Commodity and Conservation Policy Impacts on Risk and Returns

Dana L. Hoag and Douglas L. Young

Crop yields, farm income risk and returns, and soil losses were simulated from 1974 to 1984 for southeastern Washington Palouse-region farms in three climatic subregions under alternative conservation and commodity policy scenarios. Historical commodity programs reinforced preexisting disincentives to retire highly erodible land to perennial grasses, but cropland base protection (CBP) legislation would eliminate such disincentives and increase profitability and decrease risk of land retirement. Nevertheless, additional incentives would be needed. Government rental payments can provide necessary incentives, but they are more costly without CBP. CBP was not included in the 1985 farm bill.

Key words: commodity programs, land retirement, Palouse, returns, risk, soil conservation programs.

Several new soil conservation programs were introduced with the 1985 farm bill. Major titles include sodbuster, swampbuster, conservation reserve, and conservation compliance. The objective of these new laws is to use commodity and conservation programs more efficiently to manage crop supply and reduce soil erosion.

Commodity programs have been criticized for discouraging soil conservation by providing incentives for farming highly erodible land that might otherwise have been retired to a conservation use (Batie; Block; Krauss and Allmaras; Ogg and Zellner; General Accounting Office). Commodity programs encouraged farming highly erodible land to maintain a larger acreage base and to provide a source of acreage to idle in acreage reduction programs at a low opportunity cost. Concern about soil conservation disincentives from commodity programs was heightened when it was discovered that almost half the sheet and rill erosion on U.S. cropland originates on about 10% to 12% of all cropland (U.S. Department of Agriculture—USDA).

The impacts of commodity and conservation policy instruments on the profitability and riskiness of retiring highly erodible land in the eastern Washington Palouse were examined in 1985 by Hoag. Results of that study are summarized here. Though not a substitute for national analysis, the Palouse case study presented here provides an appraisal of the possible farm-level impacts of alternative commodity and conservation programs.

Modeling Farm Profits and Risk

This study compares profits and risk of a conventional farm with no land retirement with those of a conservation farm that retires highly erodible land to a conservation use. These comparisons were made by simulating crop yields, soil loss, and farm income under historical weather and economic conditions and alternative policy assumptions for the period 1974–84.

Representative Palouse Farms

The dryland grains region of the Palouse is divided into three subregions within Whitman County, Washington. Whitman County contains the majority of Palouse river basin cropland (Hoag). Subregional analysis provides information about policy impacts under a variety of farming environments. Subregions are distinguished by average annual rainfall, which

Dana Hoag is an assistant professor in the Department of Economics and Business at North Carolina State University and Douglas Young is a professor in the Department of Agricultural Economics at Washington State University.

North Carolina Agr. Res. Service Journal Paper Series No. 10528.

reflects their relative productivity. The low-yielding subregion (LYS) averages 11–15 inches of precipitation annually, the intermediate-yielding subregion (IYS), 15–18 inches, and the high-yielding subregion (HYS), 18–22 inches.

Each Palouse subregion is represented by an average size farm of 1,000 to 2,000 acres containing typical regional soil types, topography, and crop rotations. Representative farms contain a composite of soil types in the same proportion as they occur within the respective subregions.

Whole-farm budgets were developed for each subregion with typical rotations—winter wheat-summer fallow in the LYS, winter wheat-spring barley-summer fallow in the IYS and winter wheat-dry peas in the HYS. Variable costs were assumed constant over all acres and were replaced on retired acreage by establishment and maintenance costs for a vegetative cover. Fixed costs, except for depreciation, were assumed constant when land was retired. To account for reduced equipment use, depreciation fell by half the proportion of land retired.

Estimating Historical Yields

Measuring profits and risk required estimation of land-class-related crop yields that varied over time with the same mean and variance as actual Palouse yields. Wheat, barley, and pea yield models, estimated by nonlinear least squares, were used to predict land-class-specific annual yields using a weather stress index and site characteristics as independent variables (Hoag). Yield estimates were disaggregated by land classes to determine the opportunity costs of retiring or diverting particular parts of the farm acreage. Data did not allow modeling changes in production practices in response to erosion or commodity programs.

The following general Spillman yield response functional form, with additional intercept and slope-shifting variables as explained below, was fit to sample data collected by the Soil Conservation Service on mapping units in each subregion between 1966 and 1983:

$$(1) \qquad Y = (a + b(1 - c^{D}))\exp(dT),$$

where a, b, c, and d are parameters to be estimated; Y is the yield/acre; D is topsoil depth in inches; and T, a proxy for technical progress, is the number of years from the base year. This functional relationship has been used extensively and evaluated for Palouse winter wheat and dry pea yields (Pawson et al.; Young, Taylor, and Papendick).

Slope- and intercept-shifting dummy variables were incorporated into equation (1) to improve the accuracy of yield predictions and to provide a framework to estimate effects of discretionary removal from production of certain land classes. Binary (0, 1) dummy variables tested included soil series (*SS*); land capability classes (*CLS*) 3, 4, and 6, and northern slope exposure (*NS*). The specification also included an annual crop weather stress index (*WI*), which ranged between 0 (most stressful) and 1 (no stress).

Incorporating the land and weather characteristics into the crop-response functions improved their explanatory power as measured by adjusted R^2 by five to forty percentage points. Dummy variables were retained if their t-statistics were significant at the 10% level. A few key land characteristic variables were retained regardless of statistical significance because of their theoretical importance. The final models, fit to each subregion and crop, are presented in table 1.

The ability of crop-response functions to predict yields is indicated by comparing model predictions against actual county yields. Hoag compared average annual Whitman County yields, as reported by the Washington Agricultural Statistics Reporting Service, to estimated response function predictions aggregated into a county average. County yields do not exactly portray average annual farm-level yields, but they do serve as a useful measure of annual weather influences. The equations were found to portray satisfactorily the mean and variance of county yields as well as directional changes due to weather (Hoag).

Commodity and Conservation Programs

We examine commodity program impacts on land retirement under three policy scenarios. Each scenario is simulated for the three subregions under actual weather, output price, and production cost conditions prevailing from 1974 to 1984. For each year of each simulation, net returns and soil loss are computed and compared for a conservation farm that retires erodible land and a conventional farm that does not. Two levels of erodible land retirement are considered on the conservation

Table 1. Spillman Function Crop Yield Models for Palouse Subregions

Low-yielding Subregion

$$Yw = [\underset{(6.56)}{42.08} + \underset{(1.34)}{64.26}(Chard) - \underset{(2.20)}{29.63}(Walvan) - \underset{(3.11)}{17.87}(CL3) + \underset{(.92)}{7.15}(CL4) - \underset{(2.94)}{52.71}(NS)]WI$$

$$+ [\underset{(5.08)}{64.73} - \underset{(1.11)}{64.30}(Chard)][1 - \underset{(46.95)}{.939^D}] \quad R^2 = .38 \quad \text{obs.} = 198$$

Intermediate-yielding Subregion

$$Yw = [\underset{(5.55)}{87.43} + \underset{(2.22)}{29.60}(Palouse) - \underset{(3.55)}{45.83}(CL3) - \underset{(4.91)}{65.74}(CL4) - \underset{(5.15)}{71.92}(CL6) + \underset{(1.54)}{3.27}(T)]WI$$

$$+ [\underset{(2.08)}{76.01} - \underset{(.91)}{20.98}(Palouse)][1 - \underset{(25.00)}{.950^D}] \quad R^2 = .54 \quad \text{obs.} = 122$$

$$Yb = [\underset{(3.47)}{2{,}935} - \underset{(2.45)}{2{,}182}(CL6) + \underset{(2.70)}{180}(T)]WI + \underset{(1.57)}{1{,}382}(1 - \underset{(3.90)}{.869^D})WI \quad R^2 = .44 \quad \text{obs.} = 57$$

High-yielding Subregion

$$Yw = \{[\underset{(9.52)}{63.40} + \underset{(1.53)}{20.98}(Palouse) + \underset{(2.90)}{19.34}(CL3) - \underset{(1.66)}{21.29}(CL6)]WI + (\underset{(1.31)}{60.71} + \underset{(.79)}{41.44}(Palouse)$$

$$+ \underset{(1.62)}{71.44}(Thatuna))(1 - \underset{(44.20)}{.972^D})WI\}\exp(-\underset{(1.49)}{.01}(T)) \quad R^2 = .48 \quad \text{obs.} = 212$$

$$Yp = [\underset{(1.31)}{1{,}379} - \underset{(1.44)}{761}(CL3)]WI + \underset{(3.18)}{2{,}104}(1 - \underset{(5.80)}{.835^D})WI \quad R^2 = .37 \quad \text{obs.} = 33$$

Notes: *Yw, Yb,* and *Yp* are wheat yield (bu/ac), spring barley yield (bu/ac) and dry pea yield (cwt/ac), respectively. Parentheses denote asymptotic *t*-statistics. All previously undefined variables are soil series, i.e., Palouse, Chard, Walvan, etc.

farm, all capability class 4 and 6 land and class 6 land only.

A limitation of this regional simulation approach is that it assumes, since output prices are not endogenous, that the operations of the alternative conservation-commodity policies examined would not have altered output prices markedly. However, supply shocks from land retirement likely would be limited. Erodible land is only a small portion of all cropland (about 10%), typically has less than average yields, and its participation in retirement programs is unlikely to be universal.

In the base-run scenario, it was assumed that neither conservation nor conventional farmers participated in any commodity or conservation programs. In the historical scenario, conventional and conservation farmers were assumed to have committed 100% of barley and wheat program crop acreage to all historical ASCS direct income support programs: cropland diversion for deficiency payments, paid acreage diversion, and payment-in-kind (PIK). The conservation farmer also received 75% cost sharing for establishing permanent vegetative cover on qualifying erodible land in conformity with prevailing ASCS cost-sharing provisions.

The third scenario is based on H.R. 3457, 98th Congress, *The Soil Conservation Act of 1983* (SCA). This bill combined three major conservation proposals: (*a*) cropland base acreage protection (CBP) which allows farmers to retire qualified highly erodible acreage without reducing commodity program base acreage, (*b*) conservation reserve, which provides supplementary rental payments (subsidies) to farmers for retiring highly erodible land, and (*c*) a "sodbuster" provision, which penalizes farmers who bring new highly erodible land into production by excluding them from all federal agricultural income support programs. Although H.R. 3457 was never passed, versions of everything but CBP were included in the 1985 farm bill as explained below.

A USDA two-year pilot program in 1984 offered cropland base acreage protection as described in the SCA bill and increased erodible land retirement cost sharing from 75% to 90% for farmers committing erodible land to permanent vegetative cover for at least five years. Our SCA scenario follows the 1984 pilot program and includes the 90% cost-sharing and cropland base protection. Rental payments are ignored in the first stage of the SCA scenario to examine the ability of cropland base protection and 90% cost sharing to reverse previous commodity program land retirement disincentives. Break-even rental payments are calculated in a second stage of the scenario to

Table 2. Summary of Conservation and Commodity Program Scenarios

Base Run	Historical prices and weather with no government conservation or commodity programs.
Historical run without SCA	Base run with one hundred percent participation in actual commodity and conservation programs from 1974 through 1984.
Historical run with SCA	Historical run with allowances for SCA provisions: • CBP—retire land and not reduce base. • CR—rental payments for retirement. • SB—exclusion from commodity programs for farmers "sodbusting" grassland. • CS—90 percent cost-sharing for land retirement.

evaluate their cost effectiveness with and without CBP.

The program scenarios are summarized in table 2 for added ease in recalling their content throughout this paper.

The SCA and New Farm Bill

The programs that passed in the 1985 farm bill are similar to those of the SCA. The conservation reserve is similar, except a 50% cost-share rate was chosen instead of 90. Sodbuster remained the same, and a similar program called swampbuster was added. Swampbuster disqualifies farmers who convert wetland into cropland from various government program benefits.

The major difference between the farm bill conservation reserve and the SCA reserve is in the treatment of commodity program base acreage. Signing up for the actual conservation reserve will reduce a farmer's aggregate base for the contract life by the same proportion as acreage retired. After 1990, the conservation reserve program will have ended and a new program called conservation compliance will apply. The conservation compliance program will disqualify whole farms from eligibility in various government programs, including commodity programs, if any highly erodible land is cultivated without an approved conservation plan. Consequently, the conservation reserve enacted under the 1985 farm bill provides somewhat weaker incentives for retirement through 1990 than would have been the case under the proposed SCA of 1983. However, retirement incentives will be strengthened as the 1990 deadline of the conservation compliance program approaches. Nonetheless, during the pre-1990 period when there are financial entry penalties in the form of lost base, the reserve break-even rental rates must be adjusted upward to compensate for these losses.

Farm Risk and Returns

Returns are defined as net returns to labor and management. Partial budgeting with only variable costs—and some fixed costs that change slightly—would have been sufficient for comparing returns between the conventional and conservation farm. However, we include all costs except operator's labor and management so that estimates of the probability of labor and management returns falling below zero over the simulation period could be reported as one measure of risk.

A second measure of risk used is the variance (or standard deviation) of farm returns. Decision makers' risk preferences are not modeled, but chance of loss and variance of profit provide useful information about the riskiness of the different policy scenarios. Risk is expected to be reduced with the introduction of income-stabilizing commodity programs. As a third component of risk analysis, actions were ranked using first- or second-degree stochastic dominance.

Results

Results are presented in sequence beginning with the first scenario of no programs and concluding with the historical programs complemented with SCA incentives. This organization permits evaluating conservation incentives without government programs, determining how those incentives change with the introduction of historical commodity and conservation programs, and assessing the potential of policies from the Soil Conservation Act to reverse historical commodity program disincentives to erodible land retirement.

Base-Run Results

The results of each scenario in each Palouse subregion over 1974–84 are summarized in table 3. Net returns are computed on a farm-wide basis and include amortized costs of establishment and maintenance of permanent vegetative cover on retired land net of cost sharing when appropriate and costs for idling land in compliance with commodity programs as appropriate.

Since there are costs inherent in retiring land, break-even land retirement occurs at the point where gross returns on erodible land fall short of variable costs by an amount equal to annual maintenance costs, amortized net establishment costs, and any annual fixed cost savings from retirement. The latter saving usually is quite small for Palouse farms because retirement generally would not permit reducing machinery investment. Also, it often is not possible to sell erodible land separately because it is scattered throughout each field in discontiguous small parcels on upper slopes and hilltops.

The base-run 1974–84 average return results in table 3 show that without commodity and conservation programs, farming erodible land has been more profitable (or less unprofitable) than retiring it in every subregion. The conventional farm that did not retire any land averaged higher returns than the conservation farm with class 6 retirement (C6) or with class 4 and 6 retirement (C46). Unreported year-by-year results revealed class 6 retirement was more profitable than conventional farming in 1977 and 1984 in the LYS, in 1977, 1981, 1982, and 1984 in the IYS, but never more profitable in the HYS (Hoag). In all other years farming erodible land was more profitable than retiring it because yields were not sufficiently low to push returns below break-even levels. Class 4 plus 6 retirement was never more profitable than conventional farming. These results, of course, indicate the likely need for government "rental payments" to motivate profitable retirement of erodible land in the Palouse.

Table 3 also shows that without commodity or conservation programs (the base run), the standard deviation of net returns always fell when switching from a conventional farm to land retirement of class 6 or 4 and 6. However, the probability of loss increased for the farm retiring all class 4 and 6 land in all the subregions because of the substantial decline in average net returns.

Without knowing the exact risk preferences of individual farmers, it is difficult to rank the riskiness of one action over another. Sometimes, however, actions can be ranked using

Table 3. Conventional and Conservation Farm Average Net Returns and Risk for Alternative Commodity and Conservation Policy Scenarios in the Palouse, 1974–84

			Average Net Returns and Risk by Precipitation Subregion and Policy Scenario[a]								
			Low-Yielding Subregion (2,000 ac farm)			Intermediate-Yielding Subregion (1,000 ac farm)			High-Yielding Subregion (1,100 ac farm)		
Return or Risk	Farm	Land Classes Retired	Base Run	Historical w/o SCA	Historical w/SCA	Base Run	Historical w/o SCA	Historical w/SCA	Base Run	Historical w/o SCA	Historical w/SCA
Average net returns	Conv.	none	−3,147	−2,459	−2,459	4,515	5,714	5,714	27,064	30,964	30,964
($/farm)	Cons.	6	−4,054	−7,057	−1,826	3,971	4,224	9,570	24,757	28,618	30,018
	Cons.	4 + 6	−12,571	−13,724	−4,801	−5,151	−4,411	3,989	13,143	15,992	23,569
Standard deviation	Conv.	none	33,596	34,396	34,396	27,927	26,679	26,679	44,488	41,260	41,260
of net returns	Cons.	6	32,690	36,690	32,816	26,435	26,179	23,084	43,364	40,287	39,820
($/farm)	Cons.	4 + 6	31,655	34,583	28,783	24,422	24,600	20,394	38,731	36,830	33,977
Probability of loss	Conv.	none	7/11	6/11	6/11	5/11	5/11	5/11	3/11	2/11	2/11
(years out of 11)	Cons.	6	7/11	6/11	6/11	5/11	5/11	3/11	3/11	2/11	2/11
	Cons.	4 + 6	8/11	8/11	7/11	7/11	6/11	4/11	4/11	3/11	2/11

[a] The base run simulates returns with historical weather, costs, and prices, but no commodity programs. The historical run w/o SCA adds historical commodity programs, and the historical run w/SCA further adds SCA conservation programs.

Table 4. Stochastic Dominance Results

		(Dominating/Dominated) Action or Program[a]				
		Conventional/Conservation			Historical Program/	SCA Program/ Historical
Region	Farm	Base Run	Historical	SCA	Base Run	Program
Low	CV				ND	NE
	C6	ND	FSD	ND	ND	FSD
	C46	FSD	FSD	ND	ND	FSD
Intermediate	CV				SSD	NE
	C6	ND	SSD	ND	ND	FSD
	C46	FSD	FSD	ND	SSD	FSD
High	CV				SSD	NE
	C6	FSD	FSD	ND	SSD	FSD
	C46	FSD	FSD	ND	SSD	FSD

[a] FSD and SSD denote that the appropriate action or event is dominated by the first- or second-degree stochastic dominance criterion, respectively, and ND signifies that the action or event is not dominated. NE denotes "no effect" from SCA.

stochastic efficiency based on elementary assumptions. For example, with only the assumption of positive marginal utility of net returns, an expected utility maximizer would always choose one action over another if it dominated by the first-degree stochastic dominance (FSD) criterion (Anderson, Dillon, and Hardaker). Actions not dominated using FSD may be dominated using second-degree stochastic dominance (SSD). This principle adds the assumption that decision makers are risk averse and therefore is more limiting than FSD. Often actions cannot be ranked with FSD or SSD and additional information is required about individual risk preferences.

The stochastic efficiency of conventional farming compared to conservation farming under alternative policy scenarios—with the assumption of equal probability of annual observed returns (Anderson, Dillon, and Hardaker, p. 42)—is given in table 4. In the base run, the conventional farm dominated retiring all class 4 and 6 acreage by FSD in all subregions. This indicates the conventional farm is preferred by all decision makers with positive marginal utilities for income regardless of risk preference. The conservation farm retiring class 6 land was FSD dominated by the conventional farm only in the HYS for the base run. The remaining stochastic dominance results in table 4 are reported below under subsequent scenarios.

Historical Programs without SCA

Table 3 also presents results of the simulation with historical commodity programs and historical 75% cost shares for erodible land retirement. As expected, in most cases net returns increased with 100% participation in commodity programs. However, unreported annual results revealed that in years with no commodity program payments, 1974 for example, the addition of programs increased conservation farm returns only slightly. This slight increase was due only to the 75% cost sharing for retiring erodible land. For the LYS conservation farm, commodity programs failed to increase net returns because the retired erodible class 4 acreage was relatively productive and did not represent a "cheap" source for set-aside.

Calculated break-even rental payments (incentives) to conservation farmers who retire erodible land are presented in table 5. Break-even rents are the amount required to equate the profitability of conservation and conventional farming. Readers are cautioned that because of changes in costs, prices, and government programs over the past decade, the 1974–84 average break-even bids in table 4 generally are lower than similar bids calculated for 1986.

Results in table 5 show that the introduction of historical commodity programs increased break-even rental payments for conservation farmers. Losses from conservation farming, represented by a positive break-even rent, increased more than fivefold on the C6 farm and by 20% on the C46 farm in the LYS. Introducing historical commodity programs brought similar percentage increases in the IYS and lower percentage levels in the HYS, but HYS changes were similar on an absolute basis. Historical programs increased retirement disin-

Table 5. Break-even Rental Payments for Palouse Land Retirement

Yield Subregion	Farm Size (ac)	Land Classes Retired	Break-even Rental Payments by Scenario: Base Run	Historical w/o SCA	Historical w/SCA
			($/retired acre)		
Low	2,000	6	5.67	28.74	(3.96)[a]
(11–15)		4 + 6	29.45	35.20	7.32
Intermediate	1,000	6	4.19	11.46	(29.66)[a]
(15–18)		4 + 6	34.52	36.16	6.16
High	1,100	6	52.43	53.32	21.50
(18–23)		4 + 6	63.28	68.05	33.61

[a] Conservation farm had higher returns than the conventional farm.

centives sufficiently to make the conventional farm FSD dominant over the C6 and C46 farms for all subregions except the intermediate, where C6 was SSD-dominated (table 4).

Historical commodity programs increased break-even rents because they increased the profitability of farming erodible land over the 1974–84 period. Conventional farmers could maintain a higher base and a cheaper source of set-aside. The results substantiate the claim that historical commodity programs administered by ASCS worked at cross purposes with the agency's conservation programs (Block).

Commodity programs are expected to reduce risk because income stabilization is a goal of the Agricultural Stabilization and Conservation Service. The 1974–84 commodity programs did indeed increase income stability in the IYS and HYS for the conventional farm as indicated by lower standard deviations. However, the standard deviation was not decreased in the LYS, primarily because of the sunk costs in summer fallow in PIK years, which magnified losses from participation. Participation in farm programs also generally reduced the chance of experiencing a loss in any given year. The chance of loss fell from 7/11 to 6/11 in the IYS and from 4/11 to 3/11 in the HYS for the C46 farm.

Considering both risk measures indicates that commodity programs decrease risk slightly, but do so less or even increase risk for the conservation farm. In the IYS and HYS, risk-averse farmers would choose the historical programs, except the C6 farm in the IYS, by the SSD principle (table 4). Risk increased for conservation farmers in the LYS because participation in commodity programs lowered net returns and increased the chance of a net loss. Historical programs without SCA did not dominate the base run by FSD or SSD in the LYS.

Historical Programs with SCA

The proposed Soil Conservation Act of 1983, which included cropland base protection (CBP) provisions, has no effect on net returns of the conventional farm because no acres are retired. In contrast, the conservation farm's profits increased sharply with CBP, which permitted some or all of its retired erodible acres to be counted as commodity program diversion. It no longer had to divert some of its relatively productive cultivated land to comply with set-aside programs. As shown in table 5, break-even rents decreased for all subregions. Year-by-year results revealed there was not a single year during 1974–84 in which SCA incentives failed to provide higher net returns than historical programs for the conservation farm. However, in years with zero diversion payments, the conservation farm's income rose by only a small amount attributable to increased cost sharing.

Because the Soil Conservation Act would have increased the conservation farm's net returns while not changing those of the conventional farm, the legislation would have strengthened the relative profitability of conservation farming in the Palouse. If the SCA reduces necessary break-even rental payments by as much as they were increased by the historical commodity programs, the incentives of the Soil Conservation Act are successful at offsetting commodity program disincentives to retire land. If the gap between conventional and conservation farm returns is closed by

Table 6. Cost-Effectiveness Ratios for Erodible Land Retirement in Palouse Subregions

Subregion	Land Classes Retired	Cost Effectiveness ($/ton of soil saved) With CBP Programs[a]	Without CBP Program
Low	6	.47	1.29
	4 + 6	.90	1.87
Intermediate	6	.48	.56
	4 + 6	.76	1.56
High	6	1.30	1.93
	4 + 6	1.99	2.82

Source: Hoag and Young.
[a] CBP is cropland base protection for retired cropland as incorporated in Soil Conservation Act of 1983.

more than the historical programs increase it, the SCA provides additional incentives for land retirement.

In all cases benefits from the Soil Conservation Act decreased the conservation farm's disadvantage by more than commodity programs had increased it (see table 5). In the LYS and IYS where the C6 farm's break-even rents with SCA are negative, the SCA benefits were sufficient to completely reverse commodity and production retirement disincentives.

In most cases, however, results show that even with the SCA, without rental payments, it generally is not profitable to retire erodible land in the Palouse. The preexisting production disincentives to land retirement in the Palouse are strong because of relatively high yields on erodible land and the significant costs of retiring land to a vegetative cover. Only for the very low-yielding class 6 land in the low- and intermediate-yielding subregions was the SCA sufficient to make land retirement profitable.

The conventional farm's risk is not changed by the SCA because its net returns are unaffected. However, the SCA decreased the risk, defined as standard deviation of net returns and the probability of net returns falling below zero, of both types of conservation farms in all regions. The standard deviation fell by 20%, 19%, and 8%, respectively, in the LYS, IYS, and HYS. The SCA decreased the probability of loss from 5/11 to 3/11 and 6/11 to 4/11 on the C6 and C46 farms in the IYS and from 3/11 to 2/11 on the C46 farm in the HYS. Based on these measures, we conclude the SCA could reduce the risk as well as increase the profitability of erodible land retirement in the Palouse. Also, in all cases the SCA program dominated, in FSD, the historical program, showing that the SCA is preferred by all decision makers who prefer more income to less (table 4).

The discussion above examines the SCA strictly with respect to its impact on private incentives for erodible land retirement. Hoag and Young also have examined the program's cost effectiveness with respect to public expenditures. Table 6 reports the estimated cost per ton of soil saved in each of the Palouse subregions with and without SCA cropland base protection provisions. Public costs include any required break-even rental payments, additional commodity program payments (assuming 1974–84 programs), and 90% cost sharing for perennial grass establishment. CBP saves taxpayers an estimated $.08 to $.97 per ton of soil erosion reduced, depending on the subregion and level of land retirement. These results indicate that for the Palouse, under 1974–84 commodity programs, break-even rental payments are cut sufficiently by CBP to offset larger commodity program payments.

General Appraisal of SCA

Results of analysis in other regions may differ substantially from those for the Palouse. A national analysis would be required to ascertain whether SCA would be sufficient to achieve desired retirement levels in other regions. The general condition to be met in any single year for land retirement to be profitable without commodity programs is

$$(2)\quad RFC + FRC > A(HE)\cdot(NR^{CV} - (1 - AR/HE)NR^{CS}) + AR(A)(EC - CS + MC),$$

where RFC is reduced fixed costs from retirement, such as less depreciation from reduced equipment use, FRC is the present value of future returns to conservation in the form of higher yields when retired land is put back into production, A is total farm acreage, HE is the fraction of highly erodible land on the farm, NR^{CV} and NR^{CS} are the net returns above variable costs on the highly erodible land on the CV (conventional) and CS (conservation) farm, *AR* is the fraction of the farm retired and *EC, CS,* and *MC* are the annualized establishment costs, cost-sharing, and maintenance costs of grass on retired land.

The left-hand side of condition (2) represents the two economic benefits of land retirement. As discussed previously, these values are trivial in the Palouse. The right-hand side gives the costs of land retirement, production losses, and cover costs that must be compensated for to have profitable conversion from crop production to a permanent vegetative cover. If condition (2) is not met (and it is not in the Palouse), commodity program retirement disincentives only add to preexisting disincentives by increasing the right-hand side of (2). SCA provisions may help but may not be sufficient without additional incentives such as conservation reserve rental payments. If condition (2) is met in a region, SCA will certainly reverse financial retirement disincentives of commodity programs and probably could lead to more land retirement.

Although the Soil Conservation Act would require rental payments to create positive profit incentives for land retirement in the Palouse, it is useful to examine why the SCA provisions (excluding rental payments) strengthen incentives to retire erodible land. There are four reasons the SCA strengthens the relative profitability of the conservation farm when there are acreage reduction programs. First, production net returns increase because the conservation farmer is able to devote more acres to wheat or barley production. The base acreage on the conservation farm does not decrease under the SCA. The conservation farm may use the retired acreage to fulfill diversion requirements and produce on the unretired higher-quality land, some of which would have been required to be diverted if there were no SCA.

The second reason profitability is increased is that the larger wheat acreage base permitted on the conservation farm by SCA allows larger commodity program support payments. If required percentage diversion for commodity programs is equal to or larger than the percentage of erodible acreage retired under the SCA, the conservation farm is assured a higher deficiency payment than the conventional farm because of its higher average proven yield on cultivated land. The third reason, which is related to the second, is that the conservation farm has lower diversion costs in commodity programs with SCA because it uses already retired acreage to fulfill the diversion requirements. Finally, the SCA improves the net returns of the conservation farm by increasing cost shares for land retirement from 75% to 90%.

Summary and Policy Implications

Retiring highly erodible land can appear to be an inexpensive conservation option because such land often is less productive. In the Palouse, however, retirement without policy incentives was unprofitable even in the lowest-yielding subregion at crop prices and production costs prevailing during the past decade—including price supports and cost-sharing programs that existed during that period. Unsubsidized land retirement also was unattractive from a risk standpoint because lower returns increased chances of profits falling below zero. Stochastic efficiency criteria revealed that income-seeking Palouse farmers would never prefer retiring all class 4 and 6 land without government-created incentives.

Results showed that although historical commodity programs increased returns for all farmers, these programs increased the gap between net returns for conventional and conservation farmers in the Palouse. Commodity programs generally diminished risk as measured both by standard deviation and by chance of loss. Second-degree stochastic dominance showed that the historical programs would be preferred over no programs by risk-averse farmers on every type of farm in the HYS and the conventional and C46 farms in the IYS.

The proposed SCA program changes reduced the profitability gap between conventional and conservation farming more than traditional commodity programs had increased it. The conservation farm became more profitable in the LYS and IYS for class 6 land retirement primarily because of SCA acreage base protection provisions. The SCA also reduced risk on the conservation farm. On all types of farms, the SCA program is preferred by the first-degree stochastic dominance principle to the historical program.

The results of this study indicate that a conservation reserve that pays rental payments for land retirement is needed in at least one region of the country to achieve voluntary retirement of highly erodible land. The rental payment is less when the commodity program incorporates cropland base protection measures. Cropland base protection was not offered in the 1985 farm bill. Our analysis suggests that this omission may have increased the cost of the overall land retirement program by raising rental rates in the conservation reserve more than cropland base protection costs. This assertion is supported by the results of the early bidding levels in the 1986 conservation reserve. Acceptance of bids was low because bids were higher than government bid caps (Steiner).

If programs that increase incentives for land retirement are to have the desired impact on conservation, they should be accompanied by laws that prohibit farmers from plowing erodible, presently uncultivated land to obtain program benefits. The new farm bill includes two such provisions, "sodbuster" and "swampbuster," which deny commodity program benefits to farmers who plow previously uncultivated land or convert wetland to cropland.

Cross-compliance provisions in the 1985 farm bill will deny all farm program benefits to farmers who do not have an acceptable conservation plan for highly erodible land by 1990 and are complying with it by 1995. Land retirement represents a potentially cost-effective component for such plans in many regions. As USDA more fully interprets the cross-compliance requirements and farmers become more aware of them, incentives for erodible land retirement will be substantially strengthened. In essence, cross compliance substitutes penalties for the SCA cropland base protection rewards examined in this study.

[*Received October 1985; final revision received August 1986.*]

References

Anderson, J., J. Dillon, and B. Hardaker. *Agricultural Decision Analysis.* Ames: Iowa State University Press, 1977.

Batie, S. "Policy Institutions and Incentives for Soil Conservation." *Soil Conservation Policies, Institutions and Incentives,* eds., H. G. Halcrow, E. O. Heady, and M. L. Cotner, pp. 25–40. Ankeny IA: Soil Conservation Society of America, 1977.

Block, J. "Remarks prepared for delivery by Secretary of Agriculture John R. Block at unveiling of 1983 Yearbook." Typescript, U.S. Department of Agriculture, Washington DC, 1983.

General Accounting Office. *Agriculture's Soil Conservation Programs Miss Full Potential in the Fight Against Soil Erosion.* Report to the Congress of the United States.Washington DC, 28 Nov. 1983.

Hoag, Dana L. "An Evaluation of USDA Commodity Program Incentives for Erodible Land Retirement." Ph.D. thesis, Washington State University, 1984.

Hoag, D., and D. Young. "Toward Effective Land Retirement Legislation." *J. Soil and Water Conserv.* 40(1985):462–65.

Krauss, H., and R. Allmaras. "Technology Masks the Effects of Soil Erosion on Wheat Yields—A Case Study in Whitman County, Washington." *Determinants of Soil Loss Tolerance,* eds., E. L. Schmidt et al. Madison WI: Soil Conservation Society of America, 1982.

Ogg, C., and J. Zellner. "A Conservation Reserve: Conserving Soil and Dollars." *J. Soil and Water Conserv.* 39(1984):92–94.

Pawson, W., O. Brough, J. Swanson, and G. Horner. *Economics of Cropping Systems and Soil Conservation in the Palouse.* Washington State University, Oregon State University, University of Idaho Agr. Exp. Sta. Bull. No. 2, 1961.

Steiner, F. R. "The New Federal Conservation Initiatives: Reactions from the Palouse." *J. Soil and Water Conserv.,* 41(1986):171.

U.S. Department of Agriculture, Soil Conservation Service. *Summary Statistics, 1982 National Resources Inventory.* Washington DC, 1982.

Young, D. L., D. B. Taylor, and R. F. Papendick. "Separating Erosion and Technology Impacts on Winter Wheat Yields in the Palouse: A Statistical Approach." *Erosion and Soil Productivity,* Am. Soc. Agric. Eng., St. Joseph, Michigan, 1985.