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EVALUATION OF CURRENT SOIL CONSERVATION STRATEGIES

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The evaluation of current soil conservation strategies is a large order. Although we have been involved in the evaluation of conservation programs off and on for the past two decades, we are far from having the last word on the subject. The topic is, again, an important issue much as it was during the 1930's and 1940's but for somewhat different reasons. Hopefully we can identify what we know about the effectiveness of current strategies and suggest what more we need to know. Clearly the data necessary to evaluate all current strategies is not available and our evaluation is far from complete.

The paper is divided into four broad selections. The first section spells out the major reasons for public action in regard to soil conservation. The second section briefly discusses the current soil conservation investments both public and private. The third section evaluates the current strategies, ranging from cost-sharing to regulation, in terms of economic, political, and administration effectiveness. Finally, the concluding section suggests what we have learned from the evaluation and what needs to be done so that future evaluations will have a firmer analytic basis.

Justification for Soil Conservation Programs

The primary reasons for public soil conservation activity are market failures, including externalities, and inadequate institutional arrangements. Under market failure, the difference in time preferences between the individual vs. society, distorted capital markets and imper-

fect information are three key problems. Because of age, income or other factors, individual farmers acting to maximize their current incomes may discount the need for future soil productivity more than society will. This is particularly true when one includes future generations. In fact, when considering what to leave for future generation, discounting may not be appropriate at all [17].

The likely impacts of distorted capital markets on long-term investments are well documented by others [1, 12, 13]. Income and capital gains taxes are two causes of these distortions. In addition, the U.S.'s current monetary policy of high interest rates works against long-term soil conservation investments. There is also the question of whether or not society should include a risk component in its discount factor as the individual would.[1/]

The lack of information or imperfect knowledge concerning the impacts of alternative farming practices on soil productivity can cause farmers to use practices which are not in their own best interest. With today's communication system the lack of information should be less of a problem then it was in the 1930's or 1940's. However, some of the basic information concerning practices, soil losses and productivity over time are just not available.

Another potential market failure is the lack of consideration of irreversible land use changes and the option value of unique agricultural areas.[2/] All of us see farm land being covered over by cement and asphalt. Some would argue that this is the ultimate in soil conservation. But it means the loss, for the foreseeable future, of these lands for agricultural production. To the extent that the market ignores certain

future agricultural production benefits then some of these land use shifts are unwise.

The externality aspects of soil erosion have become of increasing concern in recent years. Water quality and air quality improvement have both been cited as important U.S. goals during the 1970's. Soil conservation contributes to both of these goals. Liability for damage to neighboring lands from excess soil and water run-off has long been a matter of common law. However, this concern for off-site damages has now been expanded to include many sites downstream or downwind from farms with soil erosion problems. These external damages caused by soil erosion must be counted when determining the optimum level of soil conservation for society.

Institutions that influence the adoption of conservation practices and, therefore, soil erosion include land ownership and tenure arrangements. As renting increases as a means to get into and stay in farming, rental agreements will become more important in determining how farm operators protect the soil. The direct financial involvement of the landowner in the farm operation appears to be important in conservation decisions (see Table 1). In the Southern Plains only one out of ten landlords who cash lease all their land made conservation investments during the 1975-77 period. In contrast, nearly 40 percent of the landowners who farm some of their land and share leased the rest, made conservation investments during that period. The Southern Plains data suggest that the non-farm operator landlords and landlords who do not share in the risk of farming are less likely to make investments to maintain the productivity of their soil. Thus, under passive ownership and tenure

Table 1. Investment in Conservation by Tenure Arrangement, Southern Plains, 1975-77

Tenure Group	Proportion of tenure group making conservation investment between 1975-77*
	(Percent)
Landowner:	
- cash leases all land	10.6
- share leases all land	20.8
- farms part and cash leases rest	30.9
- farms part and share leases rest	38.4

* Coefficients estimated using the logit regression model; values are statistically significant at the 99 percent level of probability.

Source: Don Baron, Landownership Characteristics and Investment in Soil Conservation, U.S. Department of Agriculture (forthcoming Agricultural Economics Report, USDA).

arrangements, soil conservation is likely to be less than society would choose.

From an economic point of view, we should expect soil erosion to exceed what society would desire. Many individuals have imperfect knowledge, too short an investment horizon, or too high a discount rate. They ignore future generations, the externalities imposed on other individuals and the option value of land. The next question is --- have U.S. soil conservation programs and strategies been effective in reducing these differences?

Current Situation

Federal funding for soil and water conservation programs in the United States in 1980 was 1.436 billion dollars (see Table 2). All major components -- cost-sharing, technical assistance, resource management, loans and research, received increased funds over the 1955-79 period; however, in 1972 dollars these increases in funding levels were about even with the rate of inflation. Over the 30 year period the expenditure in deflated dollars per year has remained in the $700 to $750 million range. Therefore, public expenditures to support conservation programs have not increased. This implies that society, through its governmental processes, has assigned about the same level of priority to conservation investment now as it did 40 years ago. In fact, the implication may be a lower priority since the total public expenditures have increased rapidly during this period.

The largest increases in funding during the decade of the 70's were reflected in resource management and technical assistance programs. Range management, fire management and soil and water management on public

Table 2. Federal Funding for Soil and Water Conservation

Year	Cost sharing	Technical assistance	Resource management	Loans	Research	Education	Total	1972 dollars*
				Million dollars				
1950-54	1,246	291	98	15	5	NA	1,655	3,031
1955-59	1,363	352	144	67	21	NA	1,947	3,187
1960-64	1,584	454	322	80	47	NA	2,487	3,874
1965-69	1,681	643	381	141	112	NA	2,958	4,035
1970-74	1,725	953	747	192	171	54	3,842	3,808
1975-79	2,377	1,433	1,722	313	309	44	6,198	3,893
1980	487	327	458	62	91	11	1,436	717

* Implicit price deflators for purchase of structures by type, Government: Conservation and Development: Survey of Current Business, Bureau of Economic Analysis, U.S. Department of Commerce.

Source: Initial report on the Land and Water Conservation Programs, USDA, Dec. 1977. Updated by Dallas Lea, Natural Resource Economics Division, ESS, USDA, Feb. 1981.

lands represent the major components in the resource management category. The major component of technical assistance is the staff work of the Soil Conservation Service at the county level. Since personnel costs are a large share of technical assistance, rising pay scales were the major contributor to the rising costs of technical assistance.

A recent survey of landowners indicates that nearly three-fourths of the funds used for terraces, grass waterways and gully control were investments made from personal funds (see Table 3). Federal funds through cost-sharing arrangements account for about one-fifth of the investment, loans account for 5 percent. Cost-share rates generally have been in the 50-70 percent range. Yet, overall the federal share of the total investment is much lower. Much conservation investment is done without the financial help from the public sector.

In a study of natural resource capital investments since 1900, the USDA, 1979, estimates that the net value of all natural resources investments in 1972 price levels was 27.5 billion dollars.[3/] Over the 35 year period 1940-75, investment in irrigation facilities increased fourfold, drainage investments increased about 50 percent and soil and watershed conservation investments increased over 300 percent (see Table 4). The historical trends show the stock value of the irrigation facilities in the U.S. continuing to increase while the stock value of both drainage and soil and watershed conservation investments appears to have peaked in the late 60's.[4/] This study suggests that the investment in soil and water conservation is less in the mid-70's than during the 60's. Additional study is required to determine if this stock of investments is adequate to protect and maintain the resource base for current and

Table 3. Source of Funds for Selected Conservation Investments, 1975-77 - United States*

Source	Amount	Percent
	($1,000)	
Personal Funds	666,767	73
ASCS	196,651	21
Loans		
Federal Land Bank	17,160	
Individuals	8,528	
Production Credit Association	7,680	
Other banks or savings & loan associations	5,497	
Insurance companies	2,216	
Farmers Home Administration	2,173	
Small Business Administration	1,310	
Subtotal loans	(44,564)	5
Other	5,776	1
Source not reported	21,904	
Total	935,662	100

* Practices included are terraces, grass waterways, and gully control structures.

Source: Young, C. Edwin and Arthur B. Daugherty, Investments in Conservation Structures. A Preliminary Report of a Landownership Follow-on Survey (Draft ESS Staff Report, June 1980).

Table 4. Natural Resource Capital Investments in U.S. Agriculture, by Type of Facilities, 1940-1975

Year	All natural resource investments	By purpose or type of facilities		
		Agricultural irrigation facilities	Agricultural drainage facilities	Soil and watershed conservation
	Net value of capital investments billions of 1972 dollars			
1940	10.0	3.2	3.8	3.0
1945	15.0	4.0	3.9	7.1
1950	19.0	5.0	4.5	9.5
1955	20.8	6.2	4.7	9.9
1960	22.3	7.3	5.1	9.9
1965	24.6	9.1	5.4	10.0
1970	26.6	10.6	5.6	10.4
1975	27.5	12.3	5.5	9.7

Source: Adapted from Table 3, U.S. Department of Agriculture, Natural Resource Capital in U.S. Agriculture, Irrigation, Drainage and Conservation Investments Since 1900, NRED, ESCS, USDA, March 1979.

future generations. Perhaps in an era of surpluses, the historical trend has logic. But in an era where agricultural resources are expected to be fully utilized, a different investment pattern for soil and watershed conservation may be in the interest of society.

The Effectiveness of Soil Conservation Programs and Strategies

New government conservation programs have been added over the years while the old ones have been continued with only moderate changes. Although there has been much talk about the adequacy of these soil conservation programs little solid evidence has been presented to support either side of the argument. Swader, 1980, points out that "two contrary views may be derived from the same data: (1) soil conservation efforts have successfully reduced erosion by one billion tons per year, or (2) soil conservation efforts have been only 25 percent effective." Davis, 1977, finds that there is no conservation treatment on 42 percent of the U.S. cropland and he suggests that there is little public awareness among the urban population of the soil conservation problem. However, a recently USDA financed survey by Harris polls suggests that many Americans have a good understanding of soil conservation problems [11].

Our evaluation will, hopefully, help clarify our understanding of what the U.S. federal soil conservation efforts are accomplishing. To do the evaluation the conservation strategies are grouped under six headings: cost sharing, technical and educational assistance, public ownership or easements, land retirement, low interest loans, and regulation. As shown earlier, cost sharing and technical assistance are the

strategies which have received the most federal assistance. In a sense, one could say these are the only conservation strategies which have been given a good long-term try. And as we will see, the results are not encouraging.

The evaluation will focus on how these six conservation strategies reduce the difference between the amount of soil conservation society desires and what the individual farmer provides. This difference, as discussed earlier, is due to factors such as absentee landlords, downstream damages, irreversible land use changes, imperfect information, and short private time preferences. The analysis will include the consideration of the economic, administrative and political feasibility of the strategies. Certain strategies that look good in terms of net returns may well be impossible to implement or to get approved by a legislative body. Clearly, political feasibility was important in designing the Agricultural Conservation Program (ACP) which is administered by the Agricultural Stability and Conservation Service and the programs of the Soil Conservation Service (SCS). Both were designed to meet a number of objectives and to spread the program funds among many beneficiaries. These programs have been made available to farmers upon request rather than being targeted on problem areas or farms. This was done for both political and administrative reasons.

Cost Sharing (Subsidy)[5/]

The subsidy or cost-sharing strategy has probably reached more farmers than any other federal conservation effort. It is best suited to deal with cases where the benefits for society exceed those to the

individual farmer and where the farmer needs an incentive to start a new farming practice. Absentee landlords and marginal farmers who are mostly concerned about short-run returns and who heavily discount future returns would fall in this group.

The cost-sharing strategy which has been studies more than any other over the past four decades has been ACP. Since 1936, ACP has expended over $8 billion to assist farmers and landowners [23]. After World War II the funding varied, usually within the $150 to $250 million per year range. A number of studies have found that ACP cost-sharing has fallen short of its objectives in several respects. During the period of excess agricultural capacity, ACP was criticized for assisting short-term output enhancing practices such as drainage, irrigation and liming. In addition, ACP and the commodity programs were considered to have opposing objectives. The program was also cited for subsidizing profitable practices that farmers would do on their own [26].

If the cost share is to be used to assist in the technological diffusion process, then once landowners have been introduced to the practices, they should do them on their own. The number of times farmers use the same practice would be limited since farmers do not need to be educated over and over again. However, Cotner, 1964, found that ACP practices tended to be repeated and were yield enhancing and profitable to the farmer. Also, payments were made somewhat on the basis of the number of farmers per region or state; ACP was not targeted on soil conservation problem areas.

Cost sharing through ACP could also be used to pay for society's benefits from a practice that are not recovered by the landowner. However,

a USDA study of conservation practices in 171 counties found that over one-half of the practices were applied to land without serious problems (see Table 5). In contrast, only 18 percent of the practices were applied to lands eroding at 15 tons or more per acre. These lands account for 84 percent of the excess sheet and rill erosion over 5 tons per acre.[6/] The study team concludes that the targeting of erosion control funds to the seriously eroding soils could more than triple the amount of soil saved through the program [23].[7/]

The study team also found that cost-share assistance was distributed in proportion to farm numbers, rather than the extent of the erosion problem. Farms of 2,000 acres and larger account for 46 percent of all land in farms but receive less than 4 percent of all assisted practices. On the other hand, farms of 100 acres or less account for 4 percent of the farmland yet receive 28 percent of the funds [23, p. xii]. This suggests that either small farms have more erosion problems or that ACP payments are used partly as an income supplement.

In the 1960's and 70's ACP placed increased emphasis on water conservation and water quality (see Table 6).[8/] A new legislative mandate in 1979 directs ACP to provide enduring solutions to conservation and environmental protection problems [23]. Participants are required to maintain practices for a specific number of years as a condition of cost sharing, usually 5-10 years. The intent of the legislation is to target the financial assistance to genuine soil and water conservation and environmental problems.

Because of changes in policies, the distribution of ACP practices has changed over the years. In some respects, the program appears to

Table 5. Conservation Practice Adoption by Severity of the Sheet and Rill Erosion, Agricultural Conservation Program, 171 Sample Counties, 1975-78

Soil loss	Distribution of Practice
(Tons/acre)	(Percent)
0 - 4.9	52
5 - 9.9	19
10 - 14.9	11
15 - 29.9	11
30 & over	7
	100

Source: U.S. Department of Agriculture, National Summary Evaluation of the Agricultural Conservation Program, Agricultural Stabilization and Conservation Service, USDA, Phase 1, November 1980.

Table 6. 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 practice categories.

Source: U.S. Department of Agriculture, "National Summary Evaluation of the Agricultural Conservation Program," Agricultural Stabilization and Conservation Service, USDA, Phase 1, November 1980.

have achieved a slightly better balance with perceived conservation problems. However, questions remain concerning the adequacy of the program in assisting and encouraging solutions to the priority soil and water conservation problems in terms of dollars spent, practices assisted and geographic areas helped.

For example, GAO, 1977b, reported that from 1970 through 1975, the proportion of ACP cost-sharing assistance relating primarily to soil conservation practices decreased from 59 percent to 45 percent. In addition, they cited an example where a "county committee has established permanent cover as a high priority need for wind erosion control but said that farmers were more interested in obtaining financial assistance to improve their irrigation systems." Therefore, in 1975, the county committee dropped this priority designation from high to low so that the funds reserved for permanent cover could be used for irrigation systems and other practices that were in more demand by farmers. This points out that although changes have been made at the top, they may last only a few years or have little affect on the local administration of the program.[9/]

Technical Assistance

Technical assistance and educational programs help reduce information or knowledge gaps and complement other strategies. Examples might be information concerning a new no-tillage farming system from a land grant university or SCS's help in designing terraces. Educational and technical assistance can be an important part of any strategy involving new practices or special design and layout problems. Yet just the lack of information about programs may be a restraint to soil conservation. For example, a survey done by Leitch and Danielson, 1979, found the primary reason for

farmers not participating in wetlands programs was the lack of information concerning the available programs.

SCS and the agricultural extension service have been the major delivery mechanisms for the soil conservation message in the past. Since the technical expertise would be difficult and expensive to develop elsewhere, the real question is how to make the best use of these resources. What and how much to deliver is an open question. For example, GAO, 1977b, reports that too much time is spent on "developing relatively elaborate conservation plans specifically tailored for individual farmers. In 1975, SCS spent $50 million to prepare or revise 83,180 plans for an average cost of $597 per plan...On the average, one person working full time for one year could prepare or revise about 36 plans..." GAO also suggested that a more effective follow-up system was needed to answer questions farmers have when installing conservation practices.

Coordination of the conservation advice can also be a problem. "In a midwestern state, SCS conservationists recommended minimum tillage to control soil erosion problems, and included this method in the plans they developed for individual farmers in the county. The Extension Service's county agent, however, had been very reluctant to recommend minimum tillage because it can cause reduced yields and increase insect, disease and weed control problems. He recommended the use of crop rotation and contour strip cropping" [26].

"Former ASCS farm allotment programs encouraged Pacific Northwest farmers to use summer fallow (a farming practice which leaves cropland without any protective vegetation for an entire year) and discouraged some farmers from following the SCS-recommended practice of planting

protective grass on critical soil erosion areas. Although summer fallow is a very erosive practice, it was considered a conserving crop under former allotment programs because it enabled the land to conserve moisture" [26].

Finally, if SCS continues to operate on a first-come, first-served basis, any major increase in soil conservation technical assistance will require a major increase in SCS staff. On the other hand, if SCS was targeted on the high erosion areas of the U.S., staff increases could be minimized. For example, in Minnesota, this would mean concentrating SCS's efforts on five counties in Southeastern Minnesota.

When SCS was started in 1936, little was known about the extent of the soil erosion problem and most farmers were unaware of soil conservation practices. Today the situation is quite different. Farmers are much better informed and we know that the worst soil erosion occurs on only about 13 percent of our cropland [23]. Thus, for the technical assistance strategy to be cost effective, it needs to be concentrated in areas where erosion control has the highest payoff. This can be done gradually by assigning most of the new SCS staff to the erosion prone areas. However, such a policy would require strong leadership from the Secretary of Agriculture and the Congress.

In fact, there has been an effort to target soil conservation on a specific area, the Great Plains. The Great Plains Conservation Program (GPCP) was established in 1956, under SCS, to assist farmers and ranchers in making voluntary changes in their cropping systems to conserve soil and water. It is a combination of both cost-sharing and technical assistance with the objective of converting fragile soil to permanent vegetation.

The hope was that it would be more effective than the existing SCS technical assistance and ACP. However, much of the unsuitable cropland and badly depleted rangeland, which the program was intended to treat, has not been treated. Several factors contributed to the slow progress. High crop prices lowered the incentives for farmers to establish grassland or to maintain it after their GPCP contracts expire. In addition, the program failed to identify and encourage farmers to use the program, who had high-priority conservation needs [26].

A study by Kasal and Back, 1970, of the Great Plains Program also shows that the establishment of permanent vegetative cover on highly erosive land was not at the rate expected. About 15 percent of the program expenditures by 1970 were used for the conversion of cropland to grass while initially, the SCS targeted 75 percent of the program funds for permanent vegetative cover practices. Loss of income and uncertainty were primary factors cited for maintaining land in cultivated crops.

These studies suggest that our conservation strategies of technical assistance and cost-sharing need to be targeted on specific problem areas. A county or small group of counties would be the largest realistic target area with uniform soil conservation problems. In addition, for severe soil erosion areas, land retirement or outright public purchase may be necessary. Why pay for a conservation practice that will be taken out after the 3 to 10 years when the GPCP contract runs out? Would it not be cheaper to purchase a conservation easement?

Public Ownership or Easements

Public ownership or easements may be necessary to deal with some of the irreversible changes that are now taking place in land use or to retire land crop from production that is a serious erosion hazard. A number of federal agencies have used this strategy effectively such as Forest Service, Park Service, and Fish and Wildlife Service. As shown in Table 2 expenditures on public land management was $458 million in 1980, second only to federal cost sharing expenditures. A few states have also used the strategy to zone or restrict land use to agriculture.

However, easements have been used mostly to preserve non-agricultural lands and not specifically for soil conservation. In addition, public ownership or management is meeting with resistance in a number of areas particularly where land is taken out of agricultural production or prevented from moving to a new higher use [15]. Freedom of choice and the fiscal impact on the local economy seem to be major factors causing local resistance to public ownership or easements [7]. Such a program can also be a high cost alternative. For example, in 1977 the U.S. Fish and Wildlife Service paid an average of $568 per acre for 2,523 acres in a 19 county area of Minnesota [15]. In the same year the average easement payment was $320 per acre. Still this strategy has been effective in preserving wet lands and natural environments and should be considered for certain serious soil erosion areas such as the Great Plains.

Land Retirement

Land retirement is another means for dealing with erosive lands which cause large external damages. In fact, reduced erosion was one of

the side benefits of the land retirement aspects of our commodity programs. Now that those programs are no longer in effect, land retirement should be considered as a possible conservation strategy. In fact, conceptually it is no different than the easement strategy or the GPCP contracts discussed earlier.

During the 1960's, 50 to 60 million acres were annually retired under the commodity programs much of which was marginal cropland. When the farmers had a choice they would certainly retire their least productive land which was, in many cases, the most erosion prone. How much erosion control was provided in this manner is not clear. Yet we should not ignore this 50 million or more acres that is now in production and is putting additional pressure in our limited soil conservation resources.

A land retirement program focused on conserving soil would have a different impact than a general land retirement program. A program targeted on retiring the soil with the highest erosion rates would probably fall heaviest on the Southern Plains and the northeastern United States. You would also expect increased purchased chemical inputs to use existing land more intensively and possibly some movement of labor out of farming. Very likely there would be some increase in agricultural prices as production is reduced. This would pass some of the cost of soil erosion control onto the consumers while raising farm income [3].

A general land retirement as previously practiced under the commodity program would not be nearly as effective in reducing soil erosion as one targeted on the most erosion prone soils. A program targeted on the 13 percent of the crop area with erosion in excess of 5 tons per acre could achieve three times the erosion control [23]. However, both approaches

have disadvantages. A general land retirement program to conserve soil would be costly unless it was part of a commodity program. On the other hand, a land retirement program targeted on areas with high soil losses would have significant impacts on selected regions and communities. Consequently, it would likely have difficulty passing Congress and obtaining the support of local people who would be facing a drop in agricultural production, input sales and taxes.

Loans

The low interest loans for conservation practices would seem to be well suited to deal with two types of problems. First would be private interest rates that are higher than those society would select for long-term investment decisions. Second would be farm operators or landowners who have time preferences that are shorter than those of society. The problem is to identify these cases and to estimate the reduction in interest rate necessary to bring the private soil conservation investment up to the level desired by society. Currently, federal loans for conservation practices account for only 3 percent of the investment in selected conservation practices (see Table 3). In addition, these loan programs are scattered across several agencies and departments with varying policies regarding interest rates and as only an insignificant part of their overall programs. Therefore, our current experience with the low increase loan strategy may not provide an adequate basis on which to judge the effectiveness of the strategy. However, there is a definite need for researchers to test this strategy and determine its effectiveness. Researchers could also help identify target groups for the loan programs and suggest interest rate levels.

Regulation and Cross-Compliance

Regulation or land use restriction is another strategy for limiting erosion on land which causes significant external damages. These could be in terms of limiting the crops grown or requiring production practices such as contour farming. Another alternative would be to place a soil loss limit on individual farms and allow the farmers to find the best way to reduce erosion to meet the limit. Yet because soil loss is diffused and occurs over a wide area, it is not feasible to monitor soil losses on individual farms. Thus, regulations or restrictions would probably have to be limited to type of crops, timing and frequency of cultivation, and type of production practices.

The soil conservation effort that seriously considers this strategy was started under section 208 of the Federal Water Pollution Control Act Amendments of 1972. Since soil erosion is the primary source of non-point pollution, it has been an important consideration in the 208 planning. Criteria for best management practices for curbing nonpoint pollution has been developed under this legislation. Where the best management practices have been developed, they are only being applied on a voluntary basis [10].

Several major problems face regulation efforts. First, one must determine best management practices for a given area taking into account both soil loss and returns to the farmer? Second, the regulation strategy has a high administrative and measurement cost for policing various practices. Third, the program will achieve only limited success as long as it is voluntary. If manditory regulations are used the first result will likely be a legal challenge [22]. Unless farmers and

communities are compensated for the loss in production, they will strongly resist regulation. At best, the regulation strategy will probably be limited to areas with a high erosion hazard or to establishing green belts. It is no accident that current Environmental Protection Agency's best management practices for controlling nonpoint pollution are only voluntary.

A closely related strategy would be a cross-compliance system in which crop adjustment programs, crop insurance and soil conservation are all used in combination with each other to reduce erosion. If farmers do not apply conservation practices they do not have access to other federal farm programs [18]. Benbrook, 1979, feels that commodity programs remain the stabilizing feature of farm policy and that conservation incentive programs should be integrated with commodity programs through some type of extra price support incentive for conservation.

With the strong export markets of recent years, the incentives for cross-compliance have been reduced because of the lower commodity program benefits. Also, some argue that area benefiting from commodity programs contain only a portion of erosion prone areas. Therefore, the cross-compliance may be a weak stick, although it does have the political advantage of not forcing farmers to follow set practices. They get the benefits of other farm programs for following conservation practices. Under mandatory regulation they do not have any choice and they receive little in return.

An Overview

In summary, the current strategies can be regrouped into three basic types: (1) cost-share or interest rate subsidies, (2) technical

assistance and education, and (3) direct public ownership or regulation of farming practices. Clearly the farmers and land owners would prefer the subsidy approach. If benefits to society from soil conservation are high, the subsidy strategy should be designed to pay society's share. More specifically, if the problem is the high cost of investment funds, then the subsidized loan approach deserves more consideration.

The strength of the technical assistance and education strategy is twofold. First, it complements other strategies and, second, it allows freedom of individual choice. If lack of information and knowledge is a key reason why practices are not used, then this is an important strategy.

The direct public ownership or regulation to control soil erosion is viewed as the least acceptable set of strategies by local communities. The direct public ownership or land retirement involves compensation for the farmer but local communities fear the loss of revenues. Regulation without compensation has the additional problem that the farmer is faced with a stick rather than a carrot. Because of both the economic and political cost of the third group of strategies, one would expect to see them used only in case of severe erosion problems or in the preservation of unique agricultural lands.

Conclusion

Our review of the literature and data on conservation programs confirms our suspicion that a full assessment of current conservation strategies cannot be made without additional information. Soil erosion benefits are still measured in terms of miles of accomplishment, acres of coverage or number of farm plans. What we need to know concerning

conservation programs is their effect on future crop production, their cost to producers and the cost of erosion imposed on others. Obtaining this information will not be easy and will require research to quantify the relationships between soil erosion and damages downstream and between soil erosion and crop yields. Without this information, the best one can say is that one program provides a unit of erosion control more cheaply than another. We have no idea what extra value a unit of permanent vegetation has to society.

We were also surprised to find that private land owners in the mid-70's spent almost three times more than the public sector on conservation practices to prevent soil erosion. We were alarmed by the study indicating that over one-half of soil erosion practices applied in the 171 county sample were on soils without a serious degradation problem. In addition, we find that in real terms, conservation program expenditures have been rather constant over the last 30 years. Combining this information with Dr. Russell Train's statement that "we have a long way to go in solving our problems of non-point source pollution generally" [21, p. 33] and the GAO finding that "the 1983 interim water quality goals ... cannot be achieved in many regions because of nonpoint pollution" [25, p. 14] highlights what we feel is a growing concern about our soil conservation efforts.[10/]

Several responses could be made to this growing concern. First, one could argue that changes in market conditions and improved weather will reduce the problem. A second, status quo, argument would be that more time is required to reach additional farmers and that we cannot afford to do any more. A third response would be to increase spending

on existing programs to do more of the same. Fourth, new legislation could be passed to allow new approaches such as direct regulation of farming practices or the purchase of public soil conservation easements. A fifth approach would be to modify current programs and target funds on erosion prone areas and farms. This might include allocating ACP and SCS funds among counties based on an index of soil erosion problems. Funding might also vary from year to year based on weather conditions such as drought, which might cause serious erosion conditions. We need to be more concerned about revitalizing old institutions and programs. Although this appears to be a more difficult task than just starting new ones, the rewards could be substantial. The cost of starting a new program could be avoided and the existing expertise could be more fully utilized.

To implement this latter approach we need to answer some basic questions concerning program objectives, program delivery and program monitoring. Our governmental processes seem to emphasize the pragmatic short-term interests confronting the nation. Perhaps these processes preclude consideration of relevant alternative resource conservation policies since soil conservation involves long-run objectives. Soil conservation is more than maximizing the miles of terraces and the acres of vegetative cover or adding a little to farmer income. Soil conservation is a dynamic process that involves social and individual time preferences, concern for future generations, technological development and non-degradation of natural resources. More specifically, how does social time preference enter our conservation policy? Is degradation of soils consistent with the needs of future generations? Finally, should

conservation policies include consideration of technological development which encourages the use of large machinery or tends to offset the soil productivity losses associated with soil depletion?

To improve program delivery, is it possible to target our conservation efforts? The voluntary programs appear to result in practices being applied to low priority or non-existent problem areas. Targeting programs implies considerable "upfront" planning and examination of conservation problems and needs which may vary from year to year.[11/] Targeted programs means that not all landowners will have access to the programs offered.

Perhaps state and local governments should be more directly involved in conservation programs to the extent of providing funds. Are all conservation problems national in scope? What is the regional and local interest in conservation problems? If state and local governments become more directly involved in program financing, they may exhibit a greater interest in the effective administration and targeting of conservation programs.

More work is needed on program delivery mechanisms and approaches. With a need to target programs, arrangements are needed, not only to fund and encourage conservation practices, but to identify where and what type of practices are to be used.

The inventory and monitoring information on resource conservation issues is needed for two principle purposes: program administration and research. These are not mutually exclusive but in many instances the two purposes reflect different data requirements. Programs need information that will allow assessment of program needs and will permit the planning of program priorities and design. Data files are needed that

characterize problems according to their location, extent, costs and expected benefits. The mapping of land and water resources along with measurements of conservation problems is key. Collateral information on production inputs and costs, yields, practice costs and benefits, as well as program costs and impacts are needed for effective program planning and design.[12/] Of particular importance is the need to monitor losses in soil and organic matter over time and relate these losses to crop yields and pollution levels (i.e., added cost of water purification).

Research needs relate to both technical and economic issues. We know little about the fate of the soil particle that is moved through water and wind erosion. Do the receiving floodplains and areas receiving wind deposits obtain net benefits? What is the interaction of cultural practices with soil loss or with the soil creation process? Cropping systems, such as minimum tillage, need additional study.

Socio-economic research needs range from micro to macro levels of issues. Studies are needed to determine the economics of individual practices and to determine the cost effectiveness of practices or groups of practices to accomplish program objectives. Increasingly, conservation programs are viewed in terms of total systems -- conservation systems on farms, watersheds, stream reaches, river basins, etc. We need to avoid looking at one problem in isolation of other problem areas. Economic feasibility studies, as well as impact studies of total systems would provide useful knowledge on the aggregate effects. Further information is needed on the characteristics of program participants -- who participates, who doesn't and why. Participation data would be useful in designing incentive programs. Some groups may need more encouragement than others.

Analyses are needed to estimate the cost effectiveness of various conservation programs and policies. Especially important would be evaluation of strategies that target programs to priority conservation needs.

FOOTNOTES

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1/ Because of numerous public projects, the risk to society of any one project may be insignificant [1].

2/ Option value in the case of soil conservation can be defined as a willingness to pay for the preservation of a land area by an uncertain user of the land or its products. This willingness to pay is greater than the expected value of the consumer surplus obtained from the land. The difference between the willingness to pay and the expected value of the consumer surplus is the option demand.

3/ The inventory procedure to develop investment statistics considered the gross investment by both the public and private sector adjusted for depreciation and salvage values [24].

4/ The historical series are being updated; other data sources are being evaluated to corroborate the depreciation rates and maintenance investments by farmers and landowners.

5/ A strategy which has not been used and is just the opposite of cost sharing is the tax. This would be a charge or tax levied on the

farmer or other polluters. Such a charge was calculated to be the most cost effective approach by Narayanan and others, 1974 and by Taylor and Frohberg, 1977. Taylor and Frohberg, 1977, also found that although a per acre soil loss restriction or a ban on straight row cultivation were only slightly less efficient than a tax, each policy had a substantially different income distributional impact. For example, with the per acre soil loss restriction, landowners gained and consumers lost while the opposite was true of a tax or a ban on straight row cultivation.

6/ "The impact of practices on sheet and rill erosion were considered but the impact on wind and gully erosion was not. As a result, ... the practices and the program overall look less cost-effective than they may actually be with respect to erosion reduction... However, by volume, sheet and rill erosion account for the vast majority of the total erosion on a national basis" [4, p. 25].

7/ A soil of 5 tons or less is not considered serious; with proper management soil productivity can be maintained [23]. In addition, "on land eroding at an annual rate of more than 14 tons per acre ... erosion reduction costs were found to be less than $1 per ton.* In contrast, the cost per ton of erosion reduction was $4 to $45 per ton on land with annual rates of less than 5 tons per acre" [4, p. 27]. These figures must be viewed cautiously since they represent only part of the equation. The value of the soil lost and damages or pollution caused by the eroded soil is another part. Soil lost from the areas with 5 tons or less erosion, may have a high value relative to soil being eroded more rapidly.

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*Underlined phrase added by authors.

8/ Fitzgerald, 1979, points out that ACP has been production-oriented in the past but in 1978 the program was redirected towards more soil conserving and maintenance practices. He states that "we eliminated drainage-type practices this past year." Fitzgerald also feels that the Rural Clean Water Program will help improve water quality and conservation practices in areas where ACP has not been fully utilized.

9/ An alternative would be to rely on the states to provide more of the conservation assistance in the future. Iowa's Sediment Control Law is an example. This law, which is part of the Iowa Conservancy District Law, offers cost-sharing assistance to landowners to cover 75 percent of the cost of installing permanent soil and water conservation practices. For temporary practices, the state committee sets the amount. Although the erosion problem has to be a nuisance before something officially can be done, the law is felt to be working well [9].

10/ The section 208 program of the Federal Water Pollution Control Act of 1972 is added evidence that soil erosion is higher than is desired by the U.S. public.

11/ This would mean that soil conservation programs would probably have to be more flexible. Our current conservation programs are not designed to meet unusual weather conditions that may require special assistance for short periods of time.

12/ The USDA-SCS National Resource Inventory and soil mapping work has been effective in characterizing soil, land and water resources. These inventories have also helped in identifying conservation problems.

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