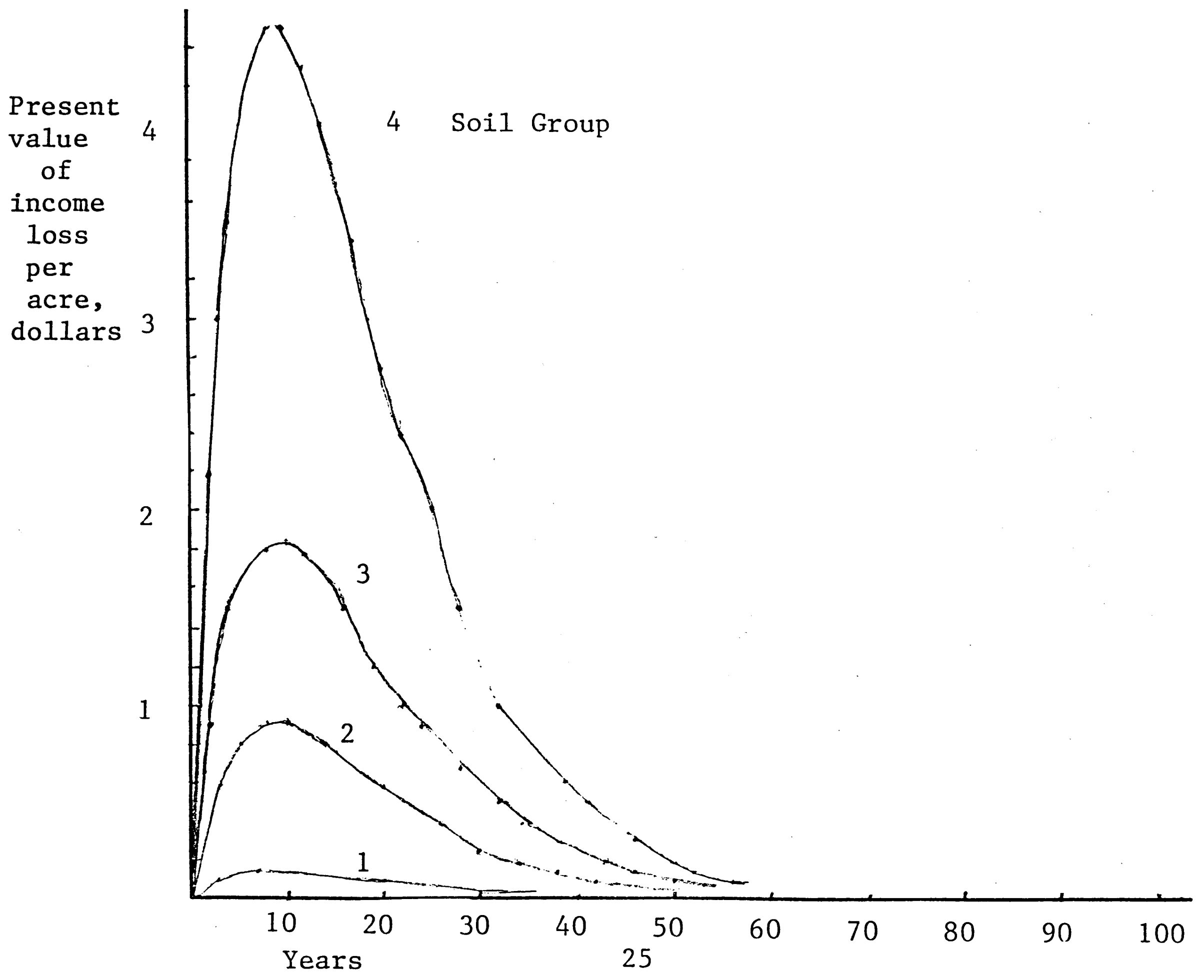


Table 13. Present Value of Loss in Income From Cropland Eroding at Present Rates, 50 and 100 Years, Daviess and Harrison Counties

Soil Group	Present Value at Discount Rate of: 0, 50 Yr	0, 100 Yr	4%, 50 Yr	4%, 100 Yr	12%, 50 Yr	12%, 100 Yr
	<----------- Dollars Per Acre					------------>
Daviess County:						
1	31	121	9	14	2	2
2	401	1806	120	194	24	24
3	993	3607	303	449	61	62
4	1096	4849	297	510	49	51
Harrison County:						
1	61	242	18	28	4	4
2	358	1541	108	170	21	22
3	752	3072	224	350	44	45
4	1612	4703	497	678	103	105

accumulated loss for soil group 4 in Daviess county is $4,849 per acre. While these losses are impressive, a large part occurs so far in the future that it is beyond the planning horizon of many landowners. Furthermore, even if the losses are considered, the present value of losses which may occur in the distant future are of little value when discounted by even low discount rates. For example, when the accumulated nominal value of $4,849 per acre is discounted for time at a 4-percent discount rate, the present value is $510. A discount rate of 12 percent reduces this present value to $51 per acre (table 13). Thus, while losses accumulated over a long period of time are large, the present value of these losses can be comparatively modest, particularly when higher discount rates are used.

The appropriate discount rate for an individual landowner varies depending on several factors. The interest paid on present loans and returns on present investments after taxes are good indicators of an appropriate discount rate. For purposes of analysis, a 12-percent discount rate was selected as representative for individual landowners. A lower discount rate of 4 percent was also used to more nearly represent society's discount rate.

Note that the present value of losses are about five times greater for the 50-year period for a discount rate of 4 percent compared with 12 percent. This difference is even larger for a 100-year period.

The functions in figures 13 and 15 demonstrate the effect of time on present values. Note that present value functions peak in about 10 years and never exceed $4.50 per acre. By year 50, present values diminish to insignificance. Because of this, the evaluation of present values for

Table 14. Present Value of Income Loss From Erosion for Row and Grain Crops, Alternative Conservation Conditions Over 50-Year Period, Daviess and Harrison Counties

County and Condition	Present Value of Loss Per Acre — Soil Group 1	2	3	4
	<---- 4% Discount Rate ----> (Dollars)			
Daviess County:				
No Additional Conservation	9	120	303	297
Minimum Till	7	84	225	183
Zero Till	2	27	73	53
Contour	5	67	171	188
Contour & Terrace 1/				
No Additional Conservation	12	161	335	254
Contour & Terrace	4	54	108	86
	<---- 12% Discount Rate ----> (Dollars)			
No Additional Conservation	2	24	61	49
Minimum Till	1	17	45	32
Zero Till	<1	5	14	11
Contour	<1	13	34	33
Contour & Terrace 1/				
No Additional Conservation	2	32	68	42
Contour & Terrace	<1	11	22	17
	<---- 4% Discount Rate ----> (Dollars)			
Harrison County:				
No Additional Conservation	18	108	224	497
Minimum Till	12	77	140	324
Zero Till	3	23	42	104
Contour	9	57	114	343
Contour & Terrace 1/				
No Additional Conservation	16	123	285	632
Contour & Terrace	7	39	80	256
	<---- 12% Discount Rate ----> (Dollars)			
No Additional Conservation	4	21	44	103
Minimum Till	2	15	28	66
Zero Till	1	5	8	21
Contour	2	11	23	70
Contour & Terrace 1/				
No Additional Conservation	3	24	55	136
Contour & Terrace	1	8	16	52

1/ On areas with slope lengths greater than 200 feet.

Table 15. Present Value of Income Maintained from Alternative Conservation Practices for Row and Grain Crops over 50-Year Period, Daviess and Harrison Counties

County and Conservation Practices	Present Value of Practice Per Acre			
	Soil Group			
	1	2	3	4
	<---- 4% Discount Rate ----> (Dollars)			
Daviess County:				
Minimum Till	2	36	78	114
Zero Till	7	93	230	244
Contour	4	53	132	109
Contour & Terrace 1/	8	107	227	168
	<---- 12% Discount Rate ----> (Dollars)			
Minimum Till	1	7	16	17
Zero Till	2	19	47	38
Contour	1	11	27	16
Contour & Terrace 1/	1	21	46	25
	<---- 4% Discount Rate ----> (Dollars)			
Harrison County:				
Minimum Till	6	31	84	173
Zero Till	15	85	182	393
Contour	9	51	110	154
Contour & Terrace 1/	9	84	205	376
	<---- 12% Discount Rate ----> (Dollars)			
Minimum Till	2	6	16	37
Zero Till	3	16	36	82
Contour	2	10	21	33
Contour & Terrace 1/	2	16	39	84

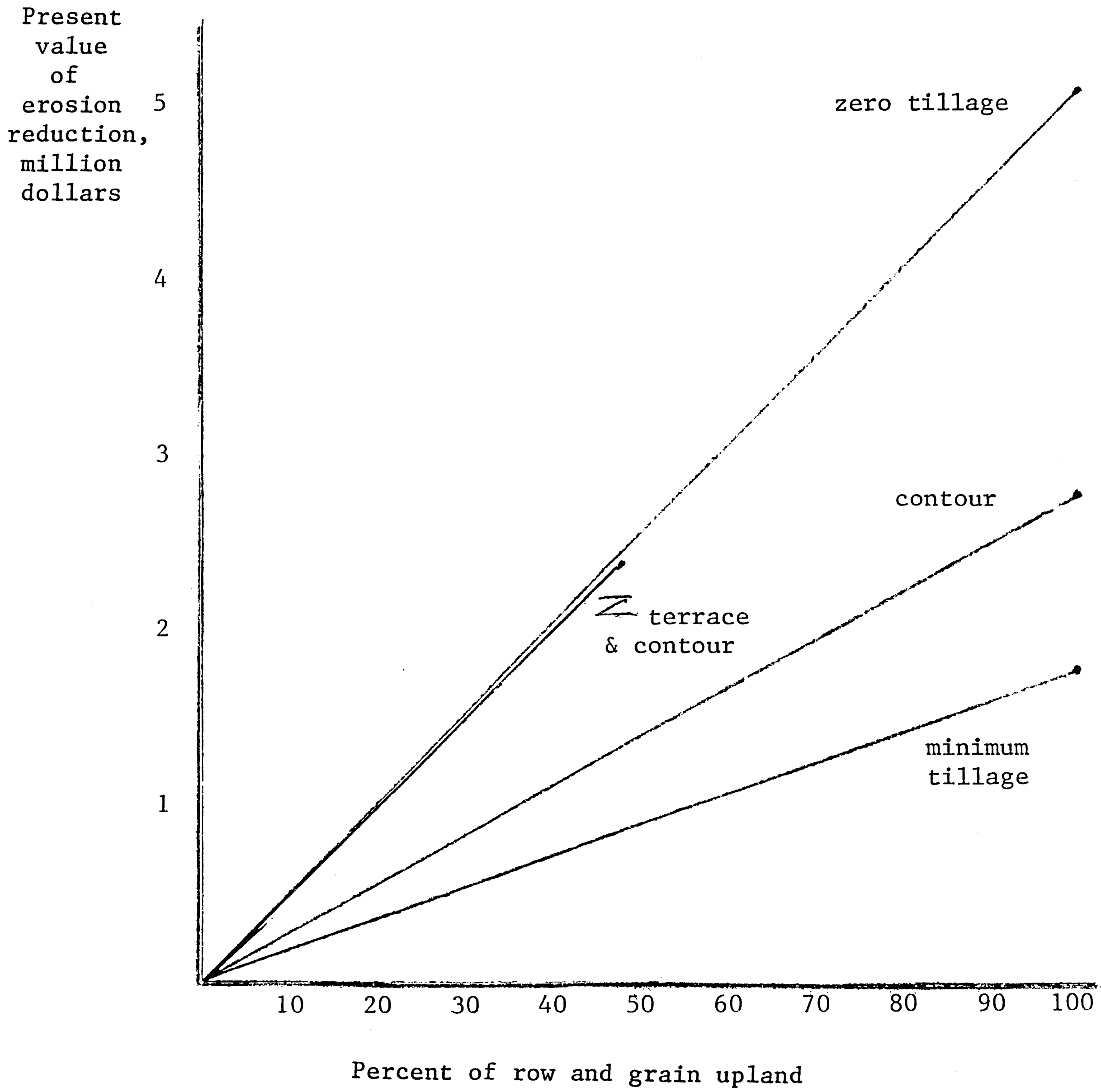
1/ On areas with slope lengths greater than 200 feet.

alternative conservation practices was confined to the 50-year period. Also shown is the importance of soils with high initial losses in productivity compared with more distant losses (figs. 12 and 13). For example, the higher initial losses in income for soil group 3 in Daviess county results in larger present values even though soil group 4 has much higher income losses over the entire period.

Present Value of Conservation Practices

The preceding section presented estimated economic losses associated with current erosion rates over a 50-year period. These losses in productivity can be reduced by adopting various conservation practices. The difference in

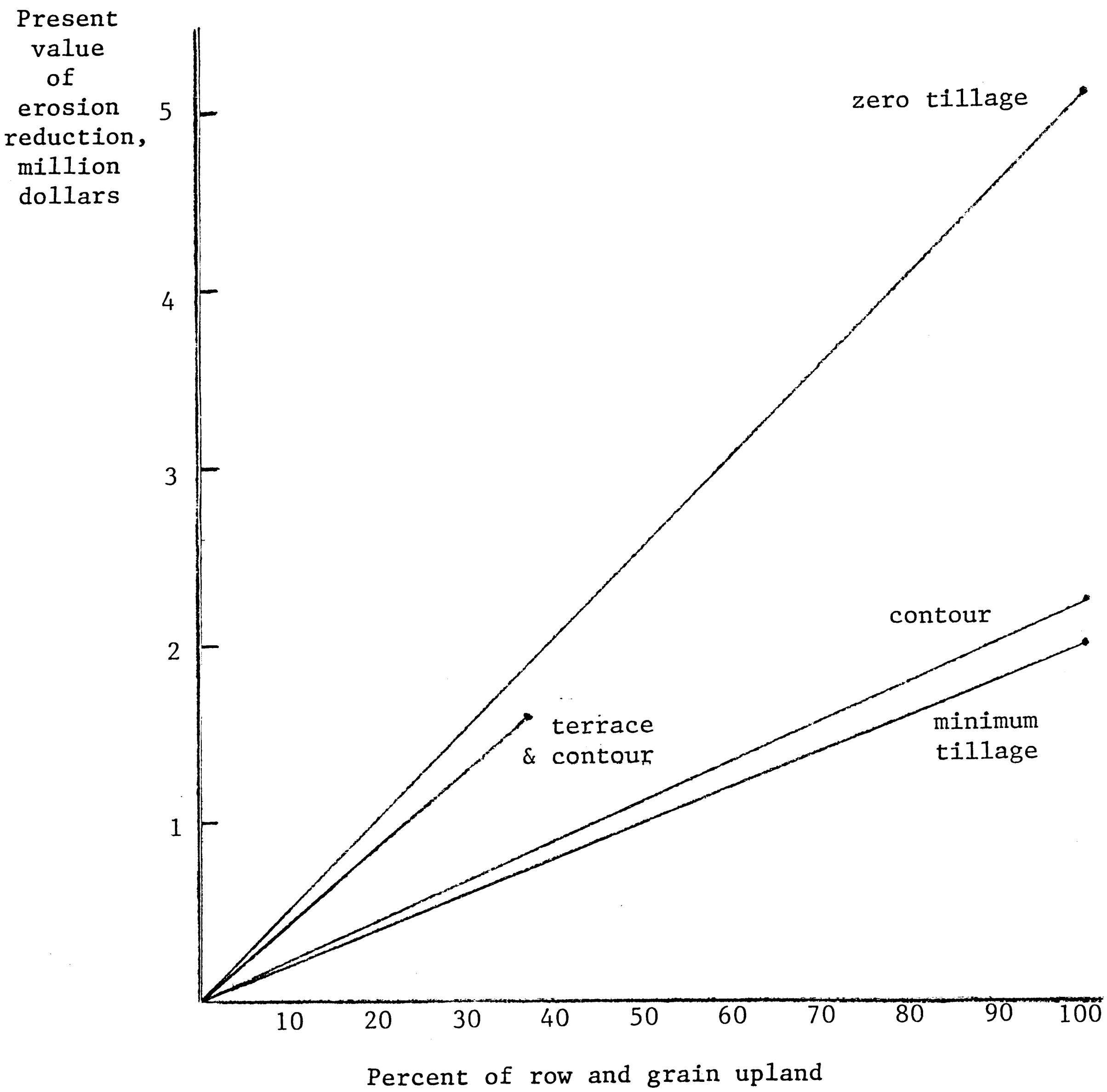
Figure 16: Present value of erosion reduction by percent of upland with practice, 50-year period, discount rate of 12 percent, Daviess county, 1982.



losses incurred with no additional conservation as represented by current erosion rates and those possible with various conservation practices represents potential benefits. If practice costs are less than these benefits, the practice is economically feasible.

The procedure used to estimate potential benefits to conservation practices involved estimating economic loss functions similar to those representing no additional conservation. Present-value functions were estimated using discount rates of 4 percent and 12 percent. Present values of losses in income for these functions for a 50-year period are presented in table 14. The difference

Figure 17: Present value of erosion reduction by percent of upland with practice, 50-year period, discount rate of 12 percent, Harrison county, 1982.



between the no additional conservation functions and those representing the four types of conservation practices are presented in table 15. These values represent the breakeven lump sum amounts that could be currently spent on practices. Any amounts less than these values would result in net benefits and any amount greater would result in net costs.

If a given conservation practice is the first adopted, it will reduce erosion more than if it is preceded by other practices. The per-acre benefits presented assume that each of the practices is the first adopted. If multiple practices are adopted on a given acre, the combined benefits of the practices would be less than the sum of the single practice.

The county-level effects of adopting various degrees of single practices on upland soil groups 2, 3, and 4 are presented in figures 16 and 17. The single practice offering the longest potential benefits is zero tillage. The present value of benefits discounted at 12 percent over a 50-year period would amount to over $5 million in each county if zero tillage were adopted on all row and grain upland. Contour farming offers the next highest potential benefits of $2.8 and $2.0 million for Daviess and Harrison counties, respectively if competely adopted. If terracing accompanied by contour farming were practiced on all cropped upland with slope lengths greater than 200 feet, benefits of $2.4 and $2.1 million would accrue. Minimum tillage, defined as those tillage operations resulting in at least 30-percent cover would result in maximum benefits of $1.8 and $2.3 million. These benefit values reflect only the value of reductions in losses in productivity. The net value of these conservation measures may be larger or smaller depending on the cost or cost savings of the individual practices.

ECONOMIC IMPACTS OF THE SOIL CONSERVATION PROGRAM 1981-83

Methodology described in the preceding sections provide the basis for predicting long-term economic losses due to decreased productivity associated with no conservation and with single conservation practices. This methodology along with additional data indicating the scope of the conservation program for the years 1981-83 is used to estimate the economic impact of the conservation program.

The original objective was to evaluate only the impacts from targeting funds. However, it became clear at an early stage of the study that impacts from targeting funds could not be evaluated in isolation of regular funds because all funds were combined and allocated by the same criteria. A rough estimate of the effects of the targeting program can be made by attributing the same impact to targeted funds as to regular funds. However, to the extent that the total program was redirected in response to the targeting objective, the impact might be greater than targeting funds, proportionate share. Analyses being made as a companion study by others may shed more light on this aspect of targeting.

Trends in the Conservation Program

There is some evidence that the conservation program has shifted from practices with primary impacts on water quality and environmental and recreational enhancement to practices mainly affecting long-term soil productivity. For example, in 1979, about 38 percent of the cost-share funds in Daviess county was spent on water impoundment or control structures. By 1983, this had decreased to 9 percent of the funds (fig. 18). In Harrison county, the proportion of funds spent on these structures decreased from 64 percent in 1979 to 11 percent in 1983 (fig. 19). This suggests that the targeting program may have not only provided additional funds, but shifts in how all funds were spent as well. In 1982, the state of Missouri started a supplementary cost-sharing program. The amount of cost-share funds added in 1982 and 1983 were $26,608 and $14,644 in Daviess county and $26,707 and $14,042 in Harrison county. All but $1,000 of the funds in Daviess county were used for cost-sharing terraces. In Harrison county, about half of the funds were used for cost-sharing terraces and the rest was used primarily for cost-

Figure 18. Cost-sharing by conservation practice, 1975-83, Daviess county

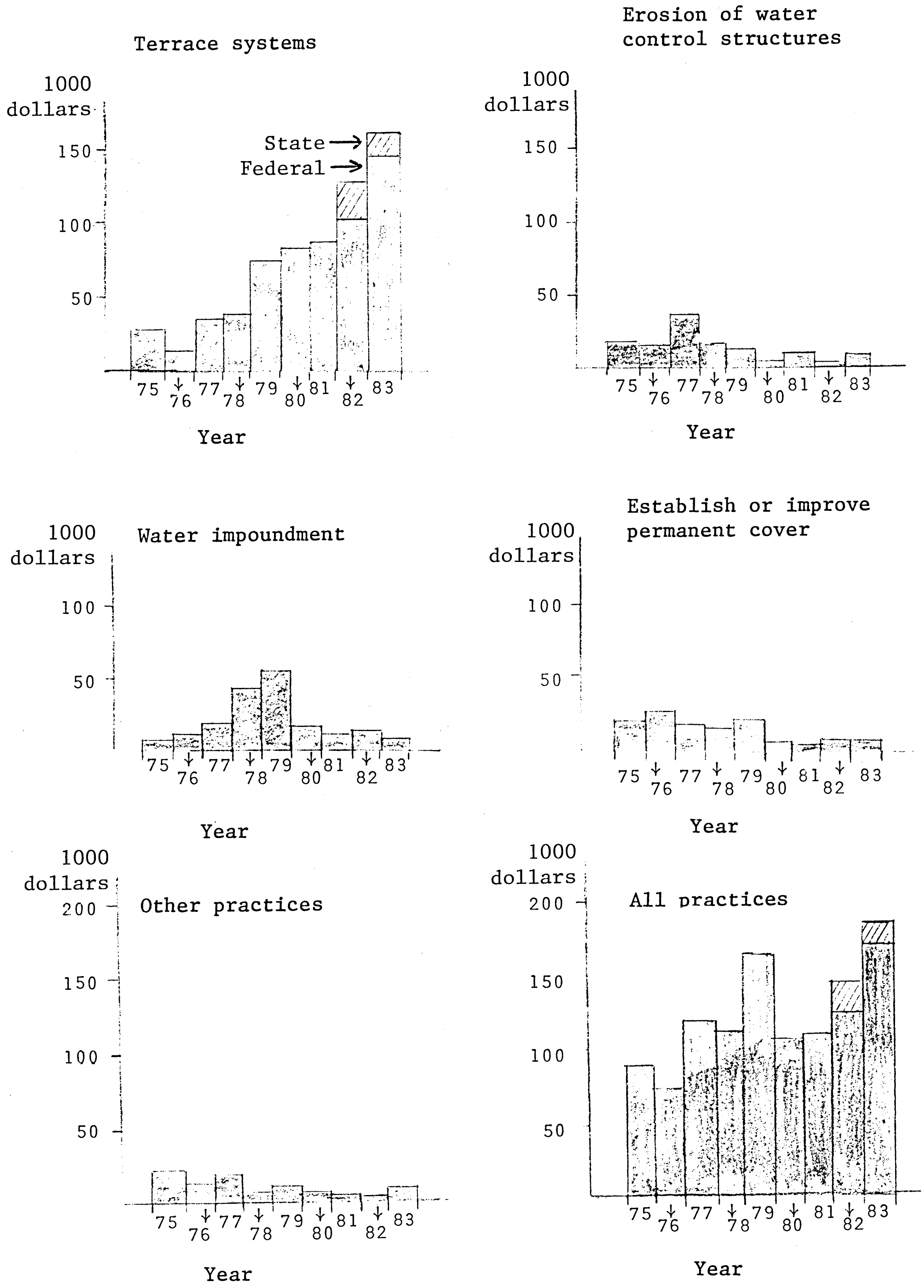


Figure 19. Cost-sharing by conservation practice, 1975-83, Harrison county

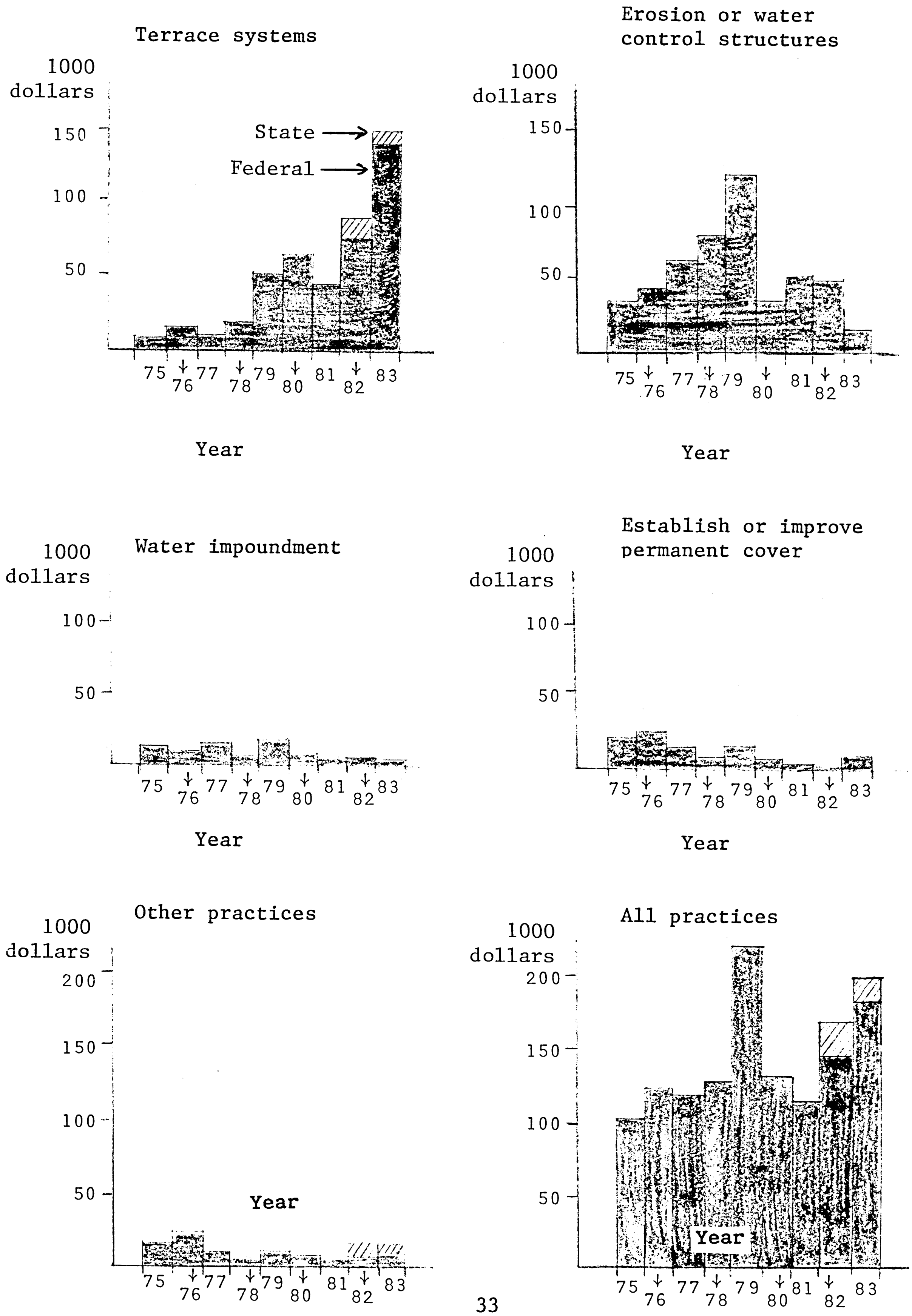


Table 16. Acres, Erosion, and Cost Share by Conservation Practice Combinations, Daviess and Harrison Counties, 1981-83

USLE Factor and Practice	Area	Soil Saved1/	Cost Share	Soil Saved Per Acre1/	Cost Share: Per Acre	Cost Share: Per Ton Saved
	Acres	Tons	Dollars	Tons	<--Dollars--->	
Daviess County:						
L Terrace	121	870	5389	7.19	44.54	6.19
LP Terrace, Contour	500	5585	36053	11.17	72.13	6.46
LPC Terr, Cont, Cons T, Cons C	5391	81861	307435	15.18	57.02	3.76
LPC Terr, Cont, Cons C	136	1486	9523	10.93	70.11	6.41
PC Cont, Cons T, Cons C	11284	100428	645	8.90	.06	.01
C Cons T, Cons C	9540	93429	0	9.79	0	0
C Cons C	463	4958	1854	10.71	4.00	.37
C Pasture & Hay Mgt.	903	9364	18286	10.37	20.23	1.95
Subtotal	28338	297981	379185	10.52	13.38	1.27
Other	574	155	34434	.27	60.00	222.15
Total	28912	298136	413619	10.31	14.31	1.39
Harrison County:						
L Terrace	4041	76658	294791	18.97	72.95	3.85
LP Terrace, Contour	663	17377	45428	26.21	68.52	2.61
LPC Terr, Cont, Cons T, Cons C	158	4803	13518	30.40	85.56	2.81
LPC Terr, Cont, Cons C	0	0	0	0	0	0
PC Cont, Cons T, Cons C	0	0	0	0	0	0
C Cons T, Cons C	0	0	0	0	0	0
C Cons C	95	2366	2674	25.00	28.23	1.13
C Pasture & Hay Mgt.	555	14332	19491	25.81	35.10	1.36
Subtotal	5512	115536	375902	20.96	68.20	3.25
Other	1221	41954	64041	34.36	52.45	1.53
Total	6733	157490	439943	23.39	65.34	2.79

1/ Sheet and rill erosion.

sharing reduced tillage. This analysis is limited to the Federal program.

The Conservation Program 1981-83

The most comprehensive set of information regarding the conservation program is the CRES data set for fiscal year 1983. The set contained detailed data for individual fields treated including acres treated, soil loss before and after treatment, total cost and cost-shares, practices applied, and land capability by individual fields. The 1983 data were used to analyze per-acre impacts which were then expanded to the 1981-83 period (see app. D for details).

Table 17. Distribution of Acreage and Erosion Reduction by Soil Groups, Daviess and Harrison Counties, 1981-83

Soil Group	Acreage Distribution	Sheet & Rill Soil Saved Distribution	Sheet & Rill Reduction in Erosion
	Percent	Percent	Tons/Acre
Daviess County:			
1	9.0	5.3	6.1
2	53.0	51.4	10.0
3	17.5	23.4	13.8
4	20.5	19.9	10.0
Total or Average	100.0	100.0	10.3
Harrison County:			
1	0	0	0
2	12.9	9.1	16.5
3	85.7	90.0	24.6
4	1.4	.9	14.8
Total or Average	100.0	100.0	23.4

Conservationists working with farmers emphasize adoption of conservation systems rather than single practices. Consequently, a large number of combinations of practices are cost-shared and adopted, some of which have a major effect on soil productivity and some which do not. Thirty-four such combinations occurred in the counties (see app. table 32). As indicated earlier, the effects of conservation practices are estimated by the change in USLE factors L, P, or C. If the CRES data set had included these changes in factors, the reduction in erosion attributed to each practice within a combination of practices could have been estimated. Lacking this information, the alternative was to combine the practices into eight groups of practices based on the expected changes in one or more USLE factor. The group of practices labeled "other," indicating the factor affected was unknown, includes practice combinations which ordinarily reduce erosion other than sheet and rill erosion. It was surprising to find that sizable reductions in sheet and rill erosion were reported for two particular practices in this group: grade stabilization structures and grass waterways in Harrison county.

Although data were available indicating soil saved other than from sheet and rill erosion, only soil saved from sheet and rill erosion is included in the analysis because this is the type of erosion directly affecting soil productivity. While some of the practices may provide significant benefits such as improved water quality and environmental enhancement, these impacts are difficult to trace and assess. Limitations of time and data prevented any evaluation of these impacts.

Table 18. Short-Term Cost of Conservation Practice Combinations, Daviess and Harrison Counties, 1981-83

USLE Factor and Practice	Cost 1/		Cost Per Acre		Cost Per Ton Saved2/	
	Total	Farmer	Total	Farmer	Total	Farmer
	<-----Dollars					----->
Daviess County:						
L Terrace	12357	6968	102.12	57.58	14.20	8.01
LP Terrace, Contour	70970	34917	141.94	69.83	12.70	6.25
LPC Terr, Cont, Cons T, Cons C	679858	372423	126.11	69.08	8.31	4.55
LPC Terr, Cont, Cons C	23176	13653	170.41	100.39	15.59	9.18
PC Cont, Cons T, Cons C	52922	52277	4.69	4.63	.53	.52
C Cons T, Cons C	1100	1100	.12	.12	.01	.01
C Cons C	6368	4514	13.75	9.75	1.28	.91
C Pasture & Hay Mgt.	50007	31721	55.38	35.13	5.34	3.39
Subtotal	896758	517573	31.65	18.27	3.01	1.74
Other	79775	45341	138.98	78.99	514.68	292.53
Total	976533	562914	33.78	19.47	3.28	1.89
Harrison County:						
L Terrace	574428	279637	142.15	69.20	7.49	3.64
LP Terrace, Contour	95552	50124	144.12	75.60	5.50	2.89
LPC Terr, Cont, Cons T, Cons C	25710	12192	162.72	77.16	5.35	2.54
LPC Terr, Cont, Cons C	0	0	0	0	0	0
PC Cont, Cons T, Cons C	0	0	0	0	0	0
C Cons T, Cons C	0	0	0	0	0	0
C Cons C	5066	2385	53.33	25.10	2.14	1.01
C Pasture & Hay Mgt.	50652	31168	91.26	56.16	3.53	2.18
Subtotal	751408	375506	136.32	68.12	6.50	3.25
Other	150720	86679	123.44	70.99	3.59	2.06
Total	902128	462185	133.98	68.64	5.73	2.94

1/ Costs from CRES plus $4.50 per acre for contour farming.
2/ Sheet and rill erosion only.

Cost-Share for Conservation Practices

The conservation program decreased sheet and rill eroison by 298,136 tons in Daviess county or about 10.3 tons per acre over the 3-year period 1981-83 (table 16). Cost-shares of $413,619 or $14.31 per acre amounting to $1.39 per ton saved were expended on 28,912 acres. In contrast, sheet and rill erosion in Harrison county was reduced by 157,490 tons or 23.4 tons per acre on 6,733 acres. The cost per acre, $65.34, was more than four times higher than Daviess county and the cost per ton reduction, $2.79, was twice that for Daviess county. The higher average reduction in erosion in Harrison county can be explained in part by the fact that more erosive soils were treated in this county. For example, 87 percent of the land was in soil group 3 or 4 compared to 38 percent in Daviess county (table 17). However, this does not fully explain the comparatively higher erosion reductions for all soil groups and practice combinations. The reporting of USLE factors for each combination of practices would have provided a basis for determining if the differences are due to practices or individuals reporting the data.

Practice combinations including terraces accounted for 21 percent of the acreage, 30 percent of the soil saved, and 87 percent of the cost-share funds in Daviess county. In Harrison county, practice combinations including terraces accounted for 72 percent of the acreage, 63 percent of the soil saved, and 80 percent of the cost-share funds.

One measure of the relative effectiveness of cost-sharing is the dollars expended per ton of erosion reduction or soil saved. This varied considerably by practice combinations. The most efficient combination of practices was contour-conservation, tillage-conservation cropping in Daviess county with a cost-share of only $0.01 per ton reduction, followed by conservation cropping only with a cost-share of $0.37 per ton reduction. The next most efficient practice was pasture and hay management with a cost-share of $1.95 per ton reduction. This practice consisted of planting and improving permanent hay or pasture.

The least efficient was the "other" combination in Daviess county with a cost of $222.15 per ton reduction. This combination consisted of practices with primary objectives other than erosion control, including land forming, water control structures, drainage, and fish pond management. As expected, the next highest combinations are those including terraces. The ranking of practices by cost-share per ton reductions were similar in Harrison county with the exception of the "other" category which was surprisingly lower than terracing.

Shortrun Impacts

The initial total shortrun costs of the conservation practices applied in the 1981-83 period was about $977,000 in Daviess county and $902,000 in Harrison county (table 18). Of this total cost, $562,000 or about 58 percent was borne by farmers in Daviess county and $462,000 or 51 percent was borne by farmers in Harrison county. The average total cost per acre was four times as high in Harrison county ($133.98) as in Daviess county ($33.78). In general, the total cost per ton of soil saved was highest for combinations involving terraces in both counties and decreased as other contouring and cover management practices were added to terracing. The total cost per ton saved for the combinations without terracing was only $0.91 per ton in Daviess county and $3.52 per ton in Harrison county. Similar costs for practices including terraces were $8.76 and $7.04 per ton, respectively.

Longrun Impacts

The onsite economic feasibility of conservation is largely determined by longrun considerations. It is only through time that the full impacts of soil losses are manifested in reduced productivity and income. Soil conservation investments are incurred mainly to prevent these losses. Some practices such as terracing require lump sum initial investments while others such as

Table 19. Long-Term Net Costs or Benefits at Discount Rates of 4 and 12 Percent, Daviess and Harrison Counties, 1980-83

USLE Factor and Practice Affected		Cost Share	Present Value of Net Costs (-) or Benefits (+) 50 Years, at Discount Rate of: 4% Farmer	4% Total	12% Farmer	12% Total
		<-------------	-------------	1000 Dollars	-------------	------------->
Daviess County:						
L	Terrace	5.4	-11.9	-17.3	-11.0	-16.4
LP	Terrace, Contour	36.1	-102.7	-138.8	-74.5	-110.6
LPC	Terr, Cont, Cons T, Cons C	307.5	415.3	107.8	-216.0	-523.5
LPC	Terr, Cont, Cons C	9.5	-36.7	-46.2	-26.3	-35.8
PC	Cont, Cons T, Cons C	.6	2407.4	2406.8	773.6	773.0
C	Cons T, Cons C	0	3081.4	3081.4	1070.1	1070.1
C	Cons C	1.8	45.9	44.1	5.2	3.4
C	Pasture & Hay Mgt.	18.3	63.6	45.3	-13.2	-31.5
	Subtotal	379.2	5862.3	5483.1	1507.9	1128.7
	Other	34.4	-43.8	-78.2	-45.1	-79.5
	Total	413.6	5818.5	5404.9	1462.8	1049.2
Harrison County:						
L	Terrace	294.8	-208.3	-503.1	-407.4	-702.2
LP	Terrace, Contour	45.4	-55.6	-101.0	-86.3	-131.7
LPC	Terr, Cont, Cons T, Cons C	13.5	24.6	11.1	-6.3	-19.8
LPC	Terr, Cont, Cons C	0	0	0	0	0
PC	Cont, Cons T, Cons C	0	0	0	0	0
C	Cons T, Cons C	0	0	0	0	0
C	Cons C	2.7	19.7	17.0	2.0	-.7
C	Pasture & Hay Mgt.	19.5	102.1	82.6	-5.1	-24.6
	Subtotal	375.9	-117.5	-493.4	-503.1	-879.0
	Other	64.0	303.4	239.4	-10.4	-74.4
	Total	439.9	185.9	-254.0	-513.5	-953.4

contouring require annual costs. Others such as conservation tillage may result in annual cost savings or benefits once the new technique is learned. These costs and benefits occurring through time can be placed on a common basis by discounting the flows to present values.

The planning horizon or future time period over which benefits and costs occur and the discount rates used to discount these flows are important variables in determining economic feasibility. The discount rate reflecting society's concern about the future loss in soil productivity is theoretically lower than that of farmers as a group. Therefore, two different discount rates were used to reflect these interests: 4 percent for society and 12 percent for

Table 20. Long-Term Net Costs or Benefits Per Ton Soil Saved at Discount Rates of 4 and 12 Percent, Daviess and Harrison Counties

			Present Value of Net Costs (-) or Benefits (+) Per Ton of Soil Saved, 50 Years, at Discount Rate of:			
			4%		12%	
USLE Factor and Practice Affected		Cost Share	Farmer	Total	Farmer	Total
			<-----Dollars Per Ton Saved 1/--->			
Daviess County:						
L	Terrace	6.19	-13.68	-19.87	-12.63	-18.82
LP	Terrace, Contour	6.46	-18.39	-24.85	-13.33	-19.79
LPC	Terr, Cont, Cons T, Cons C	3.76	5.02	1.32	-2.63	-6.39
LPC	Terr, Cont, Cons C	6.41	-24.74	-31.15	-17.68	-24.09
PC	Cont, Cons T, Cons C	.01	23.96	23.97	7.71	7.70
C	Cons T, Cons C	0.00	32.97	32.97	11.45	11.45
C	Cons C	.37	9.27	8.90	1.06	.69
C	Pasture & Hay Mgt.	1.95	6.79	4.84	-1.42	-3.37
	Subtotal	1.27	19.66	18.40	5.06	3.79
	Other	221.15	-280.96	-502.11	289.17	-510.32
	Total or Average	1.39	19.52	18.13	4.91	3.52
Harrison County:						
L	Terrace	3.85	-2.71	-6.56	-5.31	-9.16
LP	Terrace, Contour	2.61	-3.20	-5.81	-4.97	-7.58
LPC	Terr, Cont, Cons T, Cons C	2.81	5.12	2.31	-1.32	-4.13
LPC	Terr, Cont, Cons C	0	0	0	0	0
PC	Cont, Cons T, Cons C	0	0	0	0	0
C	Cons T, Cons C	0	0	0	0	0
C	Cons C	1.13	8.30	7.17	.82	-.31
C	Pasture & Hay Mgt.	1.36	7.12	5.76	-.36	-1.72
	Subtotal	3.25	-1.02	-4.27	-4.35	-7.60
	Other	1.53	7.24	5.71	-.24	-1.77
	Total or Average	2.79	1.18	-1.61	-3.26	-6.05

1/ Sheet and rill erosion.

farmers. A 50-year planning horizon was used over which projected benefits and costs occur.

When analyzed within this framework, the systems of conservation practices analyzed resulted in net benefits to both society and farmers in Daviess county. The present value of net benefits to society was $5.40 million or $18.13 per ton of soil saved and the net benefit to farmers was $1.05 million

Table 21. Long-Term Net Costs or Benefits Per Acre at Discount Rates of 4 and 12 Percent, Daviess and Harrison Counties

USLE Factor and Practice Affected		Cost Share	Present Value of Net Costs (-) or Benefits (+) Per Acre, 50 Years, at Discount Rate of: 4% Farmer	4% Total	12% Farmer	12% Total
			<------Dollars Per Acre----->			
Daviess County:						
L	Terrace	44.54	-98.36	-142.91	-90.88	-135.42
LP	Terrace, Contour	72.13	-205.57	-277.70	-149.05	-221.18
LPC	Terr, Cont, Cons T, Cons C	57.02	77.02	20.00	-40.08	-97.10
LPC	Terr, Cont, Cons C	70.11	-270.46	-340.57	-193.31	-263.42
PC	Cont, Cons T, Cons C	.06	213.35	213.29	68.56	68.50
C	Cons T, Cons C	0	323.03	323.03	112.19	112.19
C	Cons C	4.00	99.29	95.29	11.35	7.35
C	Pasture & Hay Mgt.	20.23	70.47	50.24	-14.71	-34.94
	Subtotal	13.38	206.87	193.49	53.21	39.83
	Other	60.00	-76.22	-136.22	-78.45	-138.45
	Average	14.31	201.25	186.94	50.60	36.29
Harrison County:						
L	Terrace	72.95	-51.56	-124.51	-100.78	-173.78
LP	Terrace, Contour	68.52	-83.81	-152.33	-130.17	-198.69
LPC	Terr, Cont, Cons T, Cons C	85.56	155.98	70.42	-39.85	-125.41
LPC	Terr, Cont, Cons C	0	0	0	0	0
PC	Cont, Cons T, Cons C	0	0	0	0	0
C	Cons T, Cons C	0	0	0	0	0
C	Cons C	28.23	207.40	179.17	20.40	-7.83
C	Pasture & Hay Mgt.	35.10	183.87	148.77	-9.17	-44.27
	Subtotal	68.20	-21.32	-89.52	-91.27	-159.47
	Other	52.45	248.55	196.10	-8.45	-60.90
	Average	65.34	27.61	-37.73	-76.24	-141.58

or $3.52 per ton of soil saved (tables 19 and 20). The net benefits to both society and farmers in Harrison county, however, were slightly negative. Here the net benefit to society was -$0.25 million or -$1.61 per ton of soil saved. Farmers' net benefits were -$0.51 million or -$3.26 per ton of soil saved.

The present net value of terrace systems including only terraces and/or contouring was negative to society and farmers in both counties. When conservation tillage and conservation cropping practices were added to these systems, the net present values were positive for society but negative for farmers. Combinations of practices excluding terraces resulted in long-term net benefits to society. Hay and pasture management practices were economically feasible to society but not to farmers.

The large total net present benefits in Daviess county resulted from the large benefits accruing to cover or cover-contour management practices which more than offset the negative net benefits from other practices. Conservation tillage was the main practice accounting for these large net benefits. In Harrison county, the net benefits from cover management practices were not large enough to compensate for the net costs of other practices.

The corresponding cost shares and net present values per acre are presented in table 21. While these values provide the more conventional measure of cost-shares and net costs or benefits, they are probably more subject to distortion than the cost per ton reduction figures. This occurs because of the difficulty of indicating the acreage served by some of the practices.

A note of caution is offered with this analysis. First, some practices, such as terraces, may have a higher proportion of off-site benefits not evaluated in this analysis. Second, damages associated with the erosion process were not evaluated. Third, the discount rates used to reflect society's and farmers' interests are arbitrary. Lower or higher discount rates would result in correspondingly higher or lower net values to both groups. Finally, the field data (CRES) used to represent systems of conservation practices often contained costs and cost-shares for accompanying practices which had little effect on sheet and rill erosion. The presence of these costs resulted in higher costs than if each system contained only those practices related to factors L, P, and C. However, the analysis does give a basis for ranking the systems of practices as reported in the CRES data set and an indication of the feasibility of these practices.

CONCLUSIONS

Historically, the majority of cost-sharing funds in Daviess and Harrison counties has been used to construct water control and terrace systems. More recently, the percentage of funds for water impoundments has decreased but terraces remain the mainstay of the cost-sharing program. Cover management practices, particularly conservation tillage, have been introduced but not cost-shared by the federal program. Instead it is promoted as an accompanying practice to other practices which are cost-shared.1/ The conventional wisdom is that the practice of conservation tillage is economically feasible to farmers and therefore should not be cost-shared. This analysis indicates that conservation tillage is indeed economically feasible to both farmers and society. Furthermore, it suggests that conservation tillage should be the first increment in any conservation plan whether or not the practice is directly cost-shared.

Long-term conservation benefits were estimated for a period of 50 years using a discount rate of 12 percent for farmers and 4 percent for society. Depending on the soil group, farmers could initially invest $1 to $37 per acre

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1/ The recently implemented state cost-share program does offer cost-sharing for a limited time and conditions as an incentive for farmers to try this practice. The effects of this program were not evaluated in this analysis.

in minimum tillage and break even. This increased to a range of \$3 to \$82 per acre for zero tillage. Similar breakeven values for contour farming were \$2 to \$33 per acre and for contour farming plus terracing, from \$2 to \$84 per acre.

In general, the present value of productivity saved by zero tillage is about the same as for terracing and contour farming if terracing is restricted to soils with slope lengths greater than 200 feet. The major difference in feasibility of the practices lies in their costs. Terracing requires initial investments of from \$100 to \$160 per acre. Additional annual costs are incurred for terrace maintenance and contour farming. Conservation tillage, however, results in cost savings once the technique is learned. The lack of large initial investments plus the long-term cost savings associated with conservation tillage results in significant benefits to both society and farmers. An analysis of the long-term economic impacts of conservation practices adopted as a result of the federal cost-sharing program for the years 1981-83 indicates that onsite benefits exceeded costs in Daviess county, but costs exceeded benefits in Harrison county. The present value of onsite net benefits in Daviess county were \$5.40 to society and \$1.46 million to farmers. These benefits accrued due to the large net benefits resulting from conservation tillage which more than compensated for the net losses from the single practices of terracing or the combined practices of terracing and contour farming.

In Harrison county, the conservation program resulted in an onsite long-term net loss of about \$0.25 million to society and a \$0.51-million loss to farmers. The net impacts of the program were negative in this county because of the high investments in structural measures to the exclusion of low-cost practices such as conservation tillage. This does not imply that conservation tillage was not adopted in the county. Rather, it indicates that conservation tillage was not reported as an integral part of the conservation plans adopted by farmers receiving cost-sharing.

On the surface, both counties appear to have similar soil conservation programs. Yet, net long-term benefits are large in one and slightly negative in the adjoining county. The difference is largely explained by the inclusion of conservation tillage. This highly feasible practice occurred on 91 percent of the acreage reported in the program in Daviess county compared with only 2 percent in Harrison county.

Several suggested changes in the conservation programs are offered as a result of this analysis. Some are related to the specification of conservation objectives and others are related to how these objectives might be attained more efficiently.

The recently completed NRI provides a valuable data set which can be used for quantifying sources of the physical erosion problem. The inclusion of the USLE factors in this data set provides the data for a powerful analytical model for not only analyzing the physical problem, but also the effects of alternative conservation practices. The annual CRES data set provides information useful in analyzing program effects. The usefulness of this data set would be increased considerably if it also included the USLE factors. This would permit analysis of those practices primarily affecting onsite sheet and rill erosion and consequently soil productivity. It would also permit estimating the contribution of each practice where a combination of practices is applied.

The collection and analysis of the information, as described, would permit separating practices into two groups: those primarily affecting soil productivity and those primarily affecting other objectives. This information could be used to more efficiently target practices to objectives. In those areas where soil productivity was the major objective, those practices most efficient in meeting this objective could receive priority.

The recent development of models specifying the relationship between soil productivity and levels of depletion provides the means for quantifying the long-term cost of erosion and the long-term benefits of various conservation practices. Further development and use of this methodology should be a high priority. This methodology can be used to target conservation funds on the basis of economic criteria which may be quite different than the physical measures of erosion now being used.

The conservation program was effectively targeted to the more erosive soils in both counties. About 91 percent of the soils in Daviess county and all of the soils in Harrison county were classified as 2E or greater. The major potential improvement in the targeting program lies in targeting practices as well as soils.

The inference to be drawn from the economic analysis of conservation practices applied in the two counties is that the conservation program should be centered around conservation tillage. It is the single practice with the highest net returns to both society and farmers in the short as well as the long run. As a minimum, conservation tillage should be a prerequisite to cost-sharing for less efficient practices such as terracing. With conservation tillage as the first increment for reducing erosion, other practices designed to supplement this practice might be less costly.

Society's goals could be achieved more efficiently by offering incentive payments for practices on the basis of their relative long-term net returns to the public rather than on the basis of private feasibility. If this approach were used, incentive payments for conservation tillage, conservation cropping, and contouring would receive priority over the more costly and less efficient practices. This approach would result in economic incentives more commensurate with public objectives and consequently a greater return to public expenditures for conservation.

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APPENDIX A

Computation of 1982 Agricultural Land and Soil Base

The source of inventory data for this study was the point sample data from the National Resource Inventory (NRI) collected for the base year 1982. These data were obtained by the Soil Conservation Service and entered for computer processing by the Geographic Resource Center, University of Missouri, Columbia. A computer tape containing the raw unprocessed data was obtained and a data file containing only those attributes needed for this study was created. This file continued several keypunch and other errors. These errors were identified and submitted to SCS where they were corrected.

The first step was to determine the agricultural land base and eliminate the nonagricultural land uses from the file. The NRI sample included 720 sample points in each county. The acreage represented by each sample point was calculated as 500 acres in Daviess county and 640 acres in Harrison county (app. table 1). The nonagricultural land was estimated at 18,500 acres in Daviess county and 16,640 acres in Harrison county and the agricultural land base 341,500 acres and 460,800 acres, respectively. When compared with past surveys of the counties, the agricultural land base as estimated from the 1982 NRI sample appeared reasonable (app. table 2).

Comparisons were also made between land use and soils information as estimated by NRI and other sources. Detailed soil surveys were available for each county. The estimates based on NRI data are similar to the measured acreages published in the soil surveys (app. tables 3 and 4). The percentage distribution of acreage between major crops as estimated by the Statistical Reporting Service for 1983 is not significantly different from the estimates from the NRI data (app. table 5). Thus, the estimates of land use and soils from NRI appear to be good estimates at the county level.

Appendix Table 1. Natural Resource Sample Point Data Used to Estimate Agricultural and Nonagricultural Acreage, Daviess and Harrison Counties

Land Use	Daviess	Harrison
	<------- Number of Points	------>
Farmstead	5	9
Strip Mines	2	0
Urban & Built-up	14	4
Transportation	7	1
Water	8	6
State Ownership	1	6
Total Nonagricultural	37	26
Total Agricultural	683	694
Total	720	720

Daviess county:

Total land in county = 360,320 Acres
360,320 ÷ 720 points = 500 Acres per point
Nonagricultural Land = 500 x 37 points = 18,500 Acres
Agricultural Land = 500 x 683 points = 341,500 Acres
Total Land = 500 x 720 points = 360,000 Acres

Harrison county:

Total land in county = 460,800 Acres
460,800 ÷ 720 points = 640 Acres per point
Nonagricultural Land = 640 x 26 points = 16,640 Acres
Agricultural Land = 640 x 694 points = 444,160 Acres
Total Land = 640 x 720 points = 460,800 Acres

Appendix Table 2. Comparison of Agricultural Land Base, Preliminary NRI Data and Historical Data

Year	Nonagricultural	Agricultural	Total
	<----------	Acres	---------->
Daviess:			
1958 1/	13,304	347,016	360,320
1967 1/	13,889	346,431	360,320
1976 2/	15,015	345,305	360,320
1982 3/	18,500	341,500	360,320
Harrison:			
1958 1/	15,674	445,126	460,800
1967 1/	16,280	444,520	460,800
1976 2/	16,690	444,110	460,800
1982 3/	16,640	444,160	460,800

1/ USDA Conservation Needs Inventory (CNI).
2/ USDA CNI data adjusted for Missouri 208 Water Quality Study.
3/ Preliminary USDA NRI data.

Appendix Table 3. Comparison of Soils Information, Preliminary NRI Data and Soil Survey Data, Daviess County

Map Symbol	Soil Name	Soil Survey 1/ Acres	Soil Survey 1/ Percent	1982 NRI 2/ Percent
Bk	Blockton silt loam, 1 to 4 percent slopes	2,340	0.6	0.3
Bu	Burrell silt loam, 1 to 3 percent slopes	2,320	0.6	0.9
Ed	Edina silt loam, 1 to 2 percent slopes	4,930	1.4	1.2
Et	Edina silt loam, terrace phase, 1 to 3 percent slopes	1,980	0.5	0.1
Ga	Gara loam, 3 to 8 percent slopes	7,470	2.1	3.1
Gb	Gara loam, 9 to 18 percent slopes	12,220	3.4	1.8
Gp	Gosport silt loam, 8 to 20 percent slopes	6,920	1.9	---
Gr	Grundy silt loam, 1 to 4 percent slopes	53,510	14.9	13.2
Gt	Grundy silt loam, terrace phase, 1 to 4 percent slopes	2,800	0.8	0.9
Kv	Keytesville silt loam, 3 to 7 percent slopes	7,210	2.0	1.3
La	Lacona silt loam, 2 to 8 percent slopes	10,300	2.9	1.6
Lb	Lacona silt loam, 9 to 15 percent slopes	5,060	1.4	0.7
Lg	Lagonda silt loam, 2 to 8 percent slopes	29,280	8.1	8.6
Ma	Mandeville silt loam, 2 to 5 percent slopes	4,030	1.1	0.4
Mb	Mandeville silt loam, 6 to 10 percent slopes	2,170	0.6	1.6
No	Nodaway silt loam	34,010	9.4	10.5
Sa	Sampsel silt loam, 5 to 15 percent slopes	7,130	2.0	4.1
Sb	Sandy terraces	490	0.1	0.3
Se	Seymour silt loam, 1 to 4 percent slopes	13,930	3.9	6.1
Sh	Shelby loam, 4 to 8 percent slopes	62,850	17.5	20.4
Sm	Shelby loam, 9 to 15 percent slopes	21,360	5.9	4.5
Sn	Snead silty clay, 6 to 15 percent slopes	5,380	1.5	0.1
Ss	Snead stony silty clay, 8 to 20 percent slopes	14,100	3.9	4.0
Wa	Wabash clay	9,760	2.7	2.8
Wb	Wabash silt loam	31,570	8.8	9.7
Ws	Wabash silty clay loam	7,200	2.0	1.0
	Other	---	---	0.3
	Total	360,320	100.0	100.0

1/ Soil Survey, Daviess County Missouri, Soil Conservation Service, USDA in Cooperation with Missouri Agricultural Experiment Station, Series 1959, No. 34, Issued February 1964.

2/ Preliminary data from the 1982 National Resource Inventory, Soil Conservation Service, USDA.

Appendix Table 4. Comparison of Soils Information, Preliminary NRI Data and Soil Survey Data, Harrison County

Map Symbol	Soil Name	Soil Survey 1/ Acres	Soil Survey 1/ Percent	1982 NRI2/ Percent
AdC	Adair loam, 3 to 9 percent slopes	23,750	5.2	5.2
AeC2	Adair clay loam, 5 to 9 percent slopes, eroded	13,200	2.9	5.5
AmC	Armstrong loam, 5 to 9 percent slopes	7,000	1.5	3.0
AmD	Armstrong loam, 9 to 14 percent slopes	1,100	0.2	0.3
ArC3	Armstrong clay loam, 5 to 9 percent slopes, severely eroded	3,000	0.7	1.0
Co	Colo silty clay loam	2,800	0.6	0.1
GaC	Gara loam, 5 to 9 percent slopes	9,800	2.1	2.4
GaD	Gara loam, 9 to 14 percent slopes	11,800	2.6	3.8
GaE	Gara loam, 14 to 20 percent slopes	31,000	6.7	6.5
GbD3	Gara clay loam, 9 to 14 percent slopes, severely eroded	5,800	1.3	1.3
GeF	Gasconade flaggy silty clay loam, 14 to 30 percent slopes	3,550	0.8	0.3
GsB	Grundy silt loam, 2 to 5 percent slopes	43,000	9.3	7.5
GuB2	Grundy silty clay loam, 2 to 5 percent slopes, eroded	11,700	2.5	1.6
Ha	Haig silt loam	4,500	1.0	0.7
Hu	Humeston silt loam	8,700	1.9	2.5
LaC	Ladoga silt loam, 5 to 9 percent slopes	1,250	0.3	0.3
LgB	Lagonda silt loam, 2 to 5 percent slopes	3,000	0.7	0.7
LgC2	Lagonda silt loam, 5 to 9 percent slopes, eroded	34,000	7.4	7.1
LhC3	Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded	2,300	0.5	0.9
LmC2	Lamoni clay loam 5 to 9 percent slopes, eroded	27,750	6.0	6.0
LmC3	Lamoni clay loam 5 to 9 percent slopes, severely eroded	5,500	1.2	0.4
No	Nodaway silt loam	28,500	6.2	6.1
PeB	Pershing silt loam, 2 to 5 percent slopes	4,900	1.1	0.4
PeC	Pershing silt loam, 5 to 9 percent slopes	7,000	1.5	0.9
PgC3	Pershing silty clay loam, 5 to 9 percent slopes, severely eroded	1,050	0.2	0.4
Pt	Pits, quarries	210	---	---
ShD	Shelby loam, 9 to 14 percent slopes	40,500	8.8	8.9
ShE	Shelby loam, 14 to 20 percent slopes	17,000	3.7	2.7
SkD3	Shelby clay loam, 9 to 14 percent slopes, severely eroded	28,000	6.1	7.4
SkE3	Shelby clay loam, 14 to 20 percent slopes, severely eroded	4,350	0.9	0.7
Wa	Wabash silty clay	6,700	1.5	0.7
WeB	Weller silt loam, 2 to 5 percent slopes	2,900	0.6	0.6
WeC	Weller silt loam, 5 to 9 percent slopes	780	0.2	0.4
WgC3	Weller silty clay loam, 5 to 9 percent slopes, severely eroded	710	0.2	0.3
Zo	Zook silty clay loam	15,200	3.3	3.7
Zz	Zook-Colo silty clay loams, channeled	48,000	10.2	9.7
	Water	500	0.1	---
	Total	460,800	100.0	100.0

1/ Soil Survey, Harrison County, Missouri Soil Conservation Service, USDA, in Cooperation with Missouri Agricultural Experiment Station, Issued March 1979.

2/ Preliminary data from the 1982 National Resource Inventory, Soil Conservation Service, USDA.

Appendix Table 5. Land Use Comparison, National Resource Inventory and Statistical Reporting Service, 1982

Land Use	NRI1/ 1982	SRS2/ 1982	NRI1/ 1982	SRS2/ 1982
	Percent			
Corn and Sorghum	19.3	12.6	23.6	18.6
Soybeans	58.2	59.3	37.3	46.2
Wheat and Oats	13.3	12.3	12.3	9.5
Hay	9.2	14.8	26.8	25.7
Total	100.0	100.0	100.0	100.0

1/ Preliminary data from the 1982 National Resource Inventory, Soil Conservation Service, USDA.

2/ Statistical Reporting Service, USDA.

APPENDIX B

Computation of Soil Erosion

Sheet and rill erosion is measured by the Universal Soil Loss Equation (USLE) formula (2).

$$A = RKLSCP$$

where:

A = Soil loss in tons per acre
R = Rainfall intensity
K = A soil erodibility factor
L = Slope length
S = Slope steepness
C = Vegetative cover
P = Conservation support factor.

These factors were estimated for each sample point in the NRI data set as described in Appendix A. This permitted estimating the soil loss for each sample point and aggregating soil loss by land use, soils, or any other attribute of interest.

The basic aggregations for analysis was land use and soil groups. (Soil groups are described in Appendix C.) The average values for soil loss factors and soil losses by land use and soil groups are presented in appendix tables 6 and 7. Two estimates of soil loss represented: one based on erosion computed by USLE for each NRI sample point observation and one based on erosion computed by USLE using the mean values of the soil loss factors for each land use within a soil group. The soil loss based on observations was estimated by computing the soil loss for each observation, summing these values, and dividing by the number of observations. The soil loss based on means was estimated by using the mean values of each soil loss factor for a given land use and soil group.

The difference in soil loss estimates between the two methods is indicated by the aggregation factor. The aggregation factor was computed by dividing the erosion estimate based on sample points by the erosion based on mean factor values. The aggregation factor thus indicates the under or over estimation of soil loss due to using mean USLE factors rather than individual factors for each sample point. The aggregation factor ranges from 0.509 to 1.980 for the land use-soil group combinations presented. Thus, erosion may be underestimated or overestimated by as much as 100 percent when mean factor values rather than actual factor values for sample points are used. For all land uses and soils, the two values in Daviess county are essentially the same as indicated by the aggregation factor of 0.992. For Harrison county, however, erosion as computed by individual point factors is 8.92 tons per acre, compared with 11.78 tons per acre as computed by factor means. Thus, erosion in this county based on individual point sample factors is about 76 percent of that estimated by mean factor values.

The aggregation factors were used to adjust for this difference in erosion due to using mean factor values. For example, when the effects of minimum tillage on row and grain crops were simulated using minimum tillage C factors, the resulting values were multiplied by the aggregation factors to adjust for using mean values. This insured that differences between base erosion data and simulated data were not biased due to using mean values for simulating various conservation practices.

The base land use is presented in appendix table 8 and the base erosion in appendix table 9. The effects of alternative conservation practices on sheet and rill erosion on row and grain crops labeled cropland were simulated by changing the appropriate USLE factors and computing the resulting erosion rates. Appendix tables 9 through 13 are the output of a multiplan spread sheet program which computes the total annual tons of erosion and percentage distribution of erosion for each simulation. These spread sheets were linked to appendix table 8 which contained the base acreage. The per-acre erosion rates for these tables were computed by a separate program on the mainframe computer. The USLE factors used to simulate the various practices are as follows:

Appendix table 10. Contour Only

P factors for soil groups 1, 2, and 3 = .5
P factors for soil group 4 = .6

Appendix table 11. Fall Plow Only

C factors
- Corn and Sorghum = .40
- Soybeans = .45
- Wheat and Oats = .22
- Other Cropland = .40

Appendix table 12. Minimum Tillage

C factors
- Corn and Sorghum = .18
- Soybeans = .35
- Wheat and Oats = .07
- Other Cropland = .15

Appendix table 13. Zero Tillage

C factors
- Corn and Sorghum = .03
- Soybeans = .12
- Wheat and Oats = .03
- Other Cropland = .03

Appendix table 14. Terrace and Contour

P factors for no contour = 1.0
P factors for contour same as table 5
L factor for terraces = 120 feet

A summary of the effects of the simulated practices on erosion is presented in appendix table 15. Although several other combinations of practices were simulated, only those important in the analysis are presented.

Appendix Table 6. Present USLE Factors by Land Use by Soil Groups, Daviess County, 1982 NRI Data

Land Use	Soil Loss Factor Means						USLE Based On Observations	USLE Based On Means	Aggregation Factor[1]
	R	C	K	P	S	L			
							Tons Per Acre		
Soil Group 1:									
Corn and Sorghum	200	0.40	0.35	1.00	0.92	108.82	3.30	3.16	1.042
Soybeans	200	0.40	0.32	0.99	1.01	159.33	3.56	3.55	1.003
Wheat and Oats	200	0.32	0.35	1.00	1.13	112.50	2.99	2.98	1.003
Other Cropland	200	0.34	0.34	1.00	1.00	93.33	2.41	2.75	0.875
Total Cropland	200	0.39	0.33	0.99	0.99	140.28	3.42	3.38	1.011
Hayland	200	0.14	0.32	1.00	1.00	62.50	1.07	0.95	1.126
Pastureland	200	0.04	0.31	1.00	1.74	120.14	0.73	0.44	1.644
Forestland	200	0.01	0.31	1.00	1.00	81.82	0.14	0.07	1.980
Total Average	200	0.30	0.33	1.00	1.14	131.13	2.65	2.75	0.962
Soil Group 2:									
Corn and Sorghum	200	0.38	0.37	0.88	3.83	222.29	13.08	12.50	1.046
Soybeans	200	0.40	0.37	0.90	3.65	228.45	13.68	12.79	1.069
Wheat and Oats	200	0.29	0.37	0.89	3.47	256.76	9.97	9.03	1.103
Other Cropland	200	0.37	0.37	1.00	3.75	105.00	10.50	9.91	1.059
Total Cropland	200	0.38	0.37	0.90	3.66	227.14	12.90	12.08	1.069
Hayland	200	0.02	0.37	1.00	3.67	93.33	0.90	0.50	1.815
Pastureland	200	0.04	0.38	1.00	4.46	263.65	2.36	1.94	1.214
Forestland	200	0.01	0.37	1.00	3.50	160.00	0.20	0.30	0.668
Total Average	200	0.29	0.37	0.92	3.79	228.83	9.93	9.77	1.016
Soil Group 3:									
Corn and Sorghum	200	0.34	0.34	0.92	5.78	235.22	22.55	20.08	1.123
Soybeans	200	0.39	0.33	0.90	5.81	245.17	23.78	22.84	1.041
Wheat and Oats	200	0.29	0.34	0.91	5.21	246.43	15.10	15.43	0.978
Other Cropland	200	0.35	0.35	1.00	6.00	123.75	17.37	17.93	0.968
Total Cropland	200	0.36	0.33	0.91	5.70	237.13	21.55	20.70	1.038
Hayland	200	0.03	0.34	1.00	5.68	166.36	2.83	1.58	1.787
Pastureland	200	0.03	0.32	0.99	6.52	228.21	1.98	2.10	0.942
Forestland	200	0.01	0.33	1.00	8.00	184.31	1.28	0.88	1.462
Total Average	200	0.21	0.33	0.95	6.10	225.33	12.64	13.30	0.950
Soil Group 4:									
Corn and Sorghum	200	0.21	0.37	1.00	6.00	250.00	16.54	16.16	1.023
Soybeans	200	0.40	0.34	0.81	7.70	187.75	30.13	27.94	1.078
Wheat and Oats	200	0.27	0.35	0.92	9.67	214.17	33.30	32.48	1.025
Other Cropland	200	0.44	0.37	0.50	9.00	100.00	19.17	18.85	1.016
Total Cropland	200	0.37	0.34	0.83	8.11	192.50	29.93	28.17	1.062
Hayland	200	0.01	0.37	1.00	7.00	188.33	1.11	0.82	1.348
Pastureland	200	0.05	0.32	1.00	11.41	227.59	8.53	8.01	1.064
Forestland	200	0.01	0.29	1.00	14.47	210.88	2.82	2.03	1.389
Total Average	200	0.16	0.33	0.94	10.71	209.61	14.76	21.63	0.682
All Soil Groups:									
Corn and Sorghum	200	0.38	0.36	0.94	3.09	175.93	11.33	9.21	1.230
Soybeans	200	0.40	0.34	0.92	3.85	208.98	15.10	12.31	1.226
Wheat and Oats	200	0.29	0.35	0.92	4.61	227.97	13.83	11.86	1.166
Other Cropland	200	0.36	0.35	0.97	4.69	111.88	12.96	11.66	1.111
Total Cropland	200	0.38	0.35	0.93	3.83	201.18	14.07	11.59	1.214
Hayland	200	0.04	0.35	1.00	4.73	165.73	1.96	1.61	1.219
Pastureland	200	0.04	0.33	1.00	6.07	211.67	2.88	2.53	1.139
Forestland	200	0.01	0.32	1.00	8.31	168.21	1.47	0.86	1.719
Total Average	200	0.24	0.34	0.96	4.77	199.41	9.61	9.68	0.992

[1] USLE based on observation/USLE based on means

Appendix Table 7. Present USLE Factors by Land Use by Soil Groups, Harrison County, 1982 NRI Data

Land Use	Soil Loss Factor Means						USLE Based On Observations	USLE Based On Means	Aggregation Factor[1]
	R	C	K	P	S	L			
							Tons Per Acre		
Soil Group 1:									
Corn and Sorghum	200	0.41	0.31	1.00	0.85	118.13	2.91	2.80	1.040
Soybeans	200	0.44	0.32	0.99	0.94	106.30	3.41	3.18	1.082
Wheat and Oats	200	0.40	0.32	1.00	1.00	100.00	3.30	3.12	1.056
Other Cropland	200	0.25	0.30	1.00	0.75	156.25	1.73	1.64	1.058
Total Cropland	200	0.42	0.31	0.99	0.89	113.35	3.13	2.95	1.063
Hayland	200	0.04	0.30	1.00	1.22	155.56	0.29	0.37	0.785
Pastureland	200	0.03	0.29	1.00	1.06	135.94	0.25	0.23	1.082
Forestland	200	0.00	0.34	1.00	0.73	163.64	0.04	0.07	0.542
Total Average	200	0.26	0.31	1.00	0.95	125.71	1.92	1.89	1.018
Soil Group 2:									
Corn and Sorghum	200	0.38	0.37	0.94	3.18	336.36	11.82	12.66	0.933
Soybeans	200	0.39	0.37	0.95	3.30	255.00	12.08	12.53	0.964
Wheat and Oats	200	0.33	0.37	0.88	3.50	225.00	9.63	9.95	0.967
Other Cropland	200	0.04	0.37	1.00	4.00	400.00	2.01	2.00	1.004
Total Cropland	200	0.37	0.37	0.94	3.31	280.65	11.44	11.98	0.956
Hayland	200	0.04	0.37	0.95	3.45	340.91	1.35	1.49	0.906
Pastureland	200	0.02	0.37	1.00	3.70	235.00	0.82	0.74	1.108
Forestland	200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
Total Average	200	0.24	0.37	0.95	3.40	284.21	7.63	8.32	0.917
Soil Group 3:									
Corn and Sorghum	200	0.36	0.32	0.95	6.71	216.07	24.25	24.54	0.988
Soybeans	200	0.40	0.33	0.94	6.48	238.46	28.13	27.47	1.023
Wheat and Oats	200	0.26	0.33	0.91	6.53	226.32	15.98	17.19	0.929
Other Cropland	200	0.28	0.32	1.00	8.00	295.00	26.04	30.07	0.865
Total Cropland	200	0.34	0.33	0.94	6.67	234.33	23.76	24.20	0.997
Hayland	200	0.03	0.32	0.97	7.25	255.66	2.06	2.51	0.822
Pastureland	200	0.03	0.32	1.00	7.76	237.08	2.72	2.74	0.994
Forestland	200	0.01	0.32	1.00	6.89	300.00	0.44	0.86	0.509
Total Average	200	0.16	0.32	0.97	7.18	241.33	11.40	12.74	0.894
Soil Group 4:									
Corn and Sorghum	200	0.40	0.31	0.87	11.00	188.57	47.12	46.54	1.012
Soybeans	200	0.37	0.31	0.89	9.35	202.94	34.58	36.40	0.976
Wheat and Oats	200	0.23	0.29	1.00	12.86	271.43	45.08	43.81	1.029
Other Cropland	200	0.32	0.32	0.82	10.00	337.50	41.22	41.88	0.984
Total Cropland	200	0.34	0.31	0.90	10.46	228.95	39.94	40.53	0.995
Hayland	200	0.03	0.29	1.00	11.19	271.30	5.47	4.57	1.197
Pastureland	200	0.03	0.28	1.00	13.47	219.11	5.08	5.33	0.952
Forestland	200	0.02	0.28	1.00	15.05	220.45	2.60	4.28	0.606
Total Average	200	0.09	0.29	0.98	12.73	229.06	11.62	15.24	0.762
All Soil Groups:									
Corn and Sorghum	200	0.39	0.32	0.97	3.88	183.66	14.60	11.33	1.288
Soybeans	200	0.41	0.33	0.95	4.38	188.96	17.72	13.96	1.269
Wheat and Oats	200	0.26	0.33	0.92	7.11	230.33	19.58	19.78	0.989
Other Cropland	200	0.27	0.32	0.96	6.68	280.26	22.85	20.75	1.101
Total Cropland	200	0.37	0.33	0.95	4.81	199.84	17.41	14.53	1.220
Hayland	200	0.03	0.32	0.98	7.35	260.25	2.74	2.61	1.051
Pastureland	200	0.03	0.30	1.00	8.47	211.89	3.06	2.75	1.114
Forestland	200	0.01	0.30	1.00	9.55	222.62	1.46	1.12	1.297
Total Average	200	0.17	0.31	0.98	6.85	214.51	8.92	11.78	0.757

[1] USLE based on observations/USLE based on means

Appendix Table 8. Present Land Use by Soil Groups, 1982 NRI Data

Land Use	Area	Soil Group Dist.	Total Dist.	Area	Soil Group Dist.	Total Dist.
	Acres	Percent		Acres	Percent	
Soil Group 1:						
Corn and Sorghum	19005.0	21.0	5.6	25578.0	24.5	5.8
Soybeans	40996.5	45.3	12.0	32050.8	30.7	7.2
Wheat and Oats	3982.0	4.4	1.2	626.4	.6	.1
Other Cropland	1538.5	1.7	.5	2610.0	2.5	.6
Total Cropland	65522.0	72.4	19.2	60865.2	58.3	13.7
Hayland	1991.0	2.2	.6	5742.0	5.5	1.3
Pastureland	17466.5	19.3	5.1	30693.6	29.4	6.9
Forestland	5520.5	6.1	1.6	7099.2	6.8	1.6
Total	90500.0	100.0	26.5	104400.0	100.0	23.5
Soil Group 2:						
Corn and Sorghum	11992.8	15.2	3.5	7025.2	19.3	1.6
Soybeans	35426.1	44.9	10.4	12776.4	35.1	2.9
Wheat and Oats	8521.2	10.8	2.5	2548.0	7.0	.6
Other Cropland	1972.5	2.5	.6	655.2	1.8	.1
Total Cropland	57912.6	73.4	17.0	23004.8	63.2	5.2
Hayland	5996.4	7.6	1.8	7025.2	19.3	1.6
Pastureland	13018.5	16.5	3.8	6370.0	17.5	1.4
Forestland	1972.5	2.5	.6	0	0	0
Total	78900.0	100.0	23.1	36400.0	100.0	8.2
Soil Group 3:						
Corn and Sorghum	11481.0	8.6	3.4	19206.6	10.2	4.3
Soybeans	42987.0	32.2	12.6	33329.1	17.7	7.5
Wheat and Oats	14017.5	10.5	4.1	21842.8	11.6	4.9
Other Cropland	4005.0	3.0	1.2	6402.2	3.4	1.4
Total Cropland	72490.5	54.3	21.2	80780.7	42.9	18.2
Hayland	10947.0	8.2	3.2	33894.0	18.0	7.6
Pastureland	42052.5	31.5	12.3	67788.0	36.0	15.3
Forestland	8010.0	6.0	2.3	5837.3	3.1	1.3
Total	133500.0	100.0	39.1	188300.0	100.0	42.4

Appendix Table 8. Present Land Use by Soil Groups, 1982 NRI Data (cont.)

Land Use	Area	Soil Group Dist.	Total Dist.	Area	Soil Group Dist.	Total Dist.
	Acres	Percent		Acres	Percent	
Soil Group 4:						
Corn and Sorghum	501.8	1.3	.1	4488.9	3.9	1.0
Soybeans	10036.0	26.0	2.9	10934.5	9.5	2.5
Wheat and Oats	3010.8	7.8	.9	4488.9	3.9	1.0
Other Cropland	501.8	1.3	.1	2532.2	2.2	.6
Total Cropland	14050.4	36.4	4.1	22444.5	19.5	5.1
Hayland	1505.4	3.9	.4	17265.0	15.0	3.9
Pastureland	14513.6	37.6	4.2	61348.3	53.3	13.8
Forestland	8530.6	22.1	2.5	14042.2	12.2	3.2
Total	38600.0	100.0	11.3	115100.0	100.0	25.9
All Soil Groups:						
Corn and Sorghum	42980.6	12.6	12.6	56298.7	12.7	12.7
Soybeans	129445.6	37.9	37.9	89090.8	20.1	20.1
Wheat and Oats	29531.5	8.6	8.6	29506.1	6.6	6.6
Other Cropland	8017.8	2.3	2.3	12199.6	2.7	2.7
Total Cropland	209975.5	61.5	61.5	187095.2	42.1	42.1
Hayland	20439.8	6.0	6.0	63926.2	14.4	14.4
Pastureland	87051.1	25.5	25.5	166199.9	37.4	37.4
Forestland	24033.6	7.0	7.0	26978.7	6.1	6.1
Total	341500.0	100.0	100.0	444200.0	100.0	100.0

Appendix Table 9. Present Erosion by Land Use by Soil Groups, 1982 NRI Data

Land Use	Daviess Annual Erosion Total Dist.	Daviess Annual Erosion Tons/ Acre	Daviess Annual Erosion Annual Tons	Harrison Annual Erosion Total Dist.	Harrison Annual Erosion Tons/ Acre	Harrison Annual Erosion Annual Tons
	Percent			Percent		
Soil Group 1:						
Corn and Sorghum	1.9	3.30	62716.5	1.9	2.91	74432.0
Soybeans	4.4	3.56	145947.5	2.8	3.41	109293.2
Wheat and Oats	.4	2.99	11906.2	.1	3.30	2067.1
Other Cropland	.1	2.41	3707.8	.1	1.73	4515.3
Total Cropland	6.8	3.42	224278.0	4.8	3.13	190307.6
Hayland	.1	1.07	2130.4	0	.29	1665.2
Pastureland	.4	.73	12750.5	.2	.25	7673.4
Forestland	0	.14	772.9	0	.04	284.0
Total	7.3	2.65	239931.8	5.0	1.92	199930.2
Soil Group 2:						
Corn and Sorghum	4.8	13.08	156865.8	2.1	11.82	83037.9
Soybeans	14.8	13.68	484629.0	3.9	12.08	154338.9
Wheat and Oats	2.6	9.97	84956.4	.6	9.63	24537.2
Other Cropland	.6	10.50	20711.3	0	2.01	1317.0
Total Cropland	22.8	12.90	747162.5	6.6	11.44	263231.0
Hayland	.2	.90	5396.8	.2	1.35	9484.0
Pastureland	.9	2.36	30723.7	.1	.82	5223.4
Forestland	0	.20	394.5	0	0	0
Total	23.9	9.93	783677.4	7.0	7.64	277938.4
Soil Group 3:						
Corn and Sorghum	7.9	22.55	258896.6	12.5	25.84	496298.5
Soybeans	31.2	23.78	1022230.9	23.6	28.13	937547.6
Wheat and Oats	6.5	15.10	21664.3	8.8	15.98	349047.9
Other Cropland	2.1	17.37	69566.9	4.2	26.04	166713.3
Total Cropland	47.6	21.55	1562358.5	49.2	24.13	1949607.4
Hayland	.9	2.83	30980.0	1.8	2.06	69821.6
Pastureland	2.5	1.98	83264.0	3.2	1.86	126085.7
Forestland	.3	1.28	10252.8	.1	.44	2568.4
Total	51.4	12.64	1686855.3	54.2	11.41	2148083.1

Appendix Table 9. Present Erosion by Land Use by Soil Groups, 1982 NRI Data (cont.)

	Daviess			Harrison		
	Annual Erosion			Annual Erosion		
Land Use	Total Dist.	Tons/ Acre	Annual Tons	Total Dist.	Tons/ Acre	Annual Tons
	Percent			Percent		
Soil Group 4:						
Corn and Sorghum	.3	16.54	8299.8	5.3	47.12	211517.0
Soybeans	9.2	30.13	302384.7	9.5	34.56	377896.3
Wheat and Oats	3.1	33.30	100259.6	5.1	45.08	202359.6
Other Cropland	.3	19.17	9619.5	2.6	41.22	104377.3
Total Cropland	12.8	29.93	420563.6	22.6	39.93	896150.2
Hayland	.1	1.11	1671.0	2.4	5.47	94439.2
Pastureland	3.8.	8.53	123801.0	7.9	5.08	311649.4
Forestland	.7	2.82	24056.3	.9	2.60	36509.7
Total	17.4	14.77	570091.9	33.8	11.63	1338748.8
All Soil Groups:						
Corn and Sorghum	14.8	11.33	486778.6	21.8	15.37	865285.4
Soybeans	59.6	15.10	1955192.1	39.8	17.72	1579076.0
Wheat and Oats	12.5	13.84	408786.4	14.6	19.59	578011.9
Other Cropland	3.2	12.92	103605.4	7.0	22.70	276922.8
Total Cropland	90.1	14.07	2954362.6	83.2	17.63	3299296.1
Hayland	1.2	1.97	40178.1	4.4	2.74	175410.4
Pastureland	7.6	2.88	250539.2	11.4	2.71	450631.8
Forestland	1.1	1.48	35476.5	1.0	1.46	39362.1
Total	100.0	9.61	3280556.4	100.0	8.93	3964700.5

Appendix Table 10. Erosion Assuming Contour Only

Land Use	Annual Erosion					
	Daviess			Harrison		
	Total Dist.			Total Dist.		
	Percent	Tons/ Acre	Annual Tons	Percent	Tons/ Acre	Annual Tons
Soil Group 1:						
Corn and Sorghum	1.6	1.65	31358.3	1.5	1.45	37088.1
Soybeans	3.7	1.80	73793.7	2.2	1.72	55127.4
Wheat and Oats	.3	1.49	5933.2	0	1.65	1033.6
Other Cropland	.1	1.20	1846.2	.1	.86	2244.6
Total Cropland	5.6	1.72	112931.3	3.8	1.57	95493.6
Hayland	.1	1.07	2130.4	.1	.29	1665.2
Pastureland	.6	.73	12750.5	.3	.25	7673.4
Forestland	0	.14	772.9	0	.04	284.0
Total	6.4	1.42	128585.1	4.2	1.01	105116.2
Soil Group 2:						
Corn and Sorghum	4.4	7.43	89106.5	1.8	6.28	44118.3
Soybeans	13.3	7.59	268884.1	3.2	6.36	81257.9
Wheat and Oats	2.4	5.60	47718.7	.6	5.47	13937.6
Other Cropland	.5	5.25	10355.6	0	1.00	655.2
Total Cropland	20.6	7.18	416064.9	5.6	6.08	139968.9
Hayland	.3	.90	5396.8	.4	1.35	9484.0
Pastureland	1.5	2.36	30723.7	.2	.82	5223.4
Forestland	0	.20	394.5	0	0	0
Total	22.4	5.74	452579.9	6.1	4.25	154676.3
Soil Group 3:						
Corn and Sorghum	7.0	12.25	140642.3	9.7	12.76	245076.2
Soybeans	28.1	13.21	567858.3	19.8	14.95	498270.0
Wheat and Oats	5.8	8.29	116205.1	7.6	8.78	191779.8
Other Cropland	1.7	8.68	34763.4	3.3	13.01	83292.6
Total Cropland	42.5	11.86	859469.0	40.5	12.61	1018418.7
Hayland	1.5	2.83	30980.0	2.8	2.06	69821.6
Pastureland	4.1	1.98	83264.0	5.0	1.86	126085.7
Forestland	.5	1.28	10252.8	.1	.44	2568.4
Total	48.7	7.37	983965.8	48.3	6.46	1216894.4

Appendix Table 10. Erosion Assuming Contour Only (cont.)

Land Use	Annual Erosion					
	Daviess			Harrison		
	Total Dist.			Total Dist.		
	Percent	Tons/ Acre	Annual Tons	Percent	Tons/ Acre	Annual Tons
Soil Group 4:						
Corn and Sorghum	.2	9.92	4977.9	5.8	32.48	145799.5
Soybeans	11.1	22.31	223903.2	10.1	23.29	254664.5
Wheat and Oats	3.2	21.71	65364.5	4.8	27.05	121424.7
Other Cropland	.6	22.98	11531.4	3.0	30.16	76371.2
Total Cropland	15.1	21.76	305776.8	23.8	26.66	598259.9
Hayland	.1	1.11	1671.0	3.8	5.47	94439.6
Pastureland	6.1	8.53	123801.0	12.4	5.08	311649.4
Forestland	1.2	2.82	24056.3	1.5	2.60	36509.7
Total	22.5	11.80	455305.1	41.3	9.04	1040858.5
All Soil Groups:						
Corn and Sorghum	13.2	6.19	266084.9	18.8	8.39	472082.0
Soybeans	56.1	8.76	1134439.2	35.3	9.98	889319.8
Wheat and Oats	11.6	7.97	235221.4	13.0	11.12	328175.6
Other Cropland	2.9	7.30	58496.6	6.5	13.33	162563.6
Total Cropland	83.9	8.07	1694242.1	73.6	9.90	1852141.1
Hayland	2.0	1.97	40178.1	7.0	2.74	175410.4
Pastureland	12.4	2.88	250539.2	17.9	2.71	450631.8
Forestland	1.8	1.48	35476.5	1.6	1.46	39362.1
Total	100.0	5.92	2020435.9	100.0	5.67	2517545.4

Appendix Table 11. Erosion Assuming Fall Plow Only

Land Use	Daviess Total Dist. Percent	Daviess Tons/ Acre	Daviess Annual Tons	Harrison Total Dist. Percent	Harrison Tons/ Acre	Harrison Annual Tons
Soil Group 1:						
Corn and Sorghum	1.8	3.30	62716.5	1.7	2.84	72641.5
Soybeans	4.6	4.00	163986.0	2.6	3.49	111857.3
Wheat and Oats	.2	2.05	8163.1	0	1.81	1133.8
Other Cropland	.1	2.83	4354.0	.2	2.77	7229.7
Total Cropland	6.8	3.65	239219.6	4.5	3.17	192862.3
Hayland	.1	1.07	2130.4	0	.29	1665.2
Pastureland	.4	.73	12750.5	.2	.25	7673.4
Forestland	0	.14	772.9	0	.04	284.0
Total	7.2	2.82	254873.3	4.8	1.94	202484.8
Soil Group 2:						
Corn and Sorghum	4.7	13.76	165020.9	2.1	12.43	87323.2
Soybeans	15.4	15.38	544853.4	4.2	13.94	178103.0
Wheat and Oats	1.8	7.56	64420.3	.4	6.41	16332.7
Other Cropland	.6	11.35	22387.9	.3	20.09	13163.0
Total Cropland	22.6	13.76	796682.5	6.9	12.82	294921.9
Hayland	.2	.90	5396.8	.2	1.35	9484.0
Pastureland	.9	2.36	30723.7	.1	.82	5223.4
Forestland	0	.20	394.5	0	0	0
Total	23.6	10.56	833197.4	7.3	8.51	309629.3
Soil Group 3:						
Corn and Sorghum	8.6	26.53	304590.9	12.2	26.94	517425.8
Soybeans	33.4	27.44	1179563.3	24.8	31.62	1053866.1
Wheat and Oats	4.5	11.45	160500.4	6.9	13.51	295096.2
Other Cropland	2.2	19.84	79459.2	5.6	37.16	237905.8
Total Cropland	48.8	23.78	1724113.8	49.5	26.05	2104293.9
Hayland	.9	2.83	30980.0	1.6	2.06	69821.6
Pastureland	2.4	1.98	83264.0	3.0	1.86	126085.7
Forestland	.3	1.28	10252.8	.1	.44	2568.4
Total	52.3	13.85	1848610.5	54.2	12.23	2302769.7

Appendix Table 11. Erosion Assuming Fall Plow Only (cont.)

Land Use	Annual Erosion					
	Daviess			Harrison		
	Total Dist.			Total Dist.		
	Percent	Tons/ Acre	Annual Tons	Percent	Tons/ Acre	Annual Tons
Soil Group 4:						
Corn and Sorghum	.4	31.49	15801.7	5.0	47.10	211427.2
Soybeans	9.6	33.88	340019.7	10.8	42.02	459467.7
Wheat and Oats	2.3	27.13	81683.0	4.6	43.12	193561.4
Other Cropland	.2	17.41	8736.3	3.1	51.52	130458.9
Total Cropland	12.6	31.76	446240.7	23.4	44.33	994915.2
Hayland	0	1.11	1671.0	2.2	5.47	94439.6
Pastureland	3.5	8.53	123801.0	7.3	5.08	311649.4
Forestland	.7	2.82	24056.3	.9	2.60	36509.7
Total	16.9	15.43	595769.0	33.8	12.49	1437513.8
All Soil Groups:						
Corn and Sorghum	15.5	12.75	548130.0	20.9	15.79	888817.8
Soybeans	63.1	17.22	2228422.4	42.4	20.24	1803294.1
Wheat and Oats	8.9	10.66	314766.8	11.9	17.15	506124.1
Other Cropland	3.3	14.34	114937.4	9.1	31.87	388757.4
Total Cropland	90.8	15.27	3206256.5	84.4	19.17	3586993.3
Hayland	1.1	1.97	40178.1	4.1	2.74	175410.4
Pastureland	7.1	2.88	250539.2	10.6	2.71	450631.8
Forestland	1.0	1.48	35476.5	.9	1.46	39362.1
Total	100.0	10.34	3532450.3	100.0	9.57	4252397.6

Appendix Table 12. Erosion Assuming Minimum Tillage

Land Use	Daviess Annual Erosion Total Dist.	Daviess Annual Erosion Tons/ Acre	Daviess Annual Erosion Annual Tons	Harrison Annual Erosion Total Dist.	Harrison Annual Erosion Tons/ Acre	Harrison Annual Erosion Annual Tons
Soil Group 1:						
Corn and Sorghum	1.1%	1.48	28127.4	1.2%	1.28	32739.8
Soybeans	5.2%	3.11	127499.1	3.1%	2.71	86857.7
Wheat and Oats	0.1%	0.65	2588.3	0.0%	0.58	363.3
Other Cropland	0.1%	1.06	1630.8	0.1%	1.04	2714.4
Total Cropland	6.5%	2.44	159845.6	4.4%	2.02	122675.2
Hayland	0.1%	1.07	2130.4	0.1%	0.29	1665.2
Pastureland	0.5%	0.73	12750.5	0.3%	0.25	7673.4
Forestland	0.0%	0.14	772.9	0.0%	0.04	284.0
Total	7.2%	1.94	175499.4	4.8%	1.27	132297.8
Soil Group 2:						
Corn and Sorghum	3.0%	6.19	74235.4	1.4%	5.60	39341.1
Soybeans	17.3%	11.96	423696.2	5.0%	10.84	138496.2
Wheat and Oats	0.8%	2.40	20450.9	0.2%	2.04	5197.9
Other Cropland	0.3%	4.26	8402.9	0.2%	7.54	4940.2
Total Cropland	21.5%	9.10	526785.3	6.8%	8.17	187975.4
Hayland	0.2%	0.90	5396.8	0.3%	1.35	9484.0
Pastureland	1.3%	2.36	30723.7	0.2%	0.82	5223.4
Forestland	0.0%	0.20	394.5	0.0%	0.00	0.0
Total	23.0%	7.14	563300.2	7.3%	5.57	202682.8
Soil Group 3:						
Corn and Sorghum	5.6%	11.94	137083.1	8.4%	12.12	232784.0
Soybeans	37.5%	21.34	917342.6	29.5%	24.59	819562.6
Wheat and Oats	2.1%	3.64	51023.7	3.4%	4.30	93924.0
Other Cropland	1.2%	7.44	29797.2	3.2%	13.95	89310.7
Total Cropland	46.4%	15.66	1135246.6	44.5%	15.30	1235581.3
Hayland	1.3%	2.83	30980.0	2.5%	2.06	69821.6
Pastureland	3.4%	1.98	83264.0	4.5%	1.86	126085.7
Forestland	0.4%	1.28	10252.8	0.1%	0.44	2568.4
Total	51.4%	9.44	1259743.4	51.7%	7.62	1434057.0
Soil Group 4:						
Corn and Sorghum	0.3%	14.17	7110.5	3.4%	21.19	95119.8
Soybeans	10.8%	26.35	264448.6	12.9%	32.68	357339.5
Wheat and Oats	1.1%	8.63	25983.2	2.2%	13.72	61587.7
Other Cropland	0.1%	6.53	3276.8	1.8%	19.32	48922.1
Total Cropland	12.3%	21.41	300819.1	20.3%	25.08	562969.1
Hayland	0.1%	1.11	1671.0	3.4%	5.47	94439.6
Pastureland	5.1%	8.53	123801.0	11.2%	5.08	311649.4
Forestland	1.0%	2.82	24056.3	1.3%	2.60	36509.7
Total	18.4%	11.67	450347.4	36.2%	8.74	1005567.7
All Soil Groups:						
Corn and Sorghum	10.1%	5.74	246556.5	14.4%	7.10	399984.7
Soybeans	70.8%	13.39	1732986.5	50.5%	15.74	1402255.9
Wheat and Oats	4.1%	3.39	100046.1	5.8%	5.46	161073.0
Other Cropland	1.8%	5.38	43107.6	5.3%	11.96	145887.4
Total Cropland	86.7%	10.11	2122696.6	76.0%	11.27	2109201.0
Hayland	1.6%	1.97	40178.1	6.3%	2.74	175410.4
Pastureland	10.2%	2.88	250539.2	16.2%	2.71	450631.8
Forestland	1.4%	1.48	35476.5	1.4%	1.46	39362.1
Total	100.0%	7.17	2448890.4	100.0%	6.25	2774605.3

Appendix Table 13. Erosion Assuming Zero Tillage

Land Use	Daviess Annual Erosion Total Dist.	Daviess Tons/ Acre	Daviess Annual Tons	Harrison Annual Erosion Total Dist.	Harrison Tons/ Acre	Harrison Annual Tons
Soil Group 1:						
Corn and Sorghum	0.5%	0.25	4751.3	0.4%	0.21	5371.4
Soybeans	4.3%	1.07	43866.3	2.3%	0.93	29807.2
Wheat and Oats	0.1%	0.28	1115.0	0.0%	0.25	156.6
Other Cropland	0.0%	0.21	323.1	0.0%	0.21	548.1
Total Cropland	4.9%	0.76	50055.6	2.7%	0.59	35883.3
Hayland	0.2%	1.07	2130.4	0.1%	0.29	1665.2
Pastureland	1.3%	0.73	12750.5	0.6%	0.25	7673.4
Forestland	0.1%	0.14	772.9	0.0%	0.04	284.0
Total	6.5%	0.73	65709.3	3.5%	0.44	45505.9
Soil Group 2:						
Corn and Sorghum	1.2%	1.03	12352.6	0.5%	0.93	6533.4
Soybeans	14.3%	4.10	145247.0	3.6%	3.72	47528.2
Wheat and Oats	0.9%	1.03	8776.8	0.2%	0.87	2216.8
Other Cropland	0.2%	0.85	1676.6	0.1%	1.51	989.4
Total Cropland	16.6%	2.90	168053.1	4.4%	2.49	57267.8
Hayland	0.5%	0.90	5396.8	0.7%	1.35	9484.0
Pastureland	3.0%	2.36	30723.7	0.4%	0.82	5223.4
Forestland	0.0%	0.20	394.5	0.0%	0.00	0.0
Total	20.2%	2.59	204568.0	5.5%	1.98	71975.2
Soil Group 3:						
Corn and Sorghum	2.3%	1.99	22847.2	3.0%	2.02	38797.3
Soybeans	31.1%	7.32	314664.8	21.4%	8.43	280964.3
Wheat and Oats	2.2%	1.56	21867.3	3.1%	1.84	40190.8
Other Cropland	0.6%	1.49	5967.5	1.4%	2.79	17862.1
Total Cropland	36.1%	5.04	365346.8	28.8%	4.68	377814.5
Hayland	3.1%	2.83	30980.0	5.3%	2.06	69821.6
Pastureland	8.2%	1.98	83264.0	9.6%	1.86	126085.7
Forestland	1.0%	1.28	10252.8	0.2%	0.44	2568.4
Total	48.3%	3.67	489843.5	44.0%	3.06	576290.3
Soil Group 4:						
Corn and Sorghum	0.1%	2.36	1184.2	1.2%	3.53	15845.8
Soybeans	8.9%	9.03	90625.1	9.4%	11.21	122575.7
Wheat and Oats	1.1%	3.70	11140.0	2.0%	5.88	26394.7
Other Cropland	0.1%	1.31	657.4	0.7%	3.86	9774.3
Total Cropland	10.2%	7.37	103606.6	13.3%	7.78	174590.6
Hayland	0.2%	1.11	1671.0	7.2%	5.47	94439.6
Pastureland	12.2%	8.53	123801.0	23.8%	5.08	311649.4
Forestland	2.4%	2.82	24056.3	2.8%	2.60	36509.7
Total	25.0%	6.56	253134.9	47.1%	5.36	617189.2
All Soil Groups:						
Corn and Sorghum	4.1%	0.96	41135.3	5.1%	1.18	66548.0
Soybeans	58.7%	4.59	594403.2	36.7%	5.40	480875.5
Wheat and Oats	4.2%	1.45	42899.1	5.3%	2.34	68958.8
Other Cropland	0.9%	1.08	8624.5	2.2%	2.39	29173.9
Total Cropland	67.8%	3.27	687062.0	49.2%	3.45	645556.2
Hayland	4.0%	1.97	40178.1	13.4%	2.74	175410.4
Pastureland	24.7%	2.88	250539.2	34.4%	2.71	450631.8
Forestland	3.5%	1.48	35476.5	3.0%	1.46	39362.1
Total	100.0%	2.97	1013255.8	100.0%	2.95	1310960.5

Appendix Table 14. **Potential Erosion Reduction for Row and Grain Crops From Contouring and Terracing, Daviess and Harrison Counties, 1982**

Item	Unit	Soil Group 1	2	3	4	Total
<u>Daviess County:</u>						
Present Total	Acres	65520	57910	72490	14050	209970
> 120' Length	Acres	20500	43500	57500	10000	131500
> 200' Length	Acres	13500	28000	37000	5000	83500
Present erosion	Tons/Ac.	3.4	12.9	21.6	29.9	14.1
> 120' Length						
Present	Tons/Ac.	4.2	14.7	24.7	33.4	18.9
No Contour	Tons/Ac.	4.2	16.0	25.7	38.9	20.2
Contour & Terrace	Tons/Ac.	1.6	5.8	8.6	16.8	7.2
> 200' Length						
Present	Tons/Ac.	4.4	17.0	24.1	26.8	18.7
No Contour	Tons/Ac.	4.4	17.4	24.6	29.8	19.2
Contour & Terrace	Tons/Ac.	1.5	5.8	7.5	11.9	6.2
<u>Harrison County:</u>						
Present Total	Acres	60865	23005	80780	22445	187095
> 120' Length	Acres	16000	20480	65920	17280	119680
> 200' Length	Acres	4480	12800	28800	9600	55680
Present erosion	Tons/Ac.	3.1	11.4	24.1	39.9	17.6
> 120' Length						
Present	Tons/Ac.	3.1	11.7	25.2	45.1	22.8
No Contour	Tons/Ac.	3.1	12.3	26.8	50.1	24.5
Contour & Terrace	Tons/Ac.	1.4	4.2	9.0	20.0	8.8
> 200' Length						
Present	Tons/Ac.	2.7	12.7	28.3	49.5	26.3
No Contour	Tons/Ac.	2.7	13.0	30.4	53.8	28.5
Contour & Terrace	Tons/Ac.	1.1	4.1	8.8	19.5	8.9

Appendix Table 15. Summary of Annual Sheet and Rill Erosion Per Acre and Total Erosion for Alternative Conservation Practices, Daviess and Harrison Counties

Appendix Table Number	Conservation Conditions	Erosion Per Acre		Total Erosion	
		Daviess	Harrison	Daviess	Harrison
		<-- Tons Per Acre -->		<-- Million Tons -->	
9	Present Base	14.1	17.6	2.95	3.30
10	Contour	8.1	9.9	1.69	1.85
11	Fall Plow	15.3	19.2	3.21	3.59
12	Minimum Tillage	10.1	11.3	2.12	2.11
13	Zero Tillage	3.3	3.4	.69	.65
14	Terrace and Contour				
	Slope length > 120'				
	Present base	18.9	22.8	2.49	1.90
	No contour	20.2	24.5	2.66	2.05
	Contour and Terrace	7.2	8.8	.95	.73
	Slope length > 200'				
	Present base	18.7	26.3	2.23	1.46
	No contour	19.2	28.5	2.30	1.59
	Contour and Terrace	6.2	8.9	.74	.50

APPENDIX C

Computation of Economic Loss in Productivity Resulting from Soil Depletion

Soils were aggregated into four groups. Group 1 included alluvial bottomland soils where wetness and flooding are the predominant problems rather than erosion. Soil groups 2 and 3 correspond to SCS land capability classes 2E and 3E. Soil group 4 is predominantly land capability class 4E (app. tables 16 and 17).

Since productivity data were not available for every mapping unit within a soil group, the major soils in each group were used to represent the groups. Up to four soils were used to represent the groups accounting for from 60 to 100 percent of the soil group acreage (app. table 18). The indices for the nine representative soils are plotted for up to 20 inches of depletion in appendix figure 1. Attributes of these representative soils were used as the basis for estimating the productivity of each soil group. The soil attributes as well as the soil productivity index model were provided by Dr. Scrivner, Agronomy Department, UMC (app. table 19). Since the soil productivity index model does not consider the hazard of flooding, adjustments in productivity due to the hazard were made for soil group 1 using information developed for a recent river basis study (app. table 20). Yields were reduced to 71.8 and 88.4 percent of the yield index computed by the productivity model for Daviess and Harrison counties, respectively.

Productivity indices were computed for each soil group by weighting representative soils by their distributions (app. tables 21 and 22). Yield indices for each 4 inch incremental loss in the soil profile were computed by the model. In general, the model simulates the effects of the remaining soil profile on plant growth as incremental amounts of soil are removed. 1/ Productivity indices for one inch incremental losses were estimated by extrapolation (app. table 23).

The present productivity indices for the average level of soil depletion in each soil group was estimated by using 1982 National Resource Inventory (NRI) data. The distribution of land in each erosion phase was computed by aggregating the NRI sample point data by soil group and land use (app. table 24). Erosion phase 1, slight erosion, represents an average loss of 2 inches of soil profile while phases 3 and 4 represent average losses of 6 and 12 inches, respectively. Productivity indices corresponding to these three levels of soil depletion were computed for each soil group (app. tables 25 and 26). The cropland distribution from appendix table 24 was then used to compute a weighted productivity index for each soil group. The weighted PI represents the present productivity of the soil. The difference between this PI and the PI for 0 soil depletion from appendix tables 21 and 22 represents the loss in productivity from past erosion.

1/ For a description of the model see reference 3.

The present PI was used as a basis for estimating present average yields for the major crops: corn, soybeans, and wheat. Average county yields for the years 1979-83 were used to represent present yields. Present yields for these crops were estimated by dividing the county average yields by the weighted average county PI and applying this factor to each of the soil group PIs (app. table 25).

Present gross income for each soil group was estimated for cropland by multiplying present average yields by average prices (app. table 16). Average present gross income for each soil group is thus a product of the cropland mix and yields.

The productivity data and gross income data were combined in a personal computer program and used to estimate the loss in gross income per acre for each inch eroded (app. tables 27 and 28). Finally, the annual loss in gross dollars per acre for present erosion rates was computed. The annual loss in gross income per acre for erosion rates associated with alternative conservation practices was computed in a similar manner. A program was also used to compute the annual and accumulated present values of future income for various erosion rates (app. table 29).

Appendix Table 16. Soils by Soil Groups, Daviess County

Map Symbol	Capability Class	Acres	Soil Group Dist.	Total Dist.
Soil Group 1:				
NO	2W	36019.0	39.8%	10.5%
WB	3W	33032.5	36.5%	9.7%
WA	3W	9502.5	10.5%	2.8%
ED	2W	3982.0	4.4%	1.2%
WS	2W	3529.5	3.9%	1.0%
BU	2W	2986.5	3.3%	0.9%
BK	2W	995.5	1.1%	0.3%
ET	2W	452.5	0.5%	0.1%
		90500.0	100.0%	26.5%
Soil Group 2:				
GR	2E	44973.0	57.0%	13.2%
LG	2E	29429.7	37.3%	8.6%
GT	2E	2998.2	3.8%	0.9%
MA	2E	1499.1	1.9%	0.4%
		78900.0	100.0%	23.1%
Soil Group 3:				
SH	3E	69553.5	52.1%	20.4%
SE	3E	20959.5	15.7%	6.1%
SM	3E	15486.0	11.6%	4.5%
GA	3E	10546.5	7.9%	3.1%
KV	3E	6007.5	4.5%	1.8%
LA	3E	5473.5	4.1%	1.6%
MB	3E	5473.5	4.1%	1.6%
		133500.0	100.0%	39.1%
Soil Group 4:				
SA	4E	14011.8	36.3%	4.1%
SS	7S	13548.6	35.1%	4.0%
GB	4E	6021.6	15.6%	1.8%
LB	4E	2509.0	6.5%	0.7%
SB	4S	1003.6	2.6%	0.3%
SW	4E	1003.6	2.6%	0.3%
SN	4E	501.8	1.3%	0.1%
		38600.0	100.0%	11.3%
Total All Groups		341500.0		100.0%

Source: 1982 National Resource Inventory, SCS, USDA.

Appendix Table 17. Soils by Soil Groups, Harrison County

Map Symbol	Capability Class	Acres	Soil Group Dist.	Total Dist.
Soil Group 1:				
ZZ	5W	42908.4	41.1%	9.7%
NO	2W	26935.2	25.8%	6.1%
ZO	2W	16599.6	15.9%	3.7%
HU	3W	10857.6	10.4%	2.4%
HA	2W	3236.4	3.1%	0.7%
WA	3W	3236.4	3.1%	0.7%
CO	2W	626.4	0.6%	0.1%
		104400.0	100.0%	23.5%
Soil Group 2:				
GSB	2E	33196.8	91.2%	7.5%
LGB	2E	3203.2	8.8%	0.7%
		36400.0	100.0%	8.2%
Soil Group 3:				
SHD	3E	39731.3	21.1%	8.9%
LGC2	3E	31446.1	16.7%	7.1%
LMC2	3E	26926.9	14.3%	6.1%
AEC2	3E	24290.7	12.9%	5.5%
ADC	3E	23160.9	12.3%	5.2%
AMC	3E	13369.3	7.1%	3.0%
GAC	3E	10921.4	5.8%	2.5%
GUB2	3E	6967.1	3.7%	1.6%
PEC	3E	3766.0	2.0%	0.8%
WEB	3E	2636.2	1.4%	0.6%
WEC	3E	1883.0	1.0%	0.4%
PEB	3E	1883.0	1.0%	0.4%
LAC	3E	1318.1	0.7%	0.3%
		188300.0	100.0%	42.4%
Soil Group 4:				
SKD3	4E	32573.3	28.3%	7.3%
GAE	6E	28775.0	25.0%	6.5%
GAD	4E	16574.4	14.4%	3.7%
SHE	4E	12200.6	10.6%	2.7%
GBD3	4E	5755.0	5.0%	1.3%
ARC3	4E	4488.9	3.9%	1.0%
LHC3	4E	3798.3	3.3%	0.9%
SKE3	6E	3222.8	2.8%	0.7%
LMC3	4E	1956.7	1.7%	0.4%
PGC3	4E	1956.7	1.7%	0.4%
AMD	4E	1266.1	1.1%	0.3%
GEF	7S	1266.1	1.1%	0.3%
WGC3	4E	1266.1	1.1%	0.3%
		115100.0	100.0%	25.9%
Total All Groups:		444200.0		100.0%

Source: 1982 National Resource Inventory, SCS, USDA.

Appendix Table 18. Representative Soils Distribution by Soil Groups, Daviess and Harrison Counties

Soil Group	Representative Soil	Percent Repr. Soil is of All Soils in Group	Percent Repr. Soil is of All Repr. Soils
		Percent	
Daviess County:			
1	Wabash	50.9	56.1
	Nodaway	39.8	43.9
		90.7	100.0
2	Grundy	60.8	62.0
	Lagonda	37.3	38.0
		98.1	100.0
3	Shelby	63.7	100.0
4	Sampsel	36.4	50.0
	Snead	36.4	50.0
		76.8	100.0
Harrison County:			
1	Zook	57.1	66.4
	Nodaway	25.8	30.0
	Wabash	3.1	3.6
		86.0	100.0
2	Grundy	91.2	91.2
	Lagonda	8.8	8.8
		100.0	100.0
3	Adair	25.0	37.4
	Shelby	20.9	31.3
	Lagonda	17.2	25.7
	Grundy	3.7	5.6
		66.8	100.0
4	Shelby	56.5	94.3
	Lagonda	3.4	5.7
		59.9	100.0

Appendix Table 19. Conputation of Productivity Index for Representative Soils, Daviess and Harrison Counties

Wabash Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.65	1.00	1.00	0.314	0.204
4-8	0.60	0.97	1.00	0.196	0.114
8-12	0.40	0.95	1.00	0.143	0.054
12-16	0.90	0.94	1.00	0.108	0.091
16-20	0.70	0.92	1.00	0.082	0.053
20-24	0.70	0.88	1.00	0.061	0.038
24-28	0.70	0.88	1.00	0.044	0.027
28-32	0.85	0.92	1.00	0.030	0.023
32-36	0.70	0.94	1.00	0.017	0.011
36-40	0.75	0.95	1.00	0.005	0.004
				1.000	0.620

Adair Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.85	1.00	1.00	0.314	0.267
4-8	0.85	0.95	1.00	0.196	0.158
8-12	0.85	0.94	1.00	0.143	0.114
12-16	0.85	0.92	1.00	0.108	0.084
16-20	0.75	0.94	1.00	0.082	0.058
20-24	0.55	0.97	1.00	0.061	0.033
24-28	0.40	1.00	0.99	0.044	0.017
28-32	0.50	1.00	0.94	0.030	0.014
32-36	0.45	1.00	0.92	0.017	0.007
36-40	0.55	1.00	0.89	0.005	0.002
				1.000	0.755

Zook Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.70	1.00	1.00	0.314	0.220
4-8	0.70	0.92	1.00	0.196	0.126
8-12	0.55	0.88	1.00	0.143	0.069
12-16	0.65	0.92	1.00	0.108	0.065
16-20	0.45	0.95	1.00	0.082	0.035
20-24	0.45	0.97	0.98	0.061	0.026
24-28	0.50	0.98	0.99	0.044	0.021
28-32	0.55	0.98	1.00	0.030	0.016
32-36	0.80	1.00	1.00	0.017	0.014
36-40	0.65	1.00	0.98	0.005	0.003
				1.000	0.595

Grundy Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.95	1.00	1.00	0.314	0.298
4-8	0.95	1.00	1.00	0.196	0.186
8-12	0.95	1.00	1.00	0.143	0.136
12-16	0.95	0.95	1.00	0.108	0.097
16-20	0.70	0.92	1.00	0.082	0.053
20-24	0.60	0.92	1.00	0.061	0.034
24-28	0.45	0.95	0.99	0.044	0.019
28-32	0.45	0.98	0.96	0.030	0.013
32-36	0.45	1.00	0.93	0.017	0.007
36-40	0.45	1.00	0.94	0.005	0.002
				1.000	0.845

Sampsel Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.75	1.00	1.00	0.314	0.236
4-8	0.75	1.00	1.00	0.196	0.147
8-12	0.75	1.00	0.93	0.143	0.100
12-16	0.75	1.00	0.93	0.108	0.075
16-20	0.50	1.00	0.93	0.082	0.038
20-24	0.50	1.00	0.93	0.061	0.028
24-28	0.50	1.00	0.93	0.044	0.020
28-32	0.50	1.00	0.93	0.030	0.014
32-36	0.50	1.00	0.93	0.017	0.008
36-40	0.50	1.00	0.93	0.005	0.002
				1.000	0.669

Snead Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.75	1.00	1.00	0.314	0.236
4-8	0.75	1.00	1.00	0.196	0.147
8-12	0.75	1.00	1.00	0.143	0.107
12-16	0.40	1.00	0.96	0.108	0.041
16-20	0.20	1.00	0.93	0.082	0.015
20-24	0.20	1.00	0.93	0.061	0.011
24-28	0.20	1.00	0.93	0.044	0.008
28-32	0.20	1.00	0.93	0.030	0.006
32-36	0.20	1.00	0.93	0.017	0.003
36-40	0.20	1.00	0.93	0.005	0.001
				1.000	0.576

Source: File Data from Dr. Clarence Scrivner, Department of Agronomy, University of Missouri-Columbia.

Appendix Table 19. (Continued)

Lagonda Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.95	1.00	0.96	0.314	0.286
4-8	0.95	0.98	1.00	0.196	0.182
8-12	0.90	0.95	1.00	0.143	0.122
12-16	0.85	0.92	1.00	0.108	0.084
16-20	0.80	0.83	1.00	0.082	0.054
20-24	0.70	0.88	1.00	0.061	0.038
24-28	0.55	0.94	0.98	0.044	0.022
28-32	0.55	0.97	0.95	0.030	0.015
32-36	0.55	1.00	0.92	0.017	0.009
36-40	0.55	1.00	0.91	0.005	0.003
				1.000	0.816

Nodaway Series

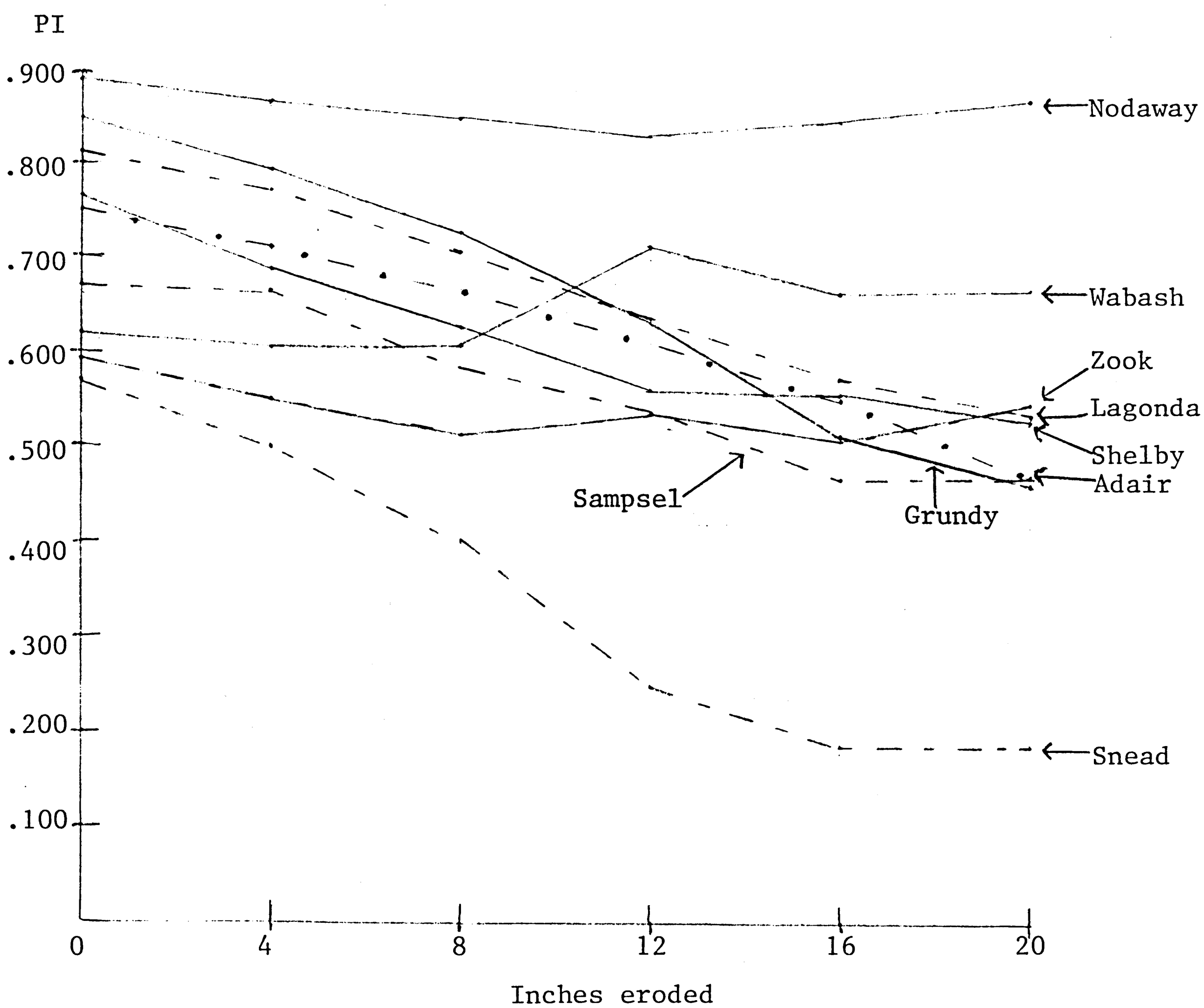
Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	1.00	1.00	0.94	0.314	0.295
4-8	0.95	1.00	0.94	0.196	0.175
8-12	1.00	1.00	0.91	0.143	0.130
12-16	0.90	1.00	0.88	0.108	0.086
16-20	0.90	1.00	0.88	0.082	0.065
20-24	0.95	1.00	0.89	0.061	0.052
24-28	0.90	1.00	0.91	0.044	0.036
28-32	0.95	1.00	0.93	0.030	0.027
32-36	1.00	1.00	0.92	0.017	0.016
36-40	1.00	1.00	0.91	0.005	0.005
				1.000	0.885

Shelby Series

Depth	Sufficiencies PAWC	Salt PH	Bulk Dens	Predicted Roots Ideal	This Soil
0-4	0.95	1.00	0.98	0.314	0.292
4-8	0.90	0.97	0.94	0.196	0.161
8-12	0.85	0.92	0.98	0.143	0.110
12-16	0.65	0.92	0.95	0.108	0.061
16-20	0.80	0.88	0.90	0.082	0.052
20-24	0.75	0.94	0.85	0.061	0.037
24-28	0.65	1.00	0.83	0.044	0.024
28-32	0.65	1.00	0.80	0.030	0.016
32-36	0.60	1.00	0.70	0.017	0.007
36-40	0.65	1.00	0.73	0.005	0.002
				1.000	0.761

Source: File Data from Dr. Clarence Scrivner, Department of Agronomy, University of Missouri-Columbia.

Appendix Figure 1: Relationship Between Productivity Index and Erosion by Major Soils, Daviess and Harrison Counties



Source: Model provided by Dr. Clarence Scrivner, Department of Agronomy, University of Missouri-Columbia.

Appendix Table 20. Adjustment Factors in Productivity Due to Flooding, Soil Group 1

Item	Soil: Wabash	Soil: Zook	Soil: Nodaway	Total
River Basin Soil Code	310	320	330	
Corn Yields, Bu. Per Acre 1/:				
Without Flooding	67.9	110.9	114.9	
With Flooding	39.9	99.7	101.3	
Percent Reduction from Flooding	58.8	89.9	88.5	
Daviess County:				
Percent Repr. Soil is of Soil Group	56.1	0	43.9	100.0
Wt. Ave. Reduction in Yield Due to Flooding	33.0	0	38.8	71.8
Harrison County:				
Percent Repr. Soil is of Soil Group	3.6	66.4	30.0	100.0
Wt. Ave. Reduction in Yield Due to Flooding	2.1	59.7	26.6	88.4

1/ Source: File data from USDA Northern Missouri River Basin Study.

Appendix Table 21. Computation of Weighted Productivity Index by Soil Groups, Daviess County

Soil Group and Soil	Dist.	Soil Depletion, Inches					
		0	4	8	12	16	20
	Percent	<-----------Productivity Index--------------->					
Soil Group 1:							
Wabash	56.1	0.620	0.606	0.608	0.719	0.661	0.667
Nodaway	43.9	.885	.863	.854	.829	.845	.869
Total or Wt. Ave.	100.0	.737	.719	.716	.767	.741	.756
Adjust for Flooding (71.8%)		.529	.516	.514	.551	.532	.542
Soil Group 2:							
Grundy	62.0	.845	.795	.728	.635	.517	.463
Lagonda	38.0	.816	.773	.704	.639	.576	.539
Total or Wt. Ave.	100.0	.834	.787	.719	.637	.540	.492
Soil Group 3:							
Shelby	100.0	.761	.686	.626	.560	.559	.527
Soil Group 4:							
Sampsel	50.0	.669	.663	.584	.538	.465	.465
Snead	50.0	.576	.502	.402	.248	.186	.186
Total or Wt. Ave.	100.0	.622	.583	.493	.393	.325	.325

Appendix Table 22. Computation of Weighted Productivity Index by Soil Groups, Harrison County

Soil Group and Soil	Dist.	Soil Depletion, Inches 0	4	8	12	16	20
	Percent	Productivity Index					
Soil Group 1:							
Zook	66.4	0.595	0.555	0.517	0.539	0.511	0.545
Nodaway	30.0	.885	.863	.854	.829	.845	.869
Wabash	3.6	.620	.606	.608	.719	.661	.667
Total or Wt. Ave.	100.0	.638	.650	.621	.633	.617	.647
Adjust for Flooding (88.4%)		.604	.575	.549	.560	.546	.572
Soil Group 2:							
Grundy	91.2	.845	.795	.728	.635	.517	.463
Lagonda	8.8	.816	.773	.704	.639	.576	.539
Total or Wt. Ave.	100.0	.843	.793	.726	.632	.522	.469
Soil Group 3:							
Adair	37.4	.755	.710	.667	.614	.554	.474
Shelby	31.3	.761	.686	.626	.560	.559	.527
Lagonda	25.7	.816	.773	.704	.639	.576	.539
Grundy	5.6	.845	.795	.728	.635	.517	.463
Total or Wt. Ave.	100.0	.777	.725	.667	.605	.559	.507
Soil Group 4:							
Shelby	94.3	.761	.686	.626	.560	.559	.527
Lagonda	5.7	.816	.773	.704	.639	.576	.539
Total or Wt. Ave.	100.0	.790	.715	.652	.584	.578	.544

Appendix Table 23. Productivity Index by Soil Group by Inches Eroded, Daviess and Harrison Counties

Inches Eroded	Daviess County Soil Group 1*	2	3	4	Harrison County Soil Group 1*	2	3	4
	<-----Productivity Index------>				<-----Productivity Index------->			
0	0.529	0.834	0.761	0.622	0.604	0.843	0.777	0.790
1	.526	.822	.742	.612	.597	.830	.764	.771
2	.523	.810	.724	.602	.590	.818	.751	.753
3	.520	.796	.705	.692	.583	.805	.738	.734
4	.516	.787	.686	.583	.575	.793	.725	.715
5	.516	.770	.671	.560	.568	.776	.710	.699
6	.515	.753	.656	.538	.562	.760	.696	.684
7	.514	.736	.641	.515	.555	.743	.681	.668
8	.514	.719	.626	.493	.549	.726	.667	.652
9	.523	.698	.609	.468	.552	.702	.651	.635
10	.532	.678	.593	.443	.555	.679	.636	.618
11	.541	.657	.576	.418	.557	.655	.620	.601
12	.551	.637	.560	.393	.560	.632	.605	.584
13	.546	.613	.609	.376	.556	.604	.593	.582
14	.541	.589	.593	.359	.553	.577	.582	.581
15	.536	.565	.576	.342	.549	.549	.571	.579
16	.532	.540	.559	.325	.546	.522	.559	.578
17	.535	.528	.551	.325	.553	.509	.546	.569
18	.538	.516	.543	.325	.559	.496	.533	.561
19	.540	.504	.535	.325	.566	.483	.520	.552
20	.542	.492	.527	.325	.572	.469	.507	.544

*Adjusted for flooding hazard.

Appendix Table 24. Land Use by Degree of Erosion, Percent of Soil Group, 1982 NRI Data

Land Use	Daviess				Harrison			
	Degree of Erosion				Degree of Erosion			
	1	2	3	Total	1	2	3	Total
Soil Group 1:								
Corn and Sorghum	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Soybeans	97.6%	2.4%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Wheat and Oats	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Other Cropland	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Total Cropland	98.5%	1.5%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Hayland	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Pastureland	100.0%	0.0%	0.0%	100.0%	97.9%	2.1%	0.0%	100.0%
Forestland	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Total	98.9%	1.1%	0.0%	100.0%	99.4%	0.6%	0.0%	100.0%
Soil Group 2:								
Corn and Sorghum	58.3%	41.7%	0.0%	100.0%	90.9%	9.1%	0.0%	100.0%
Soybeans	56.3%	43.7%	0.0%	100.0%	95.0%	5.0%	0.0%	100.0%
Wheat and Oats	41.2%	58.8%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Other Cropland	75.0%	25.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Total Cropland	55.2%	44.8%	0.0%	100.0%	94.4%	5.6%	0.0%	100.0%
Hayland	58.3%	41.7%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Pastureland	53.8%	46.2%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Forestland	75.0%	25.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
Total	55.7%	44.3%	0.0%	100.0%	96.5%	3.5%	0.0%	100.0%
Soil Group 3:								
Corn and Sorghum	34.8%	65.2%	0.0%	100.0%	50.0%	50.0%	0.0%	100.0%
Soybeans	24.4%	73.3%	2.3%	100.0%	32.7%	67.3%	0.0%	100.0%
Wheat and Oats	32.1%	60.7%	7.1%	100.0%	47.1%	52.9%	0.0%	100.0%
Other Cropland	50.0%	50.0%	0.0%	100.0%	40.0%	60.0%	0.0%	100.0%
Total Cropland	29.0%	68.3%	2.8%	100.0%	41.3%	58.7%	0.0%	100.0%
Hayland	68.2%	27.3%	4.5%	100.0%	50.9%	49.1%	0.0%	100.0%
Pastureland	59.5%	39.3%	1.2%	100.0%	66.0%	34.0%	0.0%	100.0%
Forestland	87.5%	12.5%	0.0%	100.0%	88.9%	11.1%	0.0%	100.0%
Total	45.3%	52.4%	2.2%	100.0%	53.4%	46.6%	0.0%	100.0%
Soil Group 4:								
Corn and Sorghum	0.0%	100.0%	0.0%	100.0%	28.6%	0.0%	71.4%	100.0%
Soybeans	35.0%	55.0%	10.0%	100.0%	23.5%	5.9%	70.6%	100.0%
Wheat and Oats	16.7%	66.7%	16.7%	100.0%	57.1%	0.0%	42.9%	100.0%
Other Cropland	100.0%	0.0%	0.0%	100.0%	25.0%	0.0%	75.0%	100.0%
Total Cropland	32.1%	57.1%	10.7%	100.0%	31.4%	2.9%	65.7%	100.0%
Hayland	33.3%	66.7%	0.0%	100.0%	33.3%	11.1%	55.6%	100.0%
Pastureland	65.5%	31.0%	3.4%	100.0%	55.2%	8.3%	36.5%	100.0%
Forestland	82.4%	17.6%	0.0%	100.0%	95.5%	0.0%	4.5%	100.0%
Total	55.8%	39.0%	5.2%	100.0%	52.2%	6.7%	41.1%	100.0%
All Soil Groups:								
Corn and Sorghum	69.8%	30.2%	0.0%	100.0%	76.1%	18.2%	5.7%	100.0%
Soybeans	57.1%	41.3%	1.5%	100.0%	64.7%	26.6%	8.6%	100.0%
Wheat and Oats	42.4%	52.5%	5.1%	100.0%	54.3%	39.1%	6.5%	100.0%
Other Cropland	68.8%	31.3%	0.0%	100.0%	52.6%	31.6%	15.8%	100.0%
Total Cropland	58.1%	40.2%	1.7%	100.0%	65.8%	26.4%	7.9%	100.0%
Hayland	65.9%	31.7%	2.4%	100.0%	56.0%	29.0%	15.0%	100.0%
Pastureland	67.8%	31.0%	1.1%	100.0%	69.2%	17.3%	13.5%	100.0%
Forestland	87.5%	12.5%	0.0%	100.0%	95.2%	2.4%	2.4%	100.0%
Total	63.1%	35.4%	1.5%	100.0%	67.4%	21.9%	10.7%	100.0%

Appendix Table 25. Computation of Present, Major Crop Yields by Soil Groups Based on Erosion Phase, Daviess County

Soil Group	Erosion Phase: 1 Slight 2"	2 Moderate 6"	3 Severe 12"	
	<---------Productivity Index------->			
1*	0.523	0.515	0.551	
2	.810	.753	.637	
3	.724	.656	.560	
4	.602	.538	.393	
	<--All land, Percent Distribution-->			Weighted Present PI
1	98.9	1.1	0	0.522
2	55.7	44.3	0	.789
3	45.3	52.4	2.3	.673
4	55.8	39.0	5.2	.543
Average	63.1	35.4	1.5	.649

	Cropland Dist.	Yield Per Acre**: Corn	Soybeans	Wheat
	Percent	<----------- Bu. Per Acre		--------------->
1	31.2	67.3	22.8	32.0
2	27.6	101.8	34.4	48.4
3	34.5	86.8	29.3	41.3
4	6.7	70.0	23.7	33.3
Total or Ave.	100.0	83.7	28.3	39.8

*Adjusted for flooding hazard.
**Average 5-year yields 1979-83/weighted PI.

Appendix Table 26. Computation of Present Gross Income Per Acre by Soil Groups, Daviess and Harrison Counties

Soil Group	Major Crop	Percent Dist.	Yield 1/	Price 1/	Gross Value
		Percent	Bu./Acre	$/Bu.	$/Ac.
Daviess County:					
1	Corn	30	67.3	2.87	193.15
	Soybeans	64	22.8	6.67	152.07
	Wheat	6	32.0	3.4	110.08
	Total or Ave.	100			161.87
2	Corn	21	101.8	2.87	292.17
	Soybeans	63	34.3	6.67	229.45
	Wheat	16	48.4	3.44	166.50
	Total or Ave.	100			232.55
3	Corn	17	86.8	2.87	249.12
	Soybeans	63	29.3	6.67	195.43
	Wheat	20	41.3	3.44	142.07
	Total or Ave.	100			193.89
4	Corn	4	70.0	2.87	200.90
	Soybeans	74	23.7	6.67	158.08
	Wheat	22	33.3	3.44	114.55
	Total or Ave.	100			150.15

1/ 1979-83 average.

Appendix Table 27. Computation of Annual Loss in Gross Income Per Acre, Daviess County

Daviess County Base Cropland Data

Soil Group	Percent Dist	Present PI	Inches Eroded 0	4	8	12	16	20
			Productivity Index					
1	31.2%	522	529	516	514	551	532	542
2	27.6%	789	834	787	719	637	540	492
3	34.5%	673	761	686	626	560	559	527
4	6.7%	543	622	583	493	393	325	325
	100.0%	649	699	654	608	567	530	508
		Percent of Present PI						
1		100.0	101.3%	98.9%	98.5%	105.6%	101.9%	103.8%
2		100.0	105.7%	99.7%	91.1%	80.7%	68.4%	62.4%
3		100.0	113.1%	101.9%	93.0%	83.2%	83.1%	78.3%
4		100.0	114.5%	107.4%	90.8%	72.4%	59.9%	59.9%
		100.0	107.8%	100.8%	93.7%	87.4%	81.6%	78.3%
		Present Gross	Gross Dollars Per Acre					
1		161.87	164.04	160.01	159.39	170.86	164.97	168.07
2		232.55	245.81	231.96	211.92	187.75	159.16	145.01
3		193.89	219.24	197.64	180.35	161.33	161.05	151.83
4		150.15	172.00	161.21	136.32	108.67	89.87	89.87
		191.63	206.53	193.09	179.47	167.49	156.39	150.14
	Present Inches Eroded	Loss in Gross Income Per Acre						
1	2.33	2.17	0.00	4.03	0.62	-11.47	5.89	-3.10
2	3.78	13.26	0.00	13.85	20.04	24.17	28.59	14.15
3	4.87	25.35	0.00	21.61	17.29	19.01	0.29	9.22
4	5.77	21.85	0.00	10.78	24.89	27.65	18.80	0.00
	3.84	14.90	0.00	13.44	13.62	11.98	11.10	6.25
		Loss in Gross Income Per Inch Eroded						
1		0.93	0.00	1.01	0.16	-2.87	1.47	-0.78
2		3.51	0.00	3.46	5.01	6.04	7.15	3.54
3		5.21	0.00	5.40	4.32	4.75	0.07	2.30
4		3.79	0.00	2.70	6.22	6.91	4.70	0.00
		3.88	0.00	3.36	3.40	2.99	2.78	1.56

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	3.42	143	41.81	0.022	0.024	0.004	-0.069	0.035	-0.019
2	12.90	143	11.09	0.317	0.312	0.452	0.545	0.645	0.319
3	21.55	143	6.64	0.785	0.814	0.651	0.716	0.011	0.347
4	29.93	143	4.78	0.792	0.564	1.302	1.447	0.984	0.000
	14.07	143	10.16	0.382	0.331	0.335	0.295	0.273	0.154

Appendix Table 27. (Continued)

Fall Plow-No Contour, Daviess County

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	3.68	143	38.86	0.024	0.026	0.004	-0.074	0.038	-0.020
2	15.33	143	9.33	0.376	0.371	0.537	0.648	0.766	0.379
3	26.17	143	5.46	0.953	0.989	0.791	0.870	0.013	0.422
4	38.57	143	3.71	1.021	0.727	1.678	1.865	1.268	0.000
	16.99	143	8.42	0.461	0.399	0.405	0.356	0.330	0.186

Fall Plow Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	3.65	143	39.18	0.024	0.026	0.004	-0.073	0.038	-0.020
2	13.76	143	10.39	0.338	0.333	0.482	0.581	0.688	0.340
3	23.78	143	6.01	0.866	0.898	0.719	0.790	0.012	0.383
4	31.76	143	4.50	0.841	0.599	1.382	1.535	1.044	0.000
	15.27	143	9.36	0.414	0.359	0.364	0.320	0.296	0.167

Minimum Tillage Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	2.44	143	58.61	0.016	0.017	0.003	-0.049	0.025	-0.013
2	9.10	143	15.71	0.223	0.220	0.319	0.385	0.455	0.225
3	15.66	143	9.13	0.570	0.592	0.473	0.521	0.008	0.252
4	21.41	143	6.68	0.567	0.404	0.932	1.035	0.704	0.000
	10.11	143	14.14	0.274	0.238	0.241	0.212	0.196	0.110

Zero Tillage Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	0.76	143	188.16	0.005	0.005	0.001	-0.015	0.008	-0.004
2	2.90	143	49.31	0.071	0.070	0.102	0.123	0.145	0.072
3	5.04	143	28.37	0.183	0.190	0.152	0.168	0.003	0.081
4	7.37	143	19.40	0.195	0.139	0.321	0.356	0.242	0.000
	3.27	143	43.73	0.089	0.077	0.078	0.068	0.063	0.036

Terrace and Contour

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	1.64	143	87.20	0.011	0.012	0.002	-0.033	0.017	-0.009
2	5.59	143	25.58	0.137	0.135	0.196	0.236	0.279	0.138
3	8.46	143	16.90	0.308	0.320	0.256	0.281	0.004	0.136
4	10.19	143	14.03	0.270	0.192	0.443	0.493	0.335	0.000
	6.13	143	23.33	0.166	0.144	0.146	0.128	0.119	0.067

Appendix Table 27. (Continued)

Contour Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded: Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	1.72	143	83.14	0.011	0.012	0.002	-0.035	0.018	-0.009
2	7.18	143	19.92	0.176	0.174	0.252	0.303	0.359	0.178
3	11.86	143	12.06	0.432	0.448	0.358	0.394	0.006	0.191
4	21.76	143	6.57	0.576	0.410	0.947	1.052	0.715	0.000
	8.07	143	17.72	0.219	0.190	0.192	0.169	0.157	0.088

>200' L, No Contour

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded: Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	4.4	143	32.50	0.029	0.031	0.005	-0.088	0.045	-0.024
2	17.00	143	8.41	0.417	0.412	0.596	0.718	0.850	0.420
3	24.10	143	5.93	0.877	0.910	0.728	0.801	0.012	0.388
4	26.80	143	5.34	0.710	0.505	1.166	1.296	0.881	0.000
	18.70	143	7.65	0.507	0.439	0.445	0.392	0.363	0.204

>200' L, Terrace and Contour

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded: Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	1.50	143	95.33	0.010	0.011	0.002	-0.030	0.015	-0.008
2	5.80	143	24.66	0.142	0.140	0.203	0.245	0.290	0.143
3	7.50	143	19.07	0.273	0.283	0.227	0.249	0.004	0.121
4	11.90	143	12.02	0.315	0.224	0.518	0.575	0.391	0.000
	6.20	143	23.06	0.168	0.146	0.148	0.130	0.120	0.068

Appendix Table 28. Computation of Annual Loss in Gross Income Per Acre, Harrison County

Harrison County Base Cropland Data

Soil Group	Percent Dist	Present PI	Inches Eroded 0	4	8	12	16	20
			Productivity Index					
1	32.5%	589	604	575	549	560	546	572
2	12.3%	815	843	793	726	632	522	469
3	43.2%	721	777	725	667	605	559	507
4	12.0%	640	790	715	652	584	578	544
	100.0%	680	730	683	634	591	553	528
			Percent of Present PI					
1		100.0	102.5%	97.6%	93.2%	95.1%	92.7%	97.1%
2		100.0	103.4%	97.3%	89.1%	77.5%	64.0%	57.5%
3		100.0	107.8%	100.6%	92.5%	83.9%	77.5%	70.3%
4		100.0	123.4%	111.7%	101.9%	91.3%	90.3%	85.0%
		100.0	107.4%	100.5%	93.3%	86.9%	81.3%	77.6%
		Present Gross	Gross Dollars Per Acre					
1		176.76	181.26	172.56	164.76	168.06	163.86	171.66
2		229.36	237.24	223.17	204.31	177.86	146.90	131.99
3		187.94	202.54	188.98	173.86	157.70	145.71	132.16
4		170.50	210.46	190.48	173.70	155.58	153.98	144.93
		187.31	201.21	188.25	174.67	162.84	152.19	145.41
	Present Inches Eroded		Loss in Gross Income Per Acre					
1	2.14	4.50	0.00	8.70	7.80	-3.30	4.20	-7.80
2	2.31	7.88	0.00	14.07	18.86	26.45	30.96	14.92
3	4.27	14.60	0.00	13.55	15.12	16.16	11.99	13.55
4	8.72	39.96	0.00	19.98	16.78	18.12	1.60	9.06
	3.87	13.90	0.00	12.96	13.58	11.83	10.65	6.78
		Loss in Gross Income Per Inch Eroded						
1		2.10	0.00	2.18	1.95	-0.83	1.05	-1.95
2		3.41	0.00	3.52	4.71	6.61	7.74	3.73
3		3.42	0.00	3.39	3.78	4.04	3.00	3.39
4		4.58	0.00	5.00	4.20	4.53	0.40	2.26
		3.59	0.00	3.24	3.40	2.96	2.66	1.69

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	3.13	143	45.69	0.046	0.048	0.043	-0.018	0.023	-0.043
2	11.44	143	12.50	0.273	0.281	0.377	0.529	0.619	0.298
3	24.13	143	5.93	0.577	0.572	0.638	0.682	0.506	0.572
4	39.93	143	3.58	1.280	1.395	1.172	1.265	0.112	0.632
	17.41	143	8.21	0.437	0.394	0.413	0.360	0.324	0.206

Appendix Table 28 (Continued)

Fall Plow-No Contour, Harrison County

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	3.18	143	44.97	0.047	0.048	0.043	-0.018	0.023	-0.043
2	13.57	143	10.54	0.324	0.334	0.447	0.628	0.734	0.354
3	27.58	143	5.18	0.659	0.654	0.729	0.779	0.578	0.654
4	49.54	143	2.89	1.588	1.730	1.454	1.569	0.138	0.784
	20.55	143	6.96	0.516	0.466	0.488	0.425	0.383	0.244

Fall Plow Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	3.17	143	45.11	0.047	0.048	0.043	-0.018	0.023	-0.043
2	12.82	143	11.15	0.306	0.315	0.423	0.593	0.694	0.334
3	26.05	143	5.49	0.623	0.617	0.689	0.736	0.546	0.617
4	44.33	143	3.23	1.421	1.548	1.301	1.404	0.124	0.702
	19.17	143	7.46	0.481	0.434	0.455	0.396	0.357	0.227

Minimum Tillage Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	2.02	143	70.79	0.030	0.031	0.028	-0.012	0.015	-0.028
2	8.17	143	17.50	0.195	0.201	0.269	0.378	0.442	0.213
3	15.30	143	9.35	0.366	0.363	0.404	0.432	0.321	0.363
4	25.08	143	5.70	0.804	0.876	0.736	0.794	0.070	0.397
	11.27	143	12.69	0.283	0.255	0.268	0.233	0.210	0.134

Zero Tillage Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	0.59	143	242.37	0.009	0.009	0.008	-0.003	0.004	-0.008
2	2.49	143	57.43	0.059	0.061	0.082	0.115	0.135	0.065
3	4.68	143	30.56	0.112	0.111	0.124	0.132	0.098	0.111
4	7.78	143	18.38	0.249	0.272	0.228	0.246	0.022	0.123
	3.45	143	41.45	0.087	0.078	0.082	0.071	0.064	0.041

Terrace and Contour

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded					
				Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		Annual Loss in Gross Dollars Per Acre					
1	1.59	143	89.94	0.023	0.024	0.022	-0.009	0.012	-0.022
2	4.37	143	32.72	0.104	0.108	0.144	0.202	0.237	0.114
3	9.01	143	15.87	0.215	0.214	0.238	0.255	0.189	0.214
4	7.65	143	18.69	0.245	0.267	0.224	0.242	0.021	0.121
	7.29	143	19.62	0.183	0.165	0.173	0.151	0.136	0.086

Appendix Table 28. (Continued)

Contour Only

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	1.57	143	91.08	0.023	0.024	0.021	-0.009	0.012	-0.021
2	6.08	143	23.52	0.145	0.150	0.200	0.281	0.329	0.159
3	12.61	143	11.34	0.301	0.299	0.333	0.356	0.264	0.299
4	26.66	143	5.36	0.854	0.931	0.782	0.844	0.075	0.422
	9.90	143	14.44	0.249	0.224	0.235	0.205	0.184	0.117

>200' L, No Contour

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	2.7	143	52.96	0.040	0.041	0.037	-0.016	0.020	-0.037
2	13.00	143	11.00	0.310	0.320	0.429	0.601	0.704	0.339
3	30.40	143	4.70	0.727	0.720	0.804	0.859	0.637	0.720
4	53.80	143	2.66	1.724	1.879	1.579	1.704	0.150	0.852
	28.50	143	5.02	0.716	0.646	0.677	0.589	0.531	0.338

>200' L, Terrace and Contour

Soil Group	Erosion Rate	Bulk Density	Years to Erode One Inch	Inches Eroded Present	4	8	12	16	20
	Tons/Ac	Tons/Inch		-------- Annual Loss in Gross Dollars Per Acre --------					
1	1.1	143	130.00	0.016	0.017	0.015	-0.006	0.008	-0.015
2	4.10	143	34.88	0.098	0.101	0.135	0.190	0.222	0.107
3	8.80	143	16.25	0.210	0.209	0.233	0.249	0.184	0.209
4	19.50	143	7.33	0.625	0.681	0.572	0.618	0.054	0.309
	8.90	143	16.07	0.224	0.202	0.211	0.184	0.166	0.105

Appendix Table 29. Computation of Present Value of Loss in Gross Income Per Acre, Harrison County

Harrison County Base Data, 5%, 14 yrs., Soil Group 4

		Undiscounted		Discounted	
Years	PV Factor	Annual + Cost - Gain	Accum. + Cost - Gain	Annual + Cost - Gain	Accum. + Cost - Gain
1	0.952381	1.395	1.395	1.329	1.329
2	0.9070295	2.790	4.185	2.531	3.859
3	0.8638376	4.185	8.370	3.615	7.474
4	0.8227025	5.580	13.950	4.591	12.065
5	0.7835262	6.975	20.925	5.465	17.530
6	0.7462154	8.370	29.295	6.246	23.776
7	0.7106813	9.765	39.060	6.940	30.716
8	0.6768394	11.160	50.220	7.554	38.269
9	0.6446089	12.555	62.775	8.093	46.362
10	0.6139133	13.950	76.725	8.564	54.926
11	0.5846793	15.345	92.070	8.972	63.898
12	0.5568374	16.740	108.810	9.321	73.220
13	0.5303214	18.135	126.945	9.617	82.837
14	0.505068	19.530	146.475	9.864	92.701
15	0.4810171	20.702	167.177	9.958	102.659
16	0.4581115	21.874	189.051	10.021	112.680
17	0.4362967	23.046	212.097	10.055	122.735
18	0.4155207	24.218	236.315	10.063	132.798
19	0.395734	25.390	261.705	10.048	142.846
20	0.3768895	26.562	288.267	10.011	152.856
21	0.3589424	27.734	316.001	9.955	162.811
22	0.3418499	28.906	344.907	9.882	172.693
23	0.3255713	30.078	374.985	9.793	182.485
24	0.3100679	31.250	406.235	9.690	192.175
25	0.2953028	32.422	438.657	9.574	201.749
26	0.2812407	33.594	472.251	9.448	211.197
27	0.2678483	34.766	507.017	9.312	220.509
28	0.2550936	35.938	542.955	9.168	229.677
29	0.2429463	37.203	580.158	9.038	238.715
30	0.2313774	38.468	618.626	8.901	247.616
31	0.2203595	39.733	658.359	8.756	256.371
32	0.2098662	40.998	699.357	8.604	264.976
33	0.1998725	42.263	741.620	8.447	273.423
34	0.1903548	43.528	785.148	8.286	281.709
35	0.1812903	44.793	829.941	8.121	289.829
36	0.1726574	46.058	875.999	7.952	297.781
37	0.1644356	47.323	923.322	7.782	305.563
38	0.1566054	48.588	971.910	7.609	313.172
39	0.149148	49.853	1021.763	7.435	320.608
40	0.1420457	51.118	1072.881	7.261	327.869
41	0.1352816	52.383	1125.264	7.086	334.955
42	0.1288396	53.648	1178.912	6.912	341.867
43	0.1227044	54.760	1233.672	6.719	348.586
44	0.1168613	55.872	1289.544	6.529	355.116
45	0.1112965	56.984	1346.528	6.342	361.458
46	0.1059967	58.096	1404.624	6.158	367.616
47	0.1009492	59.208	1463.832	5.977	373.593
48	0.0961421	60.320	1524.152	5.799	379.392
49	0.0915639	61.432	1585.584	5.625	385.017
50	0.0872037	62.544	1648.128	5.454	390.471
51	0.0830512	63.656	1711.784	5.287	395.758
52	0.0790964	64.768	1776.552	5.123	400.881
53	0.0753299	65.880	1842.432	4.963	405.843
54	0.0717427	66.992	1909.424	4.806	410.650
55	0.0683264	68.104	1977.528	4.653	415.303
56	0.0650728	69.216	2046.744	4.504	419.807
57	0.0619741	69.848	2116.592	4.329	424.136
58	0.0590229	70.480	2187.072	4.160	428.296
59	0.0562123	71.112	2258.184	3.997	432.293
60	0.0535355	71.744	2329.928	3.841	436.134
61	0.0509862	72.376	2402.304	3.690	439.824
62	0.0485583	73.008	2475.312	3.545	443.369
63	0.046246	73.640	2548.952	3.406	446.775
64	0.0440438	74.272	2623.224	3.271	450.046
65	0.0419465	74.904	2698.128	3.142	453.188
66	0.039949	75.536	2773.664	3.018	456.206
67	0.0380467	76.168	2849.832	2.898	459.103
68	0.0362349	76.800	2926.632	2.783	461.886
69	0.0345095	77.432	3004.064	2.672	464.558
70	0.0328662	78.064	3082.128	2.566	467.124

Appendix Table 30. Present Value of sheet and Rill Erosion Lost in 50 Years From Cropland at 0, 5, 10, and 15 Percent Discount Rates, Daviess and Harrison Counties

Soil Group	Present Erosion Rate	Present Value of Future Loss From Sheet & Rill Erosion 50 Years at Discount Rate of: 0%	5%	10%	15%
	Tons/Ac.	<------------Dollars Per Acre------------->			
Daviess County:					
1	3.42	30.60	7.11	2.52	1.22
2	12.90	400.74	92.68	32.73	15.84
3	21.55	992.86	235.26	84.42	41.16
4	29.93	1096.46	223.96	69.89	31.12
Wt. Average	14.07				
		<------------Dollars Per Ton of Present Erosion--------->			
1	---	8.94	2.08	.74	.36
2	---	31.06	7.18	2.54	1.23
3	---	46.07	10.91	3.92	1.91
4	---	36.63	7.48	2.34	1.04
Wt. Average		29.71	6.90	2.44	1.18
	Tons/Ac.	<--------------Dollars Per Acre ---------->			
Harrison County:					
1	3.13	61.20	14.22	5.03	2.44
2	11.44	358.28	83.22	29.45	14.26
3	24.13	752.60	172.61	60.48	29.14
4	39.93	1648.13	390.47	141.02	69.32
Wt. Average	17.41				
		<------------Dollars Per Ton of Present Erosion--------->			
1	---	19.55	4.54	1.61	.78
2	---	31.32	7.27	2.57	1.25
3	---	31.19	7.15	2.51	1.21
4	---	41.28	9.78	3.53	1.74
Wt. Average		28.63	6.63	2.35	1.14

Appendix Table 31. Present Value of Sheet and Rill Erosion Lost in 50 Years from Cropland at 0, 4, and 12 Percent Discount Rates, Daviess and Harrison Counties

Soil Group	Present Erosion Rate	Present Value of Future Loss From Sheet & Rill Erosion, 50 Years at Discount Rates of: 0%	4%	12%
	Tons/Ac.	<------ Dollars Per Acre		------>
Daviess County:				
1	3.42	30.60	9.18	1.83
2	12.90	400.74	119.83	23.74
3	21.55	992.86	302.82	61.48
4	29.93	1096.46	297.37	48.77
Wt. Average	14.07			
		Dollars Per Ton of Present Erosion		
1	---	8.95	2.68	.54
2	---	31.07	9.29	1.84
3	---	46.07	14.05	2.85
4	---	36.63	9.94	1.63
Wt. Average		29.72	8.91	1.77
	Tons/Ac.	<------ Dollars Per Acre		------>
Harrison County:				
1	3.13	61.20	18.37	3.65
2	11.44	358.28	107.52	21.38
3	24.13	752.60	223.56	43.78
4	39.93	1648.13	502.33	103.05
Wt. Average	17.41			
		Dollars Per Ton of Present Erosion		
1	---	19.55	5.87	1.17
2	---	31.32	9.40	1.87
3	---	31.19	9.26	1.81
4	---	41.28	12.58	2.58
Wt. Average		28.63	8.57	1.70

APPENDIX D

Computation of Economic Impacts of Conservation Program

This appendix describes the data sets and methodology used to evaluate the short- and long-term impacts of the conservation program in Daviess and Harrison counties. The conservation program includes conservation applied through the regular program as well as that accomplished from targeting. Targeting funds were treated as additions to regular funds. Any redirection of the program due to the targeting effort therefore includes not only targeting funds but also redirected regular funds. The impact of targeting may therefore be greater or less than indicated by the extra targeted funds depending on how the total funds were redirected.

CRES Data

One objective of this study was to explore the usefulness of the Conservation Reporting and Evaluation System (CRES) data for evaluating the conservation program. Printouts of CRES data were obtained from ASCS for fiscal year 1983. This data set included acres treated, soil loss before and after treatment, total cost and cost shares, practices applied, and land capability class by individual fields. There were 311 fields treated in Daviess county and 89 in Harrison county.

A multitude of conservation practice combinations were applied on these fields. Since USLE is the criteria used to estimate the change in sheet and rill erosion, it would have been desirable if the data set included the change in the USLE factors associated with the sets of practices applied. Practices could then have been combined on the basis of changes in these factors. Lacking this information, the alternative was to combine the practices into combinations based on expected changes in one or more USLE factor. This resulted in 34 combinations of practices (app. table 32).

These combinations were further aggregated into seven groups of practices representing changes in USLE factors L, P, or C and one group where changes in these factors would be expected to be negligible. This group (unknown) includes practices and practice combinations which ordinarily reduce erosion other than sheet and rill. However, sizable reductions in sheet and rill erosion were reported for combinations with two practices, namely grade stabilization structures and grass waterways. Reporting the changes in USLE factors would have more precisely indicated how these two practices affect sheet and rill erosion.

The acres, total cost, cost share, and soil saved (both sheet and rill and other erosion) were aggregated for each combination of practices (app. tables 33 and 35). Per acre and per ton of soil saved values were then computed for each combination and group of practices (app. tables 34 and 36). Note the wide range in costs, cost shares, and cost per acre or ton saved for the various practice combinations. One reason for this is total cost and cost-sharing may be reported for one practice in the combination while the major reduction in erosion is a result of an accompanied practice for which total costs and cost shares are not reported. This is particularly true for many of the practices involving cover (C). For example, costs and cost shares are reported for combination 10 which includes underground outlets, contour, and conservation tillage, conservation cropping, and diversion structures. Total costs and cost shares reflect the structural practices but the major reduction in sheet and rill erosion is most likely from the other three practices affecting C and P. The structural measures are more likely to reduce gully erosion and affect off-site water quality more than the long-term productivity of the land. Increasing water quality is one of the objectives of conservation and structural controls may be justified on this basis. However, the focus of this analysis is the onsite economic impact of conservation. Therefore, the analysis will focus on sheet and rill erosion which most directly affects productivity and the impacts of the practices as reported by CRES on net farm income. The grouping of practices by USLE factors affected causes some aggregation problems in identifying the cause-effect of specific practices. However, it does provide a means of identifying the relative cost-effectiveness of various combinations of practices.

Computation of Shortrun Net Costs

The total costs, cost shares, and farmer costs from the 1983 CRES data were aggregated for the six combinations of practices (app. tables 37 and 38). Generally, these costs do not include costs or benefits for annual practices such as conservation tillage or contour farming. Rather, they include the initial cost of structural measures, pasture seeding, etc. Adjustments were therefore made to include the shortrun costs of annual practices. One of the annual practices is conservation tillage. Conservation tillage can include a multitude of changed machine operations ranging from foregoing plowing to no tillage.

Some studies have shown that significant cost savings are possible from reduced tillage (4). Others have indicated that these savings may not, however, occur in the initial years (5). Different machinery and inputs are required which often results in an adjustment period of a few years before net benefits from conservation tillage occur. Therefore, it was assumed that, on the average, no shortrun costs or benefits would occur from adopting conservation tillage. This assumption was modified for the analysis of longrun effects.

The cost of contour farming begin the year that this practice is adopted. Contour costs vary depending on the crop and type of tillage operation. Assuming contour farming results in a 10-percent reduction in field efficiency, the estimated average annual cost of this practice was $4.50 per acre (4). This cost was added to those combinations of practices including contour farming (app. tables 37 and 38). After this adjustment, the total shortrun costs, cost shares, and farmer costs were aggregated by conservation practice groups. The per-ton reduction data were used as the basis for computing the shortrun effects of practices for the years 1981-83 (see main report).

Computation of Longrun Net Costs or Benefits

The economic feasibility of conservation generally rests on long-term impacts because conservation costs begin at the time the practice is adopted while benefits occur in the future. Some costs such as terracing must be borne as an initial lump sum while others such as contouring and terrace maintenance must be incurred annually. Onsite conservation benefits may include both annual cost savings and the prevention of future income losses due to lower productivity if conservation is not practiced.

To place costs and benefits on a common basis, they were converted to present values by discounting. Initial costs were added to discounted present values of future annual costs. The present value of future benefits was then subtracted from the present value of costs. This procedure resulted in net costs (+) or benefits (-) as computed in app. tables 40 and 41. (The conventional sign for net costs is (-) and benefits (+). Tables presented in the main report reflect the conventional signs.)

The initial costs by practices in these two tables are from 1983 CRES data. The annual cost of maintaining terraces was estimated as 5 percent of the initial cost. Estimated annual contouring costs were $4.50 per acre and the estimated net long-term cost savings (benefits) of conservation tillage were $10 per acre. These costs are based on a recent river basin study in the area (4) and represent median values for the various crops, soils, and conservation tillage practices. More precise estimates are available but could not be used because of the aggregative nature of the CRES data.

The present value of costs and benefits was computed for two discount rates: 4 percent and 12 percent. The 4-percent rate reflects a long-term value assuming no inflation and is used to represent the social discount rate. The 12-percent value more nearly reflects the private cost of capital and is used to represent farmers' discount rate. A planning horizon of 50 years was used to discount costs and benefits.

The present value of the loss in net income prevented by conservation was estimated at $10.18 per ton saved at a discount rate of 4 percent and $1.97 per ton saved at a discount rate of 12 percent for Daviess county. Equivalent figures for Harrison county were $9.30 and $1.82 respectively. These figures represent the present value of soil saved per ton reduction for each soil group weighted by the percent distribution of sheet and rill soil saved (app. table 39). For a description of the procedure used to estimate these present values by soil group, see appendix C. The net per acre and per ton reduction values as computed in appendix tables 40 and 41 were used as the basis for estimating the longrun effects of practices for the years 1981-83.

Data in the foregoing tables represent the per-acre or per-ton values for the year 1983. To evaluate impacts of the targeting program, we desired total values for the period 1981-83. Data from ASCS printouts indicated the dollars spent for cost-sharing by types of practices for the years 1980 through 1983 (app. table 42). Other information from various sources was also available for the same years (app. table 43). These data were different because of different original sources and different definitions. The ASCS accountable documents, indicating the amounts spent on practices were used as the basis for cost-shares during the 1980-1983 period. The data presented in the main report are based on the $413,619 and $39,943 spent on cost-sharing in Daviess and Harrison counties, respectively, in the 1981-83 period. The per acre and per ton values computed in appendix tables 40 and 41 were used to expand impacts to the 1981-83 period.

Appendix Table 32. Conservation Practice Combinations from CRES, Daviess and Harrison Counties

Combination	USLE Factor Affected	Soil Conservation Service Practice Code																			
		600	620	330	329	328	362	378	645	399	510	512	410	412	340	462	608	606	587	380	15
		Terrace	Underground Outlet	Contour	Cons. Till	Cons. Cropping	Diversion	Water Impoundment	Wildlife Mgt.	Fish Pond Mgt.	Pasture and Hay Mgt.	Pasture and Hay Plant	Grade Stabilization Structure	Grass Waterway Outlet	Cover and Green Manure	Precision Land Form	Main or Lateral	Subsurface Drainage	Water Control Str.	Windbreak	Unknown
1	L	X																			
2	L	X	X																		
3	LP	X		X																	
4	LP	X	X	X																	
5	LPC	X	X	X	X																
6	LPC	X	X	X	X	X															
7	LPC	X	X	X		X															
8	LPC	X		X	X	X															
9	PC			X	X	X															
10	PC		X	X	X	X	X														
11	C				X	X															
12	C		X			X	X														
13	C					X															
14	C					X															
15	C							X			X	X									
16	C										X										
17	C										X	X									
18	C							X			X										
19	C										X		X								
20	C											X									
21	C														X						
22	U		X				X														
23	U							X													
24	U							X	X												
25	U							X	X	X											
26	U												X								
27	U									X			X								
28	U													X							
29	U															X	X				
30	U																	X			
31	U									X									X		
32	U																		X		
33	U																				X
34	U																			X	

L = Length of Slope; P = Practice Factor; C = Cover; U = Unknown

Appendix Table 33. CRES Data, Daviess County, 1983

Combination	USLE Factor Affected	Acres	Total Cost	Cost Share	Soil Saved S & R	Soil Saved Other	Soil Saved Total
			---- Dollars ----		-------- Annual Tons --------		
1	L	67	5333	1950	482	49	531
2	L	0	1509	1034	0	433	433
	Total L	67	6842	2984	482	482	964
3	LP	10	600	0	150	0	150
4	LP	266	37333	19908	2934	0	2934
	Total LP	276	37933	19908	3084	0	3084
5	LPC1C2						
6	LPC1C2	2814	353943	167095	43517	1717	45234
8	LPC1C2	163	8107	2665	1690	0	1690
	Total LPC1C2	2977	362050	169760	45207	1717	46924
7	LPC2	75	12443	5258	820	0	820
	Total LPC	3052	374493	175018	46027	1717	47744
9	PC1C2	6221	0	0	55312	0	55312
10	PC1C2	10	1184	356	140	0	140
	Total PC1C2	6231	1184	356	55452	0	55452
11	C1C2	5267	608	0	51597	0	51597
12	C2						
13	C2	130	0	0	1100	0	1100
14	C2	40	3519	1024	1040	203	1243
21	C2	86	0	0	602	0	602
	Total C2	256	3519	1024	2742	203	2945
15	C3	20	2415	1372	580	78	658
16	C3	203	565	0	543	0	543
17	C3	44	4310	0	1276	0	1276
18	C3	35	11555	5924	35	157	192
19	C3						
20	C3	197	8789	2801	2743	0	2743
	Total C3	499	27634	10097	5177	235	5412
22	U						
23	U	46	26901	11843	86	812	898
24	U						
25	U						
26	U	0	4722	2517	0	398	398
27	U						
28	U	0	8523	4324	0	2514	2514
29	U	80	2500	0	0	0	0
30	U	22	900	0	0	0	0
31	U	169	0	0	0	0	0
32	U						
33	U	0	446	335	0	0	0
34	U	0	65	0	0	0	0
	Total U	317	44057	19019	86	3724	3810
Total		15965	496270	228406	164647	6361	171008

L = Length of Slope; P = Practice Factor; C1 = Conservation Tillage; C2 = Conservation Cropping; C3 = Pasture and Hay Mgt.; U = Unknown

Appendix Table 34. Computation of Cost Per Acre and Per Ton Saved, 1983 CRES Data, Daviess County

Combination	USLE Factor Affected	Cost Per Acre: Total	Cost Per Acre: Shared	Cost Per Acre: Farmer	Cost Share Per Ton Saved: S & R	Cost Share Per Ton Saved: Other	Cost Share Per Ton Saved: Total	Soil Saved Per Acre: S & R	Soil Saved Per Acre: Other	Soil Saved Per Acre: Total	Total Cost Per Ton Saved S&R
		$ Per Acre			$ Per Ton Saved			Tons Per Acre			$/Ton Save
1	L	79.60	29.10	50.49	4.05	39.80	3.67	7.19	0.73	7.93	11.06
2	L	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	2.39	2.39	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total L	102.12	44.54	57.58	6.19	6.19	3.10	7.19	7.19	14.39	14.20
3	LP	60.00	0.00	60.00	0.00	#DIV/0!	0.00	15.00	0.00	15.00	4.00
4	LP	140.35	74.84	65.51	6.79	#DIV/0!	6.79	11.03	0.00	11.03	12.72
	Total LP	137.44	72.13	65.31	6.46	#DIV/0!	6.46	11.17	0.00	11.17	12.30
5	LPC1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	LPC1C2	125.78	59.38	66.40	3.84	97.32	3.69	15.46	0.61	16.07	8.13
8	LPC1C2	49.74	16.35	33.39	1.58	#DIV/0!	1.58	10.37	0.00	10.37	4.80
	Total LPC1C2	121.62	57.02	64.59	3.76	98.87	3.62	15.19	0.58	15.76	8.01
7	LPC2	165.91	70.11	95.80	6.41	#DIV/0!	6.41	10.93	0.00	10.93	15.17
	Total LPC	122.70	57.35	65.36	3.80	101.93	3.67	15.08	0.56	15.64	8.14
9	PC1C2	0.00	0.00	0.00	0.00	#DIV/0!	0.00	8.89	0.00	8.89	0.00
10	PC1C2	118.40	35.60	82.80	2.54	#DIV/0!	2.54	14.00	0.00	14.00	8.46
	Total PC1C2	0.19	0.06	0.13	0.01	#DIV/0!	0.01	8.90	0.00	8.90	0.02
11	C1C2	0.12	0.00	0.12	0.00	#DIV/0!	0.00	9.80	0.00	9.80	0.01
12	C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	C2	0.00	0.00	0.00	0.00	#DIV/0!	0.00	8.46	0.00	8.46	0.00
14	C2	87.98	25.60	62.38	0.98	5.04	0.82	26.00	5.08	31.08	3.38
21	C2	0.00	0.00	0.00	0.00	#DIV/0!	0.00	7.00	0.00	7.00	0.00
	Total C2	13.75	4.00	9.75	0.37	5.04	0.35	10.71	0.79	11.50	1.28
15	C3	120.75	68.60	52.15	2.37	17.59	2.09	29.00	3.90	32.90	4.16
16	C3	2.78	0.00	2.78	0.00	#DIV/0!	0.00	2.67	0.00	2.67	1.04
17	C3	97.95	0.00	97.95	0.00	#DIV/0!	0.00	29.00	0.00	29.00	3.38
18	C3	330.14	169.26	160.89	169.26	37.73	30.85	1.00	4.49	5.49	330.14
19	C3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	C3	44.61	14.22	30.40	1.02	#DIV/0!	1.02	13.92	0.00	13.92	3.20
	Total C3	55.38	20.23	35.14	1.95	42.97	1.87	10.37	0.47	10.85	5.34
22	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
23	U	584.80	257.46	327.35	137.71	14.58	13.19	1.87	17.65	19.52	312.80
24	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
25	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
26	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	6.32	6.32	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
27	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
28	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1.72	1.72	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
29	U	31.25	0.00	31.25	#DIV/0!	#DIV/0!	#DIV/0!	0.00	0.00	0.00	#DIV/0!
30	U	40.91	0.00	40.91	#DIV/0!	#DIV/0!	#DIV/0!	0.00	0.00	0.00	#DIV/0!
31	U	0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	0.00	0.00	0.00	#DIV/0!
32	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
33	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
34	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total U	138.98	60.00	78.98	221.15	5.11	4.99	0.27	11.75	12.02	512.29
Total		31.08	14.31	16.78	1.39	35.91	1.34	10.31	0.40	10.71	3.01

Appendix Table 35. CRES Data, Harrison County, 1983

Combination	USLE Factor Affected	Acres	Total Cost	Cost Share	Soil Saved S & R	Soil Saved Other	Soil Saved Total
			---- Dollars ----		-------- Annual Tons --------		
1	L	5	882	497	75	127	202
2	L	1276	181212	92955	24228	4130	28358
	Total L	1281	182094	93452	24303	4257	28560
3	LP						
4	LP	210	29320	14390	5505	0	5505
	Total LP	210	29320	14390	5505	0	5505
5	LPC1C2	50	7911	4278	1520	0	1520
6	LPC1C2						
8	LPC1C2						
	Total LPC1C2	50	7911	4278	1520	0	1520
7	LPC2						
	Total LPC	50	7911	4278	1520	0	1520
9	PC1C2						
10	PC1C2						
	Total PC1C2	0	0	0	0	0	0
11	C1C2						
12	C2	30	1600	847	750	0	750
13	C2						
14	C2						
21	C2						
	Total C2	30	1600	847	750	0	750
15	C3						
16	C3						
17	C3						
18	C3						
19	C3	0	3498	1487	0	260	260
20	C3	176	12560	4691	4542	1296	5838
	Total C3	176	16058	6178	4542	1556	6098
22	U	112	7542	3429	2337	0	2337
23	U						
24	U	0	1898	716		14	14
25	U	5	1964	649	70	27	97
26	U	210	29513	12973	5190	1341	6531
27	U	0	2659	1116	0	143	143
28	U	0	1715	467	0	32	32
29	U						
30	U						
31	U						
32	U	60	2479	948	5700	0	5700
33	U						
34	U						
	Total U	387	47770	20298	13297	1557	14854
Total		2134	284753	139443	49917	7370	57287

L = Length of Slope; P = Practice Factor; C1 = Conservation Tillage;
C2 = Conservation Cropping; C3 = Pasture and Hay Mgt.; U = Unknown

Appendix Table 36. Computation of Cost Per Acre and Per Ton Saved, 1983 CRES Data, Harrison County

Combination	USLE Factor Affected	Cost Per Acre: Total	Cost Per Acre: Shared	Cost Per Acre: Farmer	Cost Share Per Ton Saved: S & R	Cost Share Per Ton Saved: Other	Cost Share Per Ton Saved: Total	Soil Saved Per Acre: S & R	Soil Saved Per Acre: Other	Soil Saved Per Acre: Total	Total Cost Per Ton Saved S&R
		$ Per Acre			$ Per Ton Saved			Tons Per Acre			$/Ton Save
1	L	176.40	99.40	77.00	6.63	3.91	2.46	15.00	25.40	40.40	11.76
2	L	142.02	72.85	69.17	3.84	22.51	3.28	18.99	3.24	22.22	7.48
	Total L	142.15	72.95	69.20	3.85	21.95	3.27	18.97	3.32	22.30	7.49
3	LP	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	LP	139.62	68.52	71.10	2.61	#DIV/0!	2.61	26.21	0.00	26.21	5.33
	Total LP	139.62	68.52	71.10	2.61	#DIV/0!	2.61	26.21	0.00	26.21	5.33
5	LPC1C2	158.22	85.56	72.66	2.81	#DIV/0!	2.81	30.40	0.00	30.40	5.20
6	LPC1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	LPC1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total LPC1C2	158.22	85.56	72.66	2.81	#DIV/0!	2.81	30.40	0.00	30.40	5.20
7	LPC2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total LPC	158.22	85.56	72.66	2.81	#DIV/0!	2.81	30.40	0.00	30.40	5.20
9	PC1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	PC1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total PC1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	C1C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	C2	53.33	28.23	25.10	1.13	#DIV/0!	1.13	25.00	0.00	25.00	2.13
13	C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
21	C2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total C2	53.33	28.23	25.10	1.13	#DIV/0!	1.13	25.00	0.00	25.00	2.13
15	C3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	C3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	C3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	C3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	C3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	5.72	5.72	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	C3	71.36	26.65	44.71	1.03	3.62	0.80	25.81	7.36	33.17	2.77
	Total C3	91.24	35.10	56.14	1.36	3.97	1.01	25.81	8.84	34.65	3.54
22	U	67.34	30.62	36.72	1.47	#DIV/0!	1.47	20.87	0.00	20.87	3.23
23	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
24	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	51.14	51.14	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
25	U	392.80	129.80	263.00	9.27	24.04	6.69	14.00	5.40	19.40	28.06
26	U	140.54	61.78	78.76	2.50	9.67	1.99	24.71	6.39	31.10	5.69
27	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	7.80	7.80	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
28	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	14.59	14.59	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
29	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
30	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
31	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
32	U	41.32	15.80	25.52	0.17	#DIV/0!	0.17	95.00	0.00	95.00	0.43
33	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
34	U	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Total U	123.44	52.45	70.99	1.53	13.04	1.37	34.36	4.02	38.38	3.59
Total		133.44	65.34	68.09	2.79	18.92	2.43	23.39	3.45	26.84	5.70

Appendix Table 37. Computation of Shortrun Costs by Major Soil Conservation Practices, Harrison County, 1983

USLE Factor and Practice Affected	CRES Acres	CRES Total Costs	Contour Added Costs	Total Costs	Cost Share	Farmer Cost	Soil Saved S & R	Soil Saved Other	Soil Saved Total
		<--- Dollars				--->	<--- Tons		--->
L Terrace	1281	182094	0	182094	93452	88642	24303	4257	28560
LP Terrace, Contour	210	29320	945	30265	14390	15875	5505	0	5505
LPC Terr, Cont, CT, CC	50	7911	225	8136	4278	3858	1520	0	1520
LPC Terr, Cont, CC	0	0	0	0	0	0	0	0	0
PC Cont., CT, CC	0	0	0	0	0	0	0	0	0
C CT, CC	0	0	0	0	0	0	0	0	0
C CC	30	1600	0	1600	847	753	750	0	750
C Past. & Hay Mgt.	176	16058	0	16058	6178	9880	4542	1556	6098
- Unknown	387	47770	0	47770	20298	27472	13297	1557	14854
Total	2134	284753	1170	285923	139443	146480	49917	7370	57287

USLE Factor and Practice Affected	Cost Per Acre Total	Cost Per Acre Cost Share	Cost Per Acre Farmer	Cost Per Ton Saved, S & R Total	Cost Per Ton Saved, S & R Cost Share	Cost Per Ton Saved, S & R Farmer	Cost Per Ton Saved, Total Total	Cost Per Ton Saved, Total Cost Share	Cost Per Ton Saved, Total Farmer
	<---- Dollars Per Acre		---->	<--- Dollars Per Ton Saved					--->
L Terrace	142.150	72.952	69.198	7.493	3.845	3.647	6.376	3.272	3.104
LP Terrace, Contour	144.119	68.524	75.595	5.498	2.614	2.884	5.498	2.614	2.884
LPC Terr, Cont, CT, CC	162.720	85.560	77.160	5.353	2.814	2.538	5.353	2.814	2.538
LPC Terr, Cont, CC	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
PC Cont, CT, CC	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
C CT, CC	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
C CC	53.333	28.233	25.100	2.133	1.129	1.004	2.133	1.129	1.004
C Past. & Hay Mgt.	91.239	35.102	56.136	3.535	1.360	2.175	2.633	1.013	1.620
- Unknown	123.437	52.450	70.987	3.593	1.527	2.066	3.216	1.367	1.849
Average	133.985	65.343	68.641	5.728	2.793	2.934	4.991	2.434	2.557

CT = Conservation Tillage; CC = Conservation Cropping

Appendix Table 38. Computation of Shortrun Costs by Major Soil Conservation Practices, Daviess County, 1983

USLE Factor and Practice Affected	CRES Acres	CRES Total Costs	Contour Added Costs	Total Costs	Cost Share	Farmer Cost	Soil Saved S & R	Soil Saved Other	Soil Saved Total
		<------	Dollars			------>	<------	Tons	------>
L Terrace	67	6842	0	6842	2984	3858	482	482	964
LP Terrace, Contour	276	37933	1242	39175	19908	19267	3084	0	3084
LPC Terr, Cont, CT, CC	2977	362050	13396	375446	169760	205686	45207	1717	46924
LPC Terr, Cont, CC	75	12443	338	12781	5258	7523	820	0	820
PC Cont. CT, CC	6231	1184	28040	29224	356	28868	55452	0	55452
C CT, CC	5267	608	0	608	0	608	51597	0	51597
C CC	256	3519	0	3519	1024	2495	2742	203	2945
C Past. & Hay Mgt.	499	27634	0	27634	10097	17537	5177	235	5412
- Unknown	317	44057	0	44057	19019	25038	86	3724	3810
Total	15965	496270	43016	539286	228406	310880	164647	6361	171008

USLE Factor and Practice Affected	Cost Per Acre Total	Cost Per Acre Cost Share	Cost Per Acre Farmer	Cost Per Ton Saved, S & R Total	Cost Per Ton Saved, S & R Cost Share	Cost Per Ton Saved, S & R Farmer	Cost Per Ton Saved, Total Total	Cost Per Ton Saved, Total Cost Share	Cost Per Ton Saved, Total Farmer
	<----	Dollars Per Acre	---->	<------		Dollars Per Ton Saved			------>
L Terrace	102.119	44.537	57.582	14.195	6.191	8.004	7.098	3.095	4.002
LP Terrace, Contour	141.938	72.130	69.808	12.703	6.455	6.247	12.703	6.455	6.247
LPC Terr, Cont, CT CC	126.116	57.024	69.092	8.305	3.755	4.550	8.001	3.618	4.383
LPC Terr, Cont, CC	170.413	70.107	100.307	15.587	6.412	9.174	15.587	6.412	9.174
PC Cont, CT, CC	4.690	0.057	4.633	0.527	0.006	0.521	0.527	0.006	0.521
C CT, CC	0.115	0.000	0.115	0.012	0.000	0.012	0.012	0.000	0.012
C CC	13.746	4.000	9.746	1.283	0.373	0.910	1.195	0.348	0.847
C Past. & Hay Mgt.	55.379	20.234	35.144	5.338	1.950	3.387	5.106	1.866	3.240
- Unknown	138.981	59.997	78.984	512.291	221.151	291.140	11.564	4.992	6.572
Average	33.779	14.307	19.473	3.275	1.387	1.888	3.154	1.336	1.818

CT = Conservation Tillage; CC = Conservation Cropping

Appendix Table 39. Computation of Weighted Average Present Value Per Ton of Soil Saved, 50 Years, Discount Rates of 4 and 12 Percent, Daviess and Harrison Counties, 1983

Soil Group	Percent Dist. Sheet & Rill Soil Saved	P.V. of Sheet & Rill Saved Per Ton Reduction at Discount Rate of:			
		4%	12%	4%	12%
	Percent	Dollars Per Ton Saved 50 years		Dollars Per Ton Saved Per Year	
Daviess County:					
1	5.3	2.68	0.54	0.05	0.01
2	51.4	9.29	1.84	.19	.04
3	23.4	14.05	2.85	.20	.03
4	19.9	9.94	1.63	.20	.04
Total or Average	100.0	10.18	1.97	.20	.04
Harrison County:					
1	0	---	---	---	---
2	9.1	9.40	1.87	.19	.04
3	90.0	9.26	1.81	.19	.04
4	.9	12.58	2.58	.25	.05
Total or Average	100.0	9.30	1.82	.19	.04

Appendix Table 40. Computation of Longrun Costs or Benefits by Major Soil Conservation Practices, Daviess County, 1983

Item	L Terrace	LP Terrace Contour	LPC Terrace Contour Cons. T Cons. C	LPC Terrace Contour Cons. C	PC Contour Cons. T Cons. C	C Cons. T Cons. C	C Cons. C	C Pasture and Hay Mgt.	- Unknown	Total
Acres:										
Terrace	67	276	2977	75						3395
Contour		276	2977	75	6231					9559
Cons. Till			2977		6231	5267				14475
Cons. Crop			2977	75	6231	5267	256			14806
Past. & Hay Mgt.								499		499
Unknown									317	317
Total	67	276	2977	75	6231	5267	256	499	317	15965
Initial Cost, $:	6842	37933	362050	12443	1184	608	3519	27634	44057	496270
Annual Cost, $:										
Terrace	342	1896	18102	622						20962
Contour		1242	13396	338	28040					43016
Cons, Till			-29770		-62310	-52670				-144750
Total	342	3138	1728	960	-34270	-52670	0	0	0	-80772
PV Annual Cost, $:										
50 yrs., 4%	7640	70107	38606	21447	-765642	-1176725	0	0	0	-1804567
50 yrs., 12%	3181	29187	16072	8929	-318747	-489886	0	0	0	-751264
PV All Cost, $:										
50 yrs., 4%	14482	108040	400656	33890	-764458	-1176117	3519	27634	44057	-1308297
50 yrs., 12%	10023	67120	378122	21372	-317563	-489278	3519	27634	44057	-254994
Soil Saved:										
Sheet & Rill	482	3084	45207	820	55452	51597	2742	5177	86	164647
Other	482	0	1717	0	0	0	203	235	3724	6361
Total	964	3084	46924	820	55452	51597	2945	5412	3810	171008
PV of Sheet & Rill Saved, 50 yrs., $:										
4%, ($10.18/T)	-4907	-31395	-460207	-8348	-564501	-525257	-27914	-52702	-875	-1676106
12%, ($1.97/T)	-950	-6075	-89058	-1615	-109240	-101646	-5402	-10199	-169	-324355
PV Net Cost (+) or Benefit (-), 50 yrs:										
4% Discount										
Total	9575	76645	-59551	25542	-1328959	-1701374	-24395	-25068	43182	-2984403
Cost Share	-2984	-19908	-169760	-5258	-356	0	-1024	-10097	-19019	-228406
Farmer	6591	56737	-229311	20284	-1329315	-1701374	-25419	-35165	24163	-3212809
12% Discount										
Total	9073	61045	289064	19757	-426803	-590924	-1883	17435	43888	-579349
Cost Share	-2984	-19908	-169760	-5258	-356	0	-1024	-10097	-19019	-228406
Farmer	6089	41137	119304	14499	-427159	-590924	-2907	7338	24869	-807755
PV Net Cost (+) or Benefit (-) Per Ton S & R:										
4% Discount										
Total	19.87	24.85	-1.32	31.15	-23.97	-32.97	-8.90	-4.84	502.11	-18.13
Cost Share	-6.19	-6.46	-3.76	-6.41	-0.01	0.00	-0.37	-1.95	-221.15	-1.39
Farmer	13.67	18.40	-5.07	24.74	-23.97	-32.97	-9.27	-6.79	280.96	-19.51
12% Discount										
Total	18.82	19.79	6.39	24.09	-7.70	-11.45	-0.69	3.37	510.32	-3.52
Cost Share	-6.19	-6.46	-3.76	-6.41	-0.01	0.00	-0.37	-1.95	-221.15	-1.39
Farmer	12.63	13.34	2.64	17.68	-7.70	-11.45	-1.06	1.42	289.17	-4.91
PV Net Cost (+) or Benefit (-) Per Acre S & R:										
4% Discount										
Total	142.91	277.70	-20.00	340.57	-213.28	-323.03	-95.29	-50.24	136.22	-186.93
Cost Share	-44.54	-72.13	-57.02	-70.11	-0.06	0.00	-4.00	-20.23	-60.00	-14.31
Farmer	98.38	205.57	-77.03	270.46	-213.34	-323.03	-99.29	-70.47	76.22	-201.24
12% Discount										
Total	135.42	221.18	97.10	263.42	-68.50	-112.19	-7.35	34.94	138.45	-36.29
Cost Share	-44.54	-72.13	-57.02	-70.11	-0.06	0.00	-4.00	-20.23	-60.00	-14.31
Farmer	90.89	149.05	40.08	193.31	-68.55	-112.19	-11.35	14.71	78.45	-50.60

Appendix Table 41. Computation of Longrun Costs or Benefits by Major Soil Conservation Practices, Harrison County, 1983

Item	L Terrace	LP Terrace Contour	LPC Terrace Contour Cons. T Cons. C	LPC Terrace Contour Cons. C	PC Contour Cons. T Cons. C	C Cons. T Cons. C	C Cons. C	C Pasture and Hay Mgt.	- Unknown	Total
Acres:										
Terrace	1281	210	50							1541
Contour		210	50							260
Cons. Till			50							50
Cons. Crop			50				30			80
Past. & Hay Mgt.								176		176
Unknown									387	387
Total	1281	210	50	0	0	0	30	176	387	2134
Initial Cost, $:	182094	29320	7911	0	0	0	1600	16058	47770	284753
Annual Cost, $:										
Terrace	9105	1466	396							10967
Contour		945	225							1170
Cons, Till			-500							-500
Total	9105	2411	121	0	0	0	0	0	0	11637
PV Annual Cost, $:										
50 yrs., 4%	203419	53866	2704							259989
50 yrs., 12%	84686	22424	1126							108236
PV All Cost, $:										
50 yrs., 4%	385513	83186	10615	0	0	0	1600	16058	47770	544742
50 yrs., 12%	266780	51744	9037	0	0	0	1600	16058	47770	392989
Soil Saved:										
Sheet & Rill	24303	5505	1520				750	4542	13297	49917
Other	4257	0	0				0	1556	1557	7370
Total	28560	5505	1520	0	0	0	750	6098	14854	57287
PV of Sheet & Rill Saved, 50 yrs., $:										
4%, ($9.30/T)	-226018	-51197	-14136	0	0	0	-6975	-42241	-123662	-464228
12%, ($1.82/T)	-44231	-10019	-2766	0	0	0	-1365	-8266	-24201	-90849
PV Net Cost (+) or Benefit (-), 50 yrs:										
4% Discount										
Total	159495	31990	-3521	0	0	0	-5375	-26183	-75892	80514
Cost Share	-93452	-14390	-4278				-847	-6178	-20298	-139443
Farmer	66043	17600	-7799	0	0	0	-6222	-32361	-96190	-58929
12% Discount										
Total	222549	41725	6271	0	0	0	235	7792	23569	302140
Cost Share	-93452	-14390	-4278				-847	-6178	-20298	-139443
Farmer	129097	27335	1993	0	0	0	-612	1614	3271	162697
PV Net Cost (+) or Benefit (-) Per Ton S & R:										
4% Discount										
Total	6.56	5.81	-2.32	#DIV/0!	#DIV/0!	#DIV/0!	-7.17	-5.76	-5.71	1.61
Cost Share	-3.85	-2.61	-2.81	#DIV/0!	#DIV/0!	#DIV/0!	-1.13	-1.36	-1.53	-2.79
Farmer	2.72	3.20	-5.13	#DIV/0!	#DIV/0!	#DIV/0!	-8.30	-7.12	-7.23	-1.18
12% Discount										
Total	9.16	7.58	4.13	#DIV/0!	#DIV/0!	#DIV/0!	0.31	1.72	1.77	6.05
Cost Share	-3.85	-2.61	-2.81	#DIV/0!	#DIV/0!	#DIV/0!	-1.13	-1.36	-1.53	-2.79
Farmer	5.31	4.97	1.31	#DIV/0!	#DIV/0!	#DIV/0!	-0.82	0.36	0.25	3.26
PV Net Cost (+) or Benefit (-) Per Acre S & R:										
4% Discount										
Total	124.51	152.33	-70.42	#DIV/0!	#DIV/0!	#DIV/0!	-179.17	-148.76	-196.10	37.73
Cost Share	-72.95	-68.52	-85.56	#DIV/0!	#DIV/0!	#DIV/0!	-28.23	-35.10	-52.45	-65.34
Farmer	51.56	83.81	-155.98	#DIV/0!	#DIV/0!	#DIV/0!	-207.40	-183.87	-248.55	-27.61
12% Discount										
Total	173.73	198.69	125.41	#DIV/0!	#DIV/0!	#DIV/0!	7.83	44.27	60.90	141.58
Cost Share	-72.95	-68.52	-85.56	#DIV/0!	#DIV/0!	#DIV/0!	-28.23	-35.10	-52.45	-65.34
Farmer	100.78	130.17	39.85	#DIV/0!	#DIV/0!	#DIV/0!	-20.40	9.17	8.45	76.24

Appendix Table 42. Cost Sharing Grouped by Type of Practices, From ASCS Printouts, 1980-83, Daviess and Harrison Counties

County and Year	Terrace System	Erosion or Water Control Structures	Water Impoundment	Establish or Improve Permanent Cover	Other Practices	Total
	<-------------------------	-----------	Dollars	-----------	------------------------->	
Daviess County:						
1983	144895	6033	9159	2450	6312	168849
1982	101505	2983	12837	2446	1068	120839
1981	84622	6271	11860	1288	2020	106061
1980	81126	3006	15511	2293	4029	105965
1981-83	331022	15287	33856	6184	9400	395749
	<-------------------------	-----------	Percent	-----------	------------------------->	
1983	85.8	3.6	5.4	1.5	3.7	100.0
1982	84.0	2.5	10.6	2.0	.9	100.0
1981	79.8	5.9	11.2	1.2	1.9	100.0
1980	76.6	2.8	14.6	2.2	3.8	100.0
1981-83	83.6	3.9	8.5	1.6	2.4	100.0
	<-------------------------	-----------	Dollars	-----------	------------------------->	
Harrison County:						
1983	144024	18108	1365	9555	7379	180431
1982	78840	53355	6803	391	3708	143097
1981	45286	54676	7219	1202	3399	111782
1980	67695	38193	9289	4439	7818	127434
1981-83	268150	126139	15387	11148	14486	435310
	<-------------------------	-----------	Percent	-----------	------------------------->	
1983	79.8	10.0	.8	5.3	4.1	100.0
1982	55.1	37.3	4.7	.3	2.6	100.0
1981	40.5	48.9	6.5	1.1	3.0	100.0
1980	53.1	30.0	7.3	3.5	6.1	100.0
1981-83	61.6	29.0	3.5	2.6	3.3	100.0

Appendix Table 43. ASCS and SCS Cost-Sharing Data by Years, From Various Sources, Daviess and Harrison Counties

Source	1980	1981	1982	1983	Total 1981-1983	Average 1981-1983
	<--------	--------	Year	--------	--------	-------->
	<--------	--------	Dollars	--------	--------	-------->
Daviess County:						
ASCS printouts by type of practice	105965	106061	120839	168849	395749	131916
ASCS Accountable Doc.						
Available	159102	208998	252762	226731	688491	229497
Spent	113261	111914	129547	172158	413619	137873
Nielson's Data	126559	198835	206017	225967	630819	210273
CRES Data	--	--	--	228406	--	--
Harrison County:						
ASCS printouts by type of practice	127434	111782	143097	180431	435310	145103
ASCS Accountable Doc.						
Available	170722	150625	213820	203800	568245	189415
Spent	122183	111950	153195	174798	439943	146647
Nielson's Data	119137	116770	186667	184493	487930	162643
CRES Data	--	--	--	139443	--	--

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Targeting