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# Soil erosion control in Western Iowa

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# Soil erosion control in Western Iowa

by

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# CHAPTER I. INTRODUCTION

After over one-third of a century of public efforts to reduce soil erosion losses, through technical assistance, incentive payments, and educational programs, soil erosion losses remain above publicly declared permissible levels in Iowa. Within the last decade, public concern has also focused upon the environmental impacts of soil erosion as water and air quality are affected by sediment and dust movements. Water quality deterioration caused by sediment and sediment transported materials has become a major policy concern for the U.S. Environmental Protection Agency, Iowa Department of Environmental Quality, Iowa Department of Soil Conservation, and the Soil Conservation Service of the USDA. Public efforts by these agencies are being taken to reduce environmental impacts of soil erosion as well as continuing efforts to maintain the soil productivity and to reduce offsite damages which occur from soil erosion and water runoff.

As public policies and programs strive to decrease soil erosion losses in what has been declared as the public interest, it becomes necessary to ascertain reasons and phenomena which help explain continuing and perhaps accelerating erosion losses as related to the extent and nature of erosion losses. This study has endeavored to identify and evaluate factors and reasons associated with erosion losses in the interest of understanding both why high levels of soil loss occur and how soil erosion may be reduced. This information constitutes a necessary foundation for soil erosion control efforts by public and private entities.

This study is another unit in a series of four erosion control studies conducted by Iowa State University during the past three decades. These studies have been beneficial in determining (1) changes in rates of soil erosion, (2) why soil erosion occurs, and (3) what ameliorative actions might be taken to mitigate this problem.

## Previous Studies in this Series

Three previous studies of soil erosion have been completed in Western Iowa. These earlier studies provide foundations for this project. Studies completed by Frey, Held, Blase, and Timmons have established a "land use laboratory" in Western Iowa and also have developed a sample of farms on which intertemporal observations and comparisons can be made (6, 10, 1). Objectives of these previous studies were (1) to ascertain levels of soil loss over time within the land use laboratory, and (2) to identify the causal factors responsible for the existing levels of soil loss. By intertemporally utilizing this previous research, it is possible to estimate elements of success or failure associated with soil erosion control in Western Iowa.

Table 1 summarizes results from previous research in the land use laboratory in terms of soil loss means for sample farms. The annual soil loss mean (ASLM) is measured in tons of soil lost per acre per year. These studies revealed a continual decrease in soil loss from 1949 to 1957.

Table 1. Previous research soil loss estimates

| Year | Annual soil loss mean (Tons per acre per year) | Investigators |
|---|---|---|
| 1949 | 21.1 | Frey (6, p. 83) |
| 1952 | 19.5 | Held (10, p. 37) |
| 1957 | 14.1 | Blase (1, p. 47) |

## Nature of Problems to Which This Study Was Directed

Maintaining the soil resource is most commonly referred to as soil conservation. This definition however is ambiguous and a lack of clarity in definition has sometimes allowed soil conservation to acquire a connotation of moral virtue which may have inhibited rational policy decisions. To avoid confusion and maintain consistency with previous research, the term soil erosion control has been adopted as a substitute for soil conservation in this study.

Soil erosion control for this analysis has meant the prevention of dimination of the discounted value of future production from a given area of soil and from a given value of labor and capital, apart from the value of the soil erosion control input assuming no change in production technology. This is a definition of soil erosion control used by Blase in previous research concerning this problem area (1). The nature of this definition allows one to define soil erosion as the antitheses of soil erosion control.

The soil erosion control problem has many facets. Physically, the movement of soil from one area to another constitutes an interspacial facet of this problem through gullying, sheet erosion, and siltation. Intertemporally, it is possible to diminish the ability of an area to produce vegetative life due to this soil movement. This of course is the physical manifestation of the definition of soil erosion.

There is a direct tie between the physical phase of soil erosion and the economic phase. The physical phase of soil erosion is important to both individual farm operators and the public because of its economic consequences. Economic problem areas are created when the physical phase of soil erosion generates such questions as: What are the present and future production consequences of soil erosion? Are private and public goals for levels of soil erosion control similar? If not, what methods can be used to reconcile private and public interests concerning soil erosion control? How can maintaining the soil resource in order to enhance future agricultural production be accomplished?

There are institutional facets to the problem of soil erosion control in addition to physical and economic considerations. Institutions constitute economic and social controls to individual or group actions and may be changed according to public demands. Institutions may inhibit or enhance the control of soil erosion. Historically the ownership of agricultural land in fee simple certainty has enabled landowners in the United States to utilize soil resources under their control with few restrictions. However, as an example of how institutions are modified, the 1971 Soil Conservancy District Law in Iowa is an institutional attempt to control soil deterioration (4). Earlier, the Soil Conservation and Domestic Allotment Act of 1936 set up the federal agricultural conservation programs (27, p. 5). Also, the Soil Conservation District Act was enacted in Iowa during 1939 (3).

Other institutions which influence the problem of soil erosion control are field boundaries generated from the rectangular survey, tax assessments on land property, tenancy arrangements which are not considerate of soil erosion control, and the inherent microinstability of the farm business which causes varying farming intensities and practices. A new era of institutional influences is being generated by the increasing public demands for environmental quality.

Inadequate soil erosion control is a problem area for resource planners in Iowa. Speculation during 1974 that the level of soil erosion control in Iowa is deteriorating rather rapidly has been a major topic of discussion by contemporary natural resource students and officials (7, 16, 22). All combinations and interactions of the physical, economic, and institutional facets of the problem of soil erosion control, form the boundaries of the problem area for this study. In order to analyze this problem and to suggest solutions, one must account for these combinations and interactions and evaluate their impact upon soil erosion control.

## Objectives of this Study

The general objectives of this project are first to estimate the rate of soil loss within the Ida-Monona-Hamburg Soil Association. Second, after the rate of soil loss has been estimated, utilization of previous research enables the researcher to determine if progress toward controlling soil erosion in Western Iowa is being made. Third, identification of the causal relationships which determine combinations of land uses, conservation practices, and topographies which in turn determine levels of soil erosion was attempted. Finally, the examination and evaluation of these causal relationships were other general objectives of this project.

Specifically this project attempted: (1) to determine the actual per farm soil loss and the farm operator's soil loss goal, (2) to determine what operator obstacles exist which retard soil erosion control, (3) examine characteristics of farms which have varying degrees of success and failure with the soil erosion control problem, (4) to examine potential alternatives for soil erosion control, and (5) to make suggestions for further research in the problem area of soil erosion control.

## Procedures Used in Pursuing Study Objectives

Project objectives were accomplished by analyzing data provided from interviews with farm operators in the land use laboratory sample. Data concerning land uses and future land use intentions were compiled through this interview process. Additional information was obtained concerning soil erosion control plans developed for each sample unit by the Soil Conservation Service (SCS). Utilizing this survey information and the universal soil loss equation annual soil loss means have been estimated for sample farms. Data were analyzed by statistical techniques in order to examine potential causal relationships which contribute to soil erosion.

## Organization of this Report

This report is organized in six chapters. In addition to this introductory chapter, the second chapter explains in detail project methodology and procedures. Changes in soil losses, soil loss goals, and erosion control obstacles over time are presented and examined in Chapter III. Chapter IV proposes possible explanations for existing levels of soil loss. Remedial measures, erosion control policy conflicts, and recommendations for further research are presented in the fifth chapter of this report. Chapter VI contains conclusions of this study.

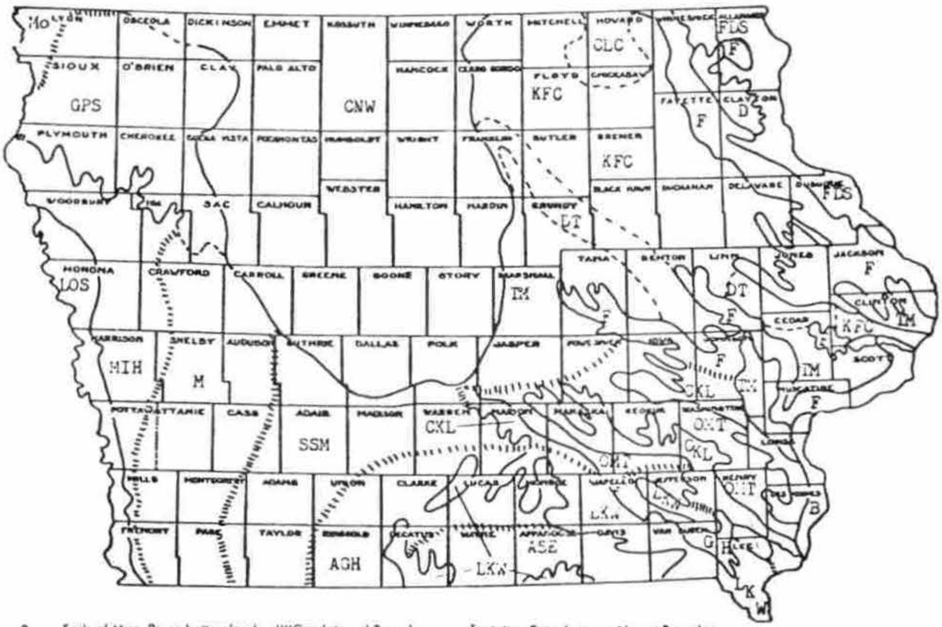
# CHAPTER II. THE STUDY AREA, SAMPLE, DATA AND PROCEDURES USED

Time series studies require strict attention to comparable research methods in order to insure that changes in observations over time are due to physical, social, economic, or institution factors rather than different research methods. In order to insure comparable results with previous studies, and also to serve as a foundation for future work, this chapter explains in detail the methodology used in this soil erosion control study.

## Area of Study

The Western Iowa land use laboratory used for this study consisted of a sample of farms from the Ida-Monona-Hamburg Soil Association. Portions of the ten counties Plymouth, Woodbury, Ida, Harrison, Monona, Crawford, Shelby, Pottawattamie, Mills, and Fremont are included in this soil association. This area is a long strip of land which is bordered by the Galva-Primghar-Sac Soil Association on the north, the Marshall Soil Association on the east, the state of Missouri on the south, and the Missouri River flood plain on the west. Land area covered by this soil association is approximately 2,860 square miles which is 1,830,400 acres or about 5.1 percent of the total area of the state of Iowa (18, p. 13). Figure 1 shows the location of the Ida-Monona-Hamburg Soil Association.

The area for the land use laboratory was selected by Frey in 1949 because of the seriousness of the erosion problem which persisted there (6, p. 57). Steep topography, large acreages of




B Soils of Miss. River bottomland ||||Gradational Boundary — —Tentative Boundary —— Abrupt Boundary

| | | | | | |
|---|---|---|---|---|---|
| AGH | Adair-Grundy-Hair | F | Fayette | M | Marshall |
| ASE | Adair-Seymour-Edina | FDS | Fayette-Dubuque-Stonyland | MIH | Monona-Ida-Hamburg |
| CKL | Clinton-Keswick-Lindley | GPS | Galva-Primghar-Sac | Mo | Moody |
| CLC | Cresco-Lourdes-Clyde | GH | Grundy-Haig | OMT | Otley-Mahaska-Taintor |
| CNW | Clarion-Nicollet-Webster | KFC | Kenyon-Floyd-Clyde | SSM | Shelby-Sharpsburg-Macksburg |
| D | Downs | LKW | Lindley-Keswick-Weller | TM | Tama-Muscatine |
| DT | Dinsdale-Tama | LOS | Luton-Onawa-Salix | | |

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Figure 1. Principal Soil Association areas in Iowa

intertilled crops, irregular distribution of rainfall, and insufficient erosion control practices were combining to make this a problem area. Results of this initial research indicated that erosion was in fact very severe in this area (6, p. 82-83). Follow-up research by Held, Blaze, and Timmons indicated that the problem of severe soil erosion continued to exist throughout the land use laboratory in the late 1950s (Table 1).

Topography of this area is dominated by narrow, gently-sloping ridges, and steep side slopes which gradually change into alluvial valleys. Streams and gullies cut deep into these alluvial valleys. In the Missouri River bluff area steep upland side slopes have eroded to form small natural benches called catsteps.

The major upland soil types are Monona, Ida, and Hamburg soils. Napier and McPaul are the major soil types forming the stream valleys. Loess is the parent material for the upland soils. Loess is a wind deposited material consisting almost entirely of silt with small amounts of sand and clay. This composition gives loess-derived soils a smooth floury texture and makes the soil susceptible to rapid erosion.

Area within the Ida-Monona-Hamburg Soil Association has been under cultivation for slightly over 100 years. The original vegetation in this area was prairie with shrubs and small trees on some slopes and smaller creek bottom areas.

Table 2 summarizes the soil characteristics of the Ida-Monona-Hamburg Soil Association.

The agricultural economy of this soil association is dominated by hetrogeneous farming operations, ranging from cash grain farms to

Table 2. Soil characteristics of the Ida-Monona-Hamburg Soil Association[a]

| Soil type | Slope percent | | Land position | Parent material | Original vegetation | Erosion hazard | Land capability class and subclass[b] |
|---|---|---|---|---|---|---|---|
| | Typical | Range | | | | | |
| Monona silt loam | 2- 5 | 1-30 | Upland ridges and side slopes | Loess | Prairie | Slight to severe | lle-llle |
| Ida silt loam | 10-20 | 6-30 | Upland ridges and side slopes | Loess | Prairie | Severe | llle-IVe |
| Hamburg silt loam | 30-60 | 30-60 | Catstep slopes | Loess | Prairie | Very severe | VIIe |
| Corstana silt loam | 14-18 | 10-30 | High upland footslopes | Collervium | Prairie | Severe | IVe |
| Napier silt loam | 2- 5 | 1-10 | Footslopes and Alluvial fans | Alluvium | Prairie | Slight to severe | lle |
| McPaul silt loam | 0- 2 | 0- 2 | Bottomland | Alluvium | Prairie | None | 1 |

[a]Adapted from (18, p. 57-58, Tables 18-A and 18-C).

[b]Land capability classes: descriptions.

lle. In this class there exists some limitations that restrict the choice of plants or require some conservation practices to avoid excessive erosion.
llle. Severe limitations restricting plant choice and requiring conservation practices to avoid excessive erosion.
IVe. Very severe limitations upon land uses.
VIIe. This land should never be cropped.
1. Few limitations restricting land use.

livestock raising and feeding. The modal farms in this area operate with a combination of cash grain and livestock operations. Approximately three quarters of gross farm income is generated by the sale of livestock or livestock products (30, p. 9). This includes grain and roughage fed to livestock. Production of hogs or cattle for slaughter requires large supplies of feed grains which in turn generates intensive land use patterns which have contributed to soil erosion control problems.

In the ten counties of the Ida-Monona-Hamburg Soil Association the average farm size was 280 acres in 1971 which was larger than the 253 acre average for the state of Iowa (11, p. 9). Farm owner-operators dominate the tenure situation, although the percentage of owner-operators in this ten-county area was 46 percent which was lower than the state average of 51 percent (30, p. 3). This factor contributes to soil erosion control problems because planning horizons of tenant operators may be shorter in general than for farm owners and thereby restrict long run farm improvement investments. Table 3 shows some characteristics of this agricultural area.

## Study Methods and Data Needs

Data needs for this study determined the research methods used in fulfilling the project objectives. Estimation of existing soil losses and operator soil loss goals determined the first data need which was to gather enough information concerning each farm operation to calculate these soil losses. Evaluation of progress or failure for soil erosion

Table 3. The Ida-Monona-Hamburg Soil Association's agricultural characteristics

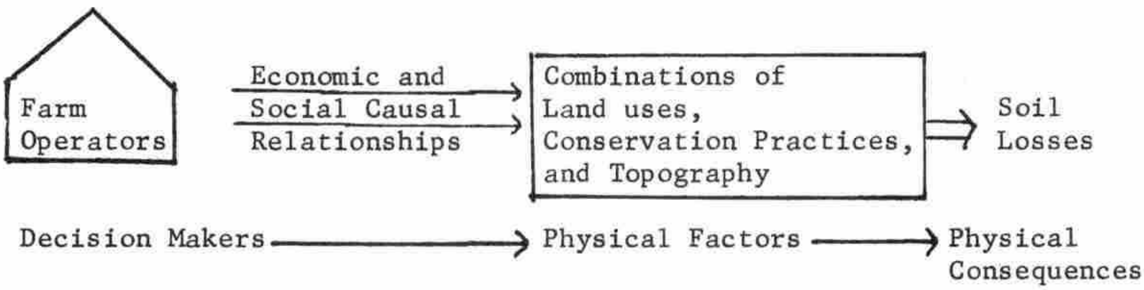
| Category | Sample area | State of Iowa |
|---|---|---|
| Gross per farm income in dollars.[a] | 37,718 | 24,044 |
| Proportion of farm income derived from livestock or livestock products in percent[a] | 78 | 78 |
| Proportions of farm operator's tenure[a] | | |
| Full owner in percent | 46 | 51 |
| Part Owner in percent | 26 | 25 |
| Renter in percent | 28 | 24 |
| Average size of farms in acres[b] | 280 | 253 |
| Average corn yield per acre in bushels[b] | 92.4 | 99.8 |
| Average soybean yield per acre in bushels[b] | 29.6 | 32.3 |

[a]Income and tenure statistics from (30).

[b]Descriptive farm statistics from (11).

control over time required that data gathered in 1974 be comparable to data from the previous studies. Additionally, to better ascertain the process with which farm operators affect levels of soil losses it was necessary for this project to interview in detail farm operators within the study area.

A hypothesized model of the process of soil erosion occurrence is illustrated in the schematic diagram below.




The model points out the most difficult data need for this project. Economic and social causal relationships which determine what combinations of land uses, conservation practices, and topography exist on a particular farm are extremely difficult to gauge. Farm operation in Western Iowa is an individualistic process under which each farm operator has practically no effective constraints upon choosing combinations of the above factors. Estimation of this process was a major challenge for this project.

## Sample Used for this Erosion Control Study

Interview costs and a study budget constraint made sampling from the study area mandatory. The same sample of farms within the area of study has been used for each of the three previous studies. By using the same sample for each study, research findings can be compared over time for one set of land. Farm owners and operators change over time but the land in the sample remained unchanged.

Frey in 1949 drew the original sample of farms from the Ida-Monona-Hamburg Soil Association. During this initial study, a headquarters rule for sample farm eligibility was used and applied to forty-eight sections of land drawn randomly from the entire soil association area. In order to be considered a sample unit, each farm had to satisfy the headquarters definition. The farm headquarters for purposes of this investigation, was a dwelling on the farm and the buildings used for housing the major part of livestock and machinery. If the dwelling was outside the boundaries of a section of land, but the buildings used for housing the major part of the livestock and machinery were within the section boundaries this was considered a headquarters farm. If the dwelling was inside the section boundaries but the buildings housing livestock and machinery was outside the section boundaries this was not considered a headquarters farm. Frey's original sample consisted of 145 farms which satisfied this definition. This sample consisted of 29,168 acres. The approximate location of the sample units within the Ida-Monona-Hamburg Soil Association are shown in Figure 2.

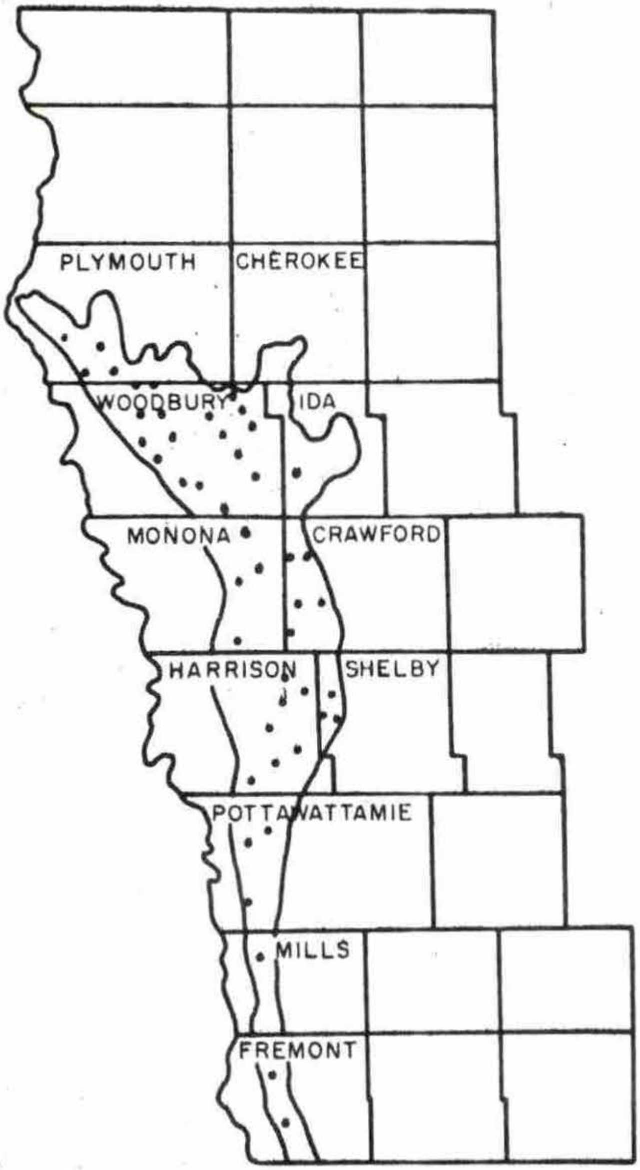



Figure 2. Western Iowa showing the approximate location of the Ida-Monona Soil Association and the survey units in a sample of farms, 1974

Since 1949 farm consolidation and recombination has resulted in a steadily declining number of farms in this sample. From 1949 to 1952 the number of sample farms had declined from 145 to 143. Blase in 1957 reidentified 138 farms for the third study. Reidentification of the sample farms was accomplished in 1974 with the assistance of county Agricultural Stabilization and Conservation Service offices. In January, 1974, the reidentification of farms showed that there were 119 farms in the sample sections that satisfied the headquarters rule. These farms comprized 23,633 acres. However, as the study progressed, six of the farm operators refused to cooperate in providing necessary information and consequently had to be dropped from the sample. Therefore, the 1974 sample consists of 113 farms containing 21,098 acres. Characteristics of the sample used for this series of studies are shown in Table 4. Counties, townships, and sections that make up the sample are listed in Appendix A.

Table 4. Sample characteristics for all studies

| Year | Number of sample farms | Acres for sample farms | Percent of study area |
|---|---|---|---|
| 1949 | 144 | 29,168 | 1.59 |
| 1952 | 143 | 28,996 | 1.58 |
| 1957 | 138 | 23,736 | 1.30 |
| 1974 | 113 | 21,098 | 1.15 |

## Methods of Obtaining Data

Through the interview process, the study strove to obtain the necessary information both to estimate soil losses and to evaluate the relationships hypothesized in the study's model. The dual objectives for the interview process were accomplished by combining farm-operator interviews with the exhibition and explanation of soil erosion control plans for each sample farm. This combination approach to the interview process was designed to create a data collection scheme that would allow sufficient information to be collected to satisfy all project objectives.

### Interview schedule

An interview schedule was designed to learn 1974 land uses, anticipated land uses, and farm operator's opinions concerning soil erosion control. Attention was given to the former interview schedules to insure that the data collected were comparable and relevant within the time series approach. The schedule that was developed in 1974 required many modifications from previous studies due to the length of time separating the studies and the corresponding major changes in farming practices.

The survey form was designed during the early summer of 1974 with assistance from the Survey Branch of the Iowa State University Statistical Laboratory. Field testing of the form was completed during August, 1974. A survey school was held in Sioux City, Iowa, during the first week of September, 1974, to instruct field workers on the survey process. All farm operator interviews were completed between August 15 and October 15, 1974, by myself and five competent interviewers employed by the

Statistical Laboratory.

Several unique survey techniques were employed throughout the data gathering process. Transparent overlays were used over aerial photos in order to gather sufficient land use information. Operator's opinions concerning open-ended questions were recorded by tape recorders to insure that incorrect generalizations were not incorporated into the study's findings. Using tape recorders in a survey project had never been done before at Iowa State University, but this technique was considered quite valuable and successful for this study. A copy of the complete interview form is contained in Appendix B.

### Soil Conservation Service erosion control plans

Determining obstacles which prevented farm operators from combining conservation practices, land uses, and topographies in such a manner as to control soil erosion was the method by which this study attempted to gauge the hypothesized relationships in the erosion process model. Through the interview process, each farm operator was shown two erosion control plans for the sample farm that he operated. Discussion of the details of these plans was designed to illuminate the causal relationships of the model. Preparation of these erosion control plans was done in the county SCS offices for each sample farm by experienced SCS staff familiar with the Ida-Monona-Hamburg Soil Association area.

Two erosion control plans for each sample farm were prepared in order to better gauge effective obstacles for soil erosion control. Differences in the plans were primarily the method of soil erosion control utilized. The first erosion control plan emphasized the mechanical erosion control technique of terracing. Dominating the recommended terrace design were the grass backslope terraces and the parallel level broadbase terraces. Other conservation techniques used in this plan were contouring, grass waterways, structures and tile, spring plowing, conservation tillage, seeding extremely steep slopes, and preserving wildlife areas. This plan was designed to allow large acreages of intertilled row crops and represented quite intensive farming methods. Erosion control plan number two emphasized vegetative erosion control practices. This plan contained no recommendations for terracing other than maintaining what terraces already existed on the sample farms. Soil erosion control was accomplished by this plan through less intensive rotations which decrease the acreage of intertilled row crops. Forage crops were substituted for row crops because they are less erosive. Conservation tillage practices were recommended more widely in this plan and all other conservation practices were applied where merited.

Both the mechanical and vegetative erosion control plans were designed to hold soil loss on the sample farms to five tons per acre per year. Five tons per acre per year has been the public policy norm for soil loss throughout previous studies in this series. This norm represents that level of soil loss which can be tolerated in the respect that soil fertility is not seriously decreased and gullying and siltation would not be serious problems (24, p. 459).

A two-plan presentation was justified due to the wide variation of farming methods in the sample area. To determine the reasons why particular land uses, conservation practices, and topography were combined as observed, it appeared desirable to approach the farming methods used by having two different erosion control plans.

Each erosion control plan contained an aerial photograph; a soil map; and detailed instructions for field boundaries, rotations, conservation practices for each sample farm. Farm plan number seventy-seven is shown in Appendix C.

## Analysis of Data

After data collection for the project was completed all data were coded and recorded on computer cards. Land use and conservation practice information were combined to estimate per farm soil losses and recorded also. A coding form and a soil loss form are contained in Appendix D.

Information obtained through the interview process was essentially in two forms. The first subset of information was utilized to calculate soil losses. Remaining information, which was primarily on the tape recorded portion of the schedule, was utilized to explain why the levels of soil losses observed existed.

### Calculation of soil losses

Estimations of soil losses and soil loss goals were calculated for this study by using information gathered in the interview and the universal soil loss equation.

All previous studies in this series have used an equation similar to the universal soil loss equation. Browning's equation and its modifications were used by the previous researchers in this series for estimating soil losses (1, p. 37) Browning's equation has been replaced by the universal soil loss equation which was compiled and published by Wischmeier and Smith in 1965 (32).

The equation is A = RKLSCP. "A" is the estimated annual soil loss in tons per acre per year, "R" is a rainfall factor, "K" represents the soil erodibility factor, "L" and "S" (usually combined) represent length and steepness of slope factors, and "C" is the rotation and management factor while "P" is the conservation practices factor.

Soil erosion is a physical function of the above factors. This equation is based on erosion control research which includes nearly 10,000 plot-years of data from 2,000 weather stations in 37 states compiled for nearly 25 years (15).

Tables of coefficients for the soil loss equation factors were supplied to the study by the SCS. These tables give predicted soil losses for specific combinations of the R, K, LS, and P factors. When multiplied by the C factor estimates of annual soil losses can be calculated. Utilizing these tables in an example a soil loss can be estimated as follows. Soil loss for a situation where a field of Ida silt loam soil supporting continuous corn with a topography of 12 percent slope and 300' slope length farmed using no contouring or terracing in Monona County could be calculated from the SCS tables. Values from the tables are RKLSP = 182 and C = .36. Therefore, the predicted annual soil loss would be 65.52 tons per acre per year.

Adaptation of the soil loss equation sometimes had to be done in order to meet certain rotations which were found in the interview process but which were not included in the tables provided by the SCS. As an example the rotation Oats-Meadow-Meadow for three-year hay ground plowed every third year was encountered often, but no C factor was supplied. Calculation of the soil loss for fields under this rotation was done by using a Wischmeier factor for 40 percent of plant cover for three months of the three-year rotation or 1/12 of the period and using a factor for 95-100 percent cover for the remaining 11/12 of the period (31). A weighted average soil loss for a field under this rotation was then calculated. Other "hybrid" C factors that were used are: Corn-Corn-Oats = .17, Soybeans-Corn-Oats = .36, and Corn-Corn-Corn-Oats = .29. Additional particulars for the soil loss equation were: 1) woodland acreage was included in pastureland while, 2) acreage classified by farm operators as wasteland was not included in soil loss calculations.

A point of importance is that the universal soil loss equation does not account for extreme stress conditions, such as abnormally heavy rains during planting season when the soil is most vulnerable to erosion. This equation estimates soil loss for the annually nonexistent average year. All soil loss calculation material used in this study is contained in Appendix E.

## Evaluation and Explanation of Soil Loss Levels

The soil loss estimates were put in perspective by comparing the results of this study with the results of the previous studies. By doing this, soil erosion control progress or failure was gauged within the study area. Comparison of farm operator's soil loss goals over time also provided insight to the intertemporal dynamics of the problem.

Individual farm operator reactions to the soil erosion control plans were categorized and examined. This was done in an attempt to delineate the relationships which were hypothesized to exist in the model of the study. Relative weights among these categories were studied to determine the significant obstacles for soil erosion control at the public policy norm.

Further explanation of the soil loss problem was attempted by utilizing multiple linear regression in attempting to estimate a soil loss function using relevant hypothesized factors as variables. Analysis of variance techniques were also employed to determine significant causal factors. Additionally, the sample farms were ranked according to soil loss levels and grouped according to breaks in this ranking. By examining characteristics of the sample farms within each group the study hoped to determine what characteristics seemed to dominate farms that were classified as either successes or failures in respect to soil erosion control. Results of these techniques were used to better understand the interworkings of the process of soil erosion.

# CHAPTER III. SOIL EROSION LOSSES, GOALS, AND OBSTACLES FOR RECOMMENDED EROSION CONTROL PRACTICES

The first general objective of this project was to estimate the rate of soil loss within the Ida-Monona-Hamburg Soil Association which occurred during 1974. This objective was accomplished using the methodologies detailed in Chapter II.

## Erosion Losses Over Time

Soil losses due to water erosion were estimated to average 17.2 tons per acre per year for the sample farms in this study. Table 5 presents the annual soil loss mean estimates for the four studies in this series. Hypotheses that the level of soil erosion losses are accelerating were supported by these results. As shown in Table 5 from 1949 through 1957,

Table 5. Soil losses measured in tons per acre per year on sample farms in 1949, 1952, 1957, and 1974

| Year of study | Annual soil loss mean[a] (tons per acre per year) |
|---|---|
| 1949 | 21.1 |
| 1952 | 19.5 |
| 1957 | 14.1 |
| 1974 | 17.2 |

[a]Hereafter the annual soil loss mean will be termed ASLM and tons per acre pear year as T./Ac./Yr.

the annual loss of soil was estimated to be decreasing. However, this trend seems to have reversed since 1957. Due to the length of time between the third and fourth studies of this series it is impossible to document precisely when this downward trend in soil losses leveled out or reversed itself. However, it does appear that by 1974, the level of soil loss had at the very least not decreased since 1957 and there exists evidence that the loss level had increased since 1957.

Estimated soil loss means from 105 of the 113 sample farms exceeded the public policy norm of 5 tons per acre per year soil loss. Abiding by this norm, 93 percent of all farm operators in this sample were violating the public interest in respect to amount of soil lost due to eriosion.

The distribution of soil loss means is presented in Figure 3 for the studies done in 1949, 1957, and 1974. The curve for the 1974 soil loss means is less convex than the 1957 curve which indicates a larger proportion of the existing soil loss means in 1974 fall in the higher ranges of the soil losses than did so in 1957. Estimated annual soil losses for the sample farms range from 51.7 to 1.1 tons for 1974.

## Erosion Loss Goals Over Time

Almost as important as the existing soil losses for the sample farms is the level at which the farm operators would like to set these losses as a goal. Farm operators' goals were also calculated during the study and are shown in Table 6.

Paralleling the actual soil losses, the farm operators' goals have increased since 1957. Additionally, only twelve of the 113 sample farmers

Figure 3. Cumulative distribution of estimated soil loss means for 1949, 1957, and 1974

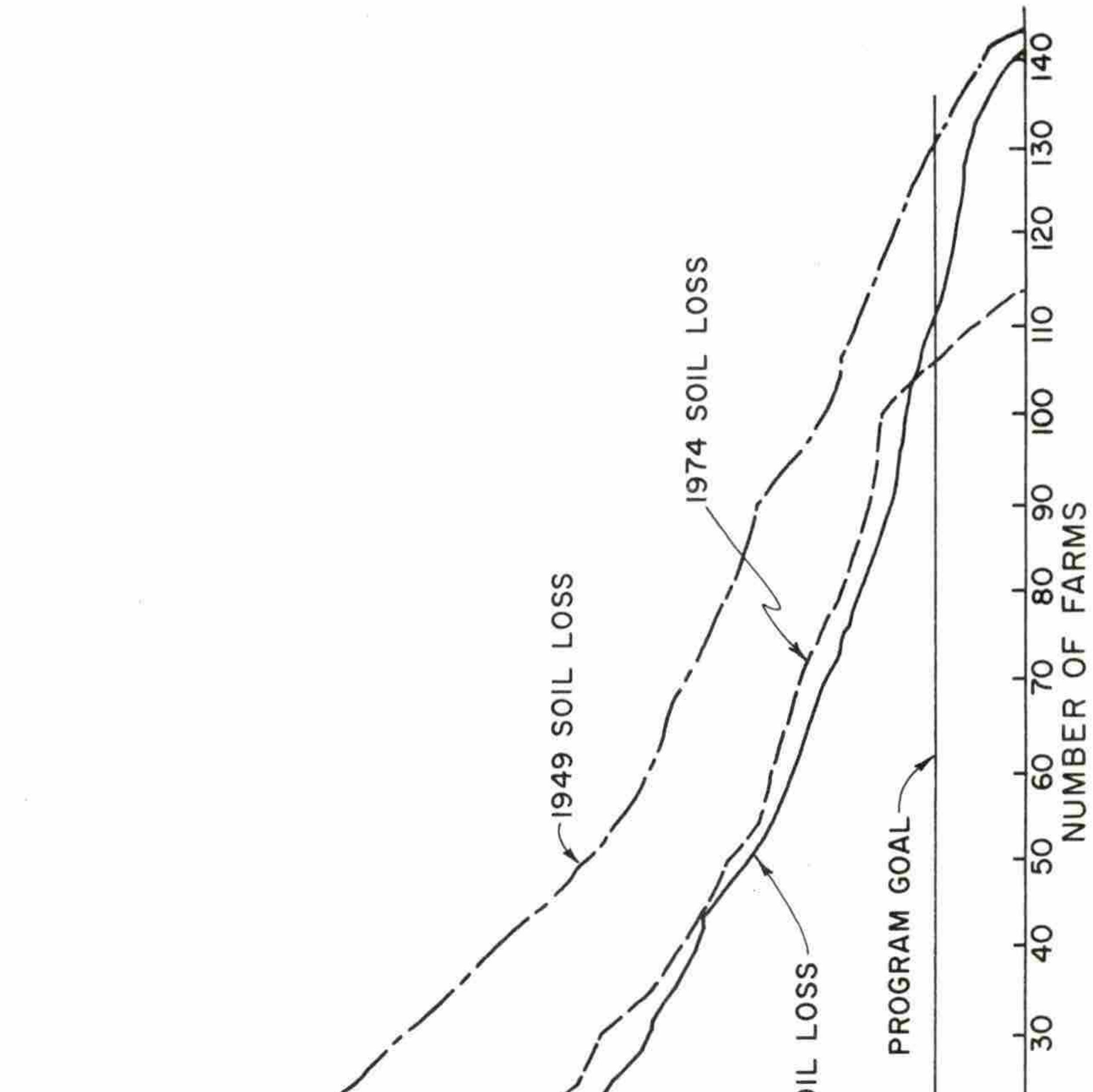

1949 SOIL LOSS
1974 SOIL LOSS
1957 SOIL LOSS
PROGRAM GOAL
NUMBER OF FARMS
TONS OF SOIL LOSS PER ACRE PER YEAR
10 20 30 40 50 60 70 80 90 100 110 120 130 140
5 10 15 20 25 30 35 40 45 50 55

Table 6. Soil loss goals for sample farms measured in tons per acre per year for 1949, 1952, 1957, and 1974

| Year of study | ASLM (T./Ac./Yr.) |
|---|---|
| 1949 | 16.4 |
| 1952 | 16.7 |
| 1957 | 11.7 |
| 1974 | 14.5 |

indicated soil loss goals that were below the public policy norm of five tons per acre per year soil loss. This implies that 89 percent of the farmers interviewed believed there existed effective obstacles that prevented them from achieving the level of the normative soil loss.

Figure 4 shows the changes in the farmers' soil loss goals over time. These curves show that in 1974 a higher proportion of the operators had soil loss goals in upper ranges of the distribution of soil losses. This situation is reflected by the less convex curve for 1974. The range of soil loss goals was from 44.0 to 1.1 tons annual loss.

Soil losses and soil loss goals are paired together in Table 7. Noteworthy is the fact that the soil loss goals estimated in 1974 are higher than the soil loss estimate of the 1957 study. This fact implies that not only does soil erosion control seem to be deteriorating, but also that farm operator toleration of soil erosion has increased since 1957.

Figure 4. Cumulative distribution of estimated soil loss goal means for 1949, 1957, and 1974

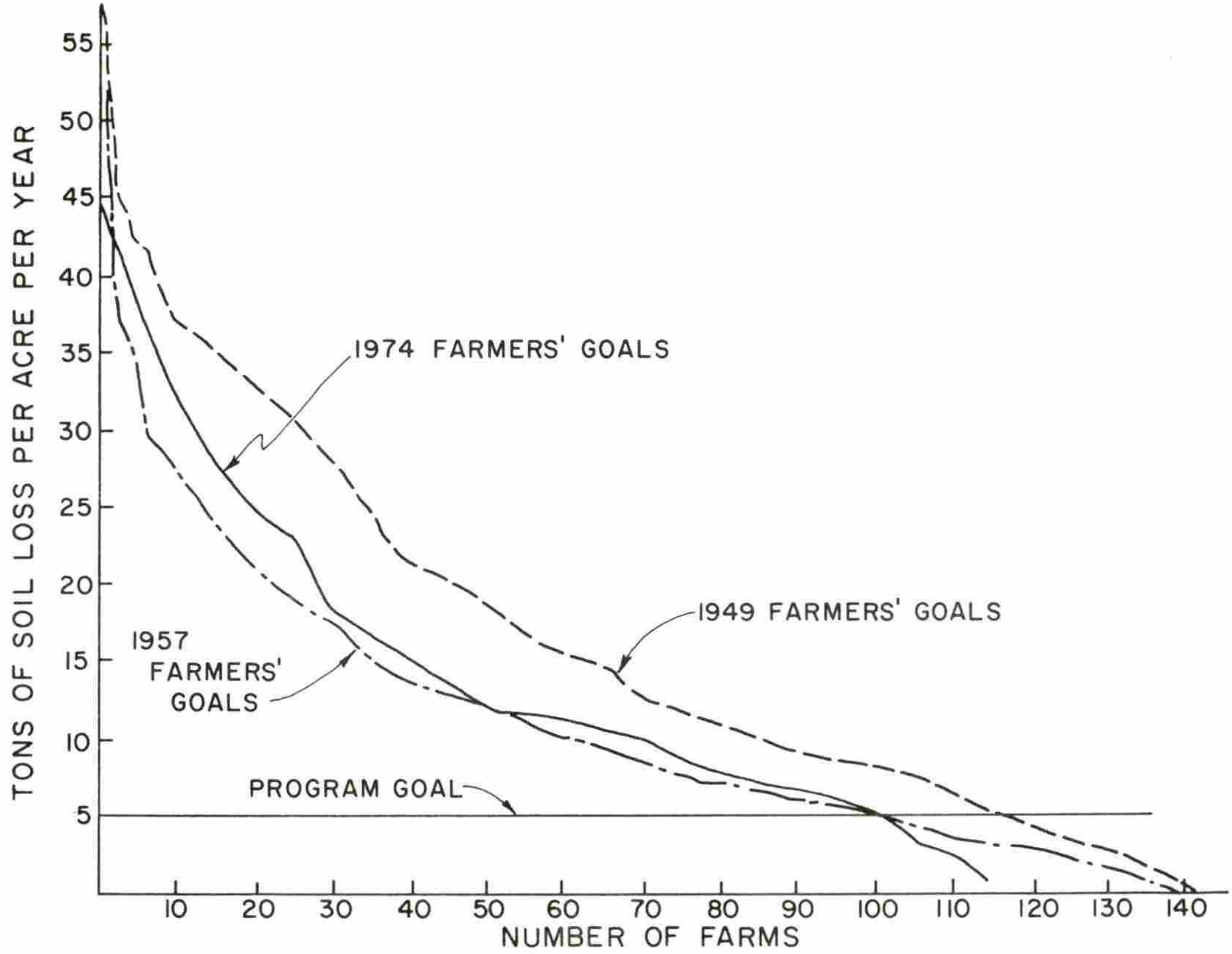

TONS OF SOIL LOSS PER ACRE PER YEAR
55
50
45
40
35
30
25
20
15
10
5
NUMBER OF FARMS
10
20
30
40
50
60
70
80
90
100
110
120
130
140
1974 FARMERS' GOALS
1949 FARMERS' GOALS
1957 FARMERS' GOALS
PROGRAM GOAL

Table 7. Soil losses and soil loss goals for sample farms in 1949, 1952, 1957, and 1974

| Year of study | ASLM (T./Ac./Yr.) | |
|---|---|---|
| | Actual | Goal |
| 1949 | 21.1 | 16.4 |
| 1952 | 19.5 | 16.7 |
| 1957 | 14.1 | 11.7 |
| 1974 | 17.2 | 14.5 |

## Erosion Control Obstacles and Soil Losses

If farm operator toleration of soil erosion has in fact increased since 1957, as indicated by Table 7, then the obstacles to soil erosion control practices must have been increased during this time period. Through the presentation of the SCS erosion control plans to each farm operator this study was able to gauge relative resistance to individual erosion control practices. These relative resistance intensities and corresponding annual soil loss means are presented for each of the erosion control practices recommended by the SCS farm planners. In addition to the relative frequencies of objections, the study obtained specific reasons why the farm operator did not approve of individual conservation practices. These specific obstacles were also examined. Combinations of the following major practices formed the entire farm plan for each sample unit.

Terracing

Terracing was the dominant erosion control practice utilized in the mechanical erosion control plan. Of the 113 erosion control plans terracing was recommended on 111 of the farms. As shown in Table 8, 64 operators or 58 percent of the total, objected to the terracing as recommended in the mechanical plan. Table 8 also shows that the farm operators who objected to the practice of terracing had a lower annual soil loss than those operators who did not object.

Table 8. Number of farm operators objecting to recommended terracing in mechanical erosion control plan and corresponding soil loss mean

| Farm operators | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| No objection to recommended terracing | 47 | 42 | 18.2 |
| Objection to recommended terracing | 64 | 58 | 16.6 |
| Total number of recommendations | 111 | 100 | 17.3 |

Specific obstacles for terracing are presented in Table 9. There are two broad categories of obstacles to terracing expressed by the farm operators. First, there appear to be many obstacles which center around the rationale for having terraces at all. Three of the four most frequently mentioned obstacles are in this category. Resistance to the amount of terracing required to hold soil loss to the public soil loss norm was stated by eighty-nine percent of those farm operators who objected to

Table 9. Obstacles cited by farm operators who objected to recommended terracing in the mechanical erosion control plan

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Disapprove of recommended amount of terracing | 57 | 89 |
| Prefer alternative use for income rather than terracing | 51 | 80 |
| Fail to see need for recommended terracing | 50 | 78 |
| Recommended terracing contradicts established farming methods | 50 | 78 |
| Recommended terracing would reduce profits on farm | 41 | 64 |
| Disapprove of suggested terrace design | 30 | 47 |
| Installation cost for terracing too high | 24 | 38 |
| Terrace maintenance too difficult | 22 | 34 |
| Terraces increase difficulty of farming | 11 | 17 |
| Terraces require too much land | 11 | 17 |
| Machinery presently owned by operator will not work as well with terraces | 11 | 17 |
| Lack of landlord cooperation[b] | 8 | 13 |
| Terracing makes fields too small | 8 | 13 |
| Operator feels land is not steep enough to merit terraces | 7 | 11 |
| Total number of recommendations | 64 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

[b]This figure is 13 percent for all operators objecting to terracing while 33 percent of all renters objecting to terracing had this obstacle.

terracing as a conservation practice. Equally important was the fact that seventy-eight percent of the objecting farm operators maintained that terracing as recommended violated their established farming methods and further they did not see a need for this practice. These obstacles and others listed show a situation in which the farm operators did not consider the problem of soil erosion to be serious enough to justify the problems caused their operations by terracing.

The second category of obstacles for terracing appeared to be a direct competition between terracing and profit maximization. Observed frequent income and profit obstacles pointed this out. Also, the less frequently but often mentioned obstacles concerning installation cost and land requirements reinforced the tradeoffs present between erosion control and profit maximization.

Frequencies of the detailed obstacles indicated that each farm operator who objected to the proposed terracing had anywhere from one to eight obstacles which prevented him from adopting the recommendations. This fact illustrates how difficult it would be to overcome this operator resistance through public agency programs.

Contouring

Contouring was recommended in both the mechanical and vegetative erosion control plans. This practice was recommended on 112 of the mechanical erosion control plans and 111 of the vegetative erosion control plans. Table 10 shows that ten farm operators objected to contouring in the mechanical plan while nine objected to contouring in the vegetative plan. In both instances those farm operators who objected to

Table 10. Number of farm operators objecting to recommended contouring in both erosion control plans and corresponding annual soil loss mean

| Farm operators | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| Mechanical plan | | | |
| No objection to recommended contouring | 102 | 91 | 17.0 |
| Objection to recommended contouring | 10 | 9 | 19.2 |
| Total number of recommendations | 112 | 100 | 17.3 |
| Vegetative plan | | | |
| No objection to recommended contouring | 102 | 92 | 16.6 |
| Objection to recommended contouring | 9 | 8 | 23.4 |
| Total number of recommendations | 111 | 100 | 17.1 |

contouring had higher annual soil loss means than those operators who did not object to this practice. Specific obstacles for contouring cited by farm operators were quite similar for both erosion control plans. Table 11 shows that the obstacles for contouring fell into two categories paralleling the terracing obstacles. Failure to see a need for contouring, dislike of point rows, and objecting to necessary field or road layout are obstacles which question the rationale for using contouring as a farming practice. Obstacles such as the belief that contouring would reduce profits and yields, illustrates some competition between this conservation practice and profit maximization.

Of the nine operators who objected to contouring in the vegetative

Table 11. Obstacles cited by farm operators who objected to recommended contouring in mechanical erosion control plan

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Fail to see need for recommended contouring | 9 | 90 |
| Dislike point rows | 9 | 90 |
| Object to field or road layout caused by contouring | 8 | 80 |
| Recommended contouring would reduce profits on farm | 7 | 70 |
| Recommended contouring reduces yields | 6 | 60 |
| Total number of recommendations | 10 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

erosion control plan six were the same operators who had objected in the mechanical plan. This meant that there were thirteen operators that objected to contouring as a conservation practice in at least one plan. Reasons given as obstacles were similar to those given for the mechanical erosion plan and are contained in Table 12. It seems that contouring in these farm operators opinions did not benefit them enough to compensate for the added bother involved.

Table 12. Obstacles cited by farm operators who objected to recommended contouring in vegetative erosion control plan

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Dislike point rows | 9 | 100 |
| Object to field or road layout caused by contouring | 8 | 89 |
| Fail to see need for recommended contouring | 7 | 78 |
| Recommended contouring would reduce profits on farm | 7 | 78 |
| Recommended contouring reduces yields | 5 | 56 |
| Total number of recommendations | 9 | 100 |

[a] Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

Rotations

A rotation was recommended for each sample farm plan of both types. These rotations tended to be very different for each farm because in the mechanical erosion control plan erosion was controlled primarily by the terraces while in the vegetative plan the control mechanism was the rotation itself. Rotations recommended in the mechanical plan were designed to complement the proposed terrace systems. These rotations attempted to maximize acreage of intertilled row crops when the constraint of five tons or less soil loss per acre per year was imposed. In order to control soil erosion in the vegetative erosion control plan smaller acreages of intertilled crops were recommended. Close growing crops which are less erosive were substituted.

Frequency of objections for both rotations are shown in Table 13. Neither set of rotations appeared to be very popular. For the mechanical plan forty-seven percent of the farm operators objected to the proposed rotation while sixty-three percent objected to the rotations necessary to control erosion through vegetative means. Annual soil loss means for those who objected to the mechanical plan rotation were lower than non-objectors while the opposite was true for the vegetative plan.

When specific obstacles to both sets of rotations are ranked, the obstacles were identical through the third most frequently mentioned. Farm operators objections to the amount and kind of rotations for either

Table 13. Number of farm operators objecting to recommended rotations for each type of erosion control plan and corresponding annual soil loss mean

| Farm operators | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| Mechanical plan | | | |
| No objection to recommended rotation | 60 | 53 | 17.6 |
| Objection to recommended rotation | 53 | 47 | 16.6 |
| Total number of recommendations | 113 | 100 | 17.2 |
| Vegetative plan | | | |
| No objection to recommended rotation | 42 | 37 | 15.9 |
| Objection to recommended rotation | 71 | 63 | 17.9 |
| Total number of recommendations | 113 | 100 | 17.2 |

plan is almost unanious. Table 14 shows that ninety-six percent of the farm operators who objected to the proposed mechanical plan rotations cited this obstacle. Again it appeared there were two areas of obstacles. Obstacles concerning kinds of rotations, established farming methods, and amounts of recommended corn and soybeans, indicated farm operator questioning of the rationale for these rotations. Obstacles which dealt with reduced profits and increased costs due to increased levels of inputs are purely economic in nature.

Table 14. Obstacles cited by farm operators who objected to recommended rotations for mechanical erosion control plan

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Objects to amount or kind of recommended rotation | 51 | 96 |
| Recommended rotations contradict established farming methods | 43 | 81 |
| Recommended rotations would reduce profits on farm | 25 | 47 |
| Recommended rotations contain too much continuous corn | 13 | 24 |
| Recommended rotations require too much fertilizer and/or herbicide | 11 | 21 |
| Recommended rotations contain too many soybeans | 9 | 17 |
| Recommended rotations do not contain enough meadow or pasture | 7 | 13 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

Table 14 (Continued)

| Obstacle | Number of farm operators | Percent of those objecting |
|---|---|---|
| Recommended rotations do not contain enough cash grain crops | 6 | 11 |
| Lack of landlord cooperation[b] | 4 | 8 |
| Short expectancy of tenure makes recommended rotations objectionable | 3 | 6 |
| Ground too steep for recommended rotations | 3 | 6 |
| Rotations contain too much meadow | 3 | 6 |
| Total number of recommendations | 53 | 100 |

[b]Twenty-one percent of all renting objectors had this obstacle.

It was also interesting to note that for the mechanical plan six of the farm operators stated that there were not enough cash grain crops in the recommended rotations in spite of the fact that these rotations were designed to maximize acreages of cash grain crops. These six farm operators had a mean annual soil loss of 26.9 tons per acre per year.

Table 15 shows the operator obstacles for the vegetative erosion control plan rotations. Because these rotations were the primary soil erosion control practice for these plans, it was important to note that similarily to terracing there are many multiple obstacles indicated. Farm operators objecting to these rotations appeared to have at least two or three specific obstacles concerning these rotations, implying that

Table 15. Obstacles cited by farm operators who objected to recommended rotations for vegetative erosion control plan

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Objects to amount or kind of recommended rotation | 68 | 96 |
| Recommended rotations contradict established farm method | 56 | 79 |
| Recommended rotations would reduce profits on farm | 53 | 75 |
| Recommended rotations contain too much meadow | 41 | 58 |
| Recommended rotations do not contain enough cash grain crops | 18 | 25 |
| Do not own livestock to use forage crops | 9 | 13 |
| Recommended rotations contain too much continuous crop | 8 | 11 |
| Lack of landlord cooperation[b] | 7 | 10 |
| Short expectancy of tenure makes recommended rotations obstacle | 4 | 6 |
| Total number of recommendations | 71 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

[b]Twenty-one percent of all renting objectors had this obstacle.

overcoming these objections through some sort of public policy action would be very difficult.

Field boundaries

Recommendations for field boundaries were made for all 113 of the erosion control plans. Field boundaries for both plans were identical so only one question concerning opinions about these field boundaries was asked. These recommended field boundaries were almost entirely drawn on the contour which in many cases caused them to be quite different than existing fields. Of the farmers interviewed, fifty-nine objected to the proposed boundaries. Table 16 shows the number of field boundary objections and the corresponding annual soil loss means.

Table 16. Number of farm operators objecting to recommended field boundaries and corresponding annual soil loss mean

| Farm operator's opinions | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| No objection to recommended field boundaries | 54 | 48 | 16.1 |
| Objection to recommended field boundaries | 59 | 52 | 18.2 |
| Total number of recommendations | 113 | 100 | 17.2 |

Specific obstacles to the recommended field boundaries center around farm operator's opinions that the fields were too small and boundaries too crooked. Table 17 shows that the indicated obstacles were primarily in the area of operator questioning the practicality of the recommended field boundaries. It was observed during the soil loss calculations that the recommended field size was substantially smaller than the observed fields.

Table 17. Obstacles cited by farm operators who objected to recommended field boundaries for both erosion control plans

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Objects to amount and kind of recommended boundaries | 54 | 92 |
| Recommended boundaries contradict established farm methods | 47 | 80 |
| Fail to see need for recommended boundaries | 47 | 80 |
| Recommended fields are too small | 28 | 47 |
| Recommended fields would not work for livestock | 9 | 15 |
| Recommended boundaries cause extra work and expense | 7 | 12 |
| Short expectancy of tenure causes boundaries to be objectionable | 7 | 12 |
| Boundaries make too many fields | 6 | 10 |
| Boundaries are too crooked | 6 | 10 |
| Total number of recommendations | 59 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

Waterways

The conservation practice of grass waterways was recommended on 111 of the sample farms for both the vegetative and mechanical erosion control plans. These recommended waterways differed according to the difference in the rotations of each plan. Thirteen farm operators objected to the proposed waterways in the mechanical plan while ten objected to the waterways for the vegetative plan. In Table 18 the annual soil loss mean for each of the objection categories is given.

Table 18. Number of farm operators objecting to recommended waterways and corresponding annual soil loss mean

| Farm operator's opinions | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| Mechanical plan | | | |
| No objection to proposed waterways | 98 | 88 | 17.0 |
| Object to proposed waterways | 13 | 12 | 19.8 |
| Total | 111 | 100 | 17.3 |
| Vegetative plan | | | |
| No objection to proposed waterways | 101 | 91 | 16.8 |
| Object to proposed waterways | 10 | 9 | 22.0 |
| Total number of recommendations | 111 | 100 | 17.3 |

Specific obstacles for grass waterways were the same for both types of erosion control plans. Table 19 shows the obstacles cited by farm operators who objected to the proposed waterways in the mechanical erosion control plan. Once again, the farm operators' obstacles question the necessity of utilizing the conservation practice. This pessimism combined with various maintenance difficulties provided the majority of the waterway obstacles.

Table 19. Obstacles cited by farm operators who objected to recommended waterways for both erosion control plans

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Fail to see need for recommended waterways | 9 | 69 |
| Operator has found herbicides ruin waterways | 9 | 69 |
| Waterway maintenance prohibits their use | 5 | 38 |
| Recommended waterways would reduce profits for farm | 5 | 38 |
| Operators feel that waterways are not necessary if using conservation tillage, terraces, or combination of both | 5 | 38 |
| Waterways use too much land | 3 | 23 |
| Total number of recommendations | 13 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

## Structures and tile

Structures and tile designed to promote better drainage, gully control, or provide necessary ravine control were recommended on thirty-eight of the 113 sample farms. Because the structures and tile recommendations were general in nature, rather than specifically for either type of erosion control plan, one question was asked concerning operator opinions about these practices. Only five of the 38 farm operators for whom structures and tile were suggested objected to this construction. Table 20 shows the summary of these objections and the corresponding annual soil loss means.

Table 20. Number of farm operators objecting to proposed structures and tile and corresponding annual soil loss means

| Farm operator's opinions | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| No objection to proposed structures and tile | 33 | 87 | 18.7 |
| Object to proposed structures and tile | 5 | 13 | 19.4 |
| Total number of recommendations | 38 | 100 | 18.8 |

All five of these farm operators stated that they did not believe there was need for the recommended structures. Two of these operators further stated that they believed the proposed structures would result in lower yields for their farms.

<u>Conservation tillage</u>

Conservation tillage (minimum tillage) was recommended on both types of the erosion control plans as an erosion control practice. For the 113 mechanical erosion control plans conservation tillage was recommended sixty-seven times, while on the vegetative plans this practice was recommended on 111 of the farms. Farm operators objected to conservation tillage nine times in the mechanical plan with three operators expressing no opinion about this practice. In the vegetative plan conservation tillage was objected to by twenty-eight farm operators with two operators expressing no opinion. These results and corresponding annual soil losses are presented in Table 21.

Table 21. Number of farm operators objecting to proposed conservation tillage and corresponding annual soil loss means

| Farm operator's opinions | Number | Percent | ASLM (T./Ac./Yr.) |
|---|---|---|---|
| Mechanical plan | | | |
| No objection to proposed conservation tillage | 55 | 82 | 16.8 |
| Object to proposed conservation tillage | 9 | 13 | 17.4 |
| No opinion | 3 | 4 | 37.7 |
| Total number of recommendations | 67 | 100 | 17.8 |
| Vegetative plan | | | |
| No objection to proposed conservation tillage | 81 | 73 | 16.9 |
| Object to proposed conservation tillage | 28 | 25 | 17.4 |
| No opinion | 2 | 2 | 21.4 |
| Total number of recommendations | 111 | 100 | 17.1 |

Table 22 lists the specific obstacles for conservation tillage in the mechanical erosion control plan. Established farming methods form the largest obstacle area. Operator beliefs that the adoption of conservation tillage would reduce profits, increase fertilizer, herbicide, and machinery costs, along with reducing yields seem to reinforce this most frequent obstacle.

Table 22. Obstacles cited by farm operators who objected to recommended conservation tillage in mechanical erosion control plan

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Recommended conservation tillage contradicts established farming methods | 9 | 100 |
| Fail to see need for recommended conservation tillage | 8 | 89 |
| Recommended conservation tillage would reduce profits on farm | 6 | 67 |
| Operator believes conservation tillage reduces yields | 5 | 56 |
| Conservation tillage causes increased problems with fertilizers and herbicides | 4 | 44 |
| Operator believes conservation tillage does not help control erosion | 3 | 33 |
| Lack of machinery for conservation tillage | 2 | 22 |
| Not enough information concerning conservation tillage | 2 | 22 |
| Total number of recommendations | 9 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

Conservation tillage was recommended on twenty-eight farms in the vegetative erosion control plans. The obstacles shown in Table 23 parallel those in Table 22. Farm operators seemed hesitant to adopt conservation

Table 23. Obstacles cited by farm operators who objected to recommended conservation tillage in mechanical erosion control plans

| Obstacle | Number of farm operators | Percent of those objecting[a] |
|---|---|---|
| Recommended conservation tillage contradicts established farming methods | 24 | 86 |
| Fail to see need for recommended conservation tillage | 22 | 79 |
| Operator believes conservation tillage reduces yields | 15 | 54 |
| Lack of machinery for conservation tillage | 11 | 39 |
| Recommended conservation tillage would reduce profits on farm | 6 | 21 |
| Increased problems or costs for herbicides and fertilizers | 6 | 21 |
| Not enough information concerning tillage | 5 | 18 |
| Recommended conservation tillage would increase weed problem | 4 | 14 |
| Operator believes conservation tillage does not help control erosion | 4 | 14 |
| Operator feels conservation tillage does not adapt to his particular soil | 4 | 14 |
| Total number of recommendations | 28 | 100 |

[a]Percentages for obstacles total more than 100 percent because individual operators reported multiple obstacles for this practice.

tillage because of anticipated lower yields and profits, increased herbicide problems, and necessary machinery changes. As the tape recordings dealing with obstacles for conservation tillage were reviewed it became evident that very little middle ground in operator opinion existed relative to this practice. Farm operators either endorse conservation tillage or wanted nothing to do with this practice at all.

### Changes in Magnitudes of Obstacles Over Time

Results of the 1957 study can be utilized to determine if there have been changes in the relative frequencies of obstacles to the major soil erosion control practices since that time. Table 24 shows that for every comparable practice the relative frequencies of the obstacles have declined. However, the magnitude of the decline in the frequency of obstacles appears to be nowhere significant. In fact the ranking of most

Table 24. Proportion of farm operators objecting to specific erosion control practices in 1957 and 1974

| Practices | Percent of farm operators who objected | |
|---|---|---|
| | 1957 | 1974 |
| Vegetative plan rotations | 71.7 | 63.0 |
| Terracing | 60.1 | 58.0 |
| Mechanical plan rotations | 51.4 | 47.0 |
| Grass waterways | 21.0 | 12.0-9.0[a] |
| Contouring | 15.9 | 12.0 |

[a]First number is for mechanical plan, second is for vegetative plan.

objected to conservation practice through least objected to practice is identical for both the 1957 and 1974 studies. This indicates that progress toward controlling soil erosion through voluntary farm operator cooperation could have at maximum been very slight. Of equal significance is the situation where the two dominant erosion control practices, terracing and high forage rotations, have the highest incidence of objections from farm operators. This implies that convincing farm operators to control soil erosion utilizing either of these practices would be very difficult.

In addition to comparing relative frequencies of objections to individual erosion control practices comparisons of frequency of actual use of the practices is possible. The trend toward adoption of most erosion control practices on at least one field had been upward as shown in Table 25. Since 1957 the proportional use of contouring and terracing on at least one field for each sample farm has increased while the use of grass waterways has declined. It is important to notice the time intervals between the studies when comparing these figures. Terracing on at least one field increased thirteen percent in five years from 1952 to 1957, however in the next seventeen years the use of terracing on at least one field increased only fifteen percent. This indicates that subsequent adoption of terracing on farms not already terraced was much slower from 1957 to 1974. However, unfortunately it is impossible to compare total acreage on which terracing is now effective in controlling erosion relative to 1957. In the same respect it is also impossible to estimate how much of the indicated contouring is on such steep slopes

Table 25. Proportion of sample farms that reported using a specific erosion control practice on at least one field in 1949, 1952, 1957, and 1974

| Practice | Percent of farms using practice on at least one field | | | |
|---|---|---|---|---|
| | 1949 | 1952 | 1957 | 1974 |
| Contouring | 51 | 65 | 62 | 92 |
| Terracing | 15 | 27 | 40 | 65 |
| Grass waterways | 33 | 46 | 72 | 62 |
| Conservation tillage | N.A. | N.A. | N.A. | 39 |

that its erosion control effectiveness is impaired.

Reporting soil losses, soil loss goals, and frequencies of operator obstacles to erosion control practices were only the first and second objectives of this study. Possible explanations of existing soil losses are examined in Chapter IV.

# CHAPTER IV. POSSIBLE EXPLANATIONS OF EXISTING SOIL EROSION LEVELS

Determination of why farm operators allow soil loss to occur at observed levels involves evaluating factors which affect the process of soil loss determination. These factors may be economic, social, institutional, or physical in nature.

This chapter analyzes individual social, institutional, physical, and economic factors hypothesized to affect existing soil loss levels. These factors which were hypothesized to affect levels of soil loss are topography, tenure status, length of tenure, size and type of farm operation, numbers of roughage consuming animals, farm operator soil erosion control information levels, age of farm operator, membership in conservation districts or organized watersheds, and particular financial data. Multiple linear regression was used in an attempt to gauge interactions between these factors and existing soil loss levels. A characteristic farm approach was then used to gain further insights upon the factor combinations effect on soil loss levels. Summarizing these techniques allows categories of effectual factors to be examined and conclusions drawn in this chapter. Comparisons of significant causal factors with results of past studies allowed examination of how soil loss level determination has changed over time.

## Hypothesized Factors Determining Soil Loss Levels

Factors such as topography, soil erosiveness, rainfall patterns, and other acts of nature are not subject to change given the constraints of existing technology. However, land use practices, including inherent capital investments, may be put into effect in a manner that lessens the impact of these physical factors. For this study, factors which may be affected by public action, factors from the economic, social, and institutional realm, are of primary interest when attempting to explain existing soil erosion levels. Evaluations of the hypothesized factors which affect soil loss levels can be accomplished by examining the individual characteristics and corresponding soil loss means.

Observed soil loss levels are three times higher than the public policy norm and appear to be increasing. Therefore, evaluation of hypothesized causal factors and formation of erosion control policies based upon significant factors is expedient.

### Topography

Topography was hypothesized to affect levels of soil loss. The fact that the Ida-Monona-Hamburg Soil Association was designated the area for this study was determined partially because of the steep slopes which characterize the farmland in this area. A topography index was constructed for each farm by using the coefficients from the universal soil loss equation which combined the rainfall, soil erodibility, and slope-length factors for the existing conditions reported on each sample farm. By using these coefficients, allowance was made for existing terrace systems as they affected the slope-length factor.

Table 26 shows four topography categories and the corresponding annual soil loss mean averages. As the topography coefficients increase, the slopes and lengths present increase also, and the impacts of any terrace systems present are decreased. This table also contains the results of an analysis of variance (ANOVA) test which concludes that the category means are statistically different.

Table 26. Topography categories, corresponding annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | Percent of area having some row crop in rotation | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|---|
| 26.67- 66.00 | 27 | 89 | 8.9 | |
| 66.01-100.00 | 27 | 74 | 12.5 | |
| 100.11-147.00 | 32 | 76 | 19.6 | 22.24[a,b] |
| 147.01-273.95 | 27 | 68 | 27.3 | |
| Total | 113 | 77 | 17.2 | |

[a]Reject hypothesis that means are equal at 1.0 percent level of significance.

[b]All table values for F statistics from (23).

Results shown in Table 26 indicate that as the lay of the land becomes steep, soil losses increase on the average more than threefold. This would indicate that cropping rotations may be quite similar on all land in the sample area. Further examination of this hypothesis showed that the proportion of the farmland in each category which was currently under a rotation which involved an intertilled row crop at least one year out of six was, in fact, almost equal. The first category of the topography coefficients had an average 89 percent of its area under such a rotation. Area characterized by topography in category two averaged 74 percent rotations of this type, while category three was 76 percent under rotations containing some row crops. The land in the roughest topography class had 68 percent of its area supporting these rotations.

Analysis showing that existing rotation intensity is not altered corresponding to topography points out the first soil loss level determining factor. However, this is not a singular factor but rather a situation based upon other factors such as the remaining hypotheses.

Tenure status

A farm operator's tenure status might well affect actions relative to controlling soil erosion. Farm operators who are owners could be expected to be more attentive to soil erosion control than operators who rent. This may be due to pride of ownership, fear of lost future productivity, and belief that they alone reap benefits of erosion control investments rather than dividing these benefits with a landlord. If this hypothesis is true, then annual soil loss means for operator owners should be lower than the corresponding means for operators who are renters.

Two facets of tenure status can be studied from the sample. Tenure on headquarter farms and tenure on all land operated were both of interest to this study. Tenure for both headquarter farms and all acres operated consisted of full owners, full renters, and operators who both owned and rented some of the land in question. Table 27 shows the number of operators in each area for each classification with corresponding annual soil loss means. Also, in Table 27 are the results of an analysis of variance test used to determine if differences in the soil loss means were significant in a statistical sense.

Table 27. Operator tenure status, corresponding annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Headquarter farm tenure | | |
| Owner | 64 | 15.5 | |
| Renter | 47 | 19.8 | |
| Combination | 2 | 8.1 | 2.68[a] |
| Total | 113 | 17.2 | |
| | Total operation tenure | | |
| Owner | 39 | 15.6 | |
| Renter | 27 | 20.9 | |
| Combination | 47 | 16.4 | 2.06[b] |
| Total | 113 | 17.2 | |

[a]Reject hypothesis that means are equal at 10 percent level of significance.

[b]Reject hypothesis that means are equal at 25 percent level of significance.

The hypothesis that farm operators who have ownership interests in the farmland have lower levels of soil loss seems to be supported by the results in Table 27. Farm operators who were owners of their headquarter farms had average soil losses of 15.5 tons per acre per year, compared with the renter soil loss mean of 19.8 tons per acre per year. For the total tenure situation, farm operators who owned all the land they were farming averaged 15.6 tons per acre per year soil loss, compared with a mean of 20.9 tons annual soil loss for operators renting all land farmed. However, due to the large variance in annual soil loss means and the relatively small sample size, the analysis of variance conclusions are possibly not as concrete as one would like. In spite of this fact, the tendency is documented.

Further examination of this factor was accomplished by asking the renting farm operators questions concerning their leasing situation. Results of questions concerning expense sharing, and landlord attitude relative to erosion control, are presented in Table 28. These answers pertain to the headquarter farms only.

From Table 28, conclusions were that lease agreements and landlord concern for soil erosion control did not appear as explanations for the situation of higher soil loss on tenant-operated farms. Farms operated with leases that provide for tenant-owner sharing of soil erosion control practices are not maintaining soil loss levels significantly lower than those farms with this type of lease. Similarly, the tenant evaluation of his landlord's concern for erosion control on the particular farm in question did not help explain the difference between soil loss levels on rented

Table 28. Peculiars of leasing arrangements for tenant-operated sample farms, corresponding annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| *Expense sharing for erosion control* | | | |
| Lease provides for sharing expenses | 6 | 19.3 | |
| Lease does not provide for sharing expenses | 41 | 19.9 | .01[a] |
| Total number of renters | 47 | 19.8 | |
| *Tenant's evaluation of landlord's concern for erosion control* | | | |
| Landlord is concerned | 35 | 19.4 | |
| Landlord is not concerned | 12 | 20.8 | .12[a] |
| Total number of landlords | 47 | 19.8 | |

[a]Accept hypothesis that means are equal.

or owned farms. Farms on which landlords were judged concerned for the problem had average soil losses of 19.4 tons per year, compared with 20.8 tons annual soil loss on those farms with tenant evaluated nonconcerned landlords. The difference in these soil loss levels was statistically insignificant. Further examination of these particular aspects for the situation of differential soil loss levels between owner-operated and tenant-operated farms would be beneficial. This data would have to be gained using a larger sample size where more information on the leasing arrangement's effect upon land use and soil erosion control investments could be gathered.

Farm operators who are renters could be expected to be practicing cropping uses which involve more corn and soybean rotations because, in one manner or another, they split the farm income with a landlord. Proportions of different crops for tenant-operated and owner-operated farms are shown in Table 29. Also, in this table are the average topography indices for owned, rented, and combination headquarter farms.

Table 29. Mean topography coefficients and percent of acreage planted to row crop by tenure classification for 1974

| Category | Number | Topography coefficient | Percent of land planted to row crop |
|---|---|---|---|
| Owner-operated farms | 64 | 110.02 | 55 |
| Tenant-operated farms | 47 | 115.85 | 68 |
| Combination | 2 | 115.65 | 49 |
| Total | 113 | 112.55 | 58 |

Table 29 shows that there is very little difference in the lay of the land between tenant-operated and owner-operated farms in this sample. This result is very reasonable. This table also shows that tenant-operated farms in the sample in 1974 were maintaining 68 percent of their land area in row crop production, compared with 55 percent row crop production by area for owner-operated farms. This result supports the hypothesis that rented farms were operated with more intensive row crop rotations. This phenomenon increased soil loss levels upon these farms.

Length of tenure

The length of time that a farm operator has some control over management decisions for a farm was also hypothesized to affect actions relative to soil erosion control. A farm operator who plans to operate the same tract for some time into the future might be expected to make investments which improve the quality of the tract, or alternatively farm in such a manner as not to impair future productivity on the tract. Similarly, past tenure length was examined to see if this hypothesis had been substantiated from past actions.

Table 30 shows both past and future tenure length categories. The first hypothesis concerning future farm tenure seemed to have been upheld. Farm operators who expect to be operating the same farms in the future have lower soil loss means. Results for past length of tenure were not as consistent, but as length of previous tenure increased, the mean soil loss figure decreased. A problem encountered here was that the number of years on the same farm does not necessarily mean the operator had assurance of remaining on the farm at any particular time. Because of this problem, the expectation of tenure influence upon adoption of erosion control measures cannot be equated with years on one farm. Analysis of variance tests for the three different categories dealing with this hypothesis concluded that there were no significant differences in these means.

Table 30. Past operator tenure lengths for headquarter farms, future tenure expectations, corresponding annual soil loss means, and analysis of variance results testing for differences in soil loss means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Length of past tenure | | |
| Less than five years | 36 | 16.8 | |
| Five-ten years | 26 | 18.4 | |
| Eleven-sixteen years | 28 | 17.4 | .18[a] |
| Seventeen or more years | 23 | 16.1 | |
| Total | 113 | 17.2 | |
| | Expected future tenure | | |
| Expect to be operating headquarter farms in one year | 105 | 16.8 | |
| Do not expect to be operating headquarter farms in one year | 8 | 22.5 | 1.92[b] |
| Expect to be operating headquarter farms in five years | 96 | 17.0 | |
| Do not expect to be operating headquarter farms in five years | 17 | 18.1 | .14[a] |
| Total | 113 | 17.2 | |

[a]Accept hypothesis that means are equal.

[b]Reject hypothesis that means are equal at 25 percent level of significance.

Size of farm operation

Acreage operated by individual operators had effects upon soil erosion control efforts. It is possible that due to scale advantages, such as increased efficiency and easier finance abilities, operators who farm larger acreages could control soil erosion better than smaller operators. However, if it was true that larger operations are more specialized and this specialization was in the production of intertilled row crops, then soil losses on larger farms would be higher than on smaller farms.

Table 31 shows that the size of operation and soil loss levels seemed

Table 31. Size of farm operation, annual soil loss means, and analysis of variance results testing for differences in soil loss means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Size of headquarter farms | | |
| Less than 160 acres | 38 | 17.5 | |
| 160-200 acres | 46 | 18.5 | 1.03[a] |
| Over 200 acres | 29 | 14.6 | |
| Total | 113 | 17.2 | |
| | Total acres operated | | |
| Less than 240 acres | 27 | 17.9 | |
| 240-319 acres | 21 | 19.5 | |
| 320-479 acres | 34 | 18.7 | |
| 480-639 acres | 18 | 11.9 | 1.58[b] |
| Over 640 acres | 13 | 14.8 | |
| Total | 113 | 17.2 | |

[a]Accept hypothesis that means are equal.

[b]Reject hypothesis that means are equal at 25 percent level of significance.

to be negatively correlated. Examining both headquarters farm size and total number of acres operated pointed out this conclusion. Annual soil loss on the largest twenty-nine headquarter farms was 14.7 tons of soil lost per year, compared with a soil loss of 18.5 tons per acre per year for those farms of 160-200 acres. For total operation size, the largest thirty-one units averaged 13.1 tons per year soil loss, compared to a soil loss rate of 18.6 tons annual soil loss for the remainder of the sample. Analysis of variance tests for differences in the category means indicated no statistical difference in means on the headquarters farms. There did exist a statistical difference between the groups' soil loss means when all acres operated were considered. Once again the tendency of these means should not be disregarded due to the computational situation of large variance and small sample size. Further examination of this hypothesis with a larger sampe size would be beneficial.

Type of farm operation

Cash grain farms and livestock farms were hypothesized to show different levels of soil loss. A farm on which a large proportion of the acreage was maintained in permanent pasture of close grown hay crops to support roughage-consuming animals likely should had a much lower soil loss than a farm with a higher proportion of row crop acreage. Farm operators classified their farms as either cash grain farms or as livestock farms in the survey. Many farm operators felt that their operation was equal in emphasis so a combination category was formed. Additionally, there was one sample farm completely in a long-term soil bank program.

Table 32 shows that the hypothesis concerning the relationship

Table 32. Type of farm operation, annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| Cash grain | 33 | 16.2 | |
| Livestock farm | 64 | 16.7 | |
| Combination | 15 | 22.6 | 1.98[a] |
| Soil bank | 1 | 1.8 | |
| Total | 113 | 17.2 | |

[a]Reject hypothesis that means are equal at 25 percent level of significance.

between type of farm operation and soil loss levels did not hold true. At 16.2 and 16.7 tons annual soil loss, the cash grain and livestock classifications are very similar in level of erosion. Farms of the combination type had higher soil losses than either cash grain or livestock operation types with 22.6 tons annual loss. The one farm that is maintained in the soil bank illustrates very well what the effect of seeding down large acreages would have on soil loss levels.

The classification of farm operation type by the farm operators may have been self-defeating. For example, a farmer who fed a large number of cattle with his home-grown grain may have classified his operation as livestock because that was how the final sale of his commodities took place. The feed lot itself would likely cover less than five acres, and the rest of his farm may be planted in corn which would be potentially a high erosion risk. Because of this, the number of roughage-consuming animals, stock cows, dairy cows, sheep, and horses on each farm was hypothesized to vary inversely with soil loss levels. Examination of this hypothesis is presented in Table 33.

Table 33. Number of roughage-consuming animals, annual soil loss means, and analysis of variance results testing for differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| No roughage-consuming animals | 27 | 19.1 | |
| 1-50 roughage-consuming animals | 35 | 19.3 | |
| 51-100 roughage-consuming animals | 29 | 16.2 | 1.95[a] |
| Over 100 roughage-consuming animals | 22 | 12.7 | |
| Total | 113 | 17.2 | |

[a]Reject hypothesis that means are equal at 25 percent level of significance.

Table 33 does show that the number of roughage-consuming animals appears to be a factor which affected the level of soil erosion. Those farms with over 100 roughage-consuming animals did have substantially lower levels of soil loss. Farms with 51-100 roughage-consuming animals also had annual soil loss levels averaging 16.2 tons which was less than the sample mean. Farms which reported no roughage-consuming animals had annual soil loss means averaging 19.1 tons per acre. This compared quite unfavorably with the figure of 12.7 tons annual soil loss for those farms averaging over 100 roughage-consuming animals per farm.

Farm operator evaluation of soil erosion control situation

Membership in either a county soil conservation district or an organized watershed project was hypothesized to be a social factor affecting soil loss levels. A membership in either type of organization was hypothesized to affect lower levels of soil loss. This hypothesis was based on expectations that memberships of this type would indicate awareness of a soil erosion control problem and also exhibit willingness to act in a remedial manner. Table 34 presents the results of testing this hypothesis.

Table 34. Conservation organization membership, corresponding annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Soil conservation district membership | | |
| Member | 27 | 18.7 | |
| Not member | 86 | 16.7 | .70[a] |
| Total | 113 | 17.2 | |
| | Organized watershed membership | | |
| Member | 29 | 15.9 | |
| Not member | 84 | 17.6 | .49[a] |
| Total | 113 | 17.2 | |

[a]Accept hypothesis that means are equal.

The resulting soil loss mean averages were exactly contradictory to the hypothesized relationship for soil conservation district membership. Sample farm operators who claimed to be members of soil conservation districts had an estimated annual soil loss of 18.7 tons per acre, compared 16.7 tons annual soil loss for those farmers with no such membership. No examination of this observation appeared satisfactory in explaining why this occurred. Comparison of annual soil loss means for members of organized watersheds and nonmembers followed the hypothesized relationship more closely. Members of organized watersheds had annual soil loss levels which averaged 15.9 tons per acre. This soil loss means was lower than the soil loss level of 17.6 tons per acre per year for farm operators who were not members of an organized watershed.

Information concerning soil erosion control and the farm operator's estimation of the degree of the erosion problem for each headquarters farm were factors hypothesized to affect levels of soil loss. Each farm operator was asked to indicate how knowledgeable he personally felt concerning soil erosion control practices. It was expected that greater knowledge of soil erosion control practices would be directly related to lower levels of soil loss.

A relationship between a farm operator's evaluation of the seriousness of the soil erosion problem on the land he farms and soil loss levels was also hypothesized. Questions concerning the nature of this factor were difficult to judge. For example, given two farm operators who both estimate soil erosion to be a serious problem on their headquarters farm. One operator may feel this way because he is experiencing gully problems and may be substituting pasture and meadow crops for intertilled row crops as a change in land use. This operator would tend to have a low annual soil loss. The second operator may feel soil erosion is a serious problem because he knows that growing corn or soybeans on steep sloping fields results in potentially high levels of erosion. However, due to personal financial constraints, he feels that production of cash grain crops is mandatory for the survival of his farm firm. This operator realizes that high levels of erosion may be occurring on his farm, but he feels that this fact is an unavoidable consequence in the financial context of his particular farm firm. This operator would tend to have a high annual soil loss. Table 35 shows results of both information level and seriousness of problem question put to the sample farm operators.

Results for both hypotheses concerning operator information level and estimation of problem degree did not support any definite relation between these factors and levels of soil loss. Testing these hypotheses did, however, bear interesting conclusions. It seemed that the farm operators either were not able to accurately gauge the amount of soil they were losing annually or that the public norm of five tons annual loss was completely irrelevant. Also interesting was the fact that over 80 percent of the interviewed operators indicated that they were well-informed concerning soil erosion control practices; however, this group had existing soil loss levels of 17.5 tons annual loss which exceeds the sample mean of 17.2 tons annual soil loss.

Table 35. Evaluation of soil erosion control problem, corresponding annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Information level | | |
| Farm operator considers himself well-informed concerning soil erosion control practices | 91 | 17.5 | |
| Farm operator does not consider himself well-informed concerning soil erosion control practices | 22 | 15.7 | .45[a] |
| Total | 113 | 17.2 | |
| | Farm operator's estimation of degree of erosion problem | | |
| A major problem | 15 | 18.4 | |
| Somewhat of problem | 64 | 16.2 | |
| A problem which needs no action | 18 | 19.1 | .43[a] |
| No problem | 16 | 17.9 | |
| Total | 113 | 17.2 | |

[a]Accept hypothesis that means are equal.

## Age of operator

Age of farm operator was hypothesized to be a factor affecting levels of soil loss. Younger farm operators were thought to be more likely to be renters and also subject to more short-term financial liabilities dealing with family support and operational expenses. These circumstances would tend to cause more intensive cropping on land operated and an aversion for risks inherent in larger cattle operations which would utilize more roughage. Ages of the farm operators interviewed range from 22 to 81 years old. These ages are grouped into four categories and are presented in Table 36 with corresponding annual soil loss mean estimates.

Table 36. Age of farm operator, corresponding soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| Less than 35 years old | 20 | 17.3 | |
| 35-44 years old | 26 | 14.5 | |
| 45-54 years old | 40 | 19.0 | .85[a] |
| Over 54 years old | 27 | 16.8 | |
| Total | 113 | 17.2 | |

[a]Accept hypothesis that means are equal.

Conclusions pertaining to the age hypothesis were not clear. Farm operators over fifty-five years old have an estimated annual soil mean of 16.8 tons which is lower than the entire sample average. However, no consistent pattern seems to exist. All farm operators under forty-five years old had an estimated soil loss mean of 15.7 tons, compared to a mean soil loss of 18.1 tons for all operators over forty-five years old.

Financial factors

Financial constraints upon land improvement investments, along with current demands for each operator's cash flow, were hypothesized to affect levels of soil loss. Large levels of short-term debts and mortgage indebtedness certainly compete with investment in soil erosion control practices. Methods of acquiring ownership were examined to ascertain any possible effect this factor could have on soil loss levels. In addition, levels of gross farm income were grouped and corresponding soil loss means studied in an effort to correlate income and soil loss levels.

Table 37 contains the soil loss levels corresponding to methods of

Table 37. Financial factors, corresponding soil losses, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Farm acquisition method | | |
| Contract | 31 | 16.4 | |
| Mortgage | 17 | 16.4 | |
| Inherit | 4 | 8.9 | .68[a] |
| Other[b] | 12 | 14.3 | |
| Total owned | 64 | 15.5 | |
| | Debt restriction for farm owners | | |
| No debt restriction | 58 | 15.3 | |
| Debt restriction on farm improvements | 6 | 17.5 | .23[a] |
| Total owned | 64 | 15.5 | |

[a]Accept hypothesis that means are equal.

[b]Includes trade, cash, and combinations of contract, mortgage, and inherit.

acquiring ownership. In addition, this table examines soil loss levels for those farm owners who stated that their mortgage indebtedness was restricting investments in farm improvements. As shown by this table, there appeared to be little difference between soil loss on farms purchased with land contracts or mortgages. Farms which were inherited by the operators would likely be free of any investment inhibiting long-term debt and thereby conceivably could have lower soil loss levels. This relationship was exhibited as Table 37 shows, inherited farms have annual soil loss means averaging 8.9 tons. However, there were only four of these farms which caused this difference to be statistically insignificant. Therefore, further study is needed with an expanded sample in order to test this hypothesis more adequately.

Restrictions on farm improvement investments caused by land debt were acknowledged by six of the sixty-four headquarter farm owners. These six operators had average soil loss means of 17.5 tons per year, compared with the overall mean loss of 15.5 tons. Because there were only six of these operators, any conclusion drawn from this portion of Table 37 would be speculation. However, it is important to note that the fifty-eight farm owners who had no land debt restriction on farm improvements had mean soil loss of over three times the public policy norm.

Gross family income and levels of short-term debt were examined to determine if these factors affected soil loss levels. Short-term debts in this analysis were debts for operating expenses such as feed, seed, fertilizer, livestock, and machinery.

Table 38 shows the tests of these two hypotheses. Gross family

Table 38. Gross family income, short-term debts, corresponding soil losses, and analysis of variance results for differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| | Gross family income | | |
| Less than $25,000 | 30 | 17.1 | |
| $25,000-$40,000 | 26 | 18.6 | |
| $40,001-$60,000 | 28 | 19.3 | |
| Over $60,000 | 27 | 12.7 | 2.21[a] |
| No response | 2 | 31.3 | |
| Total | 113 | 17.2 | |
| | Level of short-term debts | | |
| No short-term debts | 39 | 18.3 | |
| $1-$15,000 | 40 | 17.5 | 1.27[b] |
| Over $15,000 | 34 | 15.4 | |
| Total | 113 | 17.2 | |

[a]Reject hypothesis that means are equal at 10 percent level of significance.

[b]Accept hypothesis that means are equal.

income and soil loss levels seemed to be negatively correlated. This would seem appropriate because operators with higher gross incomes would tend to be farm owners and also would be able to make soil erosion control investments. Farm operators with gross incomes over $60,000 in 1974 had annual soil loss means of 12.7 tons, compared to a sample average of 17.2 tons. All farm operators with incomes less than $60,000 had annual soil loss means averaging 18.6 tons. For similar reasons as the gross income hypothesis, it was expected that short-term debt levels would be positively correlated with soil loss levels. However, the exact opposite relationship was observed. Farm operators who reported no short-term debts whatever had an annual soil loss average of 18.3 tons per acre. Farm operators who had short-term liabilities of over $15,000 were losing soil at the annual rate of 15.4 tons per acre. Examining this relation further, it was hypothesized that perhaps those operators who had large short-term liabilities were larger farm operators who were using more credit money to run their farms. Of the thirty-four farm operators with short-term debts over $15,000, fifteen had gross incomes over $60,000 per year. The larger proportion of farm operators with high levels of gross income helped explain the lower soil loss levels for farms with high short-term debts. Seventeen of these operators owned their headquarter farms, two were combination owners and renters, and fifteen were renters. These proportions are extremely close to the composition of the entire sample, and this does not contribute any further explanation toward this relationship. Some of the indicated short-term debt may be financing for terracing or machinery used to apply conservation tillage practices. Both of these items would seem to reduce levels of soil erosion.

## Multiple Regression Approach for Explaining Levels of Soil Loss

Using the previously discussed factors which affect levels of soil loss as variables in a multiple regression framework enables this study to attempt a formulation of a soil loss function equation. Some modifications were made in this list of factors before any regression work was initiated. Added to the list of variables was an index of all animal units and a short-term debt per acre operated figure. Omitted from the list of variables were the length of tenure and level of farm operator information factors.

The reason for a multiple regression approach to estimating soil loss was an attempt to gauge how interactions between the hypothesized factors would combine to explain soil loss levels. Multiple regression approaches for explaining soil loss levels have been attempted in previous studies in this series.

Seventeen variables were used in the first equation examining soil loss levels. Factors incorporated into this equation were topography, size of headquarters and total operations, ownership of headquarters and total operations, type of farm operation, soil conservation district or watershed membership, total short-term debt, short-term per acre operated, total animal units, roughage-consuming animal units, and gross income levels. Dummy variables were used to show variations in tenure status, type of farm operation, and soil conservation district or watershed membership. All variables were regressed against soil loss levels on each headquarters farm. The seventeen variables representing these factors were:

$x_1$ = topography index,

$x_2$ = size in acres of total operation,

$x_3$ = size in acres of headquarters farm,

$x_4$ = total short-term debt,

$x_5$ = short-term debt per acre operated,

$x_6$ = total animal units,

$x_7$ = roughage-consuming animal units,

$x_8$ = gross income level in dollars,

$x_9$ = 1 if headquarters farm is owned
= 0 if otherwise,

$x_{10}$ = 1 if headquarters farm is rented
= 0 if otherwise,

$x_{11}$ = 1 if total operation is owned
= 0 if otherwise,

$x_{12}$ = 1 if total operation is rented
= 0 if otherwise,

$x_{13}$ = 1 if operation is cash grain farm
= 0 if otherwise,

$x_{14}$ = 1 if operation is livestock farm
= 0 if otherwise,

$x_{15}$ = 1 if operation is combination of cash grain and livestock
= 0 if otherwise,

$x_{16}$ = 1 if soil conservation district member
= 0 if otherwise, and

$x_{17}$ = 1 if organized watershed member
= 0 if otherwise.

The regression equation calculated with all seventeen variables was:

$$\text{Soil loss} = -11.7022 + .1x_1 + .0002x_2 - .0017x_3 + .0001x_4 - .02x_5 + .008x_6 - .025x_7 - .0001x_8 + 2.13x_9 + 4.81x_{10} - .73x_{11}$$

$$- .88x_{12} + 1.84x_{13} + 1.97x_{14} + 2.66x_{15} + 98x_{16} - 3.69x_{17}.$$

For this equation, the coefficient of multiple correlation was only .479 which indicated that intially this approach toward gauging interactions of the soil loss determinants was not overly successful. T-tests were performed to determine if the estimated regression coefficients were significantly different from zero. These tests showed that at the 10 percent probability level the coefficients for variables $x_1$ (topography), $x_4$ (short-term debt), $x_7$ (roughage-consuming animals), $x_8$ (gross income), and $x_9$ through $x_{11}$ (type of operation) were significantly different from zero.

An additional equation was tested with identical variables, except for variable $x_1$. A natural logarithm of the original topography index was substituted for variable $x_1$. The resulting equation was:

$$\text{Soil loss} = - 53.9 + 11.03x_1 + .0008x_2 - .0014x_3 + .00009x_4 - .02x_5 + .009x_6 - .03x_7 - .00009x_8 + 3.94x_9 + 6.95x_{10} - 1.06x_{11} - .71x_{12} + 18.79x_{13} + 20.22x_{14} + 27.33x_{15} + 1.99x_{16} - 3.32x_{17}.$$

This equation had a coefficient multiple correlation of .506 which compared favorably with the original equation but, however, was still not satisfactory. T-tests were again performed and identical conclusions obtained. Variables $x_1$, $x_4$, $x_7$, $x_8$, $x_9$, $x_{10}$, and $x_{11}$ had estimated regression coefficients which were significantly different from zero at the 10 percent probability level as was true in the previous equation.

Many other modifications of this basic equation were tried. In no case did the amount of variation in soil loss explained by this equation exceed 51 percent. Consequently, the multiple regression approach to developing a soil loss function as hypothesized in this study's model was a failure in the respect that the process by which causal factors are combined to generate a specific soil loss level could not be determined clearly. This was due to the situations of varying combinations of the hypothesized factors affecting soil loss levels and the previously underestimated factors endogenous to the farm firm.

This approach did indicate that perhaps the process of soil loss level determination was much more random in nature than hypothesized and indicated some strong nonfirm influences. This conclusion has significant implications for public policy agencies. In order to help determine if there is a large random component to soil loss level determination, a regression using only the topography variable was run. The original topography index was regressed against soil loss levels, and the resulting equation was:

$$\text{Soil loss} = 5.284 + .106x_1.$$

The estimated regression coefficient for variable $x_1$ is significantly different from zero at the 10 percent probability level. For this equation, the coefficient of single correlation is .29. This implies that almost 30 percent of the variation in soil loss levels can be explained by topography alone. This also implies that the part of the variation in soil loss levels explained by the economic and social factors was near 20 percent.

Difficulties with the multiple regression approach led to a different type of analysis in further efforts to explain the soil loss process. By ranking the soil loss levels and grouping the farms according to soil loss levels, four classes of soil losses were generated. By examining the characteristics of the farms which fell into each soil loss category, it was hoped that characteristics of success and failure in respect to soil losses could be pinpointed.

## Characteristic Farm Approach for Explaining Levels of Soil Loss

Annual soil loss levels ranged from 1.1 to 51.7 tons per acre for the 113 sample farms. Ranking of these soil losses allowed the partitioning of four subgroups within the overall sample. It was hoped that by examining the characteristics of the farms comprising these subgroups that factors affecting varying degrees of success or failure for soil erosion control could be determined.

Group one contained farms with soil loss means estimated at 1.1 to 9.9 tons annually. This group contained thirty-five farms or slightly less than one-third of the total sample. Group one was referred to as the low soil loss category in spite of the fact that twenty-seven farms within this group had soil loss levels exceeding the public policy norm of five tons per acre annual soil loss. The mean soil loss level for this group was 6.6 tons annual loss. Group two contained forty farms or 35 percent of the total sample. This category was referred to as the moderate soil loss group, and the mean soil loss was 13.7 tons per acre per year. Groups three and four contained twenty and eighteen farms, respectively. These groups were the high soil loss categories. Category three was referred to as the high soil classification and had a mean soil loss of twenty-four tons per acre annually. In order to be classified in the very high soil loss category, group four, a farm had to have a minimum soil loss of 29.5 tons annual soil loss with the mean of this group being over seven times the public policy norm at 37.8 tons per acre annual soil loss. Examination of various characteristics of farms comprising each group are presented in Table 39.

This examination of characteristics of farms with varying degrees of success or failure with soil loss levels provided some insights for this study's soil loss model. Topography was correlated with soil loss as the higher soil losses occurred on the steeper ground. This result supports the conclusions shown in Table 26. Headquarter farms with low soil loss levels appeared to be larger in size than those farms with higher soil loss levels. Operation size also appeared to be negatively correlated with soil loss when the total operation is considered. The mean difference in total operation size from the low soil loss group to the very high soil loss group was 175 acres. Results from this type of analysis supported the tendency of larger farms to have lower levels of annual soil loss as indicated in Table 31.

Tenure status also appeared to be significantly related to soil loss levels. For both headquarters farm and total operation area, the highest proportion of total owners fell in the low soil loss category. Similarly, and especially important in the total operation case, the largest percentage of renters falls in the very high soil loss group. In this very high soil loss group, 33 percent of the farm operators rented every acre they

Table 39. Characteristic farm approach for soil loss level explanation

| Characteristic | Soil loss category: Group 1 low | Group 2 moderate | Group 3 high | Group 4 very high |
|---|---|---|---|---|
| Number of farms | 35 | 40 | 20 | 18 |
| Average soil loss mean | 6.6 | 13.7 | 24.0 | 37.8 |
| Topography index[a] | 81.58 | 99.81 | 133.48 | 173.57 |
| Headquarters farm size | 194 acres | 194 acres | 180 acres | 162 acres |
| Headquarters tenure | 69%-own<br>26%-rent<br>6%-both | 50%-own<br>50%-rent | 60%-own<br>40%-rent | 44%-own<br>56%-rent |
| Total operation size | 522 acres | 370 acres | 376 acres | 347 acres |
| Total operation tenure | 46%-own<br>11%-rent<br>43%-both | 30%-own<br>30%-rent<br>40%-both | 30%-own<br>25%-rent<br>45%-both | 28%-own<br>33%-rent<br>39%-both |
| Length of tenure on headquarters farm | 11 years | 11 years | 11 years | 9 years |
| Expected five-year operation | 86%-yes<br>9%-no<br>6%-D.K. | 88%-yes<br>10%-no<br>3%-D.K. | 80%-yes<br>5%-no<br>15%-D.K. | 89%-yes<br>6%-no<br>6%-D.K. |
| Type of farm operation | 20%-cash grain<br>69%-live-stock<br>9%-both<br>3%-soil bank | 40%-cash grain<br>48%-live-stock<br>13%-both | 45%-cash grain<br>50%-live-stock<br>5%-both | 6%-cash grain<br>61%-live-stock<br>33%-both |
| Soil conservation district member | 26%-yes<br>74%-no | 20%-yes<br>80%-no | 15%-yes<br>85%-no | 39%-yes<br>61%-no |
| Organized watershed member | 29%-yes<br>71%-no | 25%-yes<br>75%-no | 25%-yes<br>75%-no | 22%-yes<br>78%-no |

[a]The index numbers increase as the lay of the land becomes steeper.

Table 39 (Continued)

| Characteristic | Soil loss category Group 1 low | Group 2 moderate | Group 3 high | Group 4 very high |
|---|---|---|---|---|
| Operator's mean age | 46 years | 45 years | 45 years | 49 years |
| Operator's mean gross income | | | | |
| Less than $25,000 | 26% | 28% | 40% | 17% |
| $25,000-$40,000 | 14% | 28% | 35% | 17% |
| $40,001-$60,000 | 26% | 20% | 15% | 44% |
| Greater than $60,000 | 34% | 23% | 10% | 17% |
| No response | | 2% | | 6% |
| Operator receiving government assistance for erosion control | 26%-yes 74%-no | 13%-yes 87%-no | 10%-yes 90%-no | 11%-yes 89%-no |
| Mean short-term debt for operation | $13,103 | $15,060 | $11,550 | $26,611 |
| Mean short-term debt per acre per farm[b] | $28.92 | $44.26 | $35.48 | $48.81 |
| Mean number of roughage-consuming animals[c] | 101 | 64 | 58 | 33 |

[b]This figure is the mean of the short-term debt means for each farm in each group.

[c]Includes stock cows, dairy cows, sheep, and horses.

were operating. Length of past tenure on headquarter farms and expected operation five years into the future in this analysis did not vary significantly among the different soil loss groups. Results of this analysis concerning tenure characteristics supported the results shown in Tables 27 and 30 of this report.

Additionally, the amount of gross income appeared to be a factor which affected levels of soil loss. Group one of low soil loss contained the highest percentage of farm operators earning over $60,000 gross in 1974. Results of the hypothesis that income levels shown in Table 38 affect levels of soil loss were supported by this analysis.

Roughage-consuming animals again appeared to mean more acreage not in intertilled crop production and thereby were negatively correlated with soil loss levels. Farm operators characterized in the low soil loss category had an average number of roughage-consuming animals three times the number of those farms in the very high soil loss group. Results displayed in Table 33, which show that numbers of roughage-consuming animals are negatively correlated with soil loss levels, were supported by this analysis. This fact causes further doubts about the methods used to gauge farm operation types through the survey procedure.

This characteristic farm approach toward explaining soil loss levels also pointed out some factors which did not significantly affect levels of soil loss. Type of farm operation, membership in a soil conservation district or organized watershed, operator's age, and short-term debt per acre per farm did not vary greatly among the groups. A better method of defining farm operation type and an expanded sample size would be necessary to more critically examine these factors. The hypothesized relationship between operation type and soil loss levels, shown in Table 32, was not supported by this analysis while Tables 34 and 36 which deal with organization membership and age were supported by this analysis. The portion of

Table 38 dealing with levels of short-term debts was supported by this analysis.

Summarizing this analysis, it appeared that larger farm operators, who tended to own most of the land they farm, have high gross incomes, farm land which is less rolling than average for the area, and keep above average numbers of roughage-consuming animals, would tend to have lower soil loss levels than operators without these characteristics.

All subsequent analysis of soil erosion control obstacles and determining factors have not produced a definitive description of the exact workings for the hypothesized soil loss process model. Rather, this analysis and examination of obstacles for soil erosion control obstacles has shown that perhaps more of the soil loss level determination is random in nature than previously thought. This specific characteristic of the soil erosion control problem which directly confronts public policy action is based upon the conclusion of this study that soil erosion is held to be by many farm operators an unavoidable consequence of production. By this conclusion, it is maintained that soil erosion is a consequence of production rather than a cost of production because to the individual farm operator the cost involved may be nonconsequential. Unless soil erosion decreases an operator's profit margins due to decreased productivity or otherwise increasing his operation cost, he may well be indifferent to off-site sediment and nitrate pollution problems. This conclusion is drawn in response to the exhibited large proportion of randomness present in the soil loss levels for the sample farms. This conclusion is supported by the situation of erosion's effect on yields for Western Iowa as shown in Table 40. Data

Table 40. Corn yields from research watersheds at Treynor, Iowa, on eroded and uneroded Monona silt loam[a]

| Soil category | Number of samples | Corn yield in bushels per acre | | | | |
|---|---|---|---|---|---|---|
| | | 1968 | 1969 | 1970 | 1971 | Average |
| Monona silt loam | 25 | 110 | 158 | 114 | 133 | 129 |
| Monona silt loam, eroded | 19 | 114 | 153 | 119 | 123 | 127 |

[a](21, p. 210).

from the Iowa State University Experiment Farm at Treynor, Iowa, in Pottawattamie County, makes up this table. Table 40 shows that the reduction in yields due to erosion is not substantial for this area and thereby may be considered nonconsequential by many farm operators. This situation is unique to the loess derived soils which in Iowa make up only four million of the over twenty-five million acres of cropland and account for approximately 15 percent of the potential crop production in the state. However, a conclusion of this sort is significant for public policy makers because the formation of ameliorative policies for the problem of soil erosion control is made more difficult by operator attitudes of this type.

## Interrelationships Among Causal Factors and Soil Loss Level Determination

Evaluation of both farm operator obstacles toward specific soil erosion control practices and individual hypothesized causal factors affecting levels of soil loss have shown two major areas in which combinations of causal factors are important. These areas are defined by combinations of the individual causal factors. A first concern for soil erosion control is the direct competition between soil erosion control efforts and individual farm operation economic considerations such as profit maximization and competing demands for the operation's cash flow. This concern involves profit maximization in the standard economic sense of total revenue minus total cost and also includes the concept of maximization in the sense of maximizing utility from all sources of income. This utility maximization occurs for individual farm operators through intrinsic computations of both long- and short-run benefits and constraints derived through the farm firm income.

The second area where effectual factors are interrelated deals with information levels of individual farm operators. This concern is multifaceted in nature. Examination of the data previously presented in this report will support the conclusion that either farm operators are not able to quantify that amount of soil loss existing on their farms or that the public policy norm which exists by law is totally irrelevant and for any practical purpose does not exist. Additionally, there exist information problems relative to the utilization of soil erosion control practices necessary to control soil erosion near the soil loss norm level. There also exist some farm operator feelings that public policy agencies are not functioning in their best interests which makes operator agency cooperation more difficult.

More detailed examinations of interrelations among factors which affect soil loss levels will now be presented.

Soil Erosion Control and Intrafirm Economic Competition

The conclusion that soil erosion control competes with individual farm profit maximization and thereby affects soil loss levels is based upon several observed phenomena. Observations from Tables 27, 31, 38, and 39 of this report have shown that amounts of gross income, farm operation size, and operator tenure status all are related to soil loss levels. These factors all contribute to the argument that soil erosion control efforts compete with demands for alternative income uses. Farm operators with gross incomes over $60,000 a year were shown in Table 38 of this report to have the lowest average annual soil loss levels. These farms had annual soil loss means averaging 12.7 tons, compared to the sample average of 17.2 tons. This fact indicates that for levels of gross income less than $60,000, soil erosion control efforts face more effective competition with demands for alternative uses of cash flow.

High levels of gross income appear to be related to tenure classification. For the twenty-seven farms indicated in Table 38 with more than $60,000 gross income, nineteen of the headquarter farms were operated by their owners. These farms also appeared to be larger units in the sample. The twenty-seven operations with greater than $60,000 gross income had headquarter farms averaging 240 acres and a total operation average of 715 acres. These figures compare with sample averages of 172 acres for headquarter farms and 415 acres for total operation.

Tenure status was shown to affect the intensity of land use in Table 29. The fact that on tenant-operated farms all profits are divided is certainly an influence for this situation. This also illustrates competition between the firm's economic considerations and soil loss level determination.

Analysis of the soil loss levels and corresponding income, tenure, and operation size factors contribute to the arguments concerning competition between soil erosion control efforts and demands for uses of operation cash flows. This competition appears to be less for those operators with larger incomes who tend to be owners and large operators.

Additionally, farm operator obstacles for individual soil erosion control practices contain a high percentage of objections on grounds that these practices would reduce profits for the tract which they were proposed. Time series data concerning specific cropping uses within the Ida-Monona-Hamburg Soil Association area show that substitution of high demand intertilled row crops for close grown crops and pasture has been occurring throughout the entire series length of twenty-six years. Investment preferences of the sample farm operators were examined by this study. These preferences also indicate competition between soil erosion control and economic variables. Each of these phenomena will now be examined more thoroughly.

Profit obstacle for soil erosion control practices

By presenting the two type soil erosion control plans, as done in this study's interview process, it is possible to pinpoint obstacles for the two dominant erosion control techniques. As the situation in the study area now exists, relative to soil loss levels, there are only two methods of erosion control which could bring soil loss levels to the public policy norm. These practices are terracing of intertilled acreage or land use changes reducing the proportion of intertilled row crop acreage. Specific farm operator obstacles for both these practices have been presented in Tables 9 and 15, respectively.

Examination of Tables 9 and 15 shows that incidence of obstacles relating to reduction in profit levels and competition with alternative fund uses is quite high. Eighty percent of those farm operators who objected to that amount of terracing which would hold soil loss to the policy norm stated that they would prefer to use their present income for purposes other than soil erosion control. Of the farm operators who objected to terracing, 64 percent stated that they thought that the proposed terracing would reduce total profits on their headquarter farms. Other obstacles dealing directly with competition between profit levels and soil erosion control are installation costs and land requirements for terracing. These obstacles were indicated by 38 and 17 percent of those operators objecting to terracing, respectively.

Objections toward the second major soil conservation technique of reducing acreages of intertilled row crops also indicated a sharp competition between profits and reducing levels of soil loss. Of those farm operators objecting to the vegetative rotations, 75 percent stated that they objected to the proposed rotations because they would reduce profit levels on the headquarters farm. Directly related to this obstacle were the additional obstacles of these rotations containing too much meadow crops and not enough cash grain crops. Meadow crops are here viewed as less profitable to the farm operations.

Obstacles for terracing and vegetative rotations have substantiated the conclusion that soil erosion control is competing with profit maximization and also with other demands for each farm operator's cash flow. Obstacles for these practices are critical because of the importance of these erosion control techniques, but not of the overall profit related obstacles for all erosion control practices can be made. For all of the dual plans, there were 1,111 recommended soil erosion control practices on which obstacles were presented in Chapter III of this report. For these 1,111 recommended practices, there were 1,285 stated obstacles. The number of obstacles within the total group which dealt with the reduction of profit directly, increasing costs of production, or costs of recommended practices numbered 365. Thereby, over 28 percent of all obstacles for the recommended soil erosion control practices indicated competition between controlling soil loss levels and intrafirm economic considerations.

<u>Changes in the sample area cropland uses</u>

This series of soil erosion control studies is now in its twenty-sixth year. Since 1949, American agriculture in general has been experiencing many changes and economic instabilities as an industry. The movement of labor out of farming and the increasing capital intensiveness of farm operation, the continual growth in farm size, and specialization of farm type are examples of the change in farm operation during this period. These changes have been made in response to what have been viewed as economic determinants in a long-run economic context. Another of the changes in the farm sector which pertains directly to this study is the shift in cropping uses exhibited in the study area. As shown in Table 41, the composure of the cropping situation has changed during the period spanning this series. In percentage terms, the portion of the ten-county sample area which was planted to corn was identical

Table 41. Major crop acreages for the ten-county sample area for 1950, 1960, and 1970[a]

| | Number of acres and year | | | | | |
|---|---|---|---|---|---|---|
| Crop | 1950 | Percent of total | 1960 | Percent of total | 1970 | Percent of total |
| Corn | 1,419,175 | 34 | 1,752,431 | 41 | 1,414,273 | 34 |
| Soybeans | 104,745 | 2 | 239,788 | 6 | 548.170 | 13 |
| Oats | 843,521 | 20 | 504,709 | 12 | 201,828 | 5 |
| Wheat | 105,068 | 3 | 50,587 | 1 | 14,452 | 0.3 |
| Hay | 392,825 | 9 | 338,930 | 8 | 211,924 | 5 |
| Pasture | 928,376 | 22 | 770,072 | 18 | 731,039 | 17 |
| Total ac. in farms | 4,202,571 | 100 | 4,197,369 | 100 | 4,109,787 | 100 |

[a](11, 1950; 11, 1960; 11, 1970.)

for 1950 and 1970. However, the factor which is caused by an economic demand and which directly affects soil loss levels is the increase in soybean acreage. During the twenty years from 1950 to 1970, soybean acreage increased by 443,425 acres in the sample area. This fact, in addition to the steady corn acreage, raised the proportion of the sample area which was planted in intertilled row crop from 36 percent in 1950 to 48 percent in 1970. Table 41 also shows that the combined acreage of oats, wheat, and hay crops declined from 1,341,414 acres to 428,204 acres during this twenty years.

The observed long-run changes in cropping patterns for the sample area were unanimously in a direction which increases soil loss levels. A larger proportion of intertilled row crops involves a much higher erosion risk. For the sample farms, the average soil loss on fields which contained some row crop in the rotation was 22.3 tons annual loss. This includes land under rotations which varied from continuous row crop to rotations which had row crop only once in six years. Contrasting this situation was the soil loss on all land in meadow crops, hay, wheat, and pasture land. From the headquarters farm data, land under this type of cropping pattern averaged 2.0 tons annual soil loss. The increase in the proportion of the sample area planted to corn or soybeans was thereby surely increasing soil loss levels. This effect was magnified on tenant-operated farms as shown in Table 27.

Changes in the proportion of land from the sample farms in various cropping uses are presented in Table 42. The proportion of the sample area in 1974 planted to row crops was almost double that proportion

Table 42. Percent of land in various uses on a sample of farms in Western Iowa, 1949, 1952, 1967, and 1974

| Land use | Percent of land | | | |
|---|---|---|---|---|
| | 1949 | 1952 | 1957 | 1974 |
| Row crops[a] | 37.9 | 36.7 | 31.5 | 57.6 |
| Small grains[b] | 22.7 | 23.4 | 20.7 | 7.8 |
| Meadow | 17.0 | 17.1 | 25.0 | 6.3 |
| Permanent pasture | 17.2 | 16.6 | 12.9 | 20.5 |
| Other[c] | 5.2 | 6.2 | 9.9 | 7.8 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

[a]Corn or soybeans.

[b]Oats, sorghum, or wheat.

[c]Roads, lots, wasteland, and an air strip.

observed in 1957. The proportion of the sample area in the less erosive cropping uses, small grains, meadow, and permanent pasture, had declined from 58.6 percent in 1957 to 34.6 percent in 1974. The discontinuing of the Soil Bank and Acreage Reserve Programs was partially responsible for this change over time. However, the same direction of change would have been caused by price changes over time.

Long-run economic variables which have determined the observed changes in cropping patterns have been intensified since 1973, due to high cash grain prices and volatile livestock prices. This price situation has caused more favorable profit margins and less uncertainty in the production of cash grain crops relative to livestock production. In general as cash grain prices rise, and the marginal value product of each unit of land increases, production of cash grain crops on land previously held in other uses will be initiated. These additional land inputs come from that land reserve on which production of corn or soybeans had previously been judged unprofitable. This phenomenon is shown in Table 41. As shown in Table 43, twenty-six of the farm operators from the sample indicated that they increased production of corn and soybeans in 1974 on steep sloping land due to high cash grain prices in 1973. These twenty-six operators represented 23 percent of the sample and soil loss levels on these farms were estimated at 21.9 tons annual loss, compared to an estimate of 15.8 tons annual soil loss for those operators who did not increase corn and soybean acreage in 1974 because of high cash grain prices in 1973.

Table 43. Planting reactions on steep sloping land to 1973 high cash prices, corresponding annual soil loss means, and analysis of variance results testing differences in means

| Category | Number | ASLM (T./Ac./Yr.) | Calculated F for ANOVA |
|---|---|---|---|
| Did not increase acreage of corn or soybeans in reaction to high cash grain prices in 1973 | 87 | 15.8 | 6.19[a] |
| Did increase acreage of corn or soybeans in reaction to high cash grain prices in 1973 | 26 | 21.9 | |
| Total | 113 | 17.2 | |

[a]Reject hypothesis that means are equal at 2.5 percent probability level.

Nationally, the SCS has estimated that nearly one-half of the 9.5 million acres of land put into new cash grain production in 1974 was subject to a severe erosion hazard (13). It is true that as shown in Table 40 that for the medium to deep loess derived soils of the Ida-Monona-Hamburg Soil Association, this situation may not seriously affect productivity levels on land brought into production. However, on even a statewide scale, this particular area represents less than 16 percent of the total cropland area and is directly countered by an equal area of cropland subject to severe erosion damage and substantial loss of productivity (21). Nationally, the medium to deep loess soil deposits are far less important in terms of area as they are found only in southwestern Iowa, northwestern Missouri, and parts of Illinois.

Loss of food-producing capability is only part of the overall problem. Increased sediment loads, gullying, stream turbidity, and nitrate pollutants are equally as important consequences of increased soil erosion levels caused by economic determinants.

The observed situation where acreage of corn and soybeans combined has increased relative to other crops is caused by economic demands. During the last twenty-five years, the production of soybeans in this area has increased due to profit incentives. Soil loss levels are increasing in response to these profit incentives. Changes in cropping patterns which tend to increase soil losses were perhaps the most single clear-cut manifestation of the interrelationships between economic considerations and soil loss level determination.

Investment preferences and soil erosion control efforts

Priorities in investment alternatives were examined through the interview schedule in order to determine the farm operators' attitudes toward soil erosion control investments. If farm operators indicated investment priorities which ranked higher than soil erosion control practices, this would show effective competition existing between alternative demands for investment funds.

When asked in general whether each farm operator considered soil erosion practices to be a good investment, only four of the 112 operators that answered the question stated that they did not consider soil erosion control practices to be good investments.

Each farm operator was also asked to state his first and second investment priorities. These investment rankings negate the positive responses toward investments in soil erosion control. Table 44 shows that only four of the 113 farm operators listed some type of conservation item as a first investment priority, and only seven operators indicated an investment of this type as their second priority. Twenty-eight of the farm operators could not think of an existing viable second investment priority. Of these twenty-eight operators, three indicated conservation practices as a first investment priority, and every single operator indicated that he considered soil erosion control practices to be in general good investments. This fact means that at a minimum, twenty-five operators from the sample indicated that soil erosion control should be a good investment; however, they would not actually invest in such at all. Further, Table 44 points out that of the 113 sample operators, only eleven

Table 44. Investment preferences for sample farm operators

| Investment category | Number of farm operators |
|---|---|
| *First preference* | |
| Off-farm investments | 7 |
| Grain, corn, crops, beans | 14 |
| Land | 37 |
| Livestock | 34 |
| Conservation practices | 4 |
| Miscellaneous | 9 |
| Do not know or no response | 8 |
| Total | 113 |
| *Second preference* | |
| Off-farm investments | 9 |
| Grain, corn, crops, beans | 17 |
| Land | 2 |
| Livestock | 38 |
| Conservation practices | 7 |
| Miscellaneous | 12 |
| Do not know or no response | 28 |
| Total | 113 |

consider soil erosion control investments to effective competition with alternative investment choices. Over 90 percent of the sample farm operators choose alternative uses for their investment funds. Therefore, soil erosion control efforts again were judged in competition with intrafirm economic variables.

Interrelations between the factors of profit obstacles to proposed conservation practices, levels of gross income, farm tenure, farm size, price induced land use changes, and investment preferences were based upon a common denominator. The common element which causes all these factors to affect soil loss level was the situation of competition between intrafirm economic variables and soil loss levels. Decreasing these factors' impact upon raising soil loss levels through public policy actions cannot break down the interrelationships amongst these factors. Farm tenure certainly has an effect upon income levels, farm size, operator ability to make land use changes, and investment preferences. And all other arrangements of these factors contain similar interrelationships.

## Soil Erosion Control and Farm Operator Information

Estimating farm operator information levels concerning the soil erosion control problem was possible through the study's interview process. The conclusion that farm operators within the sample area were either not able to quantify the quantities of soil loss on their farms or that the public policy norm was irrelevant to the operators is based upon several observed phenomena. These phenomena within the different facets of the information problem are examined. The interrelationships of these information factors would increase soil loss levels.

### Information obstacles for soil erosion control practices

The technique of presenting two types of soil erosion control plans, which allowed this study to isolate obstacles for the major erosion control techniques which dealt with economic considerations, also will allow isolation of obstacles which deal with operator information problems. Consideration of the amounts of erosion control practices necessary to hold erosion levels to the public policy norm involve decisions on each operator's part to what level he would hole erosion on his farm(s). If a farm operator decides that the public policy norm is too severe, then the observed obstacles of disapprovement of recommended quantities, failure to see need, and contradiction of established farming methods occur. These obstacles, therefore, are related to an information gap concerning the public policy norm and farm operator's individual evaluation of this norm.

Examination of Tables 9 and 15 shows that obstacles of this type for the dominant soil erosion control practices of terracing and vegetative rotations were extremely frequent. Of the farm operators objecting to terracing, 89 percent disapproved of that amount of terracing required to bring soil losses on their headquarters farm to the level of the public policy norm. An identical occurrence of the obstacles where farm operators failed to see the need for recommended practices or that these practices violated existing farming customs was registered by 78 percent of those operators who objected to terracing. Additionally, 11 percent of those operators objecting to terracing did not feel their land was steep enough to merit terraces which is also an information problem.

Obstacles for the vegetative rotations necessary to hold soil losses to the public norm follow a similar pattern. As shown in Table 15, 96 percent of those operators objecting to these rotations objected to the amount or kind of rotation. Also, 79 percent of those operators objecting to these rotations objected because they felt their existing farming methods would be contradicted by avoiding high soil losses in this manner.

Obstacles for the two practices of terracing and vegetative rotations have shown the existence of an information gap between farm operator's estimation of an effective soil loss norm and the public norm. Information obstacles for these two dominant erosion control practices were of critical importance, but similarly to the profit obstacles, the overall importance of information obstacles was also gauged. All of the dual plans contained a total of 1,111 recommended soil erosion control practices. For these recommended practices, there were 1,285 stated obstacles of which 632 dealt with failure to see need, disapproval of recommended amount or kind, violation of established farming methods, or other information deficiencies. Information concerning the nature of the combination of soil erosion control practices necessary to hold soil loss to the public norm thereby accounted for over 49 percent of all observed obstacles for the soil erosion control plans presented.

Farm operators were questioned during the interview about the "1971 soil loss limits laws" (3, 4). The statute (467A) charges commissioners of the 100 Iowa soil conservation districts with establishing and administering regulations limiting rates of soil loss in each district equal to or less than five tons per year (12). Table 45 shows that as of 1974, eighty-three of the sample farm operators (74 percent) were not aware of this law. Farm operators who were not aware of this statute had average annual soil loss levels of 18.0 tons per acre, compared to the remaining operators' average loss of 14.8 tons. More illuminating was the situation concerning operator attitudes toward this law. Of the thirty farm operators knowledgeable of the law, nineteen approved of the statute.

Table 45. Farm operator knowledge and attitudes toward 1971 soil loss limits laws

| Category | Number | ASLM |
|---|---|---|
| Aware of law | 30 | 14.8 |
| Not aware of law | 83 | 18.0 |
| Total | 113 | 17.2 |
| | Attitude toward law | |
| Approve | 19 | 13.9 |
| Disapprove | 7 | 15.9 |
| Indifferent | 4 | 16.9 |
| Not aware | 83 | 18.0 |
| Total | 113 | 17.2 |

However, these operators were maintaining annual average soil loss means of 13.9 tons or almost three times the level regulated by the law. This indicates clearly the situation of farm operators being unable to quantify soil loss levels for their farms. This inability is conducive to high soil loss levels.

## Changes in Causal Factors Over Time

This study's analytical techniques have documented the existence of causal factors which affect soil loss levels. Steep topography, tenant tenure, small farm size, low levels of gross income, and few roughage-consuming animals all are factors which tend to increase rates of soil loss. Examination of operator obstacles to the soil erosion control practices indicated that economic competition between soil erosion control practices and intrafirm economic variables along with operator information obstacles also increased rates of soil loss.

Blase concluded in 1957 that topography, farm size, age of operator, and number of roughage-consuming animals were causal factors which effected soil loss (1, pp. 97, 229-30). Additionally, his analysis of obstacles for the proposed soil erosion control practices showed that obstacles of (1) alternative needs for income, (2) failure to see need for recommended practices, and (3) dislike of proposed field and road layout, combined with topography to increase soil loss levels (1, p. 104-105).

Topography, farm size, and numbers of roughage-consuming animals as soil loss level determining factors are similar conclusions for Blase's study and this current study. The significant obstacles from Blase's study dealing with alternative uses for income and failure to see need for recommended soil erosion control practices also correspond directly with this study's conclusions about intrafirm economic competition and operator information problems. Operator's age, dislike of proposed field and road layouts, and levels of gross incomes appear to be changes in significant factors. However, Blase did not directly consider the effects of gross incomes upon soil loss levels, and his conclusions dealing with the alternative needs for available income obstacle is judged a substitution for documentation of this factor. Operator's age and objections to proposed field and road layouts were examined by this study and were not considered significant causal factors for soil loss determination.

The fact that the factors which determine soil loss levels have not changed radically from study to study do not justify condemnation of existing soil erosion control policies or agencies concerned with these policies. Rather, this situation documents the relative strength of these factors over time in the context of increasing soil loss levels as shown earlier in this study.

## Utilization of Conclusions in Soil Erosion Control Policy

Implications and conclusions drawn from this study's reporting of the soil erosion control situation have been used in determination of soil erosion control policy. Both federal and state public policy agencies concerned with soil erosion control now have policies backed by statute and appropriations with objectives of maintaining soil productivity, decreasing levels of soil loss, and minimizing downstream nuisances due to sediment transfer. Examination and evaluation of specific laws and existing programs designed to accomplish these objectives is beyond the scope of this study. Rather, this study forms a basis for such an examination and evaluation of existing policies. Policies suggested by this study are general in nature and certainly should be overlapping with existing public policy efforts.

A conclusion that a portion of this study's soil loss level determination model is undefinable has been cited and reasons for this given. However, this study has also ascertained factors which affect soil loss levels, either positively or negatively. Encouragement of success elements and discouragement of failure elements should be the incentives for soil erosion control policies. Chapter V discusses some alternatives.

# CHAPTER V. OVERCOMING OBSTACLES TO EROSION CONTROL

Farm firms like other private firms, tend to maximize profits given the resources under their control. This tendency provides criteria for the need and nature of public policy actions. No public policy problem need exist when individual interests of profit maximization coincide with public interests. However, if market conditions, differential public and private resource use objectives, or instituional constraints, lead individual firm operators to behave in a manner judged in conflict with the public interests, governmental policies may be designed to reconcile the conflicts. Public policies regarding use of land resources have evolved over the history of the states and nation (8, 25).

Soil loss levels for the Ida-Monona-Hamburg Soil Association represent a situation where in estimated soil losses exceed the permissible soil loss goal set by public agencies in behalf of public interests. Furthermore, estimated soil losses in 1974 have increased by 22 percent since 1957. Because levels of soil losses conflict with the public goal, attention should be directed toward both 1) an examination of the public soil loss goal to determine whether or not the public interest has been defined correctly, and 2) reasons for the disparity between public and private interests. This type of policy strategy has been proposed by Penn (19, p. 233).

Three alternatives exist for resolving the problem of bringing existing soil losses and the permissible soil loss goal closer together. These alternatives include 1) reevaluation of the permissible soil loss goal, 2) reducing soil losses, and 3) combinations of the two.

Some reevaluation of the public soil loss goal appears justified because: 1) farm operators indicated in 1974 their individual soil loss goals were threefold greater than the public norm (Table 6), and 2) the Ida-Monona-Hamburg Soil Association has unique soil properties which qualifies erosion impact upon crop production (Table 40).

Calculation of soil loss goals for the sample farm operators has shown that these operators do not feel they can or should reduce soil losses to the norm level. Two influential sets of factors contribute to this problem of goal evaluation. Firstly, some farm operators do not feel that they should be responsible for the entire cost of achieving the public interest for soil erosion control. Costs for achieving the public soil loss goal are potentially increased by 1) capital expenditures for erosion control measures, and 2) decreases in net income associated with less intensive crop rotations or with erosion control structures. Secondly, during the early 1970s, several inducements were influencing farmers to produce larger grain crops. These inducements included U.S.D.A. encouragement, increasing American feedgrain exports, concern for rates of domestic food price inflation, and higher cash grain prices. These influences support a reevaluation of the public soil loss goal in consideration of effects that an expansion on both intensive and extensive margins of cultivation have upon soil loss levels (Table 43). Thus at least a portion of the gap between farm operator goals (average 14.5 T./Ac./Yr.) and the public goal (5 T./Ac./Yr.) might be explained by the turbid influences being promulgated by various governmental agencies concerned with various facets of increased agricultural production.

Research which attempts to delineate, explain, and resolve the differences between public and private soil loss goals is necessary in considering public policy options. Such research is needed to suggest and resolve trade-offs between expanding feed grain production and the erosion of soil resources.

Possibilities for reducing soil loss levels involve the identification and mitigation of obstacles for soil erosion control. This study has identified certain obstacles to soil erosion control (Chapter IV). These obstacles, in turn, suggest certain remedial measures. Policy alternatives are available which can represent and protect both the public and private interests concerning soil loss levels. Possible policies designed to overcome existing problem areas for soil erosion control may incorporate one or more of the following five policy alternatives: 1) changes in institutions, 2) investment of public funds as erosion control inducements, 3) land-use regulations, 4) acquisition of ownership, and 5) research and education. Policies proposed for reducing soil loss levels embrace these policy alternatives as guidelines in developing a soil erosion control policy model elaborated in the next section.

## Soil Erosion Control Policy Model

Utilizing estimated soil losses, soil loss goals, and information concerning soil loss causal factors, a conceptual model for soil erosion control policy is formulated and illustrated in Figure 5. Specific data from this study provide boundaries and areas of resource use responsibility. This model appears useful in developing elements of soil erosion control policy.

The policy model shown in Figure 5 consists of three zones and four points which require definition. Point "A" represents the maximum level of soil loss which has been determined by public entities as the public goal (5 T./Ac./Year). Point "D" represents the estimated existing level of soil loss for the study area. Specific values for point "D" are represented by both average soil loss for all acres, 17.2 tons per acre per year, and by the maximum per field soil loss observed, 126.5 tons per acre per year. Movement from the existing soil loss levels toward the goal soil loss levels is the objective for this policy model.

Zone III, from point "C" to "D", is that amount of soil loss reduction which farmers in the study area have indicated they could voluntarily accept responsibility. The value associated with point "C" will be on the average of 14.5 tons per acre per year, which was the amount of soil loss that sample farm operators stated as their soil loss goals. However, reasons exist why individual farmers may not move to this level. Therefore, the primary public policy role in this zone (III) is to attempt to assist farm operators in ameliorating these obstacles. Movement from point "D" to point "C" in this conceptual policy model may

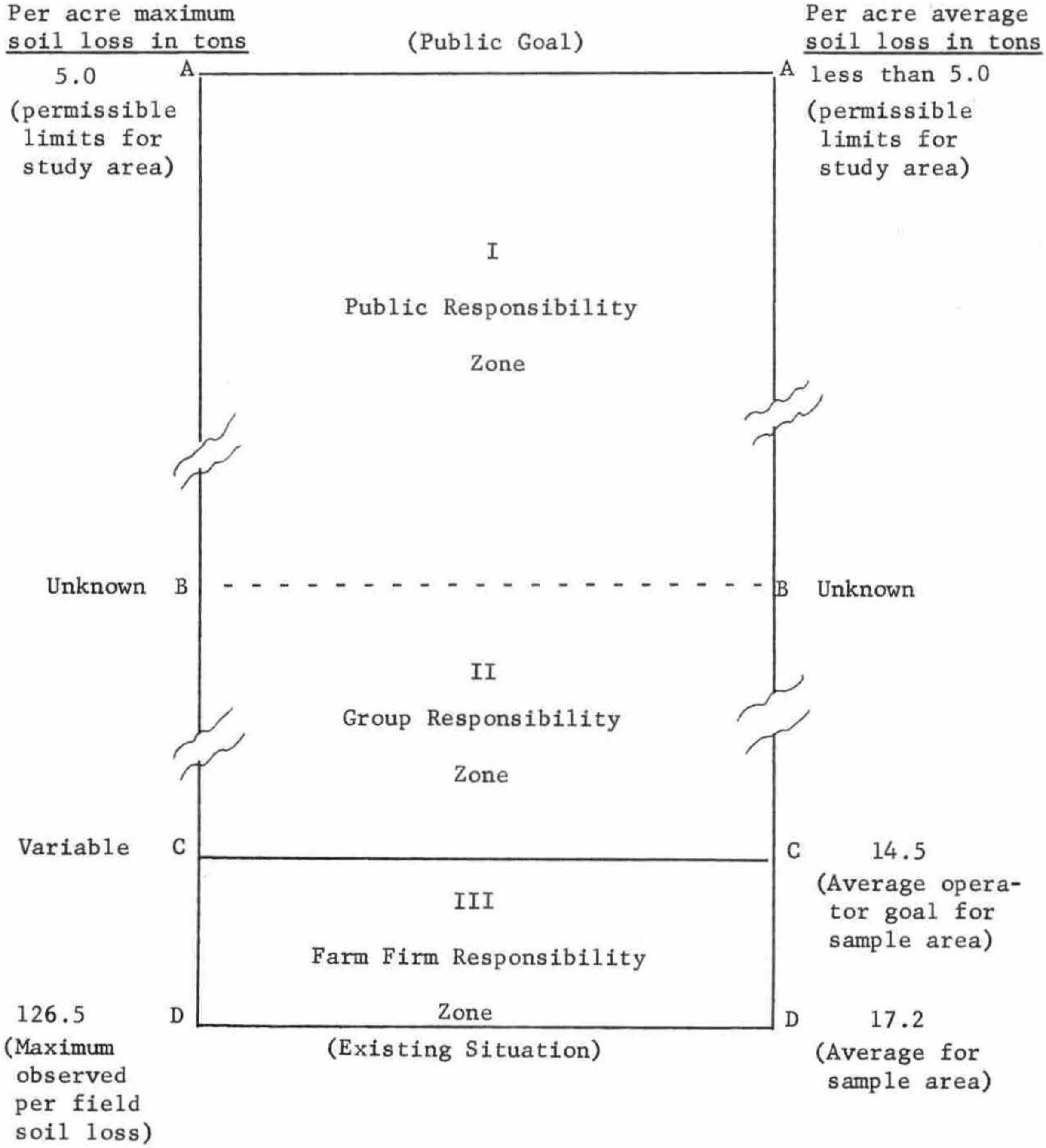



Figure 5. Proposed erosion control policy model based upon study results

be possible through relatively few inducements beyond the farm firm. However, this study has shown that both the boundary lines through points "C" and "D" have been shifting downward (Table 7). Both soil loss goals and actual soil losses have been shown to change in the same direction over time while extent of gap between farm operator goals and existing losses has changed very little over time. Indications are that the relative position of the farm firm responsibility zone may be changing. However, its dimensions appear to remain relatively constant.

Zone II, from point "C" to "B", is that amount of soil loss reduction which a single farm operator can not afford individually, but which a group of farmers can obtain through group action. Soil conservation districts, conservancy districts, and watershed districts formed under U.S. Public Law 566 are the types of groups which appear effective in this zone. Incentives for this group activity have in the past ranged from voluntary cooperation with soil conservation districts to utilization of federal or state cost sharing monies. The overall width of this zone is difficult to define specifically due to the undefined and intermingling of public and private responsibilities between Zone I and Zone II.

Area above point "B" designated Zone I is the public responsibility zone. This zone of responsibility is necessary in order to realize higher standards for soil loss levels than would be possible through combinations of private and group cabilities as illustrated by Zones II and III. In this zone, the public powers of spending, police, tax, bonding, and other regulatory powers may be used to further mitigate obstacles for soil loss reductions. There do exist in Zone II certain potential uses of public powers and compensation. However, in Zone I that amount of influence or cost sharing for particular problems involved in soil loss reduction, must be greater than is required in either the private (Zone III) or group (Zone II) identities.

Application of this conceptual soil erosion control model requires that for each zone of responsibility, three kinds of activities should be initiated. First, correct identification of obstacles retarding the movement from a lower zone border to a higher border must be ascertained. Secondly, possible remedies for these obstacles should be proposed. Thirdly, plans for implementations of potential remedies should be formulated.

This study has attempted to ascertain the obstacles for the farm firm responsibility zone (Zone II). By treating this zone within the policy model certain specifications of soil erosion control obstacles have been revealed. Figure 6 separates Zone III from its inherent role within the policy model. Suggestions for remedies have also been made for Zone III illustrated in Figure 6.

## Farm firm responsibility zone

Voluntary movement by farm operators from point "D" to point "C" (Figures 5 and 6) in the conceptual policy model is hindered by the soil loss causal factors described in Chapter IV. Renter tenure status, small farm size, low levels of gross income, few roughage-consuming animals, and rough topography are farm characteristics which are associated with increased soil loss levels, thereby inhibiting movement

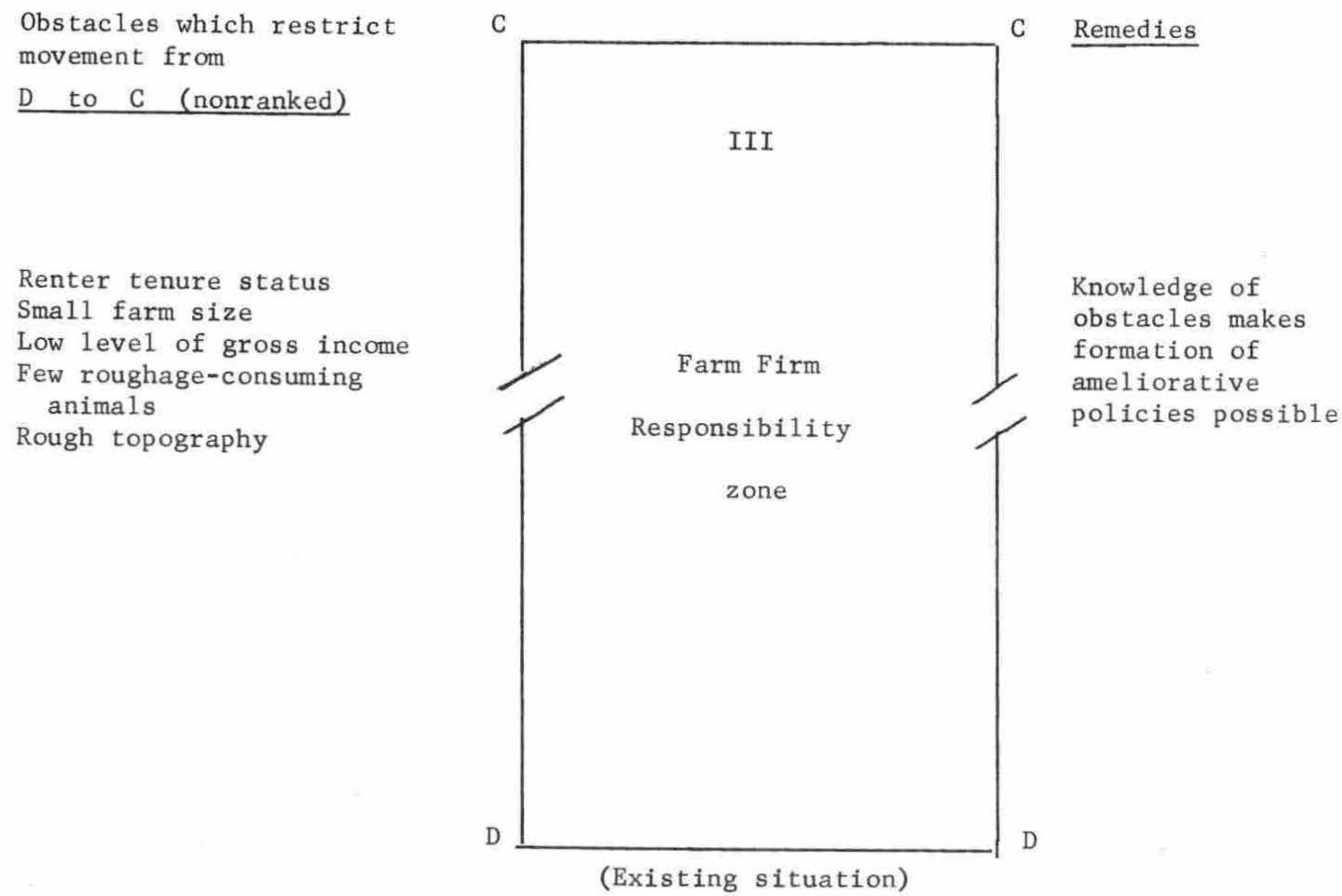



Figure 6. Farm firm responsibility zone

from point "D" to "C" in the policy model. Figure 6 details these factors. Knowledge of the nature of these factors suggests formation of ameliorative policies.

## Suggested Remedies for Erosion Control Problems

Chapter IV attempted to delineate several causal factors which affect soil erosion control. These factors have been projected into the conceptual policy models (Figures 5 and 6). Possibilities for remedies to these problems and illustrations of their interactives, are discussed in the following sections.

### Topography

Topography differs from the other causal factors in that it is not a characteristic of the farm operation but rather it is a characteristic of the soil resource. For example, degree of slope in the sample area does not cause the estimated soil losses to be over three times the public norm. Rather, it is the combination of the topography, soil erosive properties, land use, and management employed which combine to cause soil loss levels under varying slope conditions. Table 32 shows the different soil loss levels from various farm operation types. One farm in the sample has been seeded down for over two decades. The owner is ninety years old and retired. This farm is steep, has highly erosive soils, and little management input; yet it shows an estimated soil loss of only 1.8 tons per acre per year. This fact illustrates how topography alone does not cause high soil loss levels. Adapting land uses and management practices (such as terraces and contouring) to topography in order to achieve the desired soil loss and production levels constitute relevant remedial possibilities. This adaptation of land use and management practices to topography is a management policy.

Renter tenure status

Renter tenure status poses problems for erosion control policy because it appears that land tenure arrangements have added to the gap between the public and private interests in the policy model. In addition to this study, Timmons and Cormack have noted a tendency for the present system of land tenancy to disregard both public interests and private responsibilities (26).

Tenants and their landlords seem to be unable or unwilling to accept private farm operator responsibilities (Zone III, Figure 6) for protecting the soil resource. Overcoming tenant resistance in this area could be more successful if tenants were assured of the benefits associated with these responsibilities. By making use of long-term, written leases, and compensation provisions, farm owners and tenants could share both costs and benefits of necessary soil erosion control investments. Long-term leases would clarify both operator and tenant planning horizons. Provisions could be made for a settlement of shared erosion control costs if either the land owner or tenant wished to terminate the leasing arrangement before the entire amount of investment benefits had been recovered. In this manner hesitation to make land improvement investments because of undertainty that the benefits would accrue to others, would be reduced.

An institutional change such as major lease changes requires further research into the preferred and acceptable method of designing and implementing contracts of this type. Additionally, public education would be necessary to disseminate results of this research.

Renter tenure status illustrates how factors which contribute to competition between soil loss level determination and economic constraints are interrelated. Farms which were operated by tenants were smaller on the average, had fewer roughage-consuming animals, and enabled operators to earn less than average gross incomes when compared to owner operated farms. All of these factors contribute to higher soil loss levels for tenant operated farms.

Small farm size

Small farm size has been shown to be a factor which inhibits soil erosion control. Possible reasons why small farms are less able to control soil erosion may be the inability to implement soil erosion control management practices due to financial constraints and the interrelationship of the small farm problem with other causal factors.

Small farms tend to have higher production costs than large farms due to the high fixed costs including labor. Soil erosion control investments which add to production costs would thereby tend to be viewed less favorably by operators of small farms. Farm combinations are one method of spreading out both labor and fixed costs for farm operations. Combining land units to make larger farms has been going on in the sample area for the entire length of this series of studies. However, some evidence exists that the process of farm combination eventually may involve greater social costs than benefits (9). However, concerning soil erosion control investments, this level of farm size was not apparent by 1974. Farm combination can thereby be viewed as a development which has potential to allow farm operators to better absorb the costs of soil erosion control investments. Ability to absorb these costs however has not always been equal to farm operator willingness to do so. Farm combination is not really an institutional change but rather an ongoing process of striving for reduction of per unit output costs.

The problem of small farm size appears related to the causal factor of low levels of gross income. Unless nonfarm income is a large component of total income for small farmers, their net incomes are likely to be lower than net incomes for larger operators. Farm size is also related to tenure status as the rented farms in this sample averaged less acres than those farms operated by owners. Interrelationships among these causal factors imply that sets of policy recommendations are needed rather than applications of individual management practices.

Low levels of gross incomes

Inflation, increased volume of sales, and higher prices have caused gross income levels of sample farm operators to steadily increase since 1957 (28). Combined with increased levels of soil loss, this fact indicates that gross income levels are not as important to soil erosion control policy as are relative incomes among the farm operators. Chapter IV concluded that low levels of gross income have been associated with high levels of soil loss. This association has indicated that soil erosion control is competing with profit maximization. Two areas of this competition are examined and the interrelationships between income levels and other obstacles are noted.

Major agricultural income policies are formulated by the federal government in the United States. Since World War II the federal government has been actively involved in attempts to regulate agricultural income through quotas, land retirements, production controls, and regulation of farm imports and exports (including aid programs) (27). Since 1972, the United States Department of Agriculture has been promoting expansion of feed grain and soybean exports. This promotion has tended to increase farm income levels. However, governmental incentives (promotional and price induced) to increase feed grain and soybean production are in direct competition with other governmental efforts to control soil erosion. Table 43 shows the ramifications of expanding row crop area within the study area. A potential remedy for the problem of conflicting governmental influences would be the coordination of goals for American agriculture. All costs of increasing agricultural outputs must be estimated and considered, including costs of soil erosion and water pollution control caused by sediment. Formulation of agricultural resource policies conjointly with agricultural commodity export policies is an institutional change which is necessarily based upon more long-run considerations.

A second area of potential policies dealing with incomes affect upon soil losses is public participation in soil erosion control investments. If the public is committed to long-term soil resource maintenance then investments which improve the quality of land resources should perhaps be encouraged through cost-sharing and tax incentives.

Government cost-sharing for erosion control investments in 1974 was available in limited amounts to farm operators through both state and federal funds. Programs of this type appear to be justified when one considers the difference between the public and private goals for the soil resource. However, the income distribution effects of these programs remain to be examined to determine optimal allocations of cost-sharing funds.

Property tax systems based upon application of millage rates to land values tend to discriminate against farm operators who have made investments in land maintenance such as terraces. If a farm operator has made investments to control erosion which increase the value of his land relative to land without such investments, the state government might choose not to penalize him through the property tax system. Research could be initiated to determine what part of farm land values could be eligible for lower tax rates in order to encourage investments in land maintenance. Efforts in this policy area would be based upon a continuing commitment of state governments to invest in soil erosion control.

Again it should be noted that renter tenure status, small farm size, and income levels are interrelated. These interrelationships should not be underestimated where applications of soil erosion control policies are involved.

Numbers of roughage-consuming animals

Numbers of roughage-consuming animals were shown to be associated with soil loss levels in Chapter IV. Of course, it is not the livestock *per se* which produce this effect but rather the land uses necessary to their support. Policy changes which would decrease the instability in livestock profits might tend to cause land use changes conducive to soil erosion control practices. At the time the interviews with farm operators for this project were carried out, cattle feeders in Western Iowa were experiencing large losses while nine months later profit margins were being obtained. Fed cattle profitability directly affects farm operator decisions to invest in and work with cow-calf operations which utilize pasture and hay crops. If the livestock market structure were altered to include forward pricing, or some other stabilizing technique, operators might consider returns from roughage-consuming livestock more competitive to returns on crop production.

Research to increase the profitability of the livestock industry relative to crop production could be beneficial in encouraging desired land use changes. However, yield increases, particularly in corn production, have been far more substantial than rate of gain increases for livestock. If this situation could be changed and the aggregate demand for beef increased cow-calf operations would become more profitable. Improved cow-calf profit incentives particularly on steep slopes, are conducive to land use changes to alter the soil loss situation.

Policy model zones I and II

This study has concentrated upon obstacles and potential remedies for Zone III of the proposed policy model. However, during the analysis some potential obstacles for the other two zones have appeared. Zones I and II both involve varying degrees of governmental influence and are considered together.

A problem for soil erosion control seems to be the voluntary nature through which erosion control programs are administered. Farm operators who are good stewards of the land seem to control soil losses and are likely to be voluntarily cooperating with soil conservation districts and also knowledgeable of resource problems. However, farmers who are less concerned with soil resource problems have little reason to cooperate with soil erosion control programs. Mandatory membership in soil conservation districts may be a necessary step to help correct informational problems illustrated in Chapter IV.

An additional problem for Zones I and II of the policy model is the degree of public commitment in soil erosion control. Several times this study has cited conflicting governmental policies which affect resource utilization. The difference in stated public and private goals for the soil resource have also been cited as justification for erosion control cost-sharing. If public agencies are correct in their determination of public soil loss goals, then it appears that larger amounts of cost-share funds and assistance should be appropriated.

The last problem area this study has found in Zones I and II involves coordination of resource objectives between public and private groups. Any movement away from voluntary erosion control programs must be guided by both public goals and farm operator input. Administered control programs such as determination of crop uses by soil erosion control criteria, rather than price determination, must be considerate of farm operators' positions of commodity price takers and their dependency upon commodity revenue as income sources. Mandatory soil erosion control may be justified by public goals but these unique properties of the agricultural production process necessitate farm operator input.

## Erosion Control Research Needs

Throughout this study references to areas where additional research is needed have been stated. This section contains a summary of these needs.

The series of erosion control studies initiated in 1949 and continued periodically through 1974 in Western Iowa, should be continued on a periodic basis. The bench mark data and time series data available in these studies provide an unique and substantial basis for the study of erosion control progress over time. Certain improvements in the study series are suggested.

Since 1949, the acreage examined in this series of studies has declined by 8070 acres (Table 4). This is because of the headquarters rule for sample eligibility. Abandonment of the headquarters rule would accomplish two research needs for future studies in the series. If all land within each section were planned and all relevant operators interviewed, both sample size and acres in the sample would be augmented. These accomplishments would be achieved while allowing time series comparison to continue for these same sample sections. Expanded sample size could help clarify relationships between operation type, farm acquistion methods, tenure expectancy, and soil loss levels.

Soil characteristics for the loess derived soils of the Ida-Monona-Hamburg Soil Association (Table 40) have caused interpretation problems for soil erosion control investments and policies. This type of study needs to be completed for other soil associations where lack of soil erosion control has a definite effect upon physical productivity of soils.

Several citations have been made concerning problems which require further research in the soil erosion control area. Investigations need to be conducted which can further ascertain the process by which farm operators determine goals for soil erosion control. Also in the goal area, is the research need for examination of the public soil loss goals.

Research should be conducted on the necessary changes needed to implement leasing arrangements for farm land. Methods of implementing leases for longer periods of time and which include soil erosion control investment-sharing clauses need to be designed.

Research which investigates the income distribution effects of cost-sharing for erosion control needs to be done. Also, the possibility of property tax modifications to encourage erosion control investments should be examined.

Another general research need would be discovering methods to increase the efficiency of livestock production as it utilizes pasture crops. Making this activity more profitable would slow, or reverse, the observed land use changes shown in Table 42.

Further specific research is needed concerning farm operator adoption of conservation tillage practices. Implications for water quality, given derived input levels of pesticide inputs, needs to be examined.

There exist many resource problems related to these suggested research needs. This entire area contains many frontiers for additional research to identify and implement soil erosion control measures for the benefit of farm operations, land owners, and nonfarm citizens of present and future generations.

# CHAPTER VI. CONCLUSIONS

All the objectives proposed for this study have been accomplished. From the sample farms in the land use laboratory the rate of soil erosion in the Ida-Monoma-Hamburg Soil Association area was estimated. For the crop year 1974 the estimated rate of soil loss per farm ranged from 51.7 to 1.1 tons per acre per year and averaged 17.2 tons per acre per year.

Previous research using the same land area allowed the comparison of estimated soil loss rates over time. Since the last study date, 1957, the estimated rate of soil loss had increased 22 percent. This study was able to propose reasons for this increase in estimated soil loss rates. The magnitude and effect of expanding both intensive and extensive margins for row crop production upon soil loss rates was estimated in the study. Sample farm operators who increased acreage of corn or soybeans during 1974 in response to 1973 price incentives were maintaining estimated average soil losses of over 6 tons per acre per year higher than other farm operators. Crop rotations contining any row crop showed soil losses 11 times higher than meadow or pasture rotations. Additionally, the proportion of sample farmland planted to row crop had increased 26.1 percent since 1957.

Several causal factors which tended to influence the combination of soil resources and management practices in a manner generating high levels of soil loss were determined. Small farm size, renter tenure status, low-income levels, few roughage-consuming animals, competition between soil erosion control and profit maximization, along with farm operator erosion control information problems were all judged to hamper soil erosion control efforts. Analysis of particular aspects of each of these causal factors was incorporated into a soil erosion control policy model. Inability, or reluctance, to invest in soil erosion control was judged to possibly be associated with high per unit output costs related to small farm size. Uncertainty concerning the ability to recover benefits from soil erosion control investments was likely to be associated with renter tenure status. Low income levels and competition between soil erosion control and profit maximization were likely to be causing reluctance to invest in soil erosion control practices. Farm operator information concerning benefits of soil erosion control practices perhaps was contributing to slower rates of adoption for soil erosion control practices.

An erosion control policy model was proposed incorporating the causal factors believed to affect soil losses. This policy model illustrated the difference in public and private resource use goals for soil in the sample area. Methods for reducing the difference in public and private goals were suggested. These methods included 1) revising the public goals, 2) institutional changes in leasing procedures, property tax assessments, the voluntary nature of soil erosion control programs, and livestock pricing, 3) public inducements for soil erosion control by coordinating public policies toward the soil resources use and increased cost-share monies, and 4) public research and education efforts designed to increase awareness of problem areas and propose possible solutions created to mitigate obstacles which restrict the optimal utilization of this area's soil resources. If insights of the type gained by this study are used to form solutions acceptable to all concerned interests it remains possible to control soil erosion at a rate agreeable to both the public and farm operators.

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# APPENDIX A. LIST OF COUNTIES, TOWNSHIPS, AND SECTIONS OF THE SAMPLE AREA

Table A.1. List of counties, townships, and section of the sample area

| County | Township | Section number |
|---|---|---|
| Plymouth | Liberty | 29 |
| Plymouth | Hungerford | 10 |
| Plymouth | Hungerford | 23 |
| Plymouth | Lincoln | 24 |
| Woodbury | Arlington | 7 |
| Woodbury | Arlington | 23 |
| Woodbury | Wolf Creek | 6 |
| Woodbury | Wolf Creek | 20 |
| Woodbury | Floyd | 9 |
| Woodbury | Moville | 19 |
| Woodbury | Moville | 33 |
| Woodbury | Union | 17 |
| Woodbury | Kedron | 20 |
| Woodbury | Rock | 9 |
| Woodbury | Rock | 15 |
| Woodbury | Miller | 2 |
| Woodbury | Miller | 13 |
| Woodbury | Grant | 28 |
| Woodbury | Little Sioux | 1 |
| Woodbury | Liston | 9 |
| Woodbury | Oto | 28 |
| Ida | Garfield | 3 |
| Monona | St. Clair | 5 |
| Monona | Soldier | 6 |
| Monona | Jordan | 2 |
| Monona | Spring Valley | 24 |
| Crawford | Boyer | 30 |
| Crawford | Willow | 3 |
| Crawford | Willow | 26 |
| Crawford | Paradise | 7 |
| Crawford | Paradise | 29 |
| Harrison | Harrison | 33 |
| Harrison | Douglas | 2 |
| Harrison | Douglas | 30 |
| Harrison | Jefferson | 1 |
| Harrison | Union | 4 |
| Harrison | La Grange | 28 |
| Harrison | Cass | 29 |
| Shelby | Washington | 10 |
| Shelby | Washington | 19 |
| Shelby | Cass | 15 |
| Pottawattamie | Neola | 8 |
| Pottawattamie | Boomer | 24 |
| Pottawattamie | Hazeldell | 28 |
| Mills | Oak | 24 |
| Fremont | Washington | 27 |

# APPENDIX B. SAMPLE INTERVIEW FORM

No. ___________



FORM I - September, 1974

Iowa Ag Experiment Station
Project 102-40-09-09-1853

IOWA STATE UNIVERSITY

Department of Economics
and
Statistical Laboratory

Ida-Monona Soil Association
Erosion Control Study

Farm Number ____________________

County ____________________

Farm Operator ____________________

Address ____________________
(Street or R.R.)

City ____________________

Telephone No. ____________________

Enumerator ____________________

| | Date | Time |
|---|---|---|
| 1st call | ______ | ____ |
| 2nd call | ______ | ____ |
| 3rd call | ______ | ____ |

Starting Time ____________________

Hello. I am ____________________ from Iowa State University at Ames. The major objective of this project is to attempt to estimate the rate of soil loss due to water erosion on a sample of farms located in western Iowa. In addition, the survey will gather farmer operator opinions about particular soil erosion control practices and will discuss with each operator two soil conservation farm plans for his particular operation. The data from the study will provide a better understanding of the problem of soil erosion in western Iowa.

Agencies cooperating on this project are the United States Soil Conservation Service, the Iowa Agricultural and Home Economics Experiment Station and the Department of Economics at Iowa State University.

## SECTION I. General Farm Information

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First, we would like some general information about your farming operation in 1974.

1. (a) How many acres of land did you own in 1974? Include any land owned by your wife or partners, if any. ________ (a)

   (b) Of these __________ (entry in a) acres, how many if any did you rent to others in 1974? ________ (b)

   (c) Acres owned and operated in 1974 (a - b) ________ (c)

   (d) How many acres of land did you rent from others and operate in 1974? Include any land operated in partnership or as a corporation. ________ (d)

   (e) Then, that makes a total of ______ (c + d) acres operated in 1974. Does that sound about right? ________ (e)

For the purposes of this study, could we refer to the separate parcels of land that comprise your total farm as "tracts." We would like to ask you for some information for each of these tracts (if more than one).

2. (a) Of the __________ (entry in c) acres you owned and operated in 1974, how many tracts does this include? ______ tracts (Complete Table A for each tract)

   (b) Of the __________ (entry in d) acres you rented in and operated in 1974, how many tracts does this include? ______ tracts (Complete Table A for each tract)

3. The SCS has provided us with an aerial photo of your farm land. For all land shown on this photo, we would like you to identify each tract (if more than 1) and draw its boundaries on the overlay with this red pencil.

[INT: For tracts not shown on the aerial photo, complete Items (a) and (b) in Table A only]

Table A

| | Tract No. | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| a) How many acres are in this tract? | ____A. | ____A. | ____A. | ____A. |
| b) Do you own this tract, or rent it? (Circle one) | Own Rent | Own Rent | Own Rent | Own Rent |
| INT: Is this tract shown on the aerial photo? No ——> Go to the next tract; Yes ——> If owned, go to Item (c) If rented, go to Item (j) | ___ No ___ Yes | ___ No ___ Yes | ___ No ___ Yes | ___ No ___ Yes |
| WNED LAND: | | | | |
| c) How long have you owned this tract? | ____yrs. | ____yrs. | ____yrs. | ____yrs. |
| d) How was this tract acquired? (Record code No.) Purchased: 1 = Mortgage 2 = Contract 3 = Cash 4 = Inherit (gift) 5 = Other (specify) | ____ | ____ | ____ | ____ |
| e) What was the price per acre when purchased? | $ ____ | $ ____ | $ ____ | $ ____ |
| f) About how much would the land (and buildings) sell for now? | $ ____ | $ ____ | $ ____ | $ ____ |
| g) Do you still owe money on this tract? 0 = No 1 = Yes | ____ | ____ | ____ | ____ |
| If YES, Is this debt restricting your investment in improvements for this farm? 0 = No 1 = Yes | ____ | ____ | ____ | ____ |
| h) Do you expect to be operating this tract ... 0 = No 1 = Yes | | | | |
| ... 1 year from now? | ____ | ____ | ____ | ____ |
| ... 5 years from now? | ____ | ____ | ____ | ____ |
| i) What do you plan to do with this tract when you quit farming it? 1 = rent out 2 = sell 3 = keep in family 4 = other (specify) ____ 5 = (Don't know) | ____ | ____ | ____ | ____ |

Table A (cont.)

| | Tract No. I | Tract No. II | Tract No. III | Tract No. IV |
|---|---|---|---|---|
| RENTED LAND | | | | |
| (j) What is the name of the owner of this tract? | ___ | ___ | ___ | ___ |
| (k) What is the lease arrangement for this tract?<br>1 = cropshare only 3 = cash only<br>2 = cropshare & cash 4 = livestock share<br>5 = other (specify) | ___ | ___ | ___ | ___ |
| (l) Is the lease written or verbal?<br>1 = written<br>2 = verbal<br>3 = other (specify) | ___ | ___ | ___ | ___ |
| (m) What is the length of the lease (years)? | ___ | ___ | ___ | ___ |
| (n) Have you ever suggested lease changes to your landlord?<br>0 = No 1 = Yes | ___ | ___ | ___ | ___ |
| (o) Does your rental agreement provide for sharing expenses of erosion control practices?<br>0 = No<br>1 = Yes - explain, please? (Tract No. ___)<br>______________________<br>______________________ | ___ | ___ | ___ | ___ |
| (p) Do you think your landlord is concerned about erosion control on this tract?<br>0 = No - Why not? (Tract No. _____)<br>______________________<br>______________________<br>1 = Yes | ___ | ___ | ___ | ___ |
| (q) In what year did you start renting this land? | ___ | ___ | ___ | ___ |
| (r) Do you expect to be operating this tract ...<br>0 = No 1 = Yes | | | | |
| ... 1 year from now? | ___ | ___ | ___ | ___ |
| ... 5 years from now? | ___ | ___ | ___ | ___ |

## SECTION II. Land Use

More and more emphasis is being placed on protecting our farm land from soil erosion.

4. Do you have an erosion problem with any of the following on this farm ....

Yes No

___ ___ gullies? (a ditch that is too large and steep banked to be crossed by normal tillage operations)

___ ___ sheet erosion? (general soil erosion caused by water)

___ ___ siltation? (depositing of silt in low lying areas due to water movement)

___ ___ water run off? (non-saturated rain water)

___ ___ any other erosion problems? (specify) ______________________________

(a) Which one of these problems do you consider to be the most serious?

[INT: Circle the "X" for the most serious problem]

5. Do you consider soil erosion on your farm:

____ (a) a major problem
____ (b) somewhat of a problem
____ (c) a problem, but needs no action
____ (d) no problem?

6. (a) Now going back to the aerial photo, would you draw in your fields (on the overlay) as you are farming them this year, please (with black pencil). The fields shown may or may not be correct for this year, but we would like you to draw them in as they exist this year.

[INT: Table B applies only to tracts that are shown on the aerial photo. After R has drawn in boundaries for each field, number them consecutively within tract and enter tract and field number in Table B, col. (a). Complete Table B for Tract I, Field 1, then continue with 2nd field etc. until all fields of all tracts are accounted for, as applicable.]

(b) Thinking now about (Tract I) Field No. 1, as shown here, how many acres are in this field?

(c) Could you tell me your rotation plan for this field (if applicable)?

(d) Where are you in this rotation scheme this year? [INT: Circle the appropriate letter]

(e) Since you have been operating this farm, has the soil loss been great enough to reduce your yield per acre on this field?

[HAND R THE WHITE CARD]

(f) Would you refer to this card and tell me if you use any of these conservation practices on this field. (If YES, record code number of practice used)

0 = No practice used
1 = Terracing
2 = Waterways
3 = Conservation tillage
4 = Contouring
5 = Contour listing
6 = Seeding steep slopes
7 = Strip cropping (indicate crop)
8 = Residue utilization
9 = Gully-control structures
10 = Tree plant
11 = New permanent pasture
12 = Tile drainage
13 = High forage rotations
14 = Other (specify)

[INT: If terracing, grassed waterways or tile drainage is mentioned, ask:]

(g) How many miles or feet were ...

(h) Are there any conservation practices you feel you should be using on this field?
If YES: What practice is this? (Record code number)

(i) Why are you not following this practice?

(j) Do you intend to start following this practice ....

1 = .... within the next year?

5 = .... within the next five years?

0 = does not intend to start this practice

TABLE B

| ) | (b) | (c & d) | (e) | | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|
| Field No. | No. acres | Rotation | Soil loss Yes | Soil loss No | Practice used | No. Mi/Ft | Practice should use | Why not use? | Intend to use? |
| | | | | | | | | | |
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(k) Looking again at the list of practices on the (BLUE) card, are there any practices that you prefer not to use on this farm at the present time?

____ No ——> go to Section III

____ Yes ——> (a) What practice(s)?

(b) Why do you object to this practice?

| (a) Practice | (b) Reason objected to |
|---|---|
| ____________ | ____________ |
| ____________ | ____________ |
| ____________ | ____________ |
| ____________ | ____________ |

SECTION III. Soil Erosion Control & Farming Practices

7. (a) Do you have any current information concerning the costs of individual erosion control practices?

____ No ——> go to Q. 8

____ Yes ——> (b) Which practice(s)? ____________

____________

(c) Do you have any estimates of the returns of this particular erosion control practice?

____ No

____ Yes

8. What do you consider to be the main benefits of erosion control practices? [DO NOT READ]

____ (a) Maintain soil productivity

____ (b) Increase yields

____ (c) Reduce runoff pollution

____ (d) No benefits

____ (e) Hold top soil and water

____ (f) (Don't know)

Other (specify)

____ (g) ____________

____ (h) ____________

(a) Does water run off from other farms cause damage to your farming operation?

____ No
____ Yes ——> (b) Is anything being done to stop this water run off problem?

___ No ——> What needs to be done? ______________
______________________________________

___ Yes ——> What is being done? ________________
______________________________________

(a) Are you aware of the 1971 Conservancy District Act for the State of Iowa?

____ No
____ Yes ——> (b) What do you think of this state law that makes it mandatory that soil conservation practices be installed where a complaint has been filed to correct a downstream nuisance. ______________________
______________________________________________

(a) Do you consider yourself well informed about soil conservation practices?

____ No
____ Yes ——> (b) What do you consider the best sources of information concerning soil conservation practices? [DO NOT READ]

___ (1) Soil Conservation Service
___ (2) ISU Extension Service
___ (3) Newspapers
___ (4) TV - Radio
___ (5) Friends and neighbors
___ (6) Personal experience
___ (7) Other (specify) ______________________
______________________

(a) Have you sought advice concerning soil erosion control in the last year?

____ No
____ Yes ——> (b) From whom? ______________________________

. This project has been conducted three times previously - in 1949, 1952 and 1957.

(a) Do you recall having been interviewed at any of those times?

____ No

____ Yes ——> (b) Could you tell me which year or years? ____ ____ ____

(c) Did this previous interview have any effect upon your thinking toward soil erosion?

____ No

____ Yes

. (a) Do you believe that soil erosion should be a concern of the public?

____ No

____ Yes ——> (b) Should the taxpayer help share the cost of soil erosion control?

____ No

____ Yes

. In this part could we talk a little in general about some of your farming practices on all the land that you farm, please?

| | No | Yes | N.A. |
|---|---|---|---|
| (a) Do you generally remove straw from your grain fields? | ___ | ___ | ___ |
| (b) Do you generally turn under green manure? | ___ | ___ | ___ |
| (c) Do you cut clover in your oat stubble for hay? | ___ | ___ | ___ |
| (d) Do you pasture oat stubble in the fall? | ___ | ___ | ___ |

(e) In general, how do you plant your row crops?
Do you plant .... (Check all applicable)

___ (1) up and down hill?

___ (2) across slopes in straight rows?

___ (3) on the contour?

| | No | Yes | N.A. |
|---|---|---|---|
| (f) Do you like to plow for row crops in the fall? | ___ | ___ | ___ |
| (g) Do you use any other equipment to plow other than a mold-board plow? | ___ | ___ | ___ |

If YES, what? ______________________________

| | No | Yes | N.A. |
|---|---|---|---|
| . Do you apply fertilizer in the fall? | ___ | ___ | ___ |

If YES: What percent is usually applied at that time ____%

| | No | Yes | N.A. |
|---|---|---|---|
| . Is wind erosion a problem on this farm? | ___ | ___ | ___ |
| If YES: Are you doing anything to correct this? | ___ | ___ | ___ |

If YES: What are you doing? ______________________________

______________________________________________

8. (a) During this crop season, have you had any acres abandoned or lost (on all land farmed) because of ...

| | (a) No | (a) Yes | (b) No. acres |
|---|---|---|---|
| (1) .... flooding | ___ | ___ | ________ |
| (2) .... erosion, wash out | ___ | ___ | ________ |
| (3) .... silted in | ___ | ___ | ________ |

(b) If YES, how many acres?

(c) Would better erosion control practices have reduced this abandoned and/or lost acreage?

___ No
___ Yes ——> (d) By about what percent? _____%

9. (a) During this crop season have you had stands reduced because of erosion or flooding?

___ No
___ Yes ——> (b) On how many acres? ________ acres

(c) Would better erosion control practices have reduced this stand loss?

___ No
___ Yes ——> (d) What percent? _____%

0. The type of land, the crops raised thereon and many farming practices sometimes have a direct bearing on the kinds and numbers of livestock the operator keeps on his place.

(a) Concerning only the farm shown in the aerial photo at the present time, do you have any ...

| Kind of animal | (a) No | (a) Yes | (b) Number |
|---|---|---|---|
| (1) .... cows (beef or dairy) | ___ | ___ | ______ |
| (2) .... feeder cattle | ___ | ___ | ______ |
| (3) .... any other cattle | ___ | ___ | ______ |
| (4) .... sows | ___ | ___ | ______ |
| (5) .... feeder hogs | ___ | ___ | ______ |
| (6) .... any other hogs | ___ | ___ | ______ |
| (7) .... ewes | ___ | ___ | ______ |
| (8) .... any other sheep | ___ | ___ | ______ |
| (9) .... horses | ___ | ___ | ______ |

(b) If YES, how many?

## SECTION IV. Mechanical and Vegetative Plans

INT: Start tape recorder]

The SCS has prepared two erosion control plans for (that part of) your farm shown n the aerial photograph. We will refer to the first plan as the mechanical plan. t emphasizes mechanical erosion control practices - practices involving terracing, ontouring, high row crop rotations, etc. The second plan, referred to as the egetative plan, emphasizes vegetative erosion control practices - high vegetative otations, contouring, making new permanent pasture, conservation tillage, etc. The se of either of these farm plans would hold soil loss on this farm to the recommended imit for the Ida-Monona Soil Association. We would like to go over these plans with ou, and then ask your opinions concerning the individual practices which make up these lans. We will start with Plan 1 - the Mechanical Plan.

[INT: Refer again to the aerial photo. Go over the land uses or rotations for Plan 1 as suggested for each field with the respondent. Read through the accompanying instructions.

If R owns land and/or rents from one or more landlords, it may be necessary to complete a Section IV for each tract, for both Plan 1 and Plan 2.]

Plan 1 - Mechanical (Tract No. ____)

7. (a) Do you consider the use of terracing within this erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 28

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of terracing in this mechanical erosion control plan?

[INT: Check the volunteered reasons which you can clearly categorize in Col. (b-c) and go to Item (c).]

| Col. (b-c) Volunteer | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|
| ____ | (1) (For rented tracts only) Is the lack of landlord cooperation or the fact that terracing is not in your rental agreement an obstacle for terracing on this tract? . . | ___ | ___ | ___ |
| ____ | (2) Do you disapprove of the amount of terracing recommended in this erosion control plan? . | ___ | ___ | ___ |
| ____ | (3) Would you rather use your present income for expenses other than terracing? . . . . . . . | ___ | ___ | ___ |
| ____ | (4) Do you see the need for terracing as recommended by this plan? . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (5) Does the terracing recommended by this plan disagree with your established farming methods? . . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (6) Does the field or road layout on this tract cause you to object to terracing? . . . . . | ___ | ___ | ___ |
| ____ | (7) Is the machinery you now own adaptable to farming with terraces? . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (8) Do you disapprove of the suggested terrace design? . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (9) Do you consider the cost of installing terraces to be so high that it keeps you from using terraces? . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (10) Do you consider the maintenance of terraces difficult enough to prohibit their use? . . | ___ | ___ | ___ |
| ____ | (11) Do you have another specific erosion control technique in mind to substitute for terracing to stop erosion? . . . . . . . . . What technique? ____________ | ___ | ___ | ___ |
| ____ | (12) Do you believe terracing as suggested by this plan would reduce your profits on this tract? . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (13) Other ____________ | | | |
| ____ | (14) ____________ | | | |

(c) Are there any other reasons you object to terracing in this erosion control plan? (Categorize and record in Col. (b-c).)

(d) Do any of the following cause you to object to terracing in this erosion control plan?

[INT: Read all items not clearly volunteered by R and check appropriate response under Col. (d).]

(e) You have stated that you object to the use of terracing in this mechanical erosion control plan. What situations would have to change in order to overcome your objections?

[INT: It is extremely important to encourage the R to address this question directly and in some detail. No recording is necessary on the questionnaire for Item (e).]

. (a) Do you consider the use of contouring within this mechanical erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 29

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of contouring in this erosion control plan?

[INT: Check the volunteered reasons which you can clearly categorize in Col. (b-c) and go to Item (c).]

| Col. (b-c) Volunteer | | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|---|
| ____ | (1) | Do you see the need for contouring as recommended in this plan? . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (2) | Does the field or road layout on this tract cause you to object to contouring? . . . . . | ___ | ___ | ___ |
| ____ | (3) | Do you object to contouring in this plan because of the difficulty of farming point rows with large equipment? . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) | Do you feel contouring reduces yields more than costs? . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (5) | Do you believe contouring reduces erosion? . | ___ | ___ | ___ |
| ____ | (6) | Do you feel that contouring as suggested by this plan would reduce your profits on this tract? . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (7) | Other ______________________________ | | | |
| ____ | (8) | ______________________________ | | | |

(c) Are there any other reasons why you object to contouring in this erosion control plan? (Categorize and record in Col. (b-c).)

(d) Do any of the following cause you to object to contouring in this erosion control plan?

[INT: Read all items not clearly volunteered by R and check appropriate response under Col. (d).]

(e) You have stated that you object to the use of contouring in this mechanical erosion control plan. What situations would have to change in order to overcome your objections?

[INT: It is extremely important to encourage the R to address this question directly and in some detail. No recording is necessary on the questionnaire for Item (e).]

. (a) Do you consider the rotations suggested by this mechanical erosion control plan objectionable in any way relative to your farm enterprise?

- ____ No ——> Go to Q. 30
- ____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of these rotations?

[INT: Follow the procedure used in 27(b) and 28(b).]

| Col. (b-c) | | Col. (d) | | |
|---|---|---|---|---|
| Volunteer | Reason | No | Yes | N.A. |
| ____ | (1) (For rental land only) Does the lack of your landlord's cooperation cause you to object to these rotations? . . . . . . . . . | ___ | ___ | ___ |
| ____ | (2) Do you disapprove of the amount or kind of these recommended rotations? . . . . . . | ___ | ___ | ___ |
| ____ | (3) Do these rotations contradict your established farming methods? . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) Do you expect to be farming this tract long enough to follow these rotations? . . . | ___ | ___ | ___ |
| ____ | (5) Do you believe that these rotations would reduce your profits on this tract? . . . . . | ___ | ___ | ___ |
| ____ | (6) Other ______________________________ | | | |
| ____ | (7) ______________________________ | | | |

(c) Are there any other reasons why you object to these rotations?

(d) Do any of the following cause you to object to the rotations proposed in this erosion control plan?

[Follow the procedure used in 27(d) and 28(d).]

(e) You have stated that you object to the rotations in this mechanical erosion control plan. What situations would have to change in order to overcome your objections?

[Same instruction as in 27(e) and 28(e).]

. (a) Do you consider the <u>field boundaries</u> suggested by this farm plan to be objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 31

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to these <u>field boundaries</u>?

[Follow the procedure used in 27(b) and 28(b).]

| Col. (b-c) Volunteer | | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|---|
| ____ | (1) | (For rented land only) Does the lack of landlord cooperation cause you to object to these field boundaries? . . . . . . . . . | ____ | ____ | ____ |
| ____ | (2) | Do you disapprove of the amount or kind of boundaries suggested? . . . . . . . . . . | ____ | ____ | ____ |
| ____ | (3) | Do you see the need for these boundaries? . | ____ | ____ | ____ |
| ____ | (4) | Do these boundaries contradict your established farm methods? . . . . . . . . . | ____ | ____ | ____ |
| ____ | (5) | Do you expect to be farming this tract long enough to adopt these boundaries? . . . . . | ____ | ____ | ____ |
| ____ | (6) | Other ______________________________ | | | |
| ____ | (7) | ______________________________ | | | |

(c) Are there any other reasons why you object to these <u>field boundaries</u>?

(d) Do any of the following cause you to object to the <u>field boundaries</u> proposed in this erosion control plan?

[Follow the procedure used in 27(d) and 28(d).]

(e) You have stated that you object to the <u>field boundaries</u> suggested in this erosion control plan. What situations would have to change in order to overcome your objections?

[Same instruction as in 27(e) and 28(e).]

. (a) Do you consider the use of <u>waterways</u> within this mechanical erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 32

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of <u>waterways</u> in this erosion control plan?

| Col. (b-c) | | Col. (d) | | |
|---|---|---|---|---|
| Volunteer | Reason | No | Yes | N.A. |
| ____ | (1) Does your field or road layout cause you to object to the proposed waterways? . . . . | ___ | ___ | ___ |
| ____ | (2) Do you see a need for these waterways? . . . | ___ | ___ | ___ |
| ____ | (3) Do you feel that waterways require too much work to keep them from building up or cutting out? . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) Have you found that the use of herbicides ruins grass stands in waterways? . . . . . . | ___ | ___ | ___ |
| ____ | (5) Do you feel that these proposed waterways would reduce your profits on this tract? . . | ___ | ___ | ___ |
| ____ | (6) Other ______________________________ | | | |
| ____ | (7) ______________________________ | | | |

(c) Are there any other reasons why you object to <u>waterways</u> in this erosion control plan?

(d) Do any of the following cause you to object to the <u>waterways</u> in this erosion control plan?

(e) You have stated that you object to the use of <u>waterways</u> in this mechanical erosion control plan. What situations would have to change in order to overcome your objections?

2. (a) Do you consider the use of conservation tillage within this mechanical erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 33

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of conservation tillage within this erosion control plan?

| Col. (b-c) Volunteer | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|
| ____ | (1) Do you see the need for conservation tillage as proposed in this plan? . . . . . | ___ | ___ | ___ |
| ____ | (2) Does conservation tillage contradict your established farming methods? . . . . . | ___ | ___ | ___ |
| ____ | (3) Do you think conservation tillage reduces yields more than costs? . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) Do you think conservation tillage reduces erosion? . . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (5) Do you feel the use of conservation tillage as proposed in this plan would reduce your profits on this tract? . . . . . | ___ | ___ | ___ |
| ____ | (6) Other ______________________ | | | |
| ____ | (7) ______________________ | | | |

(c) Are there any other reasons why you object to conservation tillage in this erosion control plan?

(d) Do any of the following cause you to object to the use of conservation tillage in this erosion control plan?

(e) You have stated that you object to the use of conservation tillage in this mechanical erosion control plan. What situations would have to change in order to overcome your objections?

3. (a) Do you consider the use of the structures or tile within this erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 34

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of structures or tile in this erosion control plan?

| Col. (b-c) Volunteer | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|
| ____ | (1) Do you see the need for these structures or tile? . . . . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (2) Do you expect to be farming here long enough to make it worthwhile to invest in the proposed structures or tile? . . . . | ___ | ___ | ___ |
| ____ | (3) Do you consider the cost of installing the structures or tile to be too high? . . . | ___ | ___ | ___ |
| ____ | (4) Do you believe that the proposed structures or tile would result in lower yields on this tract? . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (5) Other ________________________________ | | | |
| ____ | (6) ________________________________ | | | |

(c) Are there any other reasons why you object to the structures or tile in this erosion control plan?

(d) Do any of the following cause you to object to the use of the structures or tile in this plan?

(e) You have stated that you object to the use of structures or tile in this mechanical erosion control plan. What situations would have to change in order to overcome your objections?

Plan 2 - Vegetative Plan (Tract No. _____)

[INT: Refer once more to the aerial photo. Go over the land uses or rotations for Plan 2 as suggested for each field. Read through the accompanying instructions.]

4. (a) Do you consider the use of contouring within this vegetative erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 35

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of contouring in this erosion control plan?

[INT: Check the volunteered reasons which you can clearly categorize in Col. (b-c) and go to Item (c).]

| Col. (b-c) Volunteer | | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|---|
| ____ | (1) | Do you see the need for contouring as recommended in this plan? . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (2) | Does the field or road layout on this tract cause you to object to contouring? . . . . . | ___ | ___ | ___ |
| ____ | (3) | Do you object to contouring in this plan because of the difficulty of farming point rows with large equipment? . . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) | Do you feel contouring reduces yields more than costs? . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (5) | Do you believe contouring reduces erosion? . | ___ | ___ | ___ |
| ____ | (6) | Do you feel that contouring as suggested by this plan would reduce your profits on this tract? . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (7) | Other ______________________________ | | | |
| ____ | (8) | ______________________________ | | | |

(c) Are there any other reasons why you object to contouring in this erosion control plan? (Categorize and record in Col. (b-c).)

(d) Do any of the following cause you to object to contouring in this erosion control plan?

[INT: Read all items not clearly volunteered by R and check appropriate response under Col. (d).]

(e) You have stated that you object to the use of contouring in this vegetative erosion control plan. What situations would have to change in order to overcome your objections?

[INT: It is extremely important to encourage the R to address this question directly and in some detail. No recording is necessary on the questionnaire for Item (e).]

5. (a) Do you consider the rotations suggested by this vegetative erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 36

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of these rotations?

[INT: Check the volunteered reasons which you can clearly categorize in Col. (b-c) and go to Item (c).]

| Col. (b-c) Volunteer | | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|---|
| ____ | (1) | (For rented land only) Does the lack of your landlord's cooperation cause you to object to these rotations? . . . . . . . . . | ___ | ___ | ___ |
| ____ | (2) | Do you disapprove of the amount or kind of these recommended rotations? . . . . . . . . | ___ | ___ | ___ |
| ____ | (3) | Do these rotations contradict your established farming methods? . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) | Do you expect to be farming this tract long enough to follow these rotations? . . . | ___ | ___ | ___ |
| ____ | (5) | Do you believe that these rotations would reduce your profits on this tract? . . . . . | ___ | ___ | ___ |
| ____ | (6) | Other ______________________________ | | | |
| ____ | (7) | ______________________________ | | | |

(c) Are there any other reasons why you object to these rotations?

(d) Do any of the following cause you to object to the rotations proposed in this erosion control plan?

[INT: Read all items not clearly volunteered by R and check appropriate response under Col. (d).]

(e) You have stated that you object to the rotations in this vegetative erosion control plan. What situations would have to change in order to overcome your objections?

[INT: It is extremely important to encourage the R to address this question directly and in some detail. No recording is necessary on the questionnaire for Item (e).]

5. (a) Do you consider the use of waterways within this vegetative erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Q. 37

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of waterways in this erosion control plan?

| Col. (b-c) | | Col. (d) | | |
|---|---|---|---|---|
| Volunteer | Reason | No | Yes | N.A. |
| ____ | (1) Does your field or road layout cause you to object to the proposed waterways? . . . . | ___ | ___ | ___ |
| ____ | (2) Do you see a need for these waterways? . . . | ___ | ___ | ___ |
| ____ | (3) Do you feel that waterways require too much work to keep them from building up or cutting out? . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) Have you found that the use of herbicides ruins grass stands in waterways? . . . . . . | ___ | ___ | ___ |
| ____ | (5) Do you feel that these proposed waterways would reduce your profits on this tract? . . | ___ | ___ | ___ |
| ____ | (6) Other ______________________________ | | | |
| ____ | (7) ___________________________________ | | | |

(c) Are there any other reasons why you object to waterways in this erosion control plan?

(d) Do any of the following cause you to object to the waterways in this erosion control plan?

(e) You have stated that you object to the use of waterways in this vegetative erosion control plan. What situations would have to change in order to overcome your objections?

. (a) Do you consider the use of <u>conservation tillage</u> within this vegetative erosion control plan objectionable in any way relative to your farm enterprise?

____ No ——> Go to Section V, page 25

____ Yes ——> Go to Item (b)

(b) Would you tell me why you object to the use of <u>conservation tillage</u> within this erosion control plan?

| Col. (b-c) Volunteer | Reason | Col. (d) No | Yes | N.A. |
|---|---|---|---|---|
| ____ | (1) Do you see the need for conservation tillage as proposed in this plan? . . . . . | ___ | ___ | ___ |
| ____ | (2) Does conservation tillage contradict your established farming methods? . . . . . . . . | ___ | ___ | ___ |
| ____ | (3) Do you think conservation tillage reduces yields more than costs? . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (4) Do you think conservation tillage reduces erosion? . . . . . . . . . . . . . . . . . . | ___ | ___ | ___ |
| ____ | (5) Other ______________________________ | | | |
| ____ | (6) ______________________________ | | | |

(c) Are there any other reasons why you object to <u>conservation tillage</u> in this erosion control plan?

(d) Do any of the following cause you to object to the use of <u>conservation tillage</u> in this erosion control plan?

(e) You have stated that you object to the use of <u>conservation tillage</u> in this vegetative erosion control plan. What situations would have to change in order to overcome your objections?

## SECTION V. General Information

38. What is your age at the present time? ______ years

39. How many years of schooling did you complete? ______

40. Would you classify your farm operation as

________ cash grain
or
________ livestock

41. Approximately what percent of your gross income in 1974 will come from this (Q. 40) type of farm enterprize? __________%

42. (a) Did you do any off-farm work for pay in 1974 (include custom farming but do not include exchange labor)?

________ No

________ Yes ——→ (b) How many days? __________

(b) Did your wife (if any) or any other member of your family work off the farm for pay in 1974?

| No | Yes | |
|---|---|---|
| ____ | ____ | Wife |
| ____ | ____ | Other family member(s) |

[HAND R THE GREEN CARD]

(d) Thinking of all the sources of income of your family in 1974, which letter on this card most closely represents your family's gross income?

________ (letter)

[If YES to either (a) or (c), show R the YELLOW card and ask: ]

(e) Thinking of all the sources of off-farm income of your family in 1974, which letter on this card most closely represents your family's total (off-farm) income?

________ (letter)

(f) If you were to compare your estimated 1974 net income with your total net income of five years ago, would you say you made ....

____ more money in 1974 }
____ less money } ——→ Go to Item (g)
____ about the same? ——→ Go to Q. 43

(g) What has caused this change in your net income? (Read. Check all applicable)

_____ higher prices _____ larger volume _____ higher costs

_____ lower prices _____ smaller volume _____ lower costs

Other ______________________________

43. (a) At the present time, what would you estimate the short term debts for this farm to be, including such things as feed, fertilizer, machinery, livestock and other farm expenses?

$ __________

(b) Is this amount about the average short term indebtedness for this farm?

_____ No ——> (c) What would you estimate the average amount to be?

$__________

_____ Yes

44. What farm enterprise do you like to work with ....

.... the most? ____________________

.... the least? ____________________

45. (a) What do you consider to be the most promising investment opportunity today for your farming enterprise? ____________________

(b) What do you consider to be the 2nd most promising investment opportunity today for your farming enterprise? ____________________

46. (a) Comparing your present financial situation with that of five years ago, would you say you are in a better position or worse position to make such investments at the present time?

_____ Better

_____ Worse

(b) Is it likely that you will make such an investment within the next year or so?

_____ No

_____ Yes

(c) Why do you say that? ____________________

______________________________

[If erosion control practice is mentioned in Q. 45 (a) or (b), skip to Q. 48
If erosion control practice is not mentioned in Q. 45 (a) or (b), ask:]

47. (a) Do you consider erosion control practices to be a good investment possibility?

_____ No ⟶ (b) Why not? ______________________________

______________________________

_____ Yes

(c) Do current interest rates prevent you from investing in erosion control practices?

_____ No

_____ Yes

(d) Have the increasing costs of erosion control practices delayed any plans you might have had this year to use additional practices on this farm?

_____ No

_____ Yes

(e) Did high cash grain prices in 1973 cause you to increase corn and soybean acreage on steep sloping land in 1974?

_____ No

_____ Yes

48. (a) Are you a member of the Soil Conservation District in your county?

_____ No

_____ Yes

(b) Are you a member of an organized watershed?

_____ No

_____ Yes

_____ Not Available

(c) Are you now receiving any assistance from governmental agencies to implement soil erosion control?

_____ No ⟶ Go to (f)

_____ Yes ⟶ (d) Who do you get the money from? ______________

(e) For what practices? ______________

(f) Have you experienced any difficulty within the last two years obtaining either state or federal funds for soil erosion control?

_____ No

_____ Yes ⟶ (g) What was the difficulty? ____________________

____________________________________________

(h) Which branch of the government? ____________

51. Do you believe in general that farmers in western Iowa are putting forth enough effort to adequately control soil erosion?

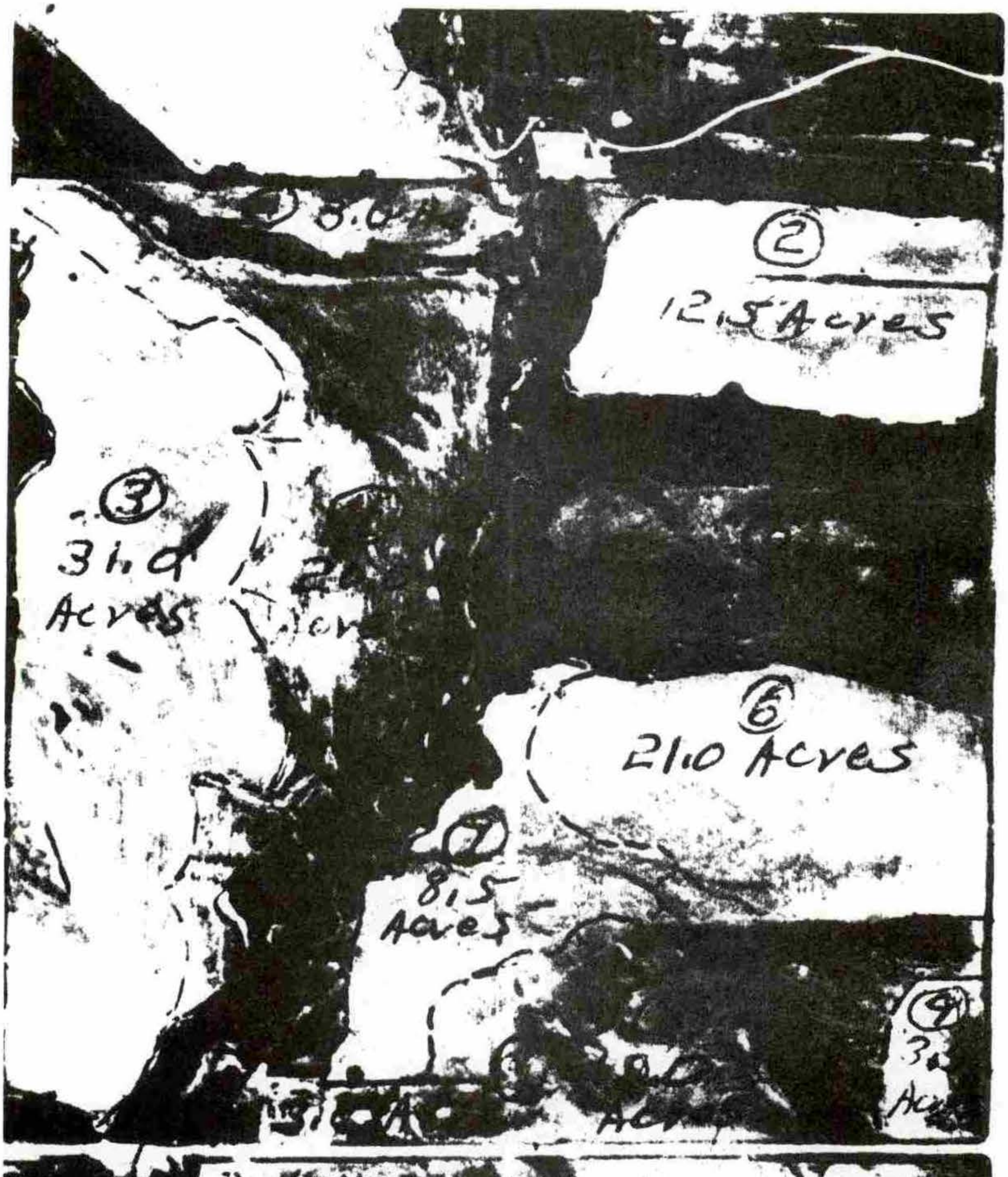
_____ No

_____ Yes

_____ (Uncertain)

Ending Time _________

APPENDIX C. SOIL CONSERVATION SERVICE FARM PLAN NUMBER SEVENTY-SEVEN



2
12.5 Acres
3
31.0 Acres
6
21.0 Acres
7
8.5 Acres


3
24
16
2
24
11
2
10-16-3
1-7-3
10-11-2
10
7
2

Farm #77 Mechanical Plan

| Field # | Acres | Rotation | Practices | Kind/Amt. of Practices |
|---|---|---|---|---|
| 4. | 20.0 | CSb | Contouring, Conservation Tillage | |
| 7. | 8.5 | CSb | Contouring, Conservation Tillage | |
| 1. | 3.0 | RRR | Contouring, Terraces, Conservation Tillage | Parallel level grass backslope terrace |
| 2. | 12.5 | RRR | Contouring, Terraces, Conservation Tillage | Parallel level grass backslope terrace |
| 3. | 31.0 | RRR | Contouring, Terraces, Conservation Tillage | Parallel level grass backslope terrace |
| 5. | 11.5 | RRR | Contouring, Terraces, Conservation Tillage | Parallel level grass backslope |
| 6. | 21.0 | RRR | Contouring, Terraces, Conservation Tillage | Parallel level grass backslope |
| 9. | 3.5 | RRR | Contouring, Terraces, Conservation Tillage | Parallel level broadbase |
| 8. | 10.0 | permanent pasture | | Pasture management and parallel level grass backslope on west part |
| 10. | 32.0 | wildlife | | |
| Total | 160.0/including 7 acres lots and roads | | | |

1. Approximately 5.5 miles of terraces are needed to implement the mechanical plan (this farm has a few terraces already built).

2. About 5000 feet of waterway needed on this farm (there may be some "overfall" problems where waterways empty into gully in field #10).

3. Use conservation tillage methods as indicated.

4. Apply lime and fertilizer as tests indicate.

5. Contour all row crops.

Farm #77 Vegetative Plan

| Field # | Acres | Rotation | Practices | Kind/Amt. of Practices |
|---|---|---|---|---|
| 4. | 20.0 | CSb | Contouring, Conservation tillage | |
| 7. | 8.5 | CSb | Contouring, Conservation tillage | |
| 9. | 3.5 | RRR | Contouring, Conservation tillage | |
| 5. | 11.5 | CCOM | Contouring, Conservation tillage | |
| 1. | 3.0 | CCOMM | Contouring, Conservation tillage | |
| 6. | 21.0 | CCOMMM | Contouring, Conservation tillage | |
| 2. | 12.5 | COM | Spring plowing, Contouring | |
| 3. | 31.0 | COMMM | Spring plowing, Contouring | |
| 8. | 10.0 | permanent pasture | | Pasture management program |
| 10. | 32.0 | wildlife | | |

Total 160 Acres/including 7 acres lots and roads

1. About 5000 feet of waterway needed on this farm (there may be some "overfall" problems where waterways empty into gully in field #10).

2. Use conservation tillage methods as indicated.

3. Contour all row crops.

4. Apply lime and fertilizer as tests indicate.

# APPENDIX D. DATA CODING AND SOIL LOSS FORMS

# Soil Loss Form

'arm Number _______

:xisting Situation — Goals

| 'ield # | Acres | RKLSP | C | T./A. | Total | Field # | Acres | RKLSP | C | T./A. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 'otal | | | | | | | | | | | |

Summary

| ctual Situation | | Goals | |
|---|---|---|---|
| 'otal Acres Tilled | ________ | Total Acres Tilled | ________ |
| .ve. Soil Loss | ________ | Ave. Soil Loss | ________ |
| 'otal Acres P.P. | ________ | Total Acres P.P. | ________ |
| .ve. Soil Loss | ________ | Ave. Soil Loss | ________ |
| 'otal Acres | ________ | Total Acres | ________ |
| ve. Soil Loss | ________ | Ave. Soil Loss | ________ |
| ve. Size of Existing Fields | ________ | Ave. Size of Existing Fields | ________ |

# SCS FARMERS - Card 01

(cc = 113)

| | |
|---|---|
| Card (01) | 1 2 |
| Identification Number | 3 4 5 |
| County number | 6 7 |

24 - Crawford
36 - Fremont
43 - Harrison
47 - Ida
65 - Mills
67 - Monona
75 - Plymouth
78 - Pottawattamie
83 - Shelby
97 - Woodbury

Sex of Respondent — 8

1 = Male
2 = Female

Interviewer Number — 9

1 = Bottorff
2 = Dreeszen
3 = Emmons
4 = Thorpe
5 = Houser & Cook or Houser

1. Acres owned and/or rented and operated.

Code actual number of acres
(In Cols. 10-24, 0's = no acres in that field)

| | |
|---|---|
| (a) How many acres of land did you own in 1974? | 10 11 12 13 |
| (b) How many did you rent to others? | 14 15 16 |
| (c) Total acres owned and operated? | 17 18 19 20 |
| (d) Acres rented from others and operated? | 21 22 23 24 |
| (e) Total acres operated? | 25 26 27 28 |

2. Tracts owned and/or rented and operated.

Code actual number of tracts
(In Cols. 29-33, 0's = no tract in that category)

| | |
|---|---|
| (a) How many tracts in the acres are owned and operated? | 29 30 |
| How many owned and operated tracts in the acres are on the photograph? | 31 |
| (b) How many tracts in the acres are rented and operated? | 32 |
| How many rented and operated tracts in the acres are on the photograph? | 33 |

(Columns 34-53 is information for owned acres on photo. Any additional tracts are coded in the same columns on cards 02, 03, and 04 - as applicable.)

Owned Land: (Table A) (Blanks in Cols. 34-53 = No owned land on photo)

(a) Number of owned acres in the tract on photo? 34 35 36

(c) How long have you owned this tract? 37 38

Code actual years
01 = 1 year or less

(d) How was this tract acquired? (Col. 39 is always 0) 39 40

Purchased:
01 = Mortgage
02 = Contract
03 = Cash
04 = Inherit (gift)
05 = Trade
06 = Combination 3 & 4
07 = Combination 2 & 4
08 = Combination 1 & 4

(e) Price per acre when purchased 41 42 43 44

Code actual dollars
9999 = No response

(f) About how much would the land and buildings sell for now? 45 46 47 48

Code actual dollars
9999 = No response

(g) Do you still owe money on this tract? 49

0 = No (Col. 50 = 8)
1 = Yes

If YES, is this debt restricting your investment in improvements for this farm? 50

0 = No
1 = Yes
8 = N.A.

(h) Do you expect to be operating this tract 1 year from now? 51

Do you expect to be operating this tract 5 years from now? 52

0 = No
1 = Yes
9 = D.K.

(i) Plans for this tract when you quit farming it? 53

1 = rent out
2 = sell
3 = keep in family
4 = 1 or 3
5 = don't know
6 = 2 or 3
7 = 1 or 2

(Columns 54-71 is information for rented acres on photo. Any additional tracts are coded in the same columns on cards 02, 03, and 04 - as applicable.)

Rented Land: (Table A) (Blanks in Cols. 54-71 = No rented land on photo)

Number of acres in this tract on photo? 54 55 56

(k) Lease arrangements for this tract 57

1 = Cropshare only
2 = Cropshare and cash
3 = Cash only
4 = Livestock share
~~5 = Others (specify)~~

(l) Is the lease written or verbal? 58

1 = Written
2 = Verbal
~~3 = Other (specify)~~

(m) What is the length of the lease (years)? 59 60

Code number of years
51 = Indefinite
52 = Long time

(n) Have you ever suggested lease changes to your landlord? 61

0 = No
1 = Yes

(o) Does rental agreement provide for sharing expenses of erosion control practices? 62

0 = No (If 0 in col. 62, columns 63-64 = 88)
1 = Yes

If YES, please explain 63 64

01 = They would stand for cat. work, if any done.
02 = Landlord would take care of expense with government assistance.
03 = Landlord took care of terrace expense.
88 = Not Applicable
99 = No Response

(p) Is your landlord concerned about erosion control on this tract? 65

0 = No
1 = Yes (If 1 in col. 65, columns 66-67 = 88)

If NO, why not? 66 67

01 = Erosion is no problem; haven't had much problem.
02 = Landlord not interested in conservation - just rents.
03 = She is a widow and not as concerned.
04 = He just never thinks about it; never mentions it.
05 = Waterways should have been rebuilt and more acres contoured.
06 = Reel elderly and health not good; elderly.
07 = Refuse tract to follow that rented it before

Continued -

(p) Continued



08 = It is all terrace, not interested in doing more.
~~09 = Concerned about erosion; wouldn't build terraces.~~
88 = Not Applicable
99 = No Response

(q) How many years have you been farming? 68 69
(to compute, subtract the year given from 1975)

(r) Do you expect to be operating this tract 1 year from now? 70

Do you expect to be operating this tract 5 years from now? 71

0 = No
1 = Yes
9 = No Response or Don't Know

72

1 = Own only
2 = Rent only
3 = Own and rent
4 = Corporation #118

SCS Farmers - # 740070

Card 5

cc: 113

Card number 1 2

Schedule number 3 4 5

4. Do you have an erosion problem with any of the following on this farm:

0 - No problem
1 - Most serious problem
2 - Have a problem

Gullies? 6

Sheet erosion? 7

Siltation? 8

Water run off? 9

Other: 1 - Flooding river 10
2 - Small ditches
3 - Rills with heavy rains
4 - Hard to keep dam fixed
5 - Everything (105)

BLANK 11

5. Do you consider soil erosion on your farm: 12

1 - A major problem
2 - Somewhat of a problem
3 - A problem, but need no action
4 - No problem

6. (k) Looking again at the list of practices on the (BLUE) card, are there any practices that you prefer not to use on this farm at the present time? 13

0 - No (Cols. 14 to 29 = 8's)

1 - Yes (followed by zeros in applicable columns if no 2nd, 3rd, or 4th "practice" and "reason.")

| | (a) Practice | | (b) Reason | |
|---|---|---|---|---|
| First | 14 | 15 | 16 | 17 |
| Second | 18 | 19 | 20 | 21 |
| Third | 22 | 23 | 24 | 25 |
| Fourth | 26 | 27 | 28 | 29 |

(a)

01 - Terracing
~~02 - Waterways~~
03 - Conservation tillage
04 - Contouring
05 - Contour listing
06 - Seeding steep slopes
07 - Strip cropping
~~08 - Residue utilization~~
09 - Gully-control structures
10 - Tree plant
11 - New permanent pasture
12 - Tile drainage
13 - High forage rotations

Card 5 (cont.) page 3

6.(k) continued.

(b) Reason

01 - Cost: the farm area is too small for new permanent pasture (012)
too much wasted ground (028)
can't afford to on cash rent (094)
too good a farm to plant trees (083)

02 - No need; don't want; enough pasture; enough trees

03 - Other practice used: contouring normally does good enough (002)
minimum tillage is better (081)

04 - Don't like; doesn't believe in: terraces; listing
conservation tillage - doesn't let rain absorb
makes more ditches (098)
not properly constructed (086)
without permanent boundary line, I don't like it (024)
ruin it for farm ground (029)
not his way of farming (046)
want to plow stubble ground (060)
too much waste land (060)
doesn't yield as good (082)
think it would cause more erosion (087); makes soil wash worse (115)
weed control problem (096)
don't think too much of this as I like to pasture (100)

05 - ASCS cuts your corn base (006)

06 - Machinery: wouldn't fit terrace and destroy too much crop (008)
wouldn't have proper machinery (038)(039)(105)(116)

07 - Wrong soil type: for listing (008, 012, 015)
hard rain - then covers crop with dirt
doesn't work here (036)
ground has too much clay soil - needs plowing (106)
too much trouble with crusting over (109)

08 - Not practical: hills lay so would need too many short terraces
don't think ground is steep enough to need this (018)
ground is too steep (059, 068)
too hilly (040)
hills too short and steep
too rocky (051, 052)
don't have enough soil on hills to warrant listing
wouldn't work here (050, 111)
too hard to do it here (058)
too much of a job to farm around (104)
corn muds under too easy
moving from farmstead and too far to keep cattle (102)
too hard to keep ground clean and don't get residue down where needed (115)

SECTION III. Soil Erosion Control and Farming Practices

7.(a) Do you have any current information concerning the costs of individual erosion control practices? 30

0 - No (Cols. 31 to 35 = 8's)
1 - Yes

(b) If Yes, which practice(s)? First 31 32

Second 33 34

01 - Terracing
02 - Waterways
09 - Gully control
14 - Use of bulldozer for dams; repairing crossing (069)

00 in Cols. 33,34 if no 2nd practice

8888 - N.A.
9999 - No response

(c) Do you have any estimates of the returns of this particular erosion control practice? 35

0 - No
1 - Yes
7 - D.K.
8 - N.A.
9 - N.R.

8. What do you consider to be the main benefits of erosion control practices?

0 - No
1 - Yes

Maintain soil productivity 36

Increase yields 37

Reduce runoff pollution 38

No benefits 39

Hold top soil and water 40

Don't know 41

Other : First 42

1 - Saves labor and expense; saves fertilizer (082) easier to farm; can use less fertilizer (106) Second 43
2 - Conserves moisture in dry weather
3 - Helps my neighbors
4 - Save tillage land (027); stop stand loss (077) ground in shape (115)
5 - Can rotate better
6 - Prevent gullies
7 - Looks better also (043); weed control (112)
8 - Less chance of accidents (091)

0 in Col. 43 if only one "other"

9. (a) Does water run off from other farms damage your farming operation? 44

0 - No (Cols. 45 to 47 = 8's)
1 - Yes

(b) Is anything being done to stop this water run off? 45

0 - No
1 - Yes
2 - Yes and No (Schedules 052, 065)
8 - N.A.

If No, what needs to be done? First response 46

Second response 47

1 - Terraces
2 - Waterways
3 - Contouring
4 - Gully control structure
5 - Dams
6 - More watersheds
7 - Weed control; less plowing (there is one of each)
9 - Isn't too much can be done (103)

0 in Col. 47 if no second response

If Yes, What is being done?

1 - Terraces
2 - Waterways
3 - Contouring
5 - Building dam
6 - Building new road to divert it (089)

10. (a) Are you aware of the 1971 Conservancy District Act for the State of Iowa? 48

0 - No (Col. 49 = 8)
1 - Yes (go to b)

(b) What do you think of this state law ...? 49

1 - It's for the birds; not much
2 - It is all right; I believe in it; good idea; thinks it is good
3 - Don't like giving people orders - this is a free country
4 - Doubt it can be enforced; can't control it
5 - No judgment; undecided; not sure

BLANK 50

Card 05 (cont.) page 6

11.(a) Do you consider yourself well informed about soil conservation practices? 51

0 - No (Col. 52 to 58 = 8's)
1 - Yes (go to b)

(b) What do you consider the best sources of information concerning soil conservation practices?

0 - Not checked
1 - Checked
8 - N.A.
9 - N.R.

Soil Conservation Service 52

ISU Extension Service 53

Newspapers 54

TV - Radio 55

Friends and neighbors 56

Personal experience 57

Other: 58

1 - Magazines
2 - ASCS
~~3 - Land Grant University~~
4 - Farm meetings
~~5 - Farm management education class (096)~~

12.(a) Have you sought advice concerning soil erosion control in the last year? 59

0 - No (Cols. 60, 61 = 8's)
1 - Yes (go to b)
9 - N.R.

(b) From whom? 60 61

1 - SCS
2 - Different farmers
3 - ASCS
4 - Extension office
8 - N.A.
9 - N.R.

0 in Col. 61 if only one source given (there is only 1 response in Col. 61)

BLANK 62

13. (a) Do you recall being interviewed previously? 63

0 - No (Cols. 64 to 67 = 8's)
1 - Yes (go to b)

(b) Which years?

| | | |
|---|---|---|
| 0 - Not interviewed | 1949 | 64 |
| 1 - Yes | 1952 | 65 |
| 8 - N.A. | 1957 | 66 |
| 9 - N.A. or D.K. | | |

(c) Did this previous interview have any effect upon your thinking toward soil erosion? 67

0 - No
1 - Yes
8 - N.A.
9 - N.R.

14. (a) Do you believe that soil erosion should be a concern of the public? 68

0 - No (Col. 69 = 8)
1 - Yes (go to b)

(b) Should the taxpayer help share the cost of soil erosion control? 69

0 - No
1 - Yes
7 - D.K.; not sure; undecided
8 - N.A.
9 - N.R.

SCS Farmers - Card 06

cc: 113

Card number (06) 1 2

Schedule number 3 4 5

15. In this part could we talk a little in general about some of your farming practices on all the land that you farm?

(a) Do you generally remove straw from your grain fields? 6

(b) Do you generally turn under green manure? 7

(c) Do you cut clover in your oat stubble for hay? 8

(d) Do you pasture oat stubble in the fall? 9

0 = No
1 = Yes
8 = N.A. (027 - soil bank)

(e) In general, how do you plant your row crops? Do you plant ... 10

1 = Up and down hill
2 = Across slopes in straight rows
3 = On the contour
4 = 1 and 2
5 = 1, 2 and 3
6 = 2 and 3
7 = 1 and 3
9 = No response

(f) Do you like to plow for row crops in the fall? 11

0 = No
1 = Yes

(g) Do you use any other equipment to plow other than a mold-board plow? 12

0 = No (Col. 13 = 8)
1 = Yes

If Yes, what? 13

1 = Disk; disk-harrow
2 = Chisel
3 = Minimum tillage planter
4 = Chisel plow and heavy disk
8 = N.A.

16. Do you apply fertilizer in the fall? 14

0 = No (Cols. 15, 16 = 88)
1 = Yes

If Yes, what percent is usually applied at that time? 15 16

Code percent given
88 = N.A.
99 = No response

17. Is wind erosion a problem on this farm? 17

0 = No (Cols. 18-20 = 888)
1 = Yes

If Yes, are you doing anything to correct this? 18

0 = No
1 = Yes
8 = N.A.

If Yes, what are you doing? 19 20

01 = Not plowing in field
02 = Strip farming some
03 = Windbreak
88 = N.A.

18. (a) Have you had any acres abandoned or lost (on all land farmed) because of ...

| | (a) item | (b) acres |
|---|---|---|
| Flooding? | 21 | 22 23 |
| Erosion, wash out? | 24 | 25 26 |
| Silted in? | 27 | 28 29 |

Cols. 21, 24, 27: 0 = No
1 = Yes

(b) If Yes, how many acres?

Cols. 22-23, 25-26, 28-29: Code actual acres
88 = No acres

If No in Cols. 21, 24 and 27, Cols. 30-32 = 888

(c) Would better erosion control practices have reduced this abandoned and/or lost acreage? 30

0 = No
1 = Yes
8 = N.A.

(d) If Yes, by about what percent? 31 32

Code actual percent

88 = N.A.
98 = 98 or more
99 = N.R.

19. (a) During this crop season have you had stands reduced because of erosion or flooding? 33

0 = No (Cols. 34-39 = 8's)
1 = Yes

(b) If Yes, on how many acres? 34 35 36

Code actual acres
888 = No acres or N.A.

(c) Would better erosion control practices have reduced this stand loss? 37

0 = No (Cols. 38,39 = 88)
1 = Yes
8 = N.A.
9 = N.R. or D.K.

(d) If Yes, what percent? 38 39

Code actual percent
88 = N.A.
98 = 98 or more
99 = N.R. or D.K.

20. (a) Concerning only the farm shown in the aerial photo at the present time, do you have any of the following and if so how many?

000 = None
Code actual number

| | | | |
|---|---|---|---|
| Cows (beef or dairy and calves) | 40 | 41 | 42 |
| Feeder cattle | 43 | 44 | 45 |
| Any other cattle | 46 | 47 | 48 |
| Sows | 49 | 50 | 51 |
| Feeder hogs | 52 | 53 | 54 |
| Any other hogs | 55 | 56 | 57 |
| Ewes | 58 | 59 | |
| Any other sheep | 60 | 61 | |
| Horses | 62 | 63 | |

S.C.S. Farmer - Project #740070

Card Number 07

(c.c. = 109 operators)
113 farms

| | | | | |
|---|---|---|---|---|
| Card Number | | | 1 | 2 |
| Schedule Number | | 3 | 4 | 5 |

Section V. - General Information

| | | | | |
|---|---|---|---|---|
| Q. 38 | Present age (range 22-81) | | 6 | 7 |
| Q. 39 | Years of schooling (range 3-16) | | 8 | 9 |
| Q. 40 | Operation classification as: | | | 10 |

1 = cash grain
2 = livestock
3 = ½ grain, ½ livestock
8 = all in soil bank

Q. 41 Percent of income from this type of farm enterprize — 11 12

Code actual percent
99 = 99% or more

Q. 42 (a) Work off-farm in 1974 — 13

0 = No
1 = Yes

If YES, number of days — 14 15 16
Code actual days
888 = Did not work off-farm
999 = No Response

(b) Wife work off-farm — 17
Other family member(s) work off-farm — 18

0 = No
1 = Yes
8 = N/A, lives alone

(d) Family's gross income for 1974 — 19 20

01 = A <10,000
02 = B 10 - 15
03 = C 15 - 20
04 = D 20 - 25
05 = E 25 - 30
06 = F 30 - 40
07 = G 40 - 50
08 = H 50 - 60
09 = I 60 - 70
10 = J 70 - 80
11 = K 80 -100
12 = L 100,000 >
99 = N/A. (ref.)

(e) Total family's off-farm income 21

1 = A <1,000
2 = B 1 - 3
3 = C 3 - 5
4 - D 5 - 8
5 = E 8 -10
6 = F 10 >
8 = N/A (none)
9 = No Response

(f) Compare 1974 income with 5 years ago 22

1 = More money in 1974
2 = Less money in 1974
3 = Same money as in 1974 (Columns 23-26 = 8)
8 = N/A (was not farming 5 yrs ago) (Columns 23-26 = 8)

(g) Cause of change

Prices - 23
1 = Higher
2 = Lower
8 = N/A

Volume - 24
1 = Larger
2 = Smaller
8 = N/A

Costs - 25
1 = Higher
~~2 = Lower~~
8 = N/A

Other - 26
8 = No other
1 = Better Crop
2 =
3 = Increase in off-farm income, job
4 = Drought this year
5 = More equity in investments
7 = Miscellaneous (death of husband, getting smarter, renter hasn't paid, better bookkeeping, retiring, 5 years ago was first year I farmed)

Q. 43 (a) Short term debts for this farm? 27 28 29 30 31 32

Code amount given
000000 = None
888888 = Rents out land

(b) Is this average? 33

0 = No
1 = Yes
8 = D.K. (just started farming, it varies so much)

If NO, what is average? 34 35 36 37 38 39

888888 = D.K. (just started farming, it varies so much)

If YES, repeat amount in columns 27-32

Q. 44 Farm enterprise you like most 40

Farm enterprise you like least 41

0 = All the same
1 = Grain, field crops, field work (driving tractor)
2 = Livestock - general (chores)
3 = Pasturing, soil erosion practices
4 = Cattle - dairy, beef
5 = Hogs, farrowing, pigs
6 = Beans (walking the beans)
7 = Haying
8 = Miscellaneous (haul manure, pitch manure, cutting weeds, chickens, sick livestock, cleaning buildings, back work, fencing, shell corn, overhaul machinery, mow lawn, custom work)
9 = NR (or none)

Q. 45 Most promising investment today 42

Second most promising investment today 43

0 = Govt. bonds, off-farm investments, ag business, family education
1 = Miscellaneous (improve land, good farming practice, seeding down, pasturing, grain storage, grain drying, machinery, equipment, new well and silo, fertilize and herbicide, improving land, improve buildings, varied production)
2 = Conservation, building dams, terracing, erosion control and practices
3 = Grain, corn, crops, beans
4 = Land
5 = Cow-calf herd, beef, dairy
6 = Hogs (facilities)
7 = Livestock
8 = D.K.
9 = N.R. (or none, retiring, so N/A)

Q. 46 (a) Better or worse financial situation than 5 yrs ago 44

1 = Better
2 = Worse
3 = About the same
8 = D.K.

(b) Likely to invest in next year 45

0 = No
1 = Yes
8 = D.K. (not sure, waiting for S.C.S.)

(c) Why do you say that 46

If had NO for response:
1 =
2 = Do not have money; have lost money; will not invest more at this time
3 = Husband died; thinking of retiring; getting too old; quit farm; health; slowing up.
4 = Do not plunge into things; prices too high; things are too uncertain; let it level off a little

5 = Have all (cows)(land) I can handle now; it all goes back into the farm
7 = Depends on what happens; can't think of anything
8 = No land to buy

If had YES for response:

1 = Surplus money; land is like social account; buy hogs and cattle; more funds available; looking for land to buy
2 = Don't know any better; will gamble on price; farm looks good
3 = Buy something that pays interest (bonds); like to invest in stock cows; not operating at capacity; buy machinery every year
4 = Must keep growing or can't make a go of it; That's my life; need machinery shed; will rent more land; have hay for more cows and land for more cows
8 = Miscellaneous (if land is available to rent; if govt. funds are available; must raise crops; livestock prices dropped; "seeding down"; might have dry year; not good investment; expected of us; retiring rougher land so can realize more; building dams now; milking is sure money
9 = N.R.

Q. 47 (a) Erosion practice good investment <u>47</u>

0 = No
1 = Yes (Col. 48 = 8)
9 = N.R.

(b) If NO, why not <u>48</u>

1 = Have enough
2 = Erosion control isn't bad, need to build up livestock
3 =
7 = Rents land
8 = N/A (Thinks it <u>is</u> good investment)
9 = N.R.

(c) Current interest rates prevent you from investing in erosion control practices? <u>49</u>

0 = No
1 = Yes
8 = N/A (rents only)

(d) Increasing costs of erosion control delayed any plans you might have had this year to use additional practices on this farm? <u>50</u>

0 = No
1 = Yes

(e) High cash grain prices in 1973 cause increase in corn and soybean acreage on steep sloping land in 1974? <u>51</u>

0 = No
1 = Yes
8 = N/A (didn't farm last year)

Q. 48 (a) Soil Conservation District member? 52

0 = No
1 = Yes
8 = D.K.

(b) Member of an organized watershed? 53

0 = No 2 = DK if available
1 = Yes 8 = Not available

(c) Receiving assistance from govt. agencies to implement soil erosion control? 54

0 = No
1 = Yes
2 = Advice, not financial

(d) If YES, who from 55

1 = Federal Govt.
2 = S.C.S.
3 =
4 =
7 = Combination: S.C.S. & A.S.C. or State & Fed.
8 = N/A (no assistance)

(e) What practices? 56

1 = 10 year soil conservation plan
2 = Conservation in general
3 = Terracing (& waterways)
4 = Gully control, dam
7 = Combination: Dams & terraces; or Terracing, seeding, and fertilizing
8 = N/A (no practices)

(f) Experienced difficulty getting state or federal funds for soil erosion control within last 2 years? 57

0 = No (Col. 58,59 = 88)
1 = Yes
2 = No, but haven't applied (Col. 58,59 = 88)

(g) If YES, what was difficulty? 58

1 = Water cutting fence line, but not dam, so refused money
2 = Lack of funds
3 =
7 = Miscellaneous (got the run around; never heard regarding the dam)
8 = N/A (didn't apply; no difficulty)

(h) Which branch of government? 59

1 = S.C.S.
2 = Federal
3 = State
4 = A.S.C.
7 = Federal & State
8 = N/A
9 = N.R.

Q. 51 Believe farmers are putting effort out to control soil erosion? 60

0 = No
1 = Yes
2 = D.K. (uncertain)
9 = N.R.

SCS Farmers - 740070

cc: 113

Card 20

| | Column(s) |
|---|---|
| Card number (20) | 1 2 |
| Schedule number (ID number for farms) | 3 4 5 |
| 27.(a) Is terracing an obstacle in the mechanical erosion control plan (MECP)? | 6 |

0 = No (Cols. 7-21 = 8's)
1 = Yes
8 = N.A.

(b) 1) Is landlord cooperation an obstacle for terracing in the MECP? — 7

0 = No
1 = Yes
8 = N.A.
9 = D.K.

2) Is recommended amount of terracing an obstacle for terracing in the MECP? — 8

0 = No
1 = Yes
8 = N.A.

3) Are alternative uses for income an obstacle for terracing in the MECP? — 9

0 = No
1 = Yes
8 = N.A.

4) Is failure to see need for terracing an obstacle in the MECP? — 10

0 = No
1 = Yes
8 = N.A.

5) Are established farming methods obstacles for terracing in the MECP? — 11

0 = No
1 = Yes
8 = N.A.

6) Is the existing field or road layout an obstacle for terracing in the MECP? — 12

0 = No
1 = Yes
8 = N.A.

7) Is present machinery an obstacle for terracing in the MECP? 13

0 = No
1 = Yes
8 = N.A.
9 = D.K.

8) Is the suggested terrace design an obstacle for terracing in the MECP? 14

0 = No
1 = Yes
8 = N.A.

9) Is installation cost an obstacle to terracing in the MECP? 15

0 = No
1 = Yes
8 = N.A.
9 = D.K.

10) Is terrace maintenance an obstacle for terracing in the MECP? 16

0 = No
1 = Yes
8 = N.A.
9 = D.K.

11) Does respondent have substitute erosion control practice(s) for terracing? 17

0 = No
1 = Minimum tillage
2 = Contouring
3 = High forage rotations
4 = Minimum tillage and contouring
5 = Minimum tillage, contouring, and rotations
6 = Dam(s) or waterways
7 = Contouring and rotations
9 = Strip cropping
8 = N.A.

12) Does respondent believe that terracing in MECP would reduce profits? 18

0 = No
1 = Yes
8 = N.A.
9 = D.K.

13) Other obstacles for terracing in the MECP? 19 20 21

1 = Too many livestock
2 = Can't use big machinery with terraces
3 = Makes fields too small
4 = Takes too much land for terraces
5 = Increases difficulty of farming
6 = Land isn't steep enough to merit terraces
7 = Installing terraces reduces yields
8 = N.A.

28. (a) Is contouring an obstacle for the MECP? 22

0 = No (Cols. 23-30 = 8's)
1 = Yes
8 = N.A. (# 069)

(b) 1) Is failure to see need for contouring an obstacle for contouring in the MECP? 23

0 = No
1 = Yes
8 = N.A.

2) Is the field or road layout an obstacle for contouring in the MECP? 24

0 = No
1 = Yes
8 = N.A.

3) Are point (short) rows an obstacle for contouring in the MECP? 25

0 = No
1 = Yes
8 = N.A.

4) Is the belief that contouring reduces yields more than costs an obstacle for contouring in the MECP? 26

0 = No
1 = Yes
8 = N.A.

5) Is belief that contouring does not control erosion an obstacle for contouring in the MECP? 27

0 = No
1 = Yes
8 = N.A.
9 = D.K.

6) Does the respondent believe that contouring in the MECP would reduce the profits on this tract? 28

0 = No
1 = Yes
8 = N.A.

7) Other obstacles for contouring in the MECP: 29 30

1 = Contouring won't work in particular field
2 = Contouring takes too much time
3 = Contouring creates small fields
8 = N.A.

29. (a) Are the rotations an obstacle in the MECP? 31

0 = No (Cols. 32-39 = 8's)
1 = Yes

(b) 1) Is landlord cooperation an obstacle for the rotations in the MECP? 32

0 = No
1 = Yes
8 = N.A.

2) Is the recommended amount or kind of the rotations an obstacle for the rotations in the MECP? 33

0 = No
1 = Yes
8 = N.A.

3) Are established farming methods an obstacle to the rotations in the MECP? 34

0 = No
1 = Yes
8 = N.A.

4) Is short expectancy of tenure an obstacle for the rotations in the MECP? 35

0 = No
1 = Yes
8 = N.A.

5) Does respondent believe that rotations proposed in the MECP would reduce profits? 36

0 = No
1 = Yes
8 = N.A.
9 = D.K.

6) Other obstacles to rotations of the MECP. 37 38 39

0 = Presently have too many livestock
1 = Presently have too few livestock
2 = Rotations require too much fertilizer and/or herbicide
3 = Not enough cash grain crops
4 = Not enough meadow or pasture
5 = Don't like continuous corn, too much grain in a row
6 = Ground too steep for these rotations
7 = Too many soybeans
9 = Too much meadow
8 = N.A.

30.(a) Are the field boundaries an obstacle for the MECP? 40

0 = No (Cols. 41-47 = 8's)
1 = Yes

(b) 1) Is landlord cooperation an obstacle for field boundaries in the MECP? 41

0 = No
1 = Yes
8 = N.A.

2) Is recommended amount or kind an obstacle for the field boundaries in the MECP? 42

0 = No
1 = Yes
8 = N.A.

3) Is the failure to see the need for the proposed field boundaries an obstacle for the field boundaries in the MECP? 43

0 = No
1 = Yes
8 = N.A.

4) Are established farming methods obstacles for the field boundaries in the MECP? 44

0 = No
1 = Yes
8 = N.A.

5) Is short expectancy of tenure an obstacle for the field boundaries in the MECP? 45

0 = No
1 = Yes
8 = N.A.
9 = D.K.

6) Other obstacles for field boundaries. 46 47

1 = Fields too small
2 = Boundaries too crooked
3 = Boundaries would not work for livestock
4 = Too many fields
5 = Extra work and expense
6 = Boundaries create too much wasteland
8 = N.A.

31.(a) Are waterways an obstacle for the MECP? 48

0 = No (Cols. 49-54 = 8's)
1 = Yes
8 = N.A. (047, 069)

(b) 1) Is the field or road layout an obstacle for the waterways in the MECP? 49

0 = No
1 = Yes
8 = N.A.

2) Is the failure to see the need for waterways an obstacle for waterways in the MECP? 50

0 = No
1 = Yes
8 = N.A.

3) Is waterway maintenance an obstacle for waterways in the MECP? 51

0 = No
1 = Yes
8 = N.A.
9 = D.K. (107)

4) Has respondent found that herbicides ruin waterways? 52

0 = No
1 = Yes
8 = N.A.

5) Does respondent believe that the waterways in the MECP will reduce profits? 53

0 = No
1 = Yes
8 = N.A.

6) Other obstacles for waterways in the MECP. 54

1 = Don't need waterways with minimum tillage
2 = Don't need waterways with terraces
3 = Don't need waterways when use terraces and minimum tillage
4 = Waterways are waste
8 = N.A.

32.(a) Is the use of conservation tillage an obstacle for the MECP? 55

0 = No (Cols. 56-63 = 8's)
1 = Yes
8 = N.A.
9 = D.K.

(b) 1) Is the failure to see a need for conservation tillage an obstacle in the MECP? 56

0 = No
1 = Yes
8 = N.A.
9 = D.K.

2) Are established farming methods an obstacle for conservation tillage in the MECP? 57

1 = Yes
8 = N.A.
9 = D.K.

3) Is the belief that conservation tillage reduces yields more than costs an obstacle for the MECP? 58

0 = No
1 = Yes
8 = N.A.
9 = D.K.

4) Is belief that conservation tillage does not reduce erosion an obstacle for conservation tillage in the MECP? 59

0 = No
1 = Yes
8 = N.A.
9 = D.K.

5) Does respondent believe that conservation tillage in MECP would reduce profits? 60

0 = No
1 = Yes
8 = N.A.
9 = D.K.

6) Other obstacles for conservation tillage in the MECP? 61 62 63

1 = Increased problems or costs for fertilizers or herbicides
2 = Lack of machinery for conservation tillage
3 = Not enough information
4 = Reduces yields
8 = N.A.
9 = D.K.

33. (a) Are structures or tile an obstacle for the MECP? 64

0 = No (Cols. 65-69 = 8's)
1 = Yes
8 = N.A.

(b) 1) Is the failure to see the need for structures or tile an obstacle for the MECP? 65

1 = Yes
8 = N.A.

2) Is short expectancy of tenure an obstacle for the structures or tile in the MECP? 66

0 = No
8 = N.A.

3) Are the costs of installation for structures or tile an obstacle for the MECP? 67

0 = No
8 = N.A.
9 = D.K.

4) Is belief that proposed structures or tile would result in lower yields an obstacle for the MECP? 68

0 = No
1 = Yes
8 = N.A.

5) Other obstacles for structures and tile? 69

8 = N.A.

34. (a) Is contouring an obstacle for the vegetative erosion control plan (VECP)? 70

0 = No (Cols. 71-78 = 8's)
1 = Yes
8 = N.A.

(b) 1) Is failure to see need for contouring an obstacle for contouring in the VECP? 71

0 = No
1 = Yes
8 = N.A.

2) Is the field or road layout an obstacle for contouring in the VECP? 72

0 = No
1 = Yes
8 = N.A.

3) Are point (short) rows an obstacle for contouring in the VECP? 73

1 = Yes
8 = N.A.

4) Is the belief that contouring reduces yields more than costs an obstacle for contouring in the VECP? 74

0 = No
1 = Yes
8 = N.A.

5) Is belief that contouring does not control erosion an obstacle for contouring in the VECP? 75

0 = No
1 = Yes
8 = N.A.
9 = D.K. (008)

6) Does the respondent believe that contouring in the VECP would reduce the profits on this tract? 76

0 = No
1 = Yes
8 = N.A.

7) Other obstacles for contouring in the VECP? 77 78

8 = N.A.

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cc: 113

Card 21

| | Column(s) |
|---|---|
| Card number (21) | 1 2 |
| Schedule number (ID number for farms) | 3 4 5 |
| 35.(a) Are the rotations an obstacle in the VECP?<br>0 = No (Cols. 7-13 = 8's)<br>1 = Yes | 6 |
| (b) 1) Is landlord cooperation an obstacle for the rotations in the VECP?<br>0 = No<br>1 = Yes<br>8 = N.A. | 7 |
| 2) Is the recommended amount or kind of the rotations an obstacle for the rotations in the VECP?<br>0 = No<br>1 = Yes<br>8 = N.A. | 8 |
| 3) Are established farming methods an obstacle to the rotations in the VECP?<br>0 = No<br>1 = Yes<br>8 = N.A. | 9 |
| 4) Is short expectancy of tenure an obstacle for the rotations in the VECP?<br>0 = No<br>1 = Yes<br>8 = N.A.<br>9 = D.K. | 10 |
| 5) Does respondent believe that rotations proposed in the VECP would reduce profits?<br>0 = No<br>1 = Yes<br>8 = N.A.<br>9 = D.K. | 11 |

6) Other obstacles to rotations of the VECP? 12 13

0 = Presently have too many livestock
1 = Presently have too few livestock
2 = Rotations require too much fertilizer and/or herbicide
3 = Not enough cash grain crops
4 = Rotations contain too much meadow
5 = Want more soybeans rather than corn
6 = Do not like continuous corn; too much corn
7 = Hay requires too much labor
8 = N.A.

36.(a) Are waterways an obstacle for the VECP? 14

0 = No (Cols. 15-20 = 8's)
1 = Yes
8 = N.A. (047, 069)

(b) 1) Is the field or road layout an obstacle for the waterways in the VECP? 15

0 = No
1 = Yes
8 = N.A.

2) Is the failure to see the need for waterways an obstacle for waterways in the VECP? 16

0 = No
1 = Yes
8 = N.A.

3) Is waterways maintenance an obstacle for waterways in the VECP? 17

0 = No
1 = Yes
8 = N.A.
9 = D.K.

4) Has respondent found that herbicides ruin waterways? 18

0 = No
1 = Yes
8 = N.A.

5) Does respondent believe that the waterways in the VECP will reduce profits? 19

0 = No
1 = Yes
8 = N.A.
9 = D.K.

6) Other obstacles for waterways in the VECP? 20

1 = Waterways are waste area
2 = Do not need waterways with established terraces
3 = Don't need waterways when use terraces and minimum tillage
8 = N.A.

37.(a) Is the use of conservation tillage an obstacle for the VECP? 21

0 = No (Cols. 22-28 = 8's)
1 = Yes
8 = N.A. (053, 069)
9 = D.K. (057, 118)

(b) 1) Is the failure to see a need for conservation tillage an obstacle in the VECP? 22

0 = No
1 = Yes
8 = N.A.
9 = D.K.

2) Are established farming methods an obstacle for conservation tillage in the VECP? 23

0 = No
1 = Yes
8 = N.A.
9 = D.K. (118)

3) Is the belief that conservation tillage reduces yields more than costs an obstacle for the VECP? 24

0 = No
1 = Yes
8 = N.A.
9 = D.K.

4) Is belief that conservation tillage does not reduce erosion an obstacle for conservation tillage in the VECP? 25

0 = No
1 = Yes
8 = N.A.
9 = D.K.

5) Other obstacles for conservation tillage in the VECP? 26 27 28

1 = Increased problems or costs for fertilizer or herbicides
2 = Lack of machinery for conservation tillage
3 = Not enough information
4 = Reduces profits
5 = Increased weed problems
6 = Doesn't adapt to particular soil
7 = Reduces yields
8 = N.A.
9 = D.K.

Average tons per acre per year soil loss on all planned acres. 29 30 31 32

Code to one decimal

Average tons per acre per year soil loss on all tilled acres. 33 34 35 36

Code to one decimal

Average tons per acre per year soil loss on all permanent pasture acres. 37 38 39 40

Code to one decimal

Operator's expected soil loss in tons per acre per year on all acres. 41 42 43 44

Code to one decimal

Operator's expected soil loss in tons per acre per year on tilled acres. 45 46 47 48

Code to one decimal

Average size of existing fields. 49 50 51

6. (e) Has operator experienced soil loss great enough to reduce yields on any field? 52

0 = No
1 = Yes

(f) Conservation practices used on at least one field? 53 - 58

0 = No practice used
1 = Terracing
2 = Waterways
3 = Conservation tillage
4 = Contouring
5 = Contour listing
6 = Seeding steep slopes
7 = Strip cropping
8 = High forage rotations
9 = Gully-control structures

6. (h) Practices operator feels should be used on at least one field. 59 - 62

0 = No practice
1 = Terracing
2 = Waterways
3 = Conservation tillage
4 = Contouring
6 = Seeding steep slopes
7 = Strip cropping
8 = High forage rotations
9 = Gully-control structures

Number of tilled acres. 63 64 65

Number of permanent pasture acres. 66 67 68

# APPENDIX E. UNIVERSAL SOIL LOSS EQUATION COEFFICIENTS

Table E.1. Average annual soil loss from continuous fallow, RKLSP values (R=160) (29)

| Slope | | For up and down hill | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | S | Soil erodibility factors - K values | | | | | | | |
| Feet | % | .17 | .20 | .24 | .28 | .32 | .37 | .43 | .49 |
| 100' | 2 | 5.4 | 6.4 | 7.7 | 9.0 | 10.2 | 11.8 | 13.8 | 15.7 |
| | 3 | 8.2 | 9.6 | 11.5 | 13.4 | 15.4 | 17.8 | 20.6 | 23.5 |
| | 4 | 10.9 | 12.8 | 15.4 | 17.9 | 20.5 | 23.7 | 27.5 | 31.4 |
| | 5 | 14.1 | 16.6 | 20.0 | 23.3 | 26.6 | 30.8 | 35.8 | 40.8 |
| | 6 | 18.2 | 21.4 | 25.7 | 30.0 | 34.3 | 39.7 | 46.1 | 52.5 |
| | 7 | 22.3 | 26.2 | 31.5 | 36.7 | 42.0 | 48.5 | 56.4 | 64.3 |
| | 8 | 26.7 | 31.4 | 37.6 | 43.9 | 50.2 | 58.0 | 67.4 | 76.8 |
| | 9 | 31.8 | 37.4 | 44.9 | 52.4 | 59.9 | 69.3 | 80.5 | 91.7 |
| | 10 | 37.0 | 43.5 | 52.2 | 60.9 | 69.6 | 80.5 | 93.6 | 106.6 |
| | 12 | 49.0 | 57.6 | 69.1 | 80.6 | 92.2 | 106.6 | 123.8 | 141.1 |
| | 14 | 62.6 | 73.6 | 88.3 | 103.0 | 117.8 | 136.2 | 158.2 | 180.3 |
| | 16 | 77.5 | 91.2 | 109.4 | 127.7 | 145.9 | 168.7 | 196.1 | 223.4 |
| | 18 | 95.2 | 112.0 | 134.4 | 156.8 | 179.2 | 207.2 | 240.8 | 274.4 |
| | 20 | 114.2 | 134.4 | 161.1 | 188.2 | 215.0 | 248.6 | 289.0 | 329.3 |
| | 24 | 157.8 | 185.6 | 222.7 | 259.8 | 297.0 | 343.4 | 399.0 | 454.7 |
| 200' | 2 | 6.2 | 9.6 | 11.5 | 13.4 | 15.4 | 17.8 | 20.6 | 23.5 |
| | 4 | 16.3 | 19.2 | 23.0 | 26.9 | 30.7 | 35.5 | 41.3 | 47.0 |
| | 6 | 25.3 | 29.8 | 35.7 | 41.7 | 47.6 | 55.1 | 64.0 | 72.9 |
| | 8 | 38.0 | 44.8 | 53.8 | 62.7 | 71.7 | 82.9 | 96.3 | 109.8 |
| | 10 | 52.5 | 61.8 | 74.1 | 86.5 | 98.8 | 114.3 | 132.8 | 151.3 |
| | 12 | 69.9 | 82.2 | 98.7 | 115.1 | 131.6 | 152.1 | 176.8 | 201.5 |
| | 14 | 89.8 | 103.6 | 126.7 | 147.8 | 169.0 | 195.4 | 227.0 | 258.7 |
| | 16 | 111.5 | 131.2 | 157.4 | 183.7 | 209.9 | 242.7 | 282.1 | 321.4 |
| | 18 | 134.4 | 158.0 | 189.7 | 221.3 | 252.9 | 292.4 | 339.9 | 387.3 |
| | 20 | 161.3 | 189.8 | 227.7 | 265.7 | 303.6 | 351.1 | 407.9 | 464.9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 300' | 2 | 10.9 | 12.0 | 15.4 | 17.9 | 20.5 | 23.7 | 27.5 | 31.4 |
| | 4 | 19.8 | 23.4 | 28.0 | 32.7 | 37.4 | 43.2 | 50.2 | 57.2 |
| | 6 | 31.8 | 37.4 | 44.9 | 52.4 | 59.9 | 69.3 | 80.5 | 91.7 |
| | 8 | 46.8 | 55.0 | 66.0 | 77.1 | 88.1 | 101.8 | 118.3 | 134.8 |
| | 10 | 65.3 | 76.8 | 92.2 | 107.5 | 122.9 | 142.1 | 165.1 | 188.2 |
| | 12 | 85.9 | 101.1 | 121.3 | 141.6 | 161.8 | 187.1 | 217.4 | 247.7 |
| | 14 | 109.6 | 128.9 | 158.7 | 180.5 | 206.3 | 238.6 | 277.3 | 315.9 |
| | 16 | 136.0 | 160.0 | 192.0 | 224.0 | 256.0 | 296.0 | 344.0 | 392.0 |
| | 18 | 165.9 | 195.2 | 234.2 | 273.3 | 312.3 | 361.1 | 419.7 | 478.2 |
| 400' | 2 | 12.5 | 14.7 | 17.7 | 20.6 | 23.6 | 27.2 | 31.6 | 36.1 |
| | 4 | 22.8 | 26.7 | 32.3 | 37.6 | 43.0 | 49.7 | 57.8 | 65.9 |
| | 6 | 36.4 | 42.9 | 51.5 | 60.0 | 68.6 | 79.3 | 92.2 | 105.1 |
| | 8 | 54.4 | 64.0 | 76.8 | 89.6 | 102.4 | 118.4 | 137.6 | 156.8 |
| | 10 | 75.1 | 88.3 | 106.0 | 123.6 | 141.3 | 163.4 | 189.9 | 216.4 |
| | 12 | 99.6 | 117.1 | 140.5 | 164.0 | 187.4 | 216.7 | 251.8 | 286.9 |
| | 14 | 126.1 | 148.3 | 178.2 | 207.9 | 237.6 | 274.7 | 319.2 | 363.8 |
| | 16 | 157.2 | 185.0 | 222.0 | 258.9 | 295.9 | 342.2 | 397.7 | 453.2 |

To determine average annual soil loss when crops are grown on the land:

1. Select the soil loss from the table above for the existing conditions.
2. Multiply the soil loss by the C factor selected under the rotation, management, or tillage system from Table E.7.

Table E.2. Average annual soil loss from continuous fallow, RKLSP values (R=180) (29)

| Slope | | For up and down hill | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | S | Soil erodibility factors - K values | | | | | | | |
| Feet | % | .17 | .20 | .24 | .28 | .32 | .37 | .43 | .49 |
| 100' | 2 | 6.1 | 7.2 | 8.6 | 10.1 | 11.5 | 13.3 | 15.5 | 17.6 |
| | 3 | 9.2 | 10.8 | 13.0 | 15.1 | 17.3 | 20.0 | 23.2 | 26.5 |
| | 4 | 12.2 | 14.4 | 17.3 | 20.2 | 23.0 | 26.6 | 31.0 | 35.3 |
| | 5 | 15.9 | 18.7 | 22.5 | 26.2 | 30.0 | 34.6 | 40.2 | 45.9 |
| | 6 | 20.5 | 24.1 | 28.9 | 33.8 | 38.6 | 44.6 | 51.9 | 59.1 |
| | 7 | 25.1 | 29.5 | 35.4 | 41.3 | 47.2 | 54.6 | 63.5 | 72.3 |
| | 8 | 30.0 | 35.3 | 42.3 | 49.4 | 56.4 | 65.3 | 75.9 | 86.4 |
| | 9 | 35.8 | 42.1 | 50.5 | 59.0 | 67.4 | 77.9 | 90.6 | 103.2 |
| | 10 | 41.3 | 48.6 | 58.3 | 68.0 | 77.8 | 89.9 | 104.5 | 119.1 |
| | 12 | 55.1 | 64.8 | 77.8 | 90.7 | 103.7 | 119.9 | 139.3 | 158.8 |
| | 14 | 70.4 | 82.8 | 99.4 | 115.9 | 132.5 | 153.2 | 178.0 | 202.9 |
| | 16 | 87.2 | 102.6 | 123.1 | 143.6 | 164.2 | 189.8 | 220.6 | 251.4 |
| | 18 | 107.1 | 126.0 | 151.2 | 176.4 | 201.6 | 233.1 | 270.9 | 308.7 |
| | 20 | 128.5 | 151.2 | 181.4 | 211.7 | 241.9 | 279.7 | 325.1 | 370.4 |
| | 24 | 177.5 | 208.8 | 250.6 | 292.3 | 334.1 | 386.3 | 448.9 | 511.6 |
| 200' | 2 | 9.2 | 10.8 | 13.0 | 15.1 | 17.3 | 20.0 | 23.2 | 26.5 |
| | 4 | 18.4 | 21.6 | 25.9 | 30.2 | 34.6 | 40.0 | 46.4 | 52.9 |
| | 6 | 28.5 | 33.5 | 40.2 | 46.9 | 53.7 | 61.9 | 72.0 | 82.0 |
| | 8 | 42.8 | 50.4 | 60.5 | 70.6 | 80.6 | 93.2 | 108.4 | 123.5 |
| | 10 | 59.1 | 69.5 | 83.4 | 97.3 | 111.2 | 128.5 | 149.4 | 170.2 |
| | 12 | 78.6 | 92.5 | 111.0 | 129.5 | 148.0 | 171.2 | 198.2 | 226.7 |
| | 14 | 101.0 | 118.8 | 142.6 | 166.3 | 190.1 | 219.8 | 255.4 | 291.1 |
| | 16 | 125.5 | 147.6 | 177.1 | 206.6 | 236.1 | 273.0 | 317.3 | 361.6 |
| | 18 | 151.2 | 177.8 | 213.4 | 249.0 | 284.5 | 329.0 | 382.4 | 435.7 |
| | 20 | 181.5 | 213.5 | 256.2 | 298.9 | 341.6 | 394.9 | 459.0 | 523.0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 300' | 2 | 12.2 | 14.4 | 17.3 | 20.2 | 23.0 | 26.6 | 31.0 | 35.3 |
| | 4 | 22.3 | 26.3 | 31.5 | 36.8 | 42.0 | 48.6 | 56.5 | 64.4 |
| | 6 | 35.8 | 42.1 | 50.5 | 59.0 | 67.4 | 77.9 | 90.6 | 103.2 |
| | 8 | 52.6 | 61.9 | 74.3 | 86.7 | 99.1 | 114.6 | 133.1 | 151.7 |
| | 10 | 73.4 | 86.4 | 103.7 | 120.9 | 138.2 | 159.8 | 185.8 | 211.7 |
| | 12 | 96.7 | 113.8 | 136.5 | 159.3 | 182.0 | 210.5 | 244.6 | 278.7 |
| | 14 | 123.3 | 145.1 | 174.1 | 203.1 | 232.1 | 268.4 | 311.9 | 355.4 |
| | 16 | 153.0 | 180.0 | 216.0 | 252.0 | 288.0 | 333.0 | 387.0 | 441.0 |
| | 18 | 186.7 | 219.6 | 263.5 | 307.4 | 351.4 | 406.3 | 472.1 | 538.0 |
| 400' | 2 | 14.1 | 16.6 | 19.9 | 23.2 | 26.5 | 30.1 | 35.6 | 40.6 |
| | 4 | 25.7 | 30.1 | 36.3 | 42.3 | 48.4 | 55.9 | 65.0 | 74.1 |
| | 6 | 41.0 | 48.2 | 57.9 | 67.5 | 77.2 | 89.2 | 103.7 | 118.2 |
| | 8 | 61.2 | 72.0 | 86.4 | 100.8 | 115.2 | 133.2 | 154.8 | 176.4 |
| | 10 | 84.5 | 99.4 | 119.2 | 139.1 | 159.0 | 183.8 | 213.6 | 243.4 |
| | 12 | 112.0 | 131.8 | 158.1 | 184.5 | 210.8 | 243.8 | 283.3 | 322.8 |
| | 14 | 142.0 | 167.0 | 200.4 | 233.9 | 267.3 | 309.0 | 359.1 | 409.2 |
| | 16 | 176.9 | 208.1 | 249.7 | 291.3 | 332.9 | 384.9 | 447.4 | 509.8 |

To determine average annual soil loss when crops are grown on the land:

1. Select the soil loss from the table above for the existing conditions.
2. Multiply the soil loss by the C factor selected under the rotation, management or tillage system from Table E.7.

Table E.3. Average annual soil loss from continuous fallow, RKLSP values (R=160) (29)

| Slope | | For contouring* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | S | Soil erodibility factors - K values | | | | | | | |
| Feet | % | .17 | .20 | .24 | .28 | .32 | .37 | .43 | .49 |
| 100' | 2 | 3.3 | 3.8 | 4.6 | 5.4 | 6.1 | 7.1 | 8.3 | 9.4 |
| | 4 | 5.4 | 6.4 | 7.7 | 9.0 | 10.2 | 11.9 | 13.8 | 15.7 |
| | 6 | 9.1 | 10.7 | 12.9 | 15.0 | 17.1 | 19.8 | 23.0 | 26.2 |
| | 8 | 16.0 | 18.8 | 22.6 | 26.3 | 30.1 | 34.8 | 40.4 | 46.1 |
| | 10 | 22.1 | 25.9 | 31.0 | 36.3 | 41.4 | 48.0 | 55.7 | 63.4 |
| | 12 | 29.4 | 34.6 | 41.4 | 48.3 | 55.4 | 64.0 | 74.2 | 84.6 |
| | 14 | 50.1 | 58.9 | 70.7 | 82.4 | 94.2 | 109.0 | 126.6 | 144.3 |
| | 16 | 61.9 | 73.0 | 87.5 | 102.1 | 116.8 | 135.0 | 156.8 | 179.2 |
| | 18 | 76.2 | 89.6 | 107.5 | 112.6 | 143.4 | 166.4 | 192.0 | 219.2 |
| 200' | 2 | 4.9 | 5.8 | 6.9 | 8.1 | 9.2 | 10.8 | 12.4 | 14.1 |
| | 4 | 8.2 | 9.6 | 11.5 | 13.4 | 15.4 | 17.8 | 20.6 | 23.5 |
| | 6 | 12.6 | 14.9 | 17.9 | 20.8 | 23.8 | 27.5 | 32.0 | 36.5 |
| | 8 | 22.9 | 26.9 | 32.3 | 37.6 | 43.0 | 49.7 | 57.8 | 65.9 |
| | 10 | 31.5 | 37.1 | 44.5 | 52.0 | 59.4 | 68.6 | 79.8 | 90.0 |
| | 12 | 41.9 | 49.3 | 59.2 | 69.0 | 78.9 | 91.2 | 105.9 | 120.8 |
| | 14 | 71.8 | 84.5 | 101.4 | 118.2 | 135.0 | 156.3 | 182.4 | 206.4 |
| | 16 | 89.3 | 105.0 | 125.9 | 146.9 | 168.0 | 193.6 | 225.6 | 257.6 |
| 300' | 2 | 6.4 | 7.7 | 9.2 | 10.8 | 12.3 | 14.2 | 16.5 | 18.9 |
| | 4 | 9.9 | 11.7 | 14.0 | 16.3 | 18.7 | 21.6 | 25.1 | 28.6 |
| | 6 | 15.9 | 18.7 | 22.4 | 25.8 | 29.9 | 34.6 | 40.3 | 45.9 |
| | 8 | 28.1 | 33.0 | 39.6 | 46.2 | 52.8 | 61.1 | 71.0 | 80.9 |
| | 10 | 39.2 | 46.1 | 55.4 | 64.5 | 73.8 | 85.3 | 99.0 | 112.8 |
| | 12 | 51.7 | 60.8 | 73.0 | 85.1 | 97.3 | 112.5 | 130.7 | 149.0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 400' | 2 | 7.5 | 8.8 | 10.6 | 12.4 | 14.1 | 16.3 | 19.0 | 21.6 |
| | 4 | 11.4 | 13.4 | 16.2 | 18.7 | 21.4 | 24.8 | 29.0 | 32.8 |
| | 6 | 18.2 | 21.4 | 25.8 | 30.1 | 34.2 | 39.7 | 46.1 | 52.5 |
| | 8 | 32.6 | 38.4 | 46.1 | 53.8 | 61.4 | 71.0 | 82.6 | 94.1 |

The effectiveness of contouring decreases as the length and steepness of slope increases. Therefore, for the most reliable estimates of soil loss, calculations for contouring from the table above should not include those figures below the solid line drawn across the table in each slope group.

To determine average annual soil loss when crops are grown on the land:

1. Select the soil loss from the table above for the existing conditions.
2. Multiply the soil loss by the C factor selected under the rotation, management or tillage system from Table E.7.

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*When alternate strips of legume - grass meadows are used on a contour strip cropping system, soil loss values for strip cropping may be obtained by multiplying the contour figures above by .5. When alternate strips of close growing crops are used in the contour strip cropping system soil loss values for strip cropping may be obtained by multiplying the contour figures above by .75.

Table E.4. Average annual soil loss from continuous fallow, RKLSP values (R=180) (29)

| Slope | | For contouring* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | S | Soil erodibility factors - K values | | | | | | | |
| Feet | % | .17 | .20 | .24 | .28 | .32 | .37 | .43 | .49 |
| 100' | 2 | 3.7 | 4.3 | 5.2 | 6.1 | 6.9 | 8.0 | 9.3 | 10.6 |
| | 4 | 6.1 | 7.2 | 8.6 | 10.1 | 11.5 | 13.3 | 15.5 | 17.6 |
| | 6 | 10.2 | 12.1 | 14.5 | 16.9 | 19.3 | 22.3 | 25.9 | 29.5 |
| | 8 | 18.0 | 21.2 | 25.4 | 29.6 | 33.9 | 39.2 | 45.5 | 51.9 |
| | 10 | 24.8 | 29.2 | 34.9 | 40.9 | 46.6 | 54.0 | 62.5 | 71.3 |
| | 12 | 33.1 | 38.9 | 46.6 | 54.4 | 62.3 | 72.0 | 83.5 | 95.2 |
| | 14 | 56.3 | 66.2 | 79.6 | 92.7 | 106.0 | 122.6 | 142.4 | 162.4 |
| | 16 | 69.7 | 82.1 | 98.5 | 114.8 | 131.4 | 151.9 | 176.4 | 201.6 |
| | 18 | 85.7 | 100.8 | 121.0 | 126.7 | 161.3 | 187.2 | 216.0 | 246.6 |
| 200' | 2 | 5.5 | 6.5 | 7.8 | 9.1 | 10.4 | 12.2 | 13.9 | 15.9 |
| | 4 | 9.2 | 10.8 | 13.0 | 15.1 | 17.3 | 20.0 | 23.2 | 26.5 |
| | 6 | 14.2 | 16.7 | 20.2 | 23.4 | 26.8 | 31.0 | 36.0 | 41.0 |
| | 8 | 25.7 | 30.2 | 36.3 | 42.3 | 48.4 | 55.9 | 65.0 | 74.1 |
| | 10 | 35.5 | 41.8 | 50.0 | 58.5 | 66.8 | 77.2 | 89.8 | 102.2 |
| | 12 | 47.2 | 55.4 | 66.6 | 77.6 | 88.7 | 102.6 | 119.2 | 135.9 |
| | 14 | 80.8 | 95.0 | 114.1 | 133.0 | 151.9 | 175.9 | 205.2 | 232.2 |
| | 16 | 100.4 | 118.1 | 141.7 | 165.2 | 189.0 | 217.8 | 253.8 | 289.8 |
| 300' | 2 | 7.3 | 8.6 | 10.4 | 12.1 | 13.8 | 16.0 | 18.5 | 21.2 |
| | 4 | 11.2 | 13.1 | 15.8 | 18.4 | 21.1 | 24.3 | 28.3 | 32.2 |
| | 6 | 17.9 | 21.1 | 25.2 | 29.0 | 33.7 | 38.9 | 45.4 | 51.7 |
| | 8 | 31.6 | 37.1 | 44.6 | 52.0 | 59.4 | 68.7 | 79.9 | 91.0 |
| | 10 | 44.1 | 51.8 | 62.3 | 72.5 | 83.0 | 95.9 | 111.4 | 126.9 |
| | 12 | 58.1 | 68.4 | 82.1 | 95.8 | 109.4 | 126.5 | 147.1 | 167.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 400' | 2 | 8.4 | 9.4 | 11.9 | 13.9 | 15.9 | 18.4 | 21.4 | 24.3 |
| | 4 | 12.9 | 15.1 | 18.2 | 21.1 | 24.1 | 27.9 | 32.6 | 36.9 |
| | 6 | 20.5 | 24.1 | 29.0 | 33.8 | 38.5 | 44.6 | 51.8 | 59.0 |
| | 8 | 36.7 | 43.2 | 51.8 | 60.5 | 69.1 | 79.9 | 92.9 | 105.8 |

The effectiveness of contouring decreases as the length and steepness of slope increases. Therefore, for the most reliable estimates of soil loss, calculations for contouring from the table above should not include those figures below the solid line drawn across the table in each slope group.

To determine average annual soil loss when crops are grown on the land:

1. Select the soil loss from the table above for the existing conditions.
2. Multiply the soil loss by the C factor selected under the rotation, management or tillage system from Table E.7.

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*When alternate strips of legume - grass meadows are used on a contour strip cropping system, soil loss values for strip cropping may be obtained by multiplying the contour figures above by .5. When alternate strips of close growing crops are used in the contour strip cropping system soil loss values for strip cropping may be obtained by multiplying the contour figures above by .75.

Table E.5. Average annual soil loss from continuous fallow, for terracing, RKLSP values (R=160) (29)

| Parallel gradient broad base terraces | | | | | | Parallel level broad base terraces | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Slope | | Soil erodibility factors | | | | Slope | | Soil erodibility factors | | | |
| Length feet | Steep-ness % | 0.24 | 0.32 | 0.37 | 0.43 | Length feet | Steep-ness % | 0.24 | 0.32 | 0.38 | 0.43 |
| 180 | 2 | 6.6 | 8.9 | 10.3 | 12.0 | 180 | 2 | 6.6 | 8.9 | 10.3 | 12.0 |
| 120 | 3 | 6.4 | 8.7 | 10.1 | 11.7 | 120 | 3 | 6.4 | 8.7 | 10.1 | 11.7 |
| 120 | 4 | 8.7 | 11.5 | 13.3 | 15.5 | 120 | 4 | 8.7 | 11.5 | 13.3 | 15.5 |
| 120 | 5 | 11.3 | 15.1 | 17.5 | 20.3 | 120 | 5 | 11.3 | 15.1 | 17.5 | 20.3 |
| 120 | 6 | 14.2 | 18.9 | 21.9 | 25.5 | 120 | 6 | 14.2 | 18.9 | 21.9 | 25.5 |
| 105 | 8 | 23.5 | 31.3 | 36.2 | 42.1 | 120 | 8 | 24.9 | 33.2 | 38.4 | 44.6 |
| 90 | 10 | 30.0 | 39.9 | 46.2 | 53.7 | 90 | 10 | 30.0 | 39.9 | 46.2 | 53.7 |
| 90 | 12 | 39.6 | 52.8 | 61.1 | 71.0 | 90 | 12 | 39.6 | 52.8 | 61.1 | 71.0 |
| 90 | 14 | 67.6 | 90.1 | 104.2 | 121.1 | 90 | 14 | 67.6 | 90.1 | 104.2 | 121.1 |
| 90 | 16 | 83.9 | 111.8 | 129.3 | 150.3 | 90 | 16 | 83.9 | 111.8 | 129.3 | 150.3 |
| 90 | 18 | 102.0 | 136.0 | 157.2 | 182.7 | 90 | 18 | 102.0 | 136.0 | 157.2 | 182.7 |

| Parallel gradient grassed backslope terr.* | | | | | | Parallel level grassed backslope terrace** |
|---|---|---|---|---|---|---|
| 245 | 2 | 6.3 | 8.4 | 9.7 | 11.3 | |
| 247 | 3 | 7.4 | 9.9 | 11.5 | 13.3 | |
| 188 | 4 | 8.1 | 10.8 | 12.4 | 14.4 | |
| 189 | 5 | 10.5 | 14.0 | 16.2 | 18.8 | |
| 130 | 6 | 9.1 | 12.1 | 14.0 | 16.2 | |
| 132 | 8 | 13.2 | 17.7 | 20.4 | 23.7 | |
| 122 | 10 | 16.2 | 21.6 | 25.0 | 29.0 | |
| 110 | 12 | 22.0 | 29.4 | 34.0 | 39.5 | |
| 114 | 14 | 28.1 | 37.5 | 43.4 | 50.4 | |
| 117 | 16 | 37.0 | 49.3 | 57.0 | 66.3 | |
| 118 | 18 | 63.0 | 84.0 | 97.1 | 112.9 | |

* The average annual soil loss given in this table is calculated on the horizontal interval between the toe of the backslope in grass and the channel of the terrace below. The steepness of slope has been reduced to that which represents the slope after construction and after stabilization from farming.

** Soil movement between terrace intervals on deep loess soils will be tolerated _if_ terraces are properly designed for alignment, spacing and capacity, and are properly constructed and maintained. It is assumed that very little soil or water will leave the terraced area.

Reference: Standard and Specification 600 and 602 1966

To determine average annual soil loss when crops are grown on the land:

1. Select the soil loss from the table above for the kind of terrace and condition.
2. Multiply the soil loss by the C factor selected under the rotation, management or tillage system from Table E.7.

Table E.6. Average annual soil loss from continuous fallow, for terracing, RKLSP values (R=180) (29)

| Parallel gradient broad base terraces | | | | | | Parallel level broad base terraces | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Slope | | Soil erodibility factors | | | | Slope | | Soil erodibility factors | | | |
| Length feet | Steep-ness % | 0.24 | 0.32 | 0.37 | 0.43 | Length feet | Steep-ness % | 0.24 | 0.32 | 0.37 | 0.43 |
| 180 | 2 | 7.4 | 9.9 | 11.5 | 13.3 | 180 | 2 | 7.4 | 9.9 | 11.5 | 13.3 |
| 120 | 3 | 7.2 | 9.6 | 11.2 | 13.0 | 120 | 3 | 7.2 | 9.6 | 11.2 | 13.0 |
| 120 | 4 | 9.8 | 13.0 | 15.1 | 17.5 | 120 | 4 | 9.8 | 13.0 | 15.1 | 17.5 |
| 120 | 5 | 12.7 | 16.9 | 19.5 | 22.7 | 120 | 5 | 12.7 | 16.9 | 19.5 | 22.7 |
| 120 | 6 | 15.9 | 21.3 | 24.6 | 28.6 | 120 | 6 | 15.9 | 21.3 | 24.6 | 28.6 |
| 105 | 8 | 26.4 | 35.2 | 40.7 | 47.3 | 120 | 8 | 28.0 | 37.3 | 43.2 | 50.2 |
| 90 | 10 | 33.7 | 44.9 | 51.9 | 60.4 | 90 | 10 | 33.7 | 44.9 | 51.9 | 60.4 |
| 90 | 12 | 44.6 | 59.4 | 68.7 | 79.9 | 90 | 12 | 44.6 | 59.4 | 68.7 | 79.9 |
| 90 | 14 | 76.0 | 101.4 | 117.2 | 136.2 | 90 | 14 | 76.0 | 101.4 | 117.2 | 136.2 |
| 90 | 16 | 94.3 | 125.8 | 145.5 | 169.0 | 90 | 16 | 94.3 | 125.8 | 145.5 | 169.0 |
| 90 | 18 | 114.7 | 153.0 | 176.8 | 205.6 | 90 | 18 | 114.7 | 153.0 | 176.8 | 205.6 |

| Parallel gradient grassed backslope terr.* | | | | | | Parallel level grassed backslope terrace** |
|---|---|---|---|---|---|---|
| 245 | 2 | 7.1 | 9.4 | 10.9 | 12.7 | |
| 247 | 3 | 8.4 | 11.2 | 12.9 | 15.0 | |
| 188 | 4 | 9.1 | 12.1 | 14.0 | 16.3 | |
| 189 | 5 | 11.8 | 15.7 | 18.2 | 21.1 | |
| 130 | 6 | 10.2 | 13.6 | 15.7 | 18.3 | |
| 132 | 8 | 14.9 | 19.9 | 23.0 | 26.7 | |
| 122 | 10 | 18.2 | 24.3 | 28.1 | 32.7 | |
| 110 | 12 | 24.8 | 33.1 | 38.2 | 44.4 | |
| 114 | 14 | 31.6 | 42.2 | 48.8 | 56.7 | |
| 117 | 16 | 41.6 | 55.5 | 64.1 | 74.5 | |
| 118 | 18 | 70.9 | 94.5 | 109.3 | 127.0 | |

* The average annual soil loss given in this table is calculated on the horizontal interval between the toe of the backslope in grass and the channel of the terrace below. The steepness of slope has been reduced to that which represents the slope after construction and after stabilization from farming.

** Soil movement between terrace intervals on deep loess soils will be tolerated <u>if</u> terraces are properly designed for alignment, spacing and capacity, and are properly constructed and maintained. It is assumed that very little soil or water will leave the terraced area.

Reference: Standard and Specification 600 and 602 1966

To determine average annual soil loss when crops are grown on the land:

1. Select the soil loss from the table above for the kind of terrace and condition.
2. Multiply the soil loss by the C factor selected under the rotation, management or tillage system from Table E.7.

Table E.7. Ratio of soil loss from cropping systems to soil loss from continuous fallow; crop management factor values for Iowa (29)

| Crop sequence | Conventional tillage: Spring plow Rd L 4/15 | Conventional tillage: Fall plow Rd L 11/1 | Conservation tillage, 66% Soil coverage with: Row crop residue*: 1500 lb | Row crop residue*: 2000-3000 lb | Row crop residue*: 3000-4000 lb | Row crop residue*: 4000-6000 lb | Row crop residue*: 6000+ lb | Sod residue**: 2000-3000 lb | Sod residue**: 3000+ lb |
|---|---|---|---|---|---|---|---|---|---|
| CSb*** | .36 | .41 | .36 | .30 | .27 | .24 | .22 | | |
| CCSb*** | .36 | .41 | .36 | .28 | .24 | .20 | .17 | | |
| Cont corn | .36 | .41 | .35 | .24 | .18 | .13 | .09 | | |
| CCCOX | .29 | .30 | .28 | .23 | .20 | .17 | .14 | .072 | .069 |
| CCOX | .26 | .28 | .26 | .22 | .20 | .18 | .16 | .066 | .063 |
| CCCOM | .17 | .19 | .18 | .14 | .12 | .09 | .08 | .058 | .057 |
| CCOM | .12 | .13 | .14 | .11 | .10 | .08 | .07 | .044 | .042 |
| CCOMM | .09 | .11 | .12 | .09 | .08 | .07 | .06 | .036 | .034 |
| CCOMMM | .08 | .09 | .10 | .08 | .07 | .06 | .05 | .030 | .029 |
| COM | .06 | .07 | | | | | | .028 | .025 |
| COMM | .047 | .05 | | | | | | .023 | .020 |
| COMMM | .038 | .042 | | | | | | .019 | .017 |
| COMMMM | .032 | .036 | | | | | | .017 | .015 |

The quantities of crop residue listed above refer to the amounts of cover in pounds per acre still remaining on the soil surface after planting.

All factors listed above are calculated with corn yields above 75 bushel per acre. If yields are expected to be less than 75 bushel per acre, use a factor for a rotation or management that is more intensive than the one in use.

A factor for plow-planting may be calculated by multiplying the factor for conventional tillage by .6.

*When meadows or catch-crops are included in the rotation, the calculations are based on plowing in a conventional manner for the first year corn and the balance of the years of corn are mulch tilled.

**When planted in sod residue, calculations are based on planting in sod without plowing for first year corn. First year corn is chemically cultivated. All succeeding corn is planted with 6000+ lbs. of residue cover.

***Rotations with soybeans are calculated with only 1500 lbs. residue for each year of soybeans.