1989

Soil Conservation Policies: A Rights Oriented And Benefit-Cost Analysis

by David W. Hughes and Walter R. Butcher

The authors are associate in research and professor, Department of Agricultural Economics, Washington State University. Concepts relating to property rights were originally stimulated by the work of Daniel W. Bromley.

AAEA 1989

#6754

Abstract

Recent changes have shifted the emphasis in soil conservation programs from subsidy to a mixture of subsidy and mandatory policies. A property rights oriented analysis allows policy makers to ascertain the distributional effects of potential and actual policies while a benefit-cost neoclassical analysis emphasizes policy efficiency implications.

Since 1935 the Soil Conservation Service and other federal government agencies have used subsidy and educational programs to encourage farm practices that reduce soil loss from the nation's cropland. In recent years, however, there appears to be a generally shifting emphasis in conservation programs from education and subsidy towards a mixture of subsidy and mandatory policies with increased emphasis on policy effectiveness and efficiency.

Legislative examples of the move towards a regulatory approach include the 1985 Food Security Act (P.L. 99-198) and its provision for farmers to adopt erosion reduction plans as a prerequisite to participation in commodity programs (Dicks). The desire to reduce soil erosion as the primary nonpoint source of water pollution has also increased at least the potential for using regulations as means of achieving conservation policy objectives. The most recent expression of this desire can be found in the latest version of the Clean Water Act (Water Quality Act of 1987) (Congressional Quarterly).

It is argued here that the move to regulatory type policies implies a basic redefinition of property rights relative to use of the soil resource. Actual and possible changes in soil conservation policies bear examination by economists, therefore, to define the magnitude and direction of net benefits resulting from the differing sets of rights determinations that underlie soil conservation policies.

Controversial soil conservation proposals also warrant examination in terms of efficiency oriented measures such as levels of topsoil saved and an overall social accounting of policy costs and benefits. In addition to demonstrating net benefits to different groups, variables such as impact on farm income and changes in government expenditures also enter into overall social accounts. Measurements that indicate policy efficiency from a social viewpoint, as well as policy effectiveness and incidence of payment, help predict policy acceptance by farmers, by other groups concerned about erosion policies, and by the public.

<u>Description of Region and Typical Farm</u>

A typical farm in the eastern Palouse farming region of eastern Washington and northern Idaho is chosen for examining the various effects of different soil conservation policies. The Palouse is characterized by highly productive and deep loam topsoils, but the region also suffers from some of the highest erosion rates in the country. Primary crops are winter wheat, spring barley, and dry peas or lentils.

A mixed integer programming model is used to represent a typical 1100 acre farm in the area. The farm is divided on the basis of land class with land classes 2 and 3 comprising one land group (land3) and land class 4 and land class 6 each comprising separate land groups (land4 and land6). The farmer is assumed to follow the same cropping rotation on each land group with the exception that only highly erodible land classes 4 and 6 can be retired from production while strip crop and divided slope are erosion control methods that can only be applied to land3.

No-till and minimum tillage methods are additional means of erosion control. Integer variables are used to represent the costs of differing combinations of machinery ownership that can result from the use of conventional or conservation tillage methods.

The farmer is assumed to have a 5 year planning period, but a 50 year planning horizon relative to the loss of productivity due to soil erosion during the current 5-year planning period. The long run effect of current erosion is accounted for by the scarcity rent of topsoil variable, which is the present value of topsoil over the ensuing 45 year period from the current 5 years of erosion. The scarcity rent value of topsoil is a function of the discount rate, expected crop prices, expected future cropping patterns, erosion rates, and yield/ topsoil depth equations as estimated by Taylor and by Hoag.

The farm is assumed to have 1985 price levels and to be eligible for participation in government commodity programs and Agricultural Conservation Program (ACP) cost-sharing programs.

Soil Conservation Policy Categories

Soil conservation policies are seen as falling into the three categories of subsidy policies, cross-compliance policies, and coercive policies. Under subsidy policies, farmers receive payments for implementing conservation practices or refraining from erosive farming methods. Examined subsidy policies include increased ACP program cost-sharing; green ticket cross-compliance where farmers received increased deficiency payments for participation in commodity programs; and a subsidy on each ton of topsoil saved.

Farmer participation in commodity programs is tied to proscribed or prescribed farming practices with cross-compliance policies. Reviewed cross-compliance policies included increasing spring barley benefits at the expense of winter wheat commodity program payments as one option and using divided slope farming on land3 and minimum tillage on land4 and land6 acreage as a different policy approach. Farmers can also retire highly erodible land and retain the base acres from that land.

Coercive policies include those where farmers are charged for eroding soil, are forced to limit soil loss to prescribed levels, or are required to use certain soil conserving practices. Coercive policies examined include different limits on whole farm erosion, per unit tax on all soil loss in excess of 5 tons per acre, and requiring rotations that included no-till farming and minimum tillage farming.

Model Results

Model results are presented in Table 1 for the baseline run under 1985 farming conditions, and for runs under various subsidy, cross-compliance, and coercive policies. All values are reported on an annualized basis. The future productivity loss due to current erosion (the scarcity rent value) is reported separately from current net returns to land and management. Net returns account for actual current costs and revenue from the farming operation while the scarcity rent, which is the anticipated opportunity costs from current farm practices, will be incurred during future years. Thus, the scarcity rent value is a change in asset value that should be included as one of the economic effects of the farm's operation.

Distributional Consequences and Property Rights

Model results can be used to reveal distributional consequences, that is, which social group would be required to pay for soil conservation under a particular policy. Distributional results are determined by the divisions of property rights that underlie proposed and actual policies.

For example, subsidy policies are consistent with farmers possessing the right of using the environment for the disposing of waste and the right of access to government farm programs while freely eroding soil. With this division of rights, reduction in erosion, desired by the rest of society, can only be obtained by bribing farmers to conserve soil which would result in taxpayers paying for increased conservation, while current farm income either remains constant or increases due to economic rents. Economic rents to farmers could be substantial if an attempt is made to gain large reductions in erosion through subsidies. For example, even assuming a perfectly administered program, a subsidy of $4.05 per ton

TABLE 1. Results Under Various Soil Conservation Policy Runs

Run Number and Name	Current Annualized Net Returns	Scarcity Rent Topsoil	Government Payments	Erosion Per Acre
	($)	($)	($)	(Tons)
Baseline Run	63,616	-3,887	38,141	19.1
Red Ticket Cross-Compliance Policies:				
C 1.10 Divided Slopes/ Minimum Tillage	53,687	-1,923	37,341	9.6
C 2.21 Increased Subsidy S. Barley/ Decreased Wheat	47,890	-2,179	33,643	14.6
C 3.20 Retired Land In Base	62,588	-2,427	41,024	13.6
Coercive Policies:				
D 1.11 13.0 Tons Soil Loss	59,125	-2,824	0	13.0
D 1.12 10.8 Tons Soil Loss	56,619	-1,792	37,228	10.8
D 1.14 9.0 Tons Soil Loss	51,558	-1,470	37,252	9.0
D 1.16 6.0 Tons Soil Loss	40,054	-1,170	36,268	6.0
D 1.18 5.0 Tons Soil Loss	35,283	-846	34,419	5.0
D 2.10 Erosion Tax $0.63	53,522	-2,708	33,056	12.4
D 2.11 Erosion Tax $0.95	50,640	-1,807	30,925	10.9
D 2.12 Erosion Tax $2.50	40,563	-1,472	26,142	9.0
D 2.13 Erosion Tax $4.05	35,283	-846	34,419	5.0
D 2.31 No-till Required	27,293	-964	38,279	6.6
Subsidy Policies:				
E 1.10 Increased Cost-sharing	62,769	-669	75,841	4.3
E 2.10 Soil Saved Subsidy $0.63	63,313	-2,708	42,811	12.4
E 2.11 Soil Saved Subsidy $0.96	65,489	-1,807	45,818	10.9
E 2.12 Soil Saved Subsidy $2.50	79,277	-1,472	64,824	9.0
E 2.13 Soil Saved Subsidy $4.05	97,230	-846	97,060	5.0
E 3.10 Green Ticket Divided Slope/Minimum	63,369	-1,923	47,022	9.6
E 3.20 Green Ticket Minimum	63,294	-2,640	59,605	7.7
E 4.10 Land6 Retirement	63,381	-3,002	38,741	17.6
E 4.11 Land4/Land6 Retirement	67,377	-2,463	51,389	13.8

Notes: The scarcity rent is the present value of future productivity loss due to erosion.

Government payments include both commodity program and Agricultural Conservation Program (ACP) payments. For erosion taxes, payments are reported net of tax receipts. Subsidy policies payments include commodity program payments, ACP payments, and other payments tied to the use of conservation practices.

of soil saved (Run E 2.13) would have induced a reduction in erosion of 14.1 tons per acre and would have lead to government payments of $53.56 per acre (Table 1). Farmer net income would have increased by $30.56 per acre, which is the amount that subsidies exceed the costs to farmers of using conservation practices.

Coercive policies, on the other hand, give soil use rights to parties that are damaged by soil erosion on agricultural land. Not surprisingly, strictly enforced coercive policies could lead to large declines in income of farmers who are not allowed to follow practices that violate the rights of off-farm parties. For example, forcing the use of no-till farming (Run D 2.31) caused predicted total annual farm erosion to decline by 13,740 tons or 66 percent, but it also caused net farm returns to decline by $36,323 or 57 percent as in shown in Table 1.

Red ticket cross-compliance policies make farmers' rights to fully participate in commodity programs conditional upon renouncing the right to freely erode soil. Significant declines in net returns and erosion could occur under properly designed red ticket cross-compliance policies, but these changes would be limited by the farmer's option of not participating if cost of compliance outweighed program benefits.

Economic Efficiency: A Benefit-Cost Analysis Of Soil Conservation Policies

The intertemporal and off-site effects of soil erosion by agricultural producers can be accounted for in a neoclassical economic welfare model. The Kaldor criterion and its operational offshoot, benefit-costs analysis, can be used to judge the social efficiency (and perhaps the desirability) of policies within such a model. Hence, analysis that successfully measured all benefits and costs arising from different soil conservation policies, could indicate a policy choice which is socially optimal under neoclassical assumptions.

Values given in Table 2 show weighted changes from the baseline solution in key variables under various soil conservation policies. Benefits and costs of various soil conservation policies, which are accounted for in model results, go to farmers, taxpayers (government expenditures), and future generations (productivity gains). By combining all of these effects in one variable, one can arrive at a measure of social net benefits termed changes in net social accounts. Changes in social accounts equal changes in current farm returns plus soil productivity losses averted and minus changes in government expenditures. Changes in social accounts are incomplete because measurements of off-site effects of soil erosion are excluded; however, the variable does provide a partial measure of the overall economic efficiency of soil conservation policies. Changes in social accounts are weighted by the reduction in soil erosion obtained under each policy to have a constant base for comparison between policies.

As shown in Table 2 all policies caused a decrease in social accounts with the exception of one green ticket (Run E 4.10) cross-compliance policy. One could argue that because social accounts are negative, social costs outweigh social benefits for virtually all policies. But including off-site effects of erosion in social accounts or increasing the value of future yield damages from erosion could result in generally positive social accounts. Negative social accounts for most conservation policies does support the conclusion that such policies are generally costly and some group in society must bear the costs (Heady 1982).

Red ticket cross-compliance policies tended to cause the smallest decline in net social accounts per ton of soil saved. The most "inefficient" red ticket policy was the spring barley subsidy for wheat

TABLE 2. Net Social Accounting Per Ton of Soil Saved Under Selected Adopted Government Programs as Compared to The Baseline Situation

Run Number and Name	Change In Current Net Returns ($/Ton)	Averted Productivity Losses ($/Ton)	Change In Government Payments ($/Ton)	Change In Social Accounts ($/Ton)
Red Ticket Cross-Compliance Policies:				
C 1.10 Divided Slopes/ Minimum Tillage	-0.95	0.19	-0.07	-0.69
C 2.21 Increased Subsidy S. Barley/Decreased Wheat	-3.18	0.35	-1.66	-1.17
C 3.20 Retired Land In Base	-0.17	0.24	0.40	-0.33
Coercive Policies:				
D 1.11 13.0 Tons Soil Loss	-0.67	0.16	0.00	-0.51
D 1.12 12.3 Tons Soil Loss	-0.69	0.20	0.00	-0.48
D 1.13 10.8 Tons Soil Loss	-0.77	0.23	-0.10	-0.44
D 1.14 9.0 Tons Soil Loss	-1.09	0.22	-0.08	-0.79
D 1.15 8.0 Tons Soil Loss	-1.31	0.21	-0.11	-0.99
D 1.16 6.0 Tons Soil Loss	-1.64	0.19	-0.13	-1.32
D 1.17 5.2 Tons Soil Loss	-1.78	0.19	-0.32	-1.26
D 1.18 5.0 Tons Soil Loss	-1.83	0.20	-0.24	-1.39
D 2.10 Erosion Tax $0.63	-1.37	0.16	-0.69	-0.52
D 2.11 Erosion Tax $0.96	-1.44	0.23	-0.80	-0.41
D 2.12 Erosion Tax $2.50	-2.09	0.22	-1.08	-0.79
D 2.13 Erosion Tax $4.05	-1.83	0.20	-0.24	-1.40
D 2.31 No-till Required	-2.64	0.21	0.01	-2.44
Subsidy Policies:				
E 1.10 Increased Cost-Sharing	-0.05	0.20	2.32	-2.17
E 2.10 Soil Saved Subsidy $0.63	-0.04	0.16	0.63	-0.51
E 2.11 Soil Saved Subsidy $0.96	0.21	0.23	0.85	-0.41
E 2.12 Soil Saved Subsidy $2.50	1.42	0.22	2.42	-0.78
E 2.13 Soil Saved Subsidy $4.05	2.17	0.20	3.81	-1.44
E 3.10 Green Ticket Divided Slope/Minimum	-0.02	0.19	0.86	-0.69
E 3.20 Green Ticket Minimum	-0.01	0.10	1.72	-1.63
E 4.10 Land6 Retirement	-0.14	0.55	0.37	0.04
E 4.11 Land4/Land6 Retirement	0.65	0.25	2.29	-1.39

NOTE: Offsite damage is not included in changes in social accounts. Averted Productivity Losses is the decline in the absolute value of the scarcity rent from the baseline solution.

subsidy policy (Run C 2.21) which resulted in a social accounts decline of \$1.17 per ton of soil saved. Several coercive and subsidy policies lead to larger declines in social accounts per ton of soil saved (Table 2).

The cost ("inefficiencies") associated with required soil conservation practices under cross-compliance regulations are limited because farmers bore all direct costs of such practices and they would not participate in overly costly programs. Further, original commodity program expenditures only "purchase" farmer participation in programs. Under red ticket cross-compliance programs funding would buy both supply control and a degree of erosion control.

Subsidy and coercive policies tended to be equally efficient in terms of changes in net social accounts per ton of soil saved. Unlike red ticket policies, there was no provision in the model for rejecting either type of policy because of excessive costs. Not surprisingly, erosion taxes and erosion reduction subsidies lead to the same farm plan with the same overall social efficiency.

Government expenditures increased under all subsidy policies as shown in Table 2. The largest weighted increases in government expenditures, and accordingly the largest declines in weighted social accounts, occurred under policies that resulted in economic rents for the farmer. For example, the Land4 and Land6 retirement policy (Run E 4.11) resulted in an increase in government expenditures of \$2.29 and a decline in social accounts of \$1.39 per ton of soil saved. The policy also caused an increase in farm economic rents of \$0.65 per ton.

Economic rents, and the associated transfer of wealth, are greatest when the government must subsidize heterogeneous farming operations. To induce less "efficient" farmers to adopt soil conservation practices the government may have to set subsidies at levels which over-subsidize more efficient adopters of such practices.

Finally, subsidy policies required large government expenditures to gain significant reductions in erosion. For example, the increased ACP cost-share policy (Run E 1.10) reduced erosion rates to 4.3 tons per acre, but increased annualized government expenditures to $75,841. The possibility of economic rents for farmers plus inefficient and large government expenditures helps to explain the growing public (taxpayer) dissatisfaction with the traditional subsidy approach to soil conservation policies.

Unlike red ticket and subsidy policies all coercive policies resulted in decreased farm profits per ton of soil saved (Table 2). But coercive policies often lead to decreases in government expenditures per ton of soil saved such as the $0.32 decline which occurred when erosion was constrained to 5.2 tons per acre (D 1.17).

Other Considerations in Conservation Policies

Even if weighted changes in overall social accounts for policies which are shown in Table 2 did measure all social costs and benefits other factors should still enter into an evaluation of conservation policies.

These elements include practical considerations such as enforcement costs, administrative feasibility of policies, possible challenges to the legal standing of policies, and slippage in policy enforcement. For example, policies such as a per unit tax on soil erosion may not be feasible because only estimates, not exact measures, of soil loss are obtainable from the Universal Soil Loss Equation or other methods of predicting soil loss.

Less mundane but equally important policy considerations include equity concerns and considerations about farm policy goals such as the maintenance of the family farm. For example, subsidy policies may be considered inappropriate if most of conservation payments go to relatively wealthy farmers. Alternatively, coercive policies could defeat farm income maintenance goals of commodity programs if farmers are forced to adopt costly soil conservation practices under such policies.

Conclusion

Soil conservation policies are examined from both a property rights viewpoint and a benefit-cost efficiency oriented analysis in this paper. Also examined is the potential for disagreement between proponents of the two approaches.

The benefit-cost approach rests on the assumption that benefits to differing groups in society can be given equal social weight whenever policies are evaluated. The emphasis of the property rights analysis is on the distributional effects of policies that result from changes in relative rights. As such the property rights approach can be said to stem from the observation that summing policy effects into single values may lead policy makers to ignore the key distributional and rights oriented effects of various policies.

Proponents of the benefit-cost approach may rebut, however, that efficiency is also an important social criterion, and by merely focusing on distributional aspects of policies, the overall social efficiency of policies may be ignored in the policy process.

Using both approaches in the evaluation of soil conservation policies sheds light on both the efficiency and the distributional effects of differing soil conservation policies. Accordingly, using a property rights and benefit-cost approach in policy analysis allows decision makers to consider both of these important policy results.

References

Bromley, Daniel W. "The Rights of Society Versus the Rights of Landowners and Operators." p. 219-232 in Soil Conservation Policies Institutions and Incentives, Ankeny, IA: Soil Conservation Society of America, 1982.

Congressional Quarterly "House Rejects Reagan Offer, Passes Clean Water Bill Again" Jan. 10, 1987 p. 91-93.

Dicks, Michael R. "What Will It Cost Farms to Comply with Conservation Provisions" in Agricultural Outlook. USDA/ERS, p. 27-30, Oct. 1986.

Heady, Earl. "Trade-Offs Among Soil Conservation, Energy Use, Exports and Environmental Quality?" p. 254-273 in Soil Conservation Policies and Institutions and Incentives, Ankeny, IA: Soil Conservation Society of America, 1982.

Hoag, Dana "An Evaluation of USDA Commodity Program Incentives for Erodible Land Retirement." Ph.D. dissertation, Dept. of Agr. Econ., Wash. State U. Pullman, 1985.

Taylor, Daniel "Evaluating the Long Run Impacts of Soil Erosion on Crop Yields and Net Farm Income in the Palouse Annual Cropping Region of the Pacific Northwest." Ph.D. dissertation, Dept. of Agr. Econ., Wash. State U. Pullman, 1982.