WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

PAPERS OF THE 1989 ANNUAL MEETING

WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

COEUR D'ALENE, IDAHO

JULY 9-12, 1989

FARMER AND TAXPAYER COST EFFECTIVENESS OF THE 1985 CONSERVATION PROVISIONS

Douglas L. Young, David J. Walker and Paul L. Kanjo

Introduction

The 1985 Food Security Act (FSA) signaled a watershed in U.S. soil Conservation policy. The Act continued the long history of taxpayer-financed soil conservation incentives by establishing the Conservation Reserve Program and by extending cost sharing for approved conservation practices. However, the Act broke with precedent in the Sodbuster, Swampbuster, and Conservation Compliance provisions which introduced an element of coercion to soil conservation policy by denying USDA program benefits to farmers who fail to comply. The first two of these provisions deny eligibility for USDA commodity and other program benefits to growers who convert previously unfarmed erodible cropland or swampland to production. Conservation compliance requires those farming erodible land to develop an acceptable conservation farm plan in order to remain eligible for USDA program benefits. Growers must develop plans by 1990 and fully implement them by 1995. The mixture of penalty and subsidy provisions in the 1985 conservation policies provides a new challenge for computing the cost effectiveness of the legislation. In view of legitimate concerns about the equity as well as the efficiency of these provisions, policymakers require estimates of both the public cost effectiveness in terms of taxpayer dollars expended per unit of erosion damage averted and private cost effectiveness in terms of farmer net income foregone per unit of erosion damage averted.

The objective of this paper is to provide estimates of the projected taxpayer and farmer cost effectiveness of alternative mixes of the 1985 conservation provisions for the Palouse region of southeastern Washington. The following section of the paper briefly reviews the theory of cost effectiveness and past applications to soil conservation. The next section describes the integer programming model used to conduct the analysis for the study region. The data and background for the analysis follow. We then present the results of the study which are followed by some conclusions.

Cost Effectiveness: Theory And Past Applications

Cost effectiveness is an evaluation method that can be used to compare alternative practices and policies for conserving soil and abating environmental damage. Ideally, cost effectiveness in conserving soil should be expressed as cost per unit of total offsite and onsite economic damage avoided (GAO, 1983). However, the difficulty in quantifying damage has led nearly all researchers to substitute for economic damage the quantity of soil lost, as measured by the Universal Soil Loss Equation. The cost effectiveness measure is most often denominated in terms of units of soil conserved per dollar of cost or its reciprocal, cost per unit conserved. A government handbook for water quality planning recommends using cost per ton of soil conserved (Montieth et al.). That compromise for the ideal measure assumes that incremental damage is constant for each ton of soil lost. This is not true for either onsite or offsite damage. Generally, productivity losses are greater for erosion on shallow soils as opposed to deeper soils

Washington State University

(Young, 1984). Similarly, sediment losses into surface waterways with high value uses impose more offsite damage than losses into deposition plains within cultivated fields.

Most researchers evaluating alternative practices for reducing soil loss use private cost effectiveness, usually measured in terms of farm income lost per ton of soil conserved (eg. Ogg et al., Mitchell et al.). Similar analysis has been used to evaluate alternative policies for encouraging soil conservation. Policy analysis as opposed to practice evaluation has employed various measures of cost effectiveness. Barbarika and Dicks and GAO (p.37) use a measure of combined selected government and private costs. Park and Sawyer use public (taxpayer) cost effectiveness. Taylor and Frohberg and Seitz et al. use a measure of social cost in the form of producer plus consumer surplus. Several studies use private cost of foregone net farm income (Miller and Gill, Spurlock and Clifton, Kramer et al., and Seale et al.).

Most researchers have considered only the direct costs of policies on a before-tax basis. However, Walker and Noble have conducted an after tax and subsidy analysis that also includes administrative costs and subsidy expense, net of tax revenues, in public (taxpayer) cost. Seale et al. as well as Walker and Noble have estimated private costs after tax and subsidy effects.

This study evaluates alternative mixes of the 1985 conservation provisions in the southeastern Washington Palouse from the standpoint of private (farmer) cost effectiveness and public (taxpayer) cost effectiveness.

Model and Data

Modeling the extensive cross-compliance features between conservation and commodity provisions contained in the 1985 Farm Bill was made possible by using a profit-maximizing farm-level mixed integer programming model. Integer zero-one variables provided the technique for modeling conservation compliance and inter-commodity cross-compliance provisions of the FSA. These variables function as "on-off" switches to enforce compliance requirements.

In the eastern Washington study region, farmers grow two commodity crops, wheat and barley. Five mutually exclusive zero-one program participation status variables were required to model grower options:

SWBMNOCRP, SWBMCRP, SWMBP, SWPBM, and SWBP.

SW(B)M(P) means sell wheat (barley) in the market (government program) and (NO)CRP means (no) participation in the Conservation Reserve Program. It was not necessary to distinguish CRP enrollment status for the last three status variables above because conservation compliance is required due to commodity program participation for these options regardless of CRP enrollment. Mutual exclusivity in program participation status was enforced by a constraint forcing the five variables to sum to one.

The model was applied to representative farms which reflected the land composition and crop yield potential of the western, central, and eastern subregions of the 1.2 million acre Palouse region in Whitman County, Washington. Annual precipitation varies across regions: 12 to 15 inches in the west, 15 to 18 inches in the central, and 18 to 22 inches in the eastern subregion. The 1,000-acre eastern and central subregion representative farms and the 2,000-acre western farm were divided into land groups by erodibility and productivity proportional to the composition of cropland in the subregions (USDA). Region-wide, 85 percent of cropland was classified as highly erodible, and most of this was also highly productive. About 50 percent of the total region lies in the higher precipitation eastern subregion.

Crop yield projections used in the analysis are based upon yield estimates by soil mapping unit reported in the Whitman County Soil Survey. These were updated to 1992 with statistical yield trend equations. Yields varied greatly over the three precipitation subregions modeled. Average wheat yields on the dominant highly erodible, high productivity land class ranged from 57 to 82 bu per year. Based on producer perceptions and experimental plot data in the central region, a yield penalty of 4 percent was imposed when moving from conventional to minimum tillage and 16 percent when moving from conventional to no-tillage (Taylor).

The Pacific Northwest adaptation of the Universal Soil Loss Equation was used to obtain annual average erosion estimates by tillage and rotation system in each subregion (McCool; Schattin). Erosion rates ranged from 43 t/a per year for summer fallow on highly erodible low-productivity land in the western subregion to less than 1 t/a on long-term CRP or grass setaside on all land classes and subregions. Production costs net of land, labor, and management were based on 1987 extension budgets (Caplan et al.). Conventional and minimum tillage costs were similar, but no-till costs were 1 to 3 percent higher for the included rotations. Permitted land uses in the model included: 1) alternative crop rotations, 2) three tillage levels (no, min, and conventional), 3) grass or fallow for setaside, and 4) conservation reserve program. Rotations in the eastern subregion included winter wheat/spring barley/dry peas, and winter wheat/dry peas. Winter wheat/spring barley/summer fallow and continuous spring barley comprised the central region rotations and winter wheat/summer fallow and flexible (depending upon spring soil moisture) spring barley were available in the western subregion.

Expectations of future prices will be important to farmers in their choice of farm plan to meet the 1990 conservation compliance deadline. A 10-year (1988-97) period was chosen as the planning horizon for these expectations. This period encompasses the 5-year (1990-95) Conservation Compliance implementation period and it also recognizes that farmers commit land to the Conservation Reserve Program for a 10-year contract. All estimates of average crop yields and prices are for 1992, the mid-point and assumed average of the 10-year planning horizon. All prices and costs are measured in 1987 dollars. Projected 1992 real market prices for dry peas, barley, and wheat were initially based upon 1981/82-1985/86 5-year averages. The barley and wheat price projections were then adjusted upward, but pea prices were not, after consultation with outlook specialists (Sargent). Target prices for wheat and barley for 1992 were based upon continuation of the downward trend in the 1985 Farm Bill target price schedule. These procedures led to market and target price assumptions of \$3.00 and \$4.00/bu for wheat, \$80.00 and \$98.46/t for barley, and \$9.08/cwt for dry peas which are not a program crop. While these historical average prices are low compared to today's level, they were used to represent long run average price expectations.

Setaside requirements were assumed to remain at the then current

(1988) levels of 27.5 percent of wheat base and 20 percent of barley base. Typical wheat and/or barley base acreages on the representative farms were judged to be slightly higher than strict rotational patterns would dictate, given recent base inflation trends in the Palouse. Established program yields for wheat and barley were assumed to be the same as farm-wide projected yields.

Results

The magnitude and distribution of taxpayer and farmer costs of the Conservation Compliance and the Conservation Reserve Program provisions for the study region were determined by initially solving the integer programming model of each representative farm for a benchmark scenario which included no conservation policies, but with the basic commodity policies. The program was then solved for profit maximizing solutions under various levels of Conservation Compliance standards and CRP rents. Farmer costs were estimated by subtracting the objective function value (net returns to land, labor, and management) for a given policy run from the benchmark value. Government costs -- comprised of commodity program deficiency payments, CRP rents, and CRP cost sharing -- were computed by subtracting outlays for these programs in the benchmark run (which included only deficiency payments) from these outlays for each policy run. This approach accounted for offsetting savings in government commodity program when land was put into CRP. Administrative costs were not included among taxpayer outlays due to a lack of reliable data on their magnitude.

Per acre costs incurred and cost effectiveness ratios per ton of soil saved are reported separately for farmers and taxpayers. These ratios are not summed on a one-to-one basis to form an "overall cost effectiveness ratio." This avoids imposing a particular implied social welfare function with respect to how costs borne by farmers and taxpayers should be weighted. Subtracting average farm-wide soil loss with a given policy from soil loss in the benchmark run provides a measure of soil saved which serves as the denominator in computing cost effectiveness ratios for taxpayer and farmer outlays.

In the benchmark run, farms in all three regions participated in wheat and barley programs and farmed all acres, except those required to meet setaside requirements. Given the substantial difference between target and market prices utilized in the analysis, this is expected. Conventional tillage was used in the eastern and central regions, but minimum tillage was used in the western region where it was less costly and carried no tillage penalty. The benchmark solutions generated erosion rates of 10.9 t/a in the eastern region, 8.7 t/a in the central region, and 10.7 t/a in the western region. Net returns ranged from $77.76/a in the eastern region, to $62.56/a in the central region, and $26.85/a in the western region.

Table 1 reports the impact of various Conservation Compliance standards as a function of soil loss tolerance (T) in the three study regions, assuming a $60/ac CRP rental payment. Sixty dollars per acre has been the prevailing maximum acceptable CRP bid throughout Whitman County during the past several CRP bidding rounds. Early interpretations of Conservation Compliance indicated that farm plans must achieve 1T, but provision for "alternative" plans has led to considerable loosening of this standard in practice. Consequently, results are presented for 1-2T and 2T as well. The 1-2T standard varies between 1 and 2T proportional to the erosion index for the farm. For comparison, results are also presented for no Conservation Compliance requirement at all, but with CRP.

The positive increase in additional taxpayer costs for CRP in Table 1 for all but two rows show that enrolling some highly erodible acres in this program was profitable for farmers in all cases except for 2T and no Conservation Compliance in the eastern subregion. These entries show the government's annualized costs per all acres in the farm for CRP rents and CRP cost sharing. CRP was always profitable in the central and western region even without the added enforcement stick of Conservation Compliance. Indeed, under the relatively low historic crop prices utilized in this analysis, it was profitable under all assumptions to enroll highly erodible land on the 2,000 - acre western region farm up to the $50,000 CRP payment limit.

When acres are entered into CRP in response to Conservation Compliance and/or the inherent profitability of CRP, government deficiency payment outlays fall. This is a result of the proportional cut in program crop bases as acres enter CRP. As shown in Table 1, these deficiency payment savings vary by subregion and program scenario, but are generally well under the additional costs of CRP rents and cost sharing. Total government outlays net of commodity program savings are also reported in Table 1. As expected, these outlays are highest in the low-yielding, low rainfall western region where $60/ac CRP rents represent considerable subsidies beyond breakeven levels.

In the productive eastern subregion, a strict IT Conservation Compliance standard was projected to cut erosion by over 60 percent or 6.8 t/a. Most of the cost was borne by farmers who incurred $1.90/t of soil saved versus $1.44/t borne by taxpayers. As expected, less stringent compliance standards result in less soil conservation. Also, as expected from theory, the average cost per ton of soil conserved increases as soil savings increase. This conclusion holds throughout for both farmer and taxpayer costs.

In contrast to the eastern subregion, the combination of Conservation Compliance and CRP generally increases western and central subregion farmers, net returns to land, labor, and management. This shows up as a negative cost per ton of soil saved or a net subsidy. Only at the 1T compliance level in the central region do farmers bear any costs of soil conservation in these two subregions. This results from the inherent profitability of CRP on the low-yielding, erodible land classes in these drier subregions. It should be recognized that CRP makes available a new and profitable land use activity in the model. The availability of this activity can change farm organization and response to constraints in many ways. Consequently, net returns increases would not be expected to be necessarily equal in absolute magnitude, but opposite in sign, to taxpayer costs. Nonetheless, farmers' benefits per ton of soil saved in these two subregions oftentimes are relatively close to taxpayer outlays.

Imposition of tighter Conservation Compliance requirements forced farmers to use no-tillage and minimum tillage in all subregions. The same cropping rotations were found to maximize profits over all compliance levels within a region: winter wheat/dry peas in the eastern subregion, winter wheat/spring barley/summer fallow in the central subregion, and winter wheat/summer fallow in the western subregion. Multi-year grass plantings for setaside were generally used to maximize profits in compliance farm plans.

Table 1 also provides similar results on the impact of varying CRP rates assuming a constant 1-2T conservation compliance standard. Over all regions at $40, $60, and $80 CRP rents, CRP provides a sufficiently profitable means of meeting Conservation Compliance requirements that taxpayers incur at least a portion of the cost of soil conservation. Interestingly, farmers continue to earn pure subsidies even at the $40 CRP rental rate in the western region.

In the eastern and central subregions under the no-CRP scenario, Table 1 displays the interesting result of a net saving by taxpayers. This result flows from the profit maximizing choice to meet the Conservation Compliance standard by privately grassing out some of the least-productive and most-erodible acres on the farm. With fewer acres available for planting, government deficiency payments fall. Interestingly, privately planting grass was more profitable than exiting the wheat program (which would preclude the need to meet the conservation standard. Given the $1.00/bu gap between market and target wheat prices, there is a strong incentive for program participation.

The relatively high farmer rents from CRP payments in less productive subregions underscore the need for differentiating CRP bid caps by land productivity, even within counties. However, program administrators have been reluctant to undertake this degree of geographic differentiation in bid caps.

Overall, soil savings in Table 1 show less response to changes in CRP bid rates than they do to changes in Conservation Compliance standards. Some results in Table 1 might at first seem anomalous but this is due to the discrete nature of the activity set. An example is the relatively high soil savings (7.5 t/ac) in the western region when no CRP rental payment is paid. This soil saving is due to the adoption of no-till on all cropland to meet the compliance standard. This saves more soil farm-wide than enrolling the most erodible land in CRP and cultivating the remainder conventionally.

Conclusions

This analysis showed that two central conservation provisions of the 1985 Farm Bill, the Conservation Reserve Program and Conservation Compliance, have the potential to force a sharing of the soil conservation burden between farmers and taxpayers. However, whether this "sharing" actually occurs, and the degree to which it occurs, depends upon the composition of the land resource base and the structure of CRP rental rates and compliance standards. In our southeastern Washington study region, relatively high county-wide CRP bid caps and relaxed Conservation Compliance standards resulted in little or no projected burden for farmers in lower rainfall, less-productive subregions. In contrast, farmers in a more highly-productive, but also highly-erodible, subregion were forced to bear 50 percent or more of the costs of soil conservation.

It should also be recognized that a priori analyses of this type hinge upon price expectations for the future. Current wheat and barley prices are 30 to 40 percent higher than the historical averages used in t*his analysis. It is still an open question as to whether current price levels or the historic averages used here are better estimates of true long-run prices.

TABLE 1. Impact of Conservation Compliance Standards and CRP Rates on Soil Conserved and Distribution of Costs

Palouse Subregion	Conserv. Compliance Standard	Gross CRP Rate ($/ac)	Soil Saved (t/ac)[a]	Cost Changes ($/ac): Taxpayers: Defic. Pmts.	Cost Changes ($/ac): Taxpayers: CRP	Cost Changes ($/ac): Taxpayers: Total	Cost Changes ($/ac): Farmers[b]	Cost of Soil Saved ($/ton) Borne By: Farmers	Cost of Soil Saved ($/ton) Borne By: Taxpayers
East	1T	60	6.8	-13.32	23.16	9.84	12.92	1.90	1.44
	1-2T	60	5.3	- 6.02	10.49	4.47	7.95	1.50	0.84
	2T	60	3.6	0	0	0	3.24	0.90	0
	None	60	0	0	0	0	0	c	c
	1-2T	None	4.7	- 4.86	0.00	-4.86	20.54	4.37	-1.01
	1-2T	40	5.3	- 6.02	6.99	0.97	11.45	2.16	0.18
	1-2T	60	5.3	- 6.02	10.49	4.47	7.95	1.50	0.84
	1-2T	80	5.3	-14.18	32.86	18.68	3.55	0.67	3.60
Central	1T	60	5.0	-16.60	25.25	8.65	1.25	0.25	1.72
	1-2T	60	4.0	- 9.83	16.65	6.82	- 2.32	-0.58	1.70
	2T	60	1.6	- 4.08	11.33	7.25	- 7.57	-4.73	4.39
	None	60	1.5	- 3.05	10.08	7.03	- 8.68	-5.79	4.84
	1-2T	None	3.3	- 7.88	0.00	-7.88	15.64	4.74	-2.38
	1-2T	40	4.0	- 9.83	11.10	1.27	3.24	0.81	0.32
	1-2T	60	4.0	- 9.83	16.65	6.82	- 2.32	-0.58	1.70
	1-2T	80	3.9	-15.65	33.92	18.27	- 9.44	-2.42	4.68
West	1T	60	3.7	- 8.89	25.00	16.11	- 3.37	-0.91	1.84
	1-2T	60	5.0	-10.92	25.00	14.08	- 9.05	-1.81	2.79
	2T	60	4.5	- 8.89	25.00	16.11	-14.22	-3.16	3.56
	None	60	4.5	- 8.89	25.00	16.11	-14.22	-3.16	3.56
	1-2T	None	7.5	0.00	0.00	0.00	10.12	1.35	0
	1-2T	40	5.7	-11.78	20.62	8.84	- 5.19	-0.91	1.55
	1-2T	60	5.0	-10.92	25.00	14.08	- 9.05	-1.81	2.79
	1-2T	80	8.4	- 5.85	25.00	19.15	-11.76	-1.40	2.28

[a]Soil saved equals the difference between erosion at no-conservation - policy benchmark and with the policy.

[b]Farmers' increased (decreased) cost equals reduction (expansion) in net income compared to benchmark.

[c]Undefined because changes in taxpayer and producer cost and soil saved with the policy equal zero.

REFERENCES

Barbarika, Jr., Alexander, and Michael R. Dicks. "Estimating the Costs of Conservation Compliance." The Journal of Agricultural Economics Research, (Summer 1988): 12-20.

Caplan, Arthur, H. Hinman, T. Hoffman and D. McCool. Crop Enterprise Budgets, Selected Tillage Systems, Western Whitman County, Washington. EB 1427, Coop. Ext., Washington State University, Pullman, 1987.

Caplan, Arthur, H. Hinman, T. Hoffman and D. McCool. Crop Enterprise Budgets, Selected Tillage Systems, Central Whitman County. EB 1433, Cooperative Extension, Washington State University, Pullman, 1987.

Caplan, Arthur, H. Hinman, T. Hoffman and D. McCool. Crop Enterprise Budgets, Eastern Whitman County. EB 1437, Cooperative Extension, Washington State University, Pullman, 1987.

Heatwole, C.D., A.B. Bottcher, and L.B. Baldwin. 1987. "Modelling Cost-Effectiveness of Agricultural Nonpoint Pollution Abatement Programs on Two Florida Basins." Water Resources Bulletin, 1987, 23(1):127-131.

Kanjo, Paul Lakong. An Economic Evaluation of Alternative Policies for Controlling Agricultural Soil Loss: A Zero-one Mixed Integer Programming Analysis. Unpublished Ph.D. dissertation. Department of Agriculture Economics, Washington State University, Pullman, 1988.

Kramer, R.A., W.T. McSweeny, W.R. Kaiser, and R.W. Stavros. 1984. "An Evaluation of Alternative Policies for Controlling Agricultural Nonpoint Source Pollution." Water Resources Bulletin, 20(1984):841-846.

McCool, D.K. and George, G.O. "A Second Generation Adoption of the Universal Soil Loss Equation for Pacific Northwest Drylands." Paper No. 83-20661 presented at summer meetings, Amer. Society Agr. Engineers, Montana State U., Bozeman, 1983.

Miller, W.L., and J.H. Gill. "Equity Consideration in Controlling Nonpoint Pollution from Agricultural Sources." Water Resources Bulletin, 12(1976):253-261.

Mitchell, Kent J., John C. Brach and Earl R. Swanson. "Costs and Benefits of Terraces for Erosion Control." Journal of Soil and Water Conservation, 35(1980)233-236.

Monteith, T.J., R.A. C. Sullivan, T.M. Heidtke and W.C. Sonzoni. Watershed Handbook: A Management Technique for Choosing Among Point and Nonpoint Control Strategies. EPA Great Lakes National Program Office, Chicago, 1981.

Ogg, Clayton W. and Ralph E. Heimlich. "Implementation of New Conservation Programs and the Need to Respond to Changing Market Conditions." Southern Journal of Agricultural Economics, 12(1980):173-177.

Park, William M. and David G. Sawyer. "Cost Effectiveness of Alternative Subsidy Strategies for Soil Erosion Control." Southern Journal of Agricultural Economics, 19(1987):21-32.

Park, W.M. and L.A. Shabman. "Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control." Water Resources Bulletin, 17(1981):1023-1028.

Sargent, Robert. Department of Agriculture Economics, Washington State University. Personal communication, 1987.

Schattin, Robert. Soil Conservation Service, Spokane, Washington. Personal communication, 1987.

Seale, R.D., J.W. Hubbard and E.H. Kaiser. "Subsidy and Tax Effects of Controlling Stream Sedimentation in South Carolina." J. Soil and Water Conservation, 40(1985):144-148.

Seitz, W.D., C.R. Taylor, R.G.F. Spitze, C. Osteen and M.C. Nelson. "Economic Impacts of Soil Erosion Control." Land Economics, 55(1979):28-42.

Spurlock, Stan R. and Ivery D. Clifton. "Efficiency and Equity Aspects of Nonpoint Source Pollution Control." Southern Journal of Agriculture Economics, 14(1982):123-129.

Taylor, Barbara Jane. Perceived Profitability in Farmers' Adoption of Soil Conservation Tillage. Unpublished M.A. thesis, Department of Agriculture Economics, Washington State University, Pullman, 1982.

Taylor, C.R. and K.K. Frohberg. "The Welfare Effects of Erosion Controls, Banning Pesticides and Limiting Fertilizer Application in the Corn Belt." American Journal of Agricultural Economics, 59(1977):25-36.

United States Department of Agriculture. Soil Survey of Whitman County, Washington. Soil Conservation Service, Colfax, Washington, 1980.

United States General Accounting Office. Report to the Congress of the United States. Agriculture's Soil Conservation Programs Miss Full Potential in the Fight Against Soil Erosion. GAO/RCED-84-48, 1983.

Walker, D.J. and D.T. Noble. "Distribution of Social Costs on the Rock creek Idaho Rural Clean Water Project." Selected paper presented at the annual meetings of the Western Agricultural Economics Association, Manhattan, Kansas. A.E. Research Series No. 259, Department of Agricultural Economics, University of Idaho, Moscow, Idaho, 1987.

Walker, D.J. and J.F. Timmons. "Cost of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation." Journal of Soil and Water Conservation, 35(1980):177-183.

Young, D.L. "Modeling Agricultural Productivity Impacts of Soil Erosion and Future Technology." Future Agriculture Technology and Research Conservation, Ames, Iowa, Iowa State University Press, 1984.