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# SOIL EROSION AND SOME MEANS FOR ITS CONTROL

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## SUMMARY

The control of soil erosion on the many farms where it is still a problem would not be difficult if it required only an understanding of the critical physical relationships between climate, topography, plant cover, water and soil as well as an ability to prescribe the proper engineering and agronomic measures for each situation. Soil losses, when greatly in excess of those produced by natural geological processes, result from the use of particular farming practices and cropping systems. While an understanding of the physical conditions which produce this erosion is essential, so is an understanding of the reasons that farmers choose the methods of farming which expose their soil to the hazard of heavy erosion losses.

Although alternatives are limited, landowners and farm operators have some leeway in selecting between those farming methods which tend to increase the loss of soil and those which tend to reduce it. Their choices are restricted by the physical environment, economic considerations and the customs and legal arrangements associated with the use and ownership of property. Little can be done to ease the restrictions of the first two factors. Customs and legal arrangements can be changed, but at a slow rate.

The decisions of farmers also reflect their personal goals, values and beliefs, and the amounts and kind of information available to them. The opinions of friends and neighbors and the resources available are also factors that farmers consider. An understanding of the environment in which decisions are made is necessary if farmers are to be encouraged to make the choices that are more conducive to erosion control and if the obstacles which prevent farmers from making such choices are to be overcome.

### Obstacles to Erosion Control

When farm people reject the physical measures needed to control erosion, they do it for a number of different reasons. Some farmers are not sufficiently aware of the rate of soil loss or its significance to be concerned. Others, with greater awareness, fail to act because of a feeling that they can continue to get along without doing anything. Still others have been misinformed about the effects of certain practices or object to those which conflict with their established pattern of farming.

Other farmers grant that the soil losses must be reduced to some extent, but, for various reasons, they feel unable to make a greater effort themselves. Some believe that the benefits they would receive from additional control measures would not be sufficient to offset other difficulties they foresee. Others cite the cost of particular measures, or of closely related investments which would be required. These farmers mention, for example, the reduction of income which would follow any curtailment of corn acreage and indicate that their present incomes are inadequate for the demands placed upon them.

Behind many of these difficulties are such things as the lack of control of, or access to, sufficient productive land or other resources to permit the kind of reorganization of the farm business so necessary with the application of certain erosion-control measures. In other instances, resources may be adequate but may not be organized in the most efficient manner. Often, particularly on rented farms but also on owner-operated farms, the operator's limited span of interest in the farm as a source of income contributes to these difficulties. Landowners often do not believe that the market value of their farms is being reduced by the level of erosion taking place.

Customary rental arrangements fail to make adequate provision for major investments that would be required by a change in farm organization to accommodate the necessary erosion-control measures. Many tenants using crop-share leases find it difficult to change certain of their farming practices and rotations unless changes are made in their leases.

### How Much Erosion Control Is Needed?

While there is general agreement that erosion losses must be reduced, there is less agreement on the degree of control that is desirable. Neither is there a clear understanding as to where the responsibility rests for the cost of achieving this control. This situation is in itself an obstacle to greater accomplishment.

Of immediate importance is the determination of a level of control over soil losses which farm people can be expected to attain without great financial sacrifice. This will not necessarily be the same from farm to farm. The difficulty and cost of bringing erosion losses down to a specified level nearly always increases as land slopes increase in steepness or length and as the percentage of the cropland on a farm with a serious erosion hazard increases.

Farmers often cannot achieve that level of erosion control on their farms which seems necessary in the public interest unless they are given financial assistance. Some of this assistance is available through the cost-sharing funds administered by federal agencies. These funds, however, are not always as effective as they might be in bridging the gap between the level of control achieved by private efforts under the most favorable conditions and the level of control desired. In some instances, payments may be inadequate to achieve the level of control desired, while in other instances they may be too generous.

Prescriptions for overcoming the known obstacles must be viewed primarily as guides for action. Their effectiveness will vary with the vigor and skill with which they are used and the circumstances of their use. It is doubtful that the obstacles can be overcome by relying solely on one or two techniques, or by neglecting to relate what is done through one agency or group to that done by others.



### **Creating an Awareness of the Problem**

If more farm people, and landlords in particular, are to be reached, a greater educational effort, supplemented with new approaches, will undoubtedly be necessary. A greater awareness might be created if soil losses were estimated, farm by farm, community by community, throughout a soil conservation district, and if this were followed by comparisons and economic interpretation. Business and professional people, especially those who have frequent opportunities to discuss matters of farm business with farmers and landowners and who provide farm owners and operators with legal and other services can be valuable allies in this effort. If such business and professional people are given an awareness of the erosion situation in the farming community and an understanding of the factors which make erosion control difficult, they can help farmers overcome some of the obstacles to greater control of erosion.

Education has an important role to play where information or understanding is the critical need. When a farmer objects that the earning capacity of his farm would be reduced if he were to adopt the recommended erosion-control measures, his objection may be based in part upon a lack of information. He may only need to be shown that his fears are groundless. On the other hand, there are situations in which this objection is valid. The difficulty arises if erosion-control measures are specified for a farm without consideration of their probable economic impact on the particular farm business.

### **Conservation Farm Plans**

Changes in the concept of soil conservation farm plans are desirable so that the plans may take into account the socio-economic factors that are so important in determining how land is used. The appraisal of the physical situation on the farm must be matched by an appraisal of various aspects of the farm business. Then it becomes possible to determine how much of the financial responsibility for erosion control a particular farmer can be expected to assume and the point at which outside assistance is necessary. Achievements in the field of electronic data processing and improvements in farm budgeting techniques make it possible to give serious consideration to the more detailed planning required by this proposal.

An expertly planned reorganization of farm enterprises will not automatically remove all obstacle situations. It may, however, shift attention from minor or inconsequential obstacles to more troublesome and more significant underlying matters—such as those of obtaining additional resources and the problems associated with tenancy and credit.

Revision of lease forms and provisions to encourage the types of investment and other changes needed might have greater chance for success if a strong community effort were made to achieve them. The psychological support that the community leaders could give would be important. Educational efforts on these matters have had little

success to date. Given support, they could accomplish much.

### **Problems of Financing Conservation Measures**

Credit appears to be a problem, not so much because of its unavailability, but because of the reluctance of farmers to use it for erosion control and closely related measures. The farm plan could suggest a scheduling of the necessary investments, both those directly related to erosion control and those required to make the plan economically feasible. It should also provide income estimates that are as accurate as possible. Well-devised plans also would be of assistance in negotiating with lenders.

Sometimes the major beneficiary of a given erosion-control measure does not own or control the land on which the measure must be installed and is under no obligation to pay any share of the costs necessary to accomplish it. A few farmers have taken advantage of the provision for pooling the federal cost-sharing payments to secure a practice on the property of another which is beneficial to them all. Little use has been made of this provision, however. Cooperative arrangements of this sort require both the stimulation and assistance which the soil conservation districts might easily provide without necessarily assuming financial responsibility.

### **Public Responsibility**

In some instances, the public interest in achieving a degree of control over erosion exceeds that which the individual farmer can afford, or which can be achieved through the cooperative efforts of several property owners. If efforts have already been made to remove existing obstacles to private performance, the responsibility for additional effort is clearly that of the larger public. This public might be the county; in other instances it might be either the state or the federal government.

The difficulties here are not so much the unwillingness of governmental units to do anything but the lack of sufficient discretion and guidance. Public funds may be used either before they are really required or to a degree that is actually unnecessary in some instances. In other situations individual farmers may be asked to do far more than should be expected of them, and, as a result, do nothing. In the interest of making the most of the financial support that is available, the criteria used in disbursing these grants merit a thorough review.

### **The Institutional Environment**

Land prices, taxes on land, interest rates, federal farm programs, and relative prices and costs determine the attractiveness of one type of farm enterprise as against others. In many instances in western Iowa, these factors tend to favor enterprises in which the erosion hazard is the greatest. One farmer, even a small group of farmers, can do little to change this economic and institutional environment. The general public should be aware of the repercussions that policies, set for accomplishing other objectives, may have with respect to ero-



sion control. If there is an opportunity to choose between different policies to accomplish a particular purpose, consideration, where possible, should be given to whatever implications they may have for the manner in which land is used.

#### **Police Powers**

Should an individual who, for reasons of his own, declines to cooperate in an erosion-control effort which benefits him and people in a large geographic area as well, be permitted to thwart it even if others are willing to bear their just share, or more, of the costs? There is little in the body of common law to back up the moral obligation such an individual may have with respect to damages to others which he brings about because of his unwillingness to change from a system of farming that contributes to the excessive runoff of water and the washing of soil. The state has at its disposal the police powers and, in turn, these may be delegated to subjurisdictions. The police powers have been

used in Iowa in an effort to eradicate noxious weeds and to safeguard the milk supply, to mention only two instances of their application to agricultural situations. They have not been made available, however, for use in combatting the problem of soil erosion. Can the desired goals in erosion control be accomplished and the investments which are being made for this purpose be protected as they should be without the use of these powers? These questions warrant more attention than they now receive.

Erosion control is something which is not accomplished on a once-and-for-all basis. Owners and operators of farms change, technology changes, and the economic and political environments change. Nor can an effective erosion-control program be built around the use of a single technique or by competing groups, each going its own way with its own approach to the problem. It can be less of a problem, however, if a greater effort is made to understand its causes and to devise means for solving the related social and economic problems.

# Soil Erosion and Some Means for Its Control<sup>1</sup>

by R. Burnell Held, Melvin G. Blase and John F. Timmons<sup>2</sup>

Soil erosion of serious proportions continues on many acres of cropland throughout the United States. Farmers in western Iowa must contend with one of the more serious soil erosion problems in the nation. Some farmers there, and many others in the United States, have been successful in reducing the loss of soil from their fields to a low level. In contrast, some have achieved only moderate control, and others, very little control.

The reasons for the varying levels of accomplishment are many. Some farmers simply are not aware of the physical magnitude or economic significance of the soil loss taking place on their farms. Others recognize that erosion is occurring but find it difficult to apply control measures because this would require them to make new investments, to change farm enterprises or cropping systems, to assume new risks or to take a temporary loss of income. Farmers are often either unable or unwilling to make these changes, given their present circumstances. The question then arises, what might be done to alter these circumstances if these are significant impediments to further erosion-control efforts?

This report summarizes the findings of investigations conducted in western Iowa in an effort to obtain an understanding of the factors which underlie the relatively slow rate of adoption of erosion-control measures there. The results of these studies and the conclusions which have been drawn from them in this report could be of general usefulness elsewhere.

## Characteristics of the Study Area

The section of western Iowa studied is a long, narrow area of nearly 1,700,000 acres, 82 percent of which is cultivated. It lies approximately parallel with the Missouri River from just above the point at which the river touches the state at Sioux City on the north and continues beyond the state boundary on the south. The area is separated from

the river and the adjacent heavy, poorly drained bottomlands by a range of bluffs. The soils of the bluffs, known as Hamburg silt, and those of the study area, the Ida and Monona soils, are loess soils of great depth. This soil material, a coarse silt, overlays glacial drift material.

The bluffs are too steep to be tilled, but the slopes leeward of the bluffs, although also steep, are largely in crops. The loess on these slopes is less coarse and more shallow than that of the bluffs, although it is more than 30 feet deep in most places.

Ida soil is found on slopes of between 8 and 25 percent. The soil is low in nitrogen and phosphorus, but crops respond well when these elements are provided. Monona soil is quite similar to Ida soil. It has a higher clay content and is usually found on slopes that are less steep than those on which the Ida soil is found. Both the water-holding capacity and the availability of phosphorus are greater for Monona soil than for Ida soil.

The coarse texture of these soils and the topography of the land makes them highly susceptible to erosion. Climate is an additional factor contributing to the erosion problem. At least one short rainstorm of great intensity usually occurs during the summer months when the surface of the soil is most vulnerable to washing. One such storm in the area produced 4-1/2 inches of rain in 75 minutes. Actual measurements of the silt deposited by the runoff from the storm in flood-control reservoirs indicated that soil losses had averaged between 20 and 40 tons per acre over the entire watershed.<sup>3</sup>

The patterns of land use and the tillage methods prevailing in western Iowa add to the existing natural erosion hazard. Most farmers devote a high proportion of their land to row crops, primarily corn, which they feed to cattle and hogs. In the last 10 years, row crops have occupied as much as 40 percent of the farm land. On many farms corn is planted on even the steepest slopes and cultivated up and down the slope. As recently as 1957, farm operators on 38 percent of the farms in a sample of 138 farms in the area were making no attempt to farm with the contour of the land. Farmers on 60 percent of these farms in 1952 were making some use of commercial fertilizers, but, by 1957,

<sup>1</sup> The observations and suggestions contained in this publication are based in part upon studies in which all three authors and Professor John C. Frey, now of Pennsylvania State University, participated at various times under the cooperative arrangements between the Iowa Agricultural and Home Economics Experiment Station and the U. S. Department of Agriculture. The cooperation of Resources for the Future, Inc. is gratefully acknowledged for enabling the senior author to devote a substantial period of time to prepare this report.

<sup>2</sup> Research Associate, Resources for the Future, Inc.; Agricultural Economist, Economic Research Service, presently on military leave; and Professor of Economics, Iowa State University; respectively.

<sup>3</sup> H. P. Johnson and R. K. Frevert. Selected intense storms in the Little Sioux River watershed. Agr. Eng. 40:26-29. 1959.



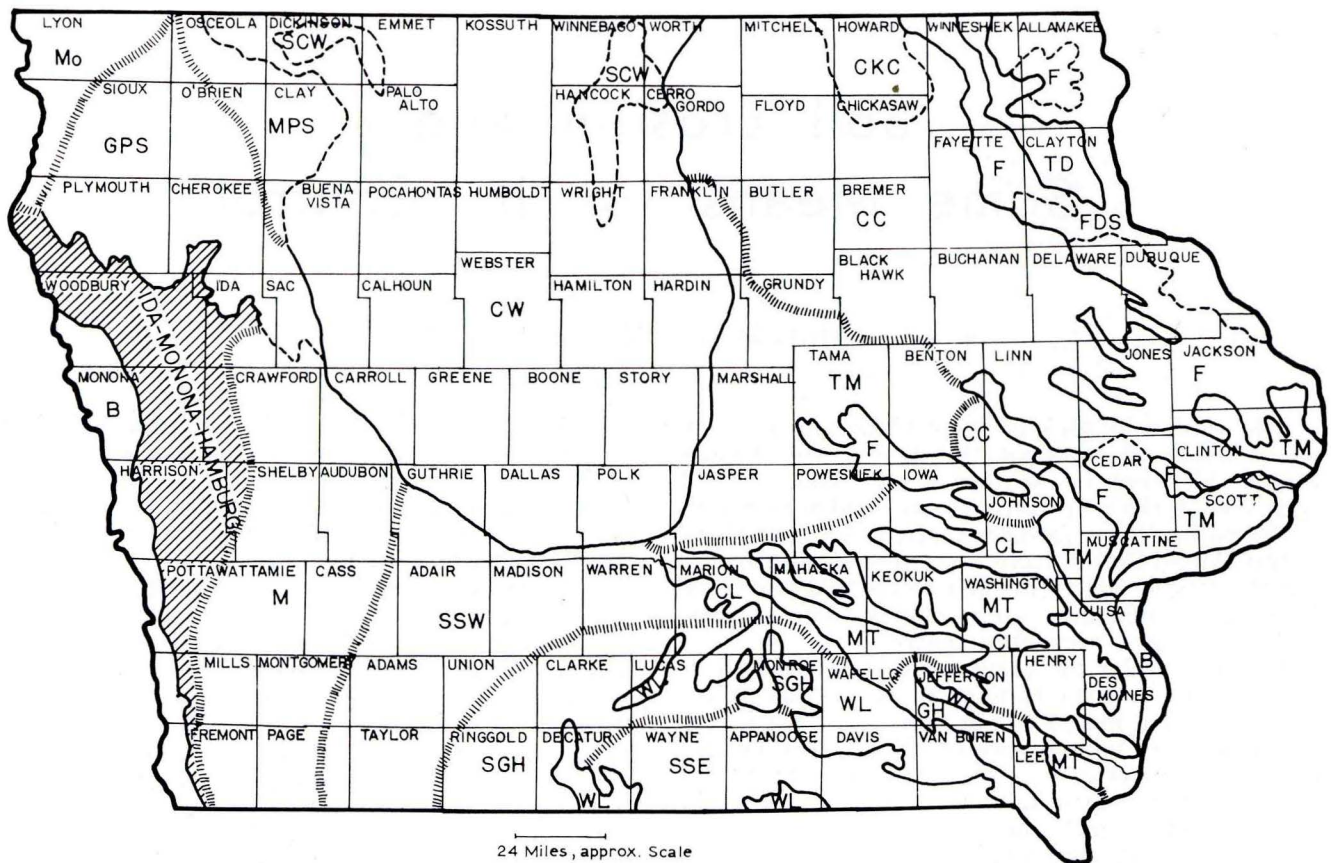


Fig. 1. Location of the Ida-Monona-Hamburg Soil Association Area in western Iowa.

fertilizers were being used on only 42 percent of them. Drouths in the immediately preceding years and the less favorable financial position of the farmers were largely responsible for this change in fertilizer use.

#### Research Procedures

Measurements of the soil loss on individual farms are difficult and expensive to obtain. An estimated rate of loss can be calculated by applying certain factors obtained from experimental work to the particular topographic and soil conditions and the soil management and cropping pattern on any farm. Such estimates indicate that soil losses from sheet erosion in the Ida-Monona area are great. Observation alone indicates the severity of gullying. Farms in the area have an average of two major gullies per farm.

For purposes of research, a sample of farms was drawn at random from all the farms in the study area. Maps were prepared for these sample farms which provided detailed information on soils and topography. Information as to the crop rotations and soil management practices followed and other related data were obtained by interview in 1949, 1952 and 1957. Soil loss rates were calculated from this information for each of these years.

The Soil Conservation Service provided two farm plans developed especially for the study for each of the sample farms. These plans were similar in con-

cept to those ordinarily developed for farmers cooperating with the program of the soil conservation district. In this instance the procedure followed differed from actual practice. The farm operators had not requested the plans and had no knowledge of them until after they were developed. Two plans were then presented to each farm operator. Both had been designed to achieve the same result—a soil loss no greater than 5 tons—and were to be viewed as alternatives. One plan accomplished the goal by a maximum use of terraces. This plan also permitted the maximum acreage of corn consistent with the erosion-control goal. The other plan eliminated terraces but achieved the same degree of erosion control through the maximum use of forage crops at the expense of the corn acreage.

The farm operators and owners were interviewed to determine their reaction to each plan and to the individual practices. If they rejected a particular practice, their reason for doing so was determined. Sufficient additional information was obtained to test the validity of the factors they indicated had prevented, or would prevent, them from carrying out the practices.<sup>4</sup>

<sup>4</sup> Detailed quantitative discussions of research procedures and the various findings are discussed in the following publications: John C. Frey. Some obstacles to soil erosion control in western Iowa. Iowa Agr. and Home Econ. Exp. Sta. Res. Bul. 391. 1952; R. Burnell Held and John F. Timmons. Soil erosion control in process in western Iowa. Iowa Agr. and Home Econ. Exp. Sta. Res. Bul. 460. 1958; Melvin G. Blase and John F. Timmons. Soil erosion control in western Iowa: progress and problems. Iowa Agr. and Home Econ. Sta. Res. Bul. 498. 1961.



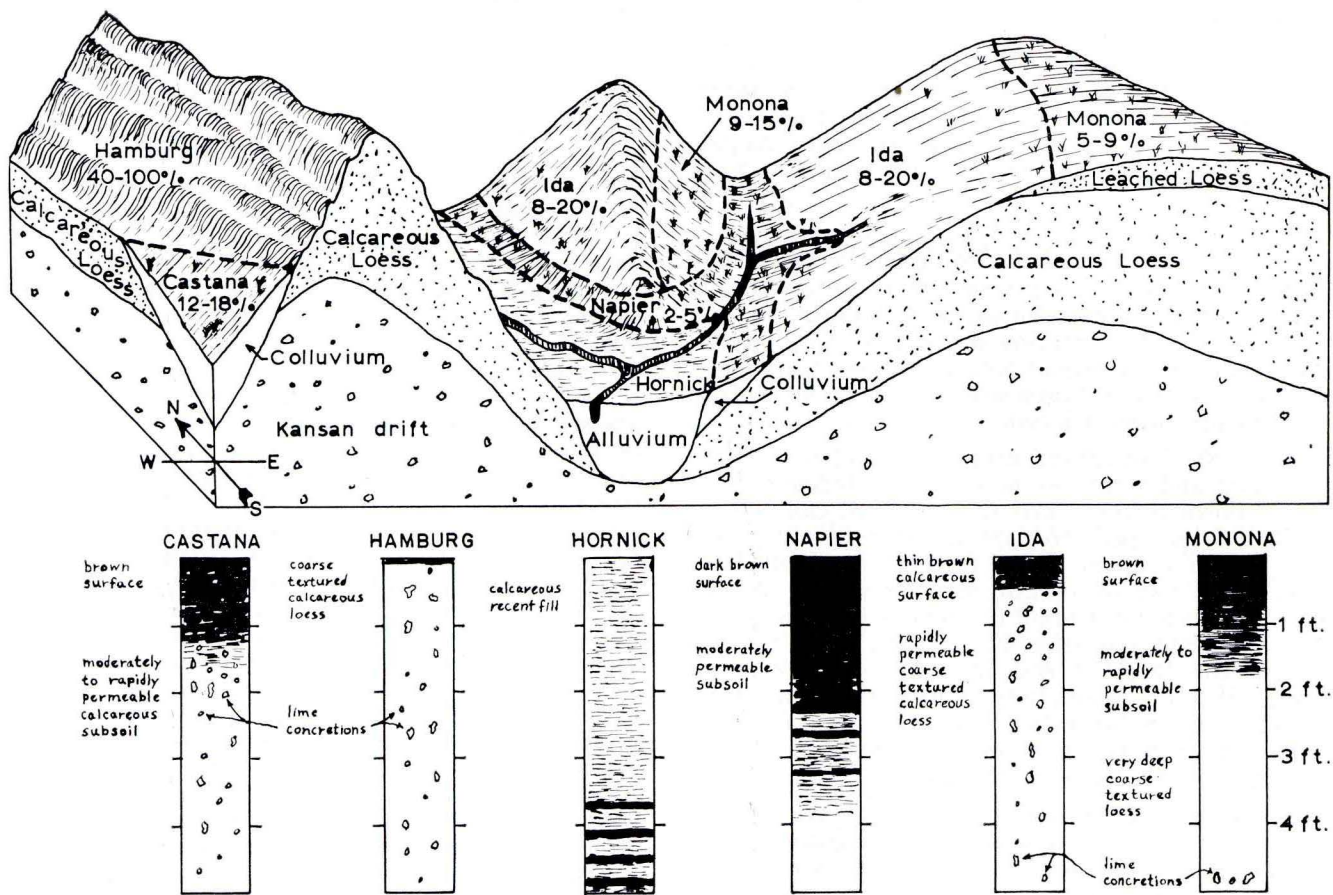


Fig. 2. The geographical relationship of the Ida-Monona-Hamburg and related soils and their characteristics.

### Extent of Soil Losses

Average erosion losses for the entire sample, when examined at three different points in time, showed a drop from an annual rate of approximately 21 tons per acre in 1949 to 20 tons in 1952 and to 14 tons in 1957. Only one of five farms had a lower rate of soil loss in 1952 than in 1949, but soil losses in 1957 were lower than 1952 losses on two of every five farms. On some farms, however, the progress made between 1949 and 1952 had been lost by 1957. More than a fourth of the farms on which erosion had been reduced during the period between 1949 and 1952 showed greater soil losses in 1957 than they had had in 1952. In addition, soil losses increased by more than 5 tons per acre for 10 percent of the farms on which there had been no important change in the rate of soil loss between 1949 and 1952. Farm operators on only 15 percent of the farms surveyed had achieved soil loss rates of 5 tons or less when they were visited in 1957.

The absolute control or prevention of all soil erosion is an undertaking that would be both difficult and of questionable value. But how much effort should be made? The Soil Conservation Service technician, in his recommendations to a farmer concerning soil erosion control, is guided by the objective of bringing soil-deteriorating processes more nearly into balance with soil-generating processes. Using this concept, only that rate of soil loss may

be permitted which does not remove the topsoil faster than it can be replaced by natural processes. Such a determination is difficult to make and must often be arbitrarily set. For the Ida-Monona soil association, this permissible rate has been set at 5 tons per acre per year. (Five tons per acre may be easier to visualize as a layer of soil covering an acre of land to the depth of 0.04 inch.) An average annual loss of soil any greater than this would be considered serious enough to warrant action to prevent it. In terms of the 5-ton standard, soil losses which averaged 20 tons per acre, or even 14 tons per acre, fall far short of being satisfactory.

This higher soil loss in many instances damages the individual farm operator, his immediate neighbors, the community and the county. Less directly, it hurts both the state and the nation. Fields, crops, roads and bridges are damaged, and drainage ditches across the bottomland are filled with silt and require periodic cleaning.

### MAJOR FACTORS HINDERING SOIL EROSION CONTROL

Reducing the losses from soil erosion is not a difficult technical achievement if one is concerned with only the physical aspects of the problem. The 5-ton goal can be achieved on most western Iowa farms in several different ways. Tillage operations performed following the contours of a field reduce, by approximately half, the loss of soil which occurs



if tillage operations do not follow field contours. If row crops are planted on ridges or in lister basins made to follow these contours, soil losses will drop to between 20 and 30 percent of the losses which occur under the conventional system. The use of terraces reduces losses to a level of 10 to 20 percent of the loss if none of these practices were followed.

The cropping pattern followed on farms also has considerable influence in determining the rate of soil loss. The greater the proportion of forage in the rotation, the lower is the soil loss. Increases in the proportion of the rotation devoted to corn require an increase in the use of mechanical measures, such as terraces, if soil losses are to be kept at a given level or are to be reduced.

The job of obtaining acceptance and use of the practices and rotations necessary to bring erosion losses down to the maximum loss that can be permitted, 5 tons per acre, appears deceptively simple for several reasons. Some farmers have much to gain from use of certain measures. The recommended mechanical practices reduce the loss of soil and the plant nutrients it contains. They also increase the level of soil moisture, an important factor in crop production in western Iowa where moisture often becomes the limiting factor in late summer. Crop yields reflect this difference when compared with areas to the east.

Assistance of various kinds is also available to farmers. Federal cost-sharing arrangements are available to help finance the construction of terraces. Incentive payments are made to encourage farmers to farm with the contour of the land. Technicians of the Soil Conservation Service are available to provide planning and technical assistance, and research results obtained on an experimental farm in the area with the same kind of soils are available through the Cooperative Extension Service. Farmers who cooperated with the federal government's 1957 acreage reserve program to reduce the output of commodities in surplus, received some compensation for reducing their corn acreage. Yet, with all these factors at work, the goal remains unattained. Why haven't the various efforts been more successful? What changes are necessary if the desired goal is to be attained?

The difficulties encountered in reducing over-all soil losses on farms in western Iowa to a 5-ton level arise from a combination of factors. An understanding of the attitudes and values of the operator himself is of primary importance if a greater response is to be obtained from efforts to increase the extent of erosion-control measures on farms. Farm operators, and nonoperating farm owners as well, differ in their goals and values, particularly in the priorities they assign to various goals and in the means they select to obtain them. Information concerning the differences and why they exist is essential to an understanding of the obstacles to greater use of erosion-control practices. However, people are more reluctant to express themselves on such things than on questions more closely related to farming operations.

### Attitudes of Farmers

The operator on each farm in the sample studied was asked on each of the three visits the kind and extent of the practices he felt were needed on his farm to reduce erosion losses. If the practices mentioned by these farmers had been applied, the average soil loss rate in 1949 would have been 16 tons rather than 21 tons; and for 1957, 12 tons rather than the 14 tons per acre estimated on the basis of practices actually in use. Thus, there is evidence of an awareness by many farmers of the need for certain additional measures to reduce erosion losses even though this goal does not coincide with the 5-ton goal.

There are, however, farmers in the area who show little or no concern about the erosion situation on their farms. Some are actually unaware that soil erosion is taking place. Others are aware of the losses but tend to discount their importance. Soil losses of 20 tons per acre, when this is seen only as 0.16 of an inch, do not seem great in any one year, especially when one considers that the material from which the topsoil was originally formed is still 100 to 400 inches deep in most of the area. The original topsoil has long been gone from the steeper slopes. The light-colored subsoil, however, still is easily tilled. With the application of barnyard and green manures and commercial fertilizers, crops respond as well, or nearly as well, as in the uneroded areas.

A frequent response to the question of why a farm operator objected to a recommended erosion-control practice was simply that he could not see the need for it. This response was given to one or more practices on 47 out of 138 farms visited in 1957. The average rate of erosion on these farms, over 16 tons per acre, was greater than the rate for the entire sample.

The loss of usable crop and pasture acreage from the farms is more obvious with gullying than with sheet erosion. Gullying is a serious matter in other respects, too. Gullies impose many inconveniences in farm operations. They make awkward field boundaries necessary and prevent ready access to fields. An enlarging gully is also a serious threat to adjoining property owners. Nevertheless, many of the gullies have existed in some stage of development for a long enough period that the present farm operator has either nearly forgotten the time when they were less developed or actually has no knowledge of that time.

The attitude of many farmers toward gullies is almost fatalistic. Once the gullies have reached through the loess to the underlying glacial till (and gullies 30 to 40 feet deep are not uncommon), nothing can be done to obliterate them short of expensive earth-moving measures. Many farmers seem to feel that there is also little they can do to prevent further enlargement of the gullies. In some instances the additional damage that can be done would be negligible in comparison to that already done. Other gullies apparently have reached their maximum length, but large sections of the soil forming the vertical walls can still slough off and tumble into the gully. Similarly, lateral gullies can,



and do, develop from the main stem. And so these U-shaped, canyon-like gullies have become an accepted, although undesirable, feature of the landscape—something that must be lived with.

### **Community Influences**

The prevailing attitudes in a farm community toward soil erosion and its control are undoubtedly an influence on individual farm operators. Sociologists are careful to distinguish between the leadership provided by formally organized groups, which would include in this case farm organizations, civic groups, churches, governmental agencies, etc., and the influence of relatives, neighbors and other respected persons outside these more formal groups. The influence of persons in the latter group may be as great or greater than that of those in the first group. If the attitudes, opinions and values of the leaders in the informal groups are unfavorable, the work of the leaders of the formally organized groups is made that much more difficult. For anyone to have the best understanding of the situation on a particular farm, he should determine as best he can the farm operator's position relative to the community and its leaders and the prevailing attitudes in the community.

The importance of community influences has been apparent in these studies. The desire of farmers in some communities to obtain federal assistance under the terms of Public Law 566, for the development of the small watershed in which their farms are located, generated a positive influence for erosion control. The importance of the thinking or reaction of neighbors was revealed in the responses obtained to a question asked of the farm operators to learn to whom they looked for information about erosion-control matters. Most of the farmers mentioned a neighbor. A much smaller number indicated someone in a government agency. The Soil Conservation Service was the agency most frequently mentioned in this respect. When farmers were asked who would be their choice of a person to organize a conservation "field" or "work" day, they most often mentioned a neighboring farmer. Some suggested a co-leadership arrangement between a leading farmer and a representative of a government agency.

Persons other than farmers—particularly bankers, lawyers and leading businessmen—also influence the attitudes of landowners toward erosion control. Whether this influence is more likely to reinforce previous attitudes rather than change them is not known. It depends upon the individuals involved.

Some landlords look to a particular farmer, whose farming ability they respect, and use him and his farming methods as a standard by which to compare the performance of the tenants on their own farms.

Representatives of public agencies who work with farm people have long recognized the importance of gaining acceptance of their programs by the outstanding and most progressive farmers in a community. However, the persons of influence in a farming community are not always found only

among these people. Some outstanding farmers have surprisingly little influence. The studies in western Iowa disclosed various instances in which a person who was opposed to certain erosion-control measures, but who had considerable influence in his neighborhood, was offsetting the example provided by a farmer who had been successful in reducing the erosion losses on his farm.

### **Lack of Concern by Owners and Operators**

Much of the effort to achieve a greater degree of erosion control by farmers is based on the assumption that, though farm owners and farm operators may not be aware of the extent of the soil losses taking place on their farms, once they become aware of the situation, they will make an effort to reduce the loss. Educational efforts premised on this thinking have been successful with some farmers. The assumption is questionable when dealing with others. A reassessment of the underlying psychology of existing education programs is needed as well as an appraisal of the entire effort. Either the information presented is not sufficiently convincing to these farm people, or they are not even being reached. Farm landlords are a particular problem, especially those with little or no direct experience in farming themselves. They and others of advanced age often have no contact with either those persons responsible for the educational efforts or their programs.

It is a mistake, however, to believe that, once farm people have been made aware of the erosion situation on their farms, they will always do something about it. More than a third of the farm operators interviewed considered the erosion-control plans recommended for their farms to be unnecessary. Although there appeared to be economic justification for this reaction in some instances, the failure of many of these people to make even those efforts to reduce erosion losses for which there was little or no cost indicated that something more than economic obstacles was involved. Sometimes it was a matter of misinformation that held them back. At other times it was the effect of custom or inertia.

Some of the reactions to the recommended practices indicated the prevalence of misinformation concerning them as well as a lack of understanding. Some farmers asserted that commercial fertilizer would cement the soil, kill earthworms or otherwise do more harm than good. Others merely indicated that they did not want the practices. Some said that contouring would increase rather than decrease erosion. Some rejected anything which in any way involved the federal government. Objections to contouring and terracing on the grounds of the inconveniences and difficulties involved could be accepted as valid, but such comments were often followed with a statement from the person interviewed that there was no real need for these practices on his farm in the first place.

When it was first introduced, farming with the contour came into direct conflict with what had been a long-established method of farming in the Corn Belt. Several generations of farmers had



taken pride in their straight-plowed furrows and checked corn fields. Older farmers and landlords often asserted that it was impossible to raise good corn unless it was planted in this manner because of the necessity of cultivating it at least once in a direction perpendicular to the planting direction to control weeds. They either ignored or were unaware of the effectiveness and general availability of herbicides which make weed control less of a problem for other farmers. Similarly, the desirability of holding cultivation to a minimum so as to avoid needless destruction of corn roots was something that did not concern them.

Traditional or customary methods of farming still have a dominant influence over some farmers. They may be willing to accept the fact that certain changes in their farming operations are desirable, but considerable inertia must be overcome before they will make the changes. As might be expected, reactions of this general type were most frequently obtained on farms where the rate of soil loss was considerably greater than for the sample as a whole. Because these farmers seldom saw a need for any change in their farming operations, their erosion-control goal, if one may be said to have existed, coincided with the relatively high loss then occurring on the farm.

Frequently farm operators objected to the extent to which a particular practice was recommended. Unlike those who were totally opposed to certain erosion-control measures, these persons recognized the need to do something. The recommended farm plans, in their view, were too demanding in the level of erosion control attempted. The operators were willing to adopt the recommended practices in part but not to the degree necessary to reduce soil losses to a level of 5 tons.

Operators sometimes preferred an intermediate plan somewhere between the extremes of (1) the maximum of mechanical practices and maximum corn acreage and (2) the plan in which corn acreage and mechanical practices were reduced but hay and pasture crops were increased. Some change in the type or amount of the practices planned for these farms would have been acceptable to these farm operators.

### **Income Considerations**

Situations in which farmers were reluctant to adopt the erosion-control measures that they recognized as having some merit were often found to have roots in one or more of three basic economic obstacles. Some farm operators and owners placed an unusually high premium on immediate income relative to that expected over a longer period of time. Often these same people, and others too, did not have farm businesses that were large enough to provide them the level of living they desired and at the same time permit them to maintain their soil resources. For other farm operators, a third type of problem existed. They were unable to reduce their erosion losses with the present organization of their farm businesses but would find it possible to reduce erosion if the farm businesses were reorganized.

Often a choice must be made in the use of land between the production of immediate income and its use for producing a larger stream of income in the future. A farmer's preference in this matter makes a great deal of difference in the control of erosion. Nearly every farm owner and operator who was interviewed gave some expression of his own time preferences, either directly or indirectly. Tenants with 1-year leases and no expectation of renewing them and landowners with similarly short expectations of continued ownership often were encountered. They were ready to sacrifice future productivity for immediate income. At the other extreme were the relatively infrequent instances of older farmers to whom income was no longer a prime objective. Their goal was to pass on to an heir a farm with the capacity of high production for the future.

Another basic economic obstacle was the small quantity of land and capital possessed by some farm operators. Many operators placed a high value on preserving the future productivity of soil. But with only a small farm business and limited financial resources with which to expand it, they found it necessary to make intensive use of the land to obtain a satisfactory level of income. Furthermore, they were not in a financial position to make investments in measures such as terraces because of the cost.

Farm situations on which soil losses are high sometimes call for only more effective use of resources already available. There were farm operators in the sample whose level of income was such that they felt they could not afford to accept a smaller corn acreage on their sloping fields. Unlike the farmers just mentioned, however, they had, or could obtain, sufficient assets which, if more effectively organized and used, would increase their output even with the adoption of those changes necessary to reduce their erosion losses. Frequently, lack of knowledge was responsible for part of this problem. In other cases their uncertainty about the future prevented the use of their land, buildings, machinery, livestock and financial resources that would have given them a larger average annual income in the long run.

Most farmers naturally expect their farming efforts each year to yield them both an immediate and, what they consider, a satisfactory income. Unless they have other sources of income, their operations must be planned to accomplish this. Most farmers are not inclined to use precise economic calculations or to weigh in detail the alternatives open to them when they make managerial decisions. Furthermore, the information they need to do this is not always available. This is particularly true with respect to the costs and returns to specific erosion-control practices. Recognizing this, much effort has been made during the last 25 years or more by the farm magazines, the agricultural colleges and various governmental agencies to demonstrate and to convince farmers that "soil conservation pays." These efforts have not always produced the results desired. The physical situation on the demonstration farm may be representative



of that for many farms in a large area, but conditions of tenure, managerial ability, capital position, and other factors which contribute to the financial success of the operator and the demonstration farm may be quite different on other farms.

In periods such as the present, when farm incomes are under pressure, farmers as a group are less ready to make investments of any kind in which there is much uncertainty present, even though there may be some promise of financial reward. Thus, while the farmers interviewed may not have fully appreciated the longer-term economic implications of erosion losses of 20 tons per acre as against 10 tons per acre, or 5 tons per acre, they were concerned with the cost and immediate income implications of the various control measures recommended in the two farm plans presented to them. In 1957, slightly more than half of the farmers objected to one or more recommended practices because they feared that to adopt it would jeopardize their income, and they were not in position to take a loss of income then even though it might be recovered at a later date.

Farmers who examined both of the plans prepared for their farms quickly discovered that there was often little choice between the two with respect to the effect of the plans on immediate net income. The plan which emphasized mechanical measures depended to a large extent upon the installation of terraces to reduce the level of soil losses. While both technical and financial assistance would have been available to farmers if they had wished to build a system of terraces, many farmers said that they would be unable to finance the work with the funds they had available. Although credit was available to most operators to cover the costs of erosion-control practices, they were reluctant to use it in this way.

Some farmers said they could not consider any investments of their own funds because of demands on their present incomes for living expenses, operating expenses and debt repayment. If funds remained after meeting these claims, they said they would consider using them to install erosion-control practices. Even then, erosion-control practices were rated relatively low compared with other investment possibilities in the farm business.

Farmers had various reasons for giving erosion-control measures this low priority. They were pessimistic as to the effect that such investments would have upon their immediate incomes. They also had noted that land prices in the area failed to reflect all the consequences of previous erosion. Changes observed in the estimated value of a group of the sample farms in the area over a 10-year period appeared to have no relation to either the amount of erosion taking place on the farm or the changes in the rate of loss which had occurred during the period.

Farmers also objected to the alternative erosion-control plan which eliminated the use of terraces but substituted a crop rotation high in forage crops and low in corn acreage. Such a cropping system, they said, would greatly reduce their immediate income. Unless they increased the number of rough-

age-consuming livestock, many of these farmers would have had no way to convert the increased quantities of forage into a marketable product. Many of them also objected to expansion of such a livestock enterprise on their farms. Some were unable to finance the purchase of the necessary livestock. Others felt that the purchase price for this type of livestock was too high or that the element of risk was too great. Still others disliked this type of farming, and in some instances, the farm operator had no, or only limited, experience with such enterprises.

### Rental Arrangements

Farm tenants also foresaw difficulties in addition to those already mentioned if they were to attempt to apply some of the recommended practices. In several instances the difficulties had arisen already. Many of the owners of tenant-operated farms showed no more concern about the erosion situation on their farms than did their tenants. They also had the same misinformation about the different practices designed to reduce soil losses. Under these conditions few tenants would find it easy to carry out the measures required on their farm to bring soil losses down to the public standard. In fact, some tenants had even been forbidden to farm with the contour because of the fear that weeds could not be properly controlled.

There also were tenants who did not cooperate with landlords who desired to bring about a more effective control of erosion through a change in farming practices.

Tenants and landlords face a particularly difficult problem with respect to the construction of a system of terraces, a project which has property-right implications similar to the construction of buildings, fences or drainage systems. Logically, the initial investment should be the responsibility of the landlord. If he does not make the investment, few tenants are likely to do so. Their usual short-term interest in the farm will not generally justify it, particularly if there is no provision in the lease to compensate the tenant in some manner if he leaves, or must give up the farm. No leases with such provisions were found on the farms studied.

Changes in rotations and the accompanying changes required in the livestock enterprise would be particularly difficult on tenant-operated farms without a change in the lease on those farms where a crop-share lease, the most common type of lease, is used. Here again, custom and inertia make such changes difficult.

Even if the difficulties could be ironed out, landlords and tenants often expressed the doubt that a level of income satisfactory to both of them could be produced on the farm if the recommended practices were adopted. In many of the instances in which an elderly landlord was involved, the farm was his or her only source of income and provided a comparatively small income at that. The prospect for the investment of the additional capital, which these farms would require if an erosion-control plan were to be successful, was not good.



## Field Layout

Both contouring and terracing often require the relocation of fences and changes in the size and shape of fields if the practices are to be most effective and if difficulties such as numerous short, point rows are to be kept to a minimum. Even so, changes in slopes make it impossible to maintain a constant width throughout any cropping strip. This and the extra trouble and expense caused by the necessity of relocating fences prevent many farm operators from using the practices. In some instances the location of roads and gullies would complicate matters and make it difficult to change existing field layouts to achieve fields of a size and shape that would permit ease and efficiency in the use of machinery.

## REMEDIAL APPROACHES TO SOIL EROSION CONTROL

A variety of obstacles stand in the way of further progress in the reduction of soil erosion in western Iowa. (The major obstacles which have just been enumerated have been tested and found to be valid.) Further analysis of these obstacles, in turn, often reveals additional difficulties. What people think and why they accept certain beliefs is important even if their attitudes or beliefs are of questionable rationality or do not agree with what is thought to be the true state of affairs. But, before anyone can expect to deal effectively with these resistances to the further control of soil erosion, he should be aware of these things so that he can react to them with full knowledge of the difficulties and not on the basis of faulty assumptions.

The positive side of the situation in western Iowa has been neglected up to this point, but there also were farms in the area on which the operators had been successful in reducing erosion losses to more acceptable levels. The favorable experiences of these operators have suggested some of the remedial measures which follow. Others are suggested because they seem to offer the logical solution to the particular problem. Not all are new, but some have not been widely used.

### Identifying Public and Private Interests

More serious than the mechanical and physical difficulties associated with farming with the contour of the land or with the installation of terraces, which are definite obstacles to be overcome, are the obstacles which have economic roots. These arise from the fact that the farm operator (and often, on rented farms, the landlord as well) is (1) largely unaware of or unconcerned about the rate of soil loss taking place, (2) unaware or uninformed of the cost of alternative techniques for reducing losses or (3) aware of the problem but under pressure to maintain his income at all costs.

These are some of the sources of difficulty in achieving greater control of soil erosion. These situations lie largely within the scope of human relations and economics. What can be done to overcome them?

Numerous suggestions can be made as to means which might be used. Not all of them will be successful but they can be tested only by actually try-

ing them. Some remedies depend largely upon arrangements which must be worked out by the farm operator himself. Others require joint efforts of tenant and landlord or the cooperative efforts of neighbors. Still others require the use of governmental powers—those of spending, taxing and policing.

The federal, state and local governments already are using, with varying degrees of intensity and success, some of their powers in an effort to overcome these difficulties. These efforts can be made more effective with a clearer knowledge of what the significant obstacles are. Further, public agencies have not begun to exhaust all the possibilities of integrating their efforts between agencies or with the efforts of farmers, nor are they empowered to take some of the action that may at times be required. The legislative and judicial bodies, as well as the administrative agencies, have roles to play to facilitate private efforts.

Some preliminary guidance can be gained by selecting the means which can be tried if agreement can be reached upon (1) the goals sought and (2) the division of responsibility for initiating and financing the efforts made. It is upon these points that some of the present difficulty rests. It must be recognized that these are matters which call primarily for political decisions based on the logic of economics. Economics provide a procedure for analyzing the situations requiring a decision. Some decisions, however, must be made which take into account factors and values other than the maximization of profit.

Sufficient recognition of a public interest in the control of erosion on privately owned land exists to justify public expenditures. Such expenditures have been made for educational efforts, technical assistance to farmers without cost and the sharing of costs on certain measures designed to reduce erosion. The extent to which such investments can be justified as in the public interest has never been established in a forthright manner. Federal agencies requesting funds to finance such efforts have often found their requests trimmed before they reached the Congress, and the Congress itself has frequently appropriated less than the requested amounts. Funds provided by state legislative bodies have been exceedingly limited.

In practice there have been, and continue to be, annual budgetary limits to the amount of soil erosion control that the federal and state governments will support. This ultimately sets a level on physical accomplishments. The size of appropriations usually is determined more as the result of intuitive judgments as to what is desirable, by political considerations and by the competition for public funds for other purposes. This happens in part because sufficient study has not been undertaken to determine the implications of various levels of soil erosion on the nation's requirements for agricultural production in the future, taking into account the dynamics of the technology of agriculture and the possibilities for meeting future requirements with alternative means.

No statement of objectives of erosion-control



in quantitative or even relative terms can be found in federal legislation. Public Law 46 of April 27, 1935, the Soil Conservation Service enabling act, declares that it is the policy of Congress "to provide permanently for the control and prevention of soil erosion." It does not indicate, however, the desirable degree of control or the basis for determining this. Public Law 461 of Feb. 29, 1936, the Soil Conservation and Domestic Allotment Act, cites as objectives, among other things, the "preservation and improvement of soil fertility, promotion of economic use and conservation of land (and) diminution of exploitation and wasteful and unscientific use of national soil resources." Such a statement provides no guidance for determining either where private responsibility ends and public responsibility begins or where the ultimate limits to public responsibility are.

The Soil Conservation Service in cooperation with state and federal agricultural research agencies has developed the previously mentioned "maximum permissible soil loss" concept. Its field personnel use this as an objective to guide their planning of erosion-control measures. The soil type, depth of the topsoil and the type of material beneath the surface of the soil, together with other factors which determine the rate of soil formation, are all taken into account. By implication, this level of erosion control is the level dictated by the public interest, although only physical factors have been considered in its determination.

This goal excludes any consideration of the cost to either the farmer or the public of achieving a loss of no more than 5 tons of soil per acre annually. Neither are there explicit calculations of the benefits expected. There simply is an unspoken assumption that the benefits will be greater than the costs at this level of erosion control. There usually is a considerable public interest and benefit to be derived from some degree of erosion control, but the optimum degree of control may very well be different from this purely physical goal. An economic analysis built on the physical analysis is necessary to determine what the optimum is. Such an analysis will consider offsite damages and benefits and the cost, in terms of other inputs, of obtaining products of a given quantity and quality in the future if existing soil resources are allowed to deteriorate. To make such calculations, one must take into account the extent to which the quantity of products consumed at some future period would decrease if prices increased, as well as changes in technology and changes in the price relationships of the other resources which would probably be substituted to some degree for soil. Allowances must be made for the uncertainties involved in these estimates, but an analysis would not be impossible.

Even though the 5-ton soil loss goal was accepted without question initially in the studies reported here, the goal itself cannot be overlooked as a possible source of difficulty. Perhaps it is more important to determine whether, or how, the responsibility for meeting the costs associated with attempts to attain a given goal is to be shared. This is the critical question. The goal should dis-

tinguish between what the public has a right to expect will be accomplished by land owners and farm operators themselves and what portion of the job must be publicly financed.

There are a number of reasons why public and private interests in erosion control do not always coincide. There also are valid reasons why the level of erosion control that can be profitably undertaken on one farm may be quite different from that on another. Many of these reasons either have been illustrated specifically, or implied, in the foregoing description of the obstacle situations. Granted that many farmers may not now be doing all that is to their advantage to do, it may not be realistic to expect that a reduction of soil losses even to the level of 10 tons per acre, much less 5 tons, can be accomplished on some farms without a considerable amount of public effort and assistance. It is important for this reason alone to determine whether the 5-ton level is really the appropriate public goal for this area. Further research on this matter is now under way in a joint project of the U. S. Department of Agriculture and the Iowa Agricultural and Home Economics Experiment Station.

One of the difficulties of the present situation is the apparent disregard for the distinction between private and public interest. In "selling" erosion-control measures to farmers with the slogan, "conservation pays," it is implied that a full program of measures will be profitable for the individual farmer when this may not always be true.

Farm plans which are drawn up to accomplish the 5-ton level of control do not spell out the areas of individual and public responsibility. It is true, of course, that a technician of the Soil Conservation Service may be available to give, at no cost, certain technical assistance and advice to the farmer in establishing the recommended practices. Further, the participating farmer can take advantage of cost-sharing arrangements—the payments available through the Agricultural Conservation Program Service of the U. S. Department of Agriculture. But these payments often are considered to be only an incentive to stimulate farmers to adopt practices such as contouring or the use of fertilizers. Once farmers' initial reluctance to use the practice has been overcome, they usually can be expected to continue it without further financial incentive if it is profitable. Sharing a cost such as that involved in the construction of terraces is, in part, a different matter. Some initial inducement again may be necessary here, but cost sharing may also be a recognition of a public interest in the practice which exceeds the private interest.

The formula used for determining the share of these costs to be borne by the farmer and by the federal government is an arbitrary one. The division of costs does not necessarily reflect the portion of the total investment which is rightly a public responsibility. Such a share might be less; it might be more. One might also question whether the public benefit is always such that the federal government is the appropriate unit of government to bear the cost, particularly if the major bene-



ficiaries are largely within the same watershed.

The lack of a clear policy with respect to the division of financial responsibility for different levels of erosion-control means, in practice, that the desired erosion-control practices will not be applied if a farmer is expected to bear the cost of carrying land-management practices beyond the point where he could be reasonably expected to benefit from them. On the other hand, if the public is too liberal in the assistance it extends and the responsibility it assumes, when such assistance is not the crucial factor in bringing about the desired changes, this represents an inefficient use of public funds. Some of the present difficulties can be traced to the inadequate attention that has been given to these matters.

The technician who draws up the farm plan and works with the farmer surely appreciates that, no matter how effective the plan may be in its conception for controlling erosion, it is of little value unless it gains the farmer's acceptance. The technician faces the problem of compromising what he feels to be a technically complete and effective set of recommendations for something much less perfect in its ability to accomplish the desired level of erosion control. He and the farm operator may consider how the plan can be adopted to the farm operator's circumstances, but neither he nor the farm operator have accurate information to guide them in determining how much of the recommended plan would be economically feasible for the farmer. The ideal physical plan may in large measure be unacceptable to the farmer.

It is interesting to note in this connection that the 46 farms with complete Soil Conservation Service farm plans in 1957 had an average rate of soil loss of 10.3 tons. Although this was less than the average soil loss of 16.5 tons on the farms without a plan, it still exceeded the 5-ton-loss goal. Farms on which plans had only recently been completed showed an average annual loss of 14.7 tons per acre. Given more time the soil losses on the farms of these cooperating farmers may be further reduced, but under the present circumstances it seems unlikely that they will reach the 5-ton level.

Some of the frustration which the soil conservationist undoubtedly faces, if he must attempt a compromise between the ideal agronomic and engineering plan and the plan which has the best chance of adoption, might be avoided if the unique features of the particular farm being planned were recognized. The farm business of one farm family can differ from that of neighboring farms in various respects even though soils, topography, climate, etc. are nearly identical. Those practices which are not financially attractive for one farm operator may be quite profitable on another farm. It might be a different matter if the operator were able to add more land to his farm, if he had more working capital or if certain changes were made in the lease in the case of a tenant-operated farm, etc.

The technician could provide a useful service to the farmer if he were able to indicate those portions of the plan that would be profitable under

the operator's present circumstances and those which would require certain changes in his farm business before they would pay. Possibly some practices then would remain which, while desirable from a public point of view, would be unprofitable for the operator to undertake without outside financial assistance. The farmer then could be encouraged to carry out those parts of the plan that lay within his capabilities and be directed to the appropriate places for any assistance he might require to make the necessary changes in the organization of his business.

The farm planner may not have the training to permit him to make the economic analysis that has been implied here. It would be most helpful, however, if such an analysis were available, not only when the plan is presented to the farmer, but also at the time when the various agronomic and engineering features of the plan are considered.

Public funds which may be spent on private lands for the control of soil erosion are extremely limited in view of the funds which could be spent to an advantage in this way. To make the most of them, it is important that these funds are not substituted for private funds—either those of individual land-owners and operators or those of several land-owners with a joint interest in the benefits accruing from work done in a small watershed.

Private responsibility can, to a point, be equated with private profitability. It must be recognized, however, that there may be situations in which public activity of some sort is necessary to remove conditions that make certain erosion-control measures financially unattractive to farmers. However, the longer run benefits from additional protective measures which are progressively more costly and yield smaller and smaller immediate and on-site benefits are properly the area of investment for public funds.

The exact limit of each level of responsibility can be defined as the point at which the expenditure of an additional dollar for erosion control would yield an additional benefit of at least \$1 for the person, the group or the public making the investment but where, if an additional expenditure were made, the returns would be less than the investment. This guide can be followed to indicate the cut-off point for public investment in erosion-control activities by limiting further investment at a given site when there are other sites which would produce a larger public benefit for the same investment of funds. This is not the usual practice, however, but the marginal investment at a site should never exceed the marginal benefits.

The owner of land on which erosion is taking place will ordinarily receive the greatest immediate benefit from the first efforts that are made to reduce the loss of soil. If he is fully aware of the erosion losses and their significance to his farming operations, he can be looked to primarily to safeguard his own property. But he may find it possible to protect his own interests without taking the measures which would reduce off-site damages or would provide benefits realizable only at a time beyond the interests of the farm owner or operator.



These benefits would justify investments only on the part of the beneficiaries. Sometimes these persons can be identified easily, and it is fairly easy to negotiate the sharing of costs among them. In other instances these things can be done only with great difficulty. Where this is the situation, the unit of government with jurisdiction which most nearly corresponds with the affected geographic area should be the general sponsor of the required measures. It might act only as an agent for a small number of readily identifiable beneficiaries and assess them the costs in proportion to the benefits received, after the manner of drainage districts.

Determining the appropriate division of responsibility, or the extent of the federal government's final responsibility in these matters is not simple. Nevertheless, the economic logic of this division of responsibility is helpful in explaining some of our present difficulties, and it can serve as a guide in attempting to overcome them.

### **Improving Knowledge of Soil Erosion and Its Consequences**

Soil losses on 33 farms in the sample studied averaged nearly 19 tons per acre in 1957, but the operators on these farms rejected the erosion-control plans laid before them largely on the grounds that they preferred to continue farming in their established manner. On 47 farms, soil losses averaged nearly 17 tons per acre. Yet, when asked why they objected to the proposed erosion-control measures, the operators said they could see no need for them. As indicated earlier, some farm operators and landlords had entirely erroneous conceptions about the effects of particular practices. Unless the farm operators and landowners on these farms, more than 57 percent of the sample, can be convinced that the rate of soil loss from their farms is great enough to reduce their incomes and that the recommended practices are effective and desirable, little or no additional progress can be expected.

Why is it possible after more than 20 years of efforts emphasizing the need to reduce soil losses to find situations of this sort on such a large proportion of a random sample of farms? Have the efforts to provide information been adequate for the job? Have the assumptions upon which such efforts have been based been correct? Has the necessary research support been available and has it been used? Have the educational efforts taken into account the social and economic circumstances in the area? Have farmers had a need for information or assistance of a kind that has not been available? Should more attention be given to increasing the appreciation and understanding of the problem among persons other than farmers in the farm community? Has too much reliance been placed upon the educational process? Most of these questions and others cannot be answered now but should be seriously considered by anyone concerned with the problem of erosion control.

There is no guarantee, of course, that there would not be other obstacles even if the effort to create increased awareness of the erosion problem

among these farmers and landowners were successful. However, the problem would be at least a step closer to eventual solution. If education is not enough to accomplish this, other measures may have to be used. Farm operators and farm landlords need a greater awareness of the seriousness, to them and to the public, of high levels of soil loss. Their knowledge of the economics of erosion and its control, some of which is still unknown, can be increased and their misconceptions corrected. But is it sufficient just to develop and make this information available to them? Can they be expected to take action voluntarily if they have previously been unmoved? Or must the information be coupled with a strong effort to persuade and convince them to accept it?

"Pressure tactics" often backfire and create increased resistance to change. Nevertheless, a less passive means seem to be required for dealing with those people who have never been very responsive to changes of any kind, for a public interest also is involved here. To the extent that public and private interests coincide, the public has a right to expect that the individual will do everything that is at least in his best interest to do.

It is possible to make reasonably reliable estimates of the current rate of soil loss on farms at a relatively small cost as was done in the studies reported here. These estimates might be used as a device to create an awareness of a problem where farm operators and owners appear to have no concern. The governing board of a soil conservation district might consider making a survey of all farms in a community or even a sample such as was used in the "National Inventory of Soil and Water Conservation Needs." Without specifying individual farms, they could make the average loss rate for the farms known to all residents of the area and perhaps contrast it with loss rates elsewhere. This might be followed up with a visit to each farm operator and landlord so that each could see where he stood with respect to other farms in the area. An estimate of the cost of this rate of loss not only to the operators and the landlords but also to the whole community would give an added measure of effectiveness to this technique.

To accomplish the job which remains to be done, the entire farm community, business and professional people as well as farm operators and owners, must be reached. All should be made more conscious of the problem, its causes and possible remedies, and the desirability of making the necessary changes.

New attitudes can be engendered. New skills can be learned. The farm community can do much to bring these things about if its members recognize and attempt to overcome the conditions which now make such changes difficult. They too can be made more aware of their stake in the problem and, if they are helped, to see the role they may play solving this problem. There are many opportunities for them to help by merely acting in their own capacities. Without overt pressure, many farmers can undoubtedly be moved to take action in response to community opinion.



While the community as a whole can assist in increasing farmers' awareness of the need for erosion-control, it may also assist—perhaps even more effectively—in breaking down customary ways of handling certain situations. Furthermore, it could help to establish new patterns under which erosion-control measures would be easier to adopt. Lawyers, bankers, real estate brokers, county government officials and others indirectly related to farming have much to offer. Their opportunity arises any time a farm operator, owner or prospective farm purchaser seeks their advice or assistance in drawing up a lease or a will, in borrowing money, in buying or selling a farm, in working out retirement plans or in filing an income tax return. But these persons must first have an understanding of the problems involved as well as the knowledge of how they can help.

Soil conservation district commissioners might wish to make greater and more extended use of this technique. With the assistance of the county extension director, representatives of the Soil Conservation Service, the Agricultural Stabilization and Conservation Committee, commercial and civic clubs and other interested agencies, it would be possible to plan and hold meetings at which the basic problems could be outlined to the business and professional people of the community and their cooperation solicited. A successful effort of this sort could uncover a number of ways of solving problems that currently face farmers who are attempting, or should be attempting, to apply certain erosion-control measures.

It would be less than honest not to recognize that obstacles have been created by some of the people in the educational and governmental agencies which have been attempting to advance the control of soil erosion. Although perhaps well-meaning, there has been friction between the personnel of various agencies doing parts of the over-all job. The failure to work in more close cooperation with each other and the mutual distrust and rivalry sometimes found have limited the progress that might have been made against the difficulties confronting farmers. These problems call for a variety of approaches. Actually the differences in the approaches and philosophies of the public agencies might well be an asset rather than a source of friction. The opportunities for coordinated and complementary activities, such as the meeting suggested above, are great. Petty opposition and needless competition only hinder the over-all effort.

### **Overcoming Income Difficulties**

Some farm operators and farm landlords objected to the recommended erosion-control measures because they anticipated a loss of income as a result. Undoubtedly, these judgements often were correct. This difficulty, however, could have been overcome if additional investments had been made—perhaps in livestock or fertilizers—or if the resources they were then using had been reorganized and used in a more efficient manner. Others, particularly landlords as a group, were clearly misinformed or without information as to the actual costs involved and

the returns that might be expected to result from the use of the practices. Half of the landlords said that they would have to borrow funds if they were to install the recommended practices. And about half of these landlords indicated that they would not contract debt for this purpose.

Judging from the interviews with the landlords, much of the current educational program is missing them. Many are women who have little knowledge of the condition of their farms. Typically, they view any new capital outlay for improvements, no matter how profitable they might be, as a threat to their immediate economic security. (There are also male landlords in this category.) Many of these women, even the widows of former farm operators, have had little or no experience with farm management matters. The benefits to be gained from erosion-control practices still must be demonstrated to them.

An opportunity exists to provide both farm operators and landlords with information pertaining to the profitability of erosion-control practices. This material should be prepared keeping in mind the handicaps which these people may be facing in their operations and should suggest methods of overcoming these handicaps. One of the most effective current techniques is that of assisting farmers to plan their business enterprises. The farm management program of the Cooperative Extension Service gives this kind of assistance to farm operators, but it reaches only a small number of the farmers in the state. The farm plans prepared by the Soil Conservation Service technicians are somewhat different in that they are largely physically orientated. Both procedures have assisted in bringing about a reduction in soil losses. Improvements can still be made in both planning procedures, however, particularly if they are joined.

Farm planners need to consider economic as well as physical factors. The planning procedure should be flexible enough to accommodate changes in economic circumstances. Most conservation farm plans do not yet meet these requirements.

The techniques for controlling soil loss and the applicability of various practices are changed from time to time as research efforts bring new information to light. The farm plans prepared in 1949 for use in making the studies summarized here were partially obsolete by 1957 and required certain changes. If these plans were outdated, there can be little doubt that plans which had been drawn up for other farms in the area at earlier times were similarly out of date. With limited resources available from the Soil Conservation Service, the soil conservation districts have apparently chosen to extend their efforts to additional farms rather than to follow up those previously planned to make any changes that might be necessary. Changes in prices, changes in owners and operators, changes in planning horizons of operators and changes in other technology are all factors which require frequent revision in farm plans. No plan can be drawn up on a "once-and-for-all" basis. If no effort is made to keep the plan current, it can accomplish only part of the over-all job.



Comprehensive erosion-control plans, which could be revised without great difficulty, could be prepared by farm planners with the aid of electronic computers. The mechanics of planning would be changed, but the basic information about the farm business would still be obtained by the planner who has been assisting the farmer. These data should include the resources available, the operator's estimates of costs and prices, estimates of the productivity of the resources and the farmer's preferences. This information in turn could be tabulated in a standardized form and submitted to a central location for development into a farm plan. An operation of this type could be administered in much the same way as the soil testing service.

The solution or farm plan developed by this means would "specify" the amount and use of all resources in the farm business and give an estimate of net farm income. Alternative plans for the same resources which would result in slightly lower farm incomes, but which might be more acceptable to farm operators could also be developed. These plans then would be sent to the county agency representative who had obtained the basic data from the farmer. He could interpret the recommendations to the farm operator.

Agency representatives could periodically check with farm operators and owners to determine whether the farm plans were still acceptable. If a plan no longer fitted a particular farm situation, it and the data on the changes could be submitted to the computing center for revision. The revision could be easily and inexpensively made if the previous plan was still on file. The low cost and speed with which computers can process large volumes of data would result in the preparation and revision of more comprehensive plans. This could be done at a lower cost per plan than with the present procedure. The data on costs and returns which this procedure would require is also needed for farm planning as it is now done.

Perhaps the greatest advantage of this technique in planning lies in the fact that economic considerations could be taken into account in a much more effective way than is now possible. A farm plan that is nothing more than an agronomic and engineering prescription for reducing soil losses may be acceptable with only minor reservations or changes to a farmer with a relatively small erosion problem. The Napier silt loam soils, with slopes ranging between 0 and 5 percent, offer a wide range of combinations of practices which make it possible to increase the income from crops and simultaneously to reduce soil losses to 5 tons. The real problem comes with farmers who have a major portion of their cropland on the steeper slopes of the Ida and Monona soils. Here it is difficult, if not impossible, for a farm operator to maximize his immediate income from crops and still reduce soil losses to a 5-ton level. Here is an instance where public agencies will undoubtedly have to make some type of investment if soil losses are to be brought down to that level.

It can be argued, and cost and return calculations based on experimental results bear it out,

that, on eroded slopes of Ida silt loam with slopes in excess of 12 percent, a farm operator cannot stay in business **unless** he makes an effort to control erosion. He can expect to see enough of an increase in yields from such an effort not only to pay for the practices but also to turn a loss into a net gain.

This is best illustrated in table 1. The study from which the data in the table are taken is based upon a hypothetical farm situation. A farm of 120 acres was used. It has but one soil: an eroded Ida silt loam. It has no slopes less than 12 percent, but some are as great as 20 percent. Given such a situation, what happens to (1) the rate of soil loss and (2) the income from crop production with various changes?

Columns A through F represent the different crop rotations that might be followed. Rows 1 through 3 show the soil loss per acre expected from each rotation, but with three different basic methods of dealing with runoff and the loss of soil, and under two different farming systems. The cash-grain system assumes that all grain produced on the farm is sold. The livestock system assumes that the grain is fed to livestock. Rows 4 through 6 duplicate the different combinations shown in the first three rows but present information as to the total crop income for the farm under each situation. Thus, both soil loss and annual crop in-

**Table 1. Soil losses and net crop income on eroded Ida silt loam (12 to 20 percent slope) under different rotations, soil management practices and farm management systems.**

	Rotations <sup>a</sup>					
	(A) CCO	(B) CCO, CO	(C) COMM	(D) CCOMM	(E) COMM	(F) COMMM
<b>Soil losses, tons per acre</b>						
1. No practices						
a. Cash crops...	319.5	213.0	106.5	95.8	63.9	42.6
b. Livestock ....	246.0	164.0	82.0	73.8	49.2	32.8
2. Terraces and contouring						
a. Cash crops...	48.0	32.0	16.0	14.4	9.6	6.4
b. Livestock ....	36.9	24.6	12.3	11.1	7.4	4.9
3. Fertilizers, terraces and contouring						
a. Cash crops...	36.9	24.6	12.3	11.1	7.4	4.9
b. Livestock ....	25.8	17.2	8.6	7.7	5.2	3.4
<b>Net crop income for 120 rotation acres (\$)<sup>b</sup></b>						
4. No practices						
a. Cash crops	-1,244	-444	-492	-740	-1,007	-1,414
b. Livestock	82	824	-19	-191	-547	-961
5. Terraces and contouring						
a. Cash crops	-1,007	-312	-180	-458	-681	-1,079
b. Livestock	420	1,172	347	222	-180	-594
6. Fertilizers, terraces and contouring						
a. Cash crops	270	665	392	205	-110	-352
b. Livestock	1,041	1,264	800	821	357	74

<sup>a</sup>C, corn; O, oats; O<sub>s</sub>, oats with sweet clover; M, meadow.

<sup>b</sup>The costs of practices have been depreciated over a 20-year period with interest at 5 percent. A value of 63 cents per hour has been placed upon the farm operator's labor. Terraces have been installed by the operator using a moldboard plow.

Source: Gordon A. Ball, Earl O. Heady and Ross V. Baumann. Economic evaluation of use of soil conservation and improvement practices in western Iowa. U. S. Dept. Agr. Tech. Bul. 1162. June 1957. Tables 6 and 14.



come for one situation can be compared with soil loss and income in any other of the situations shown.

Twenty of the 36 combinations show a farm business that is operating at a loss. If farm operators were fully aware of this, these combinations of enterprises, rotations and poor farming practices would less likely be followed. The income figure presented makes a wage allowance of 63 cents an hour for the operator's labor. Thus, what is shown, if it is not a loss, would be available to the operator as a return to his managerial ability or would allow a higher return for his labor. The cash-grain system which makes use of no practices would lose money for the operator no matter which rotation he selected. The loss would be minimized, however, with a rotation which would produce an estimated soil loss of 213 tons per acre annually, rotation B.

If mechanical practices were used without the use of fertilizers (Row 5a), each of the rotations on a cash-grain farm would result in a loss of money for the operator. Rotation C would minimize this loss, and it would also reduce soil losses dramatically from the situation in which no practices were used. The soil loss would be about 16 tons per acre. The use of fertilizers with these practices makes rotation B the most profitable, but this rotation would increase the soil loss rate to nearly 25 tons per acre. Only rotations E and F come close to achieving, or actually achieve, the desired erosion-control goal, and this is possible only with a livestock system of farming and the use of terraces and contouring. The use of fertilizers is necessary if a financial loss is to be avoided, but the combination of these practices with this system of farming will not produce a very attractive income.

The cropland of a typical farm in western Iowa would not be limited to the steep and severely eroded Ida soils such as were assumed in this situation. In actual practice where such cropland is found together with more productive cropland, the income earned on the more productive cropland would tend to offset the losses on the poorer soils. Because of this, many farmers may not be fully aware of the fact that they are losing money farming such eroded and low-yielding soils. Nor are they likely to be aware that with the right combination of mechanical practices, rotations and commercial fertilizers, these losses not only could be eliminated but crops on these soils could be made to produce an income instead of a loss.<sup>5</sup>

The soil-loss section of table 1 shows quite clearly why some farmers immediately indicate that they could not accept the recommended rotations for

<sup>5</sup> The cost and return data underlying the income figures for table 1 were built upon a set of assumptions which now tend to overestimate the income and underestimate costs. They were based upon an average of the prevailing prices and costs for the period 1948 through 1952 when these relationships were more favorable than they were in either 1957 or at present. Similarly, the cost of installing terraces varies according to the method used, and for these purposes, the **least expensive system** was selected even though it would be more realistic to substitute a more expensive system using a whirlwind terracer or bulldozer. The cost of the operator's labor was included, however; the charge for the investment was spread over a 20-year period at an interest charge of 5 percent. No provision was made, however, for any financial assistance that a farm operator would be eligible to receive under the federal cost-sharing Agricultural Conservation Program Service.

their farms. First, it shows that **both** mechanical and agronomic measures must be used to achieve the 5-ton goal on the eroded Ida slopes. Without the mechanical measures, this goal can be achieved only if corn or other row crops are almost completely eliminated from the rotation. Even when mechanical measures are used, a drastic reduction is required in the percentage of rotation land devoted to corn.

The situation is almost identical on the eroded Monona slopes of similar gradient, although these data are not shown in the table. Only on the slopes of the Monona soils that are less severely eroded and are no steeper than 8 percent can the 5-ton soil-loss goal be approached by using rotations alone. Such rotations, like those on the steeper slopes on which mechanical practices must also be used, permit corn to be planted no more than 1 year out of 4 on a cash-grain farm, or 2 years out of 5 on a livestock farm. However, a farmer willing to use mechanical measures on these lesser slopes can produce corn in a rotation with oats and sweet clover 2 years out of every 3 and still keep his losses to less than 5 tons.<sup>6</sup>

The economic well-being of the farmer comes into conflict with the 5-ton soil-loss goal at this point. The income figures in the second section of the table dramatically highlight this. The combination of rotations and mechanical practices that permits a farm operator to maximize his crop income will not reduce soil losses to the desired 5-ton level. Similarly, the rotations which enable him to minimize his income losses do not minimize soil losses.

Farm planning that takes into account the economic as well as the agronomic and engineering aspects of erosion control is essential if greater progress in the reduction of soil losses is to be achieved. Economic planning can call attention to opportunities for gaining increased control over erosion without impairing farm income. But the relation between these two goals is not always complementary. Erosion cannot always be controlled without lowering farm income. Where there are conflicts between them, farm planning, as such, cannot eliminate the conflict. But it will provide the basis for determining the level of erosion control for which the farm operator or owner can reasonably be expected to be responsible. Likewise, the point at which this responsibility shifts outside the farm firm is similarly defined.

In short, farm planning demonstrates the potentials that can be developed from the existing resources of a farm and what might be done if additional resources were available. It demonstrates the results, both economic and agronomic, of alternative courses of action. Thus, if a farm plan is prepared, at least part of what may have been a lack-of-information obstacle is overcome.

Complete farm planning, though, is not the entire answer. Planning can make a big contribution, but it needs to be followed with efforts to remove

<sup>6</sup> A. Gordon Ball, Earl O. Heady and Ross V. Baumann. Economic evaluation of use of soil conservation and improvement practices in western Iowa. U. S. Dept. Agr. Tech. Bul. 1162. June 1957. p. 19, table 9.



those remaining obstacles that (1) prevent the operator from achieving the potential specified in the plan and (2) prevent the attainment of that level of erosion control beyond the limits of private profitability but desirable from a public point of view.

### Obtaining Additional Capital and Land

A thoughtful man usually asks, "What are the alternatives?" when he is not in position to do everything that promises to be rewarding. The same course of action may look bright to him at one time and dismal at another if there are changes in the attractiveness of his alternatives. Farmers in western Iowa were reluctant to borrow funds to install erosion-control measures, and there is reason to believe that, even if money were available, other investment opportunities open to them would absorb it first. The farm operators did not hesitate to indicate what they would do with more capital if it were available. They indicated that they would buy more livestock, buy fertilizer or improve buildings. Only 3 percent of the operators gave terraces a high investment priority. Grassed waterways and gully control also were mentioned by only 2 and 3 percent of the operators, when interviewed in different years, and then only after making investments elsewhere on the farm.

These responses are not surprising. The return from an investment in erosion-control measures in western Iowa is relatively low, at least during the early years of the investment period. Funds can often be absorbed elsewhere in the farm business where they will yield a higher return. The purchase of roughage-consuming livestock or commercial fertilizer, however, can often make an indirect contribution to erosion control. This is apparent from the data shown in table 1.

Half of the landowners in 1957 indicated that they would have to borrow funds to install the recommended erosion-control practices. Of these, half said that they would not borrow the funds, for they preferred not to go into debt for more livestock, terraces or grassed waterways. Because these studies have indicated that there is a tendency for soil losses to decrease as the ability and willingness of a farm operator to borrow funds for erosion-control practices increase, information as to what might be accomplished with the use of additional capital resources is a crucial matter.

A farm plan in which both farm enterprises and erosion losses are considered might have indirect effects here. With an indication of the changes in income which could be expected from various investments—information which a complete farm plan would provide—farm operators might be more willing to borrow the funds. Banks and other lending institutions might, with greater confidence, become more aggressive in seeking to make such loans. Efforts should be increased to extend such cost and return information to the persons who could use it.

Farm operators interviewed in the studies said that they could undertake to do more if the cost of erosion-control practices were spread over long

periods of time, in the same manner as the returns to the practices frequently are. Actually, it is possible to spread many of the indirect costs—for instance, those associated with converting to a livestock system of farming—over a period of time. Ball, Heady and Baumann indicate in their study that the greatest need for additional capital would not be during the first year the plan was put into operation but somewhere between the fifth and tenth year of operation. Capital outlays would be required every year over a period of years, however, and the total investment would be large.<sup>7</sup>

Farmers who cannot obtain suitable credit on reasonable terms from other sources may obtain the necessary credit through either of two programs of the Farmers Home Administration: farm ownership loans and loans to install soil and water conservation measures.

The farm ownership loan program provides credit for farm enlargement and development up to 90 percent of the value of the borrower's farm. Loans for soil and water conservation are available to farmers or groups of farmers to pay the cash cost of projects related to soil conservation, water development and its conservation and use, and drainage. These funds come almost entirely from private lenders, but the loans are insured by the federal government.

Credit for the soil and water conservation loans has been available to Iowa farmers since 1954. In the 6-year period ending June 30, 1960, 103 borrowers in the state had used it, borrowing a total of \$379,266. However, of this total, only 16 percent was borrowed for erosion-control measures; 64 percent went into drainage projects. These statistics suggest that the credit problem, if a valid obstacle, now may be mainly a lack of knowledge of the credit facilities available, or an aversion to using credit for purposes such as erosion-control measures. Perhaps, too, the authority to make loans under this legislation could be expanded to include as a purpose the purchase of livestock and the making of similar investments indirectly related to the adoption of a conservation farm plan.

It is difficult for both owner-operators and tenants on farms of less than 120 acres to consider the adoption of erosion-control plans unless they have an above-average investment in dairy cattle, feeder cattle or some similarly intensive and specialized enterprise. Such enterprises are not within the means of all farmers, however. Intensive livestock enterprises require additional capital resources and managerial skill, and some involve greater risk than does a cash-grain system of farming. Furthermore, such small farms on the rental market are unlikely to attract tenants with these skills or resources, and the tenants found on such farms are often there only until they can find larger farms.

Consolidation of these smaller farm units through purchase is occurring and appears to be the most promising long-run solution, but this is something which will not necessarily take place at a rapid enough rate if left only to the vagaries of

<sup>7</sup> *Ibid.*, p. 59.



the market. Nearly all the owners of the small farms in the study either held them in a life estate or would not consider selling them because they knew of no other investment better suited to their purposes. Consolidation of some units through field renting is taking place but is not always a satisfactory solution because of the uncertainty of long-term control over these tracts by the operator. Moreover, some of the small units are not convenient enough to the farms of those who desire to rent additional land.

In not too many years, since the average rate of farm ownership turnover in the area is 14 years, most of these small farms will have passed to other owners. Thought might well be given to the possibility of direct action to assure that the new owners create larger, more efficient units from these suboptimum units. Means by which this might be accomplished can only be suggested. They might follow the general pattern of that used in Sweden to deal with a similar problem of farm units of uneconomic size. There, in return for income subsidies, the farm owner agrees to give the government an option to purchase his property at such time as he himself no longer wishes to operate it, unless it is purchased for incorporation into another farm unit which would result in a farm of optimum size. Any purchase of land by the government, however, is made with the intent only to resell it to individual operators as soon as an opportunity arises to enlarge another small unit.

The problem of the undersized farm would not be so difficult if more capital were available and operators had the skill to develop intensive livestock enterprises instead of intensive crop enterprises. This places the solution of the problem back in the discussion of means to overcome capital limitations and managerial deficiencies. Similarly, if the operator were less dependent upon the farm to provide an outlet for his own labor, the problem would be less difficult. Semiretired farm operators in some instances welcomed an opportunity to reduce their hours of field labor and found that livestock and forage enterprises were sufficient to provide for their income needs. Likewise, farm operators with more than just occasional off-farm employment were under less pressure to plant every possible acre in the farm to corn than were the operators with growing family responsibilities and with large debt payments to meet. Consequently, many erosion problems could be solved either if the size of the farm business were enlarged by adding more land or more livestock or if regular off-farm work were available for underemployed farm operators.

#### **REFLECTING SUSTAINED PRODUCTIVITY IN LAND PRICES**

Although no farm operator specifically said that he had paid too much for the purchase or for the rent of the land he farmed to permit him to follow a less intensive cropping system, this was undeniably the situation on a number of farms. Consider, for instance, the relationship between prices farmers pay and the prices they receive.

Between 1941 and 1959, the index of prices that farmers paid for production items rose by 105 percent. The index of prices received for feed grains and hay rose by 75 percent. Thus, in terms of production items, the purchasing power of these farm products was much less in 1959 than in 1941. The price of farm land also increased during the same period, and the increase reflects considerably more than just a rise in the general price level. The price of the highest grade of farm land in western Iowa increased nearly 200 percent while that of the lowest grade increased 165 percent.<sup>8</sup>

An acre of Iowa corn land produced 27 percent more corn during the period 1957-60 than it did for the period 1938-41. However, this increase in productivity cannot be attributed to the land, but even if it could, this increase of itself cannot justify the increase in land prices just noted. Other factors have been responsible. Land has been considered a good hedge against inflation. Even more important, the pressure to enlarge farms also has pushed the price up. Thus, while farm enlargement may be one of the keys to erosion-control on small farms in the area, this becomes more difficult to accomplish when land prices shoot up. It is a less attractive solution, particularly as land prices move beyond the range of the income that the land can be expected to produce under a cropping system that must be less intensive than that now found in the area.

Valuations greatly in excess of the long-term agricultural productivity of land aggravate the erosion problem. Such values lead not only to excessively high fixed commitments which compete for funds needed for erosion-control outlays, but also to exploitation of the farm in an effort to meet these annual payments of principal, interest and taxes. The soil is permitted to deteriorate and erode; fences, buildings and other improvements are allowed to run down. This was the situation found on a number of the farms studied, particularly those on which a young farmer with extremely limited resources had borrowed money to purchase a farm in the period of very favorable corn and livestock prices immediately following the end of World War II and was struggling to produce as much income as possible.

Land prices theoretically represent the considered and rational calculations of well-informed persons who have estimated the future stream of income that can be attributed to the land and have translated this to a present worth. If there is a strong demand for land on the part of persons who wish to use landownership as a hedge against inflation, the price of land established in such a market will likely be much higher than that which would result in the absence of such buyers. Even without this factor, if the annual income which is used as the basis for capitalization consists in part of disinvestments in land through extensive soil erosion caused by rotations heavy in corn, the land value established as a result will be too high since it will be based upon an income which cannot be maintained.

<sup>8</sup> Dwight Maxon Gadsby. Are Iowa farm land prices tapering off? Iowa Farm Sci. Vol. 14, No. 8, Feb. 1960, p. 4.



Many of the farm operators interviewed felt that if soil losses on a farm were not greatly in excess of those on other farms in the community, the value of the farm on the market would not reflect the failure to control erosion nor, if an effort had been made to control erosion, would the market value be enough greater to justify that effort. Their views seem to be well founded. Changes in land prices from 1949-57 apparently had no relation to either the change in erosion between those years or the level of erosion in 1957.

To meet this obstacle effectively is not a simple matter. One can caution those who appraise land for purchase and tax purposes to distinguish between income which results from the true productive powers of the land itself and that which is merely disinvested capital. This, however, may not be as simple as it sounds unless the appraiser has information derived from a study of the problem. He should also take into account future decreased yields and increased costs arising from soil erosion. Such information is not readily available now.

### Improving Leasing Arrangements

The difficulties presented by existing leasing arrangements on farms in western Iowa were among the most important of the obstacles encountered on rented farms. Approximately half of the tenants mentioned the problem, but their concern in most instances was that their landlord would not permit the use of the plan because his income would be reduced. Such a reaction was usually an amplification of the operator's objection that the plan would severely reduce his own income. The reaction of many landlords also focused upon the reduced income they anticipated. Seldom did they see anything in the leases they were using that they felt should be changed to facilitate the adoption of recommended conservation practices.

If these objections were nothing more than a reiteration of the previously discussed obstacle of insufficient resources and the fear of increased expenses and reduced income, further discussion here would add little. There can be, however, a significant difference between the ability of a tenant-operator and that of an owner-operator to make the most economic use of the resources. This gives a different slant to the income problem than that discussed previously.

The function of obtaining and organizing resources for farm production purposes tends to be a divided responsibility on most rented farms. The landlord provides the land and buildings while the tenant provides a line of machinery, his labor and most of the operating expenses. The cost of some inputs is shared. Sometimes this creates little if any problem. At other times it presents a decided obstacle.

Some tenants saw beyond the immediate objections they felt the landlord would have to the reduced corn acreage and emphasized these difficulties. They noted that practices such as terracing, and possibly the construction of grassed waterways, would actually be the responsibility of the landlord. Many said that these were practices which they

could not consider undertaking unless they could be assured of a relatively long-term occupancy of the farm or unless they would eventually be compensated for their investment.

Scarcely mentioned, but obviously recognized, were the indirect investments that the adoption of an erosion-control plan would require to maintain or improve the income of landlord and tenant. Tenant operators, except those who were operating under a livestock-share lease, had at best only small livestock enterprises. To make more effective use of the roughage that would be produced under a shift to rotations with less corn, a livestock system of farming is necessary. While the livestock investment would be the responsibility of the tenant under a crop-share lease, the building and fencing requirements would almost of necessity be the responsibility of the landlord as the depreciation schedule for these investments would span a greater number of years than the tenant's expectancy of tenure. Yet, because the investment would primarily benefit the tenant, the landlord would have little incentive to make it unless he could raise the rent on the farm in some way or switch to a livestock-share lease. Even if he might otherwise be willing to make such an investment, there might well be other more profitable investment opportunities available to him.

The increased use of fertilizer, while of some direct value in the reduction of erosion, has a greater indirect value in establishing satisfactory stands of grass and legumes for grassed waterways and in the hay and pasture sequences of the crop rotation. It is also valuable in that when combined with terracing and contouring, which help retain additional water and increase soil moisture, higher corn yields are possible. On some farms this cost would be shared. On others, it would fall largely on the tenant, who would receive some, but not all, of the benefits of the investment. He would have little incentive to carry his investment in fertilizer to the point of its most profitable use, considering the returns to both tenant and landlord.

If there were more bargaining between tenant and landlord in establishing the terms of leases, presumably some of these difficulties would be resolved. Bargaining, however, is not as important with respect to some of the major terms of the leases in the area as is the custom of the community. Yield data collected in 1949 on the farms studied indicated a corn-yield difference of as much as 30 bushels an acre between farms. With a range in productivity as great as this, one would expect to find a fair degree of variation in the rental terms, yet in 35 cases out of 40 in which the crop-share lease was used, the landlord's share of the crops was half of the corn and two-fifths of the oats. Four of the five remaining farms divided both the corn and the oats crops equally.

There was somewhat more variation in the manner in which certain costs were shared. The cost of seed grain was usually shared by landlord and tenant when the crop-share lease was used. Half of the landlords paid the same proportion of the cost of seed corn as the proportion of the crop



they received. Twelve percent paid a somewhat lesser share of these costs, while the remaining 38 percent paid none at all. Fertilizer costs were generally divided equally, although, with only half of all farms in the sample using commercial fertilizers, there is no indication of how the costs would be shared on rented farms not now using it. Grass and legume seedings were the responsibility of the landlord on 95 percent of the farms using the crop-share lease, but in nearly every instance, the tenant paid a cash rent for the land in hay or pasture. Nevertheless, a few tenants not only supplied part or all of the seed for such seedings but also paid a cash rent on this land.

No attempt has been made to judge the relative equity of the different leases. Much more information than that which was obtained would be needed to do this. Some of the greater variation found in the manner in which the above-mentioned costs were divided could have been the result of an effort to deal with what may have been special circumstances on particular farms. However, it is unlikely that these differences could have been as great as the differences in the productive capacity of the different farms. If additional adjustments were deemed necessary, there would have been greater equity if the share of the crop paid in rent had been adjusted accordingly. Unless costs are shared in proportion to the benefits each party to the lease receives, and unless such adjustments are made throughout the lease, distortions can easily arise in which the incentive is destroyed for the landlord or the tenant either to make the investment initially or to push it to the level at which it would be at an optimum—considering the costs and returns to both parties rather than to one or the other alone.

Obtaining or maintaining permanent or semipermanent facilities—such as the buildings necessary for livestock production, fencing for contour farming and terraces—on farms with a crop-share lease may be handled in at least two ways. The concepts of property rights vest the ownership of such improvements, termed fixtures, in the landowner regardless of who makes the investment. Thus, if possible, it is desirable that the landlord make these investments. If he makes them, a specially designated “improvement rent” can be determined quite apart from, and in addition to, the shares established for the crop enterprises. Should the landlord be unable or unwilling to do this himself, he might be willing to safeguard his tenant’s investment by agreeing to some form of compensation for the tenant upon termination of his tenure.

There is no problem, of course, if both parties to a lease share the costs of the investment in the same proportions as they will share the benefits. The difficulty arises in determining what these benefits will be. For instance, preliminary research indicates that there are small current benefits to be gained from terracing. Grassed waterways and gully-control measures may yield some immediate returns as, for instance, reducing farm machinery operating costs in the process of producing crops. The same can be said for the savings in tractor

fuel which come from farming with the contour instead of up and down the slope. But there are also long-run benefits to the landowner which are of little concern to the tenant. The long-term value of the land, or, the long-term productivity of the farm, is safeguarded against the inroads of gullies which could destroy the usefulness of parts of the farm if not controlled or prevented.

It is reasonable to expect the tenant to share part of the cost of terraces, grassed waterways and gully-control structures, if they are profitable to the farm business, only if he is assured of receiving (1) benefits from them or (2) compensation for their unexhausted value when he leaves the farm.

A tenant, if willing to make such an investment, might still be financially unable to share in the cost. Credit then becomes a problem. Lending agencies would question the use of the proceeds of a loan to make an investment on property of another. But if the landlord were willing to sign the note with his tenant, credit would be less difficult to obtain. Should the tenant leave before the note was paid, the landlord could assume that portion of the note that would represent the amount of compensation due the departing tenant if the remaining benefits from the investment were equal to, or greater than, the amount of the loan.

On some farms it is important that attention be given to the protection of the rights of the landlord. The doctrine of “waste” found in common law theoretically protects the landlord from injury to his property. A tenant has the right to use the property and enjoy the benefits that can be derived from it if he maintains it in the condition in which he received it. He may not use the property in such a way as to lessen its value to the owner without being held accountable for the injury.<sup>9</sup> Such injuries constitute “waste.” The question of what constitutes waste has usually been determined on the basis of what an owner exercising “good husbandry” would do. The Iowa Code allows injured parties treble damages for waste.<sup>10</sup>

With increasing importance being attached to erosion control and the problem of attaining it on rented farms, the doctrine of waste could be made to help serve this end. (An injunction to prevent waste could be used in life estate situations, too.) But the landlord need not wait for the courts to define “good husbandry” if a clause in the lease sets forth what will be expected of the tenant in the way of conservation measures. A provision to compensate the tenant for the unexhausted value of investments which he makes should accompany compensation of the landlord for any deterioration of the property or the liquidation of the “soil-capital” of the landlord.

The adoption of rental shares on a flexible basis might be one means of preventing waste on share-rented farms. This rests on the idea that lines can

<sup>9</sup> H. T. Tiffany. *A treatise on the law of the landlord and tenant*. Vol. 1. Callaghan and Co., Chicago, 1912, p. 705.

<sup>10</sup> Iowa Code, 1950:658. 1950. A case in point was that of *Rickers vs. Kroeger* in the District Court at Carroll, Iowa in 1948. The defendant plowed a hayfield and planted it to corn against the landlord’s wishes. During the crop season the field was subject to an increased amount of erosion. The jury awarded the plaintiff \$300 for actual damages and \$200 in exemplary damages.



be drawn between "soil-depleting" maintenance and "soil-building" rotations and practices. A rental arrangement might be worked out with a basic rental share. This share would apply when rotations and farming practices were used which tended to maintain the same level of fertility and the same and lower rate of soil loss which existed on the farm when the tenant took it over. To the extent that the rotations used by the tenant tended to reduce soil loss or build up the level of fertility, the rental share paid by the tenant would be reduced. To the extent that rotations and practices were followed which permitted soil losses to increase and depleted the level of fertility, the tenant's rent would be increased.<sup>11</sup> This procedure also would correct a situation in which the landlord made little or no contribution to increase the output of the farm.

The use of flexible rental shares would place the tenant more nearly in the same position as an owner-operator in making decisions about the use of crop rotations, soil management practices and erosion-control measures. Since exploitive practices would be reflected back to the tenant in the form of higher rent, there would be less incentive for him to farm in such a manner. The system would be flexible enough, however, to permit him to adjust to changes in economic conditions by making changes in rotations.

Rotations can be reorganized on many farms with only a small outlay of capital which would make possible an increase in income as well as a decrease in soil loss. To a limited extent, this has been shown in table 1. Corn is planted every other year on some fields of low-fertility Ida soil which will yield only 20 bushels to the acre or less. If these fields were taken out of corn and seeded with a grass and legume mixture, total corn production during the entire rotation would be reduced only slightly. In many cases the loss in corn production would be more than replaced by the higher yields that could be expected from the use of commercial fertilizer on the remaining corn land. The costs of seed, planting, cultivating and harvesting would be saved, which could more than offset the value of the corn that the land might have produced.<sup>12</sup>

In some farm situations, the landlord accepted the suggested erosion-control measures but was reluctant to push the tenant too far or too fast for fear of losing an otherwise desirable tenant. Tenants on other farms showed the same hesitancy to urge that particular changes be made. While they saw the desirability of the changes, they did not want to lose possession of the farm. In still other instances both the tenant and landlord were waiting for the other to take the initiative. But in some cases tenants had assumed the initiative and had succeeded in bringing about the desired changes. The tenants tended to rely on practices which required little cash outlay. Practices such as contouring, strip cropping and con-

tour listing save tons of soil at little or no cash expense. On both tenant- and owner-operated farms where the need for immediate income is urgent, these practices should be stressed as strongly as terraces are stressed to farmers who are better able to adopt a more costly, permanent control measure.

The use of incentive payments is certainly justified even if the practices do not involve a substantial cash outlay or are of sufficient immediate benefit to cover their costs to the user, provided the payment is stopped after the initial resistance has been overcome.

Is there any reason why these payments should not be applied to the related but more basic problems of landlord-tenant relationships? For instance, they might be used to induce landlords and tenants to reconsider and change their existing leasing arrangements if this is necessary to remove an obstacle to the use of certain erosion-control measures.

Increased emphasis on extension education on leasing arrangements is also desirable. This might take the form of "rental clinics" to which interested persons would be invited and encouraged to come for assistance in making changes in their leases. Changes from such conventional arrangements have long been advocated but with relatively little effect. Much of the resistance may be only inertia and a lack of understanding concerning the desirability of such changes. This resistance could be melted if considerably more effort were made to overcome it.

Some changes may be resisted if there is concern that the change will give undue advantage to one or the other party. The question of "what is equitable" is bound to arise when a change is considered where, as before, the question could be avoided. Changes will often require a written lease if there has been none before. This may require the assistance of an outside third party, most often a lawyer, country banker or real estate and insurance broker. To some people, this is merely a needless expense. If the job is done by someone without an understanding of the type of lease that will permit the optimum organization and use of resources on the farm, it may well be a needless expense.

If changes are to be made in leasing arrangements, trained people would be needed to give service in these matters. Farm renters and landlords would have to be educated to use such services. Public-spirited persons with an interest in obtaining wider use of erosion-control measures might well consider what might be done to provide such services. The directors of a soil conservation district, recognizing the importance of such services, might take the initiative to organize and promote an effort such as a rental clinic. The Cooperative Extension Service should be able to assist in this too.

#### **Obtaining Cooperation Between Farmers**

Up to this point we have considered the mea-

<sup>11</sup> The "Browning factors" used to determine the soil losses in this study also could be used to determine the net effect of simultaneous changes.

<sup>12</sup> Harald R. Jensen, Economics of crop rotations. Unpublished Ph.D. thesis, Iowa State University Library, Ames, Iowa, 1950. pp. 156-183.



asures necessary to bring about the degree of erosion control that is consistent with the economic interests of informed farm operators. To be realistic we must be prepared to accept something less than complete success in overcoming these obstacles and to recognize that it will take time to accomplish the remedial measures that are needed. But now attention will be shifted to the question of how the level of erosion control thus accomplished by individual farmers is likely to measure up to the goal of reducing losses to a maximum of 5 tons per acre. If farmers cannot achieve that goal by their own efforts, we should not overlook the fact that it may be within the power of a group of farmers to do part of the job.

Undoubtedly there are many farms on which erosion losses could be adequately controlled without undue economic hardship, but there are also farms on which this cannot be done. Indeed, there may be farms on which the erosion problem itself is minor and would not justify additional measures to reduce or control runoff. Yet, because of the critical location of a farm in a watershed and the manner in which property lines are drawn, water accumulating on this farm and flowing to lower farms is a source of great damage. The benefits from a system of soil and crop management practices which accrue to the property owner at the site on which they must be applied may not be sufficient to justify them. If the offsite benefits which these measures create could also be credited to them, however, it would justify their use. Legal devices of various kinds are necessary to "assemble" these offsite benefits in order to justify the costs of the required measures.

Means are available by which benefiting landowners may share the cost of erosion-control measures on the land of others, but little use is being made of them. The arrangements are new in their application to erosion-control problems but not new in themselves. The techniques have been important in solving similar problems which have arisen in connection with the drainage of agricultural land. There are undoubtedly many instances in which this procedure could be economically justified, but farm people will need to be acquainted with this possibility and encouraged to use the techniques. In some instances they will also need to be helped to initiate and negotiate the agreements.

In some situations the relatively simple and informal private agreements between several farmers are sufficient. The Agricultural Conservation Program Service of the U. S. Department of Agriculture has been helpful in this respect. It has permitted farmers to pool the financial assistance they receive from the agency to defray a portion of the cost of a measure jointly installed for their common benefit on the property of one of the co-operators. There were 106 of these pooling agreements in Iowa in 1957 and 144 in the following year. Payments per agreement averaged \$1,112 in 1957 and \$775 in 1958. This arrangement is still relatively unknown and unused, however.

Legal machinery also has been provided for more formal arrangements. In 1949, the Iowa 53d

General Assembly passed an act which empowered county boards of supervisors to establish conservancy districts when approved by (1) the soil conservation district within which they might lie, (2) the Iowa State Conservation Commission and (3) the Iowa Natural Resources Council. Two or more landowners may take the initiative for the establishment of such a district by petitioning their board of supervisors. After the provisions of the law have been met, the district can then make use of the county's authority to issue bonds and to levy and collect taxes on land in the district which is benefited. These funds are to be used for the purpose of establishing and maintaining erosion-control measures or other improvements in the watershed or drainage basin.

In effect, the legislation made it possible to create districts with powers similar to drainage districts. Subsequent legislation permits the soil conservation districts themselves to create sub-districts for watershed protection and flood prevention. These districts also have the power to levy a special annual tax, not to exceed four mills, on the assessed valuation of all real estate within the subdistrict. These monies are to be used for (1) the repair, alteration, maintenance and operation of the works of improvement of the subdistrict and (2) their organizational expenses.

Since the problem in situations such as these is usually one of how runoff water is to be handled, it is also important to note the rulings of Iowa courts on the rights and responsibilities of landowners in dealing with runoff from their farms and that coming onto their farms. This is a troublesome area at the moment, for the body of common law does not lend itself too well to matters of erosion control. Water, of course, must flow from higher to lower ground, and the courts have usually taken the point of view that little or nothing can be done about it. As long as the landowner on the higher ground does nothing to disturb the natural course of the runoff and does not increase its flow, he cannot be held legally responsible for damages to another's property. Responsibility for damages does occur if these conditions are violated, however.<sup>13</sup>

This rule was modified when drainage became of greater importance in Iowa.

... so that the upper proprietor may drain his land into natural water course without liability to a lower proprietor for resulting damages although the effect of such drainage is to throw the surface water in somewhat increased volume at times on the land of the lower proprietor . . . . But the principle has still been maintained that the upper proprietor may not discharge collected water upon lower land, even though in a water course, in an unusual manner or in unusual quantities.<sup>14</sup>

Thus, unless the operator of Farm A disturbs the natural course of the water or increases its flow "in an unusual manner or in unusual quantities," the operator on Farm B may do nothing about it. He may not even build levees or dams to

<sup>13</sup> Livingston vs. McDonald (June 28, 1866) 21 Iowa 160.

<sup>14</sup> Martin vs. Schwertly (May 15, 1912) 155 Iowa 347. p. 351.



keep the water off his farm. But if the operator of Farm A were to build terraces and grassed waterways and drain them in such a way that the water followed a different course across the neighboring farm, even if the volume of water was no more than that which had previously drained, the operator on Farm A might be liable for any damages on Farm B.<sup>15</sup>

New concepts in legal arrangements would be helpful in dealing with the problems of runoff and its damages. A foundation has already been laid for this in some of the decisions which have been made with respect to drainage problems.

An example of such a problem involved a dispute between two drainage districts which were using a common drain. The court was asked to decide whether draining water from higher to lower ground was always an undisputable right of the owners of higher land. It also had to determine whether the upstream landowners were free of any obligations or whether they received a benefit which carried an obligation to assist in paying the cost of dredging the downstream portion of the drain.

The court ruled that the right which the upper district claimed was no longer a natural right but a privilege because "unusual quantities" of water were being discharged upon the lower district. The court said,

. . . it is important to note that there is a limit to the manner and quantity in which water may be drained by the individual landowner from the dominant to the servient land.  
. . . but when the individual landowner organizes a drainage district with his neighbors and there is included in such district the lands of various members thereof, the collective body, through the drainage district, may unusually increase the volume of water from the dominant estate enclosed by the district onto the servient estate below, although the single individual of the group draining his own land could not so do . . . . When organized into such a district the landowners may drain ponds, collected and gathered waters, and bring the waters from one watershed into another. That they could not have done as individuals.<sup>16</sup>

Conservancy districts faced with the problem of changes in water courses as a result of constructing terraces and waterways may find that the decision in this case establishes a valuable precedent for them.

With respect to benefits, the court pointed out that the privilege extended to the district to drain larger volumes of water, in contrast to the total volume that might be drained if each member of the district acted alone, established an interest on the part of the district in the condition of the lower drain. While a right had been created for the benefit of the district, it was also accompanied by an obligation. The court stated this obligation very simply as follows:

Obviously, it is equitable that the drainage districts

that discharge their waters into said common outlet, and thereby necessarily contribute to its becoming clogged with silt and debris, should bear their proportionate share of the cost and expense of cleaning out said ditch and maintaining it . . . .<sup>17</sup>

Such court decisions in drainage disputes have tended to strengthen the right of the upper landowner to drain onto a lower landowner without liability for damages. This concept is a desirable one in the relatively level areas of Iowa where internal drainage of the soils is poor. Until the water can be removed, the land is relatively unproductive. The doctrine owed its support, in part, to the interest which society had in expanding agricultural production.

The situation on hilly land is quite different. The problem no longer is that of removing excess water, for both surface and internal drainage are excellent, especially in the Ida-Monona soil area. Public concern in this area is for safeguarding production on that land which is being farmed and of reducing damages to other property. The courts in Iowa have had no occasion to re-examine the earlier rulings concerning runoff and its damages. It is conceivable that they might at some future time develop a doctrine which would hold that the landowner on the higher ground has the responsibility to minimize the damage to farms below him from runoff originating on his farm by using the appropriate cropping systems, soil management practices or mechanical erosion-control measures. Should this happen, it would be much easier to negotiate agreements between farmers for the sharing of some of these costs which are now separated by property boundaries from the benefits they create.

#### **PUBLIC CONTRIBUTIONS TO SOIL EROSION CONTROL**

There is a limit to the amount of soil erosion control which landowners who enjoy offsite benefits can afford to help finance on the property of others, just as there is a limit to what the individual alone can accomplish on his own land. If additional efforts cannot be justified by the benefits which the individual landowners or the neighboring landowners receive, if further efforts are justifiable at all, the responsibility for the cost of achieving them must be borne by the public body—a county, state or federal government—which is most representative of the principal beneficiaries of the additional erosion control desired.

#### **The Public Role**

Governmental units have several roles to play. Up to this point we have considered governmental units only in the role of facilitator. They provide the services, sometimes the financial assistance as well, that assist the individual and the group to overcome the obstacles which prevent them from making the greatest effort of which they are economically capable. We have seen how important public-supported research and education have been and the continuing need for these services.

<sup>15</sup> H. W. Hannah. Soil conservation and the rule of law. *Jour. Soil and Water Conserv.* 5:106-110. 1950.

<sup>16</sup> Board of Supervisors of Pottawattamie County vs. Board of Supervisors of Harrison County (June 24, 1932) 214 Iowa 655. p. 673.

<sup>17</sup> *Ibid.*, p. 676.



We have given brief attention to technical assistance available from the Soil Conservation Service personnel assigned to work with the local soil conservation districts, to the incentive payments that are available through the Agricultural Conservation Program Service, to the educational efforts of the Cooperative Extension Service, and to the credit available through the Farmers Home Administration. In some instances these agencies could initiate valuable new services.

We have suggested how the soil conservation districts in Iowa, which are units of local government, might play an even more active role in coordinating these and other efforts. They appear to be the most logical organization to take the lead in initiating new efforts to lessen some of the more difficult problems that face farmers in reducing their soil losses. We have also noted that these districts now have powers that enable them to tax lands which benefit from certain erosion-control measures in order that these might receive the necessary maintenance. This is a power which Iowa counties also have.

A second role of public bodies is that of filling the gap between the level of erosion control which is economically possible for private persons or small groups and the additional effort which is deemed essential for the public good. This public role, in Iowa and most states, had been left primarily for the federal government to assume.

Governmental participation comes largely through activities administered by the Agricultural Conservation Program Service, which shares the cost of certain measures undertaken by farmers, and the Soil Conservation Service, which has administrative responsibility for the funds which are available under the Watershed Protection and Flood Prevention Act. There are, however, many situations in which the benefits are confined largely to the state or some definable part of it. Consequently, there is justification for expecting greater responsibility for such work from the states even though it seems unlikely that they will assume it.

#### **Cost-Sharing Arrangements**

Some, but not all, of the financial assistance provided by the Agricultural Conservation Program Service can be placed in this category of "filling the gap." The sharing of the cost of some practices in certain situations may be a means of supplementing the income of the participating farmer. Payments which share the cost of draining cropland, for example, would be nothing more than subsidies to the landowner to increase the productive capacity of his farm if the addition of this tillable land to his farm did not result in less intensive use of eroding land. Other payments, if carefully handled, can be used to cause farmers to adopt erosion-control practices which they have previously overlooked or resisted for some reason. They can also be used advantageously to stimulate farm operators and landlords to make other changes which would facilitate the adoption of erosion-control measures. The use of public funds,

however, does not necessarily fill the gap between what the farmer can do and what society desires. Such payments cannot be expected to do more than to secure the accomplishment of practices which a farm operator expects to be profitable.

If the public goal calls for a greater degree of erosion control than the farmer can reasonably accomplish, an estimate should be made of what it would cost the owner or operator to prevent the loss of the additional tons of soil. With this guidance, the public's share of the total cost of the erosion-control measures to achieve a particular goal could be determined. This payment might cover more than half the entire cost of some practices in some situations and less in others.

The Watershed Protection and Flood Prevention Act as amended, and as interpreted through policy and administrative decisions of the U. S. Department of Agriculture, is the medium through which the greatest public financial responsibility is now being assumed for measures on privately owned lands. These measures are designed to produce both private and public benefits. Although closely related to the problem of excessive erosion on agricultural land, the emphasis is first of all on water, particularly on flooding. But it is clearly recognized that the usefulness of the retention reservoirs and other devices on which a successful effort must depend can be jeopardized if erosion-control measures are not used on the land which lies above these structures. Thus, the legislation itself requires that at least half of the land in the watershed above such structures must be protected by appropriate conservation measures before federal assistance may be provided for the structure.

Some of these land-treatment measures conceivably can be financed with the assistance of the previously discussed cost-sharing arrangements of the Agricultural Conservation Program Service. Often the federal government also bears an additional share of the cost of certain measures, because the Act defines works of improvement for flood prevention to include both structural and land-treatment measures. Further, the Act authorizes the federal government to assume the entire construction and engineering costs of any measures which have the purpose of flood prevention or flood control.

There are many local beneficiaries in such projects who bear no share of the cost of these measures because the federal government assumes all of them. Thus, the pendulum has moved to the opposite extreme in depending too much upon the public at large to bear costs which a more limited public might be expected to bear. Nevertheless, this does provide one solution for financing some of the land-treatment measures which appear to be in the public interest but are beyond the capabilities of the landowner or small groups of landowners.

The watershed approach provides an opportunity and a convenient framework within which to secure the cooperation of neighboring land-



owners in applying what can come the closest to being an integrated system of practices and erosion-control measures which complement each other from farm to farm. This integration goes a step farther as a result of the authority given to the counties by the Iowa General Assembly to take part in the watershed projects. Thus, with this delegation of authority, mutual problems of farmers and the county government, with respect to gullies that destroy roads and bridges as well as cropland, can be handled more effectively.

All the resources of the public programs now operating are needed if such a project is to succeed. Even so, this may not be sufficient, considering the requirement that the local sponsoring group must secure the cooperation of the owners of at least half of the critically situated land in the watershed which the Act requires before the project can proceed. Additional means, however, may be placed at the disposal of units of local government. One of these is the property tax and possible modifications in it that might make it easier to obtain the necessary changes in land use to reduce erosion losses.

#### **Tax Adjustments on Farm Property**

Taxes on Iowa farm land have increased at almost the same rapid rate as farm land values in recent years. An index of taxes levied per acre, with the 1945 average equal to 100, shows the levy for 1950 equal to 159 and that for 1957, 206. It rose to 228 in 1959.<sup>18</sup> Taxes on farm property in Iowa were greater in total than the expenditures made for fertilizer, lime and seed in 1959. They were about equal to the combined outlays for hired labor and seed.<sup>19</sup> Certain tax concessions or adjustments may provide sufficient incentive to landowners to cause them to adopt certain erosion-control measures.

As an example of what might be done, the taxes levied on cropland might be reduced if specified erosion-control practices were installed on lands subject to heavy soil losses. In some instances this might be an additional incentive for farmers to remove row crops from steep slopes and to establish sod crops on them. The public benefits from this and similar changes in land management practices might easily justify such a policy. A precedent for action of this sort can be found in the special tax treatment afforded by Iowa law for owners of land on which orchards and forest reservations have been established.<sup>20</sup> Compliance with the provisions of this law governing the size of the tract, planting density, species planted and management practices followed entitles the owners to an assessed valuation of only \$4 an acre. A provision of this type should have great attraction during a period of declining farm prices when production costs and taxes tend to remain high. Dur-

ing such a period, some land to which a law of this nature would apply would then likely be near enough to the margin for corn production that tax relief would be sufficient incentive to bring about a change in its use.

If tax incentives such as the type mentioned became important, counties in which there was a large proportion of this type of land would eventually be forced to raise all tax rates. This would tend to overtax the remaining cropland unless county expenditures were reduced or new tax sources found. In some instances, counties might require state aid to make up lost tax revenues. The immediate effect of special tax treatment is likely to cause a loss of tax revenue. The long-run alternative of inaction would lead to similar results. On the other hand, the tax incentive to protect the productive capacity of the benefited property could result in its continuation on the tax rolls producing something instead of gradually becoming worthless with a lien of unpaid taxes against it and little possibility of restoring its productivity.

#### **Use of Public Control Measures**

Perhaps it is of no immediate concern to anyone whether a landowner or farm operator applies such erosion-control and water-disposal measures as are profitable to him. There are, however, methods of farming and use of the land which produce significant offsite damages, or seriously jeopardize the present or future well-being of others. In these cases, the way in which privately owned land is used and managed is of the utmost importance to other property owners and the public at large.

If the property owner controls a strategically located area of land and persuasion fails, and if offers of technical assistance and financial assistance are spurned, is there justification for the use of some type of coercion?

This question immediately stirs up a storm of controversy. True, such action is generally undesirable if other means will accomplish the public purpose. Coercive methods have not often been used to secure a particular use of land, but there are precedents. And the moment one moves away from agricultural uses of land, there are many instances in which the police powers of the state have been and are being used.

The rights in property that an individual enjoys are exclusive but far from absolute. Further, they are separable, meaning that certain rights may be reduced without destroying other rights. Private property is subject to taxation. In certain situations and under certain conditions, private property may be taken in part or in whole by a governmental body if it chooses to exercise its right of eminent domain. Due process of law must be observed, and the property owner must, of course, be justly compensated. Then there are the various police powers which the states enjoy and which can be delegated by them to subordinate units of government.

The police powers have been used in Iowa on problems concerning agriculture. They have been

<sup>18</sup> U. S. Department of Agriculture, Agricultural Research Service, Agr. Finance Rev. Vol. 22, Sept. 1960.

<sup>19</sup> U. S. Department of Agriculture, Agricultural Marketing Service, The farm income situation, supplement, July 1960. State Estimates of Farm Income, 1949-59.

<sup>20</sup> Iowa Code, 161:1-15, 441:5, 1958.



used in the efforts to eradicate bovine tuberculosis. Various regulations have been imposed upon dairy farmers to assure that consumers have a safe and clean supply of milk. There are the weed laws which are closely related to the land and the manner in which it is managed. If noxious weeds infest a farm and the owner takes no steps to destroy them, local units of government have the power upon due notice, to enter the property and destroy the weeds before they have a chance to infest the farms of others. The cost of destroying the weeds is charged as a lien against the property. These applications of the police powers to agricultural problems are now firmly established in Iowa.

The police powers could be employed to obtain soil erosion-control measures by enacting land-use ordinances or rural zoning. Both techniques use the police power. Although it is exercised by the state government, it is delegated to subordinate units of government. However, it has never been delegated to soil conservation districts in Iowa. Land-use ordinances provide a method whereby a local unit of government, if given this power by the state, may specify the uses which may be made of the land under various circumstances as well as the erosion-control practices that must be carried out. Such ordinances, formulated by the governing board of a soil conservation district, must be approved by the required majority of qualified voters. The regulations should govern the use of land in the interest of preventing or controlling soil erosion. They could cause the discontinuance of an existing use of land, or, on the positive side, require the use of particular practices.

Colorado is the only state in which there has been any extensive experience with land-use ordinances. The technique has worked there where the local leadership has been "strong and capable" and the land owners have been well informed. Nevertheless, it has been termed ". . . a drastic tool to be employed only in situations that demand drastic action."<sup>21</sup>

Zoning ordinances, widely used in urban areas to regulate land use, have had much more limited use in rural areas. As a technique to secure socially desirable use of land, they have much less immediate effect than land-use ordinances. They usually permit a continuation of existing but nonconforming uses and, consequently, the desired changes are slower to be realized. If elimination of the nonconforming use can be handled by other means, perhaps by compensation, a zoning ordinance would provide a useful function by preventing a return to the former undesired uses or practices.

The most desirable solution to the problem of conflicting interests between an individual and the public is one in which the conflict can be resolved without diminishing the welfare of either. For this reason the attention of this study has been focused on removing the obstacles which prevent the individual, or the group, from undertaking those erosion-control measures which would otherwise

be profitable for them. The use of the police power, however, would seem justified if, after efforts had been made such that an individual could overcome all obstacles, he still refused to adopt the measures which were to his interest to use. To the extent that noncooperation in such an instance would mean the continuation of offsite damages and would prevent others from reducing the soil losses on their property to the fullest possible extent, an even stronger case can be built for granting the soil conservation districts authority to use the police powers.

### Production Controls and Soil Erosion Control

Success in achieving greater control over soil erosion also depends upon the measures that are taken to deal with another problem—that of adjusting resource use and the production of farm commodities to the normal requirements of the nation. Man-hours of labor used in agriculture dropped 32 percent from 1950 through 1960, and cropland used for crops decreased nearly 6 percent during the same period. But it was possible to meet consumer demands without fully using all the land and labor resources which are now committed to agricultural production.<sup>22</sup>

If adjustments in farm production were made by making less intensive use of land most vulnerable to soil washing, efforts to control farm output would make erosion control easier to accomplish. But no deliberate effort has been made to concentrate such adjustments on this type of land. The statistics on the compliance of farmers with their corn acreage allotments, when these existed, indicate that a much smaller percentage of the farmers in western Iowa reduced their corn acreage than was the case for the state as a whole. Nevertheless, the acreage allotments were a factor in reducing soil losses on some of the farms studied.

The lower rate of compliance in western Iowa undoubtedly reflects the importance given to livestock production in that area. Farm operators who expected to sell a significant amount of their corn crop found it more advantageous to comply with their allotments to become eligible for the direct benefits of the support price given corn. Farmers feeding most of their crop to livestock more often found it advantageous to ignore the acreage restrictions. Corn acreage allotments were abandoned in 1959. This step made it possible for any farmer to take advantage of the price-support benefits given to corn without restrictions on the acreage planted, and thus forage crops were put at an even greater economic disadvantage as competitors for cropland.

As long as they existed, acreage allotments were a problem to administrators who were concerned that all farmers be treated equitably and that efforts to achieve adjustments in production be compatible with the objective of reducing soil losses on farms. The legislation authorizing corn allotments specified that the acreage necessary

<sup>21</sup> Stanley W. Voelker. Land-use ordinances of soil conservation districts in Colorado. Colo. Agr. Exp. Sta. Tech. Bul. 45. 1952. p. 55.

<sup>22</sup> Changes in farm production and efficiency. U. S. Dept. Agr. Stat. Bul. 233. 1961. Tables 4 and 15.



to produce the required supply of corn for the nation should be apportioned to the various counties of the commercial corn-producing area on the basis of the acreage each county had planted to corn in the previous 10 years, with allowances for abnormal weather and "for the promotion of soil-conservation practices." Nevertheless, even if such "promotion of soil-conservation practices" were desirable, no county's allotment could be reduced by more than 2 percent on this account. Within the counties, the allotments were to be apportioned among farms by local committees of farmers "on the basis of tillable acreage, crop-rotation practices, type of soil, and topography."<sup>23</sup>

This discretionary power given to local administrators to take account of differences in the erosion hazard between farms and the extent to which various operators were dealing with it was laudable, but even the most conscientious committees had little leeway with which to make such adjustments. Because compliance with allotments was voluntary, a farmer who felt that his allotment was too low might elect to ignore it entirely if there was a good probability that the crop income from the acreage in excess of his allotment, even at the unsupported price, would at least equal his income from the lesser acreage at the support price.

If a national allotment was too high (or failed to take into account that increased use of fertilizers could readily substitute for a reduction in crop-acres) farm incomes tended to improve, but supplies in excess of normal requirements accumulated as federally owned stocks. And there was no assurance that lands highly vulnerable to erosion were being removed from corn production. Allotments which would more nearly correct these shortcomings would seriously reduce farm income if they were complied with. If farmers rejected them, the goal of production control would be frustrated again. Compulsory compliance through the use of marketing quotas, such as are used with tobacco and wheat, was authorized for corn in the basic legislation for a number of years but was judged to be both administratively and politically infeasible to enforce.

What might appear to be undue preoccupation with matters of farm income at the expense of erosion control should not be criticized without recognizing that, in periods of depressed incomes in agriculture, many farm operators will exploit the soil resources at their disposal to the fullest in an effort to survive. This may happen even though it may cause heavy losses of soil which, over a longer period of time, might seriously harm the landowner and the public as well. This has been reflected in the increased importance that farmers in these studies have attached to the possible income effects of the recommended erosion-control practices.

Programs to achieve production adjustments may be complementary in some respects with efforts to reduce erosion losses, and this should be

given more active attention. Deliberate plans for the removal of the most erodible soils from intensive production are needed. The decision to cooperate in this effort cannot be left entirely in the hands of the owners and operators, but provision should be made to justly compensate them for any damages they suffer. A possibility which has already received some attention is the purchase of land-use easements by the federal government. At the least, it is important that consideration be given to the effect which public efforts to secure production adjustments may have so that these efforts themselves do not become obstacles to the control of erosion.

### Continuing Nature of Soil Erosion Control

The task of soil erosion control is a continuing job on the part of all individuals and governmental agencies sharing these responsibilities. Many people in western Iowa, both farmers and government representatives, seem to feel that once a farm operator has accepted most of the erosion-control measures recommended for his farm, little remains to be done. This attitude conflicts with the findings of the studies made in western Iowa. They emphasize the continuing nature of all efforts toward soil erosion control. There are several reasons for this.

First, owners of land change frequently. Over a 14-year period, all of the land in the area of this study, on the average, changes ownership. This means that, each year, 7 percent of the land changes ownership. It also means that continuing efforts are needed to work with new owners each year in understanding and in remedying their erosion-control problems.

Second, operators of the land change even more often than owners. The average rate of change in operators is such that a different operator could be expected on any farm after a period of 9 years. This means that each year a change in operators will have taken place on 11 percent of the farms. Continuing efforts are needed to work with these new operators each year in understanding and in remedying their erosion-control problems.

Third, economic conditions are in a continuous process of change. Prices and costs change so that what is profitable or possible for the individual at one time may be unprofitable at another time. Erosion-control recommendations must be altered or the means for applying them must be adjusted in keeping with changing economic conditions.

Fourth, natural factors beyond the control of individuals, such as drouth, floods, frosts, insects and disease, disrupt any given set of erosion-control plans and practices. These kinds of natural environmental factors require consistent follow-up efforts to keep erosion-control plans in tune with changes in such factors.

Fifth, technological changes are continually coming about as a result of research and the application of research findings. New fertilizers, new crop varieties, revised rotations, mechanical devices, weed and insect control measures and changed specifications for terraces are a few ex-

<sup>23</sup> 52 Stat. 52.





amples of technological changes that are continually taking place. These changes demand reassessments of erosion-control measures with resultant changes on individual farms.

Sixth, government programs of acreage allotments, price supports and related measures change. With changes come repercussions in erosion-control measures.

Thus, erosion control is a task set in an exceedingly dynamic environment. It calls for an equally dynamic total effort for erosion control if erosion-control measures are to keep pace with the changing conditions of our times.

If the erosion-control objective set by society is to be reached with the limited funds available for the job, efforts must start with the individual farmer and landowner. He must be informed and motivated to accomplish those measures which are profitable for him. The public must be ready to help remove the obstacles that the individual cannot overcome alone. Beyond the level of what is profitable to the farm operator are measures that can be accomplished only by two or more farm operators working together. Public responsibility for more direct assistance in financing the re-

quired changes begins at the point where the groups of farmers can do no more.

If the gap between present erosion losses and the public soil loss goal is to be eliminated, it will come about through the use of various tools and techniques used in different combinations to meet the problems that arise. An effective erosion-control program cannot be built around the use of a single technique. Problems not only are different from farm to farm but are different on the same farm over a period of time. What was acceptable to an operator under a particular tenure situation, with given price and cost ratios, with a given financial situation and given objectives and with a given attitude toward the problem of erosion may be unworkable with changes in any of these factors.

The control of erosion is a continuing problem rather than one which is amenable to a permanent "once-and-for-all" solution. Even so, it can be less of a problem in the future than it is now if the socioeconomic factors which make it a problem are more fully understood and if the techniques used to cope with it are kept flexible to meet changing economic and social situations.