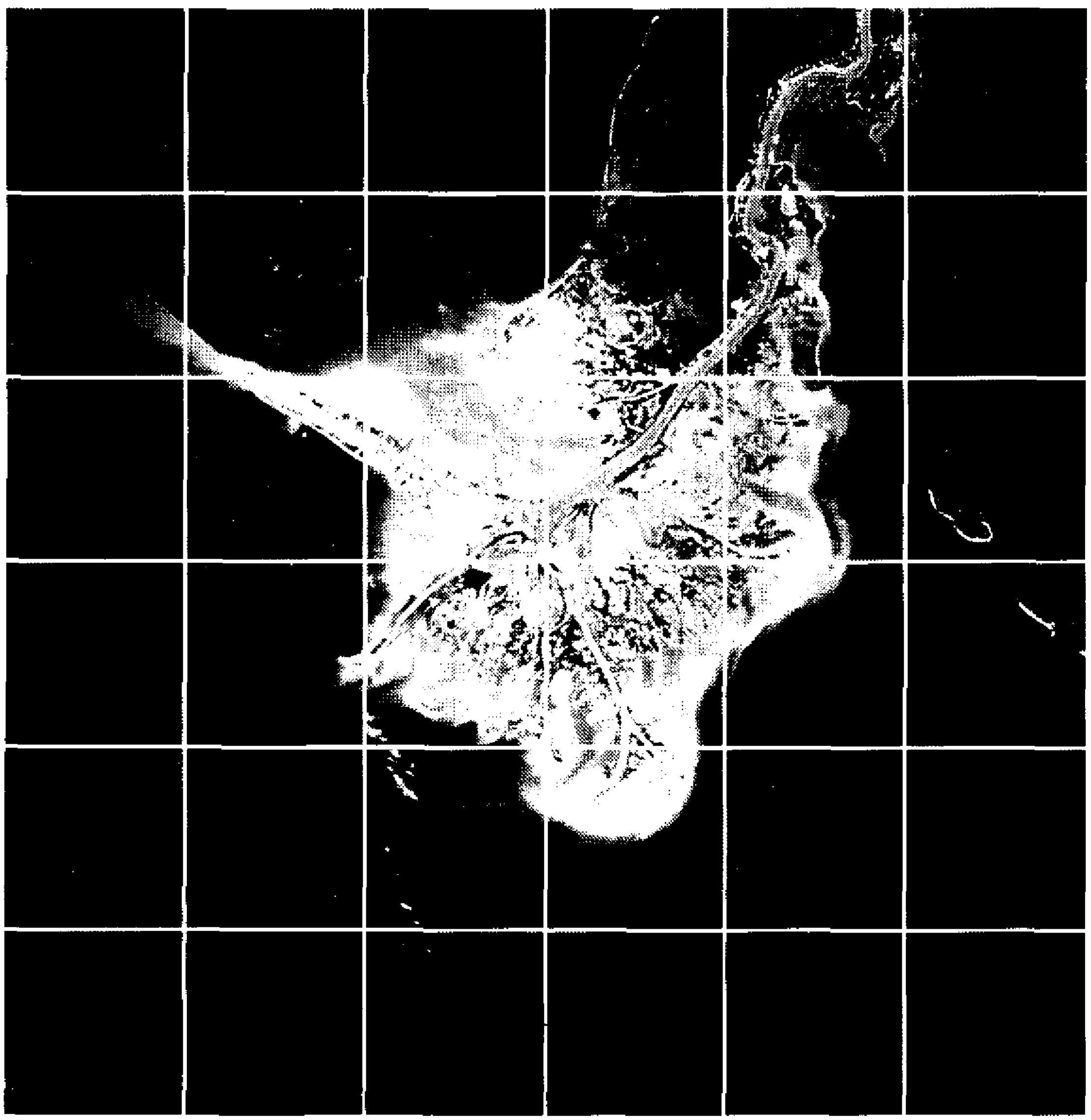
SOIL CONSERVATION IN AMERICA

WHAT DO WE HAVE TO LOSE?



AMERICAN FARMLAND TRUST

SOIL CONSERVATION IN AMERICA

What Do We Have to Lose?

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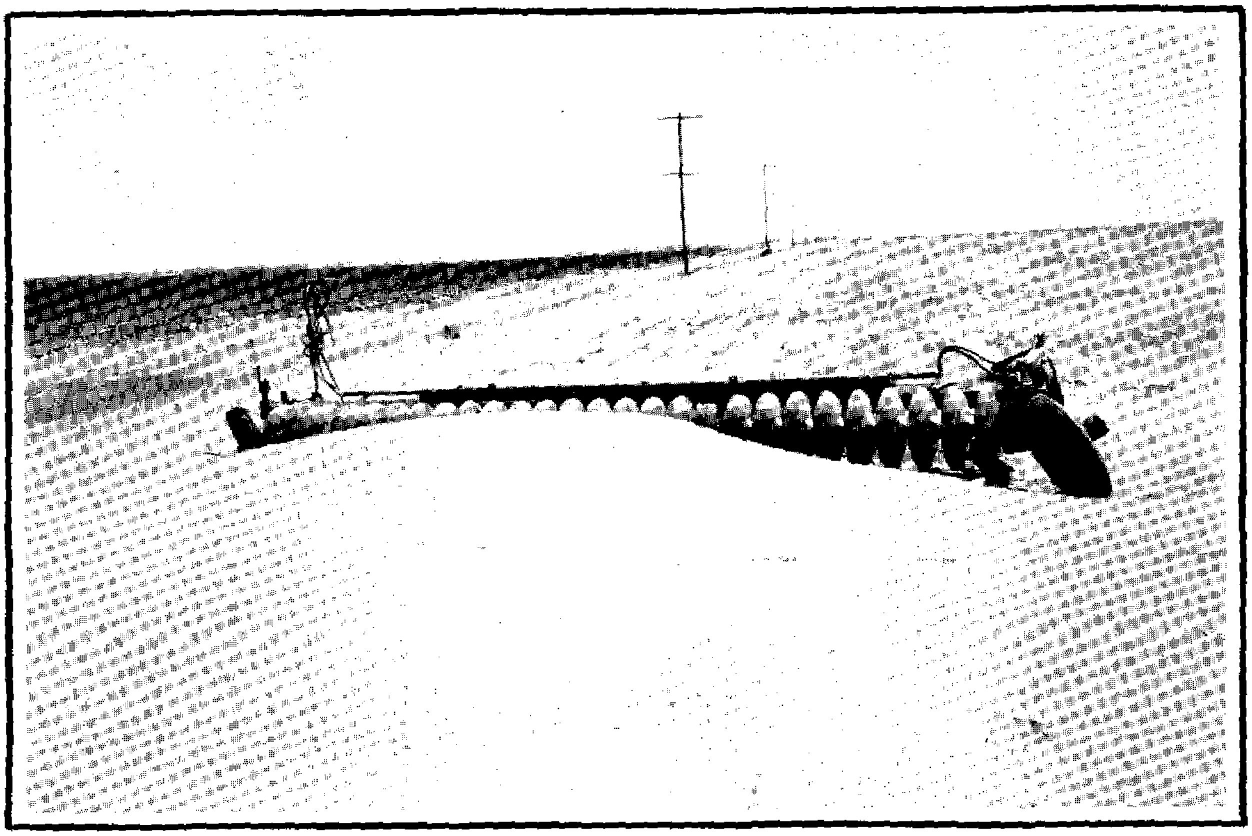


Prepared by
the American
Farmland Trust

American Farmland Trust
1717 Massachusetts Avenue, N.W.
Washington, D.C. 20036 (202) 332-0769

PREFACE

At no time in the fifty-year history of the soil conservation movement have there been such grave misgivings concerning the adequacy of Federal programs as are heard today. Some observers credit the conservation programs of the U.S. Department of Agriculture with solid performance, and consider inadequate funding of those programs to be the central policy problem. Others claim that the Federal government can not or should not play a significant role, especially in the context of the budget crisis facing national policymakers.

When the American Farmland Trust was invited by the House of Representatives subcommittee on Conservation, Credit and Rural Development to conduct an independent analysis of Federal soil conservation programs, we saw an opportunity to inform this debate, and include the views of people who often are left out of policy debates — farmers themselves. Farmers' answers to critical questions about participation in Federal programs and the effects of these programs, coupled with expert analysis, offer insight which suggests the need for substantial re-direction of soil conservation in the United States. Our specific recommendations for change in programs and policies comprise the third element of this report.

Special credit for this report is due to its principal investigators, Norman A. Berg, Our Senior Advisor and former Chief of the Soil Conservation Service, and Robert J. Gray, our Director of Policy Development and former Executive Director of the National Agricultural Lands Study. We are grateful to the Andrew W. Mellon Foundation, whose generous support of our public policy program has made possible the timely completion of this special project.

As you read these pages, the Congress will have already begun to act upon several of the recommendations from the study, advanced in preliminary testimony by Messrs. Berg and Gray. We are gratified by this interest on the part of the policymakers, so soon after completion of the project. We invite the reader's participation in this dialogue about the future direction of soil conservation; there is no more compelling resource priority than protection of the farmland, including its productive soils, upon which we and much of the world depend for sustenance.

Douglas P. Wheeler
Washington, D.C.

Acknowledgements

This report culminates a two year study made possible by the valuable contributions of many people.

Steering Committee

From the inception of this study, a Steering Committee comprised largely of farmers, ranchers, representatives of agribusiness and conservationists, met with the AFT staff to discuss every aspect of the study, and tirelessly reviewed the work as it progressed. While not every member of the Steering Committee agrees with our findings or recommendations in their entirety, their contributions have been invaluable and were gratefully received.

Roger Allbee (Springfield, MA)
Ted Bailey (New Bern, NC)
Jerry Barnett (St. Louis, MI)
Vivian Creswick (Cantril, IA)
Merle Doughty (Jamesport, MI)
Clarence Durban (Plain City, OH)
Eugene Glock (Rising City, NE)
Stanley Head (Frankfort, KY)
Chris Johannsen (Columbia, MI)
Lee Kolmer (Ames, IA)
Ron Kroese (St. Paul, MN)
Ron Lawfer (Kent, IL)
Hillard Morris (Mason, IL)
Walt Peechatka (Ankeny, IA)
Phil Peterson (Oregon, WI)
Richard Poor (Neosho, MI)
Duane Sand (Des Moines, IA)
June Saylor (Clovis, NM)
Cathy Scherler (Sheridan Lake, CO)
Ralph Schnur (Colo, IA)
Dan Stadtmueller (Monticello, IA)
William Walker (Nashville, TN)
Wayne White (DeKalb, IL)
James Winningham (Arthur, IL)

Writers and Analysts

Ken Cook, who has written extensively on conservation policy in the Journal of Soil and Water Conservation and elsewhere was the principal analyst and writer for this study. His depth of understanding of the issues and his willingness to commit extra effort contributed significantly to the quality of this report.

A key element of this project involved in-depth interviews with almost 700 farmers and ranchers in six counties in the mid-west and Great Plains. We were very fortunate to have Dr. J. Dixon Esseks, Professor of Political Science at Northern Illinois University (DeKalb), and Dr. Steven Kraft, Assistant Professor of Agribusiness Economics at Southern Illinois University (Carbondale) to head this interview project. Their detailed analysis of the survey will be presented in a separate AFT publication, "Government's Role in Promoting Soil Conservation: Farmers Perceptions in Six Diverse Sites".

The work and ideas of several other people significantly influenced the content of this report. In the late 1970's, Dr. Arnold Miller, formerly with the Department of Agriculture and now an economist with the Farm Credit Administration in Washington, D.C., extensively and creatively analyzed the 1977 National Resources Inventory. Although most of Miller's work remains unpublished, he generously provided AFT with both data and his analyses. The discussion of soil erosion conditions and conservation practices in Chapter 2 would not have been possible without this material.

A similar debt is owed Dr. Charles Benbrook, formerly Staff Director for the Subcommittee on Department Operations, Research, and Foreign Agriculture, of the House Agriculture Committee, and now Executive Director of the Board on

Agriculture at the National Academy of Sciences. Benbrook collaborated with Miller on many of the original NRI analyses and was with Miller, one of the early conceptualizers of the conservation reserve.

At critical junctures in the study, AFT benefitted greatly from the expertise of Howard Hjort and R. Neil Sampson, who helped define the policy issues at the outset of the study, and advised us on analyses and recommendations as the study progressed. The final report may not altogether reflect their advice, but it certainly could not have been produced without their help.

Teresa Hidlebaugh served as an analyst, writer, graphics artist and organizer in the early phase of the study, and had much to do with getting it off the ground. Tom Mierzwa and John Tkach helped early on with research and writing.

Technical Papers

Twenty authors contributed twenty-two technical papers which broaden the information background for this analysis. An addendum listing the authors and titles appears on the last page of this report. AFT will publish these in a separate volume, "Technical Papers on Soil Conservation Issues for the 1980's".

Other Contributors

Many other individuals reviewed draft chapters of the report or otherwise contributed information or insights along the way. Needless to say, they are not responsible for any errors or misinterpretations that may be found in the report.

Ray Aldrich
Bob Anderson
Orin Hanson
Doug Helms
Wayne Bjorlie
Lester Brown
A. Barry Carr
Wayne Chapman
Charlie Cox
Pierre Crosson
Gerald Darby
Tim Denley
Paul Dyke
John Fedkiw
Klaus Flach
Clete Gillman
Jim Guiltmier
Mack Gray
Jerry Lee
Chris Leman
Gary Margheim
Karen Kates Marshall
Richard Highfill
Maureen Hinkle
William Larson
Gerald Root
Neil Schaller
Max Schnepf
Jim Speith
Peter Tidd
David Walker
Jack Webb
Randy Weber
Kenneth L. Williams
Doug Young
Jeff Zinn
Gordon Nebeker
Clayton Ogg
Karla Perri
Karl Reinhardt

We especially wish to thank all of our colleagues at AFT who pitched in innumerable times to help during the course of the study. We would particularly like to thank James Riggle for assisting in the interview process and for the secretarial support provided by Michele Dickey.

We are also grateful to Margaret Maizel who selected the landsat images used on the front and back cover and for researching and writing the background information.

Finally, we are grateful to the staff at Specialty Binding & Printing, Shepherdstown, West Virginia, for the design and production of this report; in particular Gary and Paul James, John Strider, Jeffrey Frankenberry, Lesa Webber and Arnold Heatwole. Dan Hildt from Graphics in General in Washington, D.C. designed the front and back cover.

Robert J. Gray

Robert J. Gray
Director of Policy Development

Norman A. Berg

Norman A. Berg
Senior Advisor

About The Cover

About The Landsat Sensor Thematic Mapper

Thematic Mapper is an advanced sensor on Landsat IV which was launched by NASA in 1982. The Landsat sensors are sensitively-tuned detectors of specific kinds of Electromagnetic Radiation that are reflected by matter on the earth's surface. This includes energy ranging from the invisible, through visible wavelengths and into the infrared ranges that are associated with intrinsic thermal energy emitted by sensed materials. Depending on the composition of the materials analysed and other physical conditions, spectral characteristics can range from very simple to exceedingly complex.

Thematic Mapper provides spatial, spectral and radiometric sensitivity that is far greater than that possible from sensors on previous satellites. Areas of 6-10 acres (compared to about 90 acres previously) can now be delineated in standard image reproductions. Sensitivity to reflectance has been increased from 64 to 256 separate values. Together with other technical advances, this affords better discrimination between vegetation types for crop identification and analysis as well as greater capability for analysis of changes in, and composition of water bodies.

Of the seven spectral bands (separate components of detectable energy) used in *Thematic Mapper*, the majority were chosen for their agricultural importance in vegetation monitoring and detection.

Three of the latter bands were used to develop the false color composite images shown here: *Band 1*(wavelength, 0.45-0.52 micrometers) is designed for water body penetration. It is thus useful for detecting suspended solids due to siltation loadings from soil erosion, and is particularly useful for coastal water mapping. It is also valuable for differentiation of soil from vegetation, and deciduous from coniferous flora. *Band 3* (0.63-0.69 um) is a band which discerns varying chlorophyll concentrations in plants. This provides additional vegetation discrimination such as detection of various stages in plant vigor due to growth, decay and disease. *Band 4* (0.74-0.90 um) is useful for determining biomass content; and for delineation of biological composition of matter on land as well as water. This includes microorganisms such as algae communities in water bodies as well as macrovegetation in wetlands.

By conventional image processing, bright red areas in reproductions delineate actively growing crops and other vegetation. Darker red coloration corresponds to forestlands. Blue and blue-grey colors denote urban areas as reflected for example, by roofs and roads. Clear water appears black (no reflectance due to complete light absorption), but as amounts of suspended sediment increase, reflected light from water bodies can range from dark to lighter blue and to green. At maximal sediment loadings, water can appear yellow or even nearly white.

ABOUT THE COVERS

Front Cover Plate

Satellite image of the Mississippi River Delta in flood following major rainstorms and flooding in the Upper River Basin. False Color Composite of the 55-mile southern terminus of the delta generated by Landsat IV Thematic Mapper on January 15, 1983. The upper border of the image is aligned perpendicular to the northwest.

Heavy rains which fell in the river basin in the last week of December, 1982 produced major flooding which continued into the first weeks of January, 1983. This, and other widespread heavy rainstorms on New Years Day in the eastern and northeastern parishes of Louisiana caused agricultural losses amounting to 11.5 million dollars due to inundation of pasture- and crop-lands and to livestock losses.

The bright red coloration in the body of the delta corresponds to grasses and other wetlands vegetation which appear green in conventional color photography. The bright yellow appearance of the river and the delta area is characteristic of extremely heavy concentrations of suspended soils particles in the water. In fact, outer margins of the delta area appear to be obliterated by the high reflectance from the river water.

As the turbid jets of shallow river water enter the gulf, the sediment becomes diluted, settles out into the deeper waters, and is carried to sea in prevailing gulf currents. The satellite detects this phenomenon as a halo of green plumes surrounding the delta which fade into the clearer deep blue water of the gulf.

The U.S. Army Corps of Engineers estimates that the river basin can yield nearly 900 million tons of sediment a year. Major river control structures built by 1963 reduced the suspended sediment load reaching the delta from 434 to approximately 255 million tons per year, most of which passes into the Gulf of Mexico.

Back Cover Plate

Satellite image of the confluence of the Missouri, Mississippi and Illinois Rivers at St. Louis, Missouri. False Color Composite generated by Landsat IV, Thematic Mapper on August 29, 1982 – full scene coverage (115 mi x 115 mi).

The top edge of the image is aligned perpendicular to the north, northeast. Though reproduction here is not of the fine quality of the original image, limited interpretation is still possible.

Three subregions — each approximately 200 miles in length — in the Upper Mississippi Region are drained by the Missouri from the west (lower left), Mississippi from the north, and the Illinois River to the east. These watersheds contain some of the nation's most highly erodible land.

A major storm in the Kansas City area deposited 12 inches of rain on August 12, 1982; inducing serious and prolonged flooding together with major soil erosion. Later, a small but significant storm produced 3 inches of rain in a 150 mile square area around Peoria in the Illinois River watershed on the 24th of August. In contrast, little precipitation occurred in the Mississippi Sub-region during the two weeks prior to August 29th when this image was collected.

Differences in relative reflectance in the Missouri and Illinois Rivers appear to be roughly related to the intensity and timing of the two storms along the Missouri and Illinois Rivers together with the fact that the Missouri River is known to contribute approximately 70 percent of the average annual sediment load of the Mississippi at St. Louis.

Twenty-six sets of locks and dams on the Mississippi north of St. Louis are used to maintain shipping channels and water supply as well as to provide hydro-electric power, among other purposes. Effective operation of these systems is dependent upon extensive dredging operations maintained by the U.S. Army Corps of Engineers.

In contrast to the uniformity of reflectance along the Missouri and Illinois Rivers, weaker, intermittent siltation patterns are visible in the Mississippi River. Spacing of these patterns corresponds to the spacing of locks and dams 24, 25 and 26. In the absence of significant precipitation, this could be caused by disturbance of silt from the river bottom by pumping of dams for river traffic and/or to activation of hydro-electric generators to meet peak demands for power that are common in the area at this time of year.

'Privatization' of the Landsat Program

The Landsat program entails a major investment of public revenues for the advancement of critical knowledge of the nation's and the world's natural resources; their present condition, and their changing response to natural phenomena and the effects of măn's activities on earth.

On March 19, 1984 and pursuant to the President's Directive Number 54 of 1979, the U.S. Department of Commerce accepted bids from several major, private consortia proposing to acquire ownership and operation of the present Landsat program. Current Administration policy in the transfer of this NASA program to the private sector stipulates that, while user access to this information shall not be interrupted unnecessarily, the government will no longer invest in research and development of operational satellites.

ACKNOWLEDGEMENTS

Satellite images on color slides (St. Louis; ACC 372, ID 40183-1552; Mississippi Delta, ACC 41, ID 40044-16085) were obtained from the EROS

Data Center, Sioux Falls, South Dakota through the National Cartographic Information Center, USGS, Reston, Virginia. Climatological and Storm Data for Louisiana, January 1983 and for Missouri, Iowa and Illinois, August 1982 were obtained from the National Climatological Center, NOAA; Asheville, North Carolina.

Information on the Mississippi River was obtained from a report "Characteristics of Suspended Sediment Regime in the Mississippi River Basin" by the New Orleans District, U.S. *Army Corps of Engineers, and from Dr. A* Hurme, Dredging Division, U.S. Army Corps of Engineers, Washington, DC.

Dr. Jan Gervin, and Mr. William J. Campbell, NASA; Goddard Spaceflight Center, Beltsville, Maryland also provided information on satellite imagery.

Table of Contents

Executive Summary

Soil Conservation In America: What Do We Have To Lose?

One of America's most serious environmental problems, soil erosion on U. S. cropland, can be substantially solved at a reasonable cost, within the decade. Accomplishing this goal will require important changes in the current Federal programs for supporting crop prices and farm incomes. It will also require reforms in soil conservation programs established in the U. S. Department of Agriculture (USDA) a half century ago. Unless these fundamentally new approaches to Federal farm and conservation policy are undertaken, soil erosion will continue to cost the United States billions of dollars annually in damage to agricultural productivity and water quality. Perhaps the most tragic aspect of this extensive, but insidious deterioration and misuse of America's most valuable natural resource, is that it is largely avoidable.

The American Farmland Trust arrived at these conclusions in the course of an eighteen month study. The research involved extensive analysis of recent information — much of it previously unpublished — on soil erosion, conservation measures, and USDA conservation programs; hour-long personal interviews with 700 farmers in six states; the commissioning of 22 technical papers by widely-regarded experts on a variety of conservation topics; and consultation with leading conservationists, including a special 24 member advisory panel for the project.

Four central findings emerged from this research.

1. *First, a disturbingly wide gap exists between the magnitude of soil erosion problems on the 413 million acres of U. S. cropland, and the degree of erosion control afforded through present government policies and programs and the efforts of individual farmers.* For example, even at a fairly high level of funding, the National Conservation Program announced by Agriculture Secretary John Block late in 1982 is projected to reduce national soil loss by less than 2 percent by fiscal year 1987. In general, USDA's traditional conservation programs seem to be having a modest effect on soil conservation. It has proven to be very difficult, politically and administratively, for USDA to redirect existing conservation program resources among geographic areas — for example, to areas where erosion problems are severe.

2. *The first reliable, nationally consistent estimates of soil erosion in the United States, obtained by a USDA survey in 1977, revealed that a very large share of the country's soil erosion is associated with a relatively small proportion of the land.* This observation was found to be true of the major types of erosion — wind, sheet and rill — and applies to all land uses (cropland, rangeland, pasture and forest). In 1977, about 38 million acres of non-irrigated cropland — 11 percent of the total — eroding in excess of 15 tons per acre annually, accounted for 1.328 billion tons of soil erosion, or about 53 percent of the total sheet, rill and wind erosion on nonirrigated cropland. Taken alone, sheet and rill erosion, the most serious forms of soil loss on U. S. cropland, are even more highly concentrated: in 1977, 25 million acres, just 6 percent of total cropland, accounted for 43 percent of the total tonnage of cropland sheet and rill erosion (828 million tons per year). Although there are important exceptions, AFT's review of the research on erosion's effects on soil productivity and off-site damages leads us to conclude that most of the damage being done by erosion in the United States is associated with land experiencing high rates of soil loss. Typically, those rates exceed the national average soil loss by a factor of three or more.

3. *The highly erodible lands that account for much of the erosion problem on U. S. cropland appear to be eluding most methods of conservation farming, as well*

as the services of traditional USDA conservation programs. Overall, relatively few acres of U. S. cropland were treated with conservation practices in 1977, and AFT found that conservation measures of all types tended to be concentrated on land with fairly modest soil erosion hazards. For example, only 7 percent of the nation's 413 million acres of cropland was terraced in 1977, and on most of that land erosion was not a severe problem even before the practice was installed. About 27 million acres of cropland — 7 percent of the total — were treated with minimum tillage techniques and the use of crop residues, a combination referred to as "conservation tillage". Most experts regard conservation tillage as the most promising soil conservation technology for much of America's cropland, because, used properly, it saves farmers not only soil, but also time and money. For those reasons, conservation tillage has become increasingly popular in recent years. However, AFT found that about 60 percent of the land where conservation tillage was applied in 1977 had a very modest erosion hazard before the practice was adopted. By contrast, because of the expense and engineering problems involved, erosion control practices tend to be largely absent from highly erodible land. And the voluntary nature of USDA conservation programs, together with the very limited financial incentives they offer, have made it particularly difficult for those programs to effectively deal with land having severe erosion problems. The most effective means for coping with erosion on such land is to shift its use to hay, pasture, or forest production. *AFT proposes to modify USDA crop price support programs to facilitate land use shifts of this type, to achieve soil conservation and production adjustment goals simultaneously.*

4. *Certain USDA programs, particularly the crop price support programs, could be modified to provide substantial soil conservation benefits, but now serve to subsidize abusive land practices.* Despite the rapid rise in U. S. crop exports over the past decade, the USDA has implemented short term land idling programs to counteract crop surpluses in eight of the past 10 years. The 1983 Payment-In-Kind program was the most extreme example of such programs in history. Most analysts forsee a continuing, if more periodic, need for acreage reduction programs. But as the programs are devised and operated now, very little conservation is achieved. The programs run for just one year at a time, making it difficult for farmers to match program guidelines with long-term conservation plans without incurring financial losses. Because the farm program benefits are proportional to the acreage kept in erosion-prone program crops (corn, wheat, soybeans), the programs actually subsidize production of those crops on marginal land that should be kept in conserving uses such as hay, pasture, forest or wildlife cover.

These central research findings led AFT to propose a new strategy for soil conservation on U. S. cropland.

First, establish the nondegradation of agricultural resources as a central goal of national policy.

Second, establish a long-term cropland reserve program for highly erodible cropland under the umbrella of USDA's traditional conservation and commodity programs.

Third, eliminate those elements of Government policies and programs which subsidize future cultivation of highly erodible lands.

Fourth, reduce the "maintenance" and production-oriented aspects of USDA's technical and financial assistance for soil conservation, and focus that assistance on cost-effective erosion control methods on land where soil loss is likely to be causing chronic on-site or off-site damages.

The Final Report of the AFT Soil Conservation Policy Project includes twenty-three recommendations for implementing this overall strategy. AFT believes the debate over omnibus farm legislation in 1985 will provide an unusual opportunity to make soil and water conservation an integral part of overall farm policy. This report is intended to provide a framework to help all interested parties assess the need for and merits of new conservation policy initiatives such as "sodbuster" legislation and a soil conservation reserve. Throughout the deliberation on the 1985 farm bill, the American Farmland Trust will continue to refine our analysis of these ideas, and communicate our findings to farmers, policymakers, and the general public.

It is clear that the United States has reached a crisis in our farm and soil conservation policies. AFT has concluded that modest reforms of those policies could go a long way toward resolving the problem of soil erosion on America's cropland. It is imperative that the nation adopt government policies and programs that help farmers conserve their soil for the benefit of future generations. The United States already has lost a great deal by failing to cope with the problem of soil erosion. If we do not act responsibly, resolutely, and soon, we stand to lose a great deal more.

I. Toward a National Policy for Agricultural Resource Conservation

Recommendation 1. *A national policy for agricultural resource conservation should be established by the United States in the 1985 farm bill and adhered to by all agencies of the government. As part of this policy, Congress and the Executive Branch should establish goals for the conservation of the nation's agricultural resources. The overall aim of these goals should be to maintain or improve the inherent productivity and quality of soil and water resources, and to minimize adverse environmental effects related to the use of those resources. Two central themes should form the basis for this policy declaration. Government policies and activities should recognize: (1) the long-term nature of agricultural resource conservation planning and implementation and; (2) inherent differences in the quality and capabilities of land for sustainable agricultural production.*

Recommendation 2. *The Secretary of Agriculture should establish within USDA a permanent coordinating body, with a fulltime staff, and chaired by the Deputy Secretary of Agriculture, to assess and analyze all aspects of all USDA programs as they affect agricultural resource conservation. This group should: be responsible for assuring that agricultural resource conservation goals are acted upon with the most efficient government programs and activities; be responsible for evaluations of all department programs directly or indirectly affecting agricultural resource conservation; have the authority to recommend to the Secretary special studies, projects, and new policy and program initiatives across the Department that would enhance agricultural resource conservation. The coordinating body should be given overall responsibility for the Department's RCA activities. This body should also coordinate USDA activities related to development and implementation of the national policy on agricultural resource conservation recommended above.*

Recommendation 3. *The House and Senate Agriculture Committees should conduct oversight investigations, including public hearings, into (1) the performance of USDA conservation programs after the first cycle of the RCA and (2) the conservation effects of USDA's commodity and credit programs.*

Recommendation 4. *Cropland in the U. S. should be designated into one of three groups by local conservation districts on the basis of practical, consistent, and scientifically sound criteria reflecting the land's vulnerability to erosion. The classification system would serve as a general guide to local conservation districts, Agricultural Stabilization Committees, and USDA field personnel as they consider applications for conservation programs, crop price support programs, and other USDA programs. The system should reflect the land's quality and capability for sustainable agricultural production without excessive soil erosion. To the extent possible, Government policies and programs should encourage agricultural practices appropriate to the land's quality and capability, as reflected by this classification.*

Recommendation 5. *Primary technical responsibility for developing the classification scheme and for local designation of cultivated land into Group 1, 2 or 3 should be given to the Soil Conservation Service, working through and in cooperation with local soil and water conservation districts. The classifications should be consistent with any standards established by the local districts. General guidelines for the classification procedure should be prepared by SCS national and state offices, but should be subject to approval, modification and appeal through local conservation districts. An appeal procedure should be established in order that farmers or other interested individuals may bring to the attention of conservation district committees additional factors which should be considered in making a classification.*

Recommendation 6. *Land in Group 1 should be set-aside, diverted, or otherwise retired from production of cultivated crops as a requirement for participation in USDA crop price support programs only when inadequate acreage is obtained for production control purposes from Land Groups 2 and 3. Land in Group 1 should also not generally be eligible for publicly supported financial and technical assistance for erosion control, unless the public's interest in such assistance can be demonstrated on a case-by-case basis.*

Recommendation 7. *The USDA's traditional technical and financial assistance efforts for erosion control, as well as Extension Service activities, should place high priority on cost-effective tillage practices, primarily on moderately erodible Land Group 2.*

Recommendation 8. *The Department of Agriculture should proceed with targeting efforts now underway for technical and financial assistance for soil erosion control. However, the total number of counties designated for targeted assistance should be frozen at 800, the number anticipated for participation by Fiscal Year 1984. No additional target areas should be designated until the success of the 1981-84 targeting effort has been fully evaluated.*

Recommendation 9. *The Pilot Variable Cost-Share Level Program of ACP should gradually replace existing procedures for the overall ACP over a 5 year period, beginning in FY 1985. Also beginning in 1985, SCS should experiment with the variable cost-share* *level approach in cost-sharing activities under the Great Plains Conservation Program. In both programs, emphasis should be given to assisting cost-effective conservation practices on Land Group 2. This can be achieved by awarding financial assistance within the broad Group 2 category to land with the most serious erosion problems.*

Recommendation 10. *In formulating and implementing USDA commodity price support programs, high priority should be assigned to long-term conversion of Group 3 land to conserving uses such as pasture, hay, range, forest or wildlife habitat. To the extent possible within the context of production adjustment goals, commodity price support programs should encourage this conversion by offering farmers multi-year conservation reserve contracts for Group 3 land. Periodic, one-year set-asides and diversions should also be directed to Land Groups 2 and 3 as production adjustment requirements may warrant. Legislative authority for nationwide implementation of a conservation reserve should be provided in the 1985 farm bill.*

Recommendation 11. *For highly erodible lands not covered by a conservation reserve contract, the Agricultural Conservation Program, Experimental Rural Clean Water Program, or Great Plains Conservation Program should be used to encourage the establishment and maintenance of permanent vegetative cover.*

Recommendation 12. *Wherever state or local conservation programs have been adopted to encourage conversion of Group 3 lands to stable uses, USDA should make a special effort to provide assistance via the conservation reserve or long term ACP and GPCP land retirement contracts.*

Recommendation 13. *Through legislative and administrative initiatives, Group 3 lands not devoted to the production of crops as of a specified date should be designated as ineligible for future participation in USDA commodity programs (including the conservation reserve), the federal crop insurance program and other publicly funded programs. Toward this end, the Congress should expeditiously enact an effective version of the "Sodbuster bill".*

Recommendation 14. *USDA should encourage member organizations of the Farm Credit System to adopt procedures and policies designed to encourage enrollment of Land Group 3 in the conservation reserve, or otherwise encourage conserving use of Group 3 lands. FCS should also adopt sanctions consistent with those contained in sodbuster legislation to discourage future cultivation of Group 3 lands now in conserving uses.*

Recommendation 15. *In repatriating land received through loan foreclosures or bankruptcies, the Farmers Home Administration (FmHA) should encourage sustainable use of the land, including enrollment of any Group 3 land in the conservation reserve.*

Recommendation 16. *In analyzing and presenting the results of the 1982 National Resources Inventory (NRI), USDA should give first priority to information on soil erosion and conservation on cropland. The information should be presented in a form that will enable farmers, the public, conservation experts and the Congress to evaluate the need for and potential effectiveness of new conservation program initiatives, particularly the conservation reserve and the sodbuster bill, in early 1984. Information on erosion and conservation practices on cropland should be presented in a manner that corresponds with the three land groups proposed in this report, or a comparable scheme.*

Recommendation 17. *USDA should make a special effort to distribute data tapes and documentation for the 1977 and 1982 NRIs to a wide range of public and private groups and individuals with an interest in conservation. Detailed documentation of the statistical design and reliability of the survey, and the design of the computerized survey data base, should also be prepared for dissemination to analysts and interested individuals outside the USDA. To encourage more detailed, regional research using the NRI data, SCS and other USDA agencies should offer financial support, on a competitive basis, for graduate students and other researchers interested in conducting investigations using the NRI. USDA may wish to establish categories and types of analyses they would like to see conducted by outside researchers. To provide a focal point for this research and to publicize its results, USDA should devote a keynote session of the annual USDA outlook conference to soil and water conservation trends and their implications for public policy.*

Recommendation 18. *USDA should, to the extent feasible, collect data on farm and conservation programs, natural resources, and other topics in a manner that allows these data to be integrated and coherently analyzed. The department should establish a computerized data base accessible to all appropriate agencies which links natural resource, and farm and conservation program data collected by the department.*

Recommendation 19. *USDA should initiate a joint SCS-ARS project to update and improve the Land Capability Class System (LCCS). This joint project should produce a report by January 1985, describing the genesis of the system and its current* *strengths and shortcomings for farm planning and agricultural policy purposes. The report also should make recommendations for improving the LCCS for these purposes.*

Recommendation 20. *USDA should continue to implement the Conservation Reporting and Evaluation System (CRES), and should to the extent feasible use the information to direct conservation program activities and expenditures in the most efficient manner.*

Recommendation 21. *The Secretary of Agriculture should have an effective inter-agency mechanism to coordinate the research efforts on the impacts of soil erosion on productivity and off-site damages. These efforts should be substantially expanded beginning in fiscal year 1985.*

Recommendation 22. *In cooperation with county governments and conservation districts, each state should develop a comprehensive plan for reducing soil erosion damage statewide. The plan should include standards, guidelines and deadlines for achieving state soil conservation goals, and programs that have a mix of incentive and requlatory features.*

Recommendation 23. *County governments and conservation districts should be jointly responsible for implementing state soil conservation programs. Conservation districts should continue their role of providing clerical assistance and office facilities to SCS, and of providing education and technical assistance. County governments should assume responsiblity for implementing mandatory features of state laws.*

Introduction

Should the soil erosion conditions of today persist for the next fifty years, the Great Plains will not roil up and vanish in tremendous storms of dust. The Corn Belt will not become a wasteland, its precious topsoil washed into the Mississippi Delta and beyond. National crop yields will not plummet, nor will food prices jump abruptly as a consequence of erosion. Few fields, and fewer farms, will be ruined irretrievably by the loss of topsoil. No political party, administration, or institution will ever be confronted by or held accountable for a catastrophic decline of America's most productive natural resource. Were the consequences of soil erosion this dramatic and obvious, there would be little need for this report.

The insidious and incremental nature of the erosion process guarantees that it may never be manifested as an environmental crisis. Unlike many other nations, the U.S. is fortunate in that we may never face a distinct and obvious turning point beyond which a national erosion disaster will be averted only by decisive action. Yet this very bounty of America's soil resources introduces a tragic paradox: the gradual and complex nature of soil erosion and its consequences make it difficult to convince farmers, the public and the political system of the need to act resolutely. The danger is that society may not act until extensive damage has been done.

If there is a soil erosion crisis, then, it is in the policy realm. Conservation has remained on the margins of America's agricultural policies. Decisions about farm price and income supports, loans, crop insurance, agricultural research and many other governmental activities, continue to be made with little consideration being given to their effects on land and water resources — and very often the effects are adverse. The traditional, voluntary government programs to encourage conservation have solved only a small part of the problem. Yet the existence of these programs has provided farm policy makers and, to an extent, the farm community, with an excuse for not facing difficult ethical, social and political problems related to land use and government programs. In fact, conservationists and their organizations have themselves avoided some of the more controversial policy issues, including questions about the relevance and effectiveness of the traditional government conservation programs.

The United States faces many serious agricultural resource problems. In some parts of the country, the principal problem is the conversion of prime and important farmland to non-farm uses. In some irrigated regions, excessive build-up of salt is destroying soil quality, while in others, water shortages are an acute problem. Even with respect to soil erosion, there are serious problems on land uses other than cropland: soil loss on overgrazed rangeland is a prime example. By focusing on cropland erosion, AFT does not mean to slight these or other resource issues. Rather, we have directed our analysis and recommendations to cropland erosion because numerous studies have documented it as a key resource issue facing the United States. Moreover, erosion control on cropland has been a central goal of U.S. policy, and a central thrust of major Federal programs, for half a century. In sheer physical terms, almost half of the total U.S. soil loss occurs on cropland. As we document in this report, America is far from achieving an acceptable level of soil conservation on a substantial portion of the country's cropland. Given the seriousness of the problem, and the longstanding importance of Federal policies and programs in this area, AFT concluded that priority attention to cropland erosion would be a very valuable use of the organization's own limited resources. By extension, essentially the same logic applies to the Federal Government, which must prioritize its efforts among many competing concerns about agricultural resource conservation.

In AFT's view, the cost of soil erosion in this country is substantial. The United States stands to lose a great deal by failing to take more meaningful action to reduce excessive soil loss. Moreover, this loss is largely unnecessary, and hence wasteful. Although great strides have been made in our scientific understanding of the effects of erosion, that understanding is still far from complete. It is known that soil erosion can diminish the inherent productivity of land and damage crops directly. Sediment and run-off from eroding land can lead to costly pollution and sediment damage. Gully formation can interfere with field operations. Yet, because of variations from site to site, and because these problems are complex and have received limited attention from the scientific community, no reliable estimate of the total social cost of erosion is available. These scientific inadequacies are being attacked piecemeal, and a more concerted effort is needed. At the same time, it must be recognized that determining the social cost of soil erosion with great precision would in itself be a very expensive undertaking. Important as it is to improve the knowledge base for public policies, it is equally important to devise the best policies possible with information that will always be incomplete. We have barely begun to use what we know about soil erosion and conservation needs to formulate responsible public policies in the United States.

In AFT's view, the soil erosion problem in the United States is more accurately described as an avoidable waste of valuable resources than as an impending catastrophe. As a strategy to expand support for soil conservation, inaccurate and overly dramatic descriptions of the extent and consequences of soil erosion have been tried many times before, without notable success. Moreover, the hyperbole so common to presentations of erosion problems often attracts attention at the price of making the situation seem hopeless, or of distorting the types of policies that ought to be considered. Then, too, there is the possibility that exaggeration will invite an anti-conservationist backlash that could undercut what is now a very gratifying concern with soil conservation among the general public and in the farm community. Probably the most devastating consequence of overly dramatic rhetoric has been to engender skepticism among many farm policy makers, particularly among the economists who play such key roles in policy decisions. This has contributed to the isolation of conservation concerns that naturally occurs in the policy process due to the fact that soil erosion and conservation are long-term issues. As a result, the tendency to relegate conservation problems to traditional conservation programs is reinforced. Suggestions for conservation-minded reform of major farm programs continue to be dismissed as meddlesome or unjustified.

Public support for soil conservation runs deep. AFT believes it will be strengthened by information presented in this report. It is inappropriate, if not counterproductive, to portray the central policy problem as being primarily one of inadequate funding for existing conservation programs. New policy and program initiatives are needed. Most conservationists now accept that proposition. And because all previous attempts to dismantle or significantly reduce the current conservation effort have met with strong opposition and consistent Congressional rebuffs, conservationists also recognize that new approaches, and constructive criticism of old ones, will not threaten existing programs.

Nevertheless, the public is also growing somewhat impatient with the apparent impasse in the struggle against erosion probelms, particularly with government processes that work at cross purposes, some promoting conservation while others discourage it. AFT believes the only way to end this impasse is to reformulate these government processes to consistently support conservation. It is not necessary for conservationists or conservation organizations to wholly abandon traditional approaches, or to retract public expressions of grave concern about the future of America's agricultural resources. However, conservationists will have to recognize, more fully than they often have in the past, that conservation as well as erosion has its cost. A prudent policy must seek the best available means to minimize both of these costs and at the same time seek to balance them.

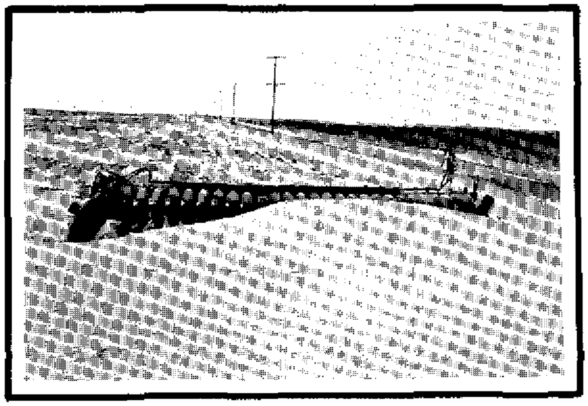
AFT takes some comfort in the fact that the nation has time to avoid the dire consequences excessive soil erosion could cause over the long run. We are also encouraged by the increasing sophistication of conservation science and policy analysis that has occurred in the past five years. As we will demonstrate in Chapters 1 and 2, conservationists have rather recently acquired information with which to persuasively argue for conservation-minded reforms in U.S. farm policy. The central implication of Chapter 3 is that the farm economy has embarked on a course which can lead to great progress in soil conservation, or accelerated degradation of the land, depending on policy decisions taken in the next few years. The theme of Chapter 4 is that existing government conservation policies, programs and agencies desperately need to confront and overcome longstanding flaws and limitations in dealing with erosion problems. As we will explain in Chapter 5, the recently available information about erosion in the U.S, the outlook for the farm economy, the policy environment in Washington, strong public support for conservation, and the imminent debate on the 1985 farm bill, all coincide to make the next few years critical ones in the history of soil conservation policy.

Based on this analysis of resource information and Federal programs, in Chapter 6 we propose 23 recommendations, each of which is accompanied by a background statement and suggestions for implementation.

It remains to be seen whether conservationists and policymakers will capitalize on this historic turning point in agricultural resource policy.

Chapter One

Erosion, Productivity and Pollution



Soil erosion causes two general types of damage. On-site damages can reduce the productivity of land, labor and capital in a number of ways. Off-site damages consist primarily of accelerated run-off of polluting fertilizer nutrients and pesticides and transport of sediment to water bodies or other sediment-sensitive areas (newly germinated crop fields, roads, drainage systems, and so forth). Productivity damages, particularly those which diminish the physical and biological capacity of the land to support plant life, have been a central concern of soil conservationists since the 1930s. In the 1970s, public concern over water pollution shifted attention to some of the off-site damages associated with soil erosion and water run-off from cropland. (1) This chapter reviews some of the recent research and analysis pertaining to the damaging effects of soil erosion in the United States.

Effects of Erosion on Productivity

Productivity is a measure of the amount of land, labor or capital (fertilizer, pesticides, or other inputs) required to produce a given amount of product. Erosion can reduce productivity by altering the crop rooting zone in ways that ultimately require more of each (or all) of these categories of inputs to produce a given amount of crops, including animal forage (thus reducing the output of animals and animal products). The rate at which erosion causes such damages is generally very slow. And because so many factors enter into crop production, it is usually impossible to distinguish the productivity effects of erosion in most situations over the short term. Indeed, separating and quantifying the long term effects is also very difficult.

Erosion directly affects the inherent productive capacity of land in two general ways: (1) by degrading the physical, chemical and biological characteristics of the uppermost layer of soil; and (2) by reducing the depth of the plant rooting zone.

The gradual, selective removal of soil organic matter and finer soil particles from an eroding surface diminishes a soil's capacity to absorb and retain water and nutrients in forms accessible to plants. Naturally, the potential for water erosion in a field is increased if the soil becomes progressively less able to absorb water. Numerous field studies have established that erosion can severely damage the inherent capacity of soils to sustain plant life. If the degradation of this natural productivity is not offset by the addition of plant nutrients or organic matter to the soil, for example, then crop yields almost always decline. (The next section discusses the more complex interactions that are obtained when such amendments are made, as is the case in normal farm operations.) The rate and magnitude of productivity loss depends on the qualities of the virgin soil (thickness, organic matter and nutrient content) and the amount of soil loss. Productivity is also diminished as water run-off and wind erosion carry off valuable nutrients and pesticides which the farmer (and society) would prefer to have remain where they were applied.

Erosion also leads to a reduction in the depth of a rooting zone that is favorable for plants. In the most drastic cases erosion exposes bedrock that is totally inhospitable to higher plant forms. More commonly, erosion causes the rooting zone to shift downward to subsoil materials that usually are not as favorable to plant growth. For example, most subsoils in the humid, eastern United States have large proportions of clay (very fine soil particles). As erosion progressively exposes these subsoils the rooting zone may become more acidic, more prone to compaction from animal or machinery traffic, and less able to absorb water and retain it in forms accessible to roots. As a result, more lime may be needed to obtain a favorable soil pH; tillage operations may have to be more thorough to aerate the soil. The diminished water holding capacity of an eroded field in effect creates a more "arid" micro-environment for plants. More precipitation (or irrigation water) is required to achieve the desirable level of moisture in the eroded soil.

Erosion can also directly damage growing plants, with the effect of reducing crop yields (or the amount of forage available to animals), or requiring replanting, with its attendant costs. "Erosion damage to crops occurs as a result of the abrasive action of wind on plants, removal of plants by water laden with eroded soil, and deposition of soil on plants, especially young seedlings. Crop damage may occur when erosion rates are below those considered damaging to soil." (2) One authority notes that "estimated crop tolerances to wind erosion range from nearly zero (onion, cucumbers, lettuce) to above the soil loss tolerance limit (buckwheat, barley), with most crops showing some damage at a soil erosion level of 1 ton per acre yearly or less." (3)

The vulnerability of crops and soils to erosion damage is compounded by the fact that the periods of greatest potential for erosion are generally in the early phases of crop development. For wind erosion, late winter and early spring are the most critical times, newly germinated winter grain crops being particularly susceptible to damage. (4) For water erosion, crops are most vulnerable in May and June, when plants are small and nearly all the soil surface is exposed to spring rains. (5) This is also the period when newly-applied pesticides and fertilizers are most likely to be picked up by water run-off and carried into streams, rivers and lakes.

Of course, some of the most fertile soils in the world were formed over thousands of years by colluvial deposits of sediment from upland areas. Essentially the same process is relevant in assessing the impact of erosion on a given field. Much of the eroded soil is deposited at the foot of a slope (or at a ridge or other barrier in the case of wind erosion). The soil, organic matter, and associated nutrients are not lost entirely from the ecosystem — or even necessarily from a specific farm. In this sense the convenient phrase "soil loss" is somewhat misleading. (6) However, "eroded sediments from sloping cropland are often of little immediate value, or may be detrimental, when deposited on other croplands. Such sediments may be deposited on soils already deep and highly fertile, and thus add nothing to the productivity of the soil." (7) Needless to say, it is usually impractical to return water or wind-eroded sediments to their origin.

Interaction Of Technology and Erosion on Productivity

The same human agricultural activities which accelerate the natural processes of erosion can also obscure their effects on productivity. This is because modern farming systems are not reliant solely on the inherent productive capacity of soils. Capital, in the form of production inputs, and to a degree labor, can enable *crop yields* to rise despite continuous soil loss. If crop yields per acre are the measure of productivity, it may appear that soil erosion is of no consequence. But if erosion results in a need for ever greater quantities of, say, fertilizer to maintain per acre yields, then the productivity of that input actually has declined (more fertilizer is needed to produce a given amount of crop). Conservationists refer to this phenomenon as "masking", and it has been described by Neil Sampson:

"In the past, many adverse effects of soil erosion on the productivity of land have been masked by other factors. New and more productive crop varieties coupled with the heavy use of fertilizers, better control of pests and crop diseases, and improved tillage and planting methods have resulted in yield increases despite topsoil loss. While these technological increases have masked the permanent effects of soil erosion, they have not eliminated them. We are now dependent on such technology (much of which is growing more expensive as petroleum prices rise), and must . . . . continue to have similar technological breakthroughs in the coming years to maintain or improve crop yields. How seriously this affects our future ablity to produce will depend on our success in controlling erosion." (8)

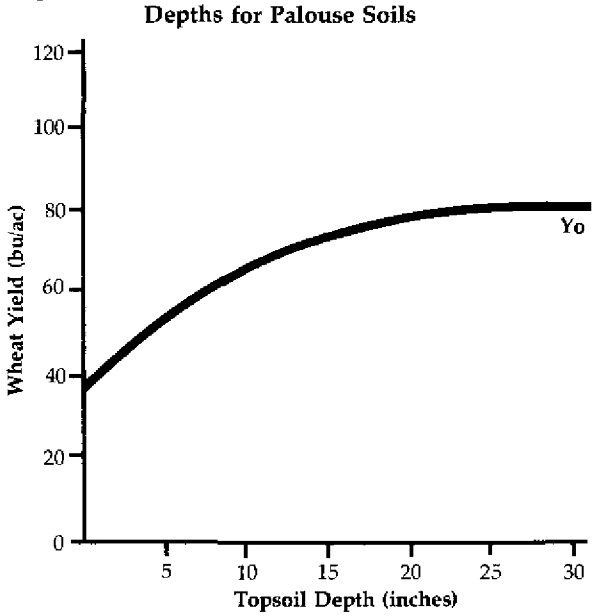
It is very difficult to establish the productivity effects of erosion in the context of a modern farming operation. If a farmer never changes any aspect of his farming practices, it is probable that excessive erosion gradually will diminish his per acre crop yields in a way that is evident. Again, the erosion rate and the initial quality of the farmer's soil would have much to do with the timing and magnitude of the yield decline. But a farmer typically modifies many of his practices from year to year. He may increase his seed rate by a few pounds per acre, increase the amount of fertilizer applied, use a new, more efficient combine, etcetera. (Or he may use less seed and fertilizer, and his combine may break down in the middle of the harvest season.) With all of these factors acting to potentially increase (or decrease) per acre yields, it is virtually impossible to distinguish the effects of even very high rates of soil erosion in the short term. And in the short term, of course, weather, good or bad, can substantially overshadow the effects of inputs or erosion. Many observers predicted that the idling of 80 million acres of land in the 1983 Payment-in-Kind (PIK) program would result in higher average yields on land that was planted, on the theory that farmers would tend to use more fertilizer, pesticides, etc. After a wet spring delayed planting in many parts of the country and a devastating drought parched tens of millions of acres during the summer, USDA estimated that total corn and soybeans yields would be half of the average of the prior years. It is unlikely that more fertilizer or pesticides had a discernible effect in the face of such extreme weather conditions. But were yields somewhat higher where conservation measures retained moisture-holding organic matter?

Measuring the impact of erosion on crop yields or on the productivity of individual production inputs is difficult even in an experimental setting. But agricultural economists David Walker and Douglas Young have recently helped conservationists conceptualize how technology and erosion interact. They argue that technology may not only "mask" the productivity damage caused by erosion, but may actually increase that damage.

To "disentangle the simultaneous influence of erosion on yields," they define erosion damage as "the difference between realized yield with technology on eroded soil and potential yield with technology on conserved soil." (9) The crux of their insight rests on the relationship observed by many researchers between yield and topsoil depth. In essence, yields decline as topsoil depth decreases, all other things being equal. But the rate of decline is not constant: the decline in yields per inch of topsoil reduction is variable, tending to increase markedly after soil depth has been reduced to a critical threshold. Essentially no yield decline is observed on very thick soils even with very high rates of erosion because the plant-sustaining properties of the soil remain virtually unchanged. But on most soils yield declines begin to accelerate after a period of sustained soil loss. (Figure 1)

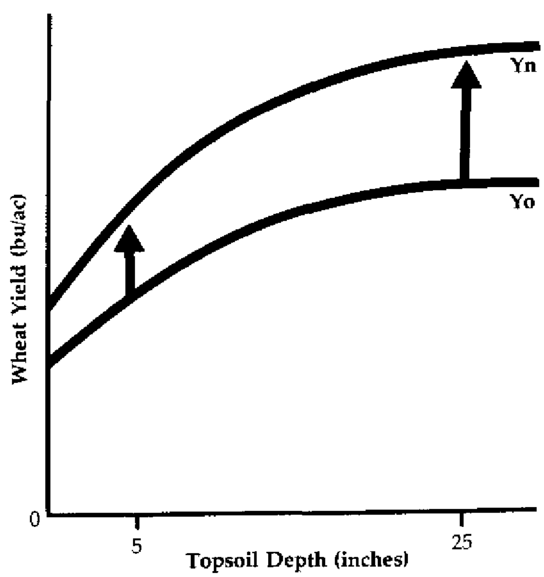
According to Walker and Young, "available evidence suggests that general yield-enhancing technology will often shift the [relationship between yield and topsoil depth] in a skewed manner, with technology increasing yields more on

Figure 1 — Wheat Yields at Different Topsoil Depths for Palouse Soils



Source: Walker and Young, 1982

Figure 2 — Technology Increases Yields More on Deeper Soils



Source: Walker and Young, 1982

deep topsoil." This is depicted in Figure 2. "Technological advance shifts the yield function upward over time from Yo to Yn," they observe. "Yields increase at all topsoil depths, but the greatest gains occur on the deeper soils." (10)

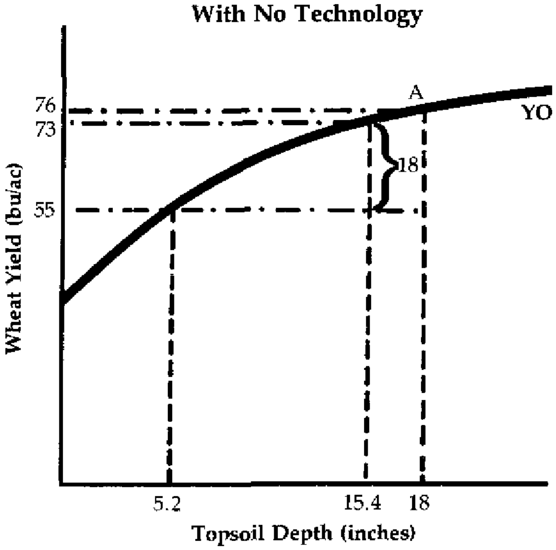
But how can technological advance *increase* yield damage from erosion? Walker and Young develop this argument using Figures 3 and 4. In Figure 3, technology remains unchanged. "Starting at point A with 18 inches of topsoil, the yield curve shows wheat yield at 76 bushels. The use of an erosive, conventional tillage system that permits an average soil loss of 0.2 inches (30 tons) per year would reduce topsoil to 5.2 inches after a period of 64 years and, in the absence of technological advance, would reduce wheat yield to 55 bushels." If, instead, a conservation tillage system had been used (and if it would produce the same yield at equal topsoil depth), and the erosion rate had been reduced to 0.04 inches (6 tons) per acre annually, after 64 years the topsoil depth would be 15.4 inches instead of 5.2 inches; wheat yield would have been 73 bushels instead of 55 bushels — or one third greater.

But what if technology advances? In Figure 4 it does. "Over a 64 year period, technological progress promoting yield growth at the annual rate of 1 percent per year will shift the topsoil-yield response curve from Yo to Yn. During these 64 years, wheat yield would increase from point A (76 bushels) to point C (105) bushels even after heavy erosion left only 5.2 inches of remaining topsoil." Has technology compensated for or otherwise masked the effects of erosion? Not exactly. "Wheat yield would be even higher if the same technological progress had been applied to the 15.4 inches of topsoil preserved by conservation," explain Walker and Young.

"With the use of conservation, improved future technology applied to the deeper topsoil would produce 139 bushels at point E. Considering the interaction of erosion and technology, the erosive practice reduced true wheat yield potential from 139 to 105 bushels. Therefore yield damage from the extra soil loss with the erosive practice is 34 bushels, whereas it was computed in Figure 3 to be 18 bushels when technology was static."

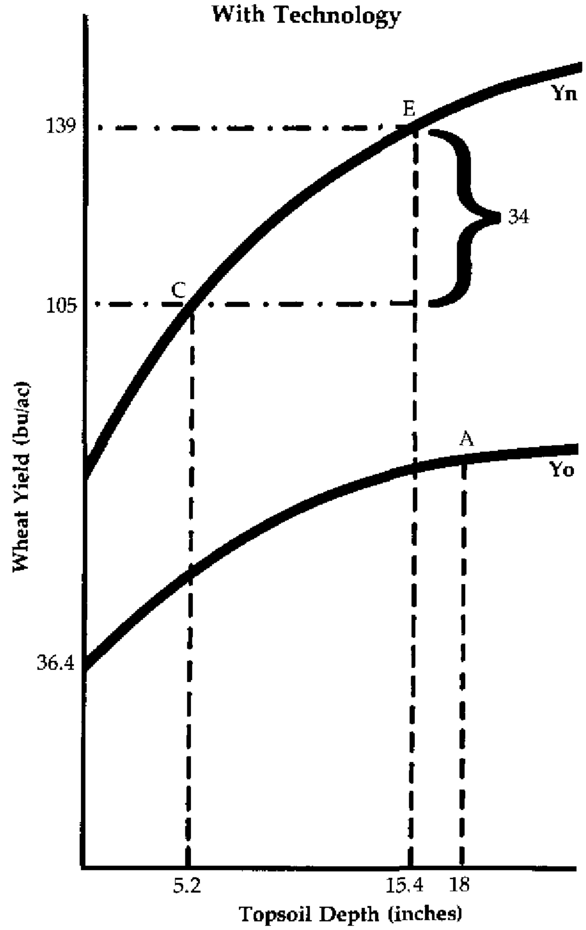
Obviously, the shape of the curve — that is, the rate at which productivity declines with soil loss — fundamentally affects the impact of erosion on crop yields, regardless of the assumptions made regarding technology. If the curve were very flat, as would be the case where topsoil is thick and the subsoil favorable to plant growth

Figure 3 — Erosion Damage To Yields With No Technology



Source Walker and Young, 1982.

Figure 4 — Erosion Damage To Yields With Technology



Source: Walker and Young, 1982.

(or where erosion rates are extremely low), the effects of erosion would be slight even over a very long period of time. The same would be true if it were feasible to correct the damage done by erosion through a change in management. For example, if the damage derived from lowered soil organic matter content the loss might be rectified over a period of years by planting and maintaining a forage legume like clover to return organic matter to the soil.

These qualifications merely reflect the diversity of soils; they do not contradict or weaken the very valuable conceptualizations of Walker and Young. "It is incorrect to think that technology, because it boosts yields, mitigates the need for conservation," the economists conclude. "Technology boosts yields even more on deeper topsoil, making conservation more important — not less important — in terms of future farm income." (11)

Productivity Losses On Diverse Soils

As Walker and Young readily acknowledge, different soils and crops exhibit different responses to erosion, technology, and to the simultaneous effects of both. But if changes in technology are taken into account, the rate of yield decline varies primarily because of the depth and quality of the soil remaining after it has been eroded.

University of Missouri soil scientist Clarence L. Scrivner, and his coworkers Larie Kiniry and M.E. Keener, have developed a method to quantify soil productivity. Their work assumes "that the soil is a major determinant of yield or productivity, due to the environment it provides for root growth". They allow that yield also is influenced by climate, management and the genetic potential of the crop. But their work focuses on soil features which "most influence root growth", namely the water storage capacity, aeration, the mass of the soil per unit volume (its "bulk density"), acidity (the soil pH), and the amount of soluble salts (measured by electrical conductivity). The Missouri investigators have developed "soil productivity indices", which enable them to compare an "ideal" soil, in which all of these features are optimal for root growth, to any other soil. It also allows them to predict how crop yields per acre will change, all other things being equal, as soil erosion shifts the plant rooting zone to progressively lower parts of a soil profile. (12)

A team of scientists led by William E. Larson at the University of Minnesota have modified this productivity index. The Minnesota scientists have taken advantage of an enormous, computerized data base of information on U.S. soils assembled by SCS through its soil survey work. (13) Using their model, they can estimate for a given set of soils — "soil mapping units" — the effects erosion will have on a productivity index. Declining productivity is expressed as a percentage: the predicted yield per acre for a specific soil as a percentage of the maximum yield when key soil characteristics are optimal. For illustrative purposes they have described the effects of erosion on the potential productivity of three general types of soil, depicted in Figure 5. These graphs illustrate the same phenomenon described Walker and Young, the difference being that they show the damage in terms of cumulative erosion instead of declining soil depth.

Each of the three soils in Figure 5 has a surface soil favorable to root growth and hence to crop production, but the quality of their subsoils varies dramatically. Erosion of soil A impairs potential productivity very little, since the subsoil exposed by erosion is nearly as favorable to plants as the eroded topsoil. Soil B withstands erosion for a time, much like soil A, but gradually the plants must cope with an unfavorable subsoil — it may be poorly aerated, highly acidic, unable to store water in forms available to plants. As a result, the potential productivity of the soil gradually declines with protracted erosion. Of course, more intensive, and probably more expensive, management techniques or improved plant varieties may continue to boost actual production despite this erosion; but both potential and, in the long term, actual future production will decline. Walker and Young of course made the same point by noting yield benefits that will be accrued to conservation in the future.

The effect of erosion on soil C can truly be described as catastrophic. Both potential and actual productivity plummet as erosion lowers the rooting zone toward a "consolidated" (bedrock) layer. Clearly, even a very low level of erosion will in a fairly short time ruin this type of soil.

Estimate of Erosion Effects on Productivity

Although a considerable amount of research was conducted between 1930 and 1960 on the relationship between erosion and crop yields, very little additional work had been done until recently. Three ongoing research efforts now provide valuable, and rather consistent indications of the effect erosion has had and will continue to have on crop yields.

Using the productivity index approach, Larson and his colleagues have estimated the effects of erosion on potential soil productivity for selected areas of the country, mostly in the Corn Belt. "We simulated soil erosion at the rate reported in the [1977] NRI data base for 25, 50 and 100 years and calculated the PI [productivity index] at each time increment." When the productivity index was statistically analyzed in relation to corn yield in major land resource area (MLRA) 105 in southeastern Minnesota, about 71 percent in the variation in corn yield was explained by the values of the productivity index. In other words, erosion was identified as a major factor in explaining observed changes in crop yield over time. The results of this analysis are shown in Table 1.

Productivity losses, or reductions in potential corn yield, are projected to be quite low for land with slopes of less than 6 percent, even over 100 years. This is primarily because of relatively low rates of erosion on this land as estimated in the 1977 NRI. Although there are exceptions, within a given landscape thick topsoils tend to be associated with flat to moderate slopes, at least where the chief cause of erosion is rainfall and water run-off. (Conversely, steeper slopes are more likely to have thinner topsoils within a given landscape.) "Greatest productivity losses are projected to occur on soils with slopes exceeding 6 percent. While the severity of losses increase with slope, the soils of greatest concern in this MLRA are those with slopes between 6 and 12 percent. This is because of the large percentage (25 percent) of soils in this class." (14)

Additional results for other MLRAs are reported in Table 2. In all MLRAs studied, greater productivity losses were associated with steeper slopes and relatively high sheet and rill erosion rates. "The maximum loss was 56 percent on 8,500 hectares (21,000 acres) of land in MLRA 105 (southeastern Minnesota) with slopes of 20 to 45 percent. In MLRA 134 (western Iowa and Missouri) the maximum loss in 100 years was 23 percent and in MLRA 107 (southern Mississippi Valley) it was 5 percent. In both of these MLRAs the maximum loss was on land with a 6 to 12 percent slope." (15) It was also on land where erosion rates averaged 5 to 10 times the national average rate for cropland in 1977. On the national level, according to Crosson, et al., the Minnesota team "interpret their results as indicating that continuation of 1977 rates of erosion for 100 years would reduce natonal average crop yields by not less than 5 to 10 percent from what they otherwise would be. " (16) Larson and his coworkers observe:

"The postulated relation between erosion and soil productivity should be verified further as more data are obtained. These relations can then be used in making soil conservation policy. For example, from what we have learned, conservation efforts should be concentrated *where erosion damage is greatest,* not necessarily where the greatest amount of erosion occurs." (17) This important conclusion reflects the differential effect of erosion on thick, favorable soils in contrast to thin soils with unfavorable subsoils. Most conservationists recognize the implication of this observation: that high erosion rates on thick soils may cause less productivity damage than much lower rates on thin soils. However, with some exceptions the PI approach confirms the commonsense view that high erosion rates

Table 1.
Change In PI By Slope Class For Soils In MLRA 105 In Minnesota After 25, 50 and 100 Years.

Slope (%)	*Acreage (1000's)*	*USLE Erosion[1] Rate (Tons/Acre/Yr)*	*Average Loss In PI (%) 25 Years*	*50 Years*	*100 Years*
0-2	140	1.1	0	0	1
2-6	471	4.2	1	1	2
6-12	225	(9.4)	2	3	5
12-20	56	(15.8)	10	14	15
20-45	21	30.0	20	35	56

[1] This column was calculated by AFT. Erosion rates were weighted by acreage in row crops and small grains for each slope class. Erosion rates in parentheses are for slightly different slope groups than were used by Pierce, et al. (1983): (9.4) corresponds to slopes of 10 to 20 percent. These estimates are included to indicate direction and approximate magnitude of change in USLE rate.

Source: Pierce, et al. (1983).

The AFT Survey on Soil Conservation

How serious do farmers think erosion problems are on their land? Do they tend to practice soil conservation on land they own, but not on land they rent? How important have government technical and financial assistance been in inducing farmers to adopt conservation practices? Where do farmers get their information on erosion control? Would most farmers be willing to adopt conservation practices in order to be eligible for government programs like PIK? Do they think the government should pay some farmers to plant highly erodible land to a permanent cover crop?

Finding out what farmers actually are doing and thinking about soil conservation was a key part of the AFT study. So in the fall of 1982, we spent about an hour interviewing each of nearly 700 farmers in six different parts of the country. We wanted to find out what types of conservation practices were being used by farmers, and how extensively. We also wanted to determine the importance of existing government conservation programs to farmer decisionmaking, and learn farmers' views on a variety of conservation policy ideas, including controversial ideas like cross compliance.

The first step was to select the survey areas. We wanted to meet several criteria. First, to maximize our ability to generalize from the survey findings, we wanted the areas to represent a broad mix of farming activities, farm size, ownership, and tenure patterns, and natural conditions. Second, the areas had to have serious erosion problems. In each of the six counties where we conducted the survey, local SCS officials estimated the average erosion rates were at least two times greater than the official soil loss "tolerance" levels. In addition, because our resources were limited, the study areas could not be so large that we could not afford to interview adequate size samples of farmers. Finally, we selected areas where we were confident we could find local people to conduct lengthy, personal interviews. Characteristics of the study sites and the county they are in, and of the farmers interviewed, are described elsewhere in this report.

Once the sites were selected, a random sample of farmers was picked from the rolls at the county office of the Agricultural Stabilization and Conservation Service. AFT then conducted interviews with representatives of public, agricultural agencies and private farm organizations in the area. This helped us gauge the form and extent of local conservation efforts. It also enabled us to determine the types of erosion control practices that were currently in use there, were cost shared by ASCS, and were judged most appropriate by representatives of Cooperative Extension, SCS, the conservation district, and ASCS.

At about the same time a questionnaire was developed based on a number of research hypotheses. The questionaire was "pretested" with farmers at each site, and modified to improve its clarity and content. Residents of each study site were trained as interviewers, and they contacted the farmers and administered the questionnaire.

Major findings of the AFT survey are presented throughout this report. A detailed description and analysis of the survey will be presented in a separate AFT publication being prepared by the survey's principal investigators: J. Dixon Esseks, Associate Professor of Political Science at Northern Illinois University, and Steven E. Kraft, Assistant Professor of Agribusiness Economics at Southern Illinois University-Carbondale.

Table 2.
Soil erosion rates, initial productivity, and changes in productivity after 50 and 100 years of erosion in two MLRA's broken down by slope class.

MLRA	*Slope (%)*	*Acres (thousands)*	*Soil loss (ton/acre year)*	*Initial PI*	*Loss in PI (%) 50 years*	*100 years*
107	0 to 2	2105	2.2	0.48	<1	<1
	2 to 6	2857	8.0	0.94	1	2
	6 to 12	2024	27.2	0.84	3	5
	12 to 20	929	50.9	0.96	3	4
Overall		7915	17.0	0.91	2	3
134	0 to 2	4549	5.4	0.78	1	2
	2 to 6	1628	16.0	0.76	4	8
	6 to 12	578	50.4	0.72	16	23
	12 to 20	114	95.0	0.76	15	15
Overall		6869	13.8	0.77	3	5

Source: Larson, et al. (1983)

AFT FARMER SURVEY CHARACTERISTICS OF THE SURVEY SITES

Nixon Creek Watershed, Haywood County, Tennessee.

The Nixon Creek watershed in west Tennessee comprises 28,000 acres, much of it highly erodible. The SCS District Conservationist estimates that annual soil losses per acre range from 12 to 54 tons, with an average of about 20 tons — four times greater than the national average on cropland. According to the 1978 Census of Agriculture, 91 percent of the value of agricultural products in the county was derived from crops. The county is part of an area targeted for combined SCS-ASCS efforts to reduce soil erosion. About 70 percent of the county's cropland in 1978 was in soybeans and corn.

Rattlesnake Creek Watershed, Grant County, Wisconsin.

About 80 percent of this watershed's 35,000 acres are cropland. Soil losses in the watershed range from 3 to 50 tons per acre annually, with an average of about 25 tons. Rattlesnake Creek is located in a county with a large dairy farming sector. Corn and hay are the major crops.

Coal Creek Watershed, Warren and Marion Counties, Iowa.

Soil losses at this survey site average 10 tons per acre annually, though they may range as high as 35 tons. Over sixty percent of the Coal Creek watershed's 48,000 acres is in cultivated crops. The 1978 Census found that 28 percent of the value of farm marketings in Marion County came from crops, and the majority from production of slaughter hogs and pigs. In 1978, 52 percent of Marion County's cropland was in corn and 28 percent was in soybeans.

Ora-Bradley Area, Jackson County, Illinois.

At least five small watersheds drain this area of 48,000 acres. About half the land is in row crops. Soil losses range from 5 to 20 tons per acre annually, averaging more than 10 tons per year. Jackson County's farm marketings in 1978 consisted primarily of crops (72 percent), with soybeans and corn dominating.

Perry County, Missouri.

The Survey was conducted in an area distinguished by a particular group of soils, collectively called the Menfro soil association. The area comprises over 20,000 acres of which about 69 percent is cropland. Soil losses range from 5 to 60 tons each year, with 17 tons for an average. Over two thirds of the value of farm marketings in 1978 came from livestock. Hay, corn and soybeans each accounted for about one fourth of the county's cropland acreage in 1978.

Cope Soil and Water Conservation District, Washington County, Colorado.

The Cope SWCD is over half a million acres, almost evenly divided into dryland crops and range. This is the only survey site where wind poses a major erosion hazard, and annual soil losses average over 9 tons per acre (4 tons from wind, 5 tons from water). The range of soil loss is 3 to 45 tons per acre per year. In 1978, 44 percent of the farm marketings for Washington County were from crops, 56 percent from livestock. Dryland wheat is the major crop.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites,* American Farmland Trust, forthcoming.

are a good litmus of the significance of erosion-induced damage to productivity.

In the next chapter we will show that a very large proportion of the erosion in the United States occurs on a fairly small amount of land, on which erosion rates tend to be three or more times greater than the national average. In devising conservation policies, it is important to recognize the fact that these highly erodible lands include some fields with thick and favorable soil profiles that are able to withstand high rates of erosion with little or no productivity loss (even though off-site damages might be substantial). It is equally important to acknowledge that some thin soils may be gravely vulnerable to even low rates of erosion. Thus a policy that relied solely on erosion rates to gauge erosion damage would overprotect some thick soils, and underprotect some thin ones.

As a general principle, however, much of the threat posed by erosion in the United States is associated with a fairly small amount of highly erodible land that is now in cultivation, or soon will be. What's more, with existing data and methods of analysis, scientists, conservationists, and conservation program administrators can reliably identify the vast majority of America's cropland that is acutely threatened by erosion. The technical and scientific capacity to make such determinations should improve markedly over the next few years.

This general principle is supported by other recent analyses and research. "Quantification of the effects of soil erosion on crop yields (was) recognized as a fundamental analytic capability required to satisfy nearly all basic provisions" of the Soil and Water Resources Conservation Act of 1977 (RCA). (18) In the first "appraisal" of America's soil and water resource conditions and trends, mandated by the act, the Department of Agriculture developed a mathematical model to project the yield damage caused by soil erosion.

Known as the RCA Yield-Soil Loss Simulator (YSLS), the model is based on a series of equations in which the yield of each of ten basic crops is explained as a function of soil depth and texture (proportion of sand, silt and clay), the slope and capability class of the land, and other factors. The influence of these factors on the yields having been mathematically established by the equations, the simulator can then be used to establish a "base yield" from which changes in soil productivity can be estimated over time, taking into account technological advance and the damage caused by sheet and rill erosion.

According to Crosson et al. (1983), national average loss of 8 percent of yield potential was projected by the Simulator if 1977 sheet and rill erosion rates were to continue for 50 years. ("The projections are apart from the growth of yields expected from advances in technology and management.") Some of the effects of erosion on yields, as projected by the Simulator, are given in Table 3. Clearly, within a given geographic region, land with relatively low sheet and rill erosion rates in 1977 — say, less than 2 tons per acre — tended to have the highest corn and soybean yields. Both the farmers land and society would lose a great deal if erosion impaired production on this fertile land. Fortunately, nearly all of this land's potential productivity will be realized fifty years hence, despite erosion, because the rates of erosion are low and the topsoils are relatively thick.

Higher erosion rates are associated with lower "present yields" in Table 3, a relationship that has led some observers to conclude that such land is of little consequence in terms of present or future national crop production. However, as Walker and Young have observed, the potential productivity of highly erodible land will undoubtedly increase in the future as new technologies become available. The future pay-off in terms of crop yield is likely to be much less on these lands if erosion continues as the rates reported in the 1977 NRI. No one knows whether new production systems might eliminate many of the factors limiting yields on these lands. Information on input costs are not available, but it is reasonable to assume that the lower present yields probably result in fairly high costs of production — and fairly low net income — on this land over the short term. Continued erosion will increase these costs at an accelerating rate over the long term, perhaps to a point where crop production becomes economically unfeasible. What is particularly troubling and paradoxical about this scenario is that highly erodible land would continue to aggravate America's persistent problems of overproduction in the short term, but erosion may destroy much of this land's potential productivity in the long term — when productivity is much more likely to be needed to meet an enlarged demand for U.S. crops. It is also important to note that there are other productive uses for this land at present, such as intensive forage production, but economic circumstances encourage production of erosion-prone crops.

As Table 3 shows, though, the higher erosion rates common on these lands — rates twice or more the national average for cropland — will over 50 years markedly reduce the potential yield. Once again, then, we see evidence that erosion is causing some damage to productivity over a very broad range of soil types. However, the most significant damage seems to be associated with relatively high erosion rates on land where the depth of soil favorable to plant development is limited.

This interpretation is corroborated by research conducted over the past two years by Pierre Crosson and colleagues at Resources for the Future (RFF). They developed another mathematical model which estimates the effects of sheet and rill erosion ("and a small number of other factors") on "the *growth* of corn, soybean and wheat yields in major producing areas for those crops." (19) The full results of this work will be presented in a forthcoming publication, but the central findings were presented at a recent symposium.

In essence, the RFF found that those counties with higher levels of sheet and rill erosion tended to have slower rates of increase in yield for the crops in question over the period 1950 to 1980. (This conclusion further supports Walker and Young's thesis regarding the extent of yield damage on eroded land). Overall, this reduction of growth was on the order of 4 percent for both corn yields (in a total of 616 counties) and soybean yields (in 299 counties). But as Table 4 indicates, the retardation of yield growth was much more substantial where erosion rates exceeded 10 tons. (Note that the observed reductions in average trend yields appear to taper off as erosion exceeds 20 tons per acre. Crosson and his coworkers discount this finding because it is based on an inadequate number of observations for erosion rates in that range; they anticipate better data would show erosion effects greater

Table 3.
Expected Changes in Corn and Soybean Yields in Selected Producing Areas If 1977 Erosion Rates Continue for the Next 50 Years.

Crop and producing area	*Soil group*[1]	*1977 annual rate of erosion*	*Cumulative soil loss over 50 years*	*Present yield*	*Maximum potential yield in 2030*[2]	*Yield in 2030 if present erosion rate continues*	*Percentage of maximum yield in 2030*[3]
		(tons/acre)	*(inches)*	*(units)*[4]	*(units)*[4]	*(units)*[4]	*(percent)*
Corn	1	2.5	0.8	101	152	152	100
10[5]	2	5.5	1.8	81	121	120	99
(Pennsylvania	3	8.1	2.7	74	111	107	96
and New York)	4	9.2	3.1	66	99	91	92
	5	13.6	4.5	67	101	94	93
	1	4.0	1.3	91	137	137	100
43	2	5.1	1.7	74	111	110	99
(Illinois and	3	18.5	6.2	71	107	90	84
Missouri)	4	14.7	4.9	62	93	76	82
	5	31.5	10.5	50	75	53	71
	1	3.9	1.3	105	157	156	99
35	2	4.1	1.4	87	131	128	98
(Illinois and	3	13.2	4.4	76	113	97	86
Ohio)	4	25.4	8.5	66	99	60	61
	5	42.4	14.1	61	92	50	54
Soybeans	1	3.9	1.3	33	50	49	99
35	2	4.1	1.4	29	43	43	99
(Illinois and	3	13.2	4.4	24	36	31	87
Ohio)	4	25.4	8.5	20	31	22	73
	5	42.4	14.1	17	26	17	67
	1	3.2	1.0	34	51	51	100
41	2	4.9	1.6	29	44	43	98
(Iowa)	3	16.6	5.6	26	39	33	85
	4	18.0	6.0	23	35	21	59
	5	32.2	10.7	20	30	24	79
	1	3.2	1.1	24	36	36	100
14	2	6.2	2.1	20	30	29	99
(South Carolina	3	15.7	5.2	17	25	21	82
and Georgia)	4	22.2	7.4	14	22	12	56
	5	17.4	5.8	12	18	16	93

[1]Soil groups are made up of aggregations of land capability classes and subclasses in the following manner:

Soil Group	Land capability class and subclass
1	I
2	II, IIIs, IIIc, IIIw, IVs, IVc, IVw, V
3	IIIe
4	IVe
5	VI, VII, VIII

[2]Based on the assumption of a 1 percent annual increase in yields resulting from improvements in technology.

[3]Yield in 2030 if present erosion rates continue as a percentage of maximum potential yield in 2030. Percentages were calculated from unrounded data and therefore may not represent the ratio between the numbers shown for maximum potential yield and eroded yield.

[4]Units are in bushels for all crops.

[5]Producing area number from the yield/soil loss simulator.

Source: 1980 RCA Yield/Soil Loss Simulator than or equal to those in the 10 ton to 20 ton range of erosion. (20))

The RFF analysts interpret their results to mean that erosion "retarded the increase of corn and soybean yields in important areas growing these crops. The amount of retardation, however, seems to have been small." The cumulative effect on the *level* of yields was smaller still — an estimated 2.5 percent lower in 1980 as a result of thirty years of erosion.

The scientists conducting these pathbreaking research projects are quick to point out that important caveats apply to their methods and results. For instance, Larson and his colleagues consider the productivity losses they report as "conservative" because their method assumes that fertilizers will always be available economically to offset erosion-induced loss of nutrients or nutrient holding capacity. They acknowledge that this assumption may not be realistic because "the cost of technological inputs may also prove limiting to crop production." They also note that "additional consequences of erosion must be considered as well": namely, off-site damages such as sedimentation of reservoirs and water pollution from nutrient and pesticide run-off, damage to crops, and loss of plant nutrients. (21)

Similar qualifications must be applied to the other two research projects discussed above. As their formulators readily acknowledge, neither the Yield-Soil Loss Simulator nor the RFF model considers off-site damages. Neither model considers the effects of wind erosion or the direct damages of erosion to crops. The YSLS did not incorporate the effects of losses in organic matter, an important component of soil productivity. The RFF approach was not able to consider county to county differences in the quality of subsoil or the depth of the rooting zone favorable to crop development. Neither model attempts to estimate the effect erosion has on the productivity of rangeland or pastureland.

Despite differences in methodology and major limitations of the database available to them, Crosson, Walker, Dyke (who developed the YSLS) and Miranowski are heartened by the apparent comparability of the results of the three independent efforts.

"The projections by Larson et al. indicate a smaller impact of 1977 erosion on crop yields than those derived from the YSLS. (Five to ten percent over 100 years compared with 8 percent over 50 years.) However, in view of the quite different methodologies underlying the two sets of projections their similarity is more striking than their difference. Moreover, both appear consistent with the results of the RFF regression analysis (corn and soybean yields reduced 2 to 3 percent by erosion over 30 years). The three sets of estimates seem to point to the conclusion that from the end of World War II to the end of the 1970s the effect of erosion on yields was small, and that if 1977 erosion continues for 100 years,

TABLE 4.

Estimated effects of sheet and rill erosion on the trend of corn and soybean yields, selected counties, 1950-1980.

	Reduction In Yield Trend Because of Erosion As a Percentage of Mean Yield Trend			
	USLE EROSION RATE			
Crop/(No. of Counties)	*5 Tons*	*10 to 20 Tons*	*20 Tons*	*All USLE*
Corn/(616)	NR	NR	NR	4[1]
Corn/(341)	3[3]	18[2]	3	1
Soybeans/(299)	4[3]	22	2	4[1]

[1]Regression coefficient for USLE significant at 1 percent probability.
[2]Regression coefficient for USLE significant at 5 percent probability.
[3]Regression coefficient for USLE significant at 10 percent probability.
NR: Not reported.

Source: Resources for the Future. Cited in Crosson, et. al. (1983).

Off-site Damages of Soil Erosion

Soil erosion and water run-off are often blamed for a variety of damages that occur when soil sediment, fertilizer nutrients and pesticides are washed from farm fields and into streams, drainage systems, reservoirs or other vulnerable areas. However, scientific understanding of the relationship between these off-site damages and soil erosion and water run-off in upland areas is exceptionally poor. Indeed, despite the flurry of interest in nonpoint pollution in the early 1970s, culminating in passage of the Experimental Rural Clean Water Program in 1979, the state-of-the-art of offsite damage assessment is far behind that of onfarm damage assessment. The present consensus among scientists was reflected by the Council on Agricultural Science and Technology (CAST) in 1982: "Quantifying the damages to waters caused by sediment from excessive soil erosion and quantifying the extent to which these damages could be reduced through erosion control measures is difficult. Nevertheless, the estimated costs are great, as are the opportunities for reducing losses and damages." (36) Similar uncertainty surrounds the damages from nutrient, pesticide and biological contaminants that enter surface waters as a result of excessive erosion; but those damages can be great as well.

Very wide variations in upland topography, the characteristics of riverine drainage systems, the sediment and pollutant tolerances of streams and their biota, and in other factors, have thus far made it difficult to generalize erosion-offsite relationships. As a result, we possess no nationally consistent and reliable data on the physical or ecological effects of erosion damage off the farm, let alone on the economic costs of these damages. And despite continuing concern about these problems, the very limited research effort now underway will not produce such information anytime soon. As one researcher has observed, "a major committment to an agricultural information system and more research is unquestionably necessary to support a nonpoint-source pollution policy." (37) Indeed, the absence of this information is partly responsible for the stagnation in national nonpoint pollution policy that has existed for the past five years.

Sediment damage is generally viewed as the most serious off-site problem caused by soil erosion. "Sediment derived from soil erosion decreases water storage capacity in lakes and reservoirs, clogs streams and drainage channels, causes deterioration of aquatic habitats, muddies recreational waters, increases water treatment costs, damages water distribution systems, and carries agricultural chemicals into water systems." (38) According to one frequently cited, but poorly substantiated estimate, about 2.1 trillion tons of suspended solids (mainly sediment, but also organic matter, plankton and other substances) are discharged into receiving waters in the U.S. annually, about two thirds of which is attributable to nonpoint sources. Cropland erosion is believed to contribute about 40 percent, and streambank erosion 26 percent of the sediment discharged into receiving waters. "Erosion from cropland is of special concern because it is a major contributor of sediment, which can carry attached particles of nutrients and pesticides into streams." (39)

Reliable data on the proportion of erosion that ends up as pollutant sediment — what soil scientists call "sediment loading ratios" — are available for relatively few watersheds. Soil scientists and hydrologists estimate that as little as five percent, or as much as 90 percent of the soil eroded from upland areas may end up as off-site sediment, depending on the size and configuration of the watershed. Moreover, the damage done by transported sediment varies markedly according to the physical and biological characteristics of the affected site. For example, the habitats of certain fish species (such as trout) may be severely damaged by a very small amount of sediment; other aquatic species are much more resilient.(40)

Several estimates have been made of the cost of erosion-related sediment damage. Most of the estimates are based on documented costs of dredging sediment. For example, "Taylor et al. estimated a cost of $17.7 million to dredge sediment deposited in lakes and reservoirs of Illinois each year, plus a probable expenditure of $6.3 million per year for sediment removal from roadside ditches." The U.S. Corps of Engineers spent $240 million in dredging operations in 1976, though the proportion attributable to agricultural erosion is not known. Sediment also contributes to flood damage by reducing the storage capacity of natural and constructed water systems. By one estimate, sedimentation contributed to $31 million in flood damages on the Obion-Forked Deer River Basin in Tennessee in 1972. National estimates of erosion-induced flood damages range from $50 million to $1 billion (41). In 1982, CAST estimated that erosion increased the price of water treatment nationally by $25 million.

Some researchers have also attempted to estimate the cost of agricultural chemicals or plant nutrients lost through erosion and run-off. Based on findings by Weber, CAST reported that losses of agricultural chemicals due to soil erosion on U.S. cropland might range from $350 million to $1.2 billion annually. In 1982, the Congressional Office of Technology Assessment estimated such loses may range from $1 billion to $4 billion annually. (42)

Methodological difficulties have made it virtually impossible to include the costs of ecological damage in estimates for sediment and nutrient runoff damage. The state-of-the-art is also unrefined for assessing the effects and costs of pesticides introduced into water systems via sediment or run-off. (43)

The most comprehensive assessement of offsite damages of erosion in the U.S. is found in a forthcoming report prepared by the Conservaton Foundation (44).

the productivity effect will continue to be small."

Small, that is, from the national perspective. But in some areas the effect may be drastic. In each of these approaches, the aggregation of data for different types of land into relatively few groupings markedly influences the estimated magnitude of productivity effects. Because so much of the land in production tends to have relatively low erosion rates, even aggregation at the MLRA level (the U.S. is divided into 156 MLRAs) tends to obscure important variations in productivity damage. Of particular concern, of course, are situations in which damage may be severe, if not irreparable. Such damage is rarely evident when land in an entire state or county is averaged together. Another concern is that whenever land is aggregated according to its rate of erosion, the estimated productivity effects often appear to be quite dramatic on land where erosion rates are high. This is evident in all three models in varying degrees.

Later in this report we argue that federal conservation programs should be focused on the land where productivity or off-site damages are most acute. Ideally, scientists would at present have the ability to precisely separate out land with very thick, favorable soils not prone to productivity losses, from land where productivity is being or already has been seriously imparied by erosion. Unfortunately, nationwide data on the erosion-productivity relationship have not been developed. Yet in most situations gross erosion rates are probably adequate indicators of hazard. At present the only systematic classification of land according to its erosion hazard is the Land Capability Class System (LCCS). But AFT and other analysts have noted serious inconsistencies in the system that compromise its use for purposes of conservation policy and programs. These deficiencies in the information base make it difficult to quantify the acreage of land to which these specifications might apply, although that capability is being developed. And in any case it will always be a matter of judgement as well as science to define "thick" and "thin" soils.

With universal application of the productivity index (or a similar method), however, field identification of the more threatened soils would be a relatively straightforward and reliable matter. Use of erosion estimation procedures such as the Universal Soil Loss Equation (USLE) for sheet and rill erosion and the Wind Erosion Equation (WEE), together with existing soil survey information and the experience of field conservationists, already provide most of the "know how" necessary for such identification. Advances in our understanding of the effects of erosion on productivity, and development of more accurate methods to estimate erosion rates, will further refine this classification ability.

Many conservationists have expressed surprise and concern about the results of the research discussed above. They feel that, even with the caveats noted by the researchers, the projections of productivity loss seem too low and may undercut support for soil conservation programs generally. How many Members of Congress will be worried about an erosion-induced yield loss of 5 to 10 percent over 100 years, they ask? How can a financially strapped farmer be expected to spend hard earned money on an expensive conservation measure that may prevent the loss of one-fifth or one-tenth of one percent of his crop yields per year — a loss of only 2.5 to 5 percent in yields over a half-century of farming?

We will return to these political and practical concerns in the concluding section of this chapter. But at this point it is important to note that the emerging understanding of erosion's effects on productivity does indeed challenge rather directly some of the basic principles underlying existing conservation policies and programs. This is not to say that conservation is not necessary. On the contrary, we feel the recent information on erosion and productivity strengthens the case for conservation. It does, however, call in to question the way society has gone about trying to help farmers conserve soil in the past.

How Much Soil Loss Is Too Much?

It is frequently stated that soil erosion rates in the United States commonly exceed the rate at which new soil is being formed. From this perspective, soil appears to be a depletable resource.

Actually, two soil formation processes are of interest when we consider the finite stock of soil. *First,* there is the very gradual formation of soil from "parent materials" such as bedrock (either consolidated or in fragments), organic deposits, or sediment (transported to a site by either water or wind). Erosion, freezing and thawing and other natural forces are the agents of this process. Also included is the transformation of deep, unfavorable soil horizons into soil material favorable to root growth. From what little is known about this process, it proceeds very, very slowly: "A renewal rate of 0.5 ton per acre per year (one inch every 300 years) is thought to be a useful average for most unconsolidated materials with the possible exception of alluvium (clay, gravel or other material deposited in recent geologic times). For most consolidated (rock) materials, rates are much lower." (22)

Obviously, any removal of soil which exceeds this very slow, intrinsic formation rate will contribute to a net reduction in the plant rooting zone. However, "on most cropland . . . . it would be extremely difficult, if not impossible, to limit erosion to 0.5 ton per acre per year without major reductions in production." (23) Or, one might add, without an essentially horticultural method of management.

A *second*, much more rapid soil formation process deepens the uppermost organically rich soil layer, known among soil scientists as the "A" horizon. The casual term "topsoil" usually refers to this layer of soil. In "permeable, medium-textured soil material in well-managed cropland an A horizon can form at the rate of 1 inch in 30 years." (23) That's about 5 tons per year, a rate ten times greater than estimated for soil formation in the rooting zone. However, most soil scientists believe that this deepening of the "A" horizon does not result in a proportionate increase in the overall depth of the plant rooting zone. The process deepens the organically rich layer as a result of additions of plant material and subsequent biological degradation which transforms the plant material to soil humus. Hence, the A horizon may progressively deepen at a rate of as much as 5 tons (1/30 inch) annually. At the same time, however, erosion may reduce the depth of the soil rooting zone.

Erosion of course affects both the A horizon — that's where the soil is eroded from — and the depth of soil favorable for root development, which over time will be diminished by any erosion rate greater than about 0.5 ton. "Topsoil" can be preserved if erosion does not exceed the formation rate of the A horizon, and can even be thickened if erosion rates are kept below that formation rate. This is important because this horizon is extremely important to the productivity of a soil. As Larson and his colleagues have put it, "*Most technological advances in soil manipulation have been in the management of the A horizon. Optimizing conditions in the subsoil is costly, difficult, or impossible.* . . . . We [meaning agricultural scientists and farmers] have been very successful at optimizing the nutrient status of soils, and are learning to optimize the physical character of the surface soil. Irrigation has raised production levels significantly in many drier areas. The cost-benefit ratio of this technology has been favorable but — with unstable energy costs, a reduction in fertilizer reserves, and depletion of aquifers — the ratio is becoming less favorable." (24)

When, in the 1950s, soil conservationists wres-

The Debate Over Soil Loss Tolerances

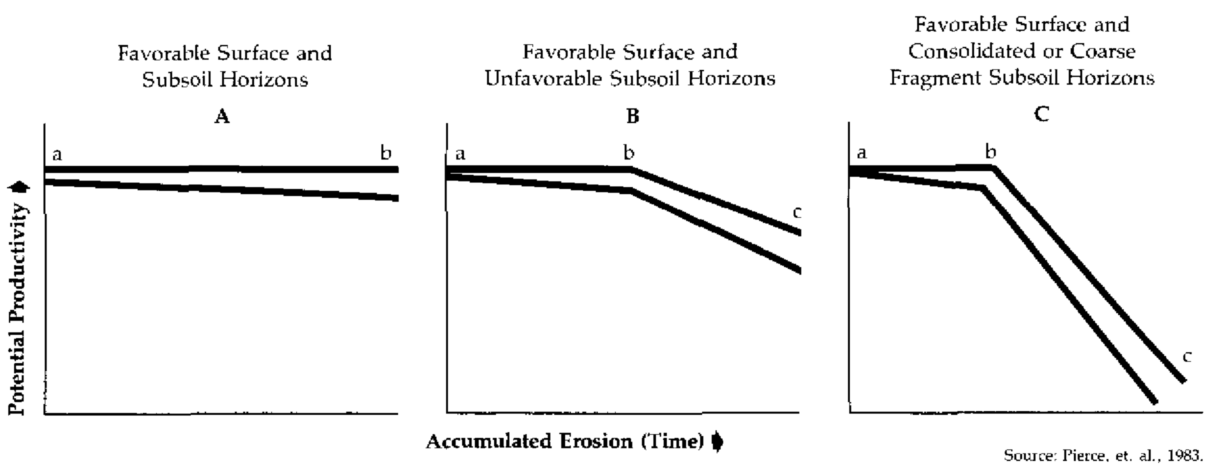
In recent years dissatisfaction with T values has resulted in a mild debate among soil scientists and conservationists. It is widely acknowledged that the scientific foundation of T values is weak (27). One controversial aspect of T values is that they reflect soil formation rates instead of productivity. In 1978 a contingent of scientists reviewing T values within SCS proposed that soil formation rates and off-site damage considerations should be replaced with depth of rooting zone as the primary determinant of soil loss tolerances. In a proposed revision of the SCS National Soils Handbook dated August 28, 1978, it was suggested that "if the soil material favorable for root growth is available in excess of present or predictable future requirements, it is tolerable to use up the excess. As the excess is used up, progressively lower soil loss tolerances are assigned so that the rate of renewal and loss will eventually balance so there is no progressive *deterioration* of the soil." Very thick soils with favorable subsoils would have been assigned T values of up to 10 tons per acre under the proposed scheme. Sediment control systems, such as grassed waterways or sediment basins, were recommended where damage to water quality was likely to result from erosion; but T values were to be set "solely on the long-term maintenance of the soil resource." (28)

The proposal caused an unexpected uproar among conservationists in the field, who felt it would compromise their credibility. For example, in 1971 Iowa passed legislation which "required all local conservation districts to establish allowable soil loss limits and to enforce these limits in response to complaints." (29) Changes in the "*allowable soil loss limits*" (T values) would have caused considerable administrative, and perhaps even legal difficulties, to say nothing of the hard feelings that may have resulted if a farmer had been forced to install conservation measures that would not have been required under the revised T values. Primarily because of political, rather than technical objections, the proposal to raise T values was dropped by SCS (although off-site damages are now to be considered separately under SCS guidelines). (30, 31) tled with the question of how much soil loss was "tolerable", they developed the concept of the soil loss tolerance, or T value. As officially defined, the T value is "the maximum rate of annual soil loss that will permit crop productivity to be obtained economically and indefinitely." (25) The estimated maximum formation rate of the A horizon evidently was the major consideration in setting the maximum soil loss tolerance for cropland at 5 tons per acre per year, though off-site damages, soil depth and a variety of other factors were considered by the local conservationists who set the values. (26) T values vary from 2 to 5 tons for cropland soils, and may be as low as 1 ton for rangeland soils. About two thirds of the cropland soils in the United States have been assigned T values of 5 tons per acre, which is also the "average" T value for all soils frequently alluded to in the media.

In the last 5 years a number of proposals have been made to revise both the methods for establishing T values and to adjust the magnitude of the values themselves. Larson (29) suggested perhaps two T values would be appropriate. A T-1 value would be based on "perpetual productivity of the soil"; a T-2 value could be set to reflect social goals, including the cost of erosion control practices, the protection of water quality, reservoir capacity, and so forth. More recently, Pierce et al. (32) have proposed that the T-1 value "be based on the assumption that soil loss resulting in a certain percentage reduction in soil productivity is tolerable. T-1 would then be defined as the amount of soil loss corresponding to that percentage reduction, divided by the number of years chosen as a planning horizon." The productivity index could be used to project changes in productivity as a soil erodes. It would then fall to the political process to determine the acceptable percentage of productivity decline and the duration of the planning horizon. The longer the planning horizon, of course, the lower the resulting T-1 value. Referring back to the three soil types in Figure 5, the deep, favorable soils might have very high T-1 values, even over a time horizon of several centuries; much thinner soils underlain by unfavorable material may have T-1 values of essentially zero over a much shorter planning horizon.

This approach would satisfy many objections to existing T values, and with a concerted effort to extend and refine the productivity index to all cropland soils, T-1 values could be developed for most soils within a relatively short period. But the T-1 concept still does not take into account the fact that crop production is a function of more than just soil productivity. Farm management techniques such as fertilization, crop rotation and crop residue use, and technological advances such as new crop varieties may serve to offest the negative effects of erosion if erosion has not caused irreparable damage to the soil. As Pierre Crosson has noted, "the rationale of T values is that each generation is but the temporary custodian of nature's endowment of resources and, for a renewable resource such as land, is obligated to pass that endowment unimpaired to the next generation . . . . But as guides to acceptable soil loss, T values impose a stricter standard for many soils than is necessary to satisfy the obligation to intergenerational equity. *Future generations will not be interested in*

Figure 5 — Concept of Eroding Productivity



Source: Pierce, et. al., 1983.

AFT FARMER SURVEY "IS EROSION A PROBLEM ON YOUR LAND?"

Since the six study sites all had average erosion rates at least two times greater than the official soil loss tolerance levels (T values), we wanted to find how area farmers viewed erosion problems on their own land. We asked: "Does any of the land you own (or rent) have erosion problems, that is, where, without some conservation measure, yields would suffer and/or field operations would be interfered with, such as because of gullies?"

On the average in the six sites about 21 percent of the farmers owning land said none of it was affected by such erosion. Nearly half of the farmer-owners in the Colorado survey area said they had no such problem, perhaps because overall erosion rates were lower there than in other survey areas. At the other extreme, only 10 percent of the farmer-owners in the Tennessee study site said none of their land was affected by such erosion. The main percentage of owned land reported as having erosion problems varied from 15 percent (Colorado) to 61 percent (Tennessee.)

Across the six sites an average of 25 percent of the surveyed farmers with leased land reported that none of it had erosion problems. Falling in this category were 55 percent of the Colorado site's respondents, but only eight percent of the Tennessee sample. The mean percentage of erosion-prone rental land, as reported by the interviewed farmers, ranged from 20 percent in the Colorado area to 60 percent in the Tennessee site.

These measures of the severity of erosion are subjective. But they do indicate the extent to which the farmers believe there is a problem on their farms. While we do not have actual field measures of erosion rates from the farmers' fields, the observations of SCS District Conservationists indicate that the actual extent of erosion problems is greater than farmers report. There are probably several reasons for this. Sheet and rill erosion are the main forms in the counties surveyed, just as they are in the U. S. as a whole. Very often, only a small amount of land within a field, farm or county is severely affected by these forms of erosion. An SCS expert would be able to identify such land and estimate the extent of sheet and rill erosion on it. But most farmers would see very little physical evidence of such erosion in their fields — a few rills after the spring rains, perhaps. This is hardly enough erosion to interfere with field operations, even though the estimated soil loss might reach 45 tons per acre yearly, as it reportedly does in some fields in most of the study areas.

But that suggests a third reason for the gap between official and farmer estimates of the problem: yield damage from erosion may be obscured by greater use of yield-enhancing inputs such as fertilizers. Even if farmers are keeping close track of their inputs, they are unlikely to attribute a declining yield response to erosion when weather, planting conditions and other factors are more obvious.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmer's Perceptions in Six Diverse Sites*, American Farmland Trust, forthcoming.

the productivity of the soil as such but in the cost of producing food and fiber. Consequently, we meet our obligation to the next generation if we so manage the nation's land and other resources that the real costs of producing food and fiber do not rise."

Crosson is simply making the point that many conservation measures are not free, though in fact the costs of conservation have never been considered in the context of setting T values. (The costs of various conservation methods will be considered in chapter three.) If the productivity and real costs of all resources employed in agricultural production are taken into account, as Crosson and other economists have suggested, conservation will be one of several measures needed to protect future generations from unwarranted increases in the cost of producing food and fiber.

Accordingly, Crosson proposes a "constant cost criterion of intergenerational equity". According to this criterion, "losses of soil productivity are acceptable if, but only if, there are compensating increases in the quantity or productivity of other resources for production of food fiber." This broader concept of productivity is, unfortunately, offset by the significantly increased amount of information needed to apply the criterion to a particular region, farm or soil. In addition to facing all the analytic difficulties previously discussed, "the constant cost criterion . . . . requires attention to a host of variables bearing on future costs of production: prospective domestic and foreign demand for food and fiber, trends in agricultural techology, prices of present and prospective inputs used in those technologies, and interest rates." (34)

In the course of making their conservation management decisions, farmers consider these "variables", albeit informally. Crosson believes the constant cost criterion could, in principle, be developed. Indeed, work on various pieces of this approach to conservation planning is underway within SCS. A key component is a computer model being developed to help farmers weigh the benefits and costs of conservation decisions over a period of 50 years.

Policy Implications

National policymakers face the same type of decisions as individual farmers. What is the optimum mix of investments in technology and conservation? Should policy be designed to protect future generations from avoidable increases in real food and fiber costs? Or to protect the resource base so that American agriculture will be able to respond to any conceivable level of demand for future food production? Or to improve the quality of rural life or the level of farm income? By optimum we mean "the mix of policies and investments that best serves the interests of society at the least cost". And costs of all types must really be considered, some of which are virtually impossible to quantify: the cost of developing a new plant variety or a new herbicide (including the possible human health and environmental costs of using that herbicide); the cost of terracing millions of acres of land that will erode at high rates if cultivated; the cost of paying farmers to reserve highly erodible land until such time as society is willing to help conserve it while it is in cultivation.

These are extremely difficult questions, and they are complicated by the historic schism that has existed between what might be styled conservationists and technological determinists. "There is a continuing tension between conservationists, who would like to slow the rate of resource use, and those inclined to rely more on development of new technology", note Crosson and four of his fellow economists. "The idea that substitution of technology for land might be a viable long-term component of the policy mix does not go down easily" with conservationists, they observe. Yet most conservationists recognize that "the present value of the costs of not mining the soil are far higher than the present value of the productivity losses which the mining implies." (35) Moreover, years of successful experience in cost-effectively restoring the productivity of many types of soils that have been degraded by erosion provides some hope that the effects of erosion are not always irreversible.

In AFT's view, two rather straightforward conservation strategies recommend themselves in attempting to balance future public investments between technology and conservation, and between these investments and future productivity losses from erosion (including the potential loss in pay-off from new technology developed in the future).

First, we must accelerate efforts to identify, and to concentrate conservation treatment on the land where on-farm and off-site damages are most severe. Clearly the work of Scrivner, Larson and others is reducing much of the uncertainty we have and about the agronomic relationship between erosion and productivity. This work should in the near future provide a more practical and reliable guide to identifying at least the extreme cases — the soils most and least vulnerable to erosion-related productivity damage. The research of RFF, Walker and Young, and the Economic Research Service is achieving similar progress in the economic realm, and will provide better means by which to balance conservation costs and benefits.

Second, we must endeavor to conserve soil resources as inexpensively as is possible within the current policy environment. In AFT's view, the possibility of implementing what might be the least expensive policy — regulation of the use of highly erodible land — is remote. But the current policy environment also does not include vast new expenditures for soil conservation programs, particularly for the purpose of "bringing the world down to T" as one conservationist has put it.

Conclusions

Soil erosion inflicts a cost on the farmer and on society, as does soil conservation. Of the two, the costs of conservation are much easier to quantify.

Clearly, one component of an "optimal" strategy for conservation is to encourage erosion prone agricultural activities on soils that require the least cost to conserve. In time, rising real prices for food and fiber will justify the cost of conservation on soils which, under present economic conditions, are mined by the "rational" individual farmer. Present farm programs and policies do not embrace this very obvious tactic.

Much of the damage erosion is doing to soil productivity appears to be associated with lands where high rates of erosion are observed. As we have noted, gross erosion rates are imperfect indicators of erosion hazards, and methods should be refined to better quantify and locate those areas where gross erosion is a poor litmus. Nevertheless, it is clear that traditional conservation policies and programs need to be more systematically oriented toward support of conservation on land most imperilled by erosion. Some basic changes in public conservation efforts are imperative.

Government commodity price support policies designed to protect farmers and consumers from the oscillatory extremes of agricultural markets provide a natural opportunity for one such change. Since these programs use short-term land use changes — set-asides and diversions of cropland to "conserving" uses — to correct for periodic overproduction of major crops, there exists a ready made opportunity for selective, long-term retirement of the fairly small amount of land that is highly vulnerable to erosion. Such a policy strategy can be viewed as a form of crop rotation, supported by public funds, that would simultaneously prolong the productive life of these lands and support overall farm income. Ideally, when society needs this fragile land for continous production of erosion-inducing crops in the future, the cost of conserving it will be justified, or at least substantially offset, by the value of the crops they yield.

Efforts now underway to quantify the erosion hazard on various lands and to provide farmers with information on the cost of alternative conservation methods show great promise. The common argument, voiced by many conservationists, that soil conservation expenditures should be devoted to getting practices "on the land" is in fact responsible for much of the inefficiency observed in government programs (and documented in Chapter 4). The argument was valid thirty years ago, when little was known about the erosion relation of erosion to productivity and off-site damages. But now it more nearly serves to protect the status quo in conservation program administration.

As will be discussed in the next chapter, a considerable amount of land is available for expansion of crop production without risk of high erosion rates. We should devise policies which selectively encourage crop production on these lands. What's more, farmers should be discouraged from bringing highly erodible land into cultivation until it is economically feasible, with or without government assistance, to protect such land.

Two principles of conservation policy emerge from this consideration of erosion and its costs to society. Government programs should be designed and implemented (1) to encourage farmers to use land within its physical, biological, and economic capabilities and; (2) to help farmers conserve soil and other resources in a cost effective manner wherever erosion will reduce the long-run productivity of land, labor and capital on which American agriculture depends.

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Chapter Two

Soil Erosion and Conservation in the United States

Introduction

For the United States as a whole, reliable estimates of soil erosion were not available until 1978. This comes as a surprise to most people, even to many who are intimately familiar with American agriculture. The widely shared impression that accurate estimates of soil loss have been available for decades reflects, in part, the casual interpretations that have often been made of the largely qualitative findings of previous conservation surveys. Much has also been made of the crude, annual SCS estimates of wind erosion damage on the Great Plains, and of estimates of localized soil erosion routinely made by soil conservationists. The public's misunderstanding of erosion conditions and trends also stems from the comparisons frequently made between erosion conditions today and those of the Dust Bowl era of the 1930s — comparisons which should be viewed as strictly figurative.(1) Indeed, reliable national and state level estimates of erosion are available only for 1977. The National Resources Inventory (NRI), conducted that year by SCS and released in 1978, became, in the jargon of statistics, the benchmark for quantifying soil erosion conditions in the United States.

This is not to imply that previous surveys of erosion conditions are of no value. The Erosion Reconnaisance Survey of 1934 and the Conservation Needs Inventories of 1958 and 1967 — all of which were also conducted by SCS — provided important information about this country's agricultural resources. But none of these efforts attempted to estimate rates of erosion, or the total tonnage of soil moved by either wind or water. Indeed, practical field methods for making such estimates were not available until the early 1960s, and are still being refined today.

This historical lack of information has affected more than just public perceptions. It has greatly impaired the functioning and evaluation of conservation programs at every level of government.(2,3) These programs have been operating for a half-century, at a cost exceeding $20 billion (unadjusted for inflation). Yet we have few reliable measures of the amount of soil thay have saved.(4) When these program have been examined for their effectiveness, the findings generally have been disappointing. This is hardly surprising, considering the inadequacy of information available to program administrators. Erosion rates have rarely been estimated by the government prior to rendering assistance to landowners. Nor have such estimates been made afterwards, to determine the amount of soil saved as a result of government assistance. Far too little has been known about the costs of alternative conservation practices, or about the relative benefits of technical and financial assistance. To be frank, only in the last few years have program managers considered information of this sort necessary for effective program operation.

The state of the conservation arts took a quantum leap with the statistics collected in the 1977 NRI. Conserving America's topsoil has always seemed a monumental task. The vast expansion of cultivated cropland in the 1970s made it seem overwhelming. But refinements in our understanding of erosion problems — their location and their actual severity — are making it feasible to design effective, affordable strategies for bringing *preventable* erosion into check.

We emphasize this point about more accurate estimates of soil erosion because it lies at the heart of the conservation policies discussed — and proposed — in this report. The challenge to public soil conservation programs is essentially the same today as it was during the Dust Bowl: to develop and promote use of erosion control techniques that are practical, economical, and sustainable. In preparing this report, we have been struck again and again by the policy opportunities afforded by the newly available — and continually improving — information on soil erosion. Without question, the 1977 NRI and other breakthroughs pose challenges to the government agencies and interest groups which have presided over public conservation programs since the late 1930s. *But if we use this information to full advantage, we should be able to rapidly eliminate much of the preventable soil loss associated with agriculture in the United States. What is more, AFT believes this goal can be achieved without drastic changes in current Government activities, and at relatively modest cost.*

We readily acknowledge that the contemporary understanding of conservation needs is incomplete. For instance, information collected in the 1977 NRI skews attentions toward those forms of erosion which can now be estimated with considerable accuracy and ease: sheet and rill erosion in humid areas, and wind erosion in the Great Plains. Fortunately, these are dominant forms of erosion. Their magnitudes can be (and have been) estimated for most climatic conditions and geographic regions.

Unfortunately, the new information on erosion is not matched by information of similar quality for many other agricultural resource problems such as water quality, soil salinity, and irrigation efficiency, to name a few. For some of these problems reliable, practical assessment techniques are not available.(5) And as one student of the USDA budget and policy process has recently observed, "resource issues that are difficult to quantify tend to get neglected."(6)

But a focus on soil erosion control is appropriate, since it has been, and remains, the principal purpose of Federal soil and water conservation programs. It is also generally considered the most serious and extensive resource problem facing American agriculture.(7) Actually, the persistence of the erosion problem is partly due to additional responsibilities that have been sought or foisted on soil conservation agencies since 1950.(8) The amount of funds and number of trained personnel available for erosion control activities has been diluted, often by projects which provide few erosion control benefits. (9)

The purpose of this chapter is to review the salient findings of the 1977 NRI that have so greatly improved the understanding of soil erosion in America. In the fall of 1984 the results of an even more extensive inventory conducted by SCS in 1982 are scheduled for release. The 1982 NRI will update the information on erosion and many other resource conditions. In conjunction with the 1977 inventory, it will also provide, for the first time, a statistically reliable basis for evaluating trends in soil erosion and conservation.

But there is much to be learned from the 1977 inventory. In fact, much of what follows has not previously been published. Our analysis of America's erosion problems has left us hopeful, not overwhelmed; and we believe it supports a mix of policies and programs that can substantially alleviate a problem of longstanding national concern.

Estimates of Soil Erosion in 1977

Six types of soil erosion were reported in the 1977 NRI: wind erosion; sheet and rill erosion; erosion occurring along gullies, streambanks, and roads, and at construction sites.

SCS used the Wind Erosion Equation (WEE), developed in the late 1950s, to estimate the potential for wind erosion on a particular site. Soil conservationists had used the WEE for many years to plan conservation measures for individual farms, but the 1977 NRI marked the first use of the equation in a statistically reliable, national inventory. Initially, SCS attempted to estimate wind erosion potential in every state.(10) But the information and technical ability required to apply the equation were not adequate in some areas.(11) Thus the 1977 NRI reported wind erosion estimates only for the 10 Great Plains States. Fortunately, this area is believed to account for most of the wind erosion in the U.S., primarily because of the dry conditions common there in the late winter and early spring.(11) In addition, millions of acres of Great Plains cropland are left fallow every year to recharge soil moisture, a practice which can leave land vulnerable to wind erosion.

This was also the first inventory to estimate sheet and rill erosion rates, using the Universal Soil Loss Equation (USLE). Sheet erosion is "the removal of a thin, fairly uniform layer of soil from the land surface by runoff water"; and rill erosion is a process "in which numerous small channels only several inches deep are formed", also as a

Estimating Wind Erosion The W. E. E.

In the early 1960s soil scientists developed a method for estimating the potential for wind erosion in the field. This Wind Erosion Equation (WEE) has the following symbolic form:

$$E = f(ICKLV)$$

Where **E** is the potential annual wind erosion rate in tons per acre per year. This potential rate is a function (f) of:

I, the soil erodibility value, reflects the size of soil particles (or aggregates). Wind tunnel experiments have shown that soil particles with diameters slightly smaller than this hyphen - are too large to be very susceptible to wind erosion. The I values range from 310 tons per acre for finely-textured, sandy soils to 2 tons per acre for soils that are coarsely textured or wet.

K is the soil ridge roughness value, and in field applications it normally has two magnitudes: Wind erosion potential is higher for a smooth field (K = 0.5) than for a "ridged" one (K = 1.0). This value is determined by inspection in the field.

C is the climate value. It is based on the average wind velocity and on the precipitation and evaporation conditions for a specific location and is obtained from SCS technical guides.

V is the vegetative cover value. It combines residue quantity, kind, and orientation (flat or standing). The value is determined by field inspection.

L is the unsheltered distance across a field along the prevailing wind direction. The unsheltered area of a field begins leeward of a protected area or from a barrier at a distance of 10 times the effective height of the barrier, perpendicular to the prevailing wind direction. In other words, a field windbreak with trees averaging 40 feet in height will protect a field on the leeward side for a distance of 400 feet.

For the 1977 NRI, SCS determined the factors in the WEE for sample points in the ten Great Plains state, and provided estimates of potential wind erosion rates and total tonnage eroded. This was the first time such estimates had been made in a national inventory.

Table 5.
Summary of Erosion Estimates in 1977 NRI.

	Million Tons	*Percent of Total Erosion**
Sheet and Rill		
Cropland	1,926	30.0
Pastureland	346	5.4
Forest land	435	6.8
Rangeland	1,155	18.0
Subtotal	3,862	60.1
Wind		
Cropland	892	13.9
Pastureland	5	—
Forest land	4	—
Rangeland	559	8.7
Subtotal	1,460	22.6
Other Erosion		
Gully	292	4.6
Streambank	553	8.6
Roads	169	2.6
Construction Sites	80	1.2
Subtotal	1,100	17.1
TOTAL EROSION	6,422	=100

Acreage By Land Use in 1977

	Million Acres
Cropland	413
Pastureland	134
Forestland	370
Rangeland	408
Total	1,325

*Percent column may not sum to 100 because of rounding.

consequence of water runoff.(13) In the USLE the two forms are estimated together. Tremendous quantities of topsil can be moved from a field through these processes. In the most extreme instances, 150 tons, or one inch of topsoil, will be lost from an acre in a single year. Yet the loss may be invisible even to the farmer, whose first spring cultivation will obliterate the tiny channels.

When a rill becomes too large to be erased by normal tillage operations, it is termed a gully.(13) SCS estimated gully erosion in the inventory, defining gullies as "rills" deeper than 12 inches.(14) Gully erosion estimates were made in a second phase of the NRI, conducted the following year. Estimates of erosion from streambanks, roads and roadsides, and construction sites also were made at that time.

Table 5 summarizes the estimates reported by SCS in 1977 for all types of erosion and for all land uses. Perhaps the most striking observation to be made about this table is the overwhelming importance of sheet and rill erosion: these forms account for 60 percent of the 6,422 million (6.4 billion) tons of erosion reported in 1977. Sheet and rill erosion on cropland alone accounted for 30 percent of the total.

Clearly, cropland and rangeland are the major sources of soil erosion from a national perspective. Combining sheet, rill and wind erosion, we observe that cropland erosion totalled 2,818 million (2.8 billion) tons, or 44 percent of the total

Estimating Sheet and Rill Erosion: The U. S. L. E.

Unquestionably, one of the major breakthroughs in the field of soil conservation was the development, in the late 1950s, of a practical method for determining sheet and rill erosion rates in the field. The use of the method, the Universal Soil Loss Equation (USLE), in the 1977 NRI, provided invaluable and unprecedented insight into the location and magnitude of the major forms of soil erosion. It also provided, for the first time, a nationwide snapshot of the types, location and effectiveness of conservation practices being used by American farmers for control of sheet and rill erosion.

The equation is based on 10,000 plot-years of soil loss and water runoff data collected by Federal-State cooperative research projects at 49 locations in the United States and Puerto Rico. The USLE is "designed to predict the longtime average soil losses in runoff from specific field areas in specified cropping and management systems." To arrive at the erosion estimate, numerical values for each of six variables must be obtained. The form of the equation is:

A = RKLSCP

where

A is the computed soil loss per unit area for a designated period of time. Generally, A is expressed in tons per acre per year.

R is a numerical indicator of the erosive forces of rainfall and runoff. Where snowmelt or irrigation runoff are significant, an additional factor may be added. Values for the R factor are listed in SCS technical guides, and were developed from rainfall data averaged over 22 years. The values range in the continental United States from 550 along parts of the Gulf coast to 20 in the arid west.

K is the inherent erodibility of a particular soil, a function of the soil's texture (mixture of sand, silt and clay sized particles), organic matter content, physical structure and permeability to water. The K factor reflects the natural susceptibility of a soil to erode, and its values range from 0.7 for highly erodible soils to 0.2 for soils highly resistant to erosion.

L and **S** are factors that adjust the soil loss estimate for effects of length, steepness and shape of field slope. In the field, the steepness of slope is determined with a special instrument (a clinometer) and expressed as a percent. The length of the same slope is paced off. In practice theses two factors are combined into a single value — LS — before being multiplied into the formula. It should be noted that the two factors interact, so that a slope with a steepness of 4 percent and a length of 75 feet has virtually the same effect on erosion as a slope 200 feet in length with a steepness of 3 percent.

The product of these four factors — RKLS — may be expressed in tons of erosion per acre per year. This represents the soil loss that would occur if the land were tilled continuously and kept barren of all vegetation. These are the worst possible "farming" conditions with respect to sheet and rill erosion, and represent a soil's inherent potential to erode.

C, the cover and managment factor, introduces the effects of crop rotations and tillage practices. Values for these factors are listed in SCS technical guides. The lower the value, the greater the protection afforded. The lowest values are achieved with well managed grasslands, the highest with extensively ("clean") tilled row crops such as cotton and soybeans, which produce little vegetative cover or residue. The less the soil is disturbed by tillage, and the greater amount of vegetation produced by the crop, the lower the erosion rate. Values for the C factor may vary from 0.003 (for pasture) to 0.7 (for clean *tilled row crops*). The C factor is "the ratio of soil loss from land cropped under specified conditions to the corresponding loss from clean-tilled, continuous fallow." The simplest interpretation of a C factor value of, say, 0.30, is that the estimated erosion is 30 percent of what it would have been with no crop and extensive tillage. In other words, the cover and management practices reduced the erosion to 30 percent of the inherent potential erosion.

P reflects the influence of supporting conservation practices (sometimes referred to in this report as traditional conservation practices). These include contouring, stripcropping and terraces (although terraces also influence sheet and rill erosion by shortening the length of slope, and this is reflected in a lower LS factor value). "The factor P in the USLE is the ratio of soil loss with a specific support practice (or practices) to the corresponding loss with up-and-down-slope culture." A value of 0.60 for the P factor would be interpreted to mean that the estimated erosion was 60 percent of what it would have been without the support practice.

As used in the 1977 NRI, the USLE has several widely recognized shortcomings. The equation often substantially underestimates sheet and rill erosion in the Pacific Northwest, where run-off from snowmelt, and not the impact of raindrops, is the chief cause of soil dislocation. The USLE also tends to underestimate erosion on irrigated land, particularly where overland flow irrigation systems are used. In addition, the 1977 estimation techniques are generally considered to have underestimated soil movement in eroded channels that were deeper than rills, but shallower than gullies (12 inches). A variety of research efforts are underway to correct these deficiencies. In AFT's view, however, the USLE provides very reliable indicators of erosion rates in those regions of the country where sheet and rill erosion are the major forms of soil loss (the Corn Belt, eastern and southeastern U. S.) In subsequent chapters, AFT will recommend that government conservation programs expenditures should be guided, in part, by USLE indicators in regions where the equation is reliable, or can be made so.

As a final point, the estimates of soil movement provided by the USLE (and, for that matter, by the WEE) do not constitute absolute "loss" of soil. The equation predicts long-term, average dislocation of soil along a slope to a point of deposition. Thus, USLE rates do not represent the amount of sediment that may enter a water body.

Interpreting The 1977 NRI

The 1977 NRI is comprised of data collected at 200,000 sample points across the United States. The sites were statistically selected to reflect the diversity of land forms and uses at the state level.

Once a sample point was located by its field coordinates, SCS personnel recorded a wide variety of observations, either by inspection or by cross referencing the sample point with soil surveys, special technical publications and other sources of information. These sample-point observations were then "expanded" by statistical formulae to reflect the acreage they represented at the state level. Aggregations of state level data provide a national picture.

Because of the way the 1977 NRI was designed, the margin of error is great where very "small" acreages are estimated for a particular land use or condition. For example, the actual acreage treated with terraces in 1977 could be substantially greater or less than the 27.5 million acres estimated in the NRI. The margin of sampling error is much less for a large category like a national cropland (413 million acres).

Hence, throughout this report AFT emphasizes the relative (i.e., percentage) magnitude of low acreage categories, rather than the absolute acreages reported in the 1977 NRI.

estimated erosion on all types of land. On rangeland these types of erosion totalled 1,714 million (1.7 billion) tons, over 26 percent of total national erosion. These forms of erosion on cropland and rangeland thus constitute 70 percent of the erosion reported by SCS in 1977.

Significant erosion problems exist on all types of land use in the United states. However, limitations of time and resources have compelled AFT to focus on cropland erosion problems in this report. This focus is appropriate, given that most of the recent, comprehensive assessments of soil erosion problems, including the RCA process, have emphasized the importance of cropland erosion.

Table 6.
Distribution of Sheet and Rill Erosion by Erosion Rate, All Land Uses Combined, 1977*.

Erosion Rate	*Total Acres*	*Cumulative Percentage of Acreage*	*Total Sheet and Rill Erosion*	*Cumulative Percentage of Erosion*
tons/acre/year	*(millions)*		*(million tons)*	
0-.9	778.7	58.8	211.0	5.5
1-1.9	174.1	71.9	252.2	12.0
2-2.9	95.1	79.1	234.9	18.1
3-3.9	62.8	83.8	218.1	23.7
4-4.9	43.7	87.2	195.7	28.8
5-5.9	29.9	89.4	163.4	33.0
6-6.9	22.7	91.1	147.2	36.8
7-7.9	17.9	92.4	130.4	40.2
8-8.9	12.7	93.4	108.0	43.0
9-9.9	10.5	94.2	98.5	45.6
10-10.9	8.5	94.8	88.7	47.9
11-11.9	7.0	95.4	79.8	49.9
12-12.9	5.7	95.8	69.5	51.7
13-13.9	4.8	96.2	65.1	53.4
14-14.9	4.0	96.4	58.0	54.9
15-19.9	14.3	97.5	246.9	61.3
20-24.9	8.4	98.1	186.8	66.2
25-29.9	5.0	98.5	139.2	69.8
30-49.9	10.7	99.4	411.7	80.4
50-74.9	4.6	99.7	271.9	87.5
75-99.9	1.6	99.8	133.0	90.9
100+	2.2	100.0	351.1	100.0
Total	1,324.5		3,861.1	

*Includes Cropland, Pastureland, Forest Land and Rangeland.

The Concentration of Soil Erosion in the United States

Without question the most important finding of the 1977 NRI was that a relatively small proportion of the Nation's agricultural land accounts for a very large proportion of the total erosion. The degree of this concentration could not be estimated with data available prior to 1977, and in fact was not fully evident for several years after the inventory results were released. It is fair to say even experienced soil conservationists were astonished by the degree of concentration of erosion nationally. Further analysis of the 1977 NRI, performed by SCS at the request of AFT in the spring of 1983, indicates that erosion is highly concentrated on small portions of each state, as well.

Table 6 indicates the concentration of sheet and rill erosion, which are estimated together, and which account for about 60 percent of the erosion reported by SCS in 1977. If the new understanding of soil erosion conditions brought about by the 1977 inventory had to be distilled into a single table, it would be this one.

It shows the number of acres and the tonnage of sheet and rill erosion for the four major land use categories according to the sheet and rill erosion rate estimated by SCS in 1977. Two important observations can be made about these data. First, of the 1.3 billion acres of land in these categories — comprising virtually all of the Nation's agriculturally significant land as of 1977 — about 29 percent, or 779 million acres, eroded at rates below 1 ton per acre annually. Hence, the majority of America's agricultural land was essentially unaffected by sheet and rill erosion. About 1.2 billion acres, 87 percent of the total, had average sheet and rill erosion rates below 5 tons per year. Yet, this vast portion of the country's agricultural land accounted for less than one third of the total estimated tonnage of sheet and rill erosion in 1977.

Looking at the botton of Table 6, an equally compelling observation can be made. Nearly 20 percent of the total sheet and rill erosion in 1977

Table 7.
Distribution of Cropland Acreage and Sheet and Rill Erosion, By Erosion Rate, 1977.

Erosion interval	*Total acres*	*Cumulative percentage of acreage*	*Total sheet and rill erosion*	*Cumulative percentage of erosion*	*Total erosion in excess of 5 tons per acre*	*Cumulative percentage of erosion in excess of 5 tons per acre*
(tons per acre)	*(millions)*		*(millions of tons)*		*(millions of tons)*	
0-1	131.6	31.8	49.2	2.6	0.0	0.0
1-2	74.6	49.8	110.6	8.3	0.0	0.0
2-3	51.5	62.3	127.5	14.9	0.0	0.0
3-4	35.9	71.0	125.0	21.4	0.0	0.0
4-5	26.0	77.3	116.3	27.4	0.0	0.0
5-6	17.6	81.6	96.2	32.4	8.2	0.9
6-7	12.6	84.6	81.8	36.6	18.6	2.9
7-8	9.3	86.9	69.4	40.2	23.0	5.4
8-9	7.3	88.7	62.0	43.4	25.4	8.1
9-10	5.8	90.1	54.6	46.2	25.8	10.9
10-11	4.8	91.3	50.2	48.8	26.3	13.7
11-12	3.7	92.2	43.1	51.0	24.4	16.3
12-13	3.0	92.9	36.9	52.9	22.1	18.7
13-14	2.8	93.6	37.1	54.8	23.3	21.2
14-15	2.4	94.2	34.6	56.6	22.7	23.6
15-20	7.8	96.1	134.8	63.6	95.8	33.9
20-25	4.4	97.1	98.0	68.7	76.0	42.1
25-30	2.9	97.8	80.6	72.9	65.8	49.2
30-50	5.5	99.1	209.0	83.8	182.4	68.8
50-75	2.3	99.6	133.8	90.7	122.5	82.0
75-100	0.8	99.8	64.4	94.0	60.6	88.5
100 +	0.7	100.0	109.8	100.0	106.3	100.0
Total	413.3		1,925.8		929.2	

— roughly 756 million tons of soil — occurred on a mere six tenths of one percent of the acreage (19.1 million acres, an area the size of Maine, out of 1.3 billion acres). If we move upward in the table and consider the most erodible 5 percent of the land base — that is, all land eroding in excess of 11 tons per acre annually — we find it accounts for 52 percent of the total sheet and rill erosion estimated by SCS in 1977.

The degree of concentration of erosion reported in 1977 has profound implications for soil conservation policy. In AFT's view, the erosion problem in the U.S. is much more manageable than it has commonly been portrayed to be. If government policies and programs could successfully promote conservation treatments on this 5 percent of the land base and bring the erosion rates on these lands to an annual average of 5 tons per acre, the volume of sheet and rill erosion in the U.S. would be reduced by 43 percent.

Comparable information for cropland is presented in Table 7, and for pastureland, forest land and rangeland in Tables A-1 through A-3 (Appendix). The incidence of erosion on cropland is of particular importance because cropland is the most productive class of land, and the most difficult class to protect from all forms of erosion. Sheet and rill erosion on cropland comprised 30 percent of all types of erosion on all land uses as reported in 1977. Cropland also accounted for about one-half of all sheet and rill erosion in 1977. Half of the cropland inventoried had sheet and rill erosion rates of less than 2 tons per year in 1977. Except in rare cases where the soil is very shallow (with bedrock or an unfavorable subsoil near the surface), cropland eroding at less than 2 tons per acre annually can be viewed as essentially unthreatened by sheet and rill erosion. Furthermore, this relatively non-erosive cropland is responsive to widely used, simple conservation tillage practices. On such land these practices virtually eliminate erosion and boost farm profits at the same time.

Looking at the most erodible cropland, it is evident that the 25 million acres (6 percent of the cropland) eroding in excess of 15 tons per acre in 1977 accounted for 43 percent of the total tonnage of cropland sheet and rill erosion (about 828 million tons). This 828 million tons amounted to 13 percent of the total soil loss from all categories of land in 1977. And note that these 25 million acres constitute less than 2 percent of all inventoried land.

These data may be simplistically used to suggest the benefits that could be realized by strategic refinements in government programs. As a rule of thumb, even highly erodible land, seeded to permanent pasture or hay, or planted in trees, will erode at less than 2 tons per acre yearly. If we could find a way to encourage farmers to convert this most erosive 25 million acres of cropland to these nonerosive uses, we would reduce cropland sheet and rill erosion from 1.9 billion tons to 1.1 billion tons.

The concentration of erosion is also observed for land used to grow specific crops in 1977. (Tables A-4 through A-6, Appendix.) Land reported by SCS as planted to a specific crop may not be planted to that crop continuously. Erosion rates on land planted to individual crops reflect actual crop rotations for that land, as noted by SCS technicians. (If they were unfamiliar with the cropping history of the land in question, they obtained the information from the operator or his neighbors, or from records in the local SCS office.) As might be expected, the degree of concentration varies among crops. For example, about 46 percent of the sheet and rill erosion on land used to grow corn in 1977 occurred on 10 percent of the corn land. For soybeans, just 7.6 percent of the acreage accounted for 40 percent of the sheet and rill erosion. Since wheat is grown in areas where both wind and water erosion problems may occur, it is appropriate to combine these forms of erosion. Taken thus, 5.7 percent of the land planted to wheat accounted for 31 percent of the erosion on wheat land in 1977.

The concentration phenomenon is at work in every state — for that matter, in every county, on most farms, and in most fields. State level data demonstrating the phenomenon are presented in Table 8. The table shows the ten states with the dubious distinction of having the greatest total sheet and rill erosion on their cropland in 1977. It shows that in Iowa, the "leading" state for sheet and rill erosion losses, about 47 percent of that erosion occurred on less than 10 percent of the cropland. In Illinois, 4 percent of the acreage contributed over 30 percent of the cropland sheet and rill erosion; and in Missouri, over half the cropland sheet and rill tonnage issued from 12.3 percent of the cropland. The ten states listed in Table 8 accounted for 61 percent of the total sheet and rill erosion on U.S. cropland in 1977. Note the extremely high average erosion rates on the most erodible acres in these states (last column). For example, in Tennessee, the most erodible 15.3 percent of the cropland acounted for 63 percent of the erosion, and eroded at an average rate of 58 tons per acre annually — twelve times greater than the national average in 1977.

Why Erosion is Concentrated

Soil conservationists have always recognized that erosion problems vary greatly from location to location, but why is so much of the sheet, rill and wind erosion concentrated on such a small portion of the land base? The amount and intensity of precipitation is of course a primary influence. Particularly in the western United States, the erosive forces of water created by melting snow or application of irrigation water are even more significant. (As we noted earlier, these influences are largely unaccounted for in the 1977 NRI.) Lack of precipitation, leading to chronically dry soil conditions, is the critical factor where wind erosion is the main hazard. Land use obviously is another important determinant of erosion rates. Any agricultural activity which diminishes vegetative cover makes land more susceptible to erosion. The relationship between vegetative cover and erosion potential explains why so much of all forms of erosion occurs on cropland and rangeland. (Pastureland is responsive to more intensive management to increase forage production than is rangeland, and therefore is less vulnerable to overgrazing and to erosion.)

Another important determinant of erosion is the topography of the land at a given location. Both the steepness and length of a field's slope are important. Table 9 clearly shows that steeper land generally was in pasture, range and forest uses in 1977. This is fortunate, since these land uses are generally associated with an amount of vegetative cover sufficient to protect the soil surface from the erosive force of rainfall and run-off.

Figure 6 illustrates the relationship between slope steepness and length, and sheet and rill erosion, for unterraced cropland in 1977. The NRI found a total of 379 million acres of cropland unterraced, and 27 million terraced. (An additional 6 million acres of unterraced mountain meadows and wild hay land were included in the "cropland" category by SCS, but are not reflected in Figure 6.) In general, average length of slopes tend to decline as the steepness of cropland increases. Sheet and rill erosion rates increase with slope steepness; the rates increase sharply on slopes greater than 5 percent.

Figure 7 provides valuable insight into the sheet and rill erosion control problem in the United States (data used to construct the figure appear in Table A-7, Appendix). It depicts the distribution of the unterraced cropland acreage according to steepness of slope — a kind of cross-sectional view of over 90 percent of the 1977 cropland base. About one fourth of the unterraced cropland had slopes of less than 1 per-

Table 8.
Concentration of Sheet and Rill Erosion on Cropland, Top Ten States, 1977.

	Total Cropland Erosion			*Cropland Eroding Above 25 Tons**				
State	*Acres (1,000)*	*Tons (1,000)*	*Average Tons/Acre*	*Acres 1,000*	*Acres %*	*Tons 1,000*	*Tons %*	*Average Tons/Acre*
Iowa	26,431	261,253	9.88	2,552	9.7	123,251	47.2	48.3
Illinois	23,836	159,479	6.69	938	3.9	48,989	30.7	52.2
Missouri	14,573	158,770	10.89	1,806	12.3	87,324	55.0	48.4
Nebraska	20,699	117,792	5.69	1,097	5.3	48,558	41.2	44.3
Kansas*	28,806	106,160	3.69	5,191	18.0	59,062	55.6	11.3
Texas*	30,439	99,546	3.27	5,548	18.2	46,881	47.1	8.5
Mississippi	7,302	77,150	10.57	667	9.1	36,144	46.9	54.2
Tennessee	4,928	69,542	14.11	756	15.3	43,736	62.9	57.9
Indiana	13,320	67,176	5.04	420	3.2	17,811	26.5	42.4
North Dakota*	26,913	53,962	2.01	2,095	7.7	17,897	33.2	8.5
10 State Total	151,217	1,170,830	7.74	21,070	13.9	529,653	45.2	25.1
U.S. Total*	413,277	1,925,849	4.66	22,327	5.4	704,161	36.6	31.5

*For Kansas, Texas and North Dakota, figures in the last five columns pertains to land eroding above five tons.
U.S. totals are adjusted for acres and tons above five tons in these states.

cent; and over 60 percent had slopes of less than 3 percent. The average slope for an acre of cropland was 3 percent in the 1977 NRI. Simply put, one of the major reasons for the high concentration of sheet and rill erosion on a small proportion of the Nation's cropland is that most cropland in America is relatively flat, and most of it has slopes of moderate length. This natural blessing has much to do with AFT's conviction that conservation efforts can eliminate much of the excessive sheet and rill erosion on U.S. cropland, if only these efforts can be concentrated where the need is greatest.

Improved Analysis Possible with the 1977 NRI

Data collected in the 1977 NRI can be used in another, more sophisticated, way to characterize the potential for sheet and rill erosion on U.S. cropland. We can combine four of the factors in the Universal Soil Loss Equation: the rainfall (R) and erodibility (K) factors, and the slope steepness (S) and length (L). We will refer to this product, RKLS, as a soil's inherent potential to erode.(15,16) Essentially, the RKLS product represents the sheet and rill erosion rate that would

Figure 6
Relation Between Slope Length And Steepness And Sheet And Rill Erosion Rate, Nonterraced Cropland, 1977.

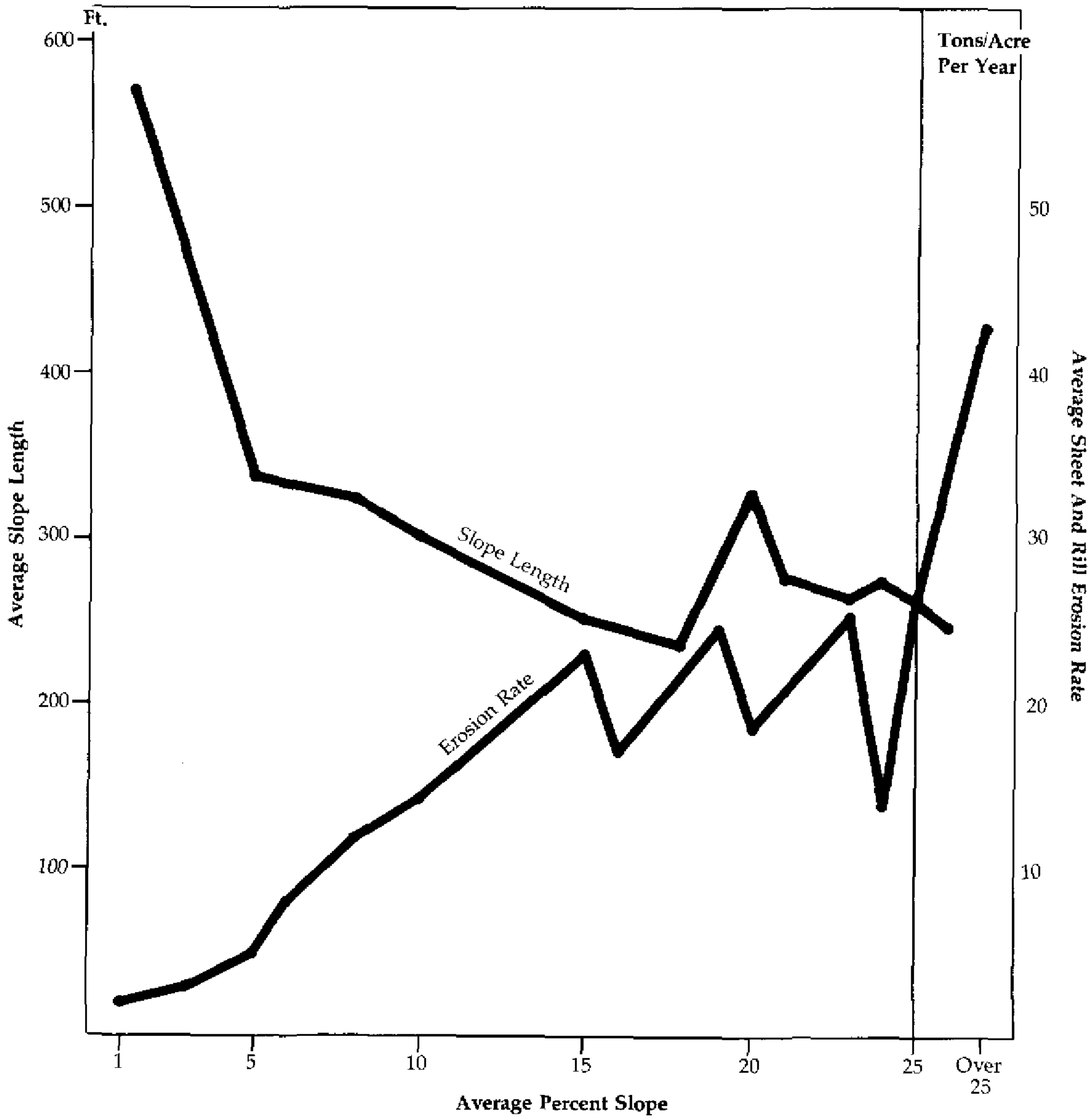


Table 9.
Slope of Agricultural Land, by Land Use, 1977.

Slope	*Cropland*	*Pastureland*	*Rangeland*	*Forest Land*	*Total Agricultural Land*
			(Percent)		
Level and nearly level (0 to 2 percent slopes)	45	28	11	27	28
Gently sloping (2 to 6 percent)	25	18	4	10	14
Sloping (6 to 12 percent slopes)	20	22	14	13	16
Moderately steep (12 to 20 percent slopes)	7	14	14	11	11
Steep (20 to 45 percent slopes)	2	10	26	12	13
Very steep (45 percent slopes)	1	8	31	27	18

eventuate from the worst possible "farming" conditions: the land would be throughly plowed every year straight up and down the prevailing slopes, and would be kept barren of any vegetation or vegetative residue. In the USLE, this condition is represented when the C and P factor values are equal to 1. Of course, these circumstances are never encountered on actual farms. But it is useful for characterizing the land's full potential to erode. The effect of conservation and other management practices on erosion is captured primarily through reductions in the value of the C and P factors, and hence a reduction in the rate of erosion estimated by the USLE.

The RKLS product is very useful for analyzing the effects of conservation practices. It allows comparison of potential sheet and rill erosion rates with the erosion rates estimated for alternative farming conditions actually observed. The difference between those rates reflects the effects of farming and conservation practices. Prior to the 1977 NRI, SCS made extensive use of this technique to determine the number and types of conservation practices necessary to achieve a desired level of erosion protection on individual farm fields. In the 1977 NRI, SCS recorded all the USLE factors, including up to three conservation practices, for nearly all of the 200,000 sample points. Because the NRI data were collected and copied onto computer tapes, a wide range of analyses can be conducted on erosion conditions and farming and conservation practices. These analyses can be performed at the state and national levels. When the much more detailed 1982 NRI becomes available, comparable analyses can be done at the multi-county level. With additional refinements in the natural resource database, county level analysis would be possible.

Estimating the overall effect of farming and conservation practices on national sheet and rill erosion levels is a good example of the new analysis made possible by the 1977 NRI. SCS inventoried 337 million acres of land planted to row crops and small grains (the crops included corn, sorgum, soybeans, cotton, peanuts, tobacco, sugar beets, potatoes, other vegetables, and all other row crops, plus wheat, oats, rice barley, flax, other close grown crops, and land in summer fallow). On the average, had this land been plowed up and down the prevailing slopes and kept barren of vegetation, the erosion rate would have equalled 21 tons per acre annually (that is, the RKLS product equalled 21 tons per acre annually). This rate is about four times greater than the 5.4 ton erosion rate actually reported by SCS in 1977. The difference is largely explained by the erosion reducing effects of the vegetative cover and management practices of the farmer, both of which are represented by the C factor in the USLE. The average C factor value reported by SCS for this land in 1977 was 0.30. Hence, the effect of the cover and management practices was to reduce actual erosion to 30 percent of potential erosion, or down to about 6.3 tons per acre per year.

The effect of traditional conservation practices like contour farming and stripcropping is captured in the P factor in the USLE. The average P factor value reported for this land in 1977 was 0.95, meaning the effect of conservation supporting practices was to reduce erosion to 95 percent of the rate that would have resulted from the cover and management practices alone. Average erosion would thus be estimated as: 6.3 tons x 0.95 = 6.0 tons (a reduction of 0.3 tons). An additional reduction of 0.6 tons was achieved through the effects of the conservation supporting practices on reducing the length of slope. This brings our final erosion rate down to the 5.4 tons per acre reported by SCS.

Like so much else about soil erosion conditions, the extent and effectiveness of conservation practices used around the nation and in individual states was not known with any precision until 1977. What is striking about the example just presented is the trivial overall contribution to sheet and rill erosion reduction made by traditional conservation measures compared to the cover and management practices.

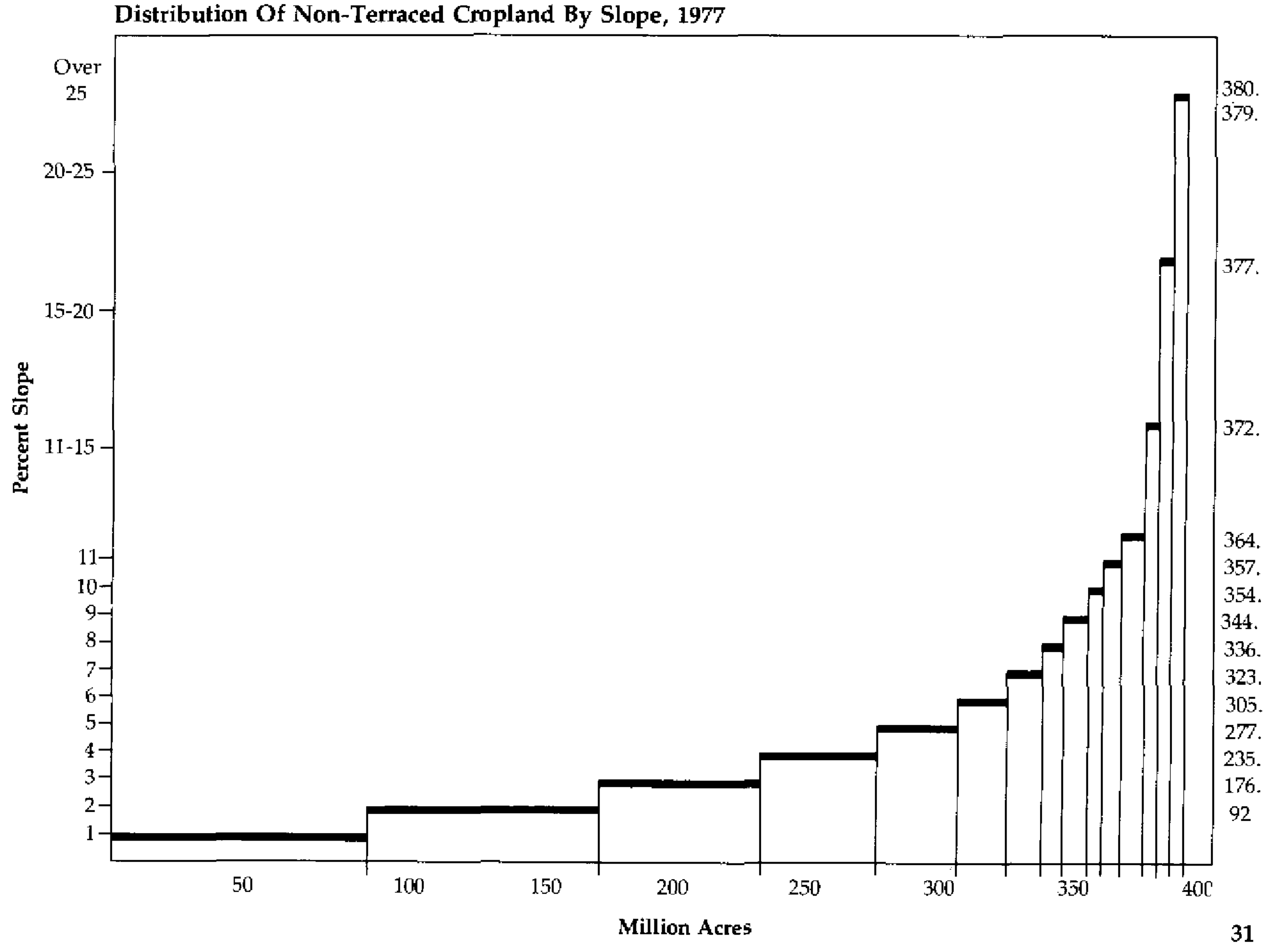
Table 10.
Supporting Practice Conditions
Land Used for Row Crops and Small Grains in 1977.

*Index of Supporting Practice Conditions (P Factor Values)**	*Acres in Millions*	*Percent of Total Acres*
0-0.099	0.2	0.1
0.100-0.199	—	—
0.200-0.299	1.3	0.4
0.300-0.399	1.3	0.4
0.400-0.499	—	—
0.500-0.599	20.6	6.1
0.600-0.699	12.3	3.6
0.700-0.799	0.3	0.1
0.800-0.899	1.4	0.4
0.900-1.000	300.1	88.9
Total	337.5	100.0

Source: Miller, 1981. Computed from National Resource Inventory data.

*Ratio of soil loss with supporting practices in place to the corresponding soil loss when tillage operations are performed directly up-and-down slopes. This is the percent of the inherent erosion potential less the impact of cover and management conditions (product of R,K,L,S, and C) that is realized after the impact of supporting practices is taken into account.

Figure 7
Distribution Of Non-Terraced Cropland By Slope, 1977



AFT FARMER SURVEY EXPLAINING FARMERS' SOIL CONSERVATION EFFORTS

What factors shape farm operators' decisions on whether to use conservation practices and how extensively to apply them? If government soil conservation agencies understand those factors, their programming to encourage conservation should be more successful. To contribute to such understanding, AFT's survey of farmers in six different-state sites gathered information both on farmers' conservation effort in 1982 — how many practices they used and the number of acres served by each practice — and on 16 factors believed capable of shaping these efforts. The factors fell into three groups: one dealing with the nature of the farmer's operation (such as size in acres and in gross sales); a second relating to his personal background (such as age and education). The third concerned his contacts with government soil conservaton agencies.

To identify which of the 16 factors appeared to influence farmers' 1982 conservation efforts, we used the analytical technique called multiple regression. This tool has the capacity to determine how much an individual factor (let us say, gross farm sales) contributes to explaining variation in what we are trying to understand (conservation effort), other likely explanatory factors being held constant. In other words, multiple regression can remove the distorting effects of rival causes.

Among the findings of this analysis, the following relationships were statistically significant: other things being equal, the larger the operation in gross farm sales, the more separate conservation practices the farmer used (in five of the six study areas) and the higher the ratio of total acres served by practices to all the acres the farmer perceived to be erosion-prone, the higher his acres-served ration (in four sites) and the more practices he applied (in three). The percent of land in row crops was a predictor of the acres-served ratio in four study areas, that is, the higher the share of row crops, the more acres served relative to total land farmed.

We found a negative association between farmer's age and conservation effort. The older the farmer, the lower his acres-served ratio (in two survey sites), and the fewer separate practices he used (in three sites).

To what use could government conservaton agencies put such findings? They indicate both targets of opportunity (relatively large farm operations, row-crop farmers, younger farmers) and client groups towards which programming efforts may have to be particularly intensive and/or innovative (farmers of smaller operations, older farmers). Also, if the agencies can help farmers who underestimate erosion hazards on their land to see the situation more accurately, their conservation effort may increase.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites,* American Farmland Trust, forthcoming.

In the next section we will explore the reasons for this relationship between traditional and C factor practices, and the significance of both types of practices in terms of sheet and rill erosion reduction on cropland. At this point we would note, however, that cover and management practices are rarely adopted by farmers expressly *for the purpose of conservation.* Soil conserving practices like conservation tillage and crop residue management are integral parts of farming activities. When they are chosen by farmers, it is primarily because they make farming operations easier and more profitable.

Conservation Practices Reported in 1977

There is a rather simple explanation for the limited influence of traditional conservation practices on soil erosion at the national level: these practices are absent from most of the nation's cropland.

This conclusion is clearly suggested by Table 10. It shows the conservation supporting practice (P factor) values in the USLE reported by SCS for the 337 million acres used for row crops and small grains in 1977. The most salient observation from the table is that 89 percent of this land had a very high value for the P factor. Supporting practices like contour farming and stripcropping were simply not observed by SCS on the vast majority of this cropland. The 0.95 average P factor value for land in row crops and small grains signifies that erosion rates were on average 95 percent of what they would have been with no P factor practices.(17) The incidence of relatively lower P factor values — in the range of 0.5 to 0.7 — represents the presence of supporting practices such as stripcropping and contouring. While these practices achieve much greater reductions in erosion, they were used on only 10 percent of the land in row crops and small grains in 1977.(18)

Looking at the incidence of specific practices, SCS reported only 9.8 million acres of cropland — less than 3 percent of the total — as having contour farming as the single conservation practice in 1977. An additional 5.5 million acres (1.3 percent) had both contour farming and crop residue use; about 769 thousand acres had contour farming combined with minimum tillage; and 1.8 million acres combined contour farming with both minimum tillage and crop residue use. About 3.1 million acres — less than one percent of the cropland — were treated with contour stripcropping, alone or in combination with other practices.

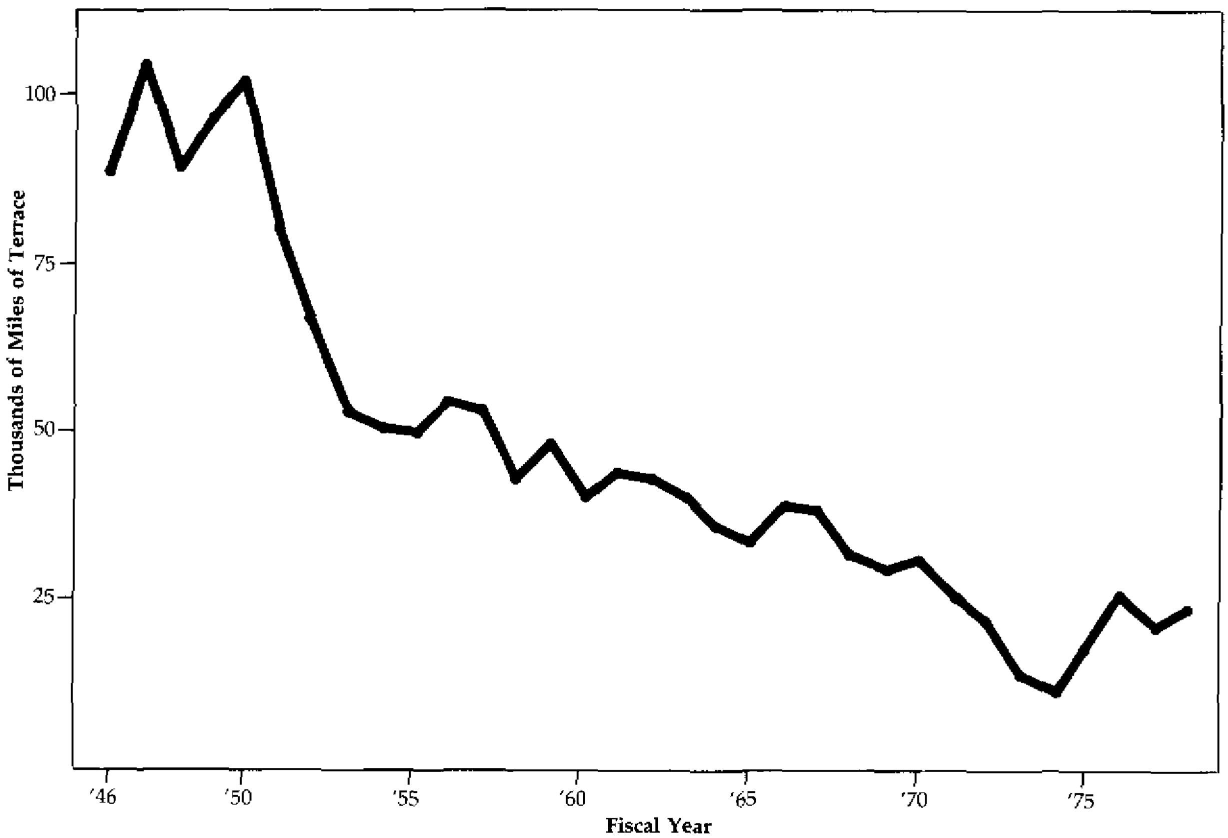
Similarly, a surprisingly small amount of cropland was protected by terraces in 1977. The total terraced area was 27.5 million acres, about 8 percent of the acreage devoted to row crops and small grains. This finding is disturbing to some conservation experts because the design, layout and financing of terrace systems have been among the most heavily promoted conservation services offered by USDA during the last four decades. Figure 8 indicates that with minor fluctuations, the amount of terraces constructed with SCS technical assistance dropped sharply and steadily between 1946 and 1978. (Note that Figure 8 depicts linear miles of terraces installed,

Table 10
Supporting Practice Conditions
Land Used for Row Crops and Small Grains in 1977

*Index of Supporting Practice Conditions (P Factor Values)**	*Acres in Millions*	*Percent of Total Acres*
0-0.099	0.2	0.1
0.100-0.199	-	-
0.200-0.299	1.3	0.4
0.300-0.399	1.3	0.4
0.400-0.499	-	-
0.500-0.599	20.6	6.1
0.600-0.699	12.3	3.6
0.700-0.799	0.3	0.1
0.800-0.899	1.4	0.4
0.900-1.000	300.1	88.9
Total	337.5	100.0

Source: Miller, 1981. Computed from National Resource Inventory data.
* Ratio of soil loss with supporting practices in place to the corresponding soil loss when tillage operations are performed directly up-and-down-slopes. This is the percent of the inherent erosion potential less the impact of cover and management conditions (product of R, K, L, S, and C) that is realized after the impact of supporting practices is taken into account.

Figure 8
Terraces Installed With SCS Assistance, 1946-1978.



not the acreage protected by the terraces.) Unfortunately, collection of data of this type for all conservation practices was discontinued by SCS in 1978. Efforts are now underway to provide information of superior quality on conservation practice and program effectiveness.

At the risk of dwelling on the obvious, most of the erosion reduction in the United States is achieved as a result of the cropping patterns and tillage methods chosen by farmers. Since their establishment, USDA conservation programs have promoted "conservation cropping systems" with mixed success. It is difficult to determine the degree to which these programs have influenced cropping patterns and rotations. In the 1977 NRI, SCS recorded the sequence or rotation of crops that had been grown in recent years as well as the crops and conservation practices in place that year at each sample point. This information, together with the tillage and other conservation practices observed, enabled SCS field technicians to determine C factor values for the USLE for each location.

Table 11 summarizes the cover and management factors recorded for the 337 million acres of land in row crops or small grains. As was the case with the conservation practice (P) factors, the lower the value for C, the greater the erosion control afforded. The table may be interpreted to show that in about 46 percent of this cropland, cover and management conditions acted to reduce potential sheet and rill erosion by at least 70 percent (that is, the C factor values were 0.299 or lower). On 92 percent of the land, the C factor was less than 0.50, meaning the cover and management conditions served to eliminate half or more of the potential erosion.

Some crops leave land more susceptible to erosion than others, as is plainly evident in Table 11. Close-grown crops such as wheat provide considerable protection from sheet and rill erosion. Sod forming crops such as improved hayland virtually eliminate sheet and rill erosion, except on the most erodible land. For example, land with an inherent potential to erode at a rate of 100 tons per acre annually would erode at only 3 tons per acre if managed for high-volume hay production. (In this case the RKLS of 100, multiplied by a C factor of 0.03, equals an erosion rate of 3 tons.) Small grain crops, such as wheat, also provide substantial protection against erosion, since they are drilled in closely spaced rows or are broadcast like grass seed. The second column in Table 11 indicates that, on average, sheet and rill erosion was reduced to 23 percent of its potential level where wheat was planted in 1977. Row crops such as corn, soybeans, sorghum and cotton, tended to have progressively less effect on erosion reduction, according to SCS observations.

The effects of crop type and cropping sequence on erosion are complex. The potential erosion reduction afforded by crops increases with the amount of vegetative material (crop residue) the crops produce. This is because more crop residue is available to protect the soil surface if the farmer chooses to leave it there after harvest. Erosion control is also superior with crops that grow

Table 11.
Average C Factor Values for Selected Crops and Farming Practices, 1977.

	— National Average C Factor Value —			
	All land in crop	*Crop residue use*	*Minimum tillage*	*No crop residue use or minimum tillage*
Corn	0.30	0.28	0.24	0.32
Sorghum	0.35	0.35	0.33	0.36
Soybeans	0.34	0.32	0.32	0.35
Cotton	0.47	0.42	0.28	0.52
Wheat	0.23	0.22	0.22	0.24
All row crops and small grains	0.30	0.28	0.25	0.32

Source: Miller, 1981. Computed from National Resources Inventories, USDA-SCS, 1978.

rapidly, forming a protective canopy of vegetation to absorb the erosive energy of rainfall. "The overall erosion reducing effectiveness of a crop depends largely on how much of the erosive rain occurs during those periods when the crop and management provide the least protection." (19)

Table 11 also illustrates the effects of crop residue and tillage practices on C factor values, and hence on actual sheet and rill erosion rates. For example, land that was planted to corn in 1977 and which also evidenced crop residue use had a *slightly lower (improved) C factor value* (average 0.28) than the "average" corn land; the average value was lowered further on land where minimum tillage practices were observed. Many tillage practices are included under the minimum tillage category. The values in Table 11 represent averages reported in the 1977 NRI. No till corn, for example, generally has a C factor value approaching that of moderately well managed pasture — about 0.15 or less.

The two most widely used conservation practices reported by SCS in 1977 were crop residue use and minimum tillage. Crop residue use is defined as "using plant residues to protect cultivated fields during critical erosion periods." SCS specifications for this practice call for residues in amounts that will reduce erosion. Minimum tillage means "limiting the number of cultural operations to those that are properly timed and essential to produce a crop and prevent soil damage."(20) Again, this definition includes a very broad array of tillage implements and practices. Some minimum tillage practices leave the soil surface entirely intact, while others invert nearly all of the surface soil. As a practical matter, it is impossible to tell from field observation if a farmer has used these practices because of their conservation benefits or for some other reason. Experts generally believe that the principal motivation for use of minimum tillage is to reduce fuel costs and labor time associated with planting: Soil conservation is a secondary and highly fortunate side effect. (12, 22, 23)

Crop residue use was the most extensively employed cropland conservation measure observed by SCS in 1977. About 118 million acres of cropland — 35 percent of the land in row crops and small grains — was treated with this practice alone. On another 5.5 million acres it was combined with contour farming; on 822 thousand acres it was combined with contour strip cropping; and on 2.3 million acres it was used in conjunction with terraces.

Minimum tillage was observed as the sole practice on 9.2 million acres of cropland in 1977. It was used in conjunction with the following practices on a sizeable acreage: contour farming, 769 thousand acres; crop residue use and contour farming, 1.8 million acres; crop residue use, 26.7 million acres. The combination of minimum tillage and crop residue use is of especial interest because it approximates the characteristics of conservation tillage, which is defined by SCS to mean "a form of noninversion tillage that retains *protective amounts of residue mulch on the surface* through the year. These include no-tillage, strip tillage, stubble mulching, and other types of noninversion tillage." (24)

Effects of Practices on Erosion Reduction

The influence of conservation practices on erosion depends on two things: the type of practice, and the erosion rate before the practice is adopted. The 1977 NRI provides a wealth of new information on both, allowing analysts to study the effects of practices that were used in 1977, or that could be used to reduce sheet and rill erosion in different regions and soil types. Even more detailed information will be provided by the 1982 NRI. Though a limited information of this sort is available for other types of erosion, what is available is useful for policy purposes.

The National Program for Soil and Water Conservation announced in December of 1982 (hereafter the National Conservation Program, or NCP) calls for an increased emphasis on conservation tillage systems throughout USDA's conservation effort, from research to technical and financial assistance. Agriculture Secretary John Block and top conservation officals in USDA have stressed the importance of conservation tillage in protecting soil resources in the most cost-effective manner. One prominent conservation leader has publically charged that "the reason Secretary Block is putting so much stress on it [conservation tillage] is that it doesn't cost the federal government anything." (25) But most conservation experts agree that conservation tillage is indeed a key to reducing erosion on America's cropland. (26) In light of these optimistic assessments, it is appropriate to begin our consideration of conservation practice effectiveness with a review of the reduction of sheet and rill erosion achieved by conservation tillage practices as reported in the 1977 NRI.

Conservation tillage combines crop residue use and minimum tillage. When individually

AFT FARMER SURVEY EXTENT OF CONSERVATION PRACTICES

How much effort do farmers devote to soil conservation? Excepting the Colorado survey site, the farmers AFT interviewed had a repertoire of three to four practices on an average. (The Colorado sample's mean was just under three). On the average, each acre in the survey areas was treated with one and a half practices.

By far the highest ranking practice, in terms of the numbers of farmers using it, was grassed waterways. Over ninety percent of the farmers used it in the Iowa and Wisconsin sites. It ranked first also in the Illinois and Missouri survey areas. It is important to note that grassed waterways in themselves do not protect large portions of a given field from erosion. They are designed to work in combination with other conservation practices, such as terraces, contour farming and diversions, which channel water into grassed waterways. The waterways conduct this concentrated flow of water off the field with minimal damage to the soil. Grassed waterways are planted in portions of sloping fields where water concentrates naturally, and where gullies are most likely to form. This practice was used on 19 to 33 percent ot the total acres given conservation treatment in five of the survey areas. The Colorado farmers did not report using this practice.

Terraces were used by many farmers, but only at the Tennessee site did they account for an appreciable percentage of the total acres treated with conservation measures (25 percent.)

Curiously, while farmers in the survey areas used some form of tillage practice to control erosion, only in the Iowa area do we find as much as 40 percent of the farmed land affected by some form of reduced tillage. And in the Tennessee study site, more land is served by terraces than by reduced tillage practices, despite the probably large cost advantage conservation tillage must have in that area. The relatively large number of farmers using tillage practices on a small amount of their land suggests a period of experimentation rather than widespread adoption of these practices.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites,* American Farmland Trust, forthcoming.

applied, these practices often constitute conservation tillage systems of limited effectiveness. Table 12 provides average erosion values and acreage for cropland treated with three important conservation practices in 1977. The table arrays the acreage and erosion rates by ranges of RKLS — the inherent potential for sheet and rill erosion.

Looking at crop residue use, the practice most commonly applied to cropland in 1977, we note that 18.5 percent of the acreage treated had an inherent erosion potential of less than 3 tons per acre per year; one third of the acreage had a potential of less than 5 tons; and 60 percent would have eroded at less than 10 tons per acre had it been tilled continuously and kept fallow. Sheet and rill erosion rates on this land would have been less than five tons per acre, even if the land had been planted to the most erosion-prone crop (for example, cotton, with an average C factor value of 0.45). This implies that the practice was not essential for *sheet and rill* erosion control on 60 percent or more of the land treated with it in 1977.

Table 12 also indicates that the actual rate of sheet and rill erosion was only one quarter of the potential rate on land treated with crop residue use (i.e., the average C factor value was 0.24). Estimated sheet and rill erosion did not exceed 3 tons per acre annually on 60 percent of the land treated with crop residue use; it did not exceed 5 tons on 82 percent of the land treated with that practice. The proportion of crop residue-treated acreage drops rather steadily as the potential sheet and rill erosion rate increases. Almost identical patterns are observed for minimum tillage and for the combination of the two practices — our proxy for conservation tillage. Indeed, it would appear the two practices used together were little better than residue use alone.

Why was conservation tillage more likely to be found on land with modest sheet and rill erosion problems in 1977? Two explanations may be offered. First, some other form of erosion may be the principal problem for which the conservation tillage is being used. Obviously, conservation tillage methods used for wind erosion control are not reflected in this analysis. Unfortunately, we do not have the data with which to characterize the equivalent of "inherent erosion potential" for wind erosion.

But we were able to perform a similar analysis of minimum tillage practices for selected states where sheet and rill were the major erosion problems. We found a pattern similar to the national one described above.

A second explanation was offered in a recent report by the U.S. Office of Technology Assess-

Table 12.
Cropland Acres Treated With Crop Residue, Minimum Tillage or Both in Combination: Acres, Average Sheet and Rill Erosion Rate, By Potential Erosion Rate (RKLS), 1977.

Potential Erosion	*Crop Residue Alone*			*Minimum Tillage Alone*			*Minimum Tillage and Crop Residue*		
(RKLS) Tons/Acre	*Acres (1,000)*	*%*	*Avg. USLE Rate Tons/Acre*	*Acres (1,000)*	*%*	*Av. USLE Rate Tons/Acre*	*Acres (1,000)*	*%*	*Avg. USLE Rate Tons/Acre*
0-0.9	6,146	5.2	0.09	820	8.9	0.07	2,237	8.4	0.06
1-1.9	7,090	6.0	0.37	342	3.7	0.23	976	3.7	0.37
2-2.9	8,546	7.3	0.66	275	3.0	0.61	1,386	5.2	0.63
3-3.9	8,898	7.6	0.92	629	6.8	0.73	1,572	5.9	0.81
4-4.9	8,211	7.0	1.26	651	7.0	1.21	2,173	8.1	1.23
5-5.9	8,038	6.8	1.54	598	6.5	1.66	2,123	7.9	1.42
6-6.9	7,043	6.0	1.74	612	6.7	1.66	1,770	6.6	1.65
7-7.9	5,647	4.8	2.14	364	3.9	2.06	1,319	4.9	1.85
8-8.9	5,701	4.8	2.49	672	7.3	2.34	1,384	5.2	2.11
9-9.9	5,316	4.5	2.75	320	3.5	2.60	945	3.5	2.42
10-10.9	4,736	4.0	3.08	319	3.4	2.58	1,138	4.3	2.73
11-11.9	4,847	4.1	3.39	250	2.7	3.30	650	3.6	2.88
12-12.9	3,717	3.1	3.62	193	2.1	2.99	849	3.2	3.19
13-13.9	3,381	2.9	3.60	135	1.5	3.28	621	2.3	3.31
14-14.9	2,939	2.5	4.02	251	2.7	3.60	493	1.8	3.71
15-15.9	2,083	1.8	4.31	121	1.3	3.92	485	1.8	4.10
16-16.9	2,110	1.8	4.36	164	1.8	3.67	319	1.1	3.18
17-17.9	1,975	1.7	4.69	113	1.2	4.30	323	1.2	4.68
18-18.9	1,516	1.3	5.23	114	1.2	4.29	408	1.5	4.30
19-19.9	1,522	1.3	5.45	116	1.3	4.86	320	1.2	4.49
20-24.9	4,619	3.9	6.39	437	4.8	5.54	1,113	4.2	5.25
25-29.9	2,888	2.5	7.30	315	3.4	7.25	772	2.9	6.48
30-34.9	1,953	1.7	9.34	193	2.1	8.31	505	1.9	7.14
35-39.9	1,489	1.3	11.01	188	2.0	7.39	292	1.1	9.19
40-44.9	1,053	—	13.21	86	1.0	9.27	265	1.0	9.44
45-49.9	906	—	12.25	171	1.9	11.19	213	—	8.62
50-74.9	2,123	1.8	15.68	274	3.0	16.74	682	2.6	12.99
75-99.9	1,244	1.0	20.24	185	2.0	17.63	379	1.4	16.64
100-149.9	1,131	—	32.36	133	1.4	26.33	393	1.5	25.62
150-199.9	476	—	39.49	58	—	26.61	145	—	26.28
Over 200	427	—	74.24	93	1.0	27.84	108	—	44.27
Total (Avg.)	117,771		(3.91)	9,192		(4.22)	26,658		(3.54)
Average "C" Factor		0.24			0.25			0.24	

Source: USDA, SCS, National Resources Inventory, 1977.

Minimum Tillage in the Corn Belt in 1977

Table 13 gives a breakdown of the cropland in the Corn Belt states that was treated with minimum tillage according to the 1977 NRI. The data in this table represent the acreage for which SCS listed minimum tillage first among three possible conservation practices in order of importance. Note that 40.8 percent of the cropland treated with minimum tillage in the region had a potential for sheet and rill erosion of less than 10 tons per acre annually; 63 percent of the Corn Belt cropland so treated had a sheet and rill erosion potential of less than 20 tons per acre. On average, had this land been planted to corn (average Cfactor value of 0.30) it would have had sheet and rill erosion rates of less than 6 tons per acre without the use of minimum tillage — or any other conservation measure. We will note, in passing, that some of the land in this table is found in the lower RKLS categories by virtue of the effect of terraces on reducing slope length (and hence also reducing the RKLS product). But as we shall see, there are relatively few terraces in the humid states, and those which do exist tend to be in the higher RKLS ranges (greater than 40 tons per acre). We can be fairly confident, then, that most of the Corn Belt cropland treated with minimum tillage had a modest potential for sheet and rill erosion *before* the practice was adopted.

Table 13.
Minimum Tillage in Corn Belt States by Potential for Sheet and Rill Erosion, 1977.

State	*Minimum Tillage Acres (1,000)*	*Percentage of Minimum Tillage Acres By Potential Erosion Rate (tons per acre)* 0-9.9	10-19.9	20-29.9	30-39.0	40-59.9	60-99.9	100+
		(Percent)						
Iowa	2,504	36.4	24.2	11.5	3.7	8.8	8.5	6.8
Illinois	1,543	41.1	21.3	16.9	9.3	4.5	4.0	2.7
Indiana	748	63.1	18.4	5.6	1.9	5.2	2.2	3.5
Missouri	702	28.6	22.9	20.9	6.6	12.1	3.8	5.0
Ohio	572	53.5	19.0	8.9	4.0	3.1	7.3	4.0
Total	6,065	40.8	22.2	13.0	12.2	7.1	6.0	4.8

ment, which examined the same data: "It seems that much of the land in conservation tillage did not have severe erosion problems prior to the adoption of the technology; i.e., motives other than erosion control have influenced farmers to adopt conservation tillage."(27) In other words, many farmers with insignificant erosion problems reap important other benefits from conservation tillage, such as fuel and labor savings. As the popular saying has it, conservation tillage saves soil, oil and toil. But where erosion rates are low to begin with, there isn't much soil to be saved with conservation tillage. For this reason, reports predicting rapid increases in the application of conservation tillage technologies must be cautiously interpreted in terms of probable erosion reduction. Moreover, as we will discuss in Chapter 4, farmers who use conservation tillage equipment do not always manage their crop residue adequately. Unless educational, technical and financial assistance efforts are more carefully focused on land where erosion problems are significant, they will not reduce the discrepancy between actual erosion control benefits and the bullish claims of conservation tillage advocates.

There is every indication that the acreage treated with conservation tillage will continue to increase at the impressive rate of the past decade. However, these technologies generally have not been used on the most erodible land, and may not be for many years — if ever. Moreover, most of the land with extremely high erosion potential cannot be adequately protected even by the most effective conservation tillage techniques, unless they are used in combination with traditional conservation practices. Controlling erosion on these lands to within acceptable levels, while continuing to use them for row crop production, would require elaborate and carefully applied conservation systems. Farming such land without abusing it generally entails private or public costs far greater than the value of crop production, even when production over the lifetime of the conservation practices is compared to the cost of those practices.

Traditional Conservation Practices

What effect have terraces, contour farming, and stripcropping had on sheet and rill erosion in the U.S. and in the states with severe erosion problems?

In Tables 14 & 15 the acreage treated by these practices is presented. Use of the practices, either alone or in combinations as observed by SCS in 1977, are listed according to ranges of potential sheet and rill erosion rates (RKLS). (A practice or combination of practices observed on less than 1 million acres was excluded from the table.) According to Table 14, of the 9.8 million acres on which contour farming was the single observed supporting conservation practice, about one third were in the uppermost ranges of potential sheet and rill erosion (RKLS of 50 tons per acre or more). Eighteen percent of the land in contour farming had a potential erosion rate of less than 10 tons. When crop residue use was combined with contour farming — was was the case on 5.5 million acres in 1977 — a somewhat greater proportion of the acreage fell in the less erodible ranges: 21 percent of this land had an inherent erosion potential of less than 10 tons, while 23.2 percent fell in the ranges above 50 tons per acre. In the case of contour stripcropping, one quarter of the 2.1 million acres treated with the practice in 1977 had a potential to erode of less than 10

Table 14.
Distribution of Conservation Practices in 1977 by Potential Sheet and Rill Erosion Rate

Potential Erosion (RKLS) Tons/Acre	*Contour Farming (Alone)*			*Contour Plus Crop Residue*			*Contour Stripcropping*			*Contouring Farming, Crop Residue Use & Min. Till*			*All Cropland**		
	Acres		*Avg. USLE*	*Acres*		*Avg. USLE*	*Acres*		*Avg. USLE*	*Acres*		*Avg. USLE*	*Acres*		*Avg. USLE*
	(1,000)	*%*	*Ton/Ac*	*(1,000)*	*%*	*Ton/Ac*	*(1,000)*	*%*	*Ton/Ac*	*(1,000)*	*%*	*Ton/Ac*	*(1,000)*	*%*	*Ton/Ac*
0-0.9	87	—	0.14	17	—	0.00	44	2.0	0.19	0	—	0	23430	5.8	0
1-1.9	71	—	0.39	7	—	0.20	60	2.8	0.30	39	2.1	0.37	18970	4.7	0
2-2.9	122	1.2	0.58	45	—	0.62	47	2.2	0.30	11	—	0.41	20251	5.0	0
3-3.9	143	1.5	0.86	121	2.2	0.89	12	—	0.16	13	—	0.60	23788	5.9	0
4-4.9	151	1.5	1.12	259	4.7	0.93	87	4.1	1.00	98	5.3	0.64	22510	5.5	1
5-5.9	250	2.6	1.04	130	2.4	1.30	43	2.0	1.42	63	3.4	0.91	21930	5.4	1
6-6.9	197	2.0	1.20	87	1.6	1.42	86	4.0	0.82	92	5.0	1.49	21330	5.3	1
7-7.9	195	2.0	1.20	131	2.4	1.95	32	1.5	1.02	24	1.3	1.27	16612	4.1	2
8-8.9	222	2.2	1.37	149	2.7	1.43	49	2.2	1.56	66	3.6	1.46	17339	4.3	2
9-9.9	323	3.3	1.71	222	4.0	1.70	27	1.3	0.59	31	1.7	1.50	15400	3.8	2
10-10.9	187	1.9	2.00	142	2.6	2.22	28	1.3	0.25	26	1.4	1.29	14577	3.6	2
11-11.9	203	2.1	2.07	174	3.2	2.43	43	2.0	2.48	55	3.0	1.72	12707	3.1	3
12-12.9	193	2.0	2.12	136	2.5	2.65	19	—	0.26	78	4.2	2.18	11322	2.8	3
13-13.9	136	1.4	2.17	171	3.1	2.24	18	—	0.27	56	3.0	2.27	10603	2.6	3
14-14.9	244	2.5	2.81	145	2.6	3.36	22	1.0	1.31	52	2.8	1.91	9497	2.3	3
15-15.9	173	1.8	2.38	118	2.1	2.51	30	1.4	7.00	33	1.8	1.59	7165	1.8	3
16-16.9	154	1.6	2.62	126	2.3	3.35	12	—	0.53	32	1.7	2.11	7911	1.9	3
17-17.9	221	2.3	3.37	157	2.8	3.15	38	1.8	0.74	63	3.4	4.02	6099	1.5	4
18-18.9	128	1.3	2.59	98	1.8	2.94	0	—	0.00	58	3.2	3.47	5661	1.4	4
19-19.9	220	2.2	3.33	126	2.3	3.01	36	1.7	0.93	33	1.8	1.38	6530	1.6	4
20-24.9	681	7.0	3.53	419	7.6	4.07	109	5.1	1.47	141	7.7	3.64	20611	5.1	5
25-29.9	643	6.6	3.92	328	5.9	4.76	54	2.5	1.55	109	5.9	4.60	14748	3.6	6
30-34.9	509	5.2	5.10	241	4.3	5.58	83	3.9	2.96	61	3.3	3.95	10004	2.5	7
35-39.9	409	4.2	6.08	311	5.6	6.92	66	3.1	2.05	38	2.1	5.72	7920	1.9	8
40-44.9	312	3.1	6.80	163	3.0	7.69	44	2.1	2.23	12	—	5.77	6354	1.6	8
45-49.9	334	3.4	8.09	206	3.7	7.75	74	3.5	2.30	42	2.3	5.75	5677	1.4	9
50-74.9	1001	10.2	8.77	455	8.2	10.26	288	13.4	2.40	118	6.4	8.43	16424	4.0	11
75-99.9	674	6.9	12.80	226	4.0	11.27	218	10.2	2.83	130	7.1	16.24	10197	2.5	15
100-149.9	872	8.9	17.16	294	5.3	16.27	203	9.4	3.46	117	6.4	17.47	10507	2.6	19
150-199.9	296	3.0	19.53	137	2.5	32.51	96	4.4	5.59	68	3.7	24.01	4660	1.1	20
Over 200	439	4.5	41.16	176	3.2	52.08	163	7.6	11.18	82	4.5	35.99	5545	1.4	42
Total	7,787		4.89	5,517		7.36	2,137		2.84	1,841		7.13	406,279		4
Average "C"		0.27			0.30			0.15			0.23			0.25	
Average "P"		0.61			0.61			0.49			0.69			0.95	

*Excludes wild hayland and mountain pasture.

Table 15.
Top Ten States for Terraced Cropland, 1977.[1]

	Terraced (1,000 acres)	*Percent of Cropland*	*State Percent By Range of RKLS*			
			0-10	*10-20*	*20-30*	*40+*
Kansas	5,611	19.5	40.4	38.6	11.5	1.0
Texas	3,681	12.1	46.5	32.4	16.2	4.9
Oklahoma	2,329	20.2	10.7	34.7	26.7	28.2
Nebraska	1,728	8.3	29.1	14.0	10.0	46.9
Missouri	995	6.8	1.0	10.9	22.4	66.0
Alabama	960	21.3	1.0	12.3	28.1	58.8
Iowa	810	3.1	4.4	10.1	9.1	76.0
Georgia	567	8.7	7.4	40.9	25.6	26.1
Colorado	379	5.3	92.1	7.9	0.0	0.0
South Dakota	257	1.5	64.6	19.5	1.9	14.0
10 State Total	17,317		30.8	29.0	15.9	24.1
Total U.S.	18,814					

[1]Acreage on which terraces were reported as the first of up to three conservation practices.

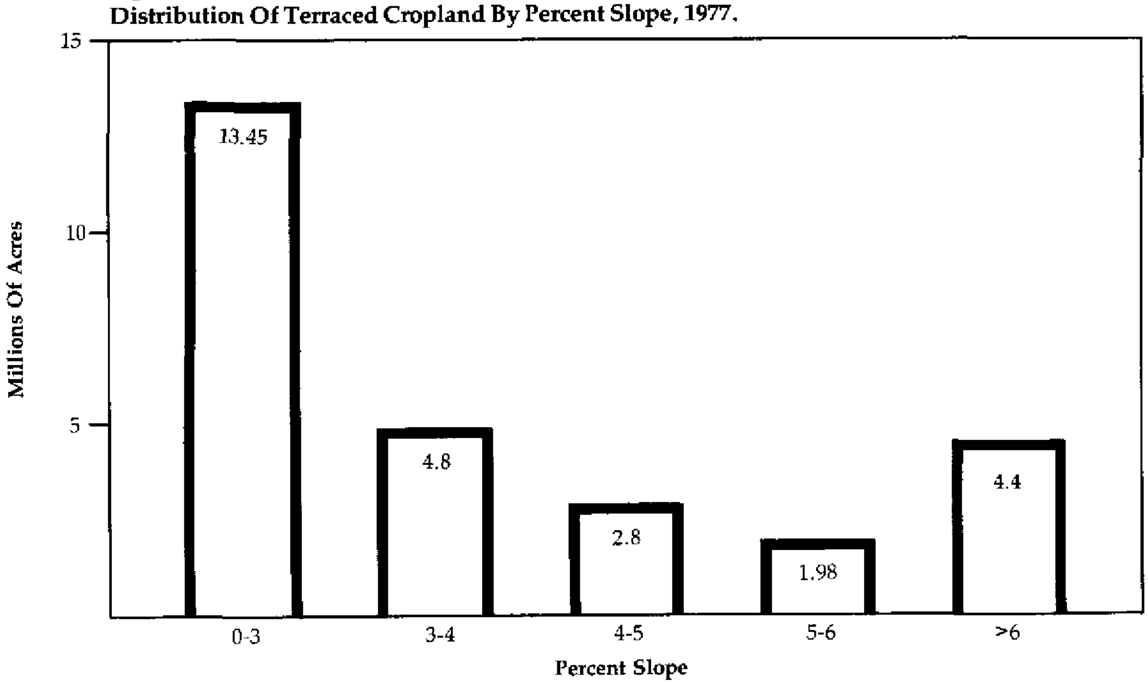
tons, comparable to the proportion observed for land treated with a combination of contour farming, crop residue use, and minimum tillage. Forty-five percent of the land treated with contour stripcropping, and 28 percent of the land treated with contouring, crop residue, and minimum tillage, had very high potential erosion rates (RKLS greater than 50 tons per acre annually).

When the distribution of these practices is compared with the distribution of all cropland according to RKLS, it is obvious — and encouraging — that some traditional conservation practices tend to be found on land with relatively severe erosion problems. Unquestionably important conservation benefits are being realized by both the individual farmers and society as a result. However, a surprising proportion of these practices and practice combinations were observed on land with modest potential for sheet and rill erosion. It is possible that these practices — terraces in particular — were adopted in some cases to control incipient gullies. But it is unlikely that wind erosion was the problem being corrected. It should be noted that most of these practices are of limited utility on the very steepest land, where the potential for sheet and rill erosion is greatest. This characteristic of these practices may explain their concentration in the mid-range of potential erosion rates, where the techniques are most beneficial and effective.

Thus far, we have focused on the physical impacts and location of conservation practices. But it is instructive to consider the interplay between the economics of conservation and the accomplishments of government programs. This relationship is most striking in the case of terrace installation. We have already pointed out that only about 9 percent of the cropland was terraced in 1977, according to SCS. As is evident in Figure 9 most of the terraces observed in 1977 were on land with very modest slopes: more precisely, half of the terraced land had a slope of less than 3 percent, and two-thirds of it had a slope of less than 4 percent.

We may deduce why terraces tended to be observed on relatively flat land by studying the data in Table 15. It lists the top 10 states for terraced land in 1977. [Here we are looking at a somewhat different presentation of the data than previously. The acreages in Table 13 correspond to the NRI sample points for which terraces were listed first in importance among the (up to three) conservation practices.] The four states with the greatest amount of terraced acreage are in the Great Plains, where, by and large, sheet and rill erosion is not a severe problem. Kansas, Texas, Oklahoma and Nebraska together account for 71 percent of the acreage where terraces were the primary conservation measure in 1977. Moreover, as the last four columns in Table 15 show, a substantial proportion — 35.4 percent —

Figure 9
Distribution Of Terraced Cropland By Percent Slope, 1977.



of the terraces in those states were observed on land which had a very low RKLS product (less than 10 tons per acre), indicating a very low potential for sheet and rill erosion, even under the worst possible conditions. Another 33 percent of the terraces in those four states were in the RLS range of 10 to 20 tons. Overall, about 60 percent of the terraced land included in Table 15 had a sheet and rill erosion potential of less than 20 tons before the terraces were installed and just below the average 21 ton potential for all cropland in 1977 (21 tons). Although the acreages listed in the table may not be precisely correct because of the statistical design and reporting system of the 1977 NRI, experts agree that they reliably reflect the general pattern of terracing in the United States.

Why the preponderance of terraces in the Plains states? Because terraces of the broad "bench" variety are valuable water conservation measures in that low rainfall region. While some gully erosion control benefits are surely realized on terraced land in the Great Plains, their popularity lies in their enhancement of water retention. "Level bench systems have more than doubled the yields of forage and grain sorghum produced on the slopes," notes a USDA publication. "The increased water storage that occurs in bench terraces during the noncrop season has provided sufficient soil water to deter complete crop failure in years when precipitation is critically short."(28)

These terrace systems (sometimes called Zingg terraces, after their developer, AW. Zingg) are "best adapted on long uniform slopes of 1 to 5 percent and on deep soils." As with other types of terraces, "construction costs become prohibitive on steep slopes," primarily because the terraces must be spaced more closely to achieve the desired erosion reduction.(28) This explains both the preponderance of terraces on the moderately sloped Great Plains' cropland, and the relative rarity of terraces in the humid parts of the United States.

Table 15 also indicates that terraces in "humid" states — Missouri, Alabama, Iowa and Georgia — tend to be concentrated on lands with significant potential for sheet and rill erosion. Well over half of the terraces in Missouri, Alabama and Iowa were observed on land with a

Table 16.
Inherent Potential for Sheet and Rill Erosion Cropland Treated and Not Treated with Selected Practices, 1977.

Inherent erosion potential[1] tons (per acre per year)	*All (readily available) cropland[2]*		*Terraced (using) slope length without terraces)*		*Not Terraced*		*Treated with contouring, min. tillage, or crop, residue use*		*Not treated with contouring, min. tillage, or crop residue use*	
	Million Acres	*%[3]*	*Million Acres*	*%[3]*	*Million Acres*	*%[3]*	*Million Acres*	*%[3]*	*Million Acres*	*%[3]*
0.0-4.99	109.0	26.8	0.5	1.8	107.5	28.4	51.7	29.4	53.1	27.9
5.0-9.99	92.6	22.8	3.0	11.0	86.4	22.8	44.7	25.5	39.1	20.6
10.0-14.99	58.7	14.4	4.0	14.5	54.5	14.4	27.2	15.5	25.2	13.3
15.0-19.99	33.4	8.2	2.1	7.6	29.5	7.8	13.7	7.8	15.0	7.9
20.0-24.99	20.6	5.0	2.4	7.2	17.9	4.7	7.7	4.3	9.8	5.2
25.0-29.99	14.8	3.6	2.1	7.6	12.7	3.4	5.2	3.0	6.9	3.6
30.0-39.99	17.9	4.4	3.8	13.8	15.3	4.0	6.5	3.7	8.3	4.3
40.0-49.99	12.0	3.0	1.6	5.8	10.5	2.8	4.0	2.3	6.1	3.2
50.0-99.99	26.6	6.5	5.4	19.6	24.4	6.4	8.4	4.8	14.5	7.6
100 & Over	20.7	5.1	2.6	9.4	20.0	5.2	6.2	3.5	12.1	6.4
Total acres[4]	406.3	100.0	27.5	100.0	378.8	100.0	175.3	100.0	190.1	100.0
Average potential tons per acre	24.8		44.6		24.7		19.8		28.1	

Source: Computed from National Resource Inventory data. USDA-SCS, 1978.

[1]RKLS product; assumes C=1.0 and P=1.0.
[2]Excludes 6.9 million acres of wild hay and mountain meadows.
[3]Percent columns may not add due to rounding.
[4]Excludes wild hay and mountain meadows.

sheet and rill erosion potential of over 40 tons per acre annually. In Georgia, terraces often were observed on land with lower erosion potential. Overall, Alabama ranked first for the proportion of its cropland protected by terraces, with 21.3 percent, followed closely by Oklahoma and Kansas. For the ten states with the highest total cropland sheet and rill erosion, an average of 8.8 percent of the cropland acreage was terraced in 1977.

Effects of Practices on Sheet and Rill Erosion

It should be clear by now that the erosion control achieved by these different practices is largely a function of the inherent erosion potential on the land on which the practices are used. The relative effectiveness of different practices for sheet and rill erosion control on cropland is graphically illustrated in Tables 16 and 17, developed by former USDA conservation program analyst Dr. Arnold Miller.

In Table 16, Miller arrayed the distribution of acreage treated with contour farming, minimum tillage, crop residue use and terracing practices according to the potential for sheet and rill erosion (RKLS). Except for terraced land, the RKLS product can be used to reflect the potential sheet and rill erosion. For terraced land Miller corrected the RKLS product to reflect the shortened slope brought about by installation of the terraces. (We noted earlier that terraces retain soil in a field by shortening the length of the eroding slope.) The second column in the table breaks down 406 million acres of cropland according to the potential sheet and rill erosion rate. Note that the average potential erosion rate for this land, 24.8 tons per acre annually, was only 56 percent of the 44.6 ton average rate for land treated with terraces. This reinforces our previous observation that terraces in general were found on land with worse than average sheet and rill erosion hazard. Averages do not tell the whole story, however. Forty-two percent of the terraces were installed on land where the erosion potential was below 25 tons — a rate lower than the average potential for all cropland. Undoubtedly we are observing the effect of the great amount of terraced land on the dry Great Plains.

Table 16 also provides insight into the erosion control effectiveness of the 175.3 million acres treated with contouring, minimum tillage, or crop residue use, alone or in some combination (column 5). The average erosion potential was 19.8 tons per acre per year, about 80 percent of the average potential for all cropland. Fully 55 percent of the land treated with one of these practices would have eroded at a rate of less than 10 tons per year if it had been kept fallow and extensively plowed. Miller notes that "some 125.6 million acres" of this land, or 72 percent, "would not erode at rates over 5 tons per acre annually if they were farmed with rows running up and down slopes [P factor value of 1.0] and with cover and management conditions reflecting the average for cultivated land on which neither minimum tillage nor crop residue use were practiced in 1977 [C factor value of 0.32, *table 9*]." *Again, we emphasize that this conclusion is based on an assessment of sheet and rill erosion only.* Minimum tillage and crop residue practices are also used to combat wind erosion, and their distribution according to wind erosion potential is not reflected in this table. However, the basic point that a high proportion of conservation tillage practices tend to be found on land with low erosion potential is irrefutable, as is evident from data presented earlier for the Corn Belt. The data in Table 16 affirm the results of numerous analyses performed by AFT and many other anlaysts: the cropland most susceptible to sheet and rill erosion, and which accounts for most of total soil loss on cropland nationally, is scarcely treated with any of these practices.(29,30)

The results of more sophisticated analysis of practice effectiveness performed by Miller are presented in Table 17. Once again, the incidence of the practices is broken down according to the potential sheet and rill erosion rate on the land on which the practices were observed in 1977. In this table, though, land with a potential to erode of less than 20 tons per acre was excluded. Also, instead of acreages, the table shows sheet and rill erosion rates. Columns or items labelled "actual NRI" correspond to what was reported by SCS in 1977. The other columns were computed after Miller made changes in the reported C and P factor values, to reflect various assumptions about alternative conservation practices. For each of these columns, the C and P factor values were changed to reflect uniform adoption of alternative practices like crop residue use and minimum tillage. For example, the third column shows the sheet and rill erosion rates that would have prevailed in 1977 on "all land in row crops and small grains" under the following assumptions: cover and management conditions would be equivalent to the average reported for land where neither minimum tillage nor crop residue use were practice (C factor value of 0.32); and where supporting ("traditional") conservation practices were not used (P factor value equal to 1.0). Miller developed this table to make comparisons between the erosion expected on untreated cropland and the various treatments indicated. The table is also useful for considering the relative erosion control benefits that could be anticipated from widespread adoption of different conservation measures.

For example, the "untreated" land that had an erosion potential of 20 to 24.99 tons per acre would have eroded at a rate of only 7.1 tons per acre because of the erosion-reducing effects of the vegetative cover provided by the crop (column 3). In other words, average vegetative cover and crop residue conditions reduce erosion to about one third of what it would be if the land were continually tilled throughout the growing season — even in the absence of any traditional conservation measures.

By comparison, land with an identical 20-24.99 ton erosion potential, but treated with crop residue use, would erode at an even lower rate of 6.4 tons (column 4). Moving across the table, we see that minimum tillage would have reduced the same potential erosion rate to 5.5 tons (column 5). Column 6 shows the effect of contour farming. The parenthesized C factor values above each column are those introduced by Miller via computer for each NRI sample point, in effect imposing equivalent conservation practices on all cropland (except, of course, that portion with an RKLS product below 20 tons). Without these assumptions it would be impossible to separate the potential erosion control benefits of the contour farming from the benefits accruing to crop rotations or residues that may have been in use. Obviously, contour farming was even more effective in reducing erosion than crop residue use or minimum tillage used alone, or, for that matter, for the two used in combination (column 7).

Conclusions

For a variety of reasons, conservation measures of all types tend to be concentrated on land with fairly modest erosion hazards. Land with very high potential for erosion largely remains untreated, and actually suffers high erosion rates as a result. These observations have important implications for public policy. There is no justification for the government to encourage intensive production on highly erodible lands where it is neither practical nor economical to control erosion within tolerable amounts. On the other hand, there is an obvious rationale for developing practical, cost-effective programs for treating these highly erodible lands, to minimize the severity of the erosion losses as much as possible. Conservation policy is thus faced with a dual

Table 17.
Potential and Actual Sheet and Rill Erosion Cropland Treated with Selected Practices, 1977.

	All land in row crops and small grains								*Terraces and Supporting Practices*		
Inherent Potential for erosion[1]	*(actual NRI)*	*(assumes C=.32, P=1.0)*	*Crop residue use alone (actual NRI)*	*Minimum tillage alone (actual NRI)*	*Contour farming alone (assumes C=.32, P is actual NRI)*	*Minimum tillage and crop residue use (actual NRI)*	*Contour farming and crop residue use (actual NRI)*	*Contour farming, min. tillage and crop residue use (actual NRI)*	*(actual NRI)*	*(assumes C=.32 with LS and P actual NRI)*	*without terraces (LS is without terraces, C is actual NRI, P=1.0)*
				AVERAGE EROSION RATE IN TONS PER ACRE PER YEAR							
20-24.99	6.0	7.1	6.4	5.5	3.8	5.3	4.1	3.6	4.2	5.2	5.6
25-29.99	7.1	8.7	7.3	7.3	5.1	6.5	4.8	4.6	4.8	5.8	7.3
30-34.99	8.3	10.4	9.3	8.3	6.0	7.1	5.6	4.0	5.4	6.8	7.8
35-39.99	9.5	12.0	11.0	7.4	7.0	9.2	6.9	5.7	6.3	8.4	10.6
40-44.99	10.9	13.6	13.2	9.3	7.4	9.4	7.7	5.8	6.8	8.6	10.4
45-49.99	11.6	15.2	12.3	11.2	9.0	8.6	7.8	5.8	7.0	9.4	13.6
50-74.99	14.4	19.5	15.7	16.7	11.3	13.0	10.3	8.4	9.4	13.3	15.8
75-99.99	19.8	27.7	20.2	17.6	16.7	16.6	11.3	16.2	14.4	19.5	22.6
100-149.99	27.8	38.3	32.4	26.4	25.4	25.6	16.2	17.5	18.9	27.4	31.2
150-199.99	38.3	54.4	39.5	26.6	35.3	26.3	32.5	24.0	33.2	46.9	39.2
300	68.7	96.0	72.0	30.0	73.4	45.0	52.1	38.3	54.6	83.5	65.6[2]

[1]Product of the R, K, and LS factors in the soil loss equation as reported for NRI sample points. Assumes the C and P are both 1.0.
[2]Average erosion rates on land with RKLS products of 200 or more when "LS" is adjusted to average slope length prior to installation of terraces.

Source: Arnold Miller, "Impact of Expanding Agricultural Production on Soil Erosion: Land Resources, Conservation Practices and Policy Choices." Prepared for the Structures of Agriculture Project, USDA.

challenge. It is bad policy to encourage production on lands where excessive erosion is inevitable. Equally bad are policies that cause scarce government funds for erosion control to be spent on land where erosion is a modest hazard. At present, government conservation efforts are severely compromised by policies of both types.

For land with moderately serious erosion problems, the 1977 data reinforce a basic conclusion repeatedly encountered in the literature on the economics of "traditional" conservation practices. The traditional practices are not economically atttractive, or even viable, for farmers in most areas of the country. The limited presence of these practices in 1977, especially on land prone to exessive erosion, is a discouraging sign. The reasons for these patterns in the use of conservation practices are as pervasive today as they were in 1977. The future portends a very limited role for traditional practices. Would drastic changes in policy arguably make them more attractive to farmers? To make terraces, stripcropping and other such measures more attractive to farmers would necessitate substantially higher levels of government financial and technical assistance. Even then, however, these practices will not be welcomed if they interfere with normal farming operations. Given certain firmly established trends in U.S. agriculture, such as the progressive move toward larger fields and equipment, toward larger and more specialized farms, it is simply impossible to place much faith in expanded government efforts to boost the adoption of traditional conservation practices. This conclusion is rather explicitly acknowledged by the emphasis placed on conservation tillage in the recently announced National Conservation Program. It represents a fundamental turn about in the approach historically taken by USDA's conservation programs.

There remains, of course, the possibility of regulating farmers to require use of specified practices. Environmental statutes passed in the last 15 years have required most other major industries to protect the environment and conserve natural resources. Conservationists have considered mandatory policies in theory, but have rarely considered them pragmatic. In our judgement, the new information demonstrating the concentration of erosion substantially undercuts both practical and political objections to mandatory policies that have been raised in the past. We believe that, in time, a consensus may form among agricultural and environmental policymakers, who will find the regulation of the small amount of highly erodible land an increasingly compelling proposition. As we have seen, a fraction of America's land base accounts for a disturbingly large proportion of the country's total erosion. We have also seen that, for the most part, conservation practices of all kinds — even those considered to enhance farm profits — were generally not in use on this land, at least as of 1977. Traditional practices like terraces, contour farming and so forth, are unlikely to be voluntarily adopted on land subject to severe erosion losses. In any case, costly, multiple combinations of such practices would be required to reduce erosion to acceptable levels on the most erodible land. For the majority of the land base, however, erosion can be controlled readily and inexpensively; on most of the Nation's cropland, for example, conservation tillage is all that is necessary to control erosion. The same is true for the majority of the land classified in 1977 as having high or medium potential for conversion to cultivated crop production. As data from the 1977 NRI and other sources suggest, the adoption of conservation tillage is proceeding apace on land where sheet and rill erosion rates are modest.

In short, the data we have reviewed overwhelmingly suggest that American agriculture can produce sufficient food and fiber for all forseeable domestic and export uses without the high level of erosion observed in 1977. What is more, achieving productive, sustainable land use patterns and conservation practices need not be exhorbitantly expensive.

These, then, are elements of an argument for regulating the small portion of land with severe erosion problems, leaving to the existing conservation programs and agencies the task of addressing erosion problems on other land. AFT believes other alternatives should be explored first. However, a major goal of the recommendations advanced in this report is to aid policymakers, conservationists and, most importantly, farmers in coming to terms with the policy implications of new information on erosion. In our view, this information rather dramatically changes the types of policies which can and must be considered to deal with agriculturally related soil loss. Exploiting this information calls for a new, strategic use of the conservation potential of existing Federal commodity and conservation programs — programs which have worked at cross purposes, or inefficiently, in achieving soil conservation in the past.

With that in mind, we would conclude this chapter by proposing that cropland should be classified into three broad categories for which discrete conservation policies should be formulated.

In the first category is land which has very modest erosion problems. All cropland eroding at less than 2 tons per acre per year under normal farming conditions with no "traditional" conservation practices would be in this category. It would also include some land with very deep soil profiles, favorable to root growth, eroding at an annual rate of up to 5 tons per acre per year (again, under normal farming conditions and with no traditional conservation practices). In essence, this category includes most of the cropland on which erosion is below the soil loss tolerance established for specific cropland soils. Where sheet and rill is the major erosion hazard, we would anticipate that this first category would include all land with an inherent potential to erode (measured by RKLS) of less than 15 tons per acre per year.

The second category would include cropland eroding between 3 and 15 tons per acre under normal farming conditions. This land generally can be adequately protected against erosion by conservation tillage systems, though in some cases traditional conservation practices may also be needed. Where sheet and rill erosion is the main hazard, the inherent erosion potential (RKLS) would be between 15 and 75 tons per acre per year.

A third category would consist of land which generally cannot be used to produce cultivated crops without eroding at rates greater than 15 tons per acre. The RKLS for this category would be 75 tons or more per acre annually.

The delineation of these categories is somewhat arbitrary; we offer it as an example of the type of approach that is needed. However, the choice of 2 tons for the first category is the minimum value for the soil loss tolerance (T value) on cropland. Adding land with deep, favorable soils where erosion may reach 5 tons per acre reflects the most common and maximum soil loss tolerance for cropland. Except where topsoil is exceedingly thin, erosion rates of less than 5 tons per acre pose little hazard to the productivity of soil resources. The RKLS of 15 tons was selected because, under average 1977 cover and management conditions (C factor of 0.30), the highest anticipated erosion rate would be 5 tons per acre annually (i.e., RKLS = 15 x 0.3 = 5 tons per acre actual erosion).

Granted, some land in this category might be contributing to off-site damages such as siltation of water impoundments or pollution of surface waters. In general, though, this category is prime land that can withstand continuous, intensive agricultural use. Where possible, it should be protected from any nonagricultural use that would impair its long-term productivity. While soil conservation measures obviously should not be discouraged on such land, usually there is little justification for government programs to provide technical or financial conservation assistance to promote their adoption. Where soil conservation practices pay for themselves as a result of enhanced crop yields or lowered production costs, as is the case with terrace construction in the Great Plains, government involvement is effective and popular. But there should be no pretense that soil conservation is a primary or even significant benefit of such program activities. Inclusion of cropland with deep soils eroding up to 5 tons per acre annually would expand the first category. AFT estimates this category would comprise most of the cropland eroding below the soil loss tolerance in 1977: about 257 million acres, or 62 percent of the total 413 million acres of cropland.

Granted, low erosion rates were observed on some of this land because of the presence of traditional conservation measures. On most cropland, though, sheet and rill erosion would not have exceeded two tons per acre under normal farming conditions, and especially if simple, widely employed conservation tillage practices were used. We can state this with some confidence with respect to sheet and rill erosion. Cropland treated with both crop residue use and minimum tillage had an average C factor of 0.24 in the 1977 NRI. Accordingly, any land with a sheet and rill erosion potential (as measured by the RKLS product) of less than 8 tons per acre would, on average, erode at a rate of less than 2 tons per acre if treated with a standard level of conservation tillage technology (i.e., RKLS of 8 x 0.24 = 1.92 tons). Thirty-seven percent of the cropland, or 152 million acres, fell within this range in 1977. As already noted, for an RKLS of 15 tons, we would anticipate actual sheet and rill erosion rates of less than 5 tons under average 1977 farming conditions. About 260 million acres, or 63 percent, of the cropland inventoried in 1977, had an RKLS of less than 15 tons.

The second category is somewhat more difficult to define with simple, quantitative criteria. Conceptually, it includes land which can be intensively and profitably farmed without excessive erosion losses when appropriate conservation practices are applied. Without such practices, land in this category would suffer erosion rates damaging to soil productivity or water quality. Generally, this is land which, under normal farming conditions and without traditional conservation practices, would erode at a rate between 5 and 15 tons per acre annually. Even if used intensively to produce row crops or small grains, however, erosion on such land can usually be reduced to the conventional soil loss tolerance limit, if not below it, with some form of conservation tillage. For the upper end of this range, no till techniques would be necessary to achieve this goal. A sizable proportion of America's cropland falls within this category, and existing policies and programs, if modified to increase their effectiveness, can do much to control erosion to acceptable levels on this land.

The final category consists of highly erodible lands suffering an annual loss of 15 tons per acre or more even when affordable, practical conservation practices like conservation tillage are employed. Essentially, this category includes land with an inherent potential for sheet and rill erosion greater than 75 tons per acre annually (as measured by the RKLS product), as well and land prone to high wind erosion losses.

We will discuss later how the potential for loss not only of soil, but also of soil productivity, should be considered in determining which category of land a specific field belongs in. In our final recommendations, we will propose that the SCS land capability class system be used in conjunction with the criteria described here to classify land according to its erosion hazard.

Any attempt to categorize land according to its erosion hazard is bound to be arbitrary, and our attempt is no different. The three categories we have proposed take into consideration recent research on the impacts of soil erosion on soil productivity and water quality, the economics of soil conservation, and the past and potential performance of government commodity and conservation programs. The categories thus have important implications for soil conservation policy.

Relatively nonerosive category 1 land requires little if any special concern or treatment because of soil erosion. Government technical and financial assistance for erosion control can be diverted from this land and focused on the other categories. Land in category 3 is highly erodible and should probably not be in intensive cultivation. Programs and policies designed to encourage conversion to hay, pasture, forest and wildlife uses offer the most practical and realistic alternative for solving conservation problems on this land. The same programs and policies should discourage fragile land already in these soil conserving uses from being intensively cultivated in the future. Category 2 land includes all soils not fitting in categories 1 and 3. This land is susceptible to moderate levels of erosion. It can and should be adequately protected by profitable, practical conservation practices.

Different conservation policies and programs are appropriate for different types of land; for various types of crops; and to bring about the adoption of the wide range of conservation practices available to farmers. Some conservation needs can be met with educational programs. Others require technical and financial assistance to help farmers install certain conservation practices. Still other needs are best met with other financial inducements or penalties to encourage the use of land according to its capability.

As we shall see in Chapter 4, the level of soil conservation being achieved by traditional conservation programs falls far short of national needs. Public funds for soil conservation are scarce today. There is every likelihood that they will continue to be scarce in the future. Hence, it is imperative that exisiting conservation programs and commodity programs do more to help farmers cope with the conservation needs of their land. To improve this match between programs and needs, AFT will propose several initiatives that are keyed to the three categories presented above. Existing programs often do the right things, but too often in the wrong place.

In the next chapter we review the economic forces which have created current land use and conservation patterns. Chapter 4 explores the strengths and weaknesses of existing conservation policies and programs. These chapters will reinforce the message of this one: soil erosion in the United States is a serious yet localized problem which can be substantially overcome, at a reasonable cost, within the next decade.

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Chapter Three

Soil Conservation in a Changing Farm Economy

In this chapter we outline the economic and policy context which strongly influences soil conservation decisions on the farm. We will necessarily have to present generalities which may not hold true in many parts of the country. Nor will we be able to explore in depth the intangible social reasons, such as a desire for more leisure time, that we know from experience affect conservation. It is important to understand this context, becauses it explains in large measure the distribution and effectiveness of conservation practices described in the previous chapter, and the successes and failures of existing conservation programs to be described in Chapter Four. Finally, in developing our recommendations, AFT has been mindful of important trends in the farm economy and government farm policy. In our view, the current economic and policy environment presents unprecedented opportunites for conservation which AFT's recommendations are designed to exploit.

The Surplus Era

For eighteen consecutive years prior to 1972 the U.S. government operated agricultural production control programs of various kinds — including payments-in-kind — to boost farm prices and incomes. In some years the programs temporarily retired as many as 60 million acres from crop production. The programs were needed because agricultural production capacity grew at a greater rate than demand. This imbalance was caused primarily by technological advances following World War II. While there have been and continue to be many social and environmental consequences of these technological developments, we consider only those with direct affects on soil conservation.

Herbicides. The 1982 report by the Congressional Office of Technology Assessment (OTA), *Impacts of Technology on U.S. Cropland and Rangeland Productivity* noted that "prior to the development of chemical herbicides in the 1940's, farmers relied on a variety of tillage practices to control unwanted plants (weeds) in their fields. It was not uncommon for Midwestern corn farmers to make as many as 10 trips across their fields before harvest, most of them to control weeds."(1)

Today it is the rare farmer who does not rely to some degree on herbicides for weed control on cropland. According to OTA, in 1976 herbicides were used on 90 percent of the corn acreage, 88 percent of the soybean acreage, 84 percent of the cotton acreage, and 38 percent of the wheat acreage. It is probably that all of these proportions are higher in 1983. As OTA put it, farmers are "spraying more, tilling less."

The reason for the widespread use of herbicides is that, compared to mechanical cultivation, they significantly reduce the labor and fuel required to control weeds. That means farmers can plant their crops closer to the optimum time. They can plant more acres with a given amount of labor and more than one crop in the same field in the same year.

The development of herbicides had revolutionary implications for soil conservation, since they made it possible to control weeds in most of the major crops with little or no disturbance of the soil surface. Tillage performed for any reason increases the susceptibility of soil to erosion, and any farming system that maintains crop residues on the surface will reduce that hazard. Where erosive crops like corn or soybeans are grown continuously, the ultimate erosion control technique is no-till planting. The crops are planted directly into sod or the residue of the previous year's crop, and weeds are controlled totally by herbicides. Used effectively, no-till systems can reduce erosion by 90 percent. Herbicides also play a critical role in eradication of shrubs in rangeland areas, facilitating the reestablishment of forage plant species that more fully protect the soil surface.

Greater reliance on herbicides increases the risk of harm to the environment and human health. If used prudently and properly, however, the use of herbicides can benefit the environment by helping to control erosion. Apart from being important production inputs throughout U.S. agriculture, herbicides are an essential element of conservation tillage, which in AFT's view should be the cornerstone of rational conservation policy over at least the next few decades.

Fertilizers. The widespread and rapid increase in the use of industrially synthesized nitrogen fertilizers, and the availability of blended bulk fertilizer combining nitrogen, phosphorus and potassium, played a major role in the growth of crop yields after World War II. The effects of this technology on soil erosion were complex. By providing farmers with a cheap and easily applied source of nitrogen, these fertilizers obviated the need for soil-building "green manure" crops such as clover, which traditionally were grown in rotation with other crops and plowed under to return nitrogen to the soil. Off-farm supply of nitrogen also allowed farmers to grow corn continuously; farmers no longer had to have a diversified crop-livestock operation to replenish nitrogen (via manure) in their fields. Moreover, use of synthetic nitrogen avoided the problem of spreading weed seed invariably contained in livestock manure, making weed control somewhat easier. In effect, fertilizer technology encouraged specialization in cash grains where other conditions were favorable, as in the Corn Belt. Extreme specialization, in the form of continuous crop monoculture, reduced the average amount of vegetative cover on a field over a season by eliminating sod based crops from the rotation. In large areas of the country, it is common for fields growing a corn or soybean rotation to be virtually unprotected from erosion from November through May.

On the positive side, intensive use of fertilizer in combination with crop varieties specially bred to respond to high levels of fertilization, led to higher crop yields and much higher plant populations per acre. The effect was to increase the vegetative canopy in the early part of the growing season, when soil is most vulnerable to erosion. A greater volume of residue was also available after harvest to protect the land from winter winds and rain, and to replenish soil organic matter.

It is difficult to generalize about the net effect of increased use of chemical fertilizers. Most authorities seem to feel the simplification of crop rotations has gone too far, offsetting to a degree the beneficial effects of fertilizers. As with other technology, the balance varies from site to site, and depends largely on the skill and conservation awareness of individual operators. Naturally, the greatest potential for serious problems occurs where hilly land has been converted to continuous use cash grain production from mixed crop-livestock farming (including hay and pasture in rotations). This trend is much in evidence in the Corn Belt and in other humid regions, and fertilizer technology has contributed to the transition.

Farm machinery. The size of farm machinery has increased for a number of reasons over the past half century. First, the relative scarcity of farm labor has necessitated greater capital inputs to achieve a given level of production. In addition, pressure to expand farm operations to increase, or maintain farm income has led to a demand for larger, faster equipment that can accomplish planting and harvesting operations in a timely manner. The timeliness of field operations became more important as average crop yields increased. Yields often drop precipitously if crops are not planted near the optimal time. Moreover, the trend toward larger equipment is self-reinforcing. Having purchased larger equipment, farmers often find it necessary to expand the acreage they farm in order to fully utilize — and pay for — the costly machinery.

Trends in equipment capacity and speed have had several effects on conservation. Larger equipment is best suited to long, parallel rows; conservation is maximized by farming land to its contours. Neil Sampson has summarized the dilemma as follows:

"The big, fast tractors of today's farm are impressive to watch at work, and a delight to operate, but they don't turn on a dime. In order to be efficient, they must be working on a long, straight run, not wasting time wriggling in and out of tight corners. Since property boundaries in much of the country are straight, and usually a half-mile or more in length, the need for tractor efficiency leads most farmers to reorganize small fields into large units, bounded only by roads, property lines, or absolutely impassable pieces of terrain . . . Windbreaks become a real pain, so thousands of miles of them have been torn out to enlarge fields so that big tractors or center-pivot sprinkler systems can have free travel. Terraces — particularly those that wander around on the contour — can't be tolerated. Those old contour terraces, with all the 'point' rows and 'stub' rows that slowed down planting and cultivation, were feasible with two-row equipment. A farmer could drive a two-row rig to the end of a set of rows that met a terrace at a sharp angle, turn around, and catch the next two rows where they joined the terrace. But with six- or eight-row equipment, an operator can't even get to the ends of some of the rows without jamming the other end of the machine in the terrace bank! So the old terraces have had to go, victims of technological obsolescence. Harvesting equipment imposes the same kinds of limits."(2)

We would emphasize that the negative effects of larger machinery have been primarily on the traditional conservation practices, especially terraces, as Sampson so clearly points out. But other traditional practices such as contour farming, contour stripcropping, grassed waterways, and diversions also have become less popular because they usually are incompatible with very large equipment.

But equipment developments are also largely responsible for the increasing success and adoption of conservation tillage. For example, early in the development of no-till planters, difficulties existed in effectively penetrating the sod or stubble, and in attaining the proper seed placement.

AFT FARMER SURVEY DO FARMERS APPLY LESS CONSERVATION EFFORT TO RENTED THAN OWNED LAND?

If the answer to this question is "yes" and rented land tends to be just as erosion-prone or more so than owned land, we may have a growing problem for soil conservation. In much of the country, increasingly more land is farmed by tenants rather than owner-operators. Some previous studies indicate that leased farmland tends to have relatively less conservation effort applied to it. Among the reasons suggested for this difference are absentee landlord's lack of information about the erosion danger to their land and tenant's reluctance to invest in improving land whose lease they may lose.

The AFT survey of farmers in six different-state study sites assessed the impact of tenure status by asking the interviewed operators to report on their conservation effort separately for owned and rented land (where the farmer had both types in 1982).

We gathered two measures of effort; the number of separate conservation practices applied to each type of land (owned and leased) and the acres served by every different practice (also broken down by tenure status). In one of the six study areas, a plurality of the relevant surveyed farmers (those with both owned and rented land) actually reported using more practices on rented acres. In a second area, the largest group of farmers (45 percent) had the same number of practices on both types of land. While owned land had the advantage in the remaining four sites, in two of those four the edge was provided by the many cases where the number of practices on owned acres was just one more than the sum on rented. Therefore, in only two of the six areas did conservation effort, as measured by number of separate practices, tend to be substantially higher on owned land.

Largely the same pattern was found when we compared our second set of measures of conservation effort: 1) the total number of acres served by all practices on owned land divided by the farmer's total owned land and 2) a similar ratio for rented acres. In one study area most of the relevant farmers reported treating their rented land better than their owned on this dimension. In five areas the reverse was indicated. However, in two of those five the majority position for owned land evaporated when we removed the cases of only slight differences in the ratios (that is, where the conservation effort ratio for owned land was no more than 10 percent larger than that for rented land).

The findings are similar also when we shift our focus from individual farmers to the aggregates of owned and rented land per study area. When we add together all acres served by tenure type and divide those sums by the total acres served by tenure type and divide those sums by the total acres in owned or rented status, the resulting ratios indicate that rented land was better treated in one study site. Owned land had the advantage in the other five, but again the differences were not large: four and seven percent (between owned and rented land) in two cases and 11 to 17 percent in the other three.

In sum, these three comparisons are consistent in indicating that, for most of the six study areas, more conservation effort was reported on owned rather than rented land but, also, that in at least two of those sites, the differences were marginal.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites,* American Farmland Trust, forthcoming.

In the last five years, heavier planting disks ("coulters"), and better design of planter frames and seed placing mechanisms have greatly minimized the equipment problems of no-till and of conservation tillage generally. Many of the improvements have come from farmers, who have built or adapted planters for their specific situations. Equipment manufacturers have greatly contributed to the spread of conservation tillage by steadily improving their planter designs.(3)

The net effect of these equipment improvements on conservation depends entirely on how they are used. The basic principle of conservation tillage is to retain a protective cover of vegetation or residue on the soil surface during periods of critical erosion hazards. Use of conservation tillage equipment *per se* does not guarantee soil conservation. Notes the OTA report, "soil savings possible with a no-till system are enormously diminished if at harvest the farmer does not return crop residues to his land . . . farmers can obtain the labor and fuelsavings benefit of conservation tillage and no-till without necessarily saving much soil in the process." In this connection, a survey by Nowak suggests that most Iowa farmers who claim to use conservation tillage systems actually maintain far less residue on their fields than is specified by SCS for adequate erosion control. Of 110 farmers surveyed whose crop rotations included corn and who claimed to practice conservation tillage, only 22 (20 percent) maintained an average of 2,000 lbs. of corn residue per acre, the amount proposed by SCS for adequate conservation tillage. Only 31 percent of the professed conservation tillage practitioners met the residue specifications for soybeans.(4)

Farm Specialization

Prior to World War II most farms were largely self-sufficient enterprises, producing and marketing a number of commodities. A major effect of pesticides, fertilizers, and other technologies was to promote specialization of farms into production of cash grains or a particular type of livestock. These technologies also encouraged regional shifts in production of certain commodies.

Some of the most important changes to affect soil conservation over the past forty years have been associated with the livestock subsector of the farm economy. The growing propensity of farmers to specialize in cash grain production, eliminating hay and pasture crops from rotations because there are no livestock on the farm to utilize them, is the most obvious and far-reaching change. All else being equal, the effect is to increase the potential for erosion. Since hilly land and dry rangeland have traditionally been used for hay and forage, the effect has been widespread and substantial.

Livestock

When the federal soil conservation programs were established in the mid-1930s, most farmers kept dairy or beef cattle — single breeds served both purposes just three or four decades ago — as well as hogs and perhaps chickens, and raised crops, all of which they sold in local markets. The livestock needed pasture and hay, which farmers generally grew in soil-conserving rotations with grain crops. These once-typical patterns have become rarities since the Second World War, even in areas with a high concentration of livestock.

For example, improvements in dairy breeding, artificial insemination, feeding techniques and dairy management increased average milk pro-

Table 18.
Milk Production by Regions and Proportion That Each Region is of Total Milk Production, United States, 1940, 1960, and 1978.

Region	*1940*	*1960*	*1978*
	(In Millions of Pounds)		
Northeast (11)	18,417	24,566	24,954
Percent	(16.8)	(20.0)	(20.5)
Lake States (3)	26,019	33,225	35,134
Percent	(23.8)	(27.0)	(28.8)
Corn Belt (5)	23,004	22,157	15,650
Percent	(21.0)	(18.0)	(12.8)
Northern Plains (4)	9,276	7,12	5,188
Percent	(8.5)	(5.8)	(4.3)
Appalachian (5)	7,257	8,883	8,273
Percent	(6.6)	(7.2)	(6.8)
Southeast (4)	3,078	3,806	4,8 8
Percent	(2.8)	(3.1)	(3.6)
Delta States (3)	3,139	3,022	2,619
Percent	(2.9)	(2.5)	(2.1)
Southern Plains (2)	6,572	4,353	4,523
Percent	(6.0)	(3.5)	(3.7)
Mountain (8)	4,399	4,750	5,400
Percent	(4.0)	(3.9)	(4.4)
Pacific (3)	8,251	11,101	15,614
Percent	(7.5)	(9.0)	(12.8)
United States	109,412	123,109[1]	121,928[1]

[1]Alaska and Hawaii only 0.1 percent of U.S. total.

duction per cow from 4,600 pounds to over 11,200 pounds per year between 1949 and 1970. By 1980, the average cow produced over 12,000 pounds of milk and milk fat annually. Total U.S. milk production remained about the same over this period (around 110 to 120 billion pounds), but the number of milk cows decreased dramatically, from 24 million in 1940 to 12 million in 1979. This increasing efficiency had significant effects on dairy farms and areas suited to dairy production. Commercial dairy operations — those with sales in excess of $2,500 — decreased in number from 405,000 in 1950 to under 200,000 in 1974. Even these figures understate the impact of dairy trends on soil conservation because the total number of farms of any size with milk cows plummeted from 4.7 million to 400,000; in 1940 three out of four farms had at least one milk cow; today it is about one in eight. While many small dairy farms were still operating in 1974 (83 percent of all dairy operations had fewer than 50 milk cows), the bulk (60 percent) of the production came from the 17 percent of dairy farms having more than 50 cows. The specialization in the dairy subsector is also reflected in the regional distribution of milk production (Table 18). Of particular note is the decline of dairying in the Corn Belt, which held 21 percent of national milk production in 1940, but only 13 percent in 1978.(5)

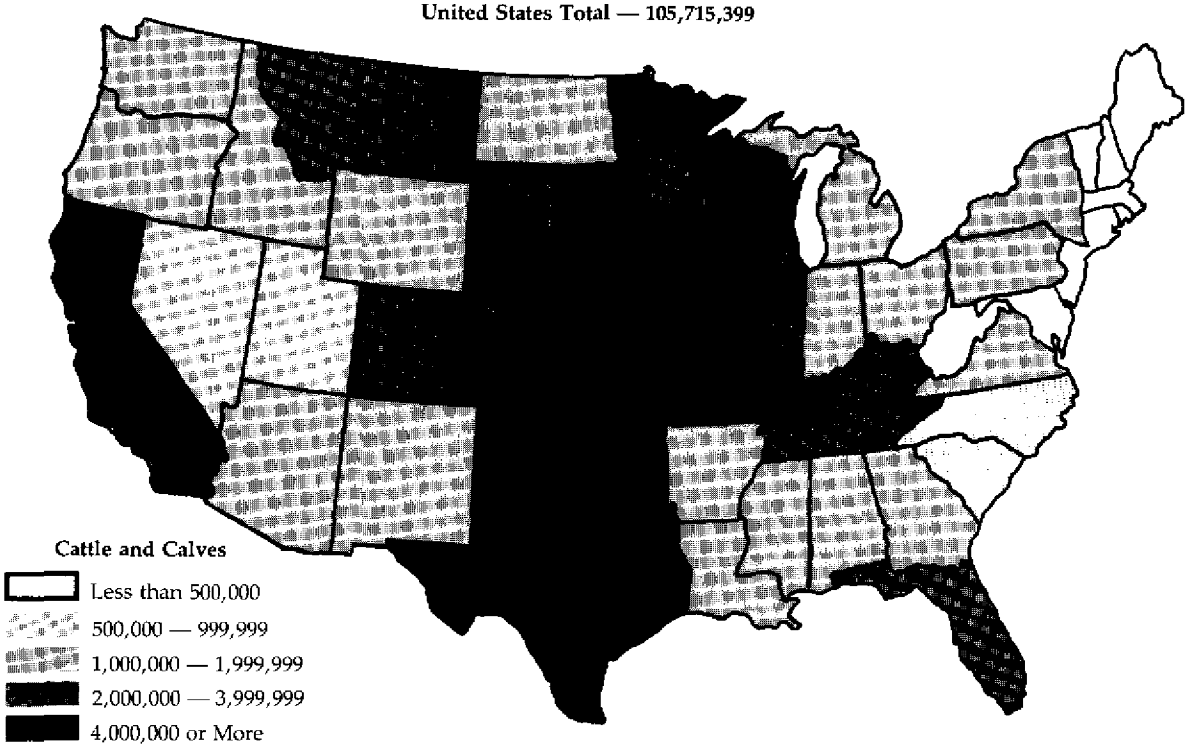
All other things being equal, then, the progressive specialization in the dairy subsector has made the task of conservation more difficult in areas where erosion is a problem.

A similar process has occurred in the beef cattle subsector. There are two basic types of beef cattle enterprise. Cow-calf operations are composed of a herd of cows kept year-round, producing heifers and steers. The cows are maintained on pasture during the spring, summer and fall, and are fed hay in the winter. Cattle-feeding operations are a second type, and involve the fattening of cattle to slaughter weights with concentrated grain and oilseed-based rations.

Describing cow-calf enterprises, one expert notes: "For the most part, cattle are still raised just about the same way as they were 50 years ago. Cow-calf ranchers have been very slow to adopt new technology except in a few specified production areas such as animal breeding, preventive medicine, transportation, water conser-

Figure 10- Cattle and Calves Inventory by State: 1978

United States Total — 105,715,399



vation, and range or pasture improvement."(6) Cow-calf operations are distributed widely throughout the country (Figure 4), and the total national inventory increases consistently with each 7-9 year "cattle cycle." However, "during the last four decades the regional distribution has changed quite substantially. This has not been a shift of production, but rather a more rapid growth in certain areas." The largest gains have come in the southeast and southwest (Table 19), which now dominate the cow-calf subsector the way the Corn Belt, Lake States and Mountain regions did thirty or forty years ago. In explaining this shift, many students of agriculture point to the comparative advantage of grain production in the Corn Belt, coupled with high land prices. It is anticipated that this trend will continue, creating greater potential for erosion and making it more difficult, though certainly not impossible, for forage based rotations to once again play a major role in profitable, conserving use of erosion-prone land. (Figure 10)

Major changes also have taken place in the cattle feeding business. The advent of large, specialized feedlots, which first appeared in California and Arizona in the late Fifties, but which are now more often associated with the Great Plains, has put small-scale, so-called "farmer feeders" in the midwest at a competitive disadvantage. "Cattle feeding prior to and immediately after World War II," notes one expert, "was synonymous with the Corn Belt. The Corn Belt, historically, has been the major surplus grain-producing region of the United States," and together with the Lake States accounted for two-thirds of total U.S. grain production in 1978. "Cattle feeders in these regions have been and are almost entirely small farmer-feeders who supplement farming or ranching enterprises with cattle feeding while producing field crops and other livestock. Farmer-feeders can use off-season labor, non-salable roughage, and other low-cost inputs in their feeding enterprise."(7)

But in the last 20 years the number of cattle on feed have grown sharply in the Central and Southern Plains, and other regions have become relatively less important (even though absolute numbers of feed cattle have increased in every region). "The development of hybrid grain sorghum, improvements in high concentrated rations with little roughage, the upsurge of highly specialized large-scale commercial feedlots along with highly skilled feedlot management, and a favorable climate were the catalysts which spurred much of the growth in these regions. Important to this growth pattern also were the readily available supplies of feed grain and feed cattle, establishment of large specialized beef slaughter facilities with national systems of beef distribution within these concentrated feeding areas.

Table 19.
Beef Cows by Region, 1950-1979.

Region	*1950*	*1955*	*1960*	*1965*	*1970*	*1975*	*1979*
				Thousands			
Northeast	75	199	210	232	258	437	365
Corn Belt and Lake States	7,070	3,799	3,970	4,962	5,822	6,473	5,147
Southeast	2,816	5,622	5,993	7,452	9,167	11,682	9,071
Northern Plains	3,121	4,809	4,592	5,982	6,410	7,716	6,083
Southwest	5,081	6,311	6,564	8,055	8,995	10,694	8,917
Mountain	2,473	3,293	3,326	4,027	4,683	4,956	4,085
Pacific	1,107	1,626	1,689	1,987	2,004	2,117	1,907
48 States	19,513	25,659	26,344	32,697	37,339	44,075	35,575
				Percent			
Northeast	0.5	0.8	0.8	0.7	0.7	26.5	25.5
Corn Belt and Lake States	12.4	14.8	15.1	15.2	15.6	11.2	11.5
Southeast	16.8	21.9	22.8	22.8	24.5	24.3	25.1
Northern Plains	18.6	18.8	17.4	18.3	17.2	1.0	1.0
Southwest	30.3	24.6	24.9	24.6	24½1	14.7	14.5
Mountain	14.8	12.8	12.6	12.3	12.5	17.5	17.1
Pacific	6.6	6.3	6.4	6.1	5½4	4.8	5.3
48 States	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Cattle Raising in the United States, ERS, U.S Department of Agriculture, Agricultural Economic Report No. 235, and (5).

and rising per capita incomes with increasing demand for beef."(8)

While farmer feeders in the Corn Belt and Lake States have access to cheaper feed, they generally face higher overhead cost for facilities. This is in part because they tend to feed only one group of cattle per year. Most analysts have concluded that cattle feeding will continue to become concentrated in large scale commercial feedlots, concentrated in the Plains and southern states.

One implication of this trend for soil erosion has been further pressure and inducement for farmer-feeders to specialize in crop production in the Corn Belt, Lake States and other regions. As is the case with some dairy operations, small farmer-feeder operations often fit awkwardly into local agricultural economies dominated by cash grain production. When a local cattle feeding operation folds, the remaining cow-calf producers may have difficulty finding places to finish and market their cattle. Decline in cattle breeding in an area in turn makes it more difficult for remaining feeders to obtain their cattle at competitive prices. This can further encourage specialization in cash grains which are more likely to create an erosion hazard than are diversified farming operations.

Regional Crop Production Trends

Some important changes have occurred in the regional distribution of crop production, with favorable and unfavorable consequences for erosion. For example, corn production has increasingly become concentrated in the Corn Belt and Lake States since 1941. (Table 20) "These two areas now account for about eight out of every 10 bushels of corn produced for grain in the United States," observes one authority. "In 1941 these same regions accounted for 6.7 bushels out of every 10 produced. The sharpest decline in share of corn production occurred in the Southeast during this period, with 1978 corn acreage for grain dropping to less than half the 1941 level, and with the share of U.S. production dropping from 14 percent to 6.9 percent."(9)

For the most part, this shift and concentration in corn production has had unfavorable implications for soil conservation. In the Corn Belt and Lake States, it has often resulted in bringing more erosion prone land into continuous row crop production. Although the land no longer planted to corn in the southeast often was prone to severe erosion losses, the decline in corn acreage has been largely made up by increases in production of soybeans, an even more erosion-prone crop.

Farm Policies and Soil Conservation

The chronic overproduction and continuous cropland retirement programs of the surplus era did have some very beneficial effects on soil conservation. Evidence suggests that, offered the opportunity, farmers tended to retire their least productive land in government programs.(10) Often the low productivity was due to soil erosion, so the production controls acted to protect the land on each farm that was most susceptible to erosion damage. The 1950s and 1960s are generally remembered as a time when great strides were made in soil conservation. Although the efforts of the conservation agencies and programs helped spread an appreciation for the need of conservation, and resulted in the appli-

Table 20. **Regional Patterns of Corn Production, 1941 and 1978**[1].

Region	*Percentage share of U.S. production* 1941	1978	*Percentage change in yield per acre 1978 over 1941*	*Million acres of corn harvested for grain* 1941	1978
Corn Belt[2]	57.6	65.0	+160	32.9	41.5
Lake States[3]	10.0	15.5	+133	5.8	11.2
Southern Plains[4]	6.9	5.4	+480	9.5	3.7
Southeast[5]	14.0	6.0	+259	18.2	7.2
Northeast[6]	2.0	2.3	+102	1.1	1.8
Other	9.5	5.0	+261	10.6	4.5
United States	100.00	100.00	+224	78.1	70.0

[1]Source: U.S. Department of Agriculture, Crop Production, Annual Summary, December 1942 and January 1979, (Washington, D.C.)

[2]Ohio, Indiana, Illinois, Iowa, Missouri, and Nebraska.

[3]Minnesota, Wisconsin, and Michigan.

[4]Kansas, Oklahoma, Colorado, and Texas.

[5]Kentucky, Tennessee, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia.

[6]New York and Pennsylvania.

cation of conservation to a sizable land area, undoubtedly much more soil was actually saved as a by-product of the land retirement schemes. Indeed, the original conservation programs were themselves something of a by-product of the early production adjustment programs of the 1930s. In the surplus era the resources alloted to the federal conservation agencies were much more in line with the task they were expected to perform.

But conservation was definitely a by-product of production controls, rather than a central aim. In fact, in some years the programs mandated the retirement of "average" land to lessen the "slippage" of production adjustment caused by retirement of marginal land — land which may have been susceptible to erosion.(11) For the most part, these programs were administered on an annual basis, and the provisions of the program for the following year were subject to change up to a few months before the planting season. The fickle nature of production adjustments has historically made them poorly suited to long term conservation planning. In addition, production adustment programs have provided an unintended incentive to farmers to periodically cultivate marginal lands. Commodity program payments made in any one year are based on yields and on the amount of land planted to program crops in previous years. Farmers usually can increase their program payments by bringing marginal land into production, then retiring the same land when government programs allow. For a variety of reasons, production control programs have created subtle incentives for farmers to abandon sod-based crop rotations in favor of continuous production of program crops; to plow up pasture and hay lands; and to eliminate stripcropping or any other conservation system which may reduce program acreage.

Following the rapid increase in grain prices which began in 1972, production controls were inactive for five years. The massive purchases of grain in the early and mid-1970s by the Soviet Union and the Eastern Bloc countries, and the increased demand for U.S. grain in the developing countries, have fundamentally changed the farm economy and the agricultural policies of the United States. Both USDA and American farmers have become more dependent on, and vulnerable to, unpredictable events in the world economy and world affairs.

In recent years, the task of production adjustment has become much more complicated. As a practical matter, the export market is much more erratic than the domestic market that formed the foundation of production adjustment in the 1950s and 1960s. Once implemented, annual commodity programs cannot be rapidly adjusted to reflect the major changes that often take place in the world market. Miscalculations about the balance of supply and demand can create hardship for U.S. farmers, excessively high costs to the Treasury, or outrage among domestic consumers (i.e., voters) and foreign customers. In a society increasingly dominated by urban voters and urban interests, any course of action that increases the odds of abrupt jumps in food prices is unthinkable. A much more politically palatable strategy implicit in farm program design for decades has been to tolerate crop surpluses until government purchase and storage subsidies become intolerably high, at which point land retirement programs are activated. These are the circumstances which led to the PIK program in 1983.

Conclusions

Unfortunately, conservation has largely been ignored in the formulation of commodity policies and programs. Granted, in recent years land retired via commodity programs must by law be devoted to a conservation use. But until this year, no attempt has been made to systematically analyze how this conservation use has been defined and enforced by the local committees who administer the commodity programs at the county level.(12) Preliminary data suggest that much less conservation was achieved in the 1983 PIK program than had been anticipated by USDA.(13)

Clearly, many opportunities exist to make conservation an integral and complementary part of USDA's crop price support programs. In AFT's view, these programs should undergo changes in the 1985 farm bill to make them less complicated and costly. However, overproduction will remain a periodic feature of U.S. agriculture, even under more streamlined programs. Some adjustment mechanism will therefore be necessary. AFT proposes that this mechanism be designed to combine both conservation and commodity program goals. The basic elements of this approach would be to:

- Offer farmers with serious conservation problems the option of entering into multi-year conservation-commodity program contracts so that public expenditures encourage, not penalize, use of crop rotations and other conservation practices.

- Offer multi-year or permanent land retirement incentives to remove the most erodible 10 to 15 percent of America's cropland from continuous cultivation, and, when needed, encourage future cropland expansion on the sizable reserve of potential cropland not subject to severe erosion.

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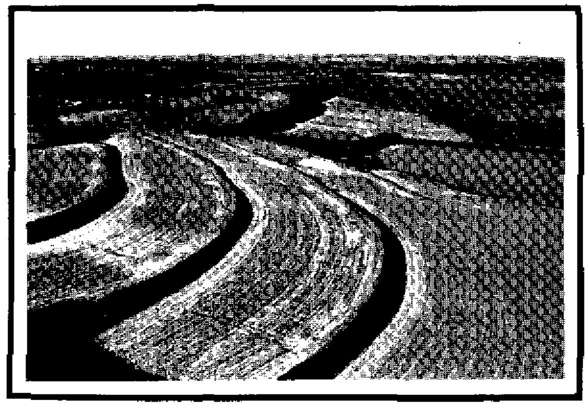
Chapter Four

Government Conservation Policy and Programs



Introduction

In February of 1977, the American farm economy was rapidly expanding in the wake of a sharp increase in U.S. agricultural exports which had begun in 1973. In the face of unprecedented increases in foreign demand for U.S. grain, government subsidized cropland retirement programs had been suspended since 1973, and farmers had continuously expanded the acreage of corn and wheat. A "new" crop, soybeans, was rapidly approaching the planted acreage of corn. The volume and value of exports of farm commodities had continually increased, breaking old records every year, as did national farm income. The money in farmers' pockets often found its way into the investment they had always trusted — land — and almost everywhere farm real estate values skyrocketed, increasing an average of 30 or 40 percent per year in the mid-seventies in some states.

In the mid-1960s, after a decade or more of chronic surpluses of farm commodites and every prospect of their continuation, it seemed reasonable to conclude, as did the major study of soil conservation programs during that period, that "the seriousness of the soil conservation problem has been at least partially abated . . . . many eroding areas have been adequately treated . . . [and] the need for concern about the future food supply is perhaps less urgent." (1) The reverse seemed true by 1977. Soil erosion seemed to many observers worse than during the Dust Bowl. Areas that formerly had been adequately treated or retired from cultivation were now being plowed up and planted to highly erodible soybeans. Concern about the future food supply was immediate and acute.

Gradually, the adverse consequencs of the abrupt change in agricultural production on America's soil resources began to attract attention. In 1976, the U.S. Congress passed the first version of what was to become the Soil and Water Resources Conservation Act (RCA), which, though vetoed by President Ford, illustrated congressional concern about the adequacy of traditional conservation programs. In 1978, America's soil erosion problem was brought to world attention by a series of articles in the *Des Moines Register* that won journalist James Risser the Pulitzer Prize. (2)

But in February of 1977, the U.S. General Accounting Office (GAO) released the first comprehensive, outside review of the major conservation programs of the U.S. Department of Agriculture. (3) Just at a time when the Congress, the farm community and the general public were becoming concerned about soil conservation, it appeared the Department's programs were a long way from providing the effective government effort the Nation required.

There were three basic themes in the GAO's findings. First, the technical assistance to farmers offered by the Soil Conservation Service (SCS) largely consisted of "developing relatively elaborate conservation plans" which in GAO's review were found often to be "outdated, forgotten by the farmer, or just not carried out or used in making farming decisions." Second, GAO observed that SCS "has taken a passive approach in carrying out" technical assistance. "It[SCS] normally works with farmers who request advice and who volunteer to participate in the program, rather than systematically seeking out and offering assistance to those having the most severe erosion control problems." Finally, two programs providing financial assistance to farmers, in the form of cost-sharing for specified conservation practices, were in GAO's view spending substantial amounts of money on practices which provided marginal soil conservation benefits. GAO claimed that in the largest cost-sharing program, the Agricultural Conservation Program (ACP), "less than half the program funds have been used for measures that are primarily oriented toward conserving the Nation's topsoil. Most of the money has gone toward measures that, although eligible for funding, are primarily production-oriented — thus financially benefitting farmers — or that result in minimal soil conservation." Likewise, in the Great Plains Conservation Program (GPCP), GAO found that funds had not always been spent on "cost sharing practices that will do the most good to alleviate soil erosion in the Great Plains."

The consequences of the GAO report are still being felt six years later. GAO's findings — for example, that erosion problems were as bad on farms cooperating with SCS as they were on noncooperating farms nearby — reopened many old criticisms on USDA's conservation programs. But in the past these criticisms had often arisen in the context of bureaucratic rivalries, or had been made by presidential administrations bent on weakening or reorganizing either of the two main conservation agencies. In instance after instance, Congressional advocates of conservation had sorted out the difficulties and protected the agencies. (4) But in 1977 it was Congress' own auditing arm that was finding fault with the Federal conservation program. The Senate agriculture committee began an oversight investigation of the Federal conservation programs, and the department's conservation agencies came under greater pressure to evaluate their programs. In light of the GAO report and rising concern about conservation, Congress decided the time had come for USDA to move beyond anecdotes to describe what had been accomplished after four decades of conservation work.

To a degree known only perhaps during the Great Depression, there was a consensus that conservation was of vital importance to the nation. Equally unprecedented was the skepticism, bordering sometimes on outright disdain, voiced in some quarters for the government institutions charged with fostering conservation. "For the nation we must set a policy of bringing soil losses within acceptable limits, just as we have set such policies for air and water pollution. Then we must give the task to an agency that will do the job," proclaimed one critic of USDA. "I would suggest that the agency responsible for acheving production goals in our society may very well not be the right agency to help the nation achieve conservation goals." (5) The general flavor of the response to the GAO report was captured in the title of a widely read article in *Science* magazine: "Soil Erosion: The Problem Persists Despite The Billions Spent On It." (6) "A lot of people didn't like the GAO report," remarked longtime Ohio conservationist Floyd Heft (now the president of the Soil Conservation Society of America) to a 1979 conference on conservation policy, "but I had to agree with too much of it for inner peace."(7)

In this chapter we review the institutions, programs and policies which have for the past half-century formed what is commonly called the "voluntary approach" to soil conservation — the government-sponsored system that is designed to promote conservation by offering free technical assistance, education, and cost sharing for conservation practices, to farmers who request it. We begin by describing aspects of the early history of the Federal involvment in soil conservation, focusing on those developments which have left an enduring mark on conservation policy. Many of the strengths and weaknesses of the voluntary system date from those formative years. Then we examine in some detail evaluations of the system's accomplishments.

The Early Conservation Movement and Its Policy Legacies

The soil conservation movement in the United States began as the one-man crusade of Hugh Hammond Bennett in the late 1920s. In the early 1930s, after a decade of depression in the farm economy, a prolonged drought scorched the Great Plains and western Corn Belt. The combination of economic and ecological disaster, which defined the Dust Bowl as both a time and a place, greatly dramatized the need for soil conservation. But it was the onset of the Great Depression that rapidly accelerated soil conservation from a modest research and demonstration effort to a massive national program within a few years. The Depression provided a context in which drastic governmental action became the norm. Programs to employ millions of idle hands were often hurriedly conceived, and executed with uneven success. The Great Depression was also the first general economic crisis in which

Conservation in the Great Depression

Most of the existing conservation agencies and programs were established in the 1930s, when the problems of soil erosion, a depressed economy, and high unemployment were considered to be intimately related. A 1937 research monograph of the Works Progress Administration (WPA) listed soil erosion third among the "causes of farm distress", behind "farming on poor land" and "excess birth rate in poor land areas". The authors observed that "excessive cropping has been especially destructive on the dry land of the Western Great Plains, where quarter sections allotted to the settlers under the homesteading laws were too small for economic use of the land . . . . The southern and western cornbelts also contain much easily eroded soil which is being destroyed because the many small farmers in the area have been concentrating on clean-cultivated row crops. In the hilly southeastern section, cotton and tobacco are being grown for the market on land from which the top soil has been completely worn away. Cultivating the subsoil requires extensive use of fertilizer, which makes farming on such land an expensive and precarious business. The cost of fertilizer consumes a large part of the farmer's income and credit, and when the crop fails he is ready for the relief rolls."(9)

rural areas were viewed as being in desperate need of relief and assistance; previously, rural America was perceived of as self-sufficient, relatively resilient segment of society. (8) This combination of circumstances made it possible for many farm policy ideas developed in the 1920s to be advanced, seriously considered, and rapidly adopted. Government conservation programs were a prime example.

By February of 1935, a few months before a permanent national program and agency for soil conservation were established within USDA, about one fifth of the country's entire relief load — roughly one million people — was made up of families whose head had usually been employed in agriculture. (10) As the Depression wore on, the Roosevelt administration emphasized getting people off the "dole" (direct cash payments) and into public works programs. Soil conservation, already a popular cause in Washington thanks largely to Bennett's crusade, provided an immediate and popular outlet for public works in rural areas.

By 1936, about 141 "demonstration projects" were administered by the year-old SCS, averaging 25,000 to 30,000 acres each, and employing a total of about 140,000 workers. Some 454 Civilian Conservation Corps camps were under SCS jurisdiction by that time, and the service also ran 48 conservation nurseries, 23 research stations, and directly employed over ten thousand people. (11, 12)

Grand as this effort was after just one year, there were plans to make it grander still, for demonstration projects had to that point served only 50,000 farmers and 5 million acres. Bennett envisioned a scheme of demonstration projects so extensive that no farmer would need to travel more than 50 miles to observe one. (13) Even by the standards of the New Deal, the cost of such an undertaking would have been "excessive, if not prohibitive". (14) And of course, conservationists realized the supply of cheap labor needed to carry out such projects would not be available once the depression had ended. Moreover, a key policy maker, Assistant Secretary of Agriculture M. L. Wilson, was convinced that only locally managed and initiated conservation efforts would endure.

These considerations led eventually to the concept of SCS as a technical assistance agency that would work through new, local units of state government, granted special jurisdiction over conservation matters. By 1937, SCS began to shift from demonstration work to direct technical assistance, and President Roosevelt had sent to every state governor a model law for establishing local "conservation districts". Within the year twenty-two states had passed some version of the law. (15, 16) At present there are nearly 3,000 conservation districts embracing 99 percent of the Nation's private farmlands.

Today's main conservation cost sharing program, the Agricultural Conservation Program (ACP), had its genesis in the same era, and for similar historical reasons. Beginning in 1933, with the passage of the Agricultural Adjustment Act, the Federal government made direct cash payments to farmers in return for participation in programs designed to reduce production of many crops, dairy products, and even for cattle and hogs. This centerpiece of the government effort to boost farm income was invalidated in 1936 by U.S. Supreme Court. Congress acted rapidly to restore a comparable system of production controls. Policy analysts in USDA had already investigated the possibility of suggesting long term conservation goals as a primary justification of production adjustment programs. The department proposed a strategy of making "payments for increased acreage of soil-conserving crops" in order to "help control the production of commercial soil-depleting crops." (17) This was the approach Congress adopted in the Soil Conservation and Domestic Allotment Act of 1936, passed just two months after the Supreme Court decision.

The 1936 Act authorized the Secretary of Agriculture to administer the combined conservation-production adjustment program though a system of state and county committees, a system still in use today. Until 1944 the Agricultural Adjustment Administration made payments to farmers for the dual purposes of conservation and production control, but in 1945 the Agricultural Conservation Program (ACP) was established as a separate program. (18) The ACP has since gone through a number of changes, but its basic function remains that of providing farmers "with payments and grants in aid to carry out approved soil and water conservation measures." (19) In recent years, both the ACP and production adjustment programs have been administered by USDA's Agricultural Stabilization and Conservation Service (ASCS) through the state and local Agricultural Stabilization Committees (ASCs).

The establishment of SCS and the Agricultural Conservation Program, and the circumstances leading up to it, have left an important legacy for conservation policy today. *Soil conservation was institutionalized as a legitimate pursuit of the Federal govermnent in the 1930s. Moreover, in a remarkably short time it became a pursuit in every county in the Nation.* To a degree this was a result of congressional concern about soil erosion — so dramatically manifested in the Dust Bowl and in the gully scarred croplands of the southeastern United States. Much of the credit for bringing the problem to national attention belongs to Hugh Hammond Bennett.

For the most part, however, conservation was undertaken on such a vast scale because of the emergency conditions of the Great Depression. It was politically necessary, though certainly in accordance with Bennett's views on conservation, to institute a program in every rural locality. This approach advanced sound land use and employed many people, and also provided the broadest possible political base for support of conservation activities. The same can be said of the system of direct payments and grants to farmers instituted under the ACP and its precursors in the first Agricultural Adjustment Act. At the outset, then, the activities of soil conservation agencies were closely associated with efforts to transfer income to most rural areas. The actual nature and severity of soil erosion problems, and their diversity across the country, was not given much attention in the early design of these programs. As we noted in Chapter 2, at that time methods for defining such problems were crude, at best. And in any event, it was a time for action, not deliberation. Even before the Depression had ended, conservation projects were becoming less important as sources of rural employment. But by then the conservation district movement was well underway, particularly in the south, and the Congress was becoming accustomed to having the services of SCS available everywhere.

Direct cash payments to farmers also were widely disbursed, at first for the combined purposes of conservation and production adjustment, and later for each purpose separately. "In the 1930s, the (combined) program reached about 3.7 million farmers and covered nearly 65 percent of the total cropland acreage in the contiguous States." (20) Most historians recognize that soil conservation was not a central working feature of the 1936 law. It was merely a convenient, universally popular rationale to help resolve the crisis of the invalidation of the 1933 Agricultural Adjustment Act. *There is no evidence that these early programs, or, for that matter, any of their successors, were designed to maximize conservation benefits.* What conservation they achieved was fortuitous.

The separation of technical assistance and cost sharing between two agencies in USDA was partly an exigency of the crisis which followed the Supreme Court decision of 1936. It was also partly the outcome of a power struggle between Bennett, SCS and their allies on the one hand, and other groups and individuals who viewed the rapid expansion and growing power of SCS with alarm. (The latter group included the Farm Bureau, the State Extension leadership, and certain figures in the Roosevelt administration.) Certainly the separation of the two forms of assistance was unfortunate. It led to a series of power struggles between two USDA agencies, both of which have always had strong Congressional patrons. Although relations between the two agencies sometimes become strained even today, most observers believe the competition has diminished somewhat at the state and national levels where it has been divisive and damaging to the goal of conservation. At the county level, relations between ASCS and SCS, and the local committees and conservation districts they serve, tend to be cordial and efficient by most accounts. It is not uncommon for local farmers to be members of both a district governing board and an agricultural stabilization committee. (21) Nevertheless, the separation of technical assistance and cost sharing greatly complicates the workings of conservation programs, especially in light of their voluntary conservation nature. The technical advice of SCS and the districts cannot be directly augmented by offers of financial assistance, which is available mainly through the ACP. (The exception is the Great Plains Conservation Program, established in 1956, which provides limited cost sharing authority to SCS in that region.) But until recently, the local ASCs have dispensed cost sharing funds on a first-come, first-served approach. ACP cost sharing priorities have not been matched formally to problems identified by SCS or conservation districts. (Improvements in this method, instituted by ASCS since 1979, will be discussed later in this chapter.)

In addition, cost sharing has for most of its history been provided to farmers on a practice by practice basis, instead of as a part of an integrated conservation plan — the approach favored by SCS and the conservation districts. In theory, each cost shared practice must meet ASCS specifications, and for some practices (usually those of an engineering nature, like terraces) the specifications are set by SCS. (Since 1950, five percent of ACP funds have been used annually to reimburse SCS for technical assistance rendered in the design and approval of such practices.) Often, however, the ASCs have proceeded with minimal information about the erosion-control benefits of the practices they were funding on specific farm fields. This procedure, too, has undergone some change in recent years.

One final legacy, observed by many writers, was the rapid broadening of responsibilities beyond the initial role of soil erosion control, in both SCS and the evolving ACP. This was the logical outcome of a more sophisticated and inclusive view of what "conservation" meant in diverse settings. Often it meant erosion control, but water conservation, soil salinity, drainage, rangeland improvement, urban sediment problems or other matters were more pressing in many areas. Both technical and financial assistance branched out to include these concerns early on. Nor was the 1977 GAO report the first time that SCS and ASCS had been criticized for assisting with practices that enhanced land values or crop yields, but contributed little in the way of soil conservation. As program responsibilities began to broaden, it became evident to many SCS personnel and conservation district cooperators that some resource problems, such as flooding, or resource development opportunities, such as a lake development, needed to be attacked from the vantage of a watershed or even larger geographic units. This line of thought led to the establishment (in 1954) of the Small Watershed Program, and (in 1962) the Resource Conservation and Development Program within SCS. Additional responsibilities have been given the SCS to assist in reclamation of stripmined land (in 1977) and a variety of other government programs. (22)

This progressive broadening of responsibilities has been welcomed by SCS. It has broadened the political base for the agency, particularly among the mushrooming suburban constituency of the post-War years. As will be clear in our discussion of funding, however, a declining share of the agency's manpower and funding were devoted to soil erosion control.

When U.S. agriculture was transformed into a more land extensive system by the events of the mid-1970s, SCS and to a degree ASCS were caught in an awkward position. Soil erosion suddenly was viewed once again as the principal agricultural resource problem, and a pressing one, at that. Dealing with erosion in an effective manner implied significant changes in program funding and program priorities.

Federal Soil Conservation Programs

The Agricultural Conservation Program

The Agricultural Conservation Program (ACP) is the main source of government financial assistance to farmers for soil and water conservation. Since 1936 about $9 billion have been paid to farmers through the program, which serves about 300,000 farmers annually.

The ACP has been criticized from its beginnings as a program devoted to transferring income to rural areas and to boosting farm production, both in the name of soil and water conservation. To a large degree these charges were accurate for most of the program's history. But in recent years, ASCS has taken steps to improve the conservation performance of the ACP, and in many respects the program now sets the pace for soil conservation policies and programs within USDA. It is also the only Federal conservation program for which adequate information is available to guage conservation accomplishments and program efficiency. Accordingly, the ACP will be discussed here in some detail.

ACP provides direct payments of up to $3,500 per year to farmers to help defray the cost of installing specified conservation measures. ACP payments may equal up to 90 percent of the total cost, but in general they defray about 50 percent. Historically, an extensive roster of practices has been available to farmers. Included were numerous practices whose main effect was to enhance farm production. Examples were liming of cropland; land drainage; reseeding, liming and fertilizing of permanent pasture. These practices were extremely popular among farmers, but they saved very little soil — or, more precisely, no one knew how much soil they were saving. Nor did program managers seem overly concerned, until very recently.

We have already noted the drubbing ACP took in the evaluation by GAO in 1977. The report amplified criticisms that had been made by SCS and by conservation district officials over the years. GAO made two specific recommendations to the Secretary of Agriculture, which are worth repeating here:

" . . . require ASCS to:

— Make a greater effort to convince the county committees that the conservation objectives of the program can be better achieved if available money is spent on critically needed soil erosion control practices, rather than on practices with unappreciable conservation benefits or on practices which primarily stimulate crop production rather than control soil erosion.

— Work closely with county committees to help them (1) identify, with the assistance of soil expert members of local program development groups, the most critical conservation needs in the area and (2) establish and implement a priority system that would channel funding assistance to the most critically needed practices which have the greatest long-term conservation benefits and which ordinarily would not be undertaken without Federal assistance."

GAO was pointing to a fundamental weakness not just of ACP, but of the voluntary system of conservation in general. The system rests on the premise that it is the local people who are best informed about local conservation needs, and are in the best position to do something about them. GAO found that the local decisions routinely did not reflect true conservation needs. Cost-sharing was distributed mainly on the basis of who requested assistance, the practices that were popular in the area, and the part of the farm for which the assistance was sought. As one USDA official put it, "The (county) committees have a certain amount of money to spend, and they try to spread it around as best they can. If a farmer comes in who meets the eligibility requirements, he'll stand a good chance of getting a share of the money. It doesn't matter if his land is eroding at 1 ton or 20 tons a year, because the selection criteria aren't tied to erosion." (23)

Since 1979, and in response to Congressional directives, the ACP has been required formally to stress long-term conservation practices directly concerned with agricultural resource conservation. "Provision for enduring solutions to conservation and environmental protection problems is accomplished by requiring participants to maintain practices for a specified number of years as a condition of cost sharing. Failure to maintain a practice for the specified lifespan requires a refund of all or a part of the cost share." Furthermore, funds are not to be expended for practices "that return an immediate benefit (to the farmer) or that have little or no soil or water conservation or pollution abatement benefits." Accordingly, ACP no longer cost shares some of the more blatantly production-oriented practices, such as drainage. (24)

These reforms preceded, and laid the legislative basis for utilizing, the findings of the ACP evaluation published in 1982. In Phase I of the ACP evaluation, SCS technicians provided data on erosion rates before and after ACP practices were installed, using the USLE. (In the first phase of the study only sheet and rill erosion were considered.) Altogether, 24,000 erosion control practices, installed between 1975 and 1978, were examined by SCS. These practices had been installed at a total cost to the program and the farmer (excluding technical assistance costs) of $20 million (1978 dollar) and reduced sheet and rill erosion by 4.1 million tons.

ASCS reported that "many cost-shared erosion control practices were found to be installed on lands suffering relatively low rates of erosion." About half the practices turned up on land where sheet and rill erosion rates were less than 5 tons per acre. "By contrast," ASCS found, "lands eroding at rates in excess of 14 tons per acre received 21 percent of the assisted erosion control practices, but account for 84 percent of the excess erosion (erosion rates in excess five tons)". About 23 percent of the practices for which SCS technicians had certified the "need" had sheet and rill erosion rates below the soil loss tolerance for the site, according to a subsequent SCS analysis of the ACP data.

There were a number of reasons given for the observed distribution of erosion control practices. First and foremost was that "historically, ACP has operated with a lack of information and techniques to estimate rates of soil erosion . . . and the impacts of assisted practices on natural resource problems." The local committees didn't have the information at hand "to direct assistance to lands with the most serious erosion problems." A second point "is simply that most agricultural land is eroding at relatively low rates", a fact that only became clear as a result of the ACP study and the first National Resources Inventory conducted by SCS at about the same time. The preponderance of land with low erosion rates was compounded by the fact that one of the most widely cost shared practices in ACP was (and still is) "improving permanent vegetative cover". This entails a payment to defray part of the cost of seed and other materials applied to pasture or hayland. Naturally, it is a popular practice among the farmers ACP tends to serve, about two thirds of whom operate livestock or combined crop and livestock farms. Of course, established fields of hay and pasture tend to have relatively low erosion rates to begin with, and this contributed to the apparent inefficiency of the program.

A similar relationship was observed with terraces. Thirty-seven percent of ACP assisted terraces were installed on land where sheet and rill erosion rates were less than 10 tons per acre annually. It turned out that many of the terraces were in the Great Plains, and were installed primarily to conserve water. Findings such as these led ASCS to observe that "since farmers choose the land to which cost-shared practices are applied, they can be expected to install them on lands where they will receive a return on their share of practice costs." Finally, some practices were cost shared to control wind erosion, but insufficient data were available to appraise wind erosion benefits in Phase I of the evaluation.

The findings of Phase I have been described in detail in the ASCS report and in a number of other publications (25, 26). However, the continuation of the ACP evaluation has produced more current, unpublished data, and shows trends in the program since 1975-78. Based on our review of these data, it would appear that the ACP has substantially improved by most performance indicators.

Table 19 lists nine ACP practices having erosion control as their principal purpose. The table provides a snapshot of ACP erosion control activity for 1975-78 and the first half of 1983. Note the significant decline in establishing permanent vegetative cover over the period. This practice involves a payment to defray part of the cost of reseeding cultivated land to pasture for a minimum of 3 years. Undoubtedly the practice was less sought after by farmers in the face of the massive diversion of land in the 1983 PIK program. The explanation for the large increase in interim cover — essentially a winter cover crop — is less clear. Also notable in the table is a proportionate decline in cost shares for improvement of permanent cover, down from 29 percent of all practices in 1975-78 to 14 percent in

TABLE 19

ACP—Assisted Erosion Control Practices Reported in Phase I Evaluation (1975-1978) and C.R.E.S. (1983).

	1975-1978		*1983*[B]	
	No.	*Percent*	*No.*	*Percent*
Establish Perm. Cover	10,315	43	969	15
Improve Perm. Cover	6,978	29	923	14
Stripcropping	172	0.7	38	0.5
Terrace	1,754	7	1,050	16
Diversions	429	2	227	3
Interim Cover	2,916	12	2,882	44
Critical Area Treatment	217	1	150	2
Minimum Tillage	119	0.5	140	2
No Till	*A*	*A*	241	4
TOTAL	23,911	• 100	6,620	100

[A] *Not Tabulated Separately In 1975-1978.*

[B] *Through June 9, 1983*

the first half of 1983. Earlier we noted the minimal erosion control benefits usually associated with this practice, which consists of topseeding and fertilizing land already in permanent cover crop. The decline in this practice suggests a programmatic shift away from less efficient erosion control practices.

Also notable in Table 19 is the sharp increase in the percentage of terrace assistance; but the largest percentage increase of all is in minimum tillage and no till practices. For these practices farmers are given a payment of about $15 per acre to defray the cost of trying the technologies for three years. Despite the relative increase in the number of cost shares for minimum tillage and no till, however, these practices remain a very minor element in the overall ACP.

Table A-11 (Appendix) shows the percentage distribution of ACP assistance arrayed by the sheet and rill erosion rate on the land before the ACP practice was installed. This table was constructed with the same data used in Table 19. Several promising trends are suggested by Table A-11. In 1975-78, 31 percent of the practices cost shared for establishment of permanent vegetative cover went on land where sheet and rill erosion was less than 2 tons before the practices was adopted. By mid-1983, only 5 percent of these practices went on such land. By contrast, in 1975-78, 15 percent of the cost shares for establishment of permanent cover went on land with pre-assistance rates greater than 20 tons. The proportion nearly doubled to 28 percent by 1983. Table A-11 also indicates a marked increase over the period in cost sharing for terraces in the high erosion ranges.

TABLE 20

Average Pre-Assistance Sheet and Rill Erosion Rate and Average Erosion Reduction (In Parentheses), Selected Conservation Practices, ACP. 1975-1978, 1982 and 1983.*

	1975-1978	*1982*	*1983**	*Change in Pre-Assistance Rate 1975-1978 To 1983 Tons Per Acre*	*%*
	– – – – Tons Per Acre – – – –				
Establish Perm. Cover	11.9 (8.3)	13.1 (12.1)	20.4 (18.4)	8.5	71
Improve Perm. Cover	7.9 (4.5)	5.8 (4.4)	7.5 (5.5)	-0.4	-5.0
Stripcropping	8.0 (3.1)	8.3 (6.3)	12.0 (9.0)	4.0	50
Terraces	14.2 (9.3)	18.5 (14.1)	17.2 (12.0)	3.0	21
Diversions	21.8 (10.6)	11.0 (7.1)	7.9 (4.9)	-13.9	-64
Interim Cover	13.7 (3.1)	19.2 (6.8)	10.6 (4.5)	-3.1	-23
Critical Area Treatment	31.3 (30.3)	48.4 (44.9)	31.8 (30.3)	0.5	2.0
Minimum Tillage	9.7 (5.9)	16.5 (11.3)	5.6 (3.1)	-4.1	-42
No Till	*NA*	*12.0 (10.2)*	*9.8 (7.1)*	*NA*	*NA*
Average All Practices	10.7 (6.5)	13.8 (9.9)	12.9 (8.4)	2.2	21
Average Post-Assistance Rate	4.2	3.9	4.5		

**Preliminary for first 6 months of 1983.*

Source: National Summary Evaluation, Phase I; CRES, ASCS/USDA.

A more general indicator of performance is provided in Table 20. It gives the average sheet and rill erosion rate on ACP-assisted land before and after it received cost sharing. As Table 20 shows, in the period 1975-78, the average sheet and rill erosion rate on land before it was given ACP assistance was 10.7 tons per acre annually. By May, 1983, pre-assistance erosion rates were 21 percent higher on average, or about 12.9 tons per acre annually. Moreover, on average more soil was being saved through ACP practices — 8.4 tons per acre versus 6.5 tons per acre annually — and thus the overall post-assistance erosion rate remained about the same. Most notable were increases in the pre-assistance erosion rates for establishment of permanent vegetative cover (from 11.9 tons to 20.4 tons per acre), terraces (from 14.2 tons to 17.2 tons per acre), and stripcropping (from 8 tons to 12 tons per acre). In the case of several of these practices the trend is not clear when the 1982 data are considered. For example, it appears that improving permanent cover was used on less erodible land in 1982 than in 1975-78 or the first half of 1983. Establishment of interim cover underwent a marked improvement in terms of its pre-assistance erosion rate in 1982, only to drop below the 1975-78 level in 1983.

Entries in Table 20 for minimum tillage and no till are cause for concern. In recent years, these have been the fastest growing practices in terms of number of ACP cost shares. In 1975-78, minimum tillage was on average used on land with pre-assistance erosion rates below the average for all practices (9.7 tons versus 10.7 tons per acre annually). The situation improved markedly in 1982, the practice being adopted on land where the average erosion rate was considerably higher than it had been in the preceding period, and also higher than the average rate for all practices by some 20 percent. In the first half of 1983, however, minimum tillage practices went on land with very modest erosion rates — 5.6 tons per acre on average, compared to 12.9 tons per acre for all ACP practices. No till practices also showed a downslide in the pre-assistance rate, though it was less drastic. And we would point out that the pre-assistance rate for no till has been below the average for all practices since data for that practice have been collected.

We may be observing two effects in these tillage practices, the first of which is the 1983 PIK program. Cost sharing applicants may have decided to take their more erodible land out of cultivation altogether by the time the cost share applications were approved. The ACP continued regardless, of course, and thus the cost sharing was spent on less erodible land, perhaps despite the intentions of the local comittees. Should this be the case, we might antcipate future improvement in the erosion control benfits of these cost shares (though they will not be captured by the evaluation system nor credited to ACP). Farmers who experience success with the practices during the three-year trial period are likely to apply those practices to their more erodible land if it is brought back into production.

A more plausible explanation, in our view, is that local committees may be approving tillage practices regardless of the erosion hazard on the land before the practices are cost shared, simply because these practices are being "emphasized" by the Department, and because they are popular with farmers for reasons other than erosion control. Since most of the land in the U.S. has fairly low erosion rates, a more or less random approval of these tillage practices will not result in significant soil savings. This apparent trend in the ACP cost sharing reinforces our earlier discussion of the 1977 NRI, in which we noted that much of the minimum tillage reported by SCS was on land with very modest erosion potential.

Ironically, tillage practices are being emphasized by USDA because of their cost effectiveness, yet they are the most expensive practices on the ACP docket in terms of their cost per ton of erosion reduction. This is evident in Table 21. The cost per ton of erosion reduction for minimum tillage has risen 75 percent since the initial ACP evaluation of 1975-78, and by mid-1983 it actually exceeded the average cost for all practices. No till practices, recorded separately since 1982, have become more cost effective in the past year: the cost per ton of erosion reduction fell from $4.69 in 1982 to $3.54 in mid-1983. However, the latter figure is more than double the average cost for all practices in mid-1983. Of course, the high cost of both minimum tillage and no till practices in ACP is the result of their being approved for land with relatively low erosion rates. Any erosion control practice will be inefficient, in terms of cost per ton of erosion reduction, if it is applied to land having low erosion rates to begin with.

But it is important to note that, overall, the ACP has shown impressive improvement in efficiency. The cost per ton of erosion reduction was $2.22 in 1975-78. In 1982, it fell to $1.66 per ton, and by mid-1983 it was $1.50 per ton of soil saved. For most practices there has been a similar decrease in cost. Actually, the efficiency has improved somewhat more than those figures suggest, because they do not reflect the effects of inflation.

Most of the improved efficiency is attributable to the increased emphasis ACP managers have placed on using reliable information about the applicants' erosion problems. Recently, ACP managers gave further guidance and encouragement to state and county ASCS offices to improve the program's cost effectiveness. State and county ASCS managers were informed that " the results from the ACP evaluation reports show that ACP practices can be made significantly

TABLE 21

Cost Per Ton of Erosion Reduction, Selected Conservation Practices, ACP, 1975-1978 To 1983.

	1975-1978	*1982*	*1983*	*Change 1973-1978 To 1983*	
	– – – – DOLLARS – – – –			*Dollars*	*%*
Establish Perm. Cover	1.91	1.09	0.64	1.27	66
Improve Perm. Cover	2.90	1.97	1.16	1.74	60
Stripcropping	1.52	1.06	0.29	1.23	81
Terraces	1.17	0.72	0.60	0.57	49
Diversions	0.69	0.97	1.35	0.66	108
Interim Cover	8.07	1.77	3.20	4.87	60
Critical Area Treatment	0.37	0.44	0.97	0.60	162
Minimum Tillage	0.98	1.52	1.71	0.73	75
No Till	NA	4.69	3.54	NA	NA
Average All Practices	2.22	1.66	1.50	0.72	32

ACP's Variable Cost Share Project

One outcome of the ACP evaluation was a pilot project designed to test ways of shifting erosion control cost sharing to land with more serious erosion problems. First launched in May of 1982, the Variable Cost Share Level Program (VCSL) was offered to all counties on a voluntary basis, and 76 counties in 23 states signed up. The program was designed to base cost sharing on the severity of the erosion problem and the percentage reduction in the erosion rate that would be achieved by the ACP practice requested by the farmer. No cost sharing was to be made available for land eroding below the conventional soil loss tolerance.

Since all VCSL counties were automatically included in the ASCS evaluation system, data on the program's effectiveness were available the very first year. The results were impressive. The 2,200 erosion control practices reported for the program as of October 27, 1982 went on land that had an average pre-assistance erosion rate of 17 tons per acre (sheet and rill only). The VCSL practices reduced it to 2.6 tons per acre on average. This compared with pre- and post-assistance averages of 14 tons and 3.9 tons per acre, respectively, for the ACP program overall at that time.

For nearly every ACP practice, the VCSL program was successful in targeting land with more serious erosion problems, and hence reduced erosion by a greater magnitude. As a result, compared to the overall ACP, the cost per ton of soil saved was lower for nearly every practice in the VCSL. Overall, by the end of 1982 the VCSL program saved soil at a cost of $1.32 per ton — 20 percent cheaper than the overall ACP at that time.

The program was for the most part well received by ASCS field personnel and local committees. Two thirds of the participating states were willing to continue the VCSL with no change in the program; another 27 percent were willing to continue it if it were modified. Only 9 percent were unwilling to continue. About three quarters of all applicants were approved under the program's criteria, and only 3 percent of the counties reported an increase in the number of appeals when an applicant was turned down. Ninety-three percent of the counties reported that the ACP assistance was handled as fast as it had been in the past, despite the increase in field and paperwork associated with the program. Three quarters of the counties indicated a willingness to continue the variable cost share approach.

A majority of the local ASCs, SCS personnel, and soil conservation districts indicated a strong level of suport for the VCSL, and over 80 percent of these parties supported the program at least "moderately". Only 24 percent of the farmers involved supported the program strongly, though another 50 percent indicated moderate support.

One surprising reaction to the pilot program came at the annual convention of the National Association of Conservation Districts in February, 1983. Despite the strong support for the VCSL among the districts which actually participated in the program, NACD passed a resolution opposing the VCSL. Nevertheless, ASCS plans to continue and expand the program on a voluntary basis, and it is likely that some successful features of the VCSL pilot effort gradually will be incorporated into the regular ACP.

more effective." One suggestion was to require installation of practices additional to those cost shared to maximize soil savings. For example, if cost sharing is granted for establishing or improving permanent vegetative cover, it was suggested that county officials insist that the cover "not be grazed below a specified height." Where terraces are cost shared, the county may additionally "require contour farming or conservation tillage as part of the terrace system." County ASCS managers were reminded that they "have the primary responsibility for getting the most conservation per ACP dollar invested. Better screening and evaluation of requests is the best method to accomplish this goal." (27)

In effect, the improved efficiency has allowed ACP to save just about as much soil in 1983 as the program saved in 1975-78 with the same appropriation level. ACP managers have estimated that about 83.4 million tons of soil loss was prevented on 10.2 million acres of land in fiscal year 1982. By 1985, they estimate that the $190 million ACP appropriation will result in soil savings of 81.2 million tons on 9.7 million acres. (28) Problems remain in the ACP with respect to erosion control. Most notable is the inefficient performance of the tillage practices and the persistence of a significant level of cost sharing for improving permanent cover. However, it seems likely that overall ACP performance will continue to improve in the years ahead. The success of the ASCS Variable Cost Share Level Program (VCSL) is one promising indication. Certainly the overall program has gained the respect of many conservationists, most of whom were critical of it in the past. One obvious reform of the program would be to shift more program resources to areas with severe erosion problems. To a degree this has been achieved through the ASCS targeting effort. But political considerations have entrenched a rule (once legislative, now administrative) that prevents any state's ACP allocation from being reduced by more than 1 percent annually. It is not longer apparent, to

AFT at least, that a wide distribution of ACP funds is still a prerequisite for the program's continued support in the Congress. But there is little evidence that the Congress will tolerate, much less initiate, an effort to more narrowly confine ACP expenditures to critical problem areas. Fortunately, considerable benefits can be reaped by targeting severe erosion problems that exist in many counties.

It is important to realize the limited effects of ACP erosion control activities, notwithstanding improvements in the program's efficiency. Savings of 80 million tons of soil make up a miniscule fraction of the 5.3 billion tons of sheet, rill and wind erosion estimated to occur annually on non-federal lands. Even with an optimal level of efficiency, ACP will play a minor conservation role in terms of its direct contribution to soil savings. The disparity of these contributions compared to the problem argues strongly for maximizing program efficiency. But it also indicates that without substantial increases in ACP appropriations, the program's chief function is to provide " seed money" for conservation practices. Ideally, the assisted practices will be maintained where they have been applied, and emulated on the vast majority of the acreage that is not directly benefitted by ACP funds.

Rough though it may be, the estimate of 80 million tons of soil saved annually through ACP is the only reliable, documented estimate of the amount of erosion saved through a USDA conservation program. AFT considers the ASCS estimate much more reliable than the estimates provided in the National Conservation Program. More to the point, the magnitude of both estimates reinforces AFT's belief that existing Federal conservation programs must be carefully evaluated for their cost-effectiveness, and supplemented with additional, innovative policies and programs.

SCS Conservation Technical Assistance

The oldest, most extensive Federal activity to promote erosion control is the free technical assistance offered by SCS to individual farmers through local conservation districts. Technical assistance is one of several activities included in the Conservation Operations (CO) program of the Service. Technical assistance includes formal and informal consultation with farmers, the development of farm conservation plans, and the design and layout of specific conservation practices as requested by a farmer. The majority of SCS technical assistance is provided to farmers who are "cooperators" with their local district, although assistance is made available to non-cooperating farmers. For example, SCS provides technical assistance to ACP applicants, who need not be cooperators, through local Agricultural Stabilization Comittees (ASCs). The technical assistance is provided only for practices requiring engineering type work, such as terraces. SCS helps determine the need and practicability of the practice or practices a farmer proposes to adopt with the help of ACP cost sharing. SCS performs practice layout and design services and inspects and certifies the practices after they have been installed.

The amount of technical assistance devoted specifically to soil erosion control cannot be determined from SCS data at this time. The amount of soil conserved by technical assistance also is unknown. In fact, discussion of technical assistance program activities for erosion control is severely hampered by the lack of an SCS evaluation of the Conservation Operations Program. At present, even rudimentary observations about the overall contribution of technical assistance to erosion control are largely confined to guesswork. Data are not available with which to estimate, for example, how much soil is saved anually as a result of the practices installed with SCS assistance. Data are not available on the percentage of conservation practices adopted by farmers for which technical assistance services have been rendered.

Technical assistance is, by nature, more difficult to evaluate than cost sharing activities. For one thing, conservation practices may be adopted by farmers years after assistance is rendered. In addition, technical assistance provided to one farmer may postively influence a neighbor. In either case, it is unlikely that an SCS employee would be "credited" with the resulting conservation work, regardless of the evaluation scheme used. Educational services provided by SCS may likewise result in uncounted conservation benefits. This situation should be rectified in mid-1984, when information gathered through a department-wide conservation data collection system is scheduled for release. Until then, evidence for the role of technical assistance must largely be confined to anecdotes.

Planning activities loom large, and controversial, in SCS technical assistance for all types of resource problems. In 1975, according to GAO, "SCS spent $50 million to prepare or revise

83,180 (farm) plans, for an average of $597 per plan. This effort required the equivalent of about 2,300 staff-years," at that time about 28 percent of SCS's permanent, full-time staff years assigned for technical assistance. (29)

The amount of effort devoted to planning within SCS has been a point of dispute since the 1930's. Under ACP, cost sharing applicants are not required to obtain a *comprehensive* farm plan from SCS. This difference in approach has been a source of friction between SCS and ASCS for many years. Historically, ACP advocates and managers have held that the planning efforts of SCS are too time consuming. Our review of ACP suggested that until recently the ACP emphasis on "action" often led to poor conservation decisions. For many years the Extension Service also generally opposed SCS planning activities. "If SCS carried its whole farm plan to its logical conclusion, it got into such matters as livestock numbers, feeding programs, farm incomes and expenses, and the like," which were the province of the Extension Service. (30) Yet SCS has rather steadfastly maintained that conservation done piecemeal could be worse than no conservation at all. It was also felt that unless a plan were developed that could credibly promise to increase farm income, farmers would not be able or inclined to find the money to adopt the conservation practices recommended in the plan.

Even within SCS and the conservation districts past emphasis on detailed farm plans is now generally viewed as excessive. GAO reported in 1977 that several SCS district conservationists felt the planning time detracted in various ways from their ability to make more frequent and effective contact with landowners. Other district conservationists noted the importance of conservation tillage in most erosion control systems, and observed that "farmers can use conservation tillage to control erosion on most cropland with little or no formal planning assistance from SCS." (31) Conservation tillage is, of course, being heavily promoted by SCS at the present time.

A 1975 survey of about 3,000 SCS line officers revealed that "the backlog of conservation plans will take SCS 57 years to revise at today's level of planning. The average date of preparation or revision on a plan in district files is 1963." About 86 percent of the survey respondents stated they were unable to do adequate follow-up on planning activities. "Appointments are not being made with cooperators to make a systematic on-the-land review of conservation plans. The evaluation of conservation plans in all states confirmed a poor implementation record through lack of effective follow up servicing of conservation plans." (31a)

Table 22, taken from the same 1975 survey, indicates that, with the exception of conservation cropping systems (soil saving crop rotations and cultural practice) and crop residue use, most planning activities yielded rather low rates of actual application of conservation practices. Thirty percent of the terraces and contour farm-

TABLE 22

Application of Selected Soil Conservation Practices as a Percent of the Acreage Planned by SCS in 1975: U.S. Average and Top 10 States for Sheet and Rill Erosion on Cropland in 1977.

	Practice					
State	*Conservation Cropping System*	*Crop Residue Use*	*Contour Farming*	*Minimum Tillage*	*Strip-Cropping*	*Terraces*
Iowa	71	95	46	22	9	30
Illinois	—	61	33	—	—	7
Missouri	—	—	99	7	—	46
Nebraska	91	28	51	—	—	57
Kansas	72	85	109	86	1	84
Texas	87	82	31	3	2	21
Mississippi	—	97	52	10	38	—
Tennessee	—	78	34	1	—	4
Indiana	69	62	37	—	16	20
North Dakota	94	94	—	7	—	5
10 State Average[1]	81	76	55	19	13	30
U.S. Average	73	60	30	18	16	30

[1] Straight Average Unweighted by Acreage.

(—) Means No Entry in Table From Which Data Were Taken.
AFT Excluded These Entries From 10 State Average.

Source: "Final Report of the Task Force on Adequacy of Conservation Systems on Cropland." SCS/USDA, 1978. pp 12-13.

ing practices planned by SCS were applied by farmers. Only about 18 percent of the minimum tillage and 16 percent of the strip cropping planned by SCS were actually applied by farmers. Table 22 also shows application of selected soil erosion control practices as a percentage of the acreage planned for the ten states that "lead" the nation in cropland sheet and rill erosion according to the 1977 NRI. Most of these states surpassed the national average in the percentage of application for conservation cropping systems, crop residue use, and contour farming. However, eight states fell below the national average in the application/planning ratio for minimum tillage and for strip cropping, and six states fell below that ratio for terracing. (The dash marks in Table 22 also appeared in the original SCS report, and AFT interpreted them to mean "less than 1 percent" or "practice not reported".)

The pattern of practice application revealed in this 1975 survey corresponds surprisingly well to the incidence of erosion control practices reported in the National Resources Inventory conducted two years later. Comparison of the two information bases suggests that SCS technical assistance is very effective, or compatible with farming operations, for practices like rotations and crop residue use. The success rate for technical assistance was also quite high for terraces in two of the Great Plains states, Nebraska and Kansas (see Table 15), where terraces can provide immediate benefits in water conservation. For other practices the ratio of application to planning is much lower. Most discouraging is the low application/planning ratio for minimum tillage. Advances in the technology since 1975 have no doubt made techincal assistance easier for that practice in recent years. However, to AFT's knowledge, SCS has not conducted similar surveys or analysis of the adequacy of conservation systems in the past 8 years.

According to the National Program for Soil and Water Conservation, released in December, 1982, SCS has changed the procedures for conservation planning to reflect the recommendations of the GAO and a 1975 SCS task force. SCS now places "less emphasis on the plan document and more emphasis on applied conservation." (32) One tangible change was the revision of the SCS National Conservation Planning Manual in 1978, which incorporated suggestions to streamline the planning procedures. Although SCS will, upon request, prepare traditional, whole-farm plans, in general plans now tend to be prepared to deal with specific problems. They are much less elaborate than those of a decade ago. Moreover, the emphasis has gradually shifted away from the engineering types of practices, which lent themselves to the development of detailed, long-term planning documents, and toward tillage, residue and other crop management practices requiring little or no formal planning. Conservation tillage is a prime example. Anecdotal accounts suggest these procedural changes have been favorably received by agency personnel and farmers. The streamlined planning process has apparently given SCS more flexibility in adjusting its workload, particularly at the district level. It also has aided in the targeting process by allowing for easier, temporary transfers of personnel to designated critical areas.

Even so, the proportion of time spent in planning activities has remained fairly constant in recent years, amounting to about 20 to 25 percent of the total technical assistance time. Because contemporary plans are officially less detailed, SCS managers presume that more acres are being planned for conservation purposes. Beginning in 1982, personnel time spent in planning and application were combined into one category in the SCS Progress Reporting System. That year an estimated 78 percent of the CTA time was devoted to planning and application of conservation practices. SCS program managers estimate that there is about a 30-70 split between field and support activities in most field offices. Based on this split, about 55 percent of total SCS technical assistance was field time, and 23 percent was planning "support" time in 1982. (33)

Some very general inferences can be made about the effect of technical assistance on erosion control from data collected through the SCS Progress Reporting System. For example, "land protected from excessive erosion" annually declined slightly from 1978 through 1980, from 37.8 million acres to 36.8 million acres, but then increased to 43.8 million acres by 1982. Personnel reductions caused the total technical service time in the agency to decline 10 percent over that period, suggesting that the "acres protected per staff year" increased by 29 percent, from 4,192 acres to 5,423 acres. (Figure 11) However, the time devoted specifically to erosion control may not have declined as rapidly as did total agency personnel over this period, and the apparent "productivity" change may have been over-stated.

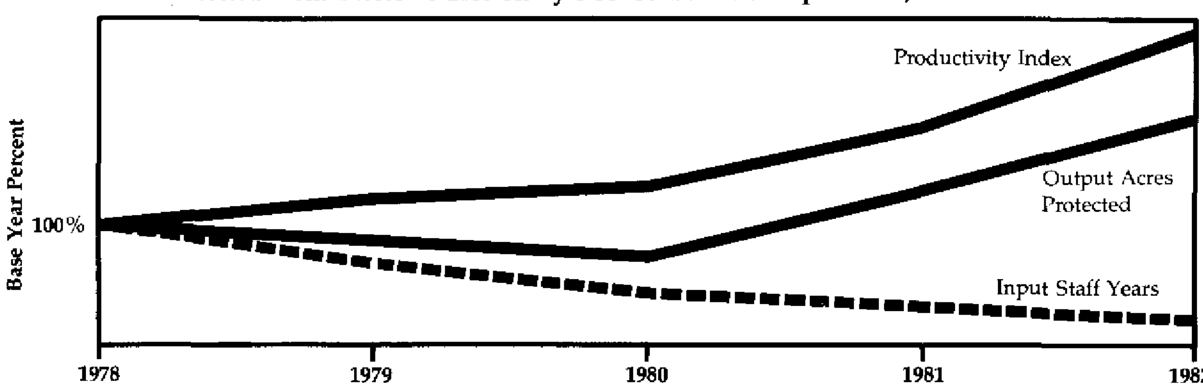
Some additional insights about SCS accomplishments can be gleaned from Table 23, which shows the acreage for which SCS technical assistance resulted in some degree of conservation in fiscal years 1981 and 1982. The assistance is divided into three categories, and the conservation achieved does not necessarily pertain to soil erosion control. "Land benefited" means "areas receiving conservation treatment, but not necessarily to the point at which deterioration of the resource is prevented." In 1981, over half of the land assisted fell in this category. Another 15 percent was "adequately treated", meaning conservation practices installed with SCS technical assistance were "in excess of those necessary to prevent deterioration and maintain the productive capability of the resource." Land is reported as "adequately protected" when SCS assistance has resulted in the use of "conservation practices and management systems necessary to arrest or prevent deterioration and maintain the productive capability of the resource bases." Where soil erosion was the resource problem being addressed, this category would include land on which soil losses have been brought below the established soil loss tolerance (T value). One third of the land assisted in 1981 was in this category.

As Table 23 indicates, in 1982 there was a slight increase in land "adequately treated" — treated, that is, with more conservation measures than were necessary. The amount of land "adequately protected" showed an 8 percent increase, from which we may infer that more land was brought below the soil loss tolerance in 1982 than in 1981. A substantial decline (of 37 percent) was reported in the acreage "benefited", on which conservation has not yet resulted in adequate protection. The decline in this category offset the modest increases in the other two in 1982, causing the overall acreage assisted to drop by 16 percent. Hence, land "adequately treated" and "adequately protected" increased as proportions of the total land assisted. We can estimate that, in 1982, about 1 out of 5 acres receiving SCS technical assistance did not have significant conservation problems before assistance was rendered. Another 42 percent of the acres were fully protected as a result of SCS assistance. Thirty nine percent of the acres, those which "benefited" from assistance, still had conservation problems afterwards. Again, data from the Progress Reporting System do not separate assistance for soil erosion from assistance for other conservation problems. We may only guess that the patterns described above would apply to erosion reduction, the agency's chief mission.

Recently, SCS has estimated the total amount of soil that will be saved annually as a result of the ongoing "targeting" of technical assistance and the regular conservation technical assistance

Figure 11- 22A

Land Protected From Excessive Erosion By SCS Conservation Operations, 1978-82.



Output: Acres Protected From Excessive Erosion			Input: Staff Years Technical Service Time			Productivity: Acres Protected Per Staff Year		
1978	37,786,437	100%	1978	9,013	100%	1978	4,192	100%
1979	37,535,282	99%	1979	8,594	95%	1979	4,368	104%
1980	36,818,117	97%	1980	8,277	92%	1980	4,448	106%
1981	40,058,006	106%	1981	8,168	91%	1981	4,904	117%
1982	43,864,543	116%	1982	8,088	90%	1982	5,423	129%

Source: SCS Progress Reporting System

effort. Targeting simply means increasing the amount of technical assistance activity in designated geographic areas where erosion or other resource problems are acute. SCS began targeting in 1980 and plans to continue it at least through 1987. Here we will consider only the accomplishments SCS anticipates from the targeted and regular technical assistance activities over the next few years. At the outset, we must emphasize that these projected savings are essentially guesses. SCS does not have actual field measurements of soil saved through its activities at present. Data of this sort will not be available until March, 1984.

Table 24 shows the total annual amount of sheet, rill and wind erosion savings projected by SCS between 1983 and 1985. Soil savings achieved on land eroding below the soil loss tolerance at the time of assistance are not included in these estimates. SCS estimates that 120 million tons of soil will be saved through technical assistance in 1983. (Table 24) This estimate is substantially higher than the 92 million ton projection made in 1982 in preparing the fiscal year 1983 budget. The revision was based on SCS analysis of data reported by ASCS for soil saved through the ACP. SCS analysts assumed that the soil saved on the acreage treated through ACP was proportional to the soil saved on "land adequately treated", as reported above. The 1983 estimate resulted when SCS "split the difference" between the lower 1983 estimate and the projection of the ACP data. Projected savings of 150 million tons in 1984 and of 177 million tons in 1985 were extrapolated from the revised 1983 estimate.

Hence, SCS projects a 25 percent increase in soil savings next year, and an 18 percent increase above the 1984 level in fiscal year 1985. The projected savings are attributed mostly to the targeting effort, which by 1985 will embrace 60 percent of the cropland eroding at rates greater the soil loss tolerance (T value). SCS analysts assume that 15 percent of the savings in 1983 — 18 million tons — will come from targeted areas. About 60 percent of the savings projected for 1985 are expected to come from targeted areas. (34)

Much lower estimates of annual soil savings in the target areas were given in the targeting proposals submitted by SCS state offices. (Figure 12 and *Table 25) SCS analysts in national headquaters* believe the state estimates are conservative because the states would prefer to have actual performance exceed official expectations. Nevertheless, the estimates reflect what SCS personnel in target areas hope to achieve. The total soil saved by technical assistance in the 132 targeted counties in the base year (1980) was 7.3 million tons. Targeting implemented in the last six months of 1981 resulted in a 21 percent increase in erosion reduction in those counties. In 1982, erosion in those counties was reduced by 13.1 million tons, a 49 percent increase over 1981 savings. In 1983 the number of targeted counties more than doubled, and estimated erosion savings jumped to 44 million tons. (35)

Assuming that the erosion rate on cropland in the targeted areas averaged 10 tons per acre each year — a conservative assumption given the national criteria for targeted areas — the total soil loss on targeted cropland would be about 205 million tons in 1981, and a like amount in 1982. Hence, SCS targeting reduced erosion by 4 percent in 1981 and by 6 percent in 1982 in targeted areas. There were a total of 58.5 million acres of cropland in the areas targeted in 1983. Assuming a 10 ton erosion rate, the total soil loss in these areas was about 585 million tons. Thus, targeted technical assistance reduced that total by an estimated 8 percent.

We also note that the average amount of soil saved per assisted acre — land "adequately protected" and "benefited" — remained at about 5.2 tons between the base year and 1983. We infer

TABLE 23

Land Benefited, Adequately Treated, and Adequately Protected with SCS Technical Assistance, Fiscal Years 1981 and 1982.

	F.Y. 1981	*F.Y. 1982*	*Percent Change*
Land Benefited	76,452,381	47,798,880	-37
Land Adequately Treated	22,105,584	22,587,930	2
Land Adequately Protected	47,798,880	51,616,093	8
TOTAL	146,357,745	121,992,903	-16

Source: SCS Progress Reporting System, National Summary, F.Y. 1981 & 1982.

TABLE 24

Estimated Soil Savings for SCS Conservation Technical Assistance, 1983-1985.

	Fiscal Year		
	1983	*1984*	*1985*
Tons of Soil Saved (Millions)	120	150	177

Source: SCS Conservation Planning and Application Staff. Personal Communication. June 23, 1983.

from this calculation that increases in soil savings anticipated for targeted SCS technical assistance will accrue primarily from expansion of targeted area, not from greater per acre savings over time. By comparison, erosion reduction for ACP assisted practices was 6.5 tons per acre in 1975-78, 9.9 tons per acre in 1982, and 8.4 tons per acre in the first six months of 1983. (See Table 20) Erosion reduction in areas targeted by ACP in 1982 averaged 17.6 tons per acre, about triple the SCS savings in targeted areas. (36) Erosion reduction in the ACP Variable Cost Share Level pilot program averaged 14.4 tons in 1982. These ACP savings would be even higher if they included wind erosion as the SCS estimates do.

In conclusion, we must reemphasize the analytical difficulties presented by the extremely limited amount of reliable data on the overall effect of SCS technical assistance. The preceding analysis is, necessarily, AFT's guesswork applied to SCS guesswork. Given those limitations, we would offer the following observations about the effect of SCS technical assistance on erosion reduction.

Overall, SCS technical assistance appears to have little direct impact on total national erosion. Even with targeting, by 1985 SCS projects savings of 177 million tons of soil annually due to SCS technical assistance. Based on erosion estimates in the 1977 NRI, this equals 6 percent of the sheet, rill and wind erosion on cropland; 3.3 percent of the sheet, rill and wind erosion on cropland, pastureland, rangeland and forest land combined; and 2.8 percent of total national erosion. (Table 1) However, erosion levels may well have increased since 1977, and may increase further by 1985. Hence, the gap between actual erosion conditions and the accomplishments of technical assistance may actually widen, despite absolute increases in the amount of soil savings projected by SCS.

Comparisons of erosion reductions estimated for SCS technical assistance and ACP financial assistance strongly suggest that cost sharing is more effective than technical assistance. Granted, some ACP financial assistance includes a considerable amount of SCS technical assistance. However, as a mechanism for reducing erosion in a cost effective manner, cost sharing seems to have an advantage within the framework of voluntary conservation programs. The advantage of cost sharing over technical assistance appears to have increased as a result of recent reforms in ACP.

Better information on the impacts of SCS technical assistance would provide a basis for making that assistance more effective. Without such information, it is impossible to assess the overall impact of the Federal conservation effort. In particular, the annual soil savings estimated for the National Conservation Program are not only very low compared to national erosion problems, they are derived from a very crude analysis that cannot be fully tested against data obtained in the field until mid-1984. *A basic intent of the RCA was to provide the Congress with reliable measures of how well Federal conservation programs perform in solving agricultural resource problems. The Congress needed such measures to judge if presidential budget requests were adequate to protect the Nation's agricultural resources, or if reforms of Federal conservation programs were warranted. The NCP therefore fails to fulfill a basic purpose of the RCA.*

The corps of over eight thousand SCS field employees involved in conservation technical assistance activities are themselves an extremely vauable national resource. Collectively, they possess skills essential to solving America's agricultural resource problems. Perhaps their greatest strength lies in their truly unique understanding of local economic and ecological forces affecting soil, water and related resources. It is not evident, however, that this skill and under-

TABLE 25

Estimated Soil Savings for Targeted Areas, SCS Technical Assistance "Base Year" Through 1983.

	Base Year	*1981*[1]	*1982*	*1983*[2]
Sheet, Rill and Wind Erosion Prevented (Million Tons)	7.3	8.8	13.1	44
Targeted				
[4] Counties	132	132	132	339
[4] Cropland Acres	20.5	20.5	20.5	58.5
Staff Years				
[4] Targeted	—	99	142	289
[4] Total	316	415	458	1,210
Tons Saved Per Staff Year		21,205	28,603	36,364
Acres Adequately				
[4] Protected (1000)	393	498	710	2,300
[4] Benefited	998	1,103	1,844	6,200
Total	1,391	1,601	2,554	8,500
Tons Saved Per Acre	**5.2**	**5.5**	**5.1**	**5.2**

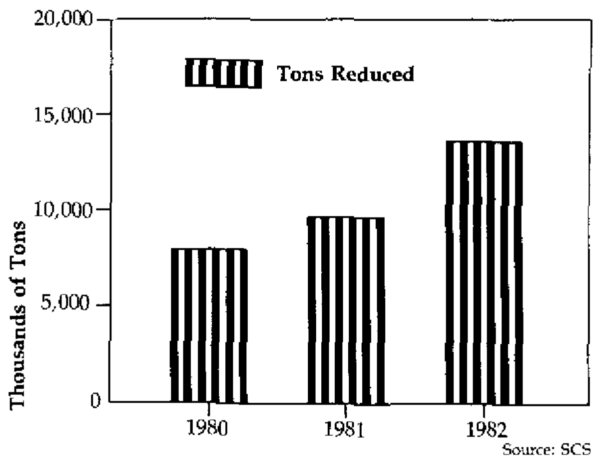
[1] F.Y. 1981 Actual Accomplishments Based on 6 Months of Targeted Operations.

Source: National Targeting Plan SCS Conservation Technical Assistance.

standing can be effectively exploited by the existing voluntary system of conservation. A critical deficiency of that system is the schism between technical and financial assistance. For the most part, SCS field staff cannot directly reinforce their technical recommendations to farmers with economic incentives. Unfortunately, incentives frequently are needed if farmers are to adopt the recommendations. Without incentives, SCS field staff have very little but "advice" to offer farmers who are abusing their land out of economic necessity (or what the farmers believe to be economic necessity). Indeed, the 1975 SCS Task Force on the Adequacy of Conservation Systems on Cropland stated a need for cost-share assistance to be added to the SCS Conservation Operations Program. (37).

Furthermore, it is often impolitic and counter-productive for SCS field staff to be too aggressive in seeking out "problem farmers" in their area, as GAO advised in 1977. To do so may risk alienating the very landowners and farmers most in need of conservation assistance. In AFT's view, the success of SCS technical assistance activities — the cornerstone of the voluntary system — rest too heavily on a relatively rare combination of personal and professional traits: technical skill; familiarity with details of local farming practices, local leaders, local customs; persuasive salesmanship, and so forth. The local familiarity is especially difficult to attain because the SCS personnel who have the most frequent contact with local farmers — the soil conservationists and techicians — advance more quickly in the SCS ranks and in salary if they transfer to new

Figure 12-
Targeted Area Accomplishments — FY 1980-1982
Cropland Erosion
Erosion Reduced



geographic areas every few years.

These problems suggest inherent, structural flaws in the system SCS field personnel must operate within. In addition to improvements in the existing program, new policy and program approaches should be designed to take fuller advantage of the SCS field force.

The Great Plains Conservation Program (GPCP)

In 1956 the Congress established a special program to deal with conservation problems common in the semi-arid Great Plains. The Great Plains Conservation Program (GPCP) is the only Federal conservation program in which both technical assistance and cost sharing are the combined responsibility of a single agency, SCS. The GPCP was established on the assumption that "if the agriculture of the region is to be stable, certain portions of it ought to be permanently in grasses." (38) The Congress authorized the program on a voluntary basis, using conservations plans for the "total conservation treatment of farm and ranch units" in the 518 eligible counties "with the most severe soil and water resource problems." Ten states have counties participating in the program: Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming.

The program operates as follows:

"To participate in the program, a land owner or operator makes application to the SCS. The district conservationist in consultation with the local soil and water conservation district assigns a priority to the application consistent with the State priority systems. In all GPCP States, erosion severity is the highest among the priority criteria. SCS assists the land user in preparing a conservation plan that sets out a system of conservation practices, a schedule for the application of the needed practices, and an estimate of the cost of the system. The plan is reviewed and approved by the local soil and water conservation district board. A contract is then developed with the land user that obligates him/her to carry out the plan as scheduled, and obligates SCS to provide the technical services and information as well as to share the cost of the conservation system set forth in the plan." (39) The program stresses treatment of all soil and water resource needs identified in that plan for the farm unit, not just erosion. Cost sharing is provided for a variety of practices, up to 80 percent of the practice cost. Practices that enhance yields are generally cost shared at a lower level than those that do not. The contracts are for 10 years, and in 1979 the cost-sharing payments per contract amounted to about $11,000 (i.e., $1,100 per year).

In theory, a key component of the GPCP contracts is the reestablishment of grasslands on areas that are marginal for cropping, primarily because of their erosion hazard. At the time of enactment, a goal of converting 16 million such acres was established by the USDA, and 95 percent of the program's funds were to be devoted to that purpose. Initially the goal was to be achieved by 1971, but Congress has subsequently extended the program on two occasions, first to 1981, and in 1980, to 1991.

Between the inception of the program in 1957 and 1979, about 108 million acres of land had

TABLE 26

Great Plains Conservation Program Accomplishments, Conservation Practices And Percent of Funds

	Practices	*Unit*	*Cumulative Thru 9/30/79*	*% of Funds*
1.	Establishment permanent vegetative cover	acres	2,802,810	12.8
2.	Establishment of field or wind stripcropping	acres	1,100,034	0.8
3.	Establishment of contour stripcropping	acres	181,938	0.4
4.	Establishment of contour farming operations on nonterraced land	acres	4,981	- -
5.	Reestablishing grasslands	acres	2,293,559	12.9
6.	Establishment of trees or shrubs	acres	60,390	1.5
7.	Establishing of permanent waterways	acres	53,754	3.4
8.	Terraces	miles	95,240	13.6
9.	Diversions	miles	5,915	1.7
10.	Grassland mechanical treatment	acres	393,067	0.2
11.	Dams for erosion control, detention, or sediment retention	number	23,494	3.0
12.	Grade stabilization structures	number	6,090	0.9
13.	Streambank or shore protection and stabilization; channel clearance, enlargement, or realignment; or construction, enlargement, or realignment of floodways, levees, or dikes	linear feet	289,833	0.2
14.	Diversion dams and spreader ditches or dikes to divert and spread water	acres	150,167	1.8
15.	Reorganizing irrigation systems	number	5,425	4.5
16.	Irrigation land leveling	acres	241,498	3.5
17.	Constructing, enlarging, or sealing dams, pits, or ponds for irrigation water	number	843	0.4
18.	Lining irrigation ditches, canals, or laterals	linear feet	1,977,004	0.9
19.	Wells	number	24,415	6.6
20.	Developing springs and seeps	number	18,104	.4
21.	Constructing, enlarging, or sealing dams, pits, or ponds	number	40,820	7.7
22.	Pipelines	miles	11,853	6.6
23.	Controlling competitive shrubs	acres	6,025,306	8.3
24.	Fences	miles	20,877	4.6
25.	Critical area treatment	acres	367,275	1.0
26.	Irrigation tailwater recovery system	number	336	0.1
27.	Disposal lagoons	number	483	- -
28.	Recreation land grading and shaping	acres	16	- -
29.	Water storage facilities	number	11,057	1.8
30.	Catchment basins	number	5	- -
31.	Shallow water areas	number	20	- -
32.	Holding ponds and tanks	number	187	0.2
33.	Installation of grass barriers	lin. ft.	1,493,248	- -

been brought into the program under 57,000 contracts. As of 1979, about 30 million acres of land were under some 12,000 contracts in the program. Land enrolled in the program constitutes about 6 percent of the GPCP area. The number of new GPCP contracts has fallen steadily in recent years as a result of the effects of inflation on an essentially level program budget of $20 million. The number of program applicants has always remained well beyond the capacity of available funds.

Table 26 lists the acreage treated with GPCP practices, and the percentage of program funds spent on different practices between 1956 and 1979. Approximately 5.1 million acres had been established or reseeded to permanent vegetative cover over that period, slightly less than one third of the goal set for the program in 1956. This figure probably overstates the program's accomplishments because it does not account for lands that may have been reconverted to intensive cultivation upon expiration of 10-year GPCP contracts since 1966. In 1976, GAO examined 98 expired GPCP contracts in four different states and found that about one quarter of the 13,000 acres converted to grass through GPCP had been reconverted to crop uses when the contracts expired. (40) Table 26 also indicates that only about 26 percent of the GPCP funds have been devoted to establishment and reseeding of permanent cover, far short of the 95 percent level originally estimated by the Department.

Two reasons are commonly given for the poor performance of the GPCP in converting land to permanent cover. First, in most instances the economic returns to cropland use exceed substantially the returns to a grassland-livestock operation. The GPCP cost share payments do not make up the difference, but merely defray part of the cost of establishing the grass cover. Second, many farmers who initially agree to establish grassland evidently do so because it fits conveniently into their crop rotation schedule. When that schedule calls for a return to cultivated crops, the grassland is plowed out again. (41,42)

The GPCP has had a very limited effect on erosion in the Great Plains region. According to one unpublished SCS estimate, between 1957 and 1979 the GPCP reduced erosion caused by water by about 75.2 million tons. Erosion caused by wind was reduced by 165.1 million tons. For both types of erosion combined, the average annual reduction was 9.2 million tons.

Most of this reduction is attributable to the technical assistance aspect of the program, not to cost sharing. According to data collected for the period 1977-1979, cost shared GPCP practices resulted in reductions of about 1.7 million tons of wind erosion and 1.2 million tons of water erosion. Combined, these figures are about one third of the estimated 9.2 million tons of erosion reduction achieved annually between 1957 and 1979. By comparison, the *annual* potential for wind erosion in the Great Plains States (as estimated by the Wind Erosion Equation) is 812 million tons, and for water erosion 334 million tons (as estimated by the USLE) according to the 1977 NRI (1,146 billion tons total). Some of this erosion occurs at rates below the level considered "tolerable" by SCS. The same source estimated average annual erosion at rates greater than 2.5 tons per acre on rangeland, and 5 tons per acre on other land, would be "excessive". Therefore the total annual "excess" erosion in the Great Plains area "is about 629 million tons by wind and 25 million tons by water", a total of 654 million tons. Based on the estimated 9.2 million ton annual reduction in water and wind erosion brought about by the GPCP, the program helps control only 0.8 percent of total erosion in the Great Plains States, and 1.4 percent of the "excess" erosion each year. (43)

The very limited effect of the program can be partly explained by its funding level, which historically has been far below the $50 million authorized by the Congress. Even at full authorization levels, however, the program still would not have had a significant effect on total erosion in the region unless substantial changes were made in program administration.

Although these estimates of GPCP accomplishments are not widely known, many people have questioned how efficient and effective the GPCP has been in saving soil. The extremely limited amount of information on the physical impacts of the program makes it impossible to quantify the program's efficiency with any degree of reliability. A crude estimate may be made, however. Between 1977 and 1979, about $10 million in GPCP funds went for cost sharing annually. Over that same period, an annual reduction of 2.9 million tons of water and wind erosion was attributed to cost shared GPCP practices. If one assumes that all of these cost shared practices were "necessary" to effect erosion control — an assumption entirely consistent with the whole-farm planning concept — then it is reasonable to charge all cost share payments against total erosion reduction. Based on this assumption, it cost $3.45 in Federal cost sharing funds, exclusive of farmer and technical assistance costs, to save a ton of soil through the Great Plains Conservation Program in 1977-1979. A less plausible assumption would attribute all soil savings to the 26 percent of the funds spent on establishment and reseeding of permanent cover. In this case the cost per ton of reduction would be about 90 cents, exclusive of farmer and technical assistance costs. The first calculation probably understates the efficiency of GPCP, and the second must certainly overstate it. SCS analysts estimate that approximately 61 percent of this $10 million in cost-sharing goes for erosion control practices. On this basis, the cost per ton of erosion reduction in 1977-1979 was $2.10. (44)As a reference point, the amount of Federal cost sharing required to reduce erosion by one ton in the Agricultural Conservation Program was about $1.11 in 1975-78, and by May of 1983, it had fallen to 73 cents per ton. The figure for ACP targeted areas was 40 cents per ton in 1982. For counties in the Variable Cost Share pilot program the figure was 43 cents in 1982.

Based on these admittedly crude estimates of GPCP costs, AFT judges that the overall ACP program was considerably more cost-effective than GPCP *before* any reforms in the ASCS program were instituted. Those reforms only appear to have widened the gap.

For the most part the very modest impact of GPCP on erosion must be attributed to conceptual and operational flaws in the program itself. Many of these flaws reflect the incompatibility between the goals and management of the program and the economics of agriculture in the Great Plains. Chief among those flaws is the apparent inability of the program consistently to enroll those areas with the most severe erosion problems. The emphasis on whole farm planning and treatment dilutes the attention paid to erosion problems. In recent years, though, the GPCP plans have, like other SCS-prepared plans, become less detailed and have tended to stress piecemeal treatment of the most serious resource problems. It is impossible to determine the contribution to erosion control made by the many GPCP practices, such as fences, ponds, wells and pipelines. These practices contribute to the feasibility of livestock production, and hence encourage grassland based agriculture. However, GAO and departmental evaluations have consistently recommended that more emphasis be placed on practices which have erosion control as their explicit purpose. Finally, the most cost-effective erosion control measures have not always been emphasized in the program, and recurrent suggestions to reallocate GPCP funds among states to better reflect actual erosion problems have not been acted upon. (44)

In 1980 and 1981 a team of SCS personnel compiled an environmental impact statement (EIS) on the Great Plains Conservation Program. This followed Congressional extension of the program in 1980, and had as its aim the improvement of GPCP during the new reauthorization period, through 1991. The SCS team analyzed seven distinct alternatives for future operation of the program, ranging from elimination of GPCP, to continuation in its present form, to varying degrees of "redirection" to increase the emphasis on a variety of resource problems. After reviewing these options, the SCS team supported the alternative calling for a redirection of more program resources into soil erosion control work on nonirrigated cropland.

The study estimated that "annual gains in reduction of wind erosion by 38.45 million tons and water erosion by 13.7 million tons would be achieved", of which 11 million tons and 2.7 million tons, respectively, would come through cost shared practices. This projection represented a six-fold increase in annual GPCP soil savings as estimated by the SCS study team. The program funds expended on rangeland practices would have dropped from 55 percent to 43 percent of the total, and the proportion spent on nonirrigated cropland would have increased from 35 percent to 50 percent. Emphasis on cost-effective practices (stripcropping in particular) would have reduced the cost per acre treated by an estimated 59 percent, from $19.23 to $7.97. The EIS suggested an "assessment" of the allocation of funds among states and among designated counties within states, "to ensure that the redirected funds are allocated to those areas where the most cost effective practices are applicable and acceptable."

This discussion has drawn heavily on the final draft of the SCS Environmental Impact Statement, which was never officially released by the Service. As might be expected, the report engendered a great deal of controversy among SCS state Conservationists and conservation district officials supportive of the existing GPCP approach. Unfortunately, the reaction to and official handling of this GPCP analysis effort and report exemplifies a recurrent problem facing SCS program evaluators and managers. SCS programs have strong supporters, most of whom are very familiar with the day to day operations of the programs, and who sincerely feel they are knowledgeable about the programs' overall accomplishments and effectiveness. The few evaluations of SCS programs that have been performed have, to a degree, failed to bear out the expectations of these supporters. The evaluations themselves, and not the program weaknesses documented in them, become the object of criticism within the SCS bureaucracy and among conservation district officials. Unflattering evaluation findings are construed as disruptive of the status quo, or as potentially threatening to the very existence of the program or the program's budget, rather than as helpful guides for improving program performance. Typically, SCS's evaluative materials remain unpublished or are not widely circulated.

But the failure to release the 1981 Environmental Impact Statement for the Great Plains Conservation Program is particularly unfortunate. For one thing, SCS conducted an extensive public participation program as part of the EIS process. We quote from the unpublished report:

"SCS placed a notice of intent to undertake such a study in the Federal Register on December 10, 1980. At the same time, approximately 13,300 letters were sent to individuals, groups, and agencies requesting their participation in the environmental evaluation and scoping process. Notice was placed in some 300 local newspapers serving the GPCP area and spot announcements were made on 87 radio and television stations requesting public participation in the environmental evaluation. Approximately 70 nationally based interest groups and organizations were contacted. Public meetings were held in the five following places: Denver, Colorado; Wichita, Kansas; Roswell, New Mexico; Bismarck, North Dakota; and Clinton, Okalahoma. Approximately 170 people attended these public meetings . . . . As a result of these efforts to involve the public in this environmental review, 1,085 comments were received from 854 individuals, 203 Federal, State, and local agencies, and 28 special interest groups (wildlife, agriculture, and banking . . ."

In addition to wasting this substantial public outreach activity, the failure to release the EIS frustrated the efforts of literally dozens of SCS personnel involved in the conduct of the study itself. To our knowledge, the only time the report has surfaced in congressional deliberations was when Rep. George Brown, Chairman of the House Agriculture Subcomittee on Department Operations, Research, and Foreign Agriculture, requested a copy of the impact statement. (46) That request was made on April 27, 1982, nearly two years after Congressional reauthorization of the GPCP triggered the EIS process, and 8 months after a final draft of the EIS was cleared for publication by SCS reviewers. No mention of the EIS or any of its findings appears in the final RCA report presented to the Congress in December of 1982.

Federal Funding For Erosion Control Efforts

Experts generally agree that erosion control has received a declining proportion of Federal conservation program funds over the years. Overall, those program funds, which for most activities peaked in the 1950s and 1960s, have also declined in terms of "constant dollars" (dollars adjusted to reflect the effects of inflation).

In his April 19, 1983 testimony before the Senate Committee on Agriculture, Nutrition and Forestry, Agriculture Secretary John Block stated that about 31 percent of the $951.8 million budget for USDA's conservation programs was devoted to "reducing erosion" in "the historical pattern through fiscal year 1981". Secretary Block announced his intention to increase that proportion to 38 percent by 1988. However, the Secretary also defended President Reagan's proposal to sharply reduce the overall conservation budget through 1987. The reductions proposed would have more than offset the increasing proportion of funds allocated to reducing erosion.

Actually, USDA budget experts consider the 31 percent figure an educated guess about the proportion of funds devoted to erosion control. As is the case with all other agencies dealing with conservation, the reporting systems used in developing SCS's budget and program activities have not separated agency expenditures in a consistent manner. Hence, the proportion of funds allotted to erosion control over the years cannot be directly calculated. In addition, various reorganizations have transferred some erosion control activities to other agencies and brought others into SCS. One major example is erosion research. (Research was the first component of the national conservation program and an important part of SCS activities in the Service's early years. Responsibility for conservation research was transferred to USDA's Agricultural Research Service in 1952.)

In 1980, ASCS published estimates showing a significant decline in ACP payments for cost shared practices in the "soil loss" category for the period 1940 to 1979. The ACP payment categories are somewhat imprecise. For instance, some "soil loss" practices may also produce important water quality benefits, and vice versa. We have already noted the historical preponderance of production-enhancing practices in the program. Nevertheless, ACP practice categories do capture the general pattern of payments according to the major benefits of the practices. In 1940 and 1950, about 85 percent of ACP payments were made for erosion control practices. By 1960 the percentage had fallen to 64 percent, then to 58 percent in 1970. The proportion spent on erosion control had risen to 59 percent by 1979. ASCS estimates that about 63 percent of the ACP funds are devoted to erosion control as of 1983. During that same period water conservation practices increased from 8.7 percent to 20 percent of ACP payments; and water quality practices went from less than 1 percent to 18 percent of the payments. (Table 27)

Both SCS and ASCS have assumed a range of new conservation activities and responsibilities over the years. These have tended to dilute the amount of funding and personnel devoted to erosion control. This problem has been exacerbated by a general decline in the buying power of the overall Federal conservation budget because approproations have not kept pace with inflation.

Figure 13 depicts the steady decline in purchasing power (constant dollars) of the total SCS budget that has occurred since the late 1970's. Much of the decrease in total SCS purchasing power results from the effects of inflation on

TABLE 27
Percentage of ACP Payments by Practice Category, 1940-79

Practice Type	*Year* 1940	1950	1960	1970	1979
Soil Loss	85.0	85.3	64.3	57.6	59.3
Water Conservation	8.7	9.8	18.1	21.7	20.4
Water Quality	.7	4.6	13.1	15.5	18.4
Forestry and Wildlife	1.5	.3	4.5	5.0	1.9

Figures Do Not Necessarily Add to 100 Percent. Some of the Practices Were Not Applicable to the Categories Selected.

esentially level congressional appropriations for river basin surveys and investigations, watershed planning, watershed and flood prevention activities, and resource conservation and development projects. (47) SCS Conservation Technical Assistance (CTA), the program most directly associated with erosion control activities, has fared somewhat better in the budget process. (Figure 14) Congressional appropriations for CTA have increased steadily throughout the last decade. However, as a result of inflation, CTA purchasing power declined 12 percent between 1974 and 1983.

Figure 15 shows the permanent full-time staff levels for CTA and the Great Plains Conservation Program. Together, these programs have historically accounted for roughly 60 percent of total SCS permanent full-time staffing. The programs also represent the heart of the SCS erosion control effort, though CTA and to a degree the GPCP staff are not exclusively assigned to soil conservation work. Between 1972 and 1981, staff levels declined by about 8 percent for each program. Considerable year to year fluctuation is evident in CTA staff levels over this ten year period. (The main CTA staff level was 8,071, and the standard deviation was 276.) CTA is part of the SCS Conservation Operations Program. That program lost 76 full-time employees between 1972 and 1981, but gained 380 part-time employees over the same period. (48)

Federal funding for conservation cost sharing declined markedly over the 1972-81 period, both in terms of actual appropriations and buying power. Table 28 shows the total appropriations for direct cost sharing programs between 1972 and 1981, in constant 1979 dollars. The buying power of the Great Plains Conservation Program declined from a high of $28 million in 1969 to $9.4 million in 1981, an average annual decrease of 8.8 percent. In constant 1979 dollars, the purchasing power of the Agricultural Conservation Program dropped from $443 million in *1969 to $152 million* in 1981, an average annual decrease of 8.6 percent. Over this same period, the buying power of congressional appropriations for SCS Conservation Technical Assistance, in constant 1979 dollars, was unchanged. (49)

Distribution of Federal Conservation Assistance Among States

Historically, the distribution of Federal technical and financial assistance for erosion control among states has not been based on reliable estimates of resource problems and conservation needs. Recently, two initiatives have been taken to modify the historical patterns of funding: changes in the state allowance system for the SCS Conservation Operations Program; and targeting of both SCS technical assistance and ACP cost sharing.

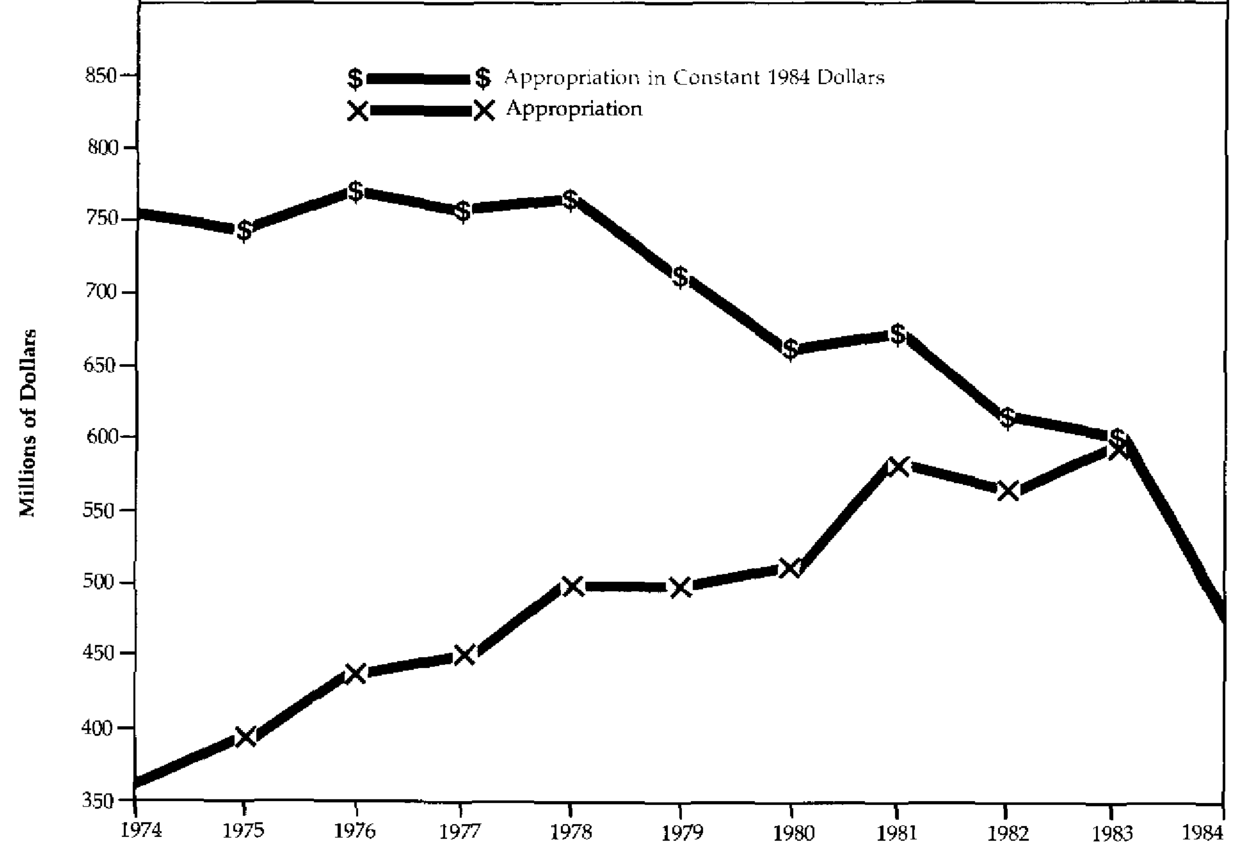
SCS Allowances To States For Conservation Operations

Since the early 1940's allowances to States for the SCS Conservation Operations Program (consisting mainly of technical assistance) have been "primarily based upon the number of organized conservation districts and, as new conservation districts were established, allowances were increased accordingly. Eventually, the previous year's allowance became the base for preparing current year allowances." (50) Attempts in the 1960s to adjust SCS state allowances to reflect findings of the 1959 and 1967 Conservation *Needs Inventories were unsuccessful*. However, the 1977 GAO report, the passage of the RCA, and completion and analysis of the 1977 NRI, provided the impetus for reassessing the state allowances. SCS developed a new formula for distributing conservation operations funds among states, which was used for the first time in developing the budget for fiscal year 1983.

The formula is divided into two parts. In the first, weight is given to the nonfederal land area, number of farms, number of conservation districts, and rural population of each state. "These four factors serve as a transition from the old allowance system to the new one, and are indicators if the extent and principal clientele that SCS works with and through." (50) These transition factors make up 50 percent of the new allowance formula for each state.

The other half of the formula is based on eight "major resource problem areas for which SCS commonly provides planning, application, and

Figure 13- All Funds (Excluding Emergency Operation)



Appropriations In: (millions)	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Actual Dollars . . .	$360.4	$388.4	$431.2	$450.2	$492.4	$494.5	$508.1	$578.3	$567.0	$582.9	$474.4
Constant Dollars .	755.2	741.5	772.9	753.2	765.6	714.5	664.3	675.4	613.1	595.2	474.4

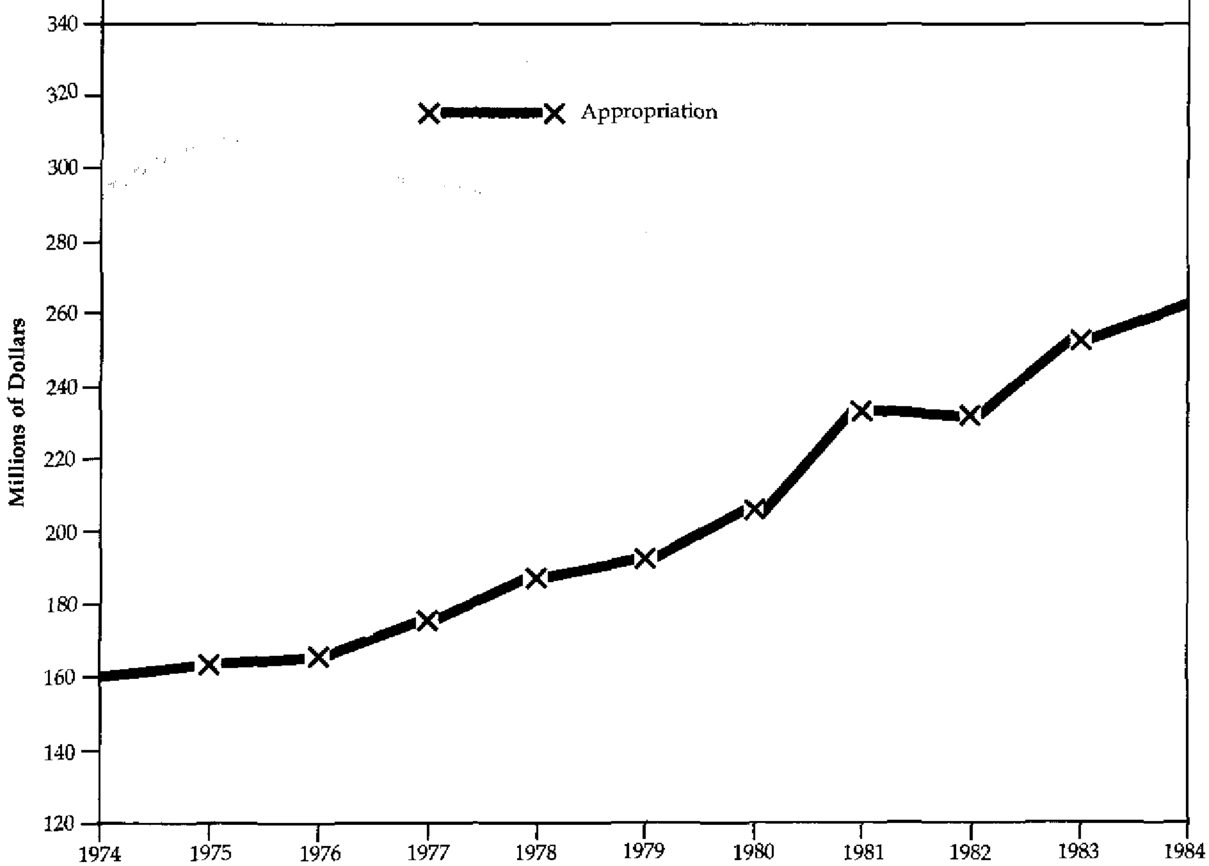
maintenance assistance: erosion control, water conservation, flood plain management and protection, range improvement, reclamation, urban development, agricultural waste management, and prime farmland protection."(51)

Of the twelve factors, the greatest weight is given to erosion problems. "The middle erosion category receives the most weight because this represents the most SCS assistance. The over 14 category received the least weight because this area represents only a small proportion of the total acreage and because some of this acreage cannot be treated. The less than 5 tons category weights represent maintenance needs." (52)

SCS analysts arrived at the allowance formula after analyzing a dozen alternatives. Initially, SCS planned to implement the new formula over a period of 5 years. However, this would have resulted in significant annual changes in the CO funding for many states. Hence, the new formula is to be implemented over a 10 year period. "For example, if a State's base allowance in 1982 (old allowance system) amounted to 2.5 percent of the total CO funds distributed to States and the formula indicated the new percentage should be 2.40 percent, the FY 1983 base allowance would be 2.49 percent. In other words, this State would have a uniform reduction of 0.01 percent per year over the next 10 years." (53)

SCS estimates that over the 10 year implementation period, 1983-1993, a total of 450 SCS staff years will be shifted among the states. Thirty states will lose a total of 45 staff years annually. Sixteen states will gain a comparable number, and four states will not be affected by the formula. (54) In 1983, Conservation Operations had a staff level of 9,901. Assuming permanent full-time staff levels for Conservation Operations would remain essentially unchanged between 1983 and 1993, as they did between 1972 and 1981, the new SCS allowance formula would shift one half of one percent of CO staff per year.

Figure 14-SCS Conservation Technical Assistance



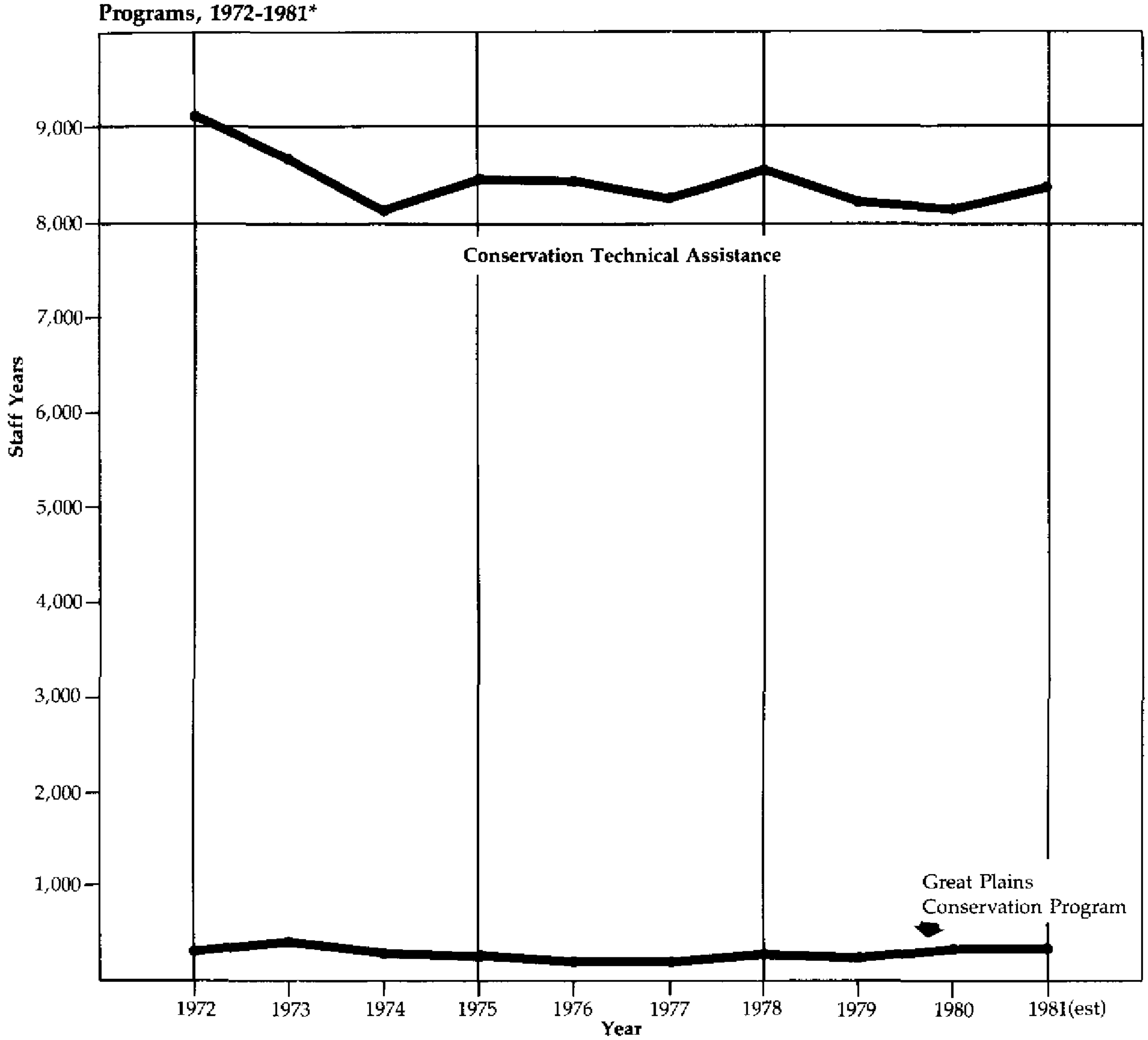
Appropriation in: (Millions)	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Actual Dollars . . .	$140.3	$162.0	$165.5	$174.3	$187.5	$192.6	$206.4	$234.0	$233.9	$251.4	$262.9
Constant Dollars .	290.9	306.4	295.4	290.6	290.7	278.1	267.5	268.9	250.0	253.9	262.9

Over ten years, the new formula would result in a reallocation of just 5 percent of total CO staff.

In AFT's view, the development of the new formula for SCS state allowances is an important step toward rationalizing the retrograde, highly political system of allocating conservation funds among states. Further revisions in the formula are now being contemplated, and SCS analysts anticipate additional changes may be made based on analysis of the 1982 NRI. However, several important points can be made about the composition and planned implementation of the new formula with respect to erosion control.

• In general, the implementation of the formula will result in trivial changes in the CO funding and staff patterns among states. AFT believes the actual impact of the formula, in terms of solving resource problems, will be inconsequential. For example, it is difficult to imagine that an annual shift of 45 SCS staff among 16 states will measurably contribute to improved resource conditions over the next 10 years. Under the old formula,

Figure 15-Permanent Full-Time Staffing, SCS Conservation Technical Assistance and Great Plains Conservation Programs, 1972-1981*



	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981(est)
GPCP	329	337	317	279	284	285	295	293	305	304
CTA	8677	8291	7844	8177	8109	7961	8136	7818	7734	7964
TOTAL	9006	8628	8161	8456	8393	8246	8431	8111	8035	8268

*1981 estimated

Source: RCA, 1980 Appraisal, Pt 2,Table 6.

TABLE 28

Appropriations for USDA Technical and Financial Assistance (In Thousands of 1979 Dollars) Fiscal Years 1969-1981.

Program	*1969*	*1970*
Technical assistance:		
Direct federal:		
Conservation Technical		
Assistance (SCS)	193,054	199,702
Cooperative Forest Management (FS)	5,866	7,178
Total Technical Assistance	198,920	206,880
Financial Assistance:		
Cost-Share Programs:		
Great Plains Conservation (SCS)	28,332	23,371
Agricultural Conservation		
Program (ASCS)	442,867	383,461
Rural Clean Water (ASCS)	—	—
Water Bank Program (ASCS)	—	—
Forestry Incentives (ASCS)	—	—
Subtotal Direct Cost-Sharing	471,199	406,832

Program	*1976*	*1977*
Technical Assistance:		
Direct Federal:		
Conservation Technical		
Assistance (SCS)	191,584	194,081
Cooperative Forest Management (FS)	6,351	6,557
	197,935	200,638
Financial Assistance:		
Cost-Share Programs:		
Great Plains Conservation (SCS)	20,291	17,753
Agricultural Conservation		
Program (ASCS)	221,037	208,186
Rural Clean Water (ASCS)	—	—
Water Bank Program (ASCS)	11,232	10,467
Forestry Incentives (ASCS)	16,848	15,701
Subtotal Direct Cost-Sharing	269,408	252,107

over the period 1972-1981 national CO staff levels annually deviated plus or minus 225 staff years from the mean of 10,000 staff years. In other words, in two out of three years, random deviations in CO staff levels are 5 times greater than the shifts *planned* under the new allowance formula. AFT deduces that political considerations have caused far too much emphasis to be placed on minimizing the impact of the new formula on the allowances of individual states. The composition and planned implementation of the CO formula is not marked by the same sense of urgency that so often characterizes official SCS publications and statements on agricultural resource problems.

• The weight of 26.5 percent assigned to soil erosion problems in the formula is generally appropriate. Likewise, it makes sense to give greatest weight within the erosion factor to land eroding at rates of 5 to 14 tons annually. Technical assistance can play an important role in controlling erosion on this land, particularly if conservation tillage and other management methods are emphasized. However, far too much weight is assigned in the formula to "maintenance" of land where sheet, rill and wind erosion rates combined are below 5 tons per acre. A very large proportion of the Nation's land would not erode at rates above 5 tons per acre under normal farming conditions and with no special conserva-

1971	1972	1973	1974	1975	Annual percentage of change 1969-75
196,494	198,095	204,775	196,935	203,614	0.9
8,145	7,207	7,128	6,507	7,488	4.2
204,639	**205,302**	**211,903**	**203,442**	**210,218**	**0.9**
21,319	21,363	20,079	18,834	18,956	-6.5
271,525	318,997	315,201	126,805	243,425	-9.3
—	—	—	—	—	ND
—	15,381	14,229	13,347	2,903	ND
—	—	—	—	18,279	ND
292,844	355,741	349,509	158,986	283,563	-6.6

1978	1979	1980	1981	Annual Percentage of change 1976-81	1969-81
189,973	176,829	180,414	191,759	NC	-0.1
5,986	5,505	5,382	6,146	- 0.7	0.4
195,959	182,334	185,796	197,905	NC	-0.1
16,471	10,265	9,452	9,382	-14.3	-8.8
193,630	179,013	164,627	152,415	- 7.2	-8.6
—	—	31,551	12,801	ND	ND
9,711	9,262	8,681	8,022	- 6.6	ND
14,567	13,500	12,434	9,601	-10.7	ND
234,379	212,040	226,745	192,221	- 4.8	-4.9

tion practices. With rare exceptions, cropland eroding at rates less than 5 tons per acre is not being severely damaged by erosion. Except in cases where a structural, engineering type practice already in place must be maintained, it is difficult to justify an SCS "maintenance" role in what often amounts to routine farming activities. If maintenance is to be included in the formula, therefore, it should reflect only that land where erosion would increase drastically in the absence of SCS technical assistance. This is particularly important at a time when official USDA policy stresses priority treatment of the worst conservation problems.

• Furthermore, while it is true that some land eroding in excess of 14 tons cannot be treated to adequately control soil loss, it is equally true that "maintenance" of land eroding below five tons seldom results in cost-effective conservation investments. Of the two categories, SCS technical assistance is far more likely to be cost-effective and necessary where erosion exceeds 14 tons per acre annually. (55) Hence, more weight should be given to the +14 ton category than to the "maintenance" category. The large amount of land eroding below 5 tons annually is distributed fairly evenly among states. And though every state has some land eroding in excess of 14 tons per acre, most of the land eroding in excess of 14 tons is concentrated in a few states. Hence, the present weighting scheme for the erosion factor has the effect of diluting CO funds for erosion control.

The CO allowance formula does not reflect contributions from nonfederal sources. SCS is in the process of analyzing these contributions for possible inclusion in the formula. The uneven pattern of state support for erosion control and other agricultural conservation activities could be somewhat redressed by assigning suitable weight to funds appropriated by state legislatures for conservation programs. A weighting scheme for state contributions should favor states that have made a commitment to conservation, and penalize those that have not.

ASCS does not have a formal effort underway to adjust its state ACP funding allocations to reflect conservation needs. For many years, Federal law prohibited ASCS from reducing the amount of ACP funds to any one state by more than 1 percent in a given year. The legislative mandate has been eliminated, but ASCS still adheres to the 1 percent rule administratively. This obvious political restriction undoubtedly hampers efficient use of ACP funds nationally. ASCS anticipates that analysis of the 1982 NRI may provide a basis for a redirection of funds based on conservation needs. In addition, the Conservation Reporting and Evaluation System (CRES) will allow ASCS administrators to determine which states spend their ACP allocation most effectively for the various resource problems. Pending these analyses of CRES and NRI information, ASCS may reallocate state funds beyond the 1 percent level in the future.

Targeting

According to the National Conservation Program released in December of 1982, both SCS and ASCS will "target an additional 5 percent of their technical and financial assistance funds each year for the next five years" to designated critical resource problem areas. By 1987, then, a total of 25 percent of SCS technical assistance and ACP financial assistance is to be devoted to target areas. Targeting is already underway in both agencies, but before discussing its implementation, some general background on the concept is appropriate.

The targeting scheme was initially proposed in Agriculture Secretary Block's "preferred program" circulated for public comment in 1981. During the RCA process, USDA analysts had extensive debates over the department's conservation priorities. In the face of severe fiscal constraints at all levels of government, it was clear that some redirection of conservation program efforts would be needed to solve the most critical resource problems. Hence, once priorities were selected, funds and personnel were to be shifted from activities of lesser importance. Initially, it also appeared that funds and personnel would be shifted among states, to reflect the RCA analysis of national conservation needs. Although the redirection theoretically would affect the entire USDA conservation effort, the original concept perserved a "base" level of technical and financial assistance across the nation, and addressed the priority problems primarily through targeting.

The 1981 "preferred program" established four national priorities which USDA programs were to address: reduction of excessive erosion; reduction of upstream flood damages; conservation of water, enhancement of water quality and supply, and conservation of resources related to urban areas and communities; and improvement of fish and wildlife habitat and increased use of organic waste. Public reaction favored the concepts of selecting priorities and targeting USDA resources to deal with them. However, pressure from State governors conservation districts, cattlemen, and from within the USDA bureacracy, resulted in a substantial broadening of the national priorities in the 1982 NCP. (56) First, there were complaints that the "preferred program centered too much emphasis on cropland and tended to ignore other land". In the NCP, the department modified the first priority, reduction of excessive erosion, to specifically include cropland, rangeland, forest land and pastureland. A second priority gave equal weight to water conservation and upstream flood damages.

With respect to soil erosion problems, the concept of targeting sprung from the concentration of erosion revealed in the 1977 NRI. Cropland erosion problems had been given special attention throughout the RCA process because erosion was most severe on cropland, and, inadequate though it was, scientific understanding about the effects of erosion was more advanced for cropland than for other land uses. In addition, the extensive analysis and mathematical modeling activities in RCA were almost exclusively focused on the interrelations between soil erosion, crop yields, and the impact of projected food supply and demand on future land use and conservation. We have already alluded to the informational basis for greater attention to erosion at the expense of other resource problems.

SCS began targeting for erosion control in seven areas in the latter half of 1981. This first effort focused exclusively on areas with very high erosion rates, such as southwestern Iowa. Many conservationists objected to the use of gross erosion rates as the criteria for targeted areas, and for fiscal year 1983, SCS modified the criteria to allow targeting of so-called "sensitive soils". The modification was intended to allow for targeting in areas where the productivity of thinner soils was threatened by relatively lower rates of erosion. In the original SCS National Targeting Plan for Fiscal Years 1981-84, as revised in September of 1982, the criteria for targeted funding for erosion control were as follows:

"1. Sensitive soils in row crop production that are eroding at more than two times the soil loss tolerance factor;

"2. Less sensitive cropland soils that are eroding at more than 2.8 times T (the soil loss tolerance factor)." (57)

According to this first plan, "Thirty three percent of the Nation's total cropland acreage (135.8 million acres) have soil loss tolerances (T) of less than five (tons per acre per year). About one third of these soils are in row crops and occur within soil areas that are eroding at rates of 2T or more." That is, this criterion encompassed about 45 million acres. "While the productivity of these soils is generally less than that of soils with T-values of five or more," the plan continued, "continued excessive erosion may drastically reduce yields and remove these from row crop production entirely." The plan estimated that "12 percent or 48 million acres of the Nation's cropland is eroding at 2.8 times T." Between the two criteria, then, about 93 million acres of cropland potentially could be targeted for erosion control.

The criteria have been substantially loosened in a revision of the SCS National Targeting Plan, dated April, 1983. For cropland areas, the new criteria for fiscal year 1985 and beyond are:

"—Areas experiencing high gross erosion rates that have high offsite damage and moderate impact on productivity.

"Sensitive soil areas where soil depth is a serious limitation and continued erosion will have a high impact on *future* productivity. (These areas have soil T values of less than 5 tons and are eroding at rates higher than T)." (58)

The first criterion does not specify what is meant by "high gross erosion", so it is impossible to estimate the acreage which could potentially be included. Indeed, this criterion is essentially qualitative. In addition, off-site damages from erosion may be considered in addition to productivity impacts under this criterion. This marks a departure from the priority implicitly given to cropland productivity problems in both the 1981 "preferred program" and its 1982 successor, the National Conservation Program (NCP).

Further broadening occurs in the criterion for "fragile soils". This criterion implies that targeting will be considered for any cropland soil eroding above its soil loss tolerance, where the tolerance is less than 5 tons per acre annually. The soil losses no longer have to be double the soil loss tolerance, nor do the "fragile soils" have to be in row crop production, as had been specified in the 1982 plan.

The revised plan does not include an estimate of the acreage that would be eligible for targeting under the new criteria. However, the plan outlines procedures which the states are to follow in proposing areas for targeted funding. Those procedures request the states to provide "for erosion . . . . the acreage eroding at more that T and more than 2T" in each county proposed for targeting. While this definition does not correspond precisely to the new targeting criteria, targeting proposals for erosion control presumably will be judged in part on this basis. Hence, 157 million acres of cropland would be eligible for erosion control targeting in 1985 and beyond. This represents a 69 percent increase in the cropland area eligible for targeting between FY 1984 and FY 1985. The 157 million acres equals 38 percent of the 413 million cropland acres and 47 percent of the 337 million acres of row crops and small grains, as estimated by the 1977 NRI.

In addition, targeting for erosion control is to be expanded to include rangeland, forest land and pastureland. "Proposals of [*sic*] erosion control on other than cropland [*sic*] will be considered on a pilot basis only until fiscal year 1985 or later." The plan does not specify how "a pilot basis" differs from regular targeting projects. "Our first objective nationally," the plan notes, "is to target a majority of the critical cropland erosion areas before expanding the focus of targeting for other land uses." When this expansion begins, all rangeland eroding in excess of 2 tons per acre will

AFT FARMER SURVEY THE NEED FOR "TARGETING" SCS PERSONNEL RESOURCES

In every one of the six AFT survey areas, the average annual soil erosion losses per acre were estimated to be at levels which threatened the land's long-term productivity for raising crops. The county office of USDA's Soil Conservation Service in the same areas all testified that they were overburdened with requests for technical assistance; they could not serve all the farmers who walked in for help. What would happen if technical staff were transferred from other states or parts of the same states to augment the personnel resources in areas like these six, where erosion levels are destructively high? Who could be served better or for the first time?

In five of the six study sites, from 41 to 60 percent of the surveyed farmers had apparently never received technical assistance either directly from SCS or indirectly through the local Soil and Water Conservation District, whose assistance work SCS provides or supervises. And it was not the case that these non-recipients had such small farming operations and collectively farmed so little land that SCS need not worry about missing them in its programming. They farmed from 27 to 43 percent of the total acres reported in operations in their five areas, and from 37 to 46 percent of their farms were above the median sizes for their samples.

Nor were they cultivating land that was mostly flat or otherwise unsusceptible to erosion, except possibly in one study area. With that exception, by their own reports, from 42 to 66 percent of the non-recipients perceived erosion problems on at least a third of the land they owned; and a third to 78 percent reported such problems on a third or more of their rented land.

Nor were most of them putting out such high conservation effort that SCS could comfort itself. ("We can afford to miss working with them at present; they're good conservationists on their own.") In all six study areas, majorities of the farmers reporting that they never had received SCS assistance were below their samples' medians for conservation effort in 1982.

Finally, it does not appear that many of the non-recipients were going to SCS or S&WCD meetings or talking with their staff, either in preparation to receive technical assistance on a formal, project basis or for obtaining advice less formally. In none of the six study sites did more than 12 percent of the non-recipients report attending a public meeting "in the last year" that was sponsored by SCS or the District. For the same period, only 3 to 11 percent reported discussing "soil conservation issues in person or on the phone with staff members" of either agency, except in the Tennessee site, where such conversations were indicated by 24 percent of the non-recipients. Moreover, on these two dimensions of recent-past contact with SCS and S&WCDs, their fellow farmers in the same areas who had reported receiving technical assistance tended to go to such meetings and talk with staff in much higher numbers.

In sum, there appears to have been a lack of contact with disturbingly large segments of the areas' farm operators. Considerable outreach work seems needed, and targeting of SCS personnel resources to such areas would help make it possible.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites*, American Farmland Trust, forthcoming.

be eligible. Assuming a 2 ton average soil loss tolerance for rangeland, about 106 million acres — one quarter of all nonfederal rangeland — would be eligible, according to erosion data from the 1977 NRI. Criteria for forest land and pastureland have not been specified. "Targeting proposals for these land uses will be considered based on the individual merits of each proposal." However, the plan is firm in stating that targeting proposals for forest and pasture "will not be considered until all other eligible erosion control problems have been considered and acted upon."

Targeting proposals will not necessarily be funded if they meet these erosion criteria. Selection is also to be based on:

"— Severity, extent, and impact of the problem

"— Degree of success expected in terms of accomplishments and cost-effectiveness

"— Local interest and/or financial support for the proposed effort."

However, SCS program managers anticipate that by 1987, target areas will embrace 60 percent of the cropland eroding in excess of soil loss tolerances. (59) Thus, 94 million acres of cropland — one out of four acres planted to row crops and small grains in 1977 — are expected to be "targeted" by 1987.

Although SCS and ASCS are targeting the same geographic areas, the erosion and other criteria were developed primarily by SCS. In FY 1982 and FY 1983, targeting proposals were jointly reviewed and approved at the national level by ASCS and SCS staff, but state and county level ASCS personnel were not consistently involved in the development of the proposals. Targeting proposals submitted for FY

1984 were generally developed in consultation with ASCS county personnel and committees and proposals must be jointly developed for FY 1985.

AFT offers the following observations, based on our analysis of the USDA targeting effort.

The targeting criteria and planned implementation are so inclusive, that they fundamentally — even fatally — compromise the concept of targeting. *Current research on the relationship between erosion and productivity does not support the blanket prioritization of erosion control on all cropland eroding above the soil loss tolerance.* As we noted in Chapter 1, that research does suggest that erosion rates must be considered in the context of the quality and depth of a soil's root zone. *In general,* however, cropland erosion rates of up to twice the soil loss tolerance — that is, 4 to 10 tons per acre annually — seem not to severely impair soil productivity, and land eroding at these rates does not merit *priority* treatment via targeting. Land eroding in this range should be treated with the "base program" of technical and financial assistance, not with targeted funds and personnel.

It goes without saying that the inclusiveness of the erosion criteria greatly dilutes the overall targeting effort. For many years, conservationists, particulary in SCS and the conservation districts, have held that the chief impediment to an effective technical assistance effort was an insufficient number of field conservationists and technicians. A similar view was expressed by the 1975 SCS Task Force on the Adequacy of Conservation Systems on Cropland. (60) Targeting is the only realistic means of increasing technical assistance levels in critical erosion areas in the context of a slow yet chronic decline in the USDA conservation budget. *Given these fiscal constraints; given the official USDA policy of concentrating conservation assistance where problems are most serious; and given the rather urgent need to demonstrate the efficacy of the department's conservation programs, the adoption of these very inclusive criteria for selecting target areas must be viewed as an indefensible and blatantly political decision to distribute targeting funds as widely as possible. As such, the criteria represent an enormous failure of the USDA bureacracy to implement necessary but politically unpopular reforms in program direction.*

The planned distribution of SCS targeting funds among 44 states will substantially offset changes in the state allowances resulting from the use of the new SCS Conservation Operations (CO) allowance formula. The two "reforms" substantially cancel one another. For example, with a CO appropriations level of $263 million held constant (adjusted for inflation) through 1987, the "base" funds for Conservation Operations would decrease by $47.122 million. This would result from a 5 percent annual diversion of base funds per year for targeting, totalling 25 percent of the CO total by 1987 than it had in 1983, despite any reallocations in the base resulting from the new allowance formula. However, the $47.112 million in targeting would be added back in, offsetting all but $10 million of the "base" loss. Only seven states would not receive targeting money by 1987, so only in these states would total CO funding be reduced by the full amount of the base reduction. Another five states would lose less than 5 percent of their total funds, and five more would lose less than 7 percent. Seventeen states would end up with net increases as a result of targeting. With a 2.8 percent annual increase in total CO appropriations, only 18 states would have lower total CO funds in 1987 than they had in 1983. With a 6.1 percent annual increase in total CO appropriations, only 18 states would have lower total CO funds in 1987 than they had in 1983. (61)

Conclusions

- Information on the impacts of Federal soil conservation programs remains inadequate, despite direct requests for such information from the Congress and several presidents. An exception is the Agricultural Conservation Program of ASCS. Estimates of the impact of Federal soil conservation programs contained in the National Conservation Program document are inadequate for national planning purposes, and fail to meet the requirements of the Soil and Water Resources Conservation Act of 1977.
- ACP managers have been able to institute a series of impressive reforms of the program, based on findings of the ongoing program evaluation. The Congress has not approved presidential requests for reductions in the program's budget, despite early evaluation results that were highly self-critical.
- The few, crude estimates that have been made of the amount of soil saved as a result of Federal programs indicate an unacceptably wide gap between national conservation needs and the accomplishments of government programs.
- In the face of political pressures, the funds and personnel in the USDA targeting effort have

AFT Farmer Survey
The Influence of Government Programs on Farmers' Conservation Efforts

In the six sites where AFT's farmer survey was conducted, various government programs were in place to encourage farmers to use sound soil conservation practices on their farms. Among the programs were USDA's cost-sharing for selected conservation practices, administered by the Agricultural Stabilization and Conservation Service (ASCS); technical assistance for installing and using practices, provided by USDA's Soil Conservation Service (SCS) as well as by Soil and Water Conservation Districts (S&WCD) through which SCS works; and educational meetings and literature about soil erosion problems and conservation practices, presented by the land-grant colleges' Cooperative Extension services.

What actual impacts did these programs have on the surveyed farmers? As sources of information about soil conservation, such programs appear to have won the respect of nearly half or more of the respondents in the six study sites. They were asked, "When you have been farming in this area and you wanted information about soil erosion problems and solutions, what persons have you found most useful as sources of such information?" The farmers were asked to identify such persons, "not by name, but by relationship to you (friend, relative) or the organization to which they belong." In response to this question, from 45 to 89 percent of the surveyed farmers mentioned ASCS, SCS, Extension, or another state-level agency concerned with conservation. In three study areas, SCS and ASCS were the two most frequently cited public agencies; in two others, Extension and SCS were the top two; and in the sixth area, ASCS and Extension were the two most important. Very few respondents listed their local S&WCD.

We wanted to learn also about the roles these agencies might have had in shaping farmer's decisions initially to use conservation practices. We had time in the interviews to discuss with care only two practices per farmer. If the respondent used more than two practices in 1982, we asked him to identify "the two most important for your farming operation." Across the six survey sites, the acres served by these top two practices (or the one or two practices used, if the farmer had a total of just one to two that year) averaged from 50 to 69 percent of the total acres to which the farmer applied conservation practices. For one-third or more of the surveyed farmers in four of the six areas, these two practices accounted for over 75 percent of their total acres served. In other words, by asking questions about these practices, we tended to be inquiring about conservation measures which, at least in terms of extent of application, were genuinely important.

In the discussions of reasons for using a practice, a total of 19 questions were asked per practice. Among them were four in which the farmer's responses could indicate a role for government conservation programs. The first of these four questions had an "open" format, in that the farmer was free to cite any reason; he was not limited to a list which included government programs as factors. Later in the discussion, however, he was directly asked, "Was among your reasons for using this practice that you were going to receive cost-sharing assistance from one or more governmental agencies?" A similarly worded question was asked about government technical assistance. A fourth question inquired if encouragement by various persons — "members of your family," "neighbors," "others" — had been a reason for using the practice. Some respondents listed conservation agency staff members under "others."

When we combined the responses to all four of these questions, we found that in four of the six study areas moderately high percentages of the surveyed farmers (nearly a third or more) reported being influenced by government programs to use one of both of their two most important conservation practices: 69 percent in the western Tennessee site, 45 percent in the central Iowa area, 38 percent in the southwestern Wisconsin site, 32 percent in the southern Illinois area, but only 29 and 22 percent, respectively, in the southeastern Missouri and eastern Colorado sites.

The reported role of government programs varied by type of conservation practice. If structural practices (such as terraces, diversions, or sediment basins) were being discussed, in 20 to 76 percent of those cases the farmer attributed influence to government assistance or encouragement from agency staff members. The average across the six sites was 40 percent. If the discussion was about tillage practices (e.g., crop rotations, contour farming, conservation tillage), in all sites fewer respondents attributed influence to government — from eight to 32 percent, with an average of only 21 percent.

This average for structural practices in farmers' perceptions of government programs' influence may reflect agencies' programming emphasis. The county ASCS committees in the six study sites allocated very little of their total cost-sharing funds to tillage practices. Many times more money went for structural practices. Also important may be differences in the conspicuousness of the influence. Government assistance for structures often takes the form of highly visible cost-sharing payments and help in technical design, whereas for tillage practices the assistance may be limited to education about the measures' benefits, costs, and techniques of application. Information about tillage practices coming from government agencies might have been more difficult to differentiate from similar facts and exhortation coming from other sources, such as friends and relatives who had experience with the practices.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites,* American Farmland Trust, forthcoming.

been spread much too thinly. In the face of severe fiscal constraints, the Department has not been able to choose among important, competing erosion control priorities, and focus a critical mass of assistance on the most pressing needs.

• Highly erodible lands, which account for a large proportion of the Nation's erosion, are unlikely to be adequately protected by existing conservation programs in the future. Nevertheless, the large amount of soil loss occurring on those lands is routinely used to justify the existence and expansion of traditional programs.

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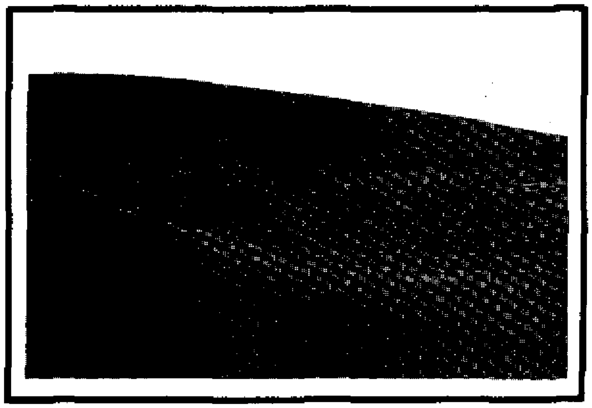
Chapter Five



A New Strategy For Soil Conservation in The United States

A new strategy for soil conservation is needed in the United States, and the next 18 months will prove critical to its development and implementation. AFT believes this strategy must have four main elements:

First, establish the nondegradation of agricultural resources as a central goal of national policy.

Second, establish a long-term cropland reserve program for highly erodible cropland under the umbrella of USDA's traditional conservation and commodity programs.

Third, eliminate those elements of Government policies and programs which subsidize future cultivation of highly erodible lands.

Fourth, reduce the "maintenance" and production-oriented aspects of USDA's technical and financial assistance for soil conservation, and focus that assistance on cost-effective erosion control methods on land where soil loss is likely to be causing chronic on-site or off-site damages.

The need for this new strategy became apparent in the course of this study. The urgency of acting upon it beginning in 1984 is dictated primarily by the deliberations which have, in effect, already begun on the omnibus farm bill of 1985. If, as AFT proposes, conservation is to receive higher priority in the farm bill debate, it is imperative to develop and promote specific and workable program proposals immediately. Given the consensus evident now in farm policy circles that nearly every aspect of the commodity programs needs to be carefully scrutinized, the 1985 farm bill process promises to be even more hurried and involuted than usual. Hence, the need for early consideration of conservation initiatives is all the more pressing.

In the next chapter AFT presents detailed recommendations for achieving the substantial conservation benefits we believe this strategy can provide. The purpose of this chapter is to describe key elements of the policy environment in which conservation initiatives will be considered over the next two years. It is an environment that presents both opportunities and obstacles to innovation in conservation programs and policies.

The Conservation Gap

AFT's proposal for a new approach to conservation policy arose from our analysis of soil erosion and its effects, and the role government programs have played, or could play, in reducing soil loss. Our overall impression is that a disturbingly wide gap exists between the magnitude of soil erosion problems and the degree of erosion control afforded through present government policies and programs and the efforts of individual farmers. AFT shares the view expressed by many conservation policy experts in recent years that the traditional soil conservation programs alone are ill-equipped to cope with present or future soil loss problems. This understanding is critical to galvanizing the traditional conservation community to press actively for new policies and programs.

To briefly review, we found that soil erosion is causing significant damage to the Nation's agricultural productivity and water quality, and, through sedimentation, to natural and constructed waterways, lakes and reservoirs. Long overdue scientific research is beginning to provide a basis for judging which soils and geographic areas are most seriously affected by erosion in the short and long term. Fortunately, it seems clear that acute damage is not pervasive; for the most part it is associated with the relatively small portion of America's land which experiences high rates of soil loss. Typically, those rates exceed the national average soil loss by a factor of three or more.

AFT's Early Action On The Conservation Reserve

In the spring of 1983 AFT began actively to promote several aspects of the strategy outlined above by means of briefings for congressional staff and USDA officials, and through numerous appearances before Congressional committees. A principle goal of these efforts was to encourage USDA to test the concept of a long term reserve for highly erodible land. In testimony before the Joint Economic Committee on June 22, 1983, AFT proposed that a pilot program of this kind be included in the 1983-84 crop programs. AFT followed up this testimony with a series of meetings with USDA officials and congressional staff. In early August, Senators Roger Jepsen (R-IA) and John Melcher (D-MT), and Representatives Ed Jones (D-TN) and Thomas Coleman (R-MO), respectively, the chairmen and ranking minority members of the House and Senate agriculture subcommittees dealing with conservation, wrote Secretary of Agriculture Block requesting a pilot program for the conservation reserve in 1983-84. At that time, it was AFT's view that a pilot program in the 1983-84 and 1984-85 crop years would provide useful information about the procedures and effectiveness of a full-scale reserve program, which could be incorporated in the 1985 farm bill. More importantly, AFT felt the very existence of a pilot program would stimulate interest in exploring the possibilities for modifying commodity programs to better reflect conservation needs.

Though it appeared favorably disposed toward the idea of a pilot program, the Block administration has maintained that new legislative authority would be necessary to implement it — a view, incidentally, with which AFT does not concur. Moreover, given the likelihood of considerable delay in passing new authorizing legislation in an election year, a pilot conservation reserve program would be in operation only a very brief time prior to the 1985 farm bill debate, if at all. AFT's concern is that ambiguous or partial results that might be obtained from a belatedly implemented pilot program could actually jepardize the case for a full scale program in 1985. Under those circumstances, serious consideration of a conservation reserve could easily be postponed until the next farm bill, in 1989.

Will the farm economy be in the doldrums five years from now, reinforcing the need for a continued, responsible Federal role in the farm economy? Or will a sudden upsurge in foreign demand for U. S. crops have "solved" the farm problem, as it was thought to have done in the mid-1970's? Will the public be as concerned as it is now about soil erosion and its consequences? Will the experience of the 1983 Payment In Kind program — with its great cost, its embarrassing largesse to large-scale farm operations, and its very modest conservation benefits — be fresh in the public mind, opening the way for program reforms? Obviously, the answer to these questions is anyone's guess. AFT is convinced, however, that as deliberations begin on the 1985 farm bill, the farm economy and farm programs, the public mood, and other factors are indeed quite favorable for consideration of novel ideas like the conservation reserve. Many of the benefits of a pilot program to test the reserve concept — rationalizing administrative procedures, estimating program costs, and so forth — would be captured by phasing in a nationwide program via the 1985 farm bill. In addition, AFT has observed a great deal of interest in the conservation reserve idea in the Congress, and in farm, conservation and environmental organizations. Although much work remains to be done, the need to introduce the concept of a conservation reserve into the policy debate is less pressing now than it was in the early summer of 1983.

The idea's currency was evident in the modification of the Agricultural Conservation Program (ACP) announced by Secretary of Agriculture John Block in December, 1983. Termed a "conservation reserve", the proposal would divert $20 million in ACP cost sharing funds to reimburse farmers for up to 90 percent of the cost of establishing permanent vegetative cover on land eroding in excess of twice the tolerable soil loss level (T value). In AFT's view, this represents another in a series of important, recent reforms of the ACP. The use of the term "conservation reserve", and the selective targeting of highly erodible land, signal a promising evolution of policy within the administration. Nevertheless, this program is fundamentally different from the conservation reserve proposed by AFT and others. First, the program reimburses farmers for only one year, and then only for the cost of seeding. More importantly, the announced *program does not operate* under the umbrella of USDA's commodity programs, and hence does not provide the integration of commodity and conservation programs that is so critically needed.

These highly erodible lands seem to be eluding most methods of conservation treatment as well as the services of traditional government conservation programs. Even profitable conservation tillage systems, the most promising soil conservation technology, are being adopted on land where the potential for erosion damage is modest. Traditional conservation practices such as terraces and contouring often are either impractical or exhorbitantly expensive to apply on the steep slopes which typify much of the country's highly erodible land. These practices were seldom observed by SCS in the 1977 National Resource Inventory, and were for the most part absent from highly erodible land. In many cases, soil loss cannot be held below the conventional tolerance levels (T values) on such land so long as it is cultivated, even if numerous, costly conservation practices are applied and carefully maintained.

Only if real prices for food rise appreciably will it be demonstrably apparent to farmers and society that such expensive conservation measures are justified. But by the time this occurs, the potential productivity of much of this land will have been severely diminished as a result of erosion, and will be costly to replenish. Also in the interim, excessive erosion on this land will continue to damage water quality and sediment-sensitive areas. For the forseeable future, then, permanent vegetative cover, in the form of pasture, hay or forest, or soil conserving crop rotations are the most efficient means for checking soil loss on much of the nation's highly erodible land.

The problem is that the farm economy provides powerful incentives for continuous cultivation of highly erodible land. Government commodity programs further aggravate the situation by actually subsidizing intensive use of fragile lands. At the same time, government conservation programs seem to be having a modest effect on soil conservation in general; certainly the unintended government subsidies for abusive land use far outweigh the incentives offered for conservation. The voluntary nature of the programs, and the limited incentives they offer land users, have made it particularly difficult for USDA conservation programs to effectively deal with land having severe erosion problems. In many cases a change in land use — usually from cultivated cropland to hay, pasture or forest — is required to conserve highly erodible land, and the conventional conservation programs do not now include a practical mechanism for encouraging such fundamental shifts. As we have seen, the one government program that was intended to promote changes to conserving land uses — the Great Plains Conservation Program administered by SCS — has enjoyed a very modest success over the past two decades.

It is unlikely that the traditional conservation programs alone can provide the means to cope with highly erodible lands. For these lands, the problem is not primarily one of technical assistance, since, apart from identifying land that is highly erodible, little in the way of technical expertise is needed. What is needed is simply a land use change to permanent, properly managed, vegetative cover. The ACP devotes as much as $50 million dollars annually — one quarter of the annual appropriation — to the establishment and improvement of permanent cover. As noted in Chapter 4, promising improvements have been made in recent years to buy more erosion control for these dollars, and further progress can be made in the future (along the lines suggested by Secretary Block's "conservation reserve" initiative announced in December — see "AFT's Early Action on the Conservation Reserve"). However, it is clear that a very substantial increase in cost-sharing funds would be required to significantly affect the millions of acres of highly erodible land. This is particularly true because a 1-year reimbursement for the cost of seeding would be an insufficient incentive for many owners of that land to convert it to permanent vegetation. Given the history of consistent and rapid decline in the buying power of ACP appropriations over the past decade, combined with the present budget deficit of $200 billion, the outlook for a significant increase in the ACP budget is exceedingly bleak.

Moreover, it has proven to be very dificult, politically and administratively, for USDA to redirect existing program resources among geographic areas — for example, to areas where erosion problems are severe. We noted in Chapter Four the disappointingly diffuse nature of the recent USDA targeting initiative.

AFT will recommend a tightening of the targeting criteria as well as limits on the geographic extent of the program. But even if it were possible to radically restructure existing conservation programs to deal with highly erodible lands, it would be imprudent to do so. Traditional technical and financial assistance can be effective means to promote erosion control where problems are serious, but not severe.

A new incentive, in the form of a long-term conservation reserve, is needed to complement existing programs.

The Farm Economy And Farm Policy In The Eighties

Over the coming decade the condition of the U. S. farm economy will be the most important determinant of conservation trends and the preoccupying concern of farm policymakers. Within the past two years, however, it has become acutely — and painfully — clear that basic changes have occurred in the nature of America's farm economy and its relation to both the U. S. and world economy. In 1983, the enormous increase in the cost of federal farm programs, the decline in the value, volume and market share of key U. S. agricultural exports, and the implementation of the most massive acreage reduction program in U. .S. history, have brought home the message that U. .S. farm policies are badly out of step with emergent world economic trends. It remains to be seen whether the anticipated reforms of these policies will take soil and water conservation into account.

The most salient economic trend in U. S. agriculture over the last decade has been the increased importance of grain and oilseed exports. By one estimate, exports accounted for just over 13 percent of the total demand for agricultural products (on a quantity basis) in 1972. By 1979/80, exports had doubled in importance, making up over 27 percent of the total demand. (1) Specifically, the crop sector became extremely dependent on exports. Although 30 percent of total farm cash receipts — including crops and livestock — were derived from export sales in 1980, over half of the cash receipts for crops were export-related. Exports account for about 65 percent of wheat production, 33 percent of corn production, and 60 percent of soybean production, and for large proportions of other crops. (2) Not surprisingly, in the mid-1970s it appeared to most observers U. S. grain and oilseed farmers were on a path of permanent ascent in farm income, propelled out of decades of chronic surpluses and government subsidies by a steady and apparently open-ended increase in foreign demand.

But the robust performance of the export sector, and the simplifying effect it promised for agriculural policy, soured in the early 1980s. As a percentage of total demand, foreign demand for agricultural products slipped to 26 percent in 1980/81, and was down yet again, to 22.5 percent, in 1981/82. (3) For the first time in a decade the actual value of U. S. agricultural exports dropped in 1982 (and again in 1983). Suddenly the importance of the export sector was not just a boon but a complicated problem for U. S. farm policymakers: the fate of the domestic farm economy hung largely on developments beyond their control or even their influence. The worldwide recession, combined with a strong U. S. dollar, are considered to be major causes of the downturn in America's agricultural exports. Other U. S. domestic policies — also largely outside traditional farm policy — have hindered export performance. Tight monetary policies on the part of the Federal reserve, which serve to raise interest rates to combat inflation, tend to attract foreign capital to the U. S., bidding up the value of the dollar relative to other currencies.

Primarily because of these important and recent changes in the way American agriculture fits into the world economy, many experts contend that a fundamentally different approach to farm programs is needed. A recurrent hypothesis dominating the debate over farm policy today is that the preeminent influence of the export sector actually has changed the very nature of overall demand for major export crops (wheat, corn and soybeans). Domestic demand for U. S. crops is relatively stable, regardless of the price. However, foreign demand appears to be much more sensitive to changes in price — and, again, the price for foreign buyers may be more a funtion of exchange rates than, say, changes in U. S. supplies. Depending on their circumstances, nations which acquire appreciable amounts of U. S. grain at a given price in one year, may buy much less the next. Their own domestic production of identical or substitute crops — which may have been encouraged by high world crop prices — may reduce or eliminate the need for imports. Either because credit is tight or for other financial reasons, importing nations may decide to reserve their foreign exchange for other investments; or they may find it advantageous to buy from a producing nation other than the United States.

The implication of these developments for U. S. agricultural policy is fundamental. If the quantity of grain demanded does not respond much either to upward or downward changes in price, as was the case when the U. S. grain market was primarily a domestic one, gross farm revenues from grain sales will increase with increases in grain prices. In the argot of economics, the demand for grain is said to be "inelastic" under such circumstances. Hence, it would be in farmers' interest to have policies and programs that keep prices as high as possible — which is precisely what farmers have fought for over the last century. However, if overall demand becomes more sensitive to price changes, as it appears to have become in the export era, a rise in price may choke off demand and result in lower farm revenues. To the extent that government farm policies — price supports, direct (target price) payments, abrupt and massive production controls — cause prices to rise above market clearing levels, they may have the perverse effect of lowering farm revenues. A further irony is that our foreign competitors will be encouraged to increase production even as we lower ours, and capture a portion of U. S. market share. (4)

Not all economist agree that the demand for wheat, feed grains, soybeans and other crops has become more "elastic" in the export era. However, most economists anticipate considerable market instability in the coming decade. A consensus seems to be forming that the proper policy response in the short term is to gradually alter or eliminate features of farm programs that insulate farmers from the world market. Over the past decade U. S. farm policies and programs have been modified in ways that make them more market-oriented (the establishment of target prices and the farmer-owned grain reserve being two examples). Most experts believe that additional steps now must be taken to assure that, in the words of Assistant Secretary of Agriculture William Lesher, farmers "feel the market" and adjust their production decisions accordingly. Lesher, among others, has specifically suggested modelling future programs for wheat and feed grains along the lines of the present program for soybeans: a low nonrecourse loan rate related to a moving average market price, no target price (nor deficiency payments), no base acreage, and no authority for set-asides or diversion. (5)

The rationale behind a program of this sort is that loans should no longer serve as artificially high floor prices for U. S. and international markets, but should merely provide a limited and short-term source of financing for farmers to adjust to seasonal variations in prices, especially the low prices common at harvest. Presumably the loan rates offered to farmers would be low relative to average market prices, so that the government would not end up holding large stocks as a result of loan defaults. The soybean program has worked in this fashion for the most part, with modest cost to the government relative to the wheat and feed grain programs. Target prices for wheat, feed grains and cotton would have to be lowered substantially and perhaps be eliminated, so as not to send untimely signals to U. S. producers and foreign competitors to increase production.

The difficulty facing farm policy makers is to determine that elusive "marketing clearing" price from year to year. To err on the low side with loan rates, target prices, and production controls, is to expose farmers to the vicissitudes of a market that is likely to be unstable in the near future. The fact that such a system has been accepted, and indeed insisted upon, by soybean producers, may be attributable to the peculiar history of the soybean market and program; it may not be entirely appropriate for other crops. It must also be borne in mind that the price and income support programs for corn also affect soybean production, since the two crops are increasingly alternates for many growers. By shifting to a soybean type program, farm policymakers would, in effect, be asking wheat and feed grain farmers to give up the few policy levers they can effectively influence — loan rates, target prices and production controls. In return, farmers would be expected to assume that international exchange rates, world economic conditions, and non-farm domestic policies in the U. S. — all of which they cannot directly influence — would perform with symphonic grace to balance supply with demand at a satisfactory level of revenue. The recent reversal of the American Farm Bureau Federation's long-time policy of eliminating many features of commodity programs signals a skepticism in the farm community about the reliablilty of the marketplace in the immediate future.

A Case For A Soil Conservation Reserve

Several prominent economists have suggested that the leap of faith toward market oriented programs should be buffered by another policy instrument: a modest sized, long-term land reserve, comprised of land most vunlerable to excessive soil loss. Much of the analytical basis for such a program, which AFT refers to as a "conservation reserve" has been developed in recent years by agricultural economists Arnold Miller, Charles Benbrook, and Clayton Ogg. Since 1982, Representative George Brown of California has been the most persistent advocate of the reserve concept in the Congress. Within the past year many other members in both houses have a reserve in one form or another, including Senator Roger Jepsen of Iowa and Rep. Ed Jones or Tennessee. AFT has drawn heavily on these sources for the discussion which follows.

Even as a short term measure to deal with emergency situations of the type that existed in the fall of 1982, large production adjustment programs like the 1983 PIK program are viewed as undesirable by virtually all observers. Such massive intervention is costly to the government, and is difficult to administer efficiently and equitably. The PIK program was also extremely disruptive to the farm service sector, and had the potential for triggering rapid increases in grain prices (this last possibility was partly realized with the record 1983 drought, and would have been a much greater concern had foreign demand recovered in the latter half of 1983).

But many experts also question the usefulness of even the more modest and typical production adjustment programs, in the form of 10 to 20 percent set-asides and diversions for the major crops. These programs typically have a limited effect on crop production, relatively low levels of farmer participation, and, as noted in Chapter 3, seem to effect a minimal degree of soil conservation despite the consistent diversion of millions of acres to "conservation use". The amount of conservation achieved on the set-aside and diverted lands is probably offset by the subsidy the commodity (and other) programs extend for the cultivation of highly erodible land.

Several key arguments pertaining to farm program costs and the efficiency of a soil conservation reserve:

Production Adjustment Is A Consistent Need. Overproduction of major crops is a tenaciously persistent feature of American agriculture. Despite the generally bullish performance of the grain and oilseed export market over the past decade, the Federal government has usually determined that production controls were necessary. In eight out of ten years between 1975 and 1984, some form of acreage reduction program has been declared by USDA to help balance supply with demand for one or more of the major crops. These programs have been costly. Over this period, the net outlays (which reflect repayment of crop loans) for the wheat, feed grains, cotton and rice programs ranged from $500 million to $13.2 billion (for the 1983 program) annually. (Outlays for the soybean loan program, which does not feature acreage adjustments, have generally been less than $75 million.) The average outlay for these crops, excluding the 1983 program, was about $2.7 billion each year. If the 1983 program is included, annual outlays averaged nearly $4 billion per year. Without basic changes in these programs, and with the substantial instability in overall demand that is anticipated by most agricultural analysts, the average cost of the crop programs may well trend upward for the remainder of the decade.

Year-To-Year Programs Exacerbate Cost. Still, these programs generally have not been considered to be efficient tools for bringing supply into balance with demand. A major cause of the inefficiency and uneven performance of commodity programs is that they are operated on a year-to-year basis. With the current approach, the major difficulty facing policymakers has been to attain a level of farmer participation in the programs that is adequate to meet acreage adjustment needs.

Program managers start each season with a more than even chance of excess supply, and no brake on production. The problem was especially acute in the fall of 1982. It was clear that a very high level of participation would be needed in a 1983 production control program to measurably reduce the tremendous surpluses of wheat, corn and cotton. The need for a large acreage reduction led to the two most controversial elements of the PIK program. First, USDA established very high ceilings on the level of compensation farmers could receive for participating: up to 80 percent of their farm's average yield for corn, and up to 95 percent for wheat. Particularly for wheat, a high rate was necessitated by the eleventh-hour declaration of the program (well after the 1983 winter wheat crop was in the ground). USDA's second critical decision, subsequently deemed illegal by the Congress' General Accounting Office (GAO), was to declare that the statutory payment limitation did not apply to payments-in-kind. The department concluded that without this waiver, very large producers would be dissuaded from enrolling in the program; without their participation, insufficient acreage would be diverted from production to improve crop prices and farm income.

The outcome of these decisions was an astonishingly high level of participation: over one million farmers (half of the U. S. total) are estimated to have enrolled in the 1983 crop programs. But this extreme response only underscores the dilemma of programs operated on a year-to-year basis. Largely because of short term budgetary considerations, as well as the political imperative to avoid sharp, government-triggered increases in consumer food prices, the crop programs have tended to provide very modest restraints on production. In retrospect, it seems the assumptions about supply and demand have been unrealistic with respect to farm income goals, and perhaps even government costs. (As we have already noted, the current programs also contribute very few conservation benefits.) A number of the problems associated with the current programs would be lessened or eliminated by establishing a longer term program to selectively retire highly erodible land. (See "Some Questions and Answers About A Soil Conservation Reserve".)

Some Questions and Answers About A Conservation Reserve Program

What is the purpose of a Conservation Reserve Program?

To devote highly erodible cropland to long-term, soil saving vegetative cover, under the umbrella of USDA's traditional crop price support programs.

A Conservation Reserve is intended to achieve two goals of U. S. farm policy with a single program: conserve the nation's topsoil, and protect farmers and consumers from extremes in commodity prices. There are two basic reasons why both goals should be approached simultaneously.

First, recent USDA studies indicate that a small amount of highly erodible cropland accounts for a very large share of U. S. soil loss. For example, in 1977, only 6 percent of the U. S. cropland accounted for 43 percent of total sheet and rill erosion on cropland. Substantial soil savings could be achieved by placing a portion of this highly erodible land into a Conservation Reserve.

Second, most analysts anticipate that crop surpluses will be a periodic problem in the coming decade. Government-subsidized production adjustment programs — set-asides and diversions of cropland to conserving uses — will continue to be used to bolster farm prices and incomes.

At present, USDA production adjustment measures have three serious shortcomings with respect to achieving conservation. First, the programs operate on a year to year basis, making it virtually impossible for farmers to incorporate short-term program requirements like set-asides into a long-term conservation system for their land. The annual process limits soil savings at the same time it encourages cultivation of highly erodible soils to preserve or enlarge the farm's "base" acreage — the larger the base, the greater the program benefits. Second, no attempt is now made to selectively enroll highly erodible land into the diversions and set-asides. Frequently farmers idle low, wet land, or land susceptible to droughts, which not only compromises the production adjustment goals of the programs, but also further reduces the programs' soil conservation benefits. The Conservation Reserve Program would be long term, and would be aimed only at highly erodible land. Third, acreage reductions for cotton are uncommon, and are nonexistent for soybeans except indirectly through the effects of the corn porgram. Yet land planted to these crops accounts for a large proportion of the total erosion on cropland. A Conservation Reserve would provide a means of enrolling such land in long term, conserving uses.

How would a Conservation Reserve Program work?

Farmers participating in USDA's voluntary crop price support programs would be given the option to enroll their highly erodible land in a reserve for 7 to 10 years. Highly erodible land in crop "bases" or soybeans as of a designated time (i.e., the 1981 crop year) would be eligible. Future cultivation of highly erodible land would have to be discouraged by sanctions similar to those imposed by S.663, the so-called "Sodbuster bill". However, AFT supports a stronger version of this legislation than was passed by the Senate in 1983.

Local USDA agencies would conduct a publicity and education campaign to acquaint farmers in their area with the Conservation Reserve. Interested farmers could apply for the program at any time, ideally when they sign up for the regular USDA commodity programs. Local conservationists could also recommend the reserve to farmers. To be enrolled in the reserve, the land would have to meet criteria for highly erodible land. The criteria would combine USDA's Land Capability Classification System with physical factors (soil type, slope) indicative of high erosion hazard.

A bidding procedure similar to the one used for this year's Payment in Kind (PIK) program would be used to determine the payment rates. Bids would be made in terms of a percentage of the yield for the eligible land. In that way, the bids would be proportionate to the productive potential of the land. Actual compensation could be made in cash or in kind. Several years' worth of payments could be provided initially in a lump sum to encourage participation.

Land enrolled in the Conservation Reserve could be devoted to productive, sustainable uses such as hay, pasture or timber production. By contrast, land enrolled in present year to year set-asides is often left essentially fallow.

The land could also be devoted to wildlife habitat, perhaps in conjunction with other state and federal wildlife programs. For example, highly erodible land adjacent to wetlands would be a priority for enrollment in the Conservation Reserve, since this could greatly augment the Water Bank Program and the Interior Department's wetlands purchase program.

Counties now receiving extra USDA conservaton technical and financial assistance via "targeting" should be strongly encouraged to participate, because they will have more resources at their disposal to help interested farmers identify eligible land.

This sounds like the old Soil Bank and other land retirement programs of the 1950s and 1960s. What's the difference?

The Conservation Reserve is fundamentally different because it aims to selectively retire only highly erodible lands. Under earlier programs any land could be enrolled, regardless of its erosion problem. The same is true of the annually operated crop programs currently in use. Today, conservationists have reliable, yet practical methods to determine erosion hazards that were not available twenty years ago. Local conservationists would use those methods to determine eligibility for the Conservation Reserve.

The Conservation Reserve would also differ by including precautions against wholesale, economically disruptive land use shifts in any given rural community, a real problem with the Soil Bank. Limits would be placed on the amount of land that could be enrolled in the Reserve in any one county. USDA studies indicate that highly erodible lands exist in the majority of the nation's agricultural counties. Thus, Conservation Reserve participants need not be concentrated in any given area or state. Finally, land enrolled in the Soil Bank was not supposed to be hayed or grazed. Those uses would be allowed in the Conservation Reserve, both to encourage a transition to more sustainable land uses, and to lower the cost to the government of removing the land from productions. In theory, farmers would receive per acre payments covering the difference between income from growing program crops and grazing or haying activities. In general, the Reserve would be carefully designed to avoid the well-documented problems of earlier programs.

Why the 7-10 year contracts? And what happens at the end of Conservation Reserve contract period?

Long-term contracts are intended to provide a transition period for eligible farmers to convert their land to sustainable farming systems. From a national perspective, a long-term reserve will assist the transition of the farm sector as a whole to a more sustainable pattern of land use,— one that helps balance supply with demand for major crops.

At the end of the contract period, the enrolled land would be removed from a farm's program base acreage. In effect, the land would fall into the "Sodbuster" category upon expiration of the reserve contract.

Clearly, this provision will discourage some farmers from participating in the conservation reserve. However, fairness dictates a limit on the duration of the payments. Farmers who have organized their operation in a way that uses highly erodible land for erosion-prone crops would be supported through the Conservation Reserve to make a transition to sustainable farming systems. Many farmers have protected highly erodible land at their own expense. It would be unfair to provide Conservation Reserve payments in perpetuity to farmers who, for a variety of reasons, have not protected highly erodible land. On the other hand, a short term Conservation Reserve contract would not provide an adequate transition period. In theory, the cost of foregoing future commodity program benefits on highly erodible land should be incorporated into the bids farmers offer to participate in the program.

There is no easy, entirely equitable answer to the problem of shifting highly erodible lands out of intensive crop production. But a long term contract, with eventual removal of the designated land from the farm's program base acreage, seems to AFT an acceptable compromise.

Why not just expand existing conservation programs to deal with highly erodible lands?

The short answer is that those programs do not offer adequate incentives to cope with erosion problems on these lands.

A number of recent studies by USDA and other sources have indicated that highly erodible land is not being protected by traditional conservation practices (terraces, windbreaks, etc.). What's even more disturbing is that the profitable new conservation tillage techniques are not finding their way to highly erodible land, either. In many cases, soil loss cannot be reduced to tolerable levels on this land if it is used for cultivated crops, even if multiple conservation measures are used in combination. Often the cheapest and most effective method for reducing soil loss on this land is to establish permanent vegetative cover, such as hay, pasture or forest. The existing conservation programs do not offer effective means for encouraging these types of land uses changes.

The problem is that farmers often find it more profitable to raise corn, soybeans, cotton, wheat and other crops that leave highly erodible land vulnerable to severe erosion. The Conservation Reserve Program would provide incentives for converting erodible land to long term, conserving uses.

How much soil could a Conservation Reserve save?

That depends on the size of the reserve and the erosion rate on the land before it is taken out of cultivation. As an example, in 1982, about 12.5 million acres of land were temporarily idled through the USDA commodity programs. By converting 12.5 million acres of cropland suffering the highest rates of sheet and rill erosion, over a peroiod of 5 to 10 years we could anticipate soil savings on the order of 600 million tons per year. That would reduce sheet and rill erosion on cropland by about one-third. By comparison, the National Conservation Program announced in December, 1982 will achieve estimated soil savings of 119 million tons annually by 1987—and only if a high level of funding is provided.

A Conservation Reserve will not solve all of the nation's erosion problems. For example, soil loss will continue to be a problem on a significant portion of U. S. rangeland. However, a Conservation Reserve could do a great deal to alleviate erosion on highly erodible land that has elluded most other technical and policy remedies. A Reserve would also make it much easier to focus the traditional technicial and financial assistance programs where they have proven most effective — on moderately erodible soils.

Will the Conservation Reserve replace the current commodity and conservation programs?

No, it will complement them. In years of extreme crop surplus, the Reserve would not totally fulfill the need for production adjustments; set-asides would also be needed. However, the Reserve should help reduce the need for very large, expensive, administratively complicated set-asides by providing long-term production reduction. In times of very tight supply, land in the Conservation Reserve could be temporarily released for crop production at the discretion of the Secretary of Agriculture.

The current conservation programs would continue serving landowners throughout the nation. The Reserve would augment traditional technical and financial assistance programs because it will be directed at lands which desperately need adequate conservation treatment, but rarely receive it.

In short, the Conservation Reserve should be seen as a means of stretching the very limited and valuable resources of SCS and ACP.

Will the Conservation Reserve require a new or expanded bureaucracy?

No. Some technical assistance will be required to assure that only highly erodible land will be enrolled in the program. In many cases the land can be identified from soil surveys or from the experience of local conservationists or SCS employees. Spot checks would also be needed to verify compliance. ASCS would have chief responsibility for program administration; SCS and conservation districts would provide most of the technical assistance. A comprehensive farm plan would not be required: the terms and requirements for the Reserve would be contained in a standard contract that would vary only according to the amount of land and the level of compensation agreed to by the government and the farmer through the bid procedure. And since the main conservation treatment would be grass, legume, or forest cover, minimal technical assistance would be needed after the Conservation Reserve contract is signed. Yet the pay-off in soil savings would be substantial.

If the Conservation Reserve is directed to highly erodible land, won't we be paying a lot of money for land that isn't very productive to begin with? And won't that cause "slippage" in the price support programs?

Unfortunately, there is no national data base relating *actual* (as opposed to *estimated*) crop yields to land types or soil erosion rates. It is generally assumed that highly erodible land is less productive than "average" land, but how much less productive it is has not been quantified. Obviously, there are instances in which highly erodible land is very productive. Southwestern Iowa and the Palouse region are both prone to high rates of soil loss, yet these lands sustain above average yields for many years. It may be desirable to enroll some of this land in the Conservation Reserve to preserve water quality. For that matter, it would be prudent to allow land with more modest erosion rates to be placed in a Reserve if local conservationists determine that it contributes importantly to sediment and water quality problems.

Actually, a Conservation Reserve program may help reduce the problem of "slippage" — the tendency for the government to pay to remove an acre from production, but get less than an acre's worth of production control. There are several reasons why the Reserve might be more effecient.

The first is the use of a bid procedure. If yields are lower-than-average on the land a farmer offers for the Reserve, the bids the farmers offers will have to be scaled down accordingly. Under current programs, the government often pays the full price of diverting land of average productivity, yet allows farmers to divert their least productive land. In fact, in the 1983 program, some farmers were allowed to place nonirrigated land in the conservation use acreage (set-aside or diversion), but received payments scaled to irrigated yields. A bid system would eliminate "slippage" of this type. According to USDA program analysts, where bids were used in the 1983 PIK program, they tended to be lower for less productive land.

The second improvement in efficiency would arise from the selective, long term retirement of specified tracts of highly erodible land. Under current programs, farmers have many opportunities to satisfy set-aside requirements of crop programs with their least productive land. This is because any land in a farm's base acreage can be used to satisfy the set-aside requirement, and the specific tract generally need not be designated until just before the final compliance date for the program — and that date is usually quite close to harvest time. For example, if a 10 percent set-aside/diversion is required for the wheat program, farmers will often plant most of their farm to wheat, then observe which fields grow best as the season advances. Just before the final compliance date they can mow or clip the fields where yields seem lower, designate this land as set-aside or diversion, and still comply with the program. A corn grower may plant very wet land which, if its yields are low and it is not harvested, can be used to satisfy set-aside requirements for a corn program. If yields are high, the farmer can designate other unharvested land, or simply drop out of the program without penalty. Obviously, long-term contracts to retire specific tracts of highly erodible land would eliminate this type of slippage in a Conservation Reserve.

How much would the Conservation Reserve cost?

USDA analysts estimate the average cost of retiring an acre of highly erodible land at about $30 to $50 per acre per year. Allowing farmers to make productive use of the land (permitting haying, pasturing, and forest use) would help lower the compensation necessary. Use of a bid procedure scaled to crop yields on the land will help keep per acre costs (and cost per unit of production control) low, too.

Once established, a 15 million acre reserve would cost $450 to $750 million annually — costs not out of line with those of the current program, and probably lower. Moreover, gradually building the reserve over a period of years would spread out the costs. With time, the reserve would begin to provide a buffer against overproduction and reduce the need for costly, annual production adjustment programs. Farm program managers would not be starting from scratch each year.

References

1. Demand estimates made by Luther Tweeten and cited by G. Edward Schuh in testimony before the Joint Economic Committee, May, 1983.
2. Statement of Alex F. McCalla before Joint Economic Committee, U. S. Congress, Wednesday, April 28, 1982. In The Changing Economics of Agriculture: Review, Evaluation, and Future Directions. 97th Congress, Second Sessions. U. S. Govt. Printing Office. Washington, 1982. pp. 167-172.
3. Tweeten's estimates cited in Schuh's testimony before the Joint Economic Committee. Earlier estimates by Tweeten appear in his statement before the JEC in 1982. (In Changing Economics of Agriculture).
4. These arguments were advanced by Edward Schuh in testimony before the Joint Economic Committee, May, 1983.
5. Speech by William Lesher, May, 1983.
6. See statement by Schuh before the JEC in May, 1983, and Tweeten's statement before the committee in April, 1982.

Chapter Six

AFT Recommendations

AFT's recommendations are grouped in the following five categories:

I. Toward a National Policy for Agricultural Resource Conservation

II. Identifying Soil Conservation Needs and Opportunities on Cropland

III. Coordinating Conservation and Commodity Programs

IV. Improving Resource Information and Conservation Programs

V. Improving State and Local Conservation Efforts

Each AFT recommendation is accompanied by a background statement that sets forth the rationale for the recommendation. Additional suggestions also are provided for implementing many of the recommendations.

I. Toward a National Policy for Agricultural Resource Conservation

Recommendation 1. *A national policy for agricultural resource conservation should be established by the United States in the 1985 farm bill and adhered to by all agencies of the government. As part of this policy, Congress and the Executive Branch should establish goals for the conservation of the nation's agricultural resources. The overall aim of these goals should be to maintain or improve the inherent productivity and quality of soil and water resources, and to minimize adverse environmental effects related to the use of those resources. Two central themes should form the basis for this policy declaration. Government policies and activities should recognize: (1) the long-term nature of agricultural resource conservation planning and implementation and; (2) inherent differences in the quality and capabilities of land for sustainable agricultural production.*

Background

The Congress and the Executive Branch have expressed some of the elements of a U. S. policy on agricultural resource conservation in numerous laws and administrative documents. The principal drawback of existing statements of national policy is their narrow scope and interpretation.

For example, the Soil and Water Resource Conservation Act of 1977 (P. L. 95-192) provides valuable "declarations of policy and purpose". However, the RCA policy declarations are limited, applying only to USDA's conservation programs (which "shall be responsive to the long-term needs of the Nation"), instead of to all USDA programs, and to government programs in general. Title XV of the Agriculture and Food Act of 1981 (P. L. 97-98, the 1981 "farm bill") "reaffirms" Congressional policy "to promote soil and water conservation, improve the quality of the Nation's waters, and preserve and protect natural resources." But , again, this is to be done "through the use of effective conservation and pollution abatement programs". It seems Congress intends only the "traditional" conservation and pollution abatement programs for this purpose, though it has become clear that modifications of government programs in general need to be considered. Both the Congress and the Executive Branch have severely hamstrung agricultural resource conservation by relegating conservation responsibilities almost entirely to these traditional programs. AFT's analysis of the most important of those programs (Chapter 4) indicated they have had, and probably will continue to have, a modest effect on a major conservation problem, soil erosion.

AFT FARMER SURVEY FARMER SUPPORT FOR EXISTING AND PROPOSED CONSERVATION POLICIES

Existing policies are more likely to be effectively implemented, and proposed policies successfully adopted and executed, if they enjoy widespread farmers support. Our survey of farm operators in six diverse areas included the component of polling the respondents as to whether they agreed with, disagreed with, or were undecided about 23 policy positions.

As might have heen expected, whether the surveyed farmers were from Colorado, Illinois, Iowa, Missouri, Tennessee, or Wisconsin, they tended to oppose any level of government — federal, state, or local — having the authority to require them to use soil conservation practices. There was widespread distaste also for the notion that local government "has the responsibility to share the cost of soil conservation." Substantial support was shown for a state cost sharing role (47 percent of the surveyed farmers approved, on average, across the six study sites), and — except in the Colorado site — majorities approved such a role for the federal government. The proposition that the federal government should spend *less* on soil conservation programs was opposed in *all six* sites (by 58 to 91 percent of the respondents).

In five sites, nearly half or more (from 45 to 78 percent) of the interviewed farmers agreed to government paying farmers to take highly erodible land out of intensive cultivation, a policy which AFT recommends for the nation's most erodible land.

Only in one study area (Colorado's) did a majority support a policy of imposing fines on landowners who allow excessive amounts of soil erosion to occur on their land. However, in all but one area, nearly half or more of the farmer respondents (45 to 68 percent) appeared to endorse a judicial deterrent to soil erosion; they agreed with the position that "individuals should be able to recover damages resulting from erosion on adjacent land."

There was majority support in all six sites for the policy that "conservation practices installed with government money be maintained for their useful life or else the money be repaid on a prorated basis."

Regarding "cross-compliance," the position that farmers should not be eligible for government commodity programs or other aid, if they "grow crops on erosive lands without conservation protections," 56 to 72 percent of the respondents in three study areas agreed, 41 and 48 percent in two others did, but only 34 percent approved it in the sixth (Tennesse's).

"Targeting," however, received majority support in all sites. From 74 to 96 percent of the surveyed farmers agreed that government should concentrate its conservation assistance "in areas of the country where soil erosion problems are the most severe." AFT advocates targeting traditional financial and technical assistance to moderately erodible land. AFT believes that land of low erosion potential should ordinarily not be eligible for "publically supported financial and technical assistance for erosion control." For highly erodible lands, AFT urges a program of long-term diversion from cultivation by offering their owners "multi-year conservation reserve contracts" to convert the lands to pasture, range, hay, forest, or wildlife habitat.

From J. Dixon Esseks and Steven E. Kraft, *Government's Role in Promoting Soil Conservation: Farmers' Perceptions in Six Diverse Sites*, American Farmland Trust, forthcoming.

A precedent for a broader policy approach is contained in Section 1540 (7) of the 1981 farm bill, in which Congress declared that USDA and other Federal agencies should "take steps to assure that the actions of the Federal Government do not cause" irreversible conversion of high quality farmland to nonagricultural uses. In addition, Congress set forth provisions to "minimize" such conversions associated with Federal programs.

AFT believes that similar steps should be taken to minimize other adverse effects of Federal programs on agricultural resources. The 1985 farm bill would be the most appropriate vehicle for establishing a comprehensive national policy. Dozens of government programs and activities, costing billions of dollars each year, have substantial — and often negative — effects on America's agricultural resources. Yet, without a coherent and explicit national policy on agricultural resource conservation, underpinned by clear national goals, it is difficult to judge the adequacy of existing conservation programs or the need for new initiatives. Likewise, it seems resource degradation, by official default, is now considered to be an acceptable side-effect of other government activities that directly or indirectly damage agricultural resources. USDA's commodity programs are the most obvious and important example. A national policy would help clarify what is expected of existing conservation programs. It also would give greater standing to agricultural resource conservation in the government policy process. As subsequent recommendations will show, AFT believes conservation goals can be integrated into a number of important government activities without unduly interfering with traditional goals of those activities.

With this recommendation AFT is proposing what is in effect a non-degradation policy for agricultural resources. Over the past decade this same approach has been applied by Congress and the Executive Branch to other key areas of environmental concern through a series of laws and regulations. The development of conservation goals for agricultural resources will not be easy, given the present scientific understanding of how farming technologies, soil and water interact. However, a comparable degree of scientific uncertainty characterizes most other environmental issues on which Congress and the Executive Branch have resolutely acted in the past — air and water pollution, endangered species, and toxic substances are but a few examples. Past experience has shown that the development of national policies accelerates relevant research and helps reduce scientific ambiguities. AFT believes such a process would substantially benefit the science and art of agricultural resource conservation.

AFT recommends that the development and implementation of the national policy proceed in phases. *First,* the Congress should enact a broad declaration of policy to be adhered to by all agencies of government. The series of Congressional hearings and the oversight investigation in AFT Recommendation 3 would be an appropriate prelude to this first step. The declaration should designate the U. S. Department of Agriculture as the lead agency in implementing and coordinating the national policy. USDA should be directed to work in close cooperation with state governments and conservation agencies, conservation districts, and other private and public entities. In effect, the approach should be similar to the one established in Section 6a of the Soil and Water Resources Act of 1977 (RCA). However, the national policy should consider all USDA programs (not only SCS programs), and responsibility for developing the policy should be given to the coordinating group proposed in AFT Recommendation 2, not to the Soil Conservation Service.

The *second* phase would require the USDA, in cooperation with other private and governmental organizations at all levels, to recommend to the Congress and the Executive Branch reliable indicators of agricultural resource conditions, and to establish national minimum conservation goals for soil and water resources. A principle aim would be to encourage and support state conservation efforts. Hence, it would be understood that individual states could set goals that are more ambitious than the national minimum goals. Public participation should be an essential element of this phase. In recommending national minimum goals, USDA should accelerate and use the products of ongoing research on soil and water conservation. The public, Congress and the Executive Branch should be periodically informed of the progress of this phase, which should be completed within two years of establishment of the national policy.

After reviewing and deliberating on the USDA recommendations, Congress and the Executive Branch should set specific deadlines for achieving agricultural resource conservation goals. In addition, the national policy should indicate the roles to be played by existing government agencies in pursuing the conservation goals.

This second phase should also see the refinement of a system of incentives and assistance to agricultural land users to achieve the resource conservation goals specified in the national policy. Traditional government technical and financial assistance for conservation would of course continue to be important. Several important new incentives are presented in this chapter, and these can and should be implemented prior to the adoption of national minimum conservation goals.

Also in this phase, the states would be encouraged to develop means by which to augment Federal efforts for meeting both national and state conservation goals. A number of states have already established standards and regulations pertaining to agricultural resource conservation, and this trend should be encouraged and supported in the context of the national policy. (See AFT Recommendations 23 and 24).

Once again, the logical legislative vehicle for the national policy would be the 1985 omnibus farm bill. In that context, a national policy would greatly assist the implementation of a wide variety of private and public conservation initiatives, including those advanced in this chapter.

With a few exceptions, AFT's recommendations are in the form of incentives for encouraging conservation. Accordingly, we believe the national policy should provide a grace period in which incentives would continue to be the chief means of attaining the policy goals. We might add that we are optimistic that many of the nation's resource problems can be resolved by these means within the decade.

However, it is appropriate for society to begin to consider regulations and penalties that may be necessary to achieve agricultural resource conservation in the forseeable future. The AFT survey and other polls and analyses suggest a growing acceptance of penalty-oriented approaches to conservation. This in part derives from the recognition that a few land users who have not participated in the voluntary system of conservation contribute disproportionately to the nation's conservation problems. In addition, grass-roots sentiment appears to have shifted progressively in favor of restrictive policies, such as "cross compliance", that tie government program benefits to accepted standards of wise land use. The AFT farmer survey found that penalty-oriented conservation policies were much more likely to be acceptable if state and local governments play the leading role in development and implementation.

Recommendation 2. *The Secretary of Agriculture should establish within USDA a permanent coordinating body, with a fulltime staff, and chaired by the Deputy Secretary of Agriculture, to assess and analyze all aspects of all USDA programs as they affect agricultural resource conservation. This group should: be responsible for assuring that agricultural resource conservation goals are acted upon with the most efficient government programs and activities; be responsible for evaluations of all department programs directly or indirectly affecting agricultural resource conservation; have the authority to recommend to the Secretary special studies, projects, and new policy and program initiatives across the Department that would enhance agricultural resource conservation. The coordinating body should be given overall responsibility for the Department's RCA activities. This body should also coordinate USDA activities related to development and implementation of the national policy on agricultural resource conservation recommended above.*

Background

This recommendation is intended to make resource conservation a more integral part of all USDA programs and activities. Historically, conservation activities and responsibilities have been spread among numerous USDA agencies, and coordination has been poor to nonexistent. The schisms between technical and financial assistance, between commodity and conservation programs, and between farm lending and conservation programs, are deeply imbedded in USDA's bureaucratic structure. AFT believes it is unrealistic to expect these various bureaucracies can be combined into a single conservation agency, as has been proposed in the past. At the same time, however, past efforts to coordinate conservation responsibilities among "equal" agencies have proven inadequate.

The two most obvious casualties of this poor coordination are the RCA process and the 1983 PIK program. The deterioration of relations between ASCS and SCS in the latter stages of the RCA process effectively eliminated the opportunity to incorporate conservation objectives more directly into ASCS commodity programs. Had the RCA interagency coordinating committee remained functional and effective, the Department could have had a number of carefully conceived conservation options available well in advance of the "emergency" deliberations on the 1983 PIK program. Lacking the experience with commodity programs necessary to develop such initiatives on its own, SCS was unable to play a telling role in the development of PIK or even, for that matter, in the more limited 1982 acreage reduction program. Other conservation-oriented segments of the USDA bureaucracy also have very limited influence on major commodity program decisions. In short, no analytical capability has been available to bridge the institutional gap between conservation and commodity program responsibilities in USDA.

A coordinating body at the Secretarial level, with responsibility for conservation across the Department, would fulfill two pressing institutional needs for improving Federal conservation efforts. First, this coordinating group would not be confined to the traditional conservaton programs, but would be able to explore conservation problems and opportunities in all USDA programs. This is critical if more conservation is to be leveraged with the Department's vast flow of services, research, loans and financial assistance, which affect every rural county in the nation. In short, the coordinating group would be positioned and equipped to play a major role in a broad range of policy decisions.

Second, the coordinating group would help coordinate and improve traditional conservation programs. The extra-agency status of the coordinating body would in general reduce the adverse effects of interagency rivalry between ASCS and SCS. Program evaluations would be designed and their conduct overseen by this coordinating group, instead of by the line agencies being evaluated, thus lending greater credibility to the evaluations. Politically sensitive conservation program reforms could be explored and proposed with some impunity by a working group at the Secretarial level, to a degree that the conservation agencies themselves rarely have been unable to manage.

To be effective, the coordinating group should be actively chaired by the Deputy Secretary, and should be comprised of Assistant Secretaries or their representatives. An adequate, full-time staff is critical to the success of the coordinating group. Much of this staff could be drawn from USDA (though it should not be assembled on a temporary "detail" basis.) The coordinating group also should have the authority to retain the services of outside organizations and individuals. The coordinating group would have primary responsibility for designing and overseeing program evaluations and other studies, but would draw on agency resources to do the actual work.

The major analyses, findings and recommendations of this body should be documented and made available to the public and Congress at the earliest possible date. The first task of the coordinating group should be to investigate long-standing but poorly documented relationships between commodity program activities and resource conservation. The alleged tendency of the system of "base acreages" in the commodity programs to discourage conserving crop rotations and cropping practices is a prominent example of a conflict that should be examined.

Recommendation 3. *The House and Senate Agriculture Committees should conduct oversight investigations, including public hearings, into (1) the performance of USDA conservation programs after the first cycle of the RCA and (2) the conservation effects of USDA's commodity and credit programs.*

Background

There exists a widespread disappointment in the Congress with the result of the first round of the RCA process, the National Conservation Program (NCP). There is also a sentiment that the 1983 PIK program, and the circumstances leading to it, provided an especially favorable opportunity for long-term soil and water conservation that now has largely been lost. Congress needs to evaluate, independently of the Department, what can be done to improve the next round of the RCA process; what the NCP can be expected to achieve; and how USDA can make better use of the commodity programs to promote long-term conservation.

Faced with dozens of conservation programs, and with several USDA bureaucracies interpreting resource conditions and conservation needs, Congress has found it difficult to determine how best to guage and improve overall progress in resource conservation. In passing the RCA Congress sought guidance from USDA on how to coordinate these many, varied conservation activities, especially in the budget process. The implementation of RCA failed to produce such guidance.

Congress indicated that the key to forming such a national conservation program was to first determine the contribution of each existing USDA conservation activity (technical assistance, financial assistance, research, and so on) to meeting national conservation needs. Congress explicitly requested such information in the RCA, but USDA has not provided it. Severe constraints on the federal budget argue strongly for focusing federal conservation activities on critical resource problems, and for eliminating ineffective or redundant programs and activities in order to sustain the priority conservation services. Yet interagency competition, and the conservation bureaucracies' awesome powers of self-preservation, have substantially limited the possibilities of meaningful evaluation and reform of the Department's conservation efforts. This stalemate must be broken if the next round of the RCA process is to be successful. The coordinating body proposed in AFT Recommendation 2 is intended to provide the type of guidance and overall assessment Congress requested of the Department six years ago. For its own part, Congress needs to exhibit more tenacity and political courage than it has in the past in appraising USDA's conservation programs. Very little in the way of effective oversight has been undertaken by the Congress since passage of the RCA.

Ideally, the House and Senate would coordinate their investigations to maximum effect, and draw upon the capabilities of the General Accounting Office, Congressional Research Service, and Office of Technology Assessment, as well as other private and public sources. The oversight investigations should focus on widely recognized conservation program deficiencies other than program funding levels. Special attention should be given to the planning and implementation of the National Conservation Program, with a view toward establishing the degree to which the NCP achieves a goal of nondegradation for U. S. agricultural resources. The investigations should also consider how contemporary conservation program activities can be more effectively coordinated with one another and with other federal programs. Based on this oversight study, the Congress may consider amendments to the RCA prior to the next cycle of resource appraisal and program formulation in 1985. Alternatively, the committees may provide guidance to the Department on the approach Congress would like to see taken in future RCA activities.

Because the Congress will soon begin formal deliberations on the 1985 farm bill, an early examination of the commodity programs would form a crucial part of the investigation. Otherwise, conservation will continue to be the orphan of "emergency" conditions that perpetually spawn commodity program decisions. The goal of the oversight would be to flush out aspects of the existing programs that either frustrate soil and water conservation efforts or potentially could assist them. AFT has already outlined in congressional testimony the central features of a long-term conservation reserve component for USDA's commodity programs. The conservation reserve is discussed in detail in AFT Recommendation 6.

II. Identifying Soil Conservation Needs and Opportunities On Cropland.

The three recommendations in the preceding section pertain to the establishment and implementation of a national policy for agricultural resource conservation. Soil erosion will be one of numerous resource problems this general policy will have to address. Recommendations in the following sections of this report focus on the narrower, but crucial problems of soil erosion control on the nation's cropland, the subject of AFT's study.

Recommendation 4. *Cropland in the U. S. should be designated into one of three groups by local conservation districts on the basis of practical, consistent, and scientifically sound criteria reflecting the land's vulnerability to erosion. The classification system would serve as a general guide to local conservation districts, Agricultural Stabilization Committees, and USDA field personnel as they consider applications for conservation programs, crop price support programs, and other USDA programs. The system should reflect the land's quality and capability for sustainable agricultural production without excessive soil erosion. To the extent possible, Government policies and programs should encourage agricultural practices appropriate to the land's quality and capability, as reflected by this classification.*

Background

If government soil conservation efforts are to be effective, efficient, and equitable, they must be based on the recognition of inherent differences in the quality of land. This recommendation proposes the first step in that process — identifying land according to conservation needs and opportunities. The land classification system is intended to provide guidance to local conservation districts, Agricultural Stabilization Committees, and USDA personnel as they review applications for ACP cost-sharing, technical assistance, crop price support programs, and other USDA program activities. Establishing this system is critical to the implementation of the new initiatives to be recommended by AFT.

Historically, government technical and financial assistance for soil erosion control have not been adequately based on actual erosion control needs. As we showed in Chapter Four, this is true of field level assistance as well as of the distribution of federal conservation program resources among states. In addition, USDA crop price support programs have been designed and operated with virtually no consideration to their effect on land use patterns. Cropland set-asides, diversions, and even long-term retirement programs like the Soil Bank of the 1950's, have not discriminated among the qualities and capabilities of land eligible for enrollment. As a result, valuable opportunities to simultaneously achieve long-term conservation and production adjustment have not been realized.

A three-tiered system would help coordinate and direct all USDA programs in a manner that will match government programs to conservation needs in the most efficient manner.

As we showed in Chapter One, the majority of America's cropland is not seriously threatened by erosion. A small amount of cropland accounts for most of the country's soil loss. In between these categories is a sizable acreage of land experiencing moderate, though often damaging levels of erosion. The key to solving America's cropland erosion problems is to identify land where erosion is a true hazard, and match new and existing government efforts to the conditions where they stand the greatest chance of success.

The three tiered system we propose here is designed to complement a new strategy for use of all USDA programs to aid conservation. That strategy may be summarized as follows.

Group 1 land is by nature essentially unthreatened by erosion, and should receive minimal technical and no financial assistance for erosion control. Other conservation problems on this land — excessive salinity, for example — may merit assistance and should be eligible for it through USDA programs. In general, land in Group 1 is prime, and capable of sustaining continuous and intensive use. Government efforts such as the Farmland Protection Policy Act and state and local farmland protection programs should be supported to preserve this land for agricultural use. AFT will recommend that under most circumstances Group 1 land should not be set-aside or diverted for the purpose of adjusting the supply of major crops.

For moderately erodible, *Group 2 land*, technical and financial assistance should be extended for cost-effective erosion control practices, primarily conservation tillage. AFT believes most of the field assistance rendered for erosion control through USDA's traditional conservation programs should be focused on Group 2 lands. If a very large degree of production adjustment is necessary to help balance supply with demand for major crops, as was the case in 1983, it may be desirable to divert or set-aside some Group 2 land.

For the most part, however, production adjustment efforts should be aimed at highly erodible, *Group 3 land*. On highly erodible land a shift into permanent vegetative cover often is the most cost-effective method for adequately conserving soil. Recommendation 6 will propose a long-term land reserve component in USDA's crop price support programs to encourage this land use shift. Technical and financial assistance for erosion control on Group 3 land should be limited to those instances where cost-effective management practices suffice to adequately protect the land from excessive soil loss if it is used for cultivated crops.

Recommendation 5. *Primary technical responsibility for developing the classification scheme and for local designation of cultivated land into Group 1, 2 or 3 should be given to the Soil Conservation Service, working through and in cooperation with local soil and water conservation districts. The classifications should be consistent with any standards established by the local districts. General guidelines for the classification procedure should be prepared by SCS national and state offices, but should be subject to approval, modification and appeal through local conservation districts. An appeal procedure should be established in order that farmers or other interested individuals may bring to the attention of conservation district committees additional factors which should be considered in making a classification.*

Background

Improvements in the quality and comprehensiveness of information about soil erosion and conservation needs are a central theme of Chapter Two. With this recommendation, AFT proposes to use some of this information to enable local land users and conservationists to tailor USDA's conservation programs, crop price support programs, and other programs to the erosion control problems and opportunities in their locality.

The proposed procedure for classifying cultivated land into three groups follows longstanding tradition. Responsibility for conservation decisionmaking — in this case, designating land in one of the three Groups — is vested with local conservation district governing boards. Technical assistance and advice would continue to be provided to these local decisionmakers by SCS, in the traditional forms of SCS technical guides and on-site support by SCS personnel. The intent of the proposed procedures is to provide local land users and conservation district committees with the best available information for identifying erosion hazards, and with the flexibility to adapt this information in a way that best suits local needs.

AFT recommends that the existing land capability classification system be used as a starting point for designating land into Groups 1-3. (5) The capability classes and subclasses would be grouped as follows:

Preliminary AFT Land Groups

Preliminary AFT Land Group	*Land Capability Class or Subclass A*	*All Cropland*[1]	
		(1,000 Acres)	Percent
1	I, II (except IIe)	130,492	31.8
2	IIe, III, IV (except IVe)	234,982	57.2
3	IVe, VI-VIII	45,492	11.0
Total		410,966	10.0

[1]Class V, wet soils, not included.

These initial groupings reflect the general assumptions of the land capability class system. Classes I & II, except for erodible subclass IIe, usually are not vulnerable to significant soil erosion damage and (barring other resource problems) are suitable for intensive use. Classes IIe, III and IVe have progressively more restrictions on their capabilities, but with adequate conservation treatment they too can support rather intensive cultivation. Much of the land in these categories can probably be adequately protected from any erosion hazards that may exist by conservation tillage systems. Classes V-VIII are considered to be unsuited for cultivation, in many cases because of an erosion hazard. Class IVe was added to Group 3 to make it consistent with the definition of "highly erodible land" in the pending "sodbuster bill", discussed below.

AFT emphasizes that the use of the present land capability class system to define the three proposed land Groups *should be viewed as an interim measure until a superior system can be developed or major flaws in the existing capability classifications can be corrected.* In discussions with conservation experts and policymakers it became clear that basing the three Groups on the capability class system offered two important advantages. First, most of the nation's cultivated cropland already has been classified under this system, and is delineated on published soil survey maps for ready reference and use by farmers and program administrators. Second, many farmers and most conservationists are familiar with the capability class system as a conservation planning tool. These attributes of the system would make forth coming attempts to link USDA program activities to the quality of the land more practical and politically acceptable. Since AFT and others hope to establish such links via the 1985 farm bill, if not sooner, it was thought that basing programs on a familiar and available land classification system was likely to pose fewer delays than would construction of an entirely new system.

More importantly, AFT believes the needed improvements in the capability class system are more likely to be made if the system is pressed into active use in USDA program decisionmaking. As we pointed out in Chapter Two, the main problem with the present system is that its classifications do not reflect modern, scientific estimates of soil erosion rates. The soil loss equations were not available to soil scientists and conservationists when the system was developed and when most of the actual classifications were made. AFT and other analysts found inconsistencies between actual and potential erosion rates reported in the 1977 NRI and the classification of the land. The most serious, but by no means the only problem, was the apparent "overclassification" of a substantial amount of Class IIIe cropland that has a high erosion hazard according to NRI data, and properly belongs in Class IVe or lower. These problems need to be corrected if new program initiatives are to be effective and, more importantly, fair to farmers. In AFT's view, since dollars and cents are involved, farmers deserve the best criteria and technical support we can afford in implementing these programs.

Correcting such problems is of fundamental importance to the success of the overall conservation strategy AFT proposes. A reliable, scientifically up-to-date classification scheme is equally important to the success of several separate initiatives that recently have attracted interest in the Congress (and which AFT supports as part of our overall strategy).

The most salient example is the so-call "sodbuster bill," which seeks to end USDA program subsidies for the future cultivation of "highly erodible lands" — lands in capability classes IVe, VIe, VII and VIII. This definition excludes some land in higher classes (notably classes IIe and IIIe) *that is certain to experience very high rates* of soil loss if it is cultivated, and to which the sanctions of the sodbuster bill should be applied. As a result, the important principles contained in the sodbuster bills as written are compromised by the exclusive use of the land capability class system to determine what is highly erodible land.

In effect, even with passage of the present version of this bill, USDA programs would continue to subsidize cultivation of a substantial amount of highly erodible land in the future: specifically, as yet uncultivated land in classes IIe and IIIe that will experience very high erosion rates if used to grow row crops and small grain. The resulting conservation problems would further strain traditional conservation programs. The effectiveness of new initiatives such as the conservation reserve also could be compromised because highly erodible land would continue to be subsidized into cultivation, offsetting, perhaps significantly, the conservation and production adjustment gains achieved in the conservation reserve. For the two policies to be consistent, any highly erodible land exempted from the sanctions of the present sodbuster proposals also would have to be designated as ineligible for the conservation reserve — otherwise the reserve itself would provide an incentive to bring highly erodible land into cultivation. As a result, a considerable amount of highly erodible land would not be affected either by the sodbuster sanctions or the incentives of the reserve.

To avoid this problem, local conservation districts, with technical support from SCS, should take scientific estimates of soil erosion into account when designating land into one of these three groups. In regions of the country where sheet and rill erosion is the primary erosion control need on cultivated cropland, AFT recommends the classification of land into Group 1, 2 or 3 should reflect the land's inherent erosion potential as estimated by four physical factors of the Universal Soil Loss Equation (the "RKLS" product).

Group 1. RKLS less than or equal to 15 tons per acre per year.

Group 2. RKLS greater than 15, but less than 75 tons per acre per year. "Moderately erodible land."

Group 3. RKLS greater than 75 tons per acre per year. "Highly erodible land."

In designating land, the first step would be for local conservation districts to apply the preliminary grouping criteria given previously — the land capability classifications provided in published soil surveys. In some instances it will be evident to conservation district committees and local SCS personnel that land classified as IIIe has an inherent erosion potential (RKLS product) exceeding 75 tons per acre annually. Hence, the land should be in Group 3, despite its capability classification. It may be appropriate to reclassify the land into a lower class. Such land would be eligible for the conservation reserve proposed in Recommendation 6. The same 75 ton criterion also should be applied to land that does not have a cropping history and which is brought into cultivation subsequent to passage of sodbuster legislation. For example land classified IIIe, but having a very high potential for sheet and rill erosion, should rightly come under the sodbuster sanctions unless adequate conservation systems are employed. *Obviously, proper designation of land into the three Groups, or reclassification in the land capability class system, should be a very high priority for conservation districts and for SCS field personnel.*

In areas where water erosion is a significant problem as a result of snowmelt, irrigation or other causes not reflected in the USLE, SCS, in cooperation with local conservation districts, should develop a practical field method for assigning land to three groups comparable to the RKLS criteria listed above. Where necessary, a qualitative system of classification should be applied to such land on an interim basis.

In areas where wind erosion is the predominant erosion hazard, a classification scheme should be developed comparable to the RKLS criteria. Ideally, the scheme should be based on factors contained in Wind Erosion Equation.

The criteria used to classify land into the three groups should be revised as soon as possible to incorporate other chemical, biological and physical factors that influence the effects of erosion on soil productivity or off-site damages (sedimentation and pollution). Ultimately, the classification scheme should employ soil productivity or off-site damage criteria.

AFT reemphasizes the need for conservation districts and SCS support personnel to complete classifications in a timely manner. Field visits should be undertaken expeditiously to resolve any classification disputes.

III. Coordinating Government Conservation and Commodity Programs.

The following recommendations describe conservation and commodity program reforms and initiatives AFT believes should be implemented for each of the Land Groups designated above.

Land Group 1

Recommendation 6. *Land in Group 1 should be set-aside, diverted, or otherwise retired from production of cultivated crops as a requirement for participation in USDA crop price support programs only when inadequate acreage is obtained for production control purposes from Land Groups 2 and 3. Land in Group 1 should also not generally be eligible for publicly supported financial and technical assistance for erosion control, unless the public's interest in such assistance can be demonstrated on a case-by-case basis.*

Background

Existing crop price support programs allow any land with a cropping history to be retired, regardless of its quality, when production controls are declared by the Secretary of Agriculture. Analysts know in a very general way that farmers tend to meet their acreage reduction requirements by temporarily retiring their less productive lands, contributing to the "slippage" phenomenon in production control programs. But it has not been established that these lands are in every case highly erodible. In fact, recent evidence suggests that the incidence of highly erodible land did not correspond to land diverted from production in 1978.

Except for seasonal factors that occasionally reduce its productivity, such as excess moisture at planting time, land in Group 1 is considered America's best and most productive and should be available for continuous production of whatever crop the land user deems best. Taking such land out of production via commodity programs results in very minimal soil conservation benefits. AFT contends that future acreage reduction could be achieved within Groups 2 and 3. Where farms are composed entirely of Group 1 lands, *no set-aside or diversion* should be required as a condition of eligiblilty for crop price support programs.

Group 1 lands ordinarily do not have significant soil erosion problems. In the past, many erosion control practices installed on such land with publically supported technical or financial assistance have actually been production-enhancing measures. This is due in part to the voluntary nature of traditional conservation programs: assistance has been extended to land with lesser soil erosion problems simply because users and owners of that land requested it. The historic inability or failure of conservation agencies, conservation districts, and Agricultural Stabilization Committees consistently to seek out land with the most serious problems served to make these voluntary programs even less effective.

AFT recognizes that there may be circumstances in which erosion control assistance should be extended to such lands. In some cases erosion problems are not adequately diagnosed either by the land capability class system or existing procedures for estimating soil loss. (Erosion problems common to overland flow irrigation systems are a good example.) Then, too, farmers may wish to experiment with erosion control techniques such as conservation tillage on their better lands before trying it on lands with significant erosion hazards. As we noted in Chapter 4, this may help to explain why ACP cost-sharing for conservation tillage systems often has been expended on land with very modest potential for erosion.

It is not AFT's intent that the land classification system should be so rigidly applied as to preclude all assistance to Land Group 1. However, AFT believes a greater degree of guidance is necessary and justified if traditional conservation programs are to become more efficient. The application of technical and financial assistance for erosion control on Land Group 1 should be judged in terms of (1) the severity of the erosion problem being treated, and (2) the degree of effort being made to solve other local erosion problems that merit higher priority and are treatable with available technical and financial assistance.

Land Group 2
Moderately Erodible Lands

Recommendation 7. *The USDA's traditional technical and financial assistance efforts for erosion control, as well as Extension Service activities, should place high priority on cost-effective tillage practices, primarily on moderately erodible Land Group 2.*

Background

Land Group 2 represents the bulk of America's cropland. Soil erosion problems on this land often can be solved by the use of conservation tillage systems alone. Technical and financial assistance are valuable means of promoting conservation tillage, and can greatly assist widespread adoption of these systems on Land Group 2.

Although ACP cost-sharing for conservation tillage (including no-till) systems has increased in recent years, it remains a very small proportion of total ACP expenditures for erosion control. And as noted in Chapter 4, many of these cost-shared practices have been approved for land that apparently does not have significant erosion problems. The proportion of SCS technical assistance devoted to conservation tillage efforts, and the type of land receiving this assistance, is not known precisely at this time. But the agency has emphasized tillage systems for some time, and the Conservaton Reporting and Evaluation System (CRES) presently will indicate the distribution of technical assistance in relation to land quality and conservaton needs.

The emphasis on conservation tillage and evaluation of program activities which promote it should be continued by ASCS and SCS. In addition, USDA should expand support for the Conservation Tillage Information Center.

Recommendation 8. *The Department of Agriculture should proceed with targeting efforts now underway for technical and financial assistance for soil erosion control. However, the total number of counties designated for targeted assistance should be frozen at 800, the number anticipated for participation by Fiscal Year 1984. No additional target areas should be designated until the success of the 1981-84 targeting effort has been fully evaluated.*

Background

The goal of devoting 25 percent of existing technical and financial assistance to targeted areas by 1987 is a worthy one, but as demonstrated in Chapter Four, the planned distribution of that assistance is far too diffuse. AFT considers it unlikely that targeting will succeed unless technical and financial assistance are focused on a smaller area. While a successful targeting program is likely to strengthen the overall bargaining position of conservation programs in the budget process, a diluted effort will only call attention to the rigidity and ineffectualness of the voluntary system in dealing with conservation problems. Freezing the *number* of counties at about 800 would allow for adjustments in event that some counties already designated should be replaced with others. For the most part, the targeting program should be allowed to run its course in counties designated as of FY 1984, and the full 25 percent of technical and financial assistance should be targeted to these counties alone. In addition, SCS and ASCS should modify the targeting criteria to focus on land within Group 2 that is experiencing soil loss in excess of twice the soil loss tolerance.

Recommendation 9. *The Pilot Variable Cost-Share Level Program of ACP should gradually replace existing procedures for the overall ACP over a 5 year period, beginning in FY 1985. Also beginning in 1985, SCS should experiment with the variable cost-share level approach in cost-sharing activities under the Great Plains Conservation Program. In both programs, emphasis should be given to assisting cost-effective conservation practices on Land Group 2. This can be achieved by awarding financial assistance within the broad Group 2 category to land with the most serious erosion problems.*

Background

In Chapter Four, AFT reviewed the variable system of cost-sharing introduced by ASCS in 1982. The promise and broad acceptance of the system by local conservationists merits its phased adoption in the overall ACP, and trial use in GPCP.

In its present form the variable system already effectively excludes most of Land Group 1 from financial assistance, since very little of this land erodes in excess of the soil loss tolerance (T value), a criterion for assistance under the program. The scaling system for variable cost-sharing should be modified to prioritize the most serious erosion control problems *within* Land Group 2.

However, since AFT will propose a new conservation reserve program for dealing with erosion on Land Group 3, it will be necessary to modify the cost sharing program for highly erodible lands. Lands in Group 3 should be offered variable cost-sharing only after an attempt has been made to enroll them in the conservation reserve, and then only if substantial soil savings can be achieved, cost-effectively, with the assistance. Where possible, cost sharing on Land Group 3 should be made for establishment of permanent vegetative cover. Failing that, conservation tillage systems should be emphasized.

Land Group 3
Highly Erodible Land

Recommendation 10. *In formulating and implementing USDA commodity price support programs, high priority should be assigned to long-term conversion of Group 3 land to conserving uses such as pasture, hay, range, forest or wildlife habitat. To the extent possible within the context of production adjustment goals, commodity price support programs should encourage this conversion by offering farmers multi-year conservation reserve contracts for Group 3 land. Periodic, one-year set-asides and diversions should also be directed to Land Groups 2 and 3 as production adjustment requirements may warrant. Legislative authority for nationwide implementation of a conservation reserve should be provided in the 1985 farm bill.*

Background

A number of experts have developed arguments for a long-term land reserve to simultaneously deal with problems of crop surplus and soil loss on highly erodible land. In the current Congress a number of individuals and groups, including AFT, have testified to committees of both houses in support of a reserve, and several bills have been introduced authorizing one.

AFT has endeavored to synthesize and

strengthen with our own analysis the case for a conservation reserve. The concept of the reserve rests on three key premises.

First, by placing a small amount of highly erodible, cultivated land into long-term, conserving uses, it will be possible to eliminate much of the preventable, excessive soil loss on America's cropland. Evidence on the concentration of all forms of erosion, which has been available only in the last few years, was presented in Chapter Two. It is now possible to identify highly erodible land with considerable reliability, and as the Introduction concluded, much of the damage being done by erosion is on this land.

Second, the long-term outlook for the farm economy suggests that government subsidized production controls will continue to be needed in the future. However, as described in the preceding chapter, these controls must be applied on a scale, and timed in a fashion that minimizes disruption of emergent world market patterns. Moreover, the controls must be of a type that is both consistent and flexible, providing farmers and consumers alike with greater protection against the vicissitudes of market prices. These requirements can be met with a small-sized, long-term conservation reserve that can be temporarily stretched with one-year set-asides in times of surplus, or temporarily returned to crop production in the event of national emergency.

Third, as was indicted in Chapter Four, the gap between soil conservation needs and conservation program accomplishments is disturbingly wide, and may widen further in the future. Incentives offered via the existing conservation programs have proven inadequate to deal with soil loss problems on highly erodible land. Indeed, the conservation programs alone cannot possibly offset the powerful incentives for improper land use provided by market forces and other USDA programs. A conservation reserve would enhance and complement the traditional conservation programs; technical and financial assistance could then be focused on problems where they have proven most effective.

The procedures of a conservation reserve program would differ very little from those of the regular crop price support programs. The main difference would be in the program contract. The program would be administered by the Agricultural Stabilization and Conservation Service, working through the local, farmer-elected Agricultural Stabilization Committees (ASCs). All Group 3 land devoted to the production of crops as of a specified date would be eligible. (The crops would include all crops for which USDA has price support programs, including soybeans.) Farmers could apply for the reserve at any time, regardless of whether production controls have been declared by the Secretary of Agriculture. The local conservation district, with SCS support, would be responsible for determining in a timely manner that the land meets the criteria for Land Group 3. The farmer would submit a bid to the ASC for the compensation the farmer would accept in return for establishing and maintaining a permanent, conserving use of the land (i.e., permanent vegetative cover) over a 10 year period. *The ASC would be authorized to accept the most cost-effective bids received in light of both acreage adjustment and soil conservation benefits.* The farmer could be compensated in cash or in kind, at the discretion of the Secretary of Agriculture. The compensation could be paid in increments over the duration of the contract, or all or a portion of the total contract payment could be made in a lump sum at the time the contract is entered into.

The contract period would be 7 to 10 years, after which time the enrolled land would be excluded from the farm's base acreage and devoted permanently to conserving uses stipulated in the contract or approved by the local soil conservation district. All reserve contracts should provide appropriate penalties for breach of contract. As was done in the 1983 PIK Program, USDA should set forth procedures by which whole-farm bids and contracts may be entered into in establishing a conservation reserve program. USDA also should establish annual and long-term county-level quotas for the amount of land that can be entered into a conservation reserve program, to avoid large, rapid land use shifts that may harm local rural economies.

To the extent feasible, USDA should strive to enroll all Group 3 lands in the reserve. All reserve contracts should provide for temporary release of the land for production of crops under conditions of national emergency. USDA should develop contingency plans to encourage use of cost-effective conservation systems, preferably no-till planting methods, whenever land is temporarily released for cultivation.

The USDA should allow for and encourage productive, sustainable uses of Group 3 lands that have been entered into the conservation reserve program. Grazing and haying should be permitted on such lands once forage crops are adequately established, provided they are adequately maintained. Where appropriate, USDA personnel should encourage development of wood lots on the reserve acreage.

To the extent feasible, USDA should encourage opportunities for converting Group 3 land to long term use as wildlife habitat. Where Group 3 lands could provide wildlife habitat near or adjacent to valuable wetlands, USDA should offer landowners a preferential opportunity to enroll in both the conservation reserve and the Water Bank Program. USDA should also inform state, local and federal wildlife agencies, as well as private wildlife and environmental groups, of opportunities to support establishment and use of wildlife habitat on Group 3 lands.

All local USDA personnel, in conjunction with the conservation districts, ASCs, and other appropriate groups, should actively publicize the conservation reserve. Special educational events should be held periodically to inform farmers and the public about the purposes and procedures of the reserve. Conservation district officers and cooperators, as well as local employees of SCS and other USDA agencies, should make a concerted and coordinated effort to contact and inform land users whose land would be eligible for the reserve.

Once again, it is vitally important that a modern and scientifically reliable land classification system be used for identifying highly erodible land. The land capability class system alone will not suffice; it will have to be supplemented by application of the soil loss equations. For example, not all class IVe land would qualify for the reserve on the basis of estimated erosion rates. Conversely, several million acres of class IIIe land having very high soil loss rates (according to the 1977 NRI) should be eligible for the reserve. The hybrid system proposed in AFT Recommendation 5 is intended to provide local conservationists and program decision-makers with a practical and reliable alternative. Moreover, since eligibility for important financial benefits will hang in the balance, it is important that the classification system be fair and defensible to farmers and conservation experts. Therefore it is important that the hybrid system be applied expeditiously as farmers apply for the reserve. AFT anticipates that the expertise of local conservation districts and USDA field personnel, particularly SCS, will be invaluable in encouraging farmers with highly erodible land to investigate the conservation reserve.

Recommendation 11. *For highly erodible lands not covered by a conservation reserve contract, the Agricultural Conservation Program, Experimental Rural Clean Water Program, or Great Plains Conservation Program should be used to encourage the establishment and maintenance of permanent vegetative cover.*

Background

Some farmers will not wish to enroll all or perhaps any of their highly erodible land in the long-term conservation reserve program. As noted previously, establishment and maintenance of permanent vegetative cover often is the most efficient means for reducing soil loss to tolerable levels on highly erodible land. The ACP, RCWP, and GPCP all provide mechanisms by which USDA can share the cost of establishing permanent vegetative cover. In ACP, the largest of these programs, the cover must be maintained for 5 years after the cost-share has been made. The RCWP and GPCP also provide cost-sharing for permanent cover in their 10 year contracts.

Ongoing reforms of the ACP, including the variable cost share program described above, will if fully implemented move the program in the direction suggested by this recommendation. Similar steps need to be taken for GPCP and RCWP.

Recommendation 12. *Wherever state or local conservation programs have been adopted to encourage conversion of Group 3 lands to stable uses, USDA should make a special effort to provide assistance via the conservation reserve or long term ACP and GPCP land retirement contracts.*

Background

The AFT farmer survey revealed considerable support for long-term land retirement programs in all but one of the six study areas. Based on contacts AFT has made throughout the country, it is likely that the conservation reserve program, even in a pilot form, will stimulate complementary initiatives at the state and local levels. USDA should encourage these intitiatives by providing additional personnel or financial support in areas where a concerted effort is being made to enroll Group 3 land in the conservation reserve. Temporary increases in assistance would be especially valuable to state and local conservation programs in the early stages of designating land groups and evaluating conservation reserve bids.

Recommendation 13. *Through legislative and administrative initiatives, Group 3 lands not devoted to the production of crops as of a specified date should be designated as ineligible for future participation in USDA commodity programs (including the conservation reserve), the federal crop insurance program and other publicly funded programs. Toward this end, the Congress should expeditiously enact an effective version of the "Sodbuster bill".*

Background

The conservation reserve is designed to help permanently convert Group 3 land currently used to grow crops to conserving uses. This recommendation is intended to eliminate USDA subsidies for future cultivation of land not currently used to produce crops. Under the conservation reserve, Land in Group 3 would only be eligible if it has been used to produce crops as of a specified date. This deadline will prevent land users from deliberately cultivating pasture, range and other land for the purpose of qualifying for conservation reserve payments. However, additional sanctions are needed to eliminate USDA subsidies for future cultivation of highly erodible land, even if it will never be eligible for the reserve.

Several versions of the "sodbuster bill" have been introduced in the 98th Congress; of these, AFT supports S.663 as passed in the summer of 1983 by the Senate agriculture committee, but does not support the version passed by the full Senate in late 1983. With the approach of the 1984 elections, it will be increasingly difficult for the Congress to act on new legislation and many experts fear that sodbuster legislation will be among the casualties. It is clear, however, that the matter will be actively taken up in debate over the 1985 farm bill.

AFT favors modifications in the definition of "highly erodible land" in existing sodbuster bills, to allow for inclusion of land that suffers high erosion rates but is not in capability classes IVe, VIe, VII and VIII. The designation of land into Groups 1-3, as previously described, should enable local conservation districts to upgrade the land classes in their area to include all land that is truly highly erodible.

Disagreements have arisen in debate over S.663 concerning the extent to which the sanctions for highly erodible land are to be applied to the whole farm. AFT supports a strong interpretation of the intent of S.663: namely, if highly erodible land not currently used to produce crops cultivated in a manner that does not meet with the approval of the local conservation district, the sodbuster sanctions should apply to the entire crop program base of which the highly erodible land is a part.

On November 18, 1983, the Senate passed the weak, original version of S.663, not the version passed by the Senate Agriculture Committee. AFT favors amending this bill to reflect the principles just described. In addition, further analysis of the impacts of the sodbuster bills in needed.

Recommendation 14. *USDA should encourage member organizations of the Farm Credit System to adopt procedures and policies designed to encourage enrollment of Land Group 3 in the conservation reserve, or otherwise encourage conserving use of Group 3 lands. FCS should also adopt sanctions consistent with those contained in sodbuster legislation to discourage future cultivation of Group 3 lands now in conserving uses.*

Background

At one time a govenment subsidized institution, the now-independent Farm Credit System is the single largest lender to American farmers. FCS could make a very valuable contribution to soil conservation by tailoring its lending policies to support the conservation reserve and the sodbuster concepts.

Recommendation 15. *In repatriating land received through loan foreclosures or bankruptcies, the Farmers Home Administration (FmHA) should encourage sustainable use of the land, including enrollment of any Group 3 land in the conservation reserve.*

Background

FmHA could constructively influence the use of land it holds temporarily until the land is resold and returned to productive use. Where this land is clearly unsuited to continuous cultivation because of erosion or other conservation hazards, FmHA could encourage or stipulate that the land be farmed in accordance with local conservation district standards. FmHA could also stipulate that the purchaser of repatriated Group 3 land must apply for the conservation reserve.

IV. Improved Resource Information and Program Evaluation

Recommendation 16. *In analyzing and presenting the results of the 1982 National Resources In-*

ventory (NRI), USDA should give first priority to information on soil erosion and conservation on cropland. The information should be presented in a form that will enable farmers, the public, conservation experts and the Congress to evaluate the need for and potential effectiveness of new conservation program initiatives, particularly the conservation reserve and the sodbuster bill, in early 1984. Information on erosion and conservation practices on cropland should be presented in a manner that corresponds with the three land groups proposed in this report, or a comparable scheme.

Background

The 1982 NRI was the most extensive and detailed on-the-ground assessment of natural resource conditions that has ever been undertaken anywhere in the world. At this writing (fall of 1983) SCS is nearing the completion of an exhaustive series of data checks, in preparation for analysis of information collected at one million sample points nationwide. SCS is to be commended for proceeding expeditiously, yet cautiously, in preparing this vast store of data for analysis by experts inside and outside USDA.

However, it is of vital importance that priority be given to the earliest possible dissemination of 1982 NRI data pertaining to soil erosion and erosion control conditions and trends on cropland. Delays in providing detailed information of this type could seriously hamper attempts to institute reforms like the sodbuster legislation and the conservation reserve via the 1985 farm bill.

The difficulty of injecting conservation concerns into the policymaking process for commodity programs has been a recurrent theme of this report. This unfortunate tradition can be overcome at least partially by an early, detailed presentation of new information obtained in the 1982 NRI. Revelation of the high concentration of soil loss on a small portion of the nation's land was pivotal to the conceptualization of the conservation reserve. Yet this "discovery" came years after results of the 1977 NRI were released. Indeed, numerous gaps remain in the analysis of the 1977 data with respect to evaluation of both the conservation reserve and sodbuster legislation; in most instances the problem is simply one of retrieving data from the NRI computer tapes.

The 1982 NRI should be utilized much more thoroughly by USDA, and in a more expeditious manner than was the case with the 1977 NRI. SCS already has announced plans for release of information from the inventory in published and computer tape forms as soon as possible. In AFT's view, in the near term it is much more important to release detailed information about cropland erosion and conservation data and trends since 1977 than it is to release summary data for each of the many resource topics covered by the 1982 NRI. The potential policy and program benefits of this erosion information more than compensate for the delay in release of other resource information. Eventually, researchers and organizations outside the department, including AFT, will develop and use even more detailed erosion information from the 1982 NRI. However, the cost of delay is great. Congress has already in effect begun its deliberations on the 1985 farm bill, and the pace will quicken early in 1984. By providing detailed erosion data from the 1982 NRI in the first few months of 1984, SCS could greatly assist efforts to evaluate conservation initiatives in the 1985 farm bill.

The data should be released in a form that will help answer some of the most obvious questions about the conservation reserve and the sodbuster legislation. That is to say, the data should enable people to estimate the amount and location of land that could be affected by each initiative, as well as estimate the amount of soil these initiatives might save.

For the purpose of evaluating the conservation reserve, AFT believes the following data would be particularly useful as a starting point. In tabular form, cropland acreage, average erosion rates, and total soil loss data should be broken down by land capability class and subclass. Within each capability class the cropland acreage and erosion tonnage estimates should be arrayed by erosion rates for sheet and rill, for wind, and for the three forms of erosion combined. In regions where sheet and rill are the major erosion problem, these same tables should be organized by ranges of the inherent potential for erosion (RKLS) as provided by the USLE factor values. If a comparable scheme can be developed from factor values in the WEE, similar tables should be prepared for areas where wind erosion data were collected. All tables should be developed for the national, state and major land resource area (MLRA) levels, as well as for major crops, so that the information will be as useful as possible to the Congress and the public. Ideally, the tables would be accompanied by state-level dot maps showing the distribution of acreage by land capability subclasses and by erosion rates (and by range of RKLS where appropriate).

To evaluate sodbuster initiatives, the acreages of high, medium, low and zero potential cropland should be broken down by land capability class and subclass. In areas where sheet and rill are the dominant erosion hazard, acreage in each potential cropland category should be arrayed by erosion rate and by ranges of the inherent potential for erosion (RKLS). Again, if a comparable scheme can be developed from the WEE, similar tables should be prepared for wind erosion potential. Maps showing the distribution of acreage by land capability classes and by potential erosion rates would also be very useful.

In effect, the above information would make it possible to estimate the amount and location of land according to the three Land Groups proposed by AFT in Recommendation 5. This information would provide a basis for assessing the potential effect of any conservation initiative that was based on erosion rates or capability classes, or on a combination of the two. Of course, this information would only indicate in a general way the location and magnitude of these potential program effects. Actual effects would be determined by farmer participation in the programs and by application of program criteria by conservation districts and Agricultural Stabilization Committees in each locality.

Conservation practice data for cropland collected in the 1982 NRI also should be published expeditiously. Almost no data if this type have been reported by SCS from the 1977 NRI. This information will enable people to discuss and locate the conservation needs that have been met, or remain unmet, by conservation practices on cropland. It will also contribute to the overall debate on the need for reform or additional funding for conservation programs, and on new policy initiatives such as the conservation reserve. The acreage treated with terraces, conservation tillage practices, contour farming methods, and stripcropping should be published at the national, state and MLRA levels, together with comparative data for those practices from the 1977 NRI. These data should be arrayed according to land capability class and subclass. In areas where sheet and rill are the major erosion hazard, the acreage treated with these practices also should be arrayed according to the inherent potential for erosion obtained from the RKLS factor values in the USLE.

Recommendation 17. *USDA should make a special effort to distribute data tapes and documentation for the 1977 and 1982 NRIs to a wide range of public and private groups and individuals with an interest in conservation. Detailed documentation of the statistical design and reliability of the survey, and the design of the computerized survey data base, should also be prepared for dissemination to analysts and interested individuals outside the USDA. To encourage more detailed, regional research using the NRI data, SCS and other USDA agencies should offer financial support, on a competitive basis, for graduate students and other researchers interested in conducting investigations using the NRI. USDA may wish to establish categories and types of analyses they would like to see conducted by outside researchers. To provide a focal point for this research and to publicize its results, USDA should devote a keynote session of the annual USDA outlook conference to soil and water conservation trends and their implications for public policy.*

Background

To date, a great deal of very valuable information contained in the 1977 NRI remains unreported and unanalyzed. It is important to complete the work on the 1977 NRI, and to enlarge and accelerate analysis of the 1982 inventory. SCS cannot be expected to do all of the analytical work that is necessary, nor even can USDA. In fact, outside researchers can and should make exhaustive use of the data, particularly in light of the fact that the 1977 NRI alone cost the government about $12 million.

SCS has announced a policy of wide access to the 1982 NRI to interested parties. AFT believes SCS and USDA generally should go one step further and actually seek out and encourage purchase and analysis of the NRI data in an easily manipulated, computerized from. If the data are to be used correctly, care must be taken to thoroughly document the inventory to minimize the chance that recipients of NRI data will misinterpret data elements. Documentation should be prepared and made available for both the 1977 and 1982 NRI tapes, as should a detailed explanation of any changes in the design and coverage of the 1977 and 1982 inventories.

This recommendation also proposes several new methods for disseminating the NRI and its results. The amount of financial support for outside research need not be very large, particularly if funds are funnelled through ongoing research projects on natural resource issues. Research with practical policy implications should receive priority, and every effort should be made to assure the research is responsive to the program missions of the Soil Conservation Service, Agricultural Research Service, Economic Research Service, and Agricultural Stabilization and Conservation Service. The Secretarial coordinating body proposed in Recommendation 2 should be responsible for establishing the research categories and for awarding research assistance. Such research need not be confined to the inventories as source material.

Although presentations on soil and water conservation topics usually are included in USDA's annual outlook conference, a keynote session each year would be more appropriate to the increased interest in and importance of these topics. A session of this nature would be a logical forum for presenting the results of the modest policy-oriented research program just proposed (though the program should not be confined to such research). Throughout this report we have noted that many farm policymakers and members of farm interest groups often consider conservation issues peripheral to their interests. This recommendation would confer on conservation issues the major status they deserve in the most important agricultural policy forum in the country.

Recommendation 18. *USDA should, to the extent feasible, collect data on farm and conservation programs, natural resources, and other topics in a manner that allows these data to be integrated and coherently analyzed. The department should establish a computerized data base accessible to all appropriate agencies which links natural resource, and farm and conservation program data collected by the department.*

Background

For a number of years conservation and commodity program experts have pointed to the inadequacy of data available to analyze program effects and performance. The problem becomes even more pronounced when one attempts to analyze the effects of current commodity (or credit, or crop insurance) programs or new program initiatives on conservation. For example, the idea of requiring approved soil conservation practices as a condition of eligibility for USDA programs — popularly termed "cross-compliance" — appears to have gained more popular support in recent years. Unfortunately, USDA has not collected or organized data on resource problems and commodity program participation in a way that would provide answers to very basic questions about cross compliance. For instance, there is no information on the soil erosion problems of participants in the commodity programs, so it is impossible to determine what soil savings cross compliance might achieve. (Conversely, data on erosion rates have not been consistently linked to farm program participation.)

As is the case with the 1977 NRI, a tremendous amount of data has been collected, but has not been made available in a useful form. In the case of USDA's commodity programs, the vast majority of the data never leaves the county office. Creation of the data base recommended here would allow for *integrated* analysis of resource conditions and trends, cropping patterns, crop yields, and farm program participation on lands enrolled in commodity price support programs. Emphasis should be placed on making data from commodity and conservation programs, soil surveys, NRIs, and other relevant sources compatible and accessible to a wide range of analysts inside and outside USDA. The availability of such data would eliminate much of the considerable amount of guesswork now involved in analyzing present programs and new initiatives. The cost of obtaining and better organizing the information would be inconsequential compared to the potential savings from improved programs and program performance.

The development of this integrated program/resource data base should be the responsibility of the secretarial coordinating body proposed in AFT Recommendation 2.

Recommendation 19. *USDA should initiate a joint SCS-ARS project to update and improve the Land Capability Class System (LCCS). This joint project should produce a report by January 1985, describing the genesis of the system and its current strengths and shortcomings for farm planning and agricultural policy purposes. The report also should make recommendations for improving the LCCS for these purposes.*

Background

A number of recent soil conservation policy initiatives have employed the LCCS for the purpose of identifying land with severe erosion problems. As noted in the background to AFT Recommendation 5, relatively recent analyses by AFT and others have revealed inconsistencies between erosion rates and capability classifications as reported in the 1977 NRI. In many major land resource areas AFT examined, for example, land classified as IIIe had potential sheet and rill erosion rates (indicated by the RKLS product) from less than 1 ton per acre to over 200 tons per acre annually. As a result, even with similar crop production systems, sheet and rill erosion rates on some IIIe land substantially exceeded rates on land classified IVe, VIe, or lower. The official guidelines for the land capability class system (Agriculture Handbook No. 210) emphasize the need to continually update the system's criteria and classifications to reflect changes in scientific understanding and farming practices. It is especially important that this be done now, as the Congress and USDA contemplate using the system for policy purposes. AFT could find no references in the scientific literature which verify the reliability and consistency of the land capability class system for assessing erosion hazards.

AFT Recommendation 5 proposed that the LCCS be used as an initial criterion to categorize cropland and potential cropland into three groups. This initial test would then be adjusted to reflect erosion rates. The purpose of this recommendation is to encourage a formal, yet expeditious review of the LCCS. This would greatly assist local conservation officials in modifying classifications in their areas for purposes of administering the conservation reserve, the sodbuster legislation, and other programs described in this report. The proposed study should be greatly facilitated by the capability to interconnect the 1982 NRI with the computerized SCS soil survey file (Soils 5). Practical recommendations and guidelines for reclassification procedures should be a central feature of the joint SCS-ARS effort. At some future date it may also be appropriate for USDA to introduce measures of soil productivity and off-site damages into the LCCS criteria.

Recommendation 20. *USDA should continue to implement the Conservation Reporting and Evaluation System (CRES), and should to the extent feasible use the information to direct conservation program activities and expenditures in the most efficient manner.*

Background

Chapter 4 emphasized the problems posed by the dearth of reliable information on the performance of USDA's conservation programs. CRES is a momentous step toward correcting this serious deficiency in the conservation policy process. In cases where technical or financial assistance are rendered primarily for erosion control purposes, data collected under CRES should be expanded beginning in the 1984 crop year to include individual values for all factors in the Universal Soil Loss Equation and the Wind Erosion Equation. This information will allow more through analysis of the reliability of CRES data, as well as more sophisticated examination of the effects of and need for conservation treatments.

Recommendation 21. *The Secretary of Agriculture should have an effective inter-agency mechanism to coordinate the research efforts on the impacts of soil erosion on productivity and off-site damages. These efforts should be substantially expanded beginning in fiscal year 1985.*

Background

In Chapter 1 we noted major gaps in the scientific understanding of basic relationships between soil erosion and producitivity and off-site damages. Ongoing research projects involving micro- and macro-modelling approaches to estimating erosion-productivity relationships should be better coordinated and expanded.

A number of benefits could be anticipated from such an effort. The proposed inter-agency group could set forth in detail the means by which existing and forthcoming research findings can be used to improve the department's ability to target conservation and commodity program activities to minimize erosion-induced productivity losses. Improved information on the effects of erosion on productivity, and on the economics of conserving productivity is needed to update soil loss tolerances (T values). As progress is made in quantifying productivity effects of erosion, a computerized system could be developed to improve on a continuing basis the accuracy and reliability of soil loss tolerance limits. Both USDA and the U. S. Environmental Protection Agency need better information to determine whether separate soil loss tolerances are warranted for non-point pollution problems and, if so, what those tolerances should be.

V. Improving State and Local Conservation Efforts

The roles of state and local governments have received increasing attention from soil conservation policy experts in recent years. Certainly one reason for this interest is the widely held perception that budgetary considerations will preclude significant expansion of traditional Federal conservation programs in the forseeable future. Even more important is the modest increase in soil and water conservation activities and budgets in many states over the past decade. Part of this increase was prompted by changes in state water quality and sediment control laws and by Section 208 of the Federal Water Pollution Control Act Amendments of 1972. Nevertheless, the role to be played by states, conservation districts, and county governments in the future is uncertain and, to a degree, controversial. It is not clear that these levels of government will be willing to shoulder a significantly greater share of the costs of conservation programs; and some conservationists fear that a stronger nonfederal role may serve as a pretext to reduce the Federal conservation budget.

Limitations of time and resources prevented AFT from examining individual state and local efforts in any detail. Several technical papers, commissioned by AFT to provide a broad assessment of these efforts, indicate that quantitative evaluations of state and local programs have not been performed. In some cases these programs are too new to have been analyzed, though it must be said that evaluations do not figure prominently in any of the programs AFT examined, some of which are considered very progressive by soil conservation policy experts. As a result, it is virtually impossible to determine how effective state or local programs are in conserving soil. Naturally, this makes it especially risky to speculate about the future role of these levels of government, or about the relative merits of federal and nonfederal soil conservation programs.

Therefore, while concentrating on policy questions at the national level, AFT has attempted to identify strengths and weaknesses of state and local programs and formulate general recommendations that complement the recommendations previously offered. AFT's working assumption is that, given the modest increase in state and local funding (adjusted for inflation) for conservation over the past decade, it is unrealistic to expect dramatic expansion of these programs in the near future. Ultimately, regulatory approaches appear to offer the greatest opportunities for state and local programs to significantly affect soil conservation.

AFT plans to do additional analysis and investigation of state and local conservation programs in the future. Further work will also be done on the effects of tax policy and education on resource conservation.

Recommendation 22. *In cooperation with county governments and conservation districts, each state should develop a comprehensive plan for reducing soil erosion damage statewide. The plan should include standards, guidelines and deadlines for achieving state soil conservation goals, and programs that have a mix of incentive and regulatory features.*

Background

The increased awareness of soil erosion problems has led to planning activities in a number of state governments over the past ten years. In most cases, states have opted for plans that parallel the federal program functions of providing education, technical assistance, farm conservation planning, and cost sharing through local units of government (usually conservation districts). In most cases states have provided minimal or no additional funds to local units of government to implement the state plans. In states where interim and long term goals have been set, no reliable methods have been established to determine how much progress actually is being made. The programs are overwhelmingly voluntary, and what regulatory aspects do exist are weak. More extensive farm conservation planning and an apparent willingness of states to direct their conservation spending to the most serious conservation problems may be counted as encouraging advances; but overall only modest progress has occurred in a few states." Progress is constrained — severely — by limited state and local financial resources, and by the unwillingness of state governments and conservation districts to adopt or exercise powers of taxation and regulation for conservation purposes. Largely because of the historic role of the conservaton districts, county governments play virtually no role in this area.

AFT's analysis of state and local conservation programs, and findings of the AFT farmer survey, lead us to conclude that states should develop conservation plans and programs, and evolve toward regulatory measures for soil conservation. The National Governors Association has been seriously considering the development of a model state law as a guide for states to use in setting up such programs.

In AFT's view, state and local programs should have several basic components. States should set general standards and guidelines for protecting farmland from erosion and should specify a schedule for compliance. Conservation districts should be responsible for setting specific standards consistent with the state guidelines. Enforcement should be the responsibility of local general government, as it is with zoning. In addition, state governments should investigate agricultural revenue bonds as a means of raising money for state soil conservation programs.

Initially, state and local programs should continue to emphasize voluntarism and incentives, but this should be done in concert with federal programs. Specifically, AFT recommends that state and local programs be designed around land groupings similar to those described in AFT Recommendation No. 4. Hence, states would strive to focus traditional technical and financial assistance on Land Group 2 (or its equivalent). In the absence of nonfederal programs for long-term retirement of Land Group 3, state and local governments could play an important role by educating farmers about the federal conservaton reserve program, and by encouraging farmers to enroll. States and conservation districts should also assist in the process of classifying land in its appropriate group, and in revising the land capability class system to more accurately reflect erosion hazards.

The initial emphasis on incentives and voluntarism should be augmented as soon as possible by complaint-triggered, mandatory conservation standards, along the lines of the Iowa program. States should establish a series of goals and interim goals for soil conservation statewide, and should consider the use of regulations after a reasonable period of offering incentives and free technical assistance to farm operators. In determining the schedule for introducing regulations, it should be noted that, for most of the nation, technical and financial assistance have already been available to farmers for five decades.

Recommendation 23. *County governments and conservation districts should be jointly responsible for implementing state soil conservation programs. Conservation districts should continue their role of providing clerical assistance and office facilities to SCS, and of providing education and technical assistance. County governments should assume responsiblity for implementing mandatory features of state laws.*

Background

Increased involvement of county governments may be the most critical need in improving state and local soil conservation programs. Historically, the voluntary system of federally subsidized incentives, education and free technical assistance funnelled through conservation districts and local agricultural stabilization committees, left no role for county governments. The need for an expanded county role has become increasingly evident over the past decade, particularly as conservationists have recognized shortcomings of an exclusively voluntary system. Many conservation districts retain legal authority for regulating land use as set forth in the standard conservation district enabling act circulated by President Roosevelt in 1937. Yet, the districts have virtually never used this authority. In recent years, a few county governments in Colorado, Wisconsin, Montana, and Minnesota have taken initiatives in the regulatory realm. The National Association of Counties has expressed general support for these types of programs. The AFT farmer survey found that support for regulatory approaches increased among farmers as the regulating entity became more localized. Federal regulations were decidedly unacceptable.

An expanded county role, particularly one with a regulatory emphasis, will likely be controversial in many areas, and may even meet opposition from local conservation district officials, who, generally prefer a strictly voluntary approach. However, just as innovations are needed at the federal level, it is clear that the nonfederal role must evolve, as well, and in a complementary fashion. A phased, regulatory approach implemented by county government offers the best opportunity for improving soil conservation programs at the local level. Local soil and water conservation districts would play an integral part in this process by assisting in the classification of land into the land groups discussed earlier; providing technical assistance to county governments in determining whether or not individual land uses were in violation of mandatory conservation provisions of state laws; and by continuing to provide logistical support to SCS, public education, and technical assistance to farmers.

Appendix

TABLE A-1

Distribution of Pastureland Acreage And Sheet And Rill Erosion, By Erosion Rate, 1977.

Erosion interval	*Total acres*	*Cumulative percentage of acreage*	*Total Sheet and rill erosion*	*Cumulative percentage of erosion*	*Total erosion in excess of 5 tons per acre*	*Cumulative percentage of erosion in excess of 5 tons per acre*
(tons per acre)	*(millions)*		*(millions of tons)*		*(millions of tons)*	
0-1	91.2	68.2	22.8	6.6	0.0	0.0
1-2	14.1	78.8	20.4	12.5	0.0	0.0
2-3	7.0	84.1	17.3	17.5	0.0	0.0
3-4	4.3	87.3	14.8	21.8	0.0	0.0
4-5	2.7	89.4	12.2	25.3	0.0	0.0
5-6	2.2	91.0	11.9	28.7	1.0	0.5
6-7	1.6	92.2	10.5	31.8	2.5	1.8
7-8	1.4	93.2	10.3	34.8	3.4	3.7
8-9	1.1	94.1	9.6	37.5	3.9	5.8
9-10	1.0	94.8	8.8	40.1	4.2	8.0
10-11	0.6	95.2	6.1	41.8	3.2	9.7
11-12	0.6	95.6	6.3	43.7	3.6	11.6
12-13	0.5	96.0	6.0	45.4	3.6	13.5
13-14	0.4	96.3	5.7	47.0	3.6	15.4
14-15	0.3	96.5	4.7	48.4	3.1	17.0
15-20	1.4	97.6	23.6	55.2	16.8	26.0
20-25	0.9	98.2	19.2	60.7	14.9	33.9
25-30	0.5	98.6	14.2	64.8	11.6	40.1
30-50	0.9	99.3	36.2	75.3	31.5	56.8
50-75	0.5	99.7	30.8	84.2	28.3	71.9
75-100	0.2	99.8	14.7	88.4	13.9	79.3
100+	0.2	100.0	40.0	100.0	38.8	100.0
Total	133.6		346.1		187.9	

Source: 1977 National Resource Inventories.

TABLE A-2

Distribution Of Forest Land Acreage And Sheet And Rill Erosion, By Erosion Rate, 1977.

Erosion interval	*Total acres*	*Cumulative percentage of acreage*	*Total sheet and rill erosion*	*Cumulative percentage of erosion*	*Total erosion in excess of 5 tons per acre*	*Cumulative percentage of erosion in excess of 5 tons per acre*
(tons per acre)	*(millions)*		*(millions of tons)*		*(millions of tons)*	
0-1	297.4	80.4	55.3	12.7	0.0	0.0
1-2	30.6	88.7	43.7	22.8	0.0	0.0
2-3	13.0	92.2	32.0	30.1	0.0	0.0
3-4	7.8	94.3	26.9	36.3	0.0	0.0
4-5	4.9	95.7	22.0	41.4	0.0	0.0
5-6	3.1	96.5	17.1	45.3	1.5	0.8
6-7	2.2	97.1	14.5	48.6	3.3	2.7
7-8	1.6	97.5	11.5	51.2	3.8	4.9
8-9	1.2	97.9	10.3	53.6	4.2	7.3
9-1	1.0	98.1	8.9	55.6	4.2	9.7
10-11	0.8	98.3	8.2	57.5	4.3	12.1
11-12	0.8	98.5	8.7	59.5	4.9	14.9
12-13	0.5	98.7	.6.1	60.9	3.7	17.0
13-14	0.5	98.8	6.9	62.5	4.4	19.5
14-15	0.3	98.9	4.8	63.6	3.1	21.3
15-20	1.2	99.2	20.7	68.4	14.6	29.7
20-25	0.7	99.4	16.2	72.1	12.6	36.8
25-30	0.3	99.5	9.3	74.2	7.6	41.2
30-50	0.9	99.8	36.8	82.7	32.2	59.5
50-75	0.5	99.9	29.0	89.4	26.6	74.4
75-100	0.2	99.9	16.6	93.2	15.6	83.7
100*a*	0.2	100.0	29.5	100.0	28.6	100.0
Total	369.7		435.0		175.2	

Source: 1977 National Resources Inventories

TABLE A-3

Distribution Of Nonfederal Rangeland Acreage And Sheet And Rill Erosion, By Erosion Rate, 1977.

Erosion interval	*Total acres*	*Cumulative percentage of acreage*	*Total erosion*	*Cumulative percentage of erosion*	*Total erosion in excess of 2 tons per acre*	*Cumulative percentage of Erosion in excess of 2 tons per acre*
(tons per acre)	*(millions)*		*(millions of tons)*		*(millions of tons)*	
0-1	258.5	63.4	83.7	7.3	0.0	0.0
1-2	54.8	76.8	77.7	14.0	0.0	0.0
2-3	23.6	82.6	58.1	19.0	10.8	1.3
3-4	14.8	86.2	51.4	23.5	21.7	4.0
4-5	10.1	88.7	45.2	27.4	25.0	7.1
5-6	7.0	90.4	38.2	30.7	24.3	10.1
6-7	6.3	91.9	40.4	34.2	27.9	13.6
7-8	93.2	39.2	37.6	28.7	17.2	17.2
8-9	3.1	94.0	26.1	39.8	19.9	19.7
9-10	2.7	94.7	26.2	42.1	20.7	22.3
10-11	2.3	95.3	24.2	44.2	19.6	24.7
11-12	1.9	95.7	21.7	46.1	17.9	26.9
12-13	1.7	96.1	20.5	47.9	17.2	29.0
13-14	1.1	96.4	15.4	49.2	13.1	30.6
14-15	1.0	96.6	13.9	50.4	12.0	32.1
15-20	3.9	97.6	67.8	56.3	60.1	39.6
20-25	2.4	98.2	53.4	60.9	48.6	45.6
25-30	1.3	98.5	35.1	64.0	32.5	49.6
30-50	3.4	99.3	128.8	75.1	.122.0	64.8
50-75	1.3	99.6	78.3	81.9	75.8	74.3
75-100	0.4	99.7	37.3	85.1	36.4	78.9
100*a*	1.1	100.0	171.8	100.0	169.6	100.0
Total	407.9		1,154.4		803.8	

Source: 1977 National Resources Inventories.

TABLE A-4

Distribution Of Sheet And Rill Erosion On Land Used To Grow Corn In 1977, By Range Of RKLS.

0 RKLS	*Acres (x 1000)*	*Average USLE*	*USLE tonnage (x 1000)*	*Average wind*	*Wind tonnage (x 1000)*
0-1	5632	0.03	145	0.14	764
1-2	1037	0.53	551	1.27	1314
2-3	2251	0.81	1832	1.64	3699
3-4	3713	1.13	4180	1.34	4068
4-5	4966	1.50	7449	1.28	6338
5-6	5807	1.75	10178	1.39	8061
6-7	5183	2.10	10880	0.96	4099
7-8	4275	2.30	9832	0.77	3276
8-9	4524	2.61	11814	1.53	6944
9-10	3383	2.89	10937	0.55	2068
10-11	3205	3.16	10143	0.20	645
11-12	2064	3.48	10309	0.69	2044
12-13	2954	3.82	11276	0.38	1115
13-14	2339	3.93	0202	0.16	373
14-15	2417	4.49	10855	2.65	6402
15-16	1709	4.43	7564	0.25	431
16-17	1736	4.69	8140	0.22	376
17-18	1138	4.77	5426	0.71	804
18-19	1287	5.20	6687	0.49	626
19-20	1486	5.44	8089	0.08	114
20-25	5315	6.15	32704	0.14	736
25-30	3535	7.08	25044	0.05	170
30-35	2460	8.30	20412	0.07	171
35-40	1956	9.68	18942	0.38	736
40-45	1490	10.06	14094	0.04	65
45-50	1560	11.47	17892	0.16	242
50-75	5027	13.70	68874	0.07	341
75-100	3385	18.30	61960	0.11	364
100-150	3320	26.58	88246	0.06	210
150-200	1482	34.98	51840	0.02	33
OVER 200	1515	63.81	96678	0.02	23
TOTAL	93452	6.99	653076	0.63	58460

Source: 1977 NRI

TABLE A-5
Distribution Of Sheet And Rill Erosion On Land Used To Grow Soybeans In 1977, By Range Of RKLS.

RRLS	*Acres (x 1000)*	*Average USLE*	*USLE tonnage (x 1000)*	*Average wind*	*Wind tonnage (x 1000)*
0-1	2621	0.00	3	0.13	351
1-2	389	0.65	253	0.65	254
2-3	778	0.96	744	0.57	444
3-4	1488	1.17	1744	0.10	145
4-5	2242	1.56	3501	0.39	869
5-6	2549	0.99	5010	0.21	541
6-7	2899	2.28	6619	0.13	379
7-8	2821	2.68	7573	0.30	836
u8-9	3158	2.92	9228	0.03	101
9-10	2405	3.23	7770	0.09	205
10-11	2966	3.43	10171	0.06	187
11-12	2508	3.94	9880	0.01	37
12-13	2229	4.10	9139	0.02	41
13-14	1849	4.39	8124	0.22	406
14-15	2053	4.74	9732	0.0	0
15-16	1530	4.99	6734	0.49	744
16-17	1631	5.15	8398	0.01	18
17-18	1232	5.42	6675	0.0	0
18-19	1095	5.96	6523	0.01	10
19-20	1298	5.75	7468	0.0	0
20-25	4171	7.08	29511	0.00	3
25-30	2761	8.03	22169	0.03	78
30-35	1893	9.19	17405	0.00	1
35-40	1618	10.75	17399	0.01	14
40-45	1108	12.90	14290	0.0	0
45-50	895	13.52	12104	0.02	16
50-75	2689	17.68	47537	0.0	0
75-100	1557	24.88	38736	0.0	0
100-150	1608	33.97	0.0	0	
150-200	606	52.76	31972	0.0	0
OVER 200	693	97.28	67416	0.0	0
TOTAL	59340	8.08	479344	0.10	5680

1/ Average Over Samples (Unweighted)
Source: 1977 NIR.

TABLE A-6

Distribution Of Sheet, Rill And Wind Erosion On Land Used To Grow Wheat In 1977, By Combined Erosion Rate.

Erosion Rate (T/A/Y)	*Average* USLE	*Average Wind*	*Acres (x 1000)*	*Tons (x 1000)*
0-1	0.49	0.34	9398	4971
1-2	1.16	0.35	10614	15988
2-3	1.80	0.67	9420	23288
3-4	2.25	1.22	7073	24526
4-5	2.63	1.85	5715	25570
5-6	3.10	2.40	4442	24447
6-7	3.56	2.89	3345	21600
7-8	3.84	3.61	2740	20463
8-9	4.58	3.88	2134	18068
9-10	4.76	4.76	1828	17395
10-11	5.15	5.34	1355	14219
11-12	5.20	6.28	957	10988
12-13	6.13	6.29	920	11418
13-14	7.66	5.89	738	9935
14-15	6.99	7.50	649	9403
15-16	7.54	7.90	616	8508
16-17	6.29	10.25	368	6085
17-18	7.81	8.59	412	7169
18-19	8.31	10.09	339	6219
19-20	8.42	11.08	368	7175
20-2	8.01	14.28	1329	29617
25-30	9.46	18.04	927	25489
30-35	10.88	21.51	587	19011
35-40	15.67	21.47	273	10139
40-45	17.48	25.08	203	8640
45-50	24.22	23.26	174	8262
50-75	31.10	27.47	270	15814
75-100	1.68	84.02	53	4542
100-150	33.00	92.98	45	5669
150-200	173.94	0.0	16	2783
Over 200	0.0	0.0	0	0
Total	3.18	3.04	67317	418401

Source: 1977 NRI

TABLE A-7

Slope Steepness And Length And USLE Erosion On Unterraced Cropland, 1977.

Slope ½	*Slope Length (in feet)*	*Acres (x 1000)*	*Average RKLS*	*Average USLE*
0-1	561.	91838	5.70	1.35
1-2	460.	84682	7.77	2.21
2-3	397.	58051	11.40	3.00
3-4	345.	41985	16.56	4.95
4-5	332.	27662	23.92	5.26
5-6	341.	17032	37.80	8.01
6-7	316.	13395	45.76	8.79
7-8	318.	8373	69.80	11.56
8-9	290.	9378	68.67	12.52
9-10	295.	3665	81.93	14.10
10-11	288.	6460	93.83	15.60
11-12	277.	1859	125.66	17.98
12-13	285.	3737	134.35	20.22
13-14	273.	757	151.89	21.25
14-15	251.	1805	153.07	23.49
15-16	280.	2441	130.96	16.36
16-17	254.	1141	187.90	25.67
17-18	233.	350	173.18	22.99
18-19	275.	770	178.48	24.42
19-20	324.	156	181.81	18.16
20-21	279.	1157	210.78	21.57
21-22	295.	177	206.54	21.78
22-23	268.		200.08	25.45
23-24	278.	92	188.06	12.73
24-25	262.	102	273.18	24.70
Over 25	235.	1434	373.79	42.25
Total	422.	378737	24.65	4.80

Average Slope (Weighed By Acreage): 3.0%

Source: 1977 NRI

Table A-11.
Percentage Distribution of Assistance by Practice By Pre-Practice Erosion Rate, 171 Sample Counties, Agricultural Conservation Program, 1975-78 and 1983*.

Average annual soil loss before treatment (tons per acre)	*Type of Practice* — *Establishing permanent vegetative cover*		*Improving permanent vegetative cover*		*Stripcropping*		*Terrace*		*Diversions*	
	1975-78	*1983*	*1975-78*	*1983*	*1975-78*	*1983*	*1975-78*	*1983*	*1975-78*	*1983*
	— Percent of Practice Total —									
0-1	14	—	25	0	11	5	1	1	12	30
1-1.99	17	5	18	23	9	3	2	1	8	9
2-2.99	9	3	12	3	8	0	3	2	7	4
3-3.99	7	5	9	10	9	5	3	2	5	4
4-4.99	6	5	5	9	10	3	6	4	5	4
5-5.99	5	5	4	8	8	3	5	4	5	1
6-6.99	4	6	3	7	7	13	6	6	6	7
7-7.99	4	4	2	6	15	11	5	5	4	5
8-8.99	2	4	2	5	6	5	6	6	5	7
9-9.99	3	5	2	3	5	3	5	5	3	2
10-10.99	2	4	2	3	3	3	6	4	3	4
11-11.99	2	5	1	2		3	4	6	2	2
12-12.99	2	4	2	2	1	—	5	6	2	2
13-13.99	2	3	1	2	2	—	3	3	1	2
14-14.99	1	3	1	2		3	4	5	2	1
15-19.99	5	11	4	5	3	24	17	15	9	6
20-24.99	4	5	2	3	1	13	6	8	4	4
25-29.99	2	5	1	1		3	3	5	2	3
30-49.00	5	10	2	1	1	3	8	10	6	3
50-74.99	2	4	1	—	—	—	1	2	3	—
75-99.99	1	2	—	—	—	—	**	—	1	—
over 100	1	2	1	—	1	—	—	—	5	—
Total Percent	100		100		100		99		100	

*Source: National Summary Evaluation, Phase I; Conservation Reporting and Evaluation System (CRES). ASCS/USDA.
— Less than 1%
** Less than 0.50%
NA: Not available

Table A-11, continued.
Percentage Distribution of Assistance by Practice By Pre-Practice Erosion Rate, 171 Sample Counties, Agricultural Conservation Program, 1975-78 and 1983*.

Average annual soil loss before treatment (tons per acre)	*Interim cover*		*Conservation tillage*		*Competitive shrub control*		*Vegetative cover on critical areas*		*Total*	
	1975-78	*1983*	*1975-78*	*1983*	*1975-78*	*1983*	*1975-78*	*1983*	*1975-78*	*1983*
	— Percent of Practice Total —									
0-1	7	—	4	—	50	NA	3	29	16.6	2
1-1.99	7	7	9	5	11	NA	1	2	14.2	8
2-2.99	3	5	16	13	8	NA	—	1	9.0	5
3-3.99	4	7	7	8	8	NA	2	2	7.0	6
4-4.99	7	7	2	12	3	NA	3	1	5.6	6
5-5.99	5	11	3	13	3	NA	1	1	4.4	8
6-6.99	11	8	7	19	2	NA	1	1	4.6	2
7-7.99	7	9	10	4	4	NA	1	2	4.2	7
8-8.99	6	7	2	2	1	NA	1	3	3.0	6
9-9.99	9	5	4	1	2	NA	1	2	3.3	4
10-10.99	7	4	2	5	1	NA	1	3	2.7	4
11-11.99	4	4	5	5	1	NA	3	1	2.1	4
12-12.99	7	3	8	1	3	NA	1	1	2.9	4
13-13.99	2	2	3	1	**	NA	11	—	1.6	2
14-14.99	2	2	1	2	**	NA	1	5	1.3	3
15-19.99	4	7	11	4	2	NA	36	10	5.9	9
20-24.99	1	3	3	2	1	NA	14	8	3.3	5
25-29.99	1	3	—	1	**	NA	2	5	1.7	3
30-49.00	2	5	1	1	**	NA	6	6	3.5	6
50-74.99	1	1	1	1	—	NA	1	10	1.5	2
75-99.99	1	—	1	—	—	NA	4	4	0.7	1
over 100	2	—	—	—	**	NA	6	4	0.9	1
Total Percent	100		100		100		100		100	

*Source: National Summary Evaluation, Phase I: Conservation Reporting and Evaluation System (CRES). ASCS/USDA.
— Less than 1%
** Less than 0.50%
NA: Not available

Table 4a.
Concentration of Wind Erosion On Cropland In The Great Plains, 1977.

	Acres	*Tonnage*		
State	*(1,000)*	*Percent of State Total*	*(1,000)*	*Percent of State Total*
Colorado[1]	886	8	40,039	40
Kansas[2]	1,151	4	32,204	38
Montana[2]	666	4	18,661	32
N. Dakota[3]	3,581	13	24,168	51
Nebraska[2]	340	2	9,520	37
N. Mexico[1]	229	10	11,847	46
Oklahoma[2]	567	5	14,826	42
S. Dakota[4]	596	3	15,969	30
Texas[5]	1,671	5 –	192,621	42
Wyoming[6]	161	5	2,489	35
Total	9,848		362,344	

[1] Cropland with average wind erosion rate of 30 or more tons per acre per year.
[2] Cropland with average wind erosion rate of 14 or more tons per acre per year.
[3] Cropland with average wind erosion rate of 4 or more tons per acre per year.
[4] Cropland with average wind erosion rate of 10 or more tons per acre per year.
[5] Cropland with average wind erosion rate of 50 or more tons per acre per year.
[6] Cropland with average wind erosion rate of 11 or more tons per acre per year.

Addendum

AMERICAN FARMLAND TRUST TECHNICAL PAPERS*
(To be published as a separate report)

Tax Credits as Incentives for Soil Conservation
Don Kelly
John Keene
John Miranowski

Cross Compliance of Programs Affecting Soil Conservation
Howard W. Hjort

Targeting Resources to Enhance Impact of Soil Conservation Programs
Glen E. Murray

Education of Landowners and Farmers for Improved Soil Conservation
Sara Ebenreck
Donald Last

Crop Set-Aside Programs
Howard W. Hjort

State Conservation Programs
Leonard Wilson

Conservation Tillage
Warren B. Saufferer
Peter J. Nowak

Owner/Operator Arrangements for Soil Conservation
David Ervin

Technology Transfer Methods for Soil Conservation
John Carlson
David Ervin

Conservation Plans
Frederick R. Steiner

Regulatory Programs/Approaches as Disincentives to Soil Erosion
Robert Coughlin

Funding Soil Conservation: Problems and Prospects
James Leigland

Long-Term Agreements (LTA's)
Lennie Losh

Irrigation and Soil Erosion
R. Neil Sampson

The Livestock Industry and Soil Quality
D. B. Polk

The Public Interest and Soil Conservation
Tom Mierzwa

Instutitional Barriers to Soil Conservation
Robert Smythe

*note: where more than one author is listed, each wrote an individual paper on the subject title.

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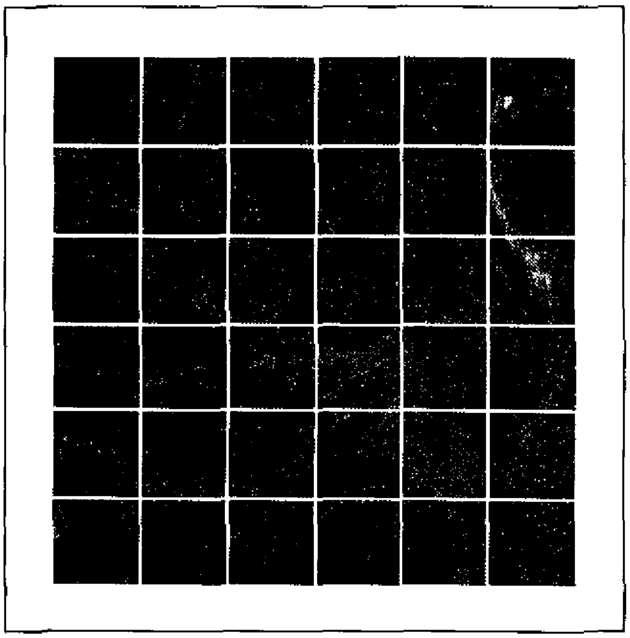

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1717 Massachusetts Avenue, N.W.
Washington, D.C. 20036