Unites States
Department of
Agriculture

Natural Resources
Conservation Service

Resource Economics
and Social Sciences
Division

Historical Notes
Number 5

# Historical Changes in Soil Erosion, 1930-1992

## The Northern Mississippi Valley Loess Hills

M. Scott Argabright, Roger G. Cronshey,
J. Douglas Helms, George A. Pavelis,
H. Raymond Sinclair, Jr.

Cover photograph: Coon Creek watershed, Vernon County, Wisconsin. Tim McCabe. 1994.

# HISTORICAL CHANGES IN SOIL EROSION, 1930-1992
## The Northern Mississippi Valley Loess Hills

M. Scott Argabright
Agronomist
NRCS-USDA, Lincoln, Nebraska

Roger G. Cronshey
Hydraulic Engineer
NRCS-USDA, Washington, D.C.

J. Douglas Helms
Senior Historian
NRCS-USDA, Washington, D.C.

George A. Pavelis
Economist
ERS-USDA, Washington, D.C.

H. Raymond Sinclair, Jr.
Soil Scientist
NRCS-USDA, Lincoln, Nebraska

**Natural Resources Conservation Service**
**Economic Research Service**
**United States Department of Agriculture**
**Washington, D.C.**
**September 1996**

## Foreword

This is a study of soil erosion conditions in the 1930's as opposed to 'now' (1992) in a major land resource area of the humid region, the Northern Mississippi Valley Loess Hills (MLRA 105), or what is sometimes called the "Driftless Area of the Northern Mississippi Valley ". The study describes and quantifies, using modern methods, the kinds of erosion problems identified in the nationwide Reconnaissance Erosion Survey, which led to the creation of what is now the Natural Resources Conservation Service (NRCS). The Survey and Service are the legacies of Hugh Hammond Bennett and other pioneers in the conservation of soil and other natural resources.

The project was a contributing component of the Third USDA Appraisal of Conditions and Trends on Soil, Water and Related Natural Resources in the United States. Such periodic assessments were mandated in the Soil and Water Resources Conservation Act of 1977. As part of this effort we undertook an historical assessment of the effect of conservation programs in an important livestock and crop production area of the Midwest. The Universal Soil Loss Equation (USLE) was applied to evaluate the magnitude of soil losses in 1982 and 1992 compared to 1930. The same methodology would be feasible for some other areas where soil erosion losses are primarily water-related.

For purposes of historical comparison it was desirable that the area be one where cropland agriculture, then and now, used a large part of the landscape. We preferred an area with a relatively rough topography, where water erosion posed a threat on slopes, as opposed to an area of slight relief. Also, because the analysis attempted to assess the probable effectiveness of private and public conservation activities, the area of study preferably would be one where there had been some early conservation initiatives by public agencies. A logical choice was an important agricultural region that included some research and demonstration projects. Also, the Driftless area has been studied by a number of geomorphologists whose works are discussed in Beach (1994). We hope this study adds to the discussion of the relationship of erosion, soil loss, and what Beach terms the 'sediment delivery problem'.

In 1933 a new Federal agency, the Soil Erosion Service, selected Coon Creek in Wisconsin as the first watershed within which to demonstrate the values of soil conservation measures. In 1935 this agency became the Soil Conservation Service, now the Natural Resources Conservation Service (NRCS). The Service began working in the Driftless area in 1933 when it located its first demonstration project at Coon Valley, Wisconsin, a 49,400-acre watershed including parts of La Crosse, Monroe and Vernon Counties. The SCS staff worked with local farmers to plan conservation measures for their farmland such as strip cropping, contouring, fencing woodland, and controlling

gullies and stream bank erosion. At about the same time the U.S. Department of Agriculture (USDA) had established a number of Conservation Experiment Stations across the country, one of which was located at nearby La Crosse, Wisconsin.[1]

Determining how effective individual conservation efforts and public programs for research, technical assistance and cost sharing have been in reducing soil erosion in a broad region like MLRA 105 was a main object of this interdisciplinary study. A second object was to illustrate a methodology whereby long-term changes in erosion conditions as determined for this region might also be applied in other regions.

The present study was greatly facilitated by the help of others in planning the work and helping access the large body of required documents and data, much of which is archival and not in the published literature. In the Department of Agriculture Lane Price and Jeffrey Goebel of the Resources Inventory Division of NRCS helped outline a general strategy for applying the USLE to 1930 conditions and using USLE data from the 1992 National Resources Inventory to approximate current conditions. NRCS Field Office Technical Guides and other interpretive data for Wisconsin, Iowa, Minnesota and Illinois were available or provided through Lee Herndon of the National Headquarters Staff of the NRCS by David Breitbach in Minnesota, John Pingry in Wisconsin, and Robert Dayton and Dennis Miller in Iowa. Mr. Miller of the NRCS State Office in Iowa and Owen Lee of the National Headquarters Staff of NRCS assisted in explaining small watershed program activities. Maps showing these projects and the status of county soil surveys in the region were prepared by Stacey Wood in NRCS The high quality and comprehensiveness of USDA's Soil and Erosion Surveys, both historic and current, were instrumental in making this study feasible.

Especially useful were onsite interviews in Elkader, Iowa in February 1995 with David Gibney, Unit Conservationist for Clayton County and Mark Bowman, farmer and Chair of the local Soil and Water Conservation District Committee. Mr. Bowman willingly shared his own experiences and recollections concerning the crop rotations and farming practices followed in the

---

[1] Details on these early conservation efforts in the region are in a 1939 unpublished document: *Project Monograph, Coon Valley and Coon Creek Project Report (Region 5, Wisc. 1).* U.S. Dept. Agr., Soil Conservation Service. 107 pp. Also see Helms, J.Douglas. 1982. "Coon Valley, Wisconsin: A Conservation Success Story" In *Readings in the History of the Soil Conservation Service.* U.S. Dept. Agr., Soil Conservation Service, Historical Notes. No.1. pp51-53. A detailed review of the evolution of conservation programs in Wisconsin is in Leonard C. Johnson's *Soil Conservation in Wisconsin: Birth to Rebirth* (Madison: University of Wisconsin, 1991). 332pp.

Northern Mississippi Valley in the 1930s and 1940s. Also, in August 1995 Rocky Taign of the Elkader Field Office of the Natural Resources Conservation Service assisted in locating sites where repeat photographs of land uses and conservation practices could be obtained.

Out of print and current State crop reports covering all counties in the study area were obtained through William Dowdy of the Crops Branch in the National Agricultural Statistics Service, with additional help from Garry Kepley, George Howse, Bernie Jansen and other personnel in Illinois, Minnesota and Iowa. Advance county sheets from the 1992 Census of Agriculture and assistance in interpreting land use items in the older Censuses were provided by Robert Smith and Debra Norton of the Census Bureau's Agriculture Division. William Lindamood, Edward Reinsel, Robert Reinsel, Dan Deprey and Sean Riley of the Economic Research Service were especially helpful in accessing and/or compiling the Census information. Others in ERS offering suggestions and assistance include Audrae Erickson, Dwight Gadsby, Ralph Heimlich, Catherine Kascak, Tim Osborn and Carmen Sandretto. In addition to contributing many hours in word processing assistance, Janice Pavelis greatly improved the layout of the numerous tables and charts supporting our analysis and conclusions.

A number of editorial improvements were suggested by Rebekah Davis, a 1995 and 1996 summer intern with the Natural Resources Conservation Service. She and another intern, Wykesha Tripp, and also Claudette Hayes of the NRCS publications group, also assisted in the printing arrangements.

## Executive Summary

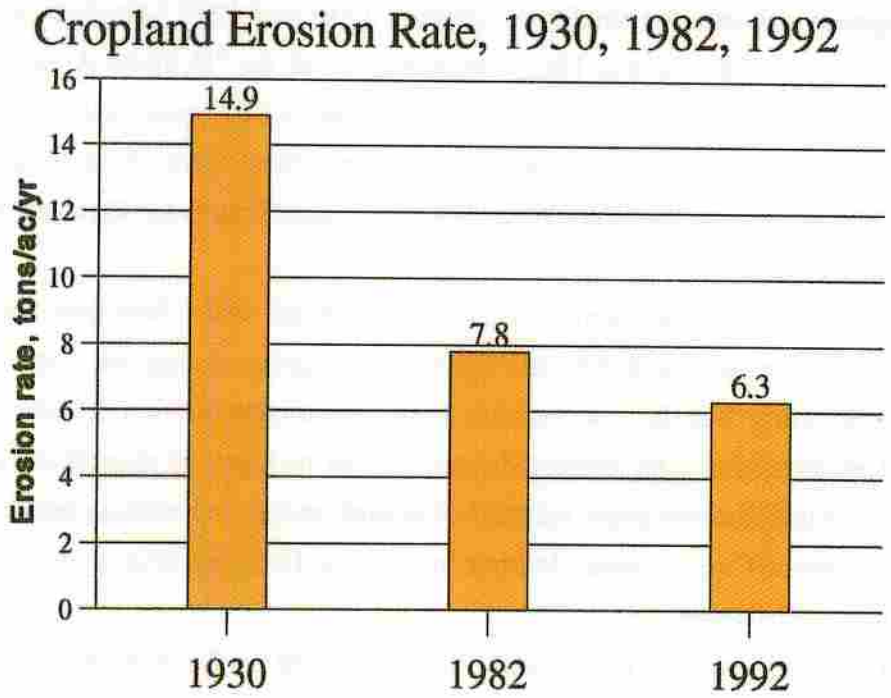
Changes in soil erosion conditions between 1930 and 1992 have been evaluated for the Northern Mississippi Valley Loess Hills, sometimes called the "Driftless Area" of the Northern Mississippi Valley. As naturally defined, this area includes 18,860 square miles (12.1 million acres) covering the major part of 28 counties--six counties in northeast Iowa, six counties in southeastern Minnesota, 15 counties in southwestern Wisconsin and a single county (Jo Daviess) in the northwest corner of Illinois (figure 1).

Five of the 28 counties were chosen as a sample for which land uses, farm management practices, farming methods, and crop and livestock enterprises during the years 1925-1935 were researched from early USDA Soil Surveys, State Experiment Station Research Bulletins, and Agricultural Census reports. This information was used to 'reconstruct' rates of soil loss for the base year 1930 on land used for row crops, oats and other small grains, and rotation meadow. The sample counties were: Clayton County, Iowa; Houston and Winona Counties, Minnesota; and Crawford and Vernon Counties, Wisconsin.

The Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith of USDA's Agricultural Research Service was used to calculate erosion rates per acre of land in these crops. The formula integrates the influences on erosion of rainfall, soil erodibility, field slope and slope length, cropping sequences, crop yields, tillage practices, and any supporting conservation measures. The erosion rates for 1930 calculated for the sample counties were compared with erosion rates for 1982 and 1982. The 1982 and 1992 rates, also based on the USLE, were made available from the National Resources Inventories of the Natural Resources Conservation Service.

Chart A shows the average annual cropland erosion rates for the region expected under the land use and management conditions prevailing in 1930, 1982 and 1992. The average annual rate of soil loss in 1930 on the land in row crops, small grains and rotation meadow is estimated to have been 14.9 tons per acre per year, plus or minus an allowance for error of 1.0 ton per acre (6.7%). There is a 95-percent level of confidence that the actual rate in 1930 was somewhere between 13.9 and 15.9 tons/ac/yr. By 1982 the average rate of soil loss on land in these three crop groups in the region had been reduced to 7.8 tons per acre per year, representing a 48-percent decrease from the 1930 rate. The allowance for sampling error in this estimate is about 0.4 ton per acre (5.1%). By 1992 the average rate of soil loss on land in these three crop groups in the region had been reduced to 6.3 tons per acre per year--a 58-percent decrease from the 1930 rate. The error in this case is about 0.3 ton per acre (4.8%).

**Chart A**

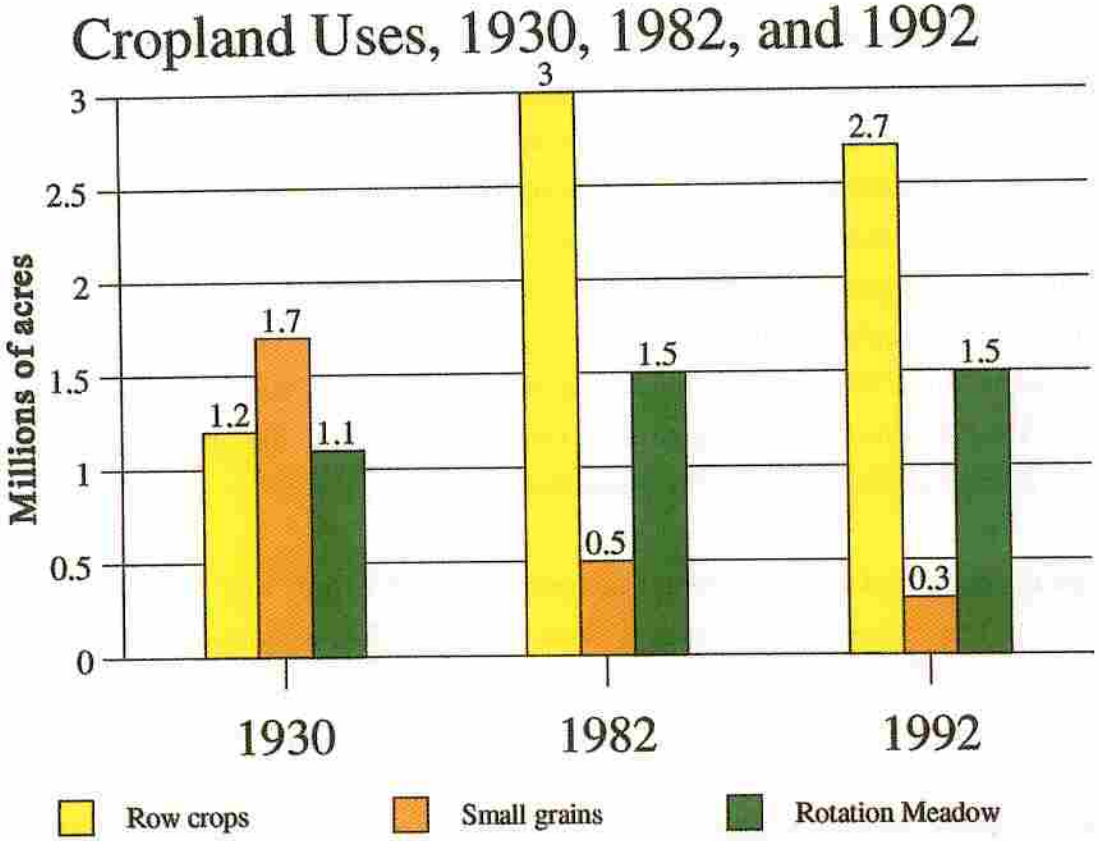



When multiplied by the acres in principal crops the reduced gross erosion rates per acre from 1930-1992 translate into a reduction of between 42 and 58 percent in the total or 'gross' amount of erosion occurring on the land in row crops, small grains, and meadow. In 1930 between 54 and 64 million tons of soil per year were being displaced from cropland. By 1992 these losses had been reduced to between 27 and 31 million tons per year. About 64 percent of the reduction in total erosion between 1930 and 1992 was achieved by 1982, and 36 percent since 1982.

'Excess' rates of erosion were also estimated. The excess rate of erosion was defined as the gross rate of soil displacement per acre less the tolerance rate '**T**' that can occur without an appreciable loss in soil productivity, and without applying additional nutrients. In 1930 about 87 percent of all land in principal crops was eroding in excess of **T.** By 1992 this proportion had been reduced to about 39 percent.

Summing up the overall results of this study: Under conditions in 1992 the average annual erosion rate per acre of the land in principal crops in the Northern Mississippi Valley Loess Hills (MLRA 105) was only 42 percent of the rate we estimated for 1930, and the total amount of soil being displaced on cropland in 1992 was only 49 percent of the amount displaced in 1930. These reductions were achieved despite the area used for row crops, small grains or rotation meadow in 1992 being 16 percent greater than in 1930. The area in row crops alone in 1992 was 2.3 times the

**Chart B**




area in row crops in 1930-- 2.7 million acres in 1992 as compared to 1.2 million acres in 1930.

Chart B compares the use of cropland for row crops, small grains and rotation meadow in 1930, 1982 and 1992. Note that the combined area in row crops or small grains in 1992 (3.0 million acres) was less than the area in 1982 (3.5 million acres), by about 500 thousand acres. The 678 thousand acres in the Conservation Reserve Program in 1992 doubtless included significant acreages cropped in 1982, but also some cropland that was not being farmed in 1982.

It appears that the reductions in erosion in this region since the 1930's were not accomplished by using land resources less intensively, such as leaving land in small grains or permanent hay meadow instead of growing more row crops. They were largely the result of investing in terraces or other improvements, practicing stripcropping, and reducing tillage.

Data from the Conservation Technology Information Center (CTIC) indicate that, as of 1994, no-till farming had been adopted on about 440,000 acres (12 percent) of the land planted to row crops or small grains, compared to none in 1930 and only 3 percent in 1984. In 1994 mulch or ridge tillage was practiced on just over a million acres (26 percent) of the acres in planted crops. Including all variations, some form of conservation tillage was practiced in the region on nearly 40 percent of the area planted to row crops or small grains in 1994.

According to the 1992 Census of Agriculture, about 66,000 acres of the croppable land (less than 1 percent) in the region were in various set-aside or similar short-term diversion programs of USDA. These programs are apart from the Conservation Reserve Program (CRP) aimed at retiring highly erodible cropland from production through long-term (10-year) contracts with landowners. A cumulative total of nearly 726 thousand acres in the region were in the Conservation Reserve in 1994. The CRP enrollments accounted for roughly 18 percent of the highly erodible cropland and for 85 percent of all cropland not harvested in the region.

**Some limitations of and important conclusions from this study are:**

1. The conservation practices initiated since the 1930's enhance many other resources and values such wildlife, water quality, and aesthetic and recreational qualities. We did not attempt to quantify these contributions. Nor did we try to determine the relative contributions of Federal or State agencies and individuals in greatly reducing erosion in the region studied, essentially because public conservation and programs involve cooperation between landowners and public agencies.

2. The various reasons why farmers may or may not give soil conservation a high priority in their management plans were not investigated here. The need for current income is an important factor in how farmers will integrate conservation in their management plans. The current preference for corn and other row crops in the study area can be attributed to their importance as cash crops, especially to support the growing hog industry. It would appear that every effort should be made to continue and improve on conservation measures protecting the cropland used so intensively.

3. Farmers of an earlier day in the region were conservation minded. Few attempted to grow corn continuously and steep slopes were generally left in hay or pasture, although pastures were often overgrazed and otherwise poorly managed. Preserving cropland fertility with barnyard manure and selecting crops to fit a primarily livestock-oriented farm economy were primary concerns. The adverse consequences of farming up and down slopes rather than on the contour, and usually removing and sometimes burning crop residues, were not well understood.

4. Farmers of today are also conservation minded but their situations and tactics differ. The apparent tendency is to plant row crops wherever feasible, but to install the necessary land improvements like terraces, farm slopes on the contour and minimize tillage operations.

5. Soil erosion has been greatly reduced since 1930 in the Driftless Area of the Northern Mississippi Valley, but the results of our study do not necessarily apply elsewhere. Agriculture is too dynamic and diverse to warrant such generalizations. However, this study does offer a clear corrective to the sweeping generalizations which claim that soil erosion has remained static or worsened since the midst of the Great Depression and the dust bowl days of sixty years ago.

6. This study represents an original effort to quantify soil erosion losses 60-plus years ago across a broad region. The numerical results, while reliable, should not be regarded as exact. Climatic conditions and basic soil characteristics may not have changed much, but it is virtually impossible and in any case would be prohibitively expensive to determine exactly how each farm field was managed in the 1930s. The results we give reflect our best judgement as to which source data, assumptions, and analytical methods to apply to the problem. In this sense our findings can be regarded as accurate representations of farming and erosion conditions in the 1930s and the present time. Further, the continued conversions to no-till farming and other variations of conservation tillage suggest that the expected average annual erosion rate on cropland as of 1995 is measurably less than the 6.3 tons/ac/yr we estimated for the year 1992.

## Contents

## Tables*



* Supplemental tables are in Appendix A.

# HISTORICAL CHANGES IN SOIL EROSION, 1930-1992
## The Northern Mississippi Valley Loess Hills, MLRA 105

### Background

This study determines changes in soil erosion conditions between 1930 and 1992 in a selected Major Land Resource Area of the United States, the Northern Mississippi Valley Loess Hills (MLRA 105), sometimes called the "Driftless Area of the Northern Mississippi Valley". It is an area of 18,860 square miles (48,847 square kilometers), including all or the major part of 15 counties in southwestern Wisconsin, six counties in southeastern Minnesota, six counties in northeast Iowa, and a single county (Jo Daviess) in the northwest corner of Illinois (figure 1).

The main comparison is between 'present' (1992) conditions and the severe conditions that were documented in the early thirties in the Reconnaissance Erosion Survey (RES) and other field studies of the time led by Hugh Hammond Bennett and others. The National Reconnaissance Erosion Survey led in large part to the soil and water conservation research and project programs in place today (U.S. National Resources Planning Board,. 1936).[2]

At a 1984 Symposium on the History of Soil and Water Conservation, Trimble observed: "Both the popular and scientific press dramatize the soil erosion problem as a 'crisis', often implying that it is worse than in the 1930's."(Trimble,1985,p.77). He and Lund express the same thoughts in their analysis of conservation progress since the 1930's in the Coon Creek Basin of Wisconsin (Trimble and Lund,1982,p.1).

Conservation programs of the U.S. Department of Agriculture have been in place for 60-plus years in the Natural Resources Conservation Service (NRCS, formerly the SCS), the Forest Service (FS), and the presently named Farm Service Agency. Others of a project-level or regional nature have continued for nearly 40 or more years, such as the Watershed Protection and Flood Prevention Program (since 1954), and the Great Plains Program (since 1958). More recent examples include the Conservation Reserve and Wetland Reserve Programs, authorized in 1985 and 1990, respectively. These programs are aimed at protecting highly erodible and/or environmentally sensitive areas through long-term contracts with landowners.

Methods for quantifying erosion and hydrologic processes have become more reliable and widely used. They have made it possible to estimate soil dislodgement, transport and sediment deposition on a more precise and local level, and to more accurately determine their economic

---

[2] Literature citations in this report employ the author-date, or author-date-page convention. A complete list of references begins on page 66.

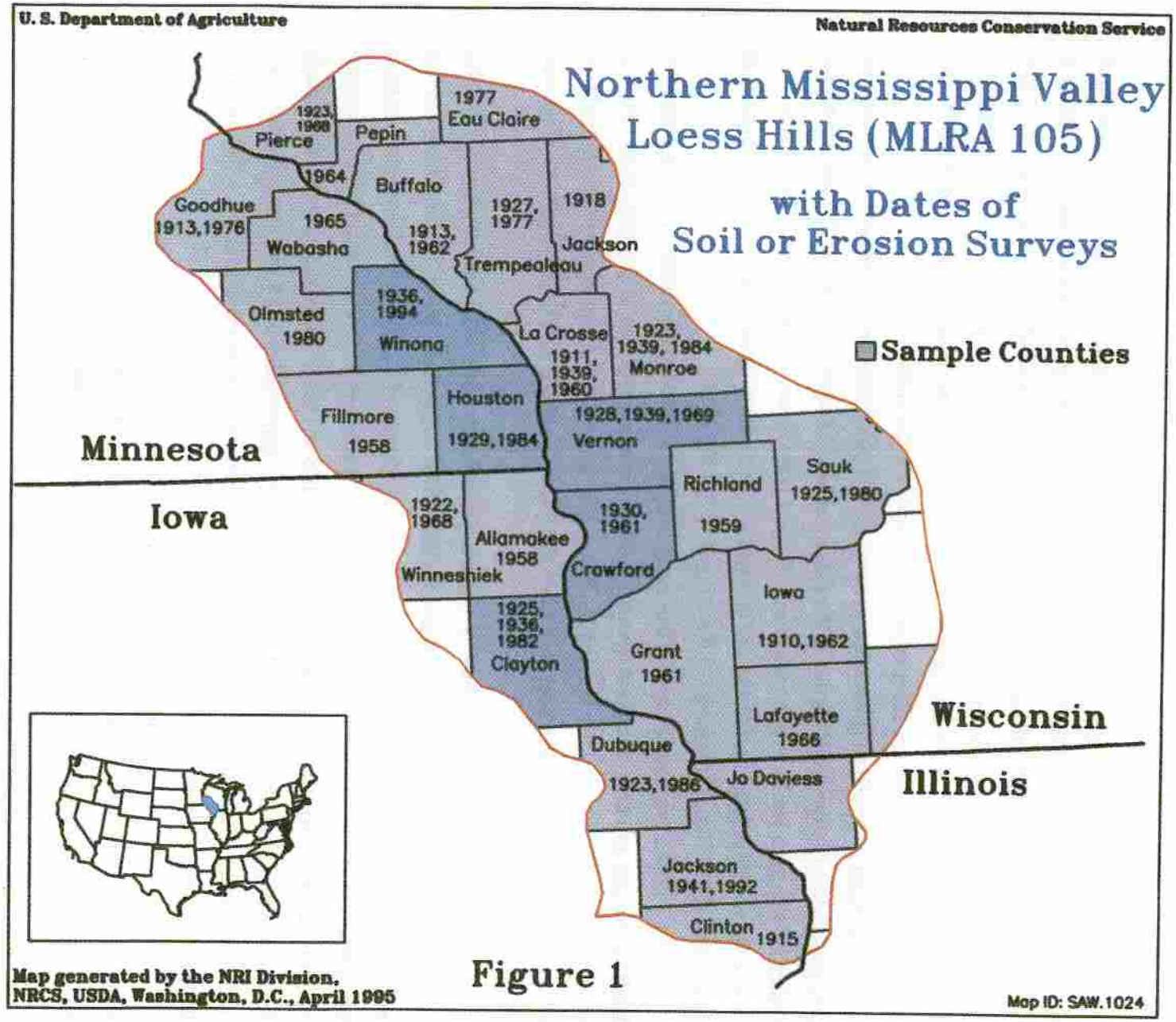

U. S. Department of Agriculture
Natural Resources Conservation Service
Northern Mississippi Valley Loess Hills (MLRA 105)
with Dates of Soil or Erosion Surveys
Sample Counties
Minnesota
Iowa
Wisconsin
Illinois
1923, 1968 Pierce
Pepin
1977 Eau Claire
1964
Buffalo
1927, 1977
1918
Goodhue 1913,1976
1965 Wabasha
1913, 1962
Jackson
Trempealeau
1936, 1994 Winona
Olmsted 1980
La Crosse 1911, 1939, 1960
1923, 1939, 1984 Monroe
Houston 1929,1984
Fillmore 1958
1928,1939,1969 Vernon
Richland 1959
Sauk 1925,1980
1922, 1968 Winneshiek
Allamakee 1958
1930, 1961 Crawford
Iowa 1910,1962
1925, 1936, 1982 Clayton
Grant 1961
Lafayette 1966
Dubuque 1923,1986
Jo Daviess
Jackson 1941,1992
Clinton 1915
Map generated by the NRI Division, NRCS, USDA, Washington, D.C., April 1995
Map ID: SAW.1024

Figure 1

significance.[3] This study focuses on soil 'displacement', and is called 'gross erosion', This is not necessarily equivalent to soil 'loss'.

The early applied economic studies dealt mostly with representative farm situations on a with- versus a without conservation level, but not tied to physical measures of soil loss (Ball and Heady,1957). Two conceptual studies for economic analysis are those of Bunce (1942), and Heady and Jensen (1951). They foresaw the need for and likely emergence of interdisciplinary research on evaluation methods and field problems.

As sedimentation and related water quality problems of nonpoint origin have become more obvious and of concern to the public, research studies have tended to encompass wider areas. Soil and water management issues, both onsite and offsite, and of both production and environmental importance, are best treated within overall frameworks that recognize and balance the interests of farmers and others. Degradation of the natural environment through excess soil erosion and various forms of pollution are a very real form of disinvestment in the stock of available resources, for individuals as well as society at large.

## Objectives and Plan of Report

The main objective was to compare erosion conditions in MLRA 105 in the base year 1930 with conditions 'now', namely as of the latest year (1992) for which the required information is available. The methodology is described in enough detail to guide similar studies in other regions. The methods may also suggest some alternative approaches for conducting similar studies.

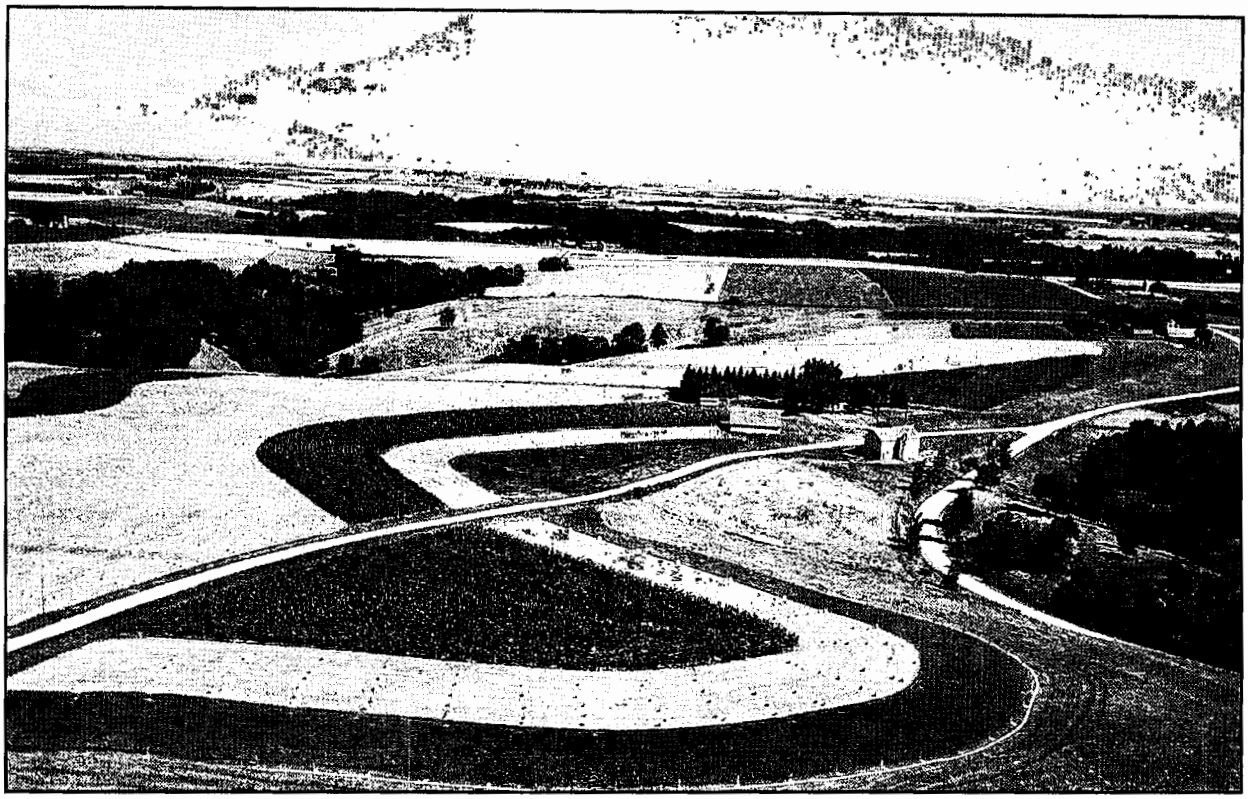
## Initial Considerations

Because soil erosion is directly associated with cropping and farm management practices under given climatic and soil characteristics, time intervals examined for area studies are best chosen to coincide with selected Censuses of Agriculture. Final State and county-level data from the Census of Agriculture for 1992 became available in late 1994 and were used in this study. Annual county-level cropping and livestock data maintained in State statistical offices were valuable

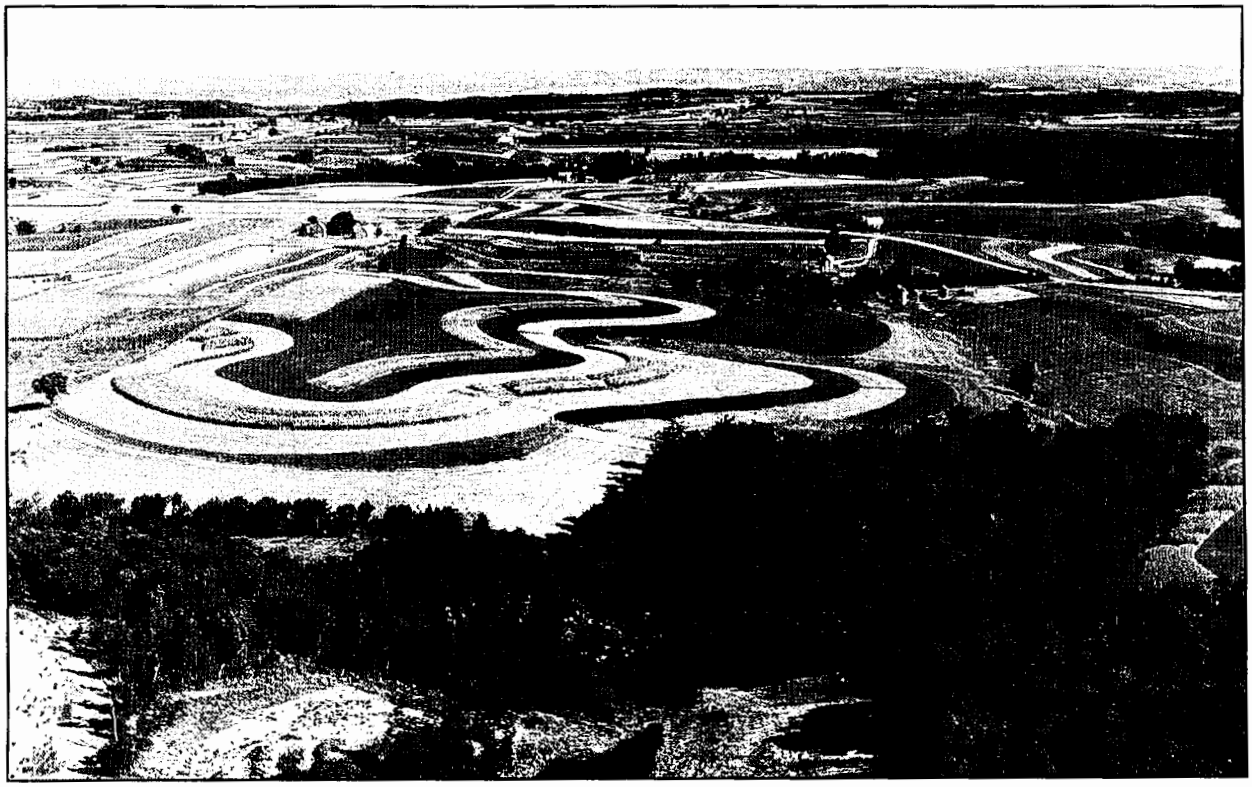
---

[3] The research of Trimble and Lund in the Coon Creek Basin of Wisconsin demonstrates how land use and management practices determine erosion levels in source areas (tributaries to PL566 structures) and can be hydrologically connected to reservoir sedimentation rates, as well as off-site stream channel erosion, valley sedimentation and out-of-basin sediment loads (Trimble and Lund, 1982). The ten subbasins they studied totaled 7,950 acres within Monroe and Vernon counties, Wisconsin, two of the 28 counties included in MLRA 105.

**Continued Use of Conservation Practices at Former SCS/USDA Demonstration Projects**



Stripcropping in Winona County, Minnesota, 1949. NRCS/USDA photo. (Minnesota-1580).



Stripcropping in the Coon Creek watershed, Wisconsin, 1963. Photo by Erwin W. Cole, NRCS/USDA. (Wisconsin 1418).

for filling gaps in the Census reports, especially in making estimates of average annual crop yields and information on planted as well as harvested acreages. Erosion calculations under field, management and probable rainfall conditions through a complete crop cycle depend on the acres of crops planted as well as harvested.

A thorough time-series evaluation of long-term changes in erosion conditions in a large multi-county area like MLRA 105 would require accessing all 20 agricultural censuses or other surveys conducted since 1880. Eight census years would be the most pertinent: 1930, 1935, 1940, 1954, 1969, 1982, 1987, and 1992. They cover the dates of early erosion surveys, early soil surveys, major turning points in national history, years in which major conservation programs were initiated, and years for which National Resource Inventory data are available.

Interval-by-interval comparisons were not made in this study. Rather, the Agricultural Census reporting year 1930 (crop season 1929) was chosen as the center-point or base year reflecting farming methods generally prevailing during the period 1925-1935, the decade prior to when the Reconnaissance Erosion Survey was conducted in 1934. The study is a cross-sectional or 'snapshot' comparison of erosion conditions, agricultural production, and conservation activity between the base year 1930 and the years 1982 and 1992, the years for which the most recent information is available--on erosion from the 1992 National Resources Inventory and on land use and crop production primarily from the corresponding Censuses of Agriculture, or from State statistical agencies and other sources as needed.

Reconstructing farming and erosion conditions of more than 60 years ago requires an understanding of the manner in which agriculture evolved in MLRA 105, and why certain cropping patterns and practices were followed. A first step was to research the development of agriculture in five sample counties, recognizing that each area has its own unique history. This important background material is in Appendix C. Some current population, income source and other economic data are also given for these counties.

It was also necessary to decide the land uses for which estimates of erosion for 1930 versus 1982 and 1992 could or should be made, given time and cost constraints as well as their technical importance. Reasons are given for restricting the erosion comparisons to cropland and selecting particular sample counties for analysis. The five counties chosen are highlighted in figure 1.

Crop and livestock production data for 1930 and 1992 were then compiled for the sample counties and all 28 counties in MLRA 105, to determine whether the sample was valid and indicate the approximate values of the various factors involved in the Universal Soil Loss Equation (USLE).

Farming systems and practices in the decade 1925-1935, as related to crop decisions, soil management problems, tillage and residue practices and conservation efforts are researched in some detail. This information was essential for determining proper values for the cover-management and conservation practice factors in the USLE. The USLE is then applied retroactively to 1930 in MLRA 105 with reference to climatic and soils information, available cropland, crop groups, crop rotations and sequences, tillage methods and residue management practices.

The estimated erosion rates for 1930 are compared with those estimated for the same five sample counties from USDA's 1982 and 1992 National Resources Inventories (NRI). The NRI rates of soil loss are similarly based on the USLE. They reflect the climatic, soils, field, and cropping characteristics plus other observations for specific sample points, rather than for complete soil map units, land use capability classes or crop groups.

Erosion rates for 1982 and 1992 for the entire 28-county region have also been obtained from the NRI. The 1982 and 1992 erosion rates for the five sample counties and the 28-county region as a whole are examined, as well as those for between 1930 and 1992 just for the five sample counties. These relations are then used to approximate erosion rates on all cultivated cropland and rotation meadow in the Northern Mississippi Valley Loess Hills as of 1930.

**Study Area MLRA 105**

Major Land Resource Area 105, the Northern Mississippi Valley Loess Hills, has a total land area according to official Census records of about 19,260 sq.miles (49,900 sq.km.), as adjusted to the boundaries of the 28 counties mainly included. Its natural size is slightly less--18,860 sq.miles, of which 103 sq.mi. are held by Federal agencies. Figure 1 shows its natural boundaries and identifies the 28 counties predominantly included. The region is comparable in size to the combined areas of New Hampshire and Vermont. A more complete description of the area is in Appendix B.

**Cropland the Major Source of Erosion**

This study was confined to the analysis of water-related (sheet and rill) erosion on cropland. Apart from cost, the reason for focusing on cropland is that the bulk (around 85 percent) of the erosion reported for an area covered in an early SCS Physical Land Survey (No. 28) for Clayton County, Iowa, was said to occur on cropland. Most of the severe sheet and gully erosion (95-100 percent) was attributed to cropland. These data do not mean that soil erosion was not a problem on pasture or woodlands. Actually, the overgrazing of woodlands and pastureland led to serious erosion, particularly gully erosion, on these lands as well as cropland.

Table 1. Severity of erosion in Clayton County, Iowa, and Winona County, Minnesota, ca. 1934

| Erosion degrees | Clayton County, IA [1] | | Winona County, MN [2] | |
|---|---|---|---|---|
| | Acres | Percent on cropland | Acres | Percent on cropland |
| No apparent erosion | 891 | 36 | 7,216 | 4 |
| Slight erosion | 2,560 | 82 | 195,541 | 32 |
| Moderate erosion | 3,258 | 90 | 122,763 | 81 |
| Severe erosion | 2,787 | 94 | 48,939 | 84 |
| Very severe erosion | 74 | 100 | 6,253 | 90 |
| Totals, all degrees | 9,840 | 85 | 374,712 | 56 |

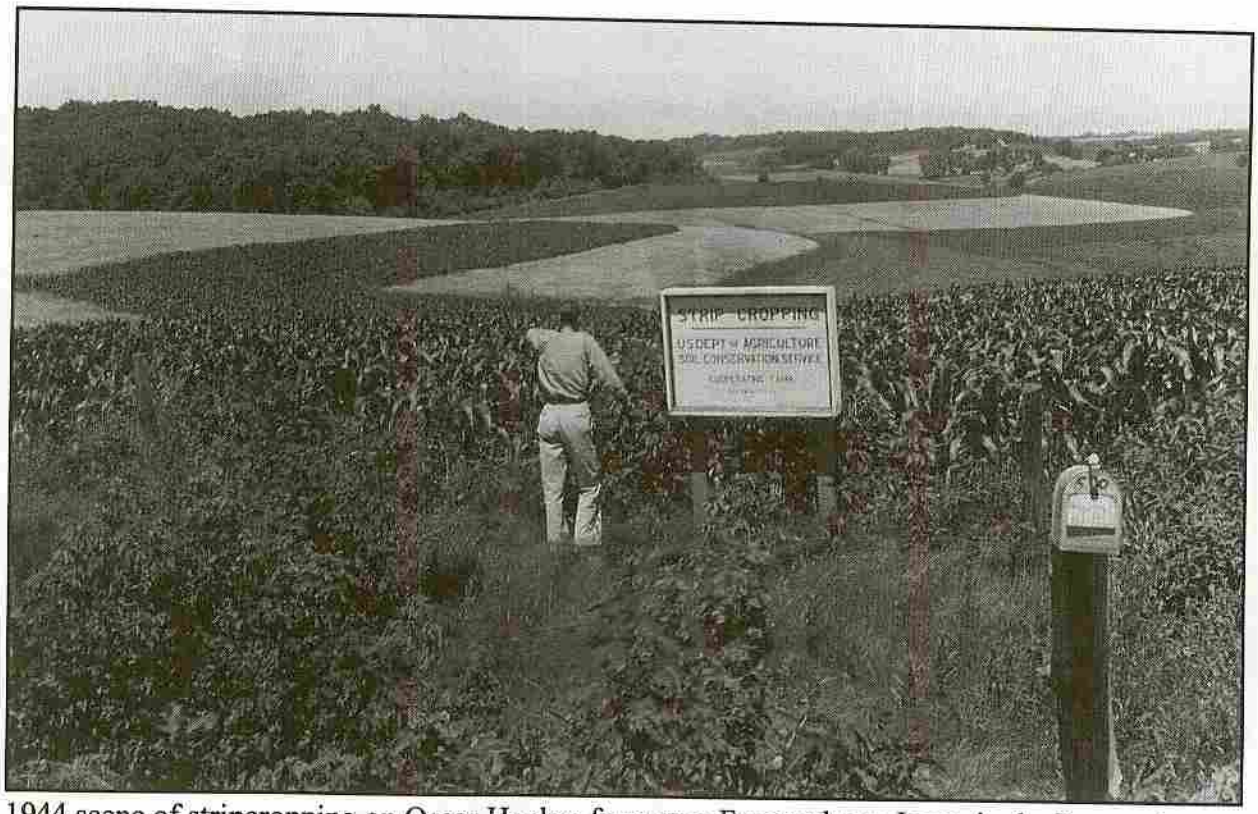
[1] Data for Clayton County refer only to the Farmersburg-McGregor Project area. See U.S. Dept. Agriculture, Soil Conservation Service. 1942. *Physical Land Use Conditions on the.Farmersburg-McGregor Project, ClaytonCounty, Iowa (D.E. Perfect and D.A. Sheetz).* Physical Land Survey No. 28. 25pp.

[2] Data for Winona County refer to the entire county. See U.S. Dept. Agriculture, Soil Conservation Service. 1936. *Erosion and Related Land Use Conditions in Winona County, Minnesota (M. H. Brown and I. F. Nygard).* Erosion Survey No.17. 27pp.

A similar situation was reported in a county-wide field study for Winona County, Minnesota. About 55 percent of all erosion, but between 84-90 percent of the severe and very severe erosion was said to be on cropland. By degrees of erosion severity, total lands eroding and percentages occurring on cropland in Clayton and Winona Counties in the 1930s are in table 1.

Comparable numerical estimates on cropland erosion are not available from early reports for the Coon Creek Project in La Crosse, Monroe, and Vernon Counties in Wisconsin, but serious soil erosion was said to occur because of the continued use of cropland, pasture, and woodland without regard for land capability or corrective conservation measures (USDA,1939,p.28).[4]

[4] For the ten sub-basins they studied, Trimble and Lund estimated annual gross erosion rates across all land uses of about 13.4 tons per acre under 1934 conditions, rates that had been reduced to 3.28 tons per acre by 1975 (Trimble and Lund,1982,pp.10-11). Specific estimates for cropland were not given.




1944 scene of stripcropping on Oscar Henkes farm near Farmersburg, Iowa, in the Farmersburg-McGregor Demonstration Project. Photo from Project files.

1995 repeat photo: Farm now owned by Lou Schrandt, showing that contour stripcropping is still being practiced. Photo by Douglas Helms, NRCS/USDA. August 1995.

**Selection of Sample Counties**

Information on erosion rates for different land uses and areas as of 1982, 1987, and 1992 are available from USDA's 1992 National Resources Inventory (NRI). Estimates of needs for erosion. control were also made in these NRI's, and also in those completed in 1958 and 1967. Findings of the 1934 Reconnaissance Erosion Survey (RES) and the successive NRI's are not directly comparable. The RES generally expressed erosion severity in terms of visible erosion problems, such as proportions of topsoil lost as of 1934, a 'state' condition. The National Resource Inventories have focused on current rates of soil loss and/or areas needing erosion control or other conservation treatments. To make the two appraisals comparable, it was necessary to research in some detail the land use and management practices that led to the serious conditions observed in the RES, using information for the decade 1925-35 from early soil surveys, localized erosion studies, agricultural censuses and other sources. Along with relevant soils and climatic data, these observations were used to 'reconstruct' erosion rates for a sample of five counties for the base year 1930, employing for this purpose the Universal Soil Loss Equation of Wischmeier and Smith (1978).

The five sample counties are not strictly a random statistical sample, but happen to be counties for which soil survey, erosion studies and other reports were available covering the decade 1925-1935, or five years on either side of the base year 1930. Soil and erosion surveys available for the 28 counties in MLRA 105 are identified in figure 1.

An initial plan was to select Clayton County, Iowa or perhaps Winona County, Minnesota for a pilot study. However, the study team concluded that the results would be more reliable and the research effort proportionately less if changes were analyzed for at least five sample counties, rather than for only one or two areas. The sample counties include: Clayton County, Iowa; Houston County, Minnesota; Winona County, Minnesota; Crawford County, Wisconsin; and Vernon County, Wisconsin. Trempealeau County, Wisconsin and Sauk County, Wisconsin were alternates.

For each of the five sample counties two soil or erosion survey reports have been completed since 1925 (figure 1). The first surveys were generally clustered during the period 1925-1935. In different levels of detail they described customary farming systems and practices during the years 1925-35 and so for the year 1930, the base year for the analysis. Data on crop and livestock production activity in the five sample counties and for the entire 28-county region were compiled for the base year 1930 and then for 1992 to indicate how well the livestock and crop production economies in the sample counties reflect those of the MLRA 105 region as a whole.

The land use and related information for the study drew on three important sources of information centered on the base year 1930: (1) The periodic (5-year) Censuses of Agriculture;

Before view of the Ed Kurth farm, Farmersburg, Iowa, Farmersburg-McGregor Demonstration Project, with terraces at top of the slope. Fields needed rearrangement for contouring and to eliminate gullied lane. Photo from Project files.

1995 repeat photo: Farm now owned by Lou Schrandt shows contour stripcropping and rearrangement of fences. Photo by Douglas Helms. NRCS/USDA. August 1995.

(2) annual crop reports compiled by State Agricultural Statisticians and the National Agricultural Statistics Services (NASS); and (3) cropping and/or management practices followed by farmers as observed in the field by soil or erosion surveyors.

Data on farm numbers, crops grown, livestock numbers, county populations, and income sources are mainly from the Censuses of Agriculture and/or Population (USDC,1927, 1931,1936,1994a,1994b). Additional information on annual crop acres, production and yields was obtained from reports and files of State agricultural statistical agencies, particularly for Illinois (1951), Iowa (1978,1981), and Minnesota (1994). Necessary background data on land uses and crops grown and crop yields in each sample county are in appendix tables A-1 through A-4.

Crop acres for 1930 and crop yields in the sample counties are in tables A-4 and A-5. The yield estimates are expressed as 'expected' rather than observed in the base year 1930, and are computed as averages during the decade 1925-1935. Yield levels and whether the residues are removed and how they are handled through tillage all influence erosion.

**Land Use and Production Profiles**

Cropping and other land uses for 1930 and 1992 for the five sample counties are consolidated and compared against all 28 counties in table A-1. In 1930 the principal field crops including rotation meadow (item B) were grown on about 71 percent of all croppable land in the sample counties and on 74 percent of the croppable land in MLRA 105. In 1992 this percentage was 79 percent in the sample and 83 percent for the region, even though cropland harvested (item D) relative to all land in farms did not change materially, remaining between 44-49 percent for the sample counties and from 47-51 percent for the general area.

Important changes did occur between 1930 and 1992 in the mix of principal crops. The area in rotation meadow increased by about 36 percent in the region, but by 68 percent in the sample counties. Row crops increased by over 130 percent in the region between 1930 and 1992 and by 91 percent in the sample counties. These increases were at the expense of decreases in small grains and by converting some new areas to cultivated cropland. The conversions were achieved by a reduction of 38 percent in cropland grazed, a reduction of 46 percent in permanent nonwooded pastureland, and some clearing of woodlands. These changes occurred despite a loss of land in farms between 1930 and 1992 of 16 percent in the sample counties and region (table A-1). Nonetheless, about the same proportion of all woodlands were grazed in 1930 in the region and the five sample counties, 81 and 87 percent, respectively (table A-2).

**Importance of Pasture and Woodland Use for Livestock**

In the five sample counties in 1930, the 574,000 acres of grazed woodlands represented almost two-thirds (63 percent) of the source of grazing land resources, compared with 47 percent in 1992.

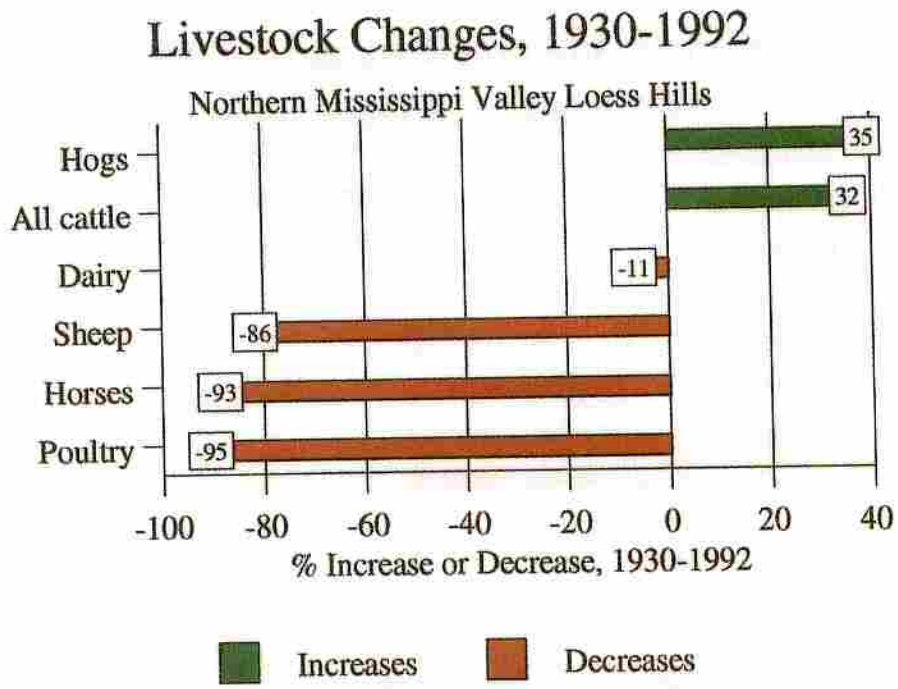
For the Coon Creek Basin in Wisconsin covering parts of La Crosse, Monroe and Vernon counties, Trimble and Lund estimated that 88 percent of the woodlands were grazed in 1934, dropping to 27 percent by 1974 (Trimble and Lund,1982,p.8). Our data indicate that the average proportion of woodlands grazed in just these three counties decreased from 80 percent in 1930 down to about 38 percent by 1992. Both sets of data indicate strong preferences in the 1930's for obtaining forages via grazing. Open and wooded pastures occupied large areas and had been grazed continuously for 50-70 years. Woodland grazing was very common, as was the overgrazing of permanent pastures. This not only caused serious sheet and gully erosion on the areas concerned, but also aggravated erosion problems on adjoining cropland.

Several factors help explain the dependence on pasture and woodlands: (1) The dairy farms required a good supply of forage. While there was a tendency to shift land from corn and small grain production to hay crops, this was done on a fairly limited basis. Other livestock farmers placed a relatively high value on cash crops and a low value on hay; (2) any hay needed was usually grown in rotation with corn or small grain feed crops if possible, rather than on permanent hay land; and (3) alfalfa was desired but was costly and in most areas alfalfa needed lime and fertilizer to get started properly. Its acreage was small and apparently limited to the best lands.

In 1992 only 45 percent of the woodlands were grazed in MLRA 105, compared with over 80 percent in 1930 (table A-2). Overall, the use of farms for grazing purposes has decreased by about 52 percent since 1930, by 64 percent on woodland as such, 45 percent for nonwooded pasture, and 37 percent for croplands previously grazed. These data reinforce the observations of Trimble and Lund that reduced woodland grazing and improved pasture management were important factors in controlling soil erosion in the Coon Creek sub-basins they studied

Figure 2 shows the relative change in numbers of various livestock from 1930 to 1992. Table 2 is a more detailed profile of the livestock economy in MLRA 105. Hogs and beef cattle inventories in the area have increased substantially; all other classes show large decreases. By 1992 the number of horses had declined to about 21,000 from the nearly 300 thousand reported on farms in 1930.

**Figure 2**




In 1930 about 85 percent of all farms in the area reported an average of 5 horses or mules.[5] The percentages were similar for the five sample counties and MLRA 105 as a whole. In those years much of the hay and other crops was needed to support the work stock. In the 1992 Census of Agriculture only 12 percent of all farms reported having horses, mules or ponies; the average in 1992 was also 5 per farm reporting.[6]

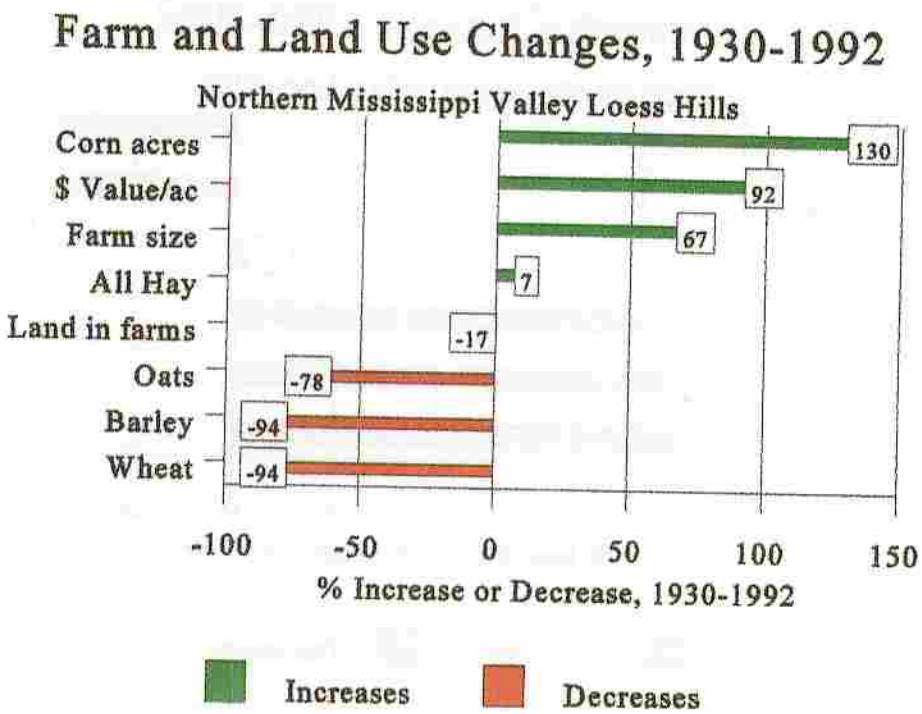
Though generally on the decline, dairying is still a major livestock industry in many counties but it is concentrated on fewer farms. Sheep and wool production have declined sharply, as have

---

[5] Rural counties in the 1930s arranged with some farmers to assist in road work, in exchange for waivers of poll taxes, in which case the farmer likely kept extra horses. Source: Mark Bowman and David Gibney. Interview with George A. Pavelis. Elkader, Iowa, 6 February 1995.

[6] The Census figures include only the horses reported by farmers, and so do not count so-called 'recreational' animals owned by nonfarm families. As of 1989 the Iowa Horse Council estimated there were 81,000 recreational horses in the State (Hendrickson,1995). In contrast, only around 47,000 horses or ponies were reported by all Iowa farmers in the 1992 Census of Agriculture.

**Figure 3**




farm flocks of poultry, but commercial poultry sales appear to have increased somewhat. The continued growth of the hog and cattle industries provides a ready market for local corn production.

**Crops and General Economic Profiles**

General changes in land use, crop distributions and other farm indicators are shown in table 3, also in figures 3 and 4. Details on land uses in 1930 in each sample county are in appendix tables A-3 and A-4. The number of farms in MLRA 105 and the sample counties fell by about 50 percent between 1930 and 1992. Average farm size in MLRA 105 has risen to 260 acres from the 155+ acres reported in 1930, while the area in farms has dropped by 17 percent.

Nominal (historical) real estate values for all counties of the United States from 1850 to 1982 have been compiled by Barnard and Jones *(1987)*. The inflation-adjusted (real) value of farmland for the 28 counties in MLRA 105 has almost doubled, from $375 per acre in 1930 to $720 per acre in 1992. Investments in machinery and equipment per farm in real terms were nearly 5 times as large in 1992 ($51,000) as in 1930 ($11,100). Farm tenancy has substantially declined.

Table 2. Livestock inventories and sales in 1930 and 1992 for five sample counties and all 28 counties in MLRA 105

| Livestock by classes | Units | 5 sample counties 1930 | MLRA total 1930 | MLRA total 1992 | MLRA change 1930-92 [1] |
|---|---|---|---|---|---|
| Total number of farms | No. | 12,891 | 71,048 | 35,230 | -51 |
| Livestock Inventories: | | | | | |
| 1. Horses, mules, or ponies | 1,000 | 52 | 298 | 21 | -93 |
| Per reporting farm | No. | 5 | 5 | 5 | 0 |
| 2. Dairy cows and heifers | 1,000 | 130 | 724 | 649 | -11 |
| Per reporting farm | No | 10 | 11 | 50 | 35 |
| 3. Beef cows and heifers | 1,000 | 5 | 38 | 283 | 645 |
| Per reporting farm | No. | 9 | 11 | 30 | 172 |
| 4. All cattle and calves | 1,000 | 294 | 1,691 | 2,235 | 32 |
| Per reporting farm | No. | NR | NR | 90 | -- |
| 5. Hogs and pigs | 1,000 | 286 | 1,676 | 2,270 | 35 |
| Per reporting farm | No. | NR | NR | 310 | -- |
| 6. Sheep and lambs | 1,000 | 60 | 455 | 64 | -86 |
| Per reporting farm | No. | NR | NR | 40 | -- |
| 7. Chickens, 3+ months old | 1,000 | 1,138 | 6,880 | 313 | -95 |
| Per reporting farm | No. | 92 | 105 | 245 | 134 |
| Selected Sales Data: [2] | | | | | |
| 8. Cattle and calves sold | 1,000 | NR | NR | 1,091 | -- |
| Per reporting farm | No. | NR | NR | 45 | -- |
| 9. Hogs and pigs sold | 1,000 | NR | NR | 4,189 | -- |
| Per reporting farm | No. | -- | -- | 555 | -- |
| 10. All chickens sold | 1,000 | 802 | 4,841 | 12,813 | 164 |
| Per reporting farm | No. | 82 | 90 | 50,000 | -- |

Source: Censuses of Agriculture for 1930, 1935 and 1992.

[1] Data in this column are the total percentage changes between 1930 and 1992.

[2] See table 6 for gross incomes from crops, livestock and livestock products.

NR = not determinable as such from the 1930 Census. -- less than 1 head or less than 1 percent.

Table 3. General economic and crop production profiles for 1930 and 1992 for five sample counties versus all 28 counties in MLRA 105

| Economic and crop items | Units | 5 sample counties 1930 | MLRA total 1930 | MLRA total 1992 | MLRA change, 1930-92 [1] |
|---|---|---|---|---|---|
| Number of farms | No. | 12,891 | 71,048 | 35,230 | -51 |
| Total land in farms | 1,000 ac | 1,990 | 11,067 | 9,185 | -17 |
| Average size of farm | Acres | 154 | 156 | 254 | 62 |
| Real estate value per acre [2] | Dollars | $350 | $375 | $720 | 92 |
| Equipment value per farm [3] | Dollars | $11,100 | $11,100 | $51,000 | 365 |
| Cropland tenancy ratio | Percent | 32 | 34 | 12 | -22 |
| Total value of product sales [2] | $millions | 178 | 982 | 2,770 | 182 |
| 1. Crops, fruits, plants | Percent | 55 | 51 | 18 | -33 |
| 2 Livestock and products | Percent | 45 | 49 | 82 | +33 |
| Total harvested cropland | 1,000 ac | 867 | 5,155 | 4,789 | -7 |
| Principal crops harvested: | | | | | |
| Hay/chop, except corn silage | 1,000 ac | 359 | 1,687 | 1,812 | 7 |
| Alfalfa only | 1,000 ac | 15 | 112 | 1,519 | 1,256 |
| Corn for all purposes | 1,000 ac | 216 | 1,128 | 2,492 | 120 |
| Soybeans for beans | 1,000 ac | -- | -- | 184 | -- |
| Oats for grain | 1,000 ac | 180 | 1,172 | 258 | -78 |
| Barley | 1,000 ac | 59 | 395 | 22 | -94 |
| Wheat for grain | 1,000 ac | 14 | 83 | 4 | -94 |
| Irish potatoes | 1,000 ac | 7 | 29 | 25 | -14 |
| Vegetables | 1,000 ac | 11 | 15 | 44 | 193 |
| Tobacco | 1,000 ac | 11 | 15 | 3 | -80 |
| Land in orchards | 1,000 ac | 4 | 18 | 6 | -67 |

Sources: Censuses of Agriculture for 1930 and 1992.

[1] All data in this column are in total percent change between 1930-1992.

[2] All land values and product sales expressed at 1992 price levels, using a 1930/1992 deflator for the U.S. gross domestic farm product (1992 index = 100; 1930 index = 20.6).

[3] Equipment values expressed at 1992 price levels, using a 1930/1992 U.S. deflator for purchase of durable farm equipment and tractors (1992 index = 100; 1930 index = 9.70).

In 1992 only 12 percent of the harvested cropland was farmed by tenants who farmed none of their own land, compared with 34 percent in 1930.

The farm economy of MLRA 105, as measured by product sales, remains livestock oriented. In 1992 about 82 percent of gross sales were from livestock or their products, compared with about 50 percent in 1930 (table 3). Crops showing large gains between 1930 and 1992 include alfalfa, corn, soybeans and vegetables. Those losing importance were the small grains and tobacco. In 1992 there were about 184,000 acres of soybeans grown for beans. A few soybeans were grown in 1930 but they were used almost entirely as an emergency hay supply. Soybeans are now a common oilseed crop in the Midwest and other regions, and are an alternative to corn and other field crops, depending on relative prices and production costs for the alternatives.

To examine how typical the land uses patterns in the five sample counties were of the 28-county region in 1930, a paired t-test was made. Two sets of 20 acreages, in 5 row crops, 3 small grains, 5 rotation meadow options and 7 other 'independent' land uses, like pasture and woodlands were compared, taking each acreage item as a percentage of all cropland harvested in each county group. It was concluded that land uses in 1930 in the five sample counties were a very good representation of land use throughout the 28-county MLRA 105. The similarity in 1930 as well as in 1992 of the relative distribution of the main crops in the sample counties and the region is evident in figure 4.[7]

This test and conclusion are important because the distribution of the various crops, associated tillage practices and methods for handling crop residues across the different counties and soils in the region also determines the distribution of values for the cover-management factor **C** in the Universal Soil Loss Equation.

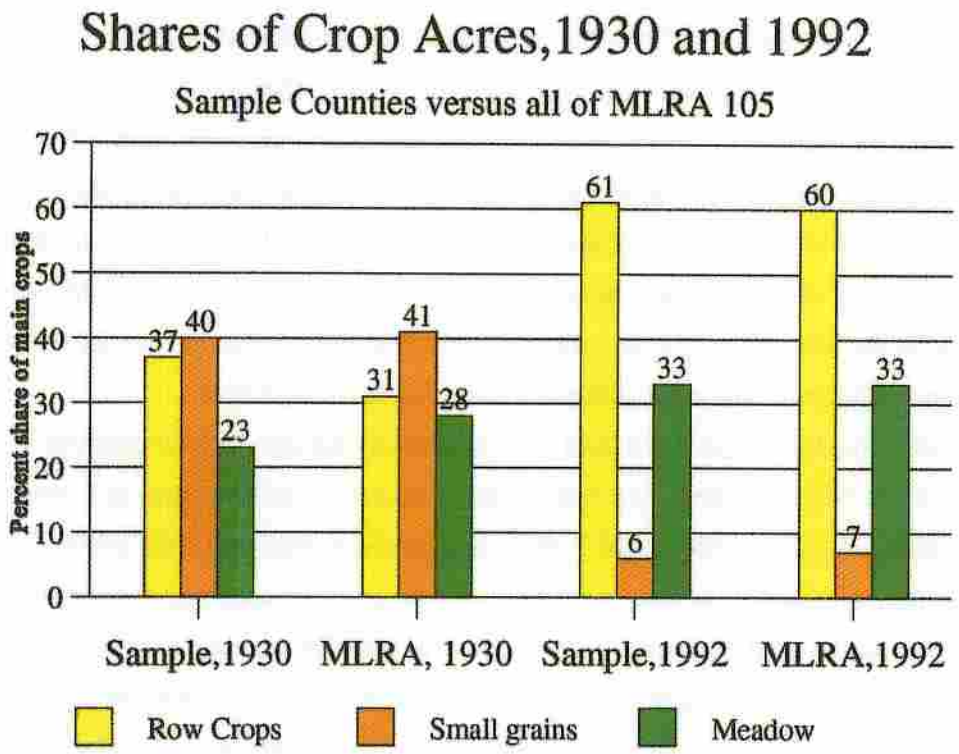
### Early Farming Systems Related to Soil Erosion

This review condenses sample county information in soil survey, census and other documents generally dated for the period 1925-1935. Some observations are from soil surveys for

---

[7] Assuming that each of the 28 counties in MLRA 105 had an equal chance of being included in either the five sampled or the 23 nonsampled counties (having an equal likelihood of having soil surveys done between 1925-35), a t-statistic was used to test the null hypothesis that in 1930 there was no relative difference between the land use patterns of the five 'sampled' and the 23 'nonsampled' counties. The calculated t-statistic, for 19 degrees of freedom, was 0.987, compared to a tabular value of 2.093 for the 95-percent level of confidence. In this case the hypothesis is not rejected.

**Figure 4**




other counties in MLRA 105, including nearby Dubuque and Clinton Counties in Iowa and Trempealeau County in Wisconsin. The principal soil or erosion surveys reviewed include those of Benton and Gray (1925), Brown and Nygard (1936), Edwards with others (1928,1930), Gray with others (1929), Perfect and Sheetz (1942), and the Coon Valley report of the Soil Conservation Service (1939).

**Crop Selection and Rotations**

In this area of narrow dissected valleys nearly all farms in 1930 included some land unsuited to tilled crops. This meant that nearly every farm had land that was left as pasture or woodland. This disproportion of land uses, together with some uncertainty of corn as a reliable crop, helps explain farming practices of the period. However, corn remained the most profitable crop to grow except for tobacco, which was limited mostly to some Wisconsin counties. Aside from avoiding cultivation of the steepest land, over much of MLRA 105 in 1930, corn was grown as often as possible without regard to surface relief. However, only enough corn to feed livestock was produced on the ridge farms because the cultivation of corn led to erosion. As this feature was too serious to ignore, corn