Chapter 3
Economic and Environmental Impacts of WLPPs

Recent implementation of working-land payment programs and new flexibility in their design raise many questions. To what degree can EQIP or CSP improve producers' environmental performance? What are the tradeoffs between improving the environment and supporting farm incomes? How might changes in these programs, such as budget levels or enrollment options, affect their outcomes? Very little data are available to assess the cost-effectiveness of programs such as EQIP or CSP. Instead, simulation models can illustrate the nature of tradeoffs implied by different program design decisions. Given the importance of these questions and the scarcity of data, this chapter uses empirical simulations to examine how alternative designs for working-land payment programs affect returns to agricultural production, consumer welfare, and the environmental performance of working croplands.

Measuring Environmental Performance

The process of cultivating crops generally results in the discharge of pollutants into water and air, which may cause human or ecological damage.[1] Working-land payment programs are designed to reduce the discharge of pollutants by encouraging use of "better" management techniques, such as conservation tillage and reduced fertilizer applications. Cost-effective WLPP design requires a measure of how these better practices affect the environment. Estimating one environmental impact is difficult by itself, but when the desire is to address multiple environmental criteria, administering program payments cost effectively becomes even more complicated. To measure overall changes to the environment resulting from WLPPs, we use an Aggregate Environmental Index (AEI). This index is similar to the Environmental Benefits Index used by USDA to assess CRP contracts.

To construct the AEI, we link crop management practices and regional topography to estimate a cropping system's impact on the resource concerns deemed most harmful to regional ecosystems. We denote the cropping systems with a subscript "i," resource concern with a subscript "j," and region with a subscript "k." This impact factor is denoted I_{kji}. We consider nine resource concerns: nitrogen discharged to surface waters, nitrogen leached into ground water, phosphorus discharged into surface waters, pesticides discharged into surface waters, pesticides leached into ground water, sediment eroded into surface waters, soil eroded via the wind into the atmosphere, carbon emitted into the atmosphere, and loss in long-term soil productivity.[2] The individual impact factors are used to generate an Aggregate Environmental Index score, AEI_{ki}, reflecting the impact of that system on the environment as a whole: $AEI_{ki} = f(I_{kji})$. Several formats have been used in the past to construct such measures of environmental quality. This report uses a weighted sum of the individual environmental indicators:

[1] Although pasture and rangeland are also eligible for enrollment in existing WLPPs, we focus our analysis on cultivated cropland.

[2] See Appendix B (www.ers.usda.gov/publications/err5) for more details.

$AEI_{ki} = \sum_j w_{kj} I_{kji}$, where w_{kj} are regional weights for the different resource concerns. Ideally, the weights chosen would reflect socio-economic preferences for mitigating the various pollutants (Heimlich, 1994). We construct several different weighting schemes (see box, “Weighting Multiple Environmental Criteria”), but for most of our analysis we use weights based on how EQIP contracts have valued different resource concerns in different regions.

Constructing Alternative WLPP Designs

We start with six hypothetical working-land payment programs (table 3.1). Each program contains one or more of the design features discussed in earlier chapters—whether previous conservation efforts are rewarded in or required for participation, whether incentives are based on practices or on performance, and whether farmers are screened according to the relative benefits and costs of their WLPP contract.

To compare alternative designs, we hold several program features constant. Each program design is simulated subject to a fixed budget. However, we

Weighting Multiple Environmental Criteria

Developing weights that reflect society's preference for different environmental benefits is difficult. Many studies ask respondents how much they are willing to pay for a reduction in their exposure to certain chemicals, such as nitrates in drinking water supplies (Crutchfield et al., 1997). Others determine how valuable variable recreation opportunities are to the public (e.g., Feather et al., 1999) or how asset values are affected by variable environmental quality (e.g., Kim et al., 2003).

However, in the absence of national or local surveys that can be applied across multiple environmental criteria, we use data about how policymakers have valued past efforts at addressing multiple environmental criteria. How public preferences translate into policymaker expenditures and mandates is well documented (Variyam and Jordan, 2001; Besley and Burgess, 2002; Dixit et al., 1997; Crémer and Palfrey, 2002). Looking explicitly at conservation programs Bastos and Lichtenberg (2001) noted that incentive payments are linked to public preferences for environmental quality. Moreover, while the link between policy expenditures for working-land payment programs, environmental standards, and public preferences may not be completely transparent, Reichelderfer and Boggess (1998) noted that policymakers could learn and improve the cost-effectiveness of conservation program controls.

Therefore, we use stated weights taken from the Conservation Reserve Program's Environmental Benefits Index and expenditure data from EQIP contracts to essentially “reveal the preference” of policymakers in reducing one pollutant vis-à-vis another. This method is appropriate for two reasons. First, it shows how multiple environmental criteria are valued under voluntary conservation programs. Second, CRP and EQIP do not weight actual physical measures of pollutant abatement, but weight management practices more or less depending upon how they are expected to result in environmental benefits, which is how we have constructed the Aggregate Environmental Index. See Web Appendix B (www.ers.usda.gov/publications/err5) for more details.

Table 3.1—Alternative program designs			
	WLPP policy options		
Policies	Budget constraint	Stewardship payments	Performance screen
Practice-Based			
(1) Good-Act (ongoing and new practice adoption)	Regional	X	
(2) Practice (new practice adoption)	Regional		
Performance-Based			
(3) Performance (new performance standard)	National		
(4) Hurdle-Low (ongoing performance above low reference level)	National	X	
(5) Hurdle-High (ongoing performance above high reference level)	National	X	
(6) Bid (new performance standard)	National		X

run multiple simulations for each program at different budget levels in order to map aggregate payments to environmental performance. All cropland currently under production is assumed eligible for program participation, and this acreage is kept constant throughout our modeling horizon. Since this report examines working-land payment programs, we do not examine program payments for enhanced environmental performance on land retired from production. Also, CSP limits eligible cropland to land that had been cropped prior to enrollment. Our model does not incorporate pasture or rangeland, although we recognize that these lands can be enrolled in either EQIP or CSP.[3]

Practice-Based Policies. Practice-based payments are fixed-rate incentive payments to producers who implement eligible conservation practices. Producers who can implement such practices at least cost are likely to benefit most from these incentives, regardless of the amount of environmental benefits achieved. Payments for practices deemed environmentally beneficial are modeled under *Good-Act* (a program that rewards ongoing and new conservation efforts) and *Practice* (a program that rewards only new conservation efforts). Here, we model those management practices that are intended to reduce soil erosion and improve water quality. They include cropping systems that employ conservation tillage, nutrient management, and conservation rotations. Given a range of potential regional payments for these management practices, the practice-based programs are simulated under various regional budgets.[4]

Under the hypothetical *Good-Act* program, eligibility for program payments does not discriminate between past or new conservation. Eligibility is constrained to apply to only those cropland acres that have been in active production. Therefore, eligible stewards who essentially have a zero WTA for their practices will be the first to accept program payments, limited by a regional budget. Once all eligible old practices have received program payments, new eligible practices are considered for participation.

[3]See Web Appendix A *www.ers.usda.gov/publications/err5/* for additional details of policy simulations.

[4]These practices represent approximately 90 percent of the nonlivestock, nonstructural EQIP contracts between 1997 and 2000 (FSA-EQIP database). Because the practice-based programs are less flexible than are the performance-based programs (fewer ways for producers to earn program payments), a regional budget restriction is imposed on the distribution of payments to producers similar to the distributional allocations of the EQIP budget. This ensures program participation will occur across all regions, even at relatively low program budgets. We do not use regional budget constraints for the performance-based simulations. There, producers can receive payments for any improvement in environmental performance regardless of the practice adopted, so participation is less likely to favor one region over another. See Web Appendix A *www.ers.usda.gov/publications/err5/* for details.

Next, a practice-based program (*Practice*) without stewardship payments is simulated using the same program payments, where eligibility is strictly limited to new adoption of practices. Stricter eligibility is likely to improve environmental cost-effectiveness, but to the extent that the program payments (including stewardship payments) do not completely cover implementation costs, the program will not provide as much income support as *Good-Act*. As before, new production acres are not eligible for payments under this program. These depictions of two different practice-based programs illustrate the tradeoff between providing stewardship payments and providing payments for newly adopted practices.

Performance-Based Policies. Performance-based policies use either performance-based payments or bid-based payments in conjunction with performance-based screens to steer participation toward producers who can deliver environmental gain at low cost. For the performance-based scenarios, payments are based on changes to the environment as measured using the Aggregate Environmental Index; i.e., payments received by participants are modeled as a function of physical effects that will likely affect environmental performance. Under the first performance-based program (*Performance*), the policymaker establishes a fixed price for environmental performance and any producer is eligible for payments based on the degree to which environmental performance increases. There are no stewardship payments attached to these contracts.

The next performance-based program (*Bid*) steers participation toward the same producers as in *Performance*, but at a lower cost using competitive bidding and performance-based screens. In these scenarios, the simulation model mimics a program in which (1) producers submit bids that include both the actions to be undertaken and the level of payment they would accept, and (2) bids are accepted or rejected on the basis of projected environmental benefits (again measured by the AEI) and costs. Here, producers submit bids for financial assistance that are at or near their WTA, minimizing the program expenditure necessary to gain their participation. Those producers who can deliver the most environmental gain per dollar will be selected for participation, up to limits imposed by the program budget.

Another type of performance-based program combines performance-based payments with stewardship payments, but limits eligibility to producers who have already achieved environmental performance above a fixed "reference level" (see Claassen et al., 2001; Johansson et al., 2002). We examine two reference levels. The first reference level (measured using the AEI) is set relatively low (*Hurdle-L*), such that 33 percent of farms (38 percent of current acres) are eligible for program payments even if they do not engage in new conservation efforts. The second reference level (*Hurdle-H*) is set higher, such that only 25 percent of farms, representing 20 percent of current acres, are eligible to receive payments without implementing new conservation practices. Here, the program decisionmaker sets a given price for each AEI point generated above the reference level, and then opens the program for enrollment.

Simulating Producers' Adjustments to Policy. Our model simulates how different agri-environmental program designs can encourage farmers to alter production and management practices, and how these changes may affect production and, as a result, commodity prices. An environmental process model estimates the environmental changes flowing from adjustments to cropping and management practices prompted by program payments. Linking production practices (such as crop rotation, irrigation, tillage, and fertilizer application rate) to an environmental model in this fashion illustrates how different WLPP designs result in different economic and environmental effects across sectors and regions (fig. 3.1).[5] We examine these effects in the medium run (e.g., 5-10 years), meaning that we model changes in price and production levels, but we assume that technology (e.g., types of cropping systems) and the resource base (e.g., the amount of land in crop production) are constant.

[5]For a more detailed description of the modeling, see Web Appendix A *www.ers.usda.gov/publications/err5/*.

You Get What You Pay For

For a given budget, the *Performance* and *Bid* programs achieve much greater improvements in environmental performance than the practice-based programs. Whereas practice-based payments provide fixed payments for eligible practices, performance-based programs link either payment amounts or the likelihood of participation to a practice's efficacy at, say, reducing soil erosion or pesticide leaching. In this manner, practices that most improve environmental performance will receive the highest payment or will be most likely to be enrolled, while those practices that marginally improve environmental performance will receive a lower payment or will be less likely to be enrolled.

Increasing Costs of Environmental Performance. At the national level, as producers improve environmental performance on cropland, it becomes more costly and requires more program payments for each additional unit of performance (fig. 3.2). Program designs do differ in the degree to which increasing environmental performance is associated with progressively higher

Figure 3.1
Simulation methodology

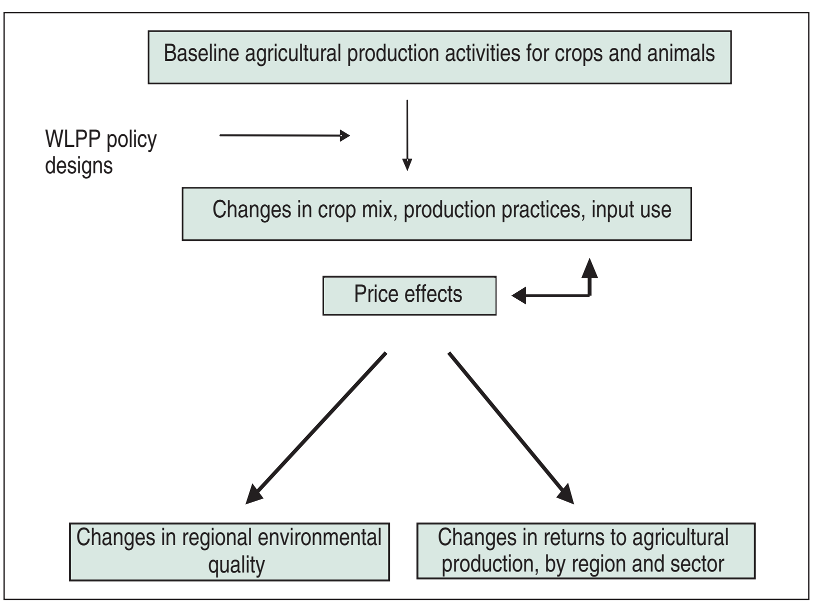
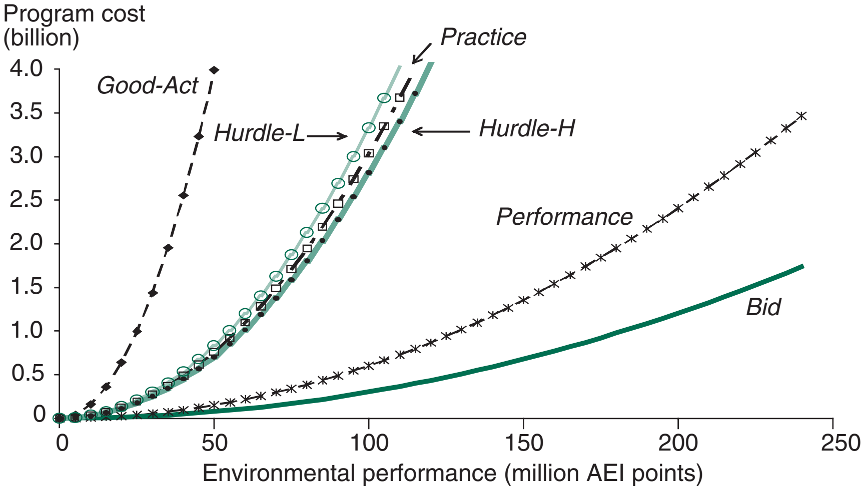


Figure 3.2
Enhancing aggregate environmental performance on working lands



program payments. For example, the more constrained payments are, the less likely they will be sufficient to cover producers' WTA for new practices. However, producers' WTA for old practices is essentially zero, which means the provision of stewardship payments increases the cost of the program per environmental increment if old and new practices compete for payments, especially at lower budget levels. Results show that at the $250-million level, *Practice* (where only new practices are eligible) achieves 12 times the improvements in environmental performance achieved by *Good-Act* (a program that rewards both new and old practices). At the $500-million level, *Practice* is still four times more cost effective than *Good-Act*. This illustrates that, under our depiction of stewardship payments, at lower budget levels a larger proportion of funds is devoted to rewarding past stewardship than is directed toward new conservation efforts. Under other designs, program decisionmakers might fix the percentage of the program budget that is to be set aside for stewardship payments and for new conservation efforts.

Unless stewardship payments are positively correlated with potential for achieving new environmental benefits and negatively correlated with producer WTA for taking the necessary action, they do little to encourage participation among producers who could (in addition to a history of good stewardship) take additional actions to improve environmental quality. As configured in our model and in the Conservation Security Program, stewardship payments are based on land rental rates, which may be unrelated to either environmental benefits or conservation costs.[6] Such payments differ from those of other working-land payment programs, which base payments primarily on practice installation or adoption cost. Because stewardship and existing-practice payments are tied directly to land rental rates, producers have the greatest incentive to participate when land rent is high and the cost of addressing resource concerns is low. Given this incentive structure, a CSP-type program will direct participation incentives toward high-benefit, low-cost producers, land, and practices *only* to the extent that environmental benefits are positively correlated with land rents used to establish the base payment and negatively correlated with conservation costs, which is unlikely (see "Correlating Costs, Benefits, and Rental Rates," p. 15).

[6]See Web Appendix C *www.ers.usda.gov/publications/err5/* for more discussion of correlating costs, benefits, and rental rates.

The performance-based, hurdle programs mimic a good-actor type of program by providing payments for cropping systems already performing above the reference level. The higher the reference level, the less likely producers will receive payments based on what they are already doing. However, the higher the reference level, the fewer ways there are for producers to reach the hurdle. This loss in flexibility will also inflate the cost of the program. Yet, because payments are based on performance, they are more cost-effective than *Good-Act*. They achieve improvements in environmental performance at costs similar to the *Practice* program.

Why Bidding Increases Cost-Effectiveness

By comparison, the performance-based programs, *Performance* and *Bid*, produce more environmental gain per dollar of program expenditure (i.e., flatter supply curves for environmental benefits—fig. 3.2) than the other program designs. Payments for *Performance* are equal to a fixed payment per point multiplied by the amount of environmental benefits generated by the contract, as measured by the AEI. For example, a *Performance* payment of $5 per AEI point would result in a 10-percent increase in environmental performance (or 110 million AEI points) from current levels (fig. 3.3). The annual program payments under *Performance* would be approximately $550 million (areas A+B in fig. 3.3). When producers bid for payments, they can increase the likelihood of being enrolled in the program by submitting a low bid. If program enrollment is competitive, producers have incentive to submit bids that equal their WTA. We take cost as a proxy for WTA, so that aggregate payments in *Bid* are equal to the area under the payment—marginal benefits curve, or the shaded triangle (B) in fig. 3.3, approximately $275 million.

Environmental Cost-Effectiveness. Another way to compare programs is to fix the budget and measure environmental cost-effectiveness (table 3.3). Holding the budget fixed at approximately $1 billion,[7] we see that a performance-based program with bid-down provisions (*Bid*) could improve

[7]This is roughly equal to projected average annual EQIP expenditures between the years 2002-2007 (www.ers.usda.gov/Features/farmbill/titles/titleIIconservation.htm#working, 2003).

Figure 3.3
Payments and program costs—performance-based WLPP

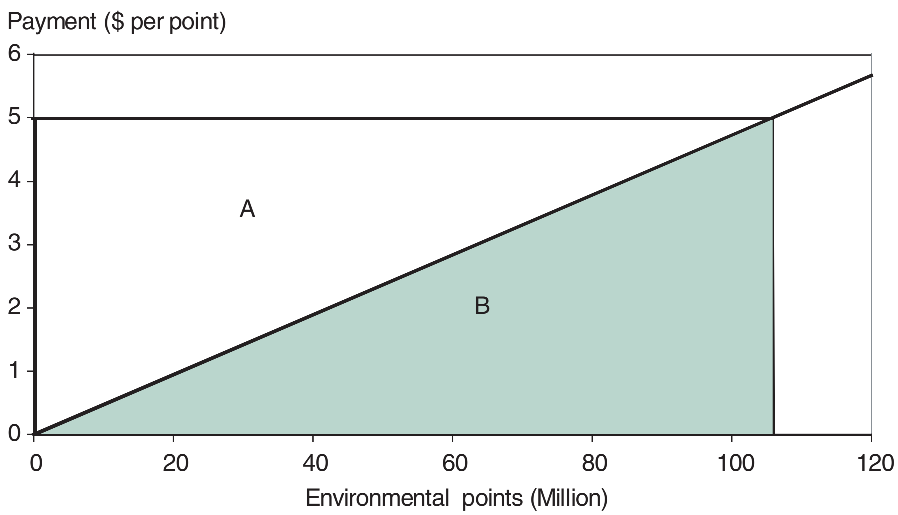


Table 3.3—Environmental performance at the $1-billion level

Region[1]	*Good-Act*	*Hurdle-L*	*Hurdle-H*	*Practice*	*Performance*	*Bid*
	% Increase in environmental performance					
Northeast	0.9	1.2	2.9	0.8	4.3	6.3
Lake States	0.0	0.3	1.0	4.1	8.7	15.4
Corn Belt	0.0	8.0	8.5	10.3	12.0	13.2
Northern Plains	0.5	0.8	2.3	2.2	12.4	17.4
Appalachia	0.0	2.4	4.0	6.4	11.5	13.9
Southeast	5.8	1.8	1.8	5.7	9.3	15.2
Delta States	5.8	2.4	2.4	5.8	15.5	19.9
Southern Plains	4.3	2.1	4.4	4.3	10.3	15.0
Mountain	2.1	1.3	2.1	2.0	14.8	20.9
Pacific	4.1	1.1	7.0	4.1	7.8	11.9
United States	1.3	3.3	4.4	5.6	11.7	15.5

[1]Northeast = CT, DE, MA, MD, ME, NH, NJ, NY, PN, RI, VT; Lake States = MI, MN, WI; Corn Belt = IA, IL, IN, MO, OH; Northern Plains = KS, ND, NE, SD; Appalachia = KY, NC, TN, VA, WV; Southeast = AL, FL, GA, SC; Delta States = AR, LA, MS; Southern Plains = OK, TX; Mountain = AZ, CO, ID, MT, NM, NV, UT, WY; Pacific = CA, OR, WA.

environmental performance (as measured by the AEI) by more than 15 percent over current production patterns. Without the bid-down provisions, such a program (*Performance*) could improve environmental performance by nearly 12 percent, relative to base production patterns. A practice-based program with good-actor payments (*Good-Act*) might increase environmental performance by about 1 percent. However, without stewardship payments, a practice-based working-lands program (*Practice*) might enhance environmental performance by about 5.6 percent.[8] Both of the hurdle programs (*Hurdle-H* and *Hurdle-L*) have lower environmental cost-effectiveness than Practice at this budget because they pay for already existing conservation practices.

This highlights the fact that, overall, programs that pay for practices already established are generally less cost-effective than those that do not. A performance-based program with bidding provisions achieves environmental improvements at an average cost of $6 per aggregate environmental point; without the bidding provision, the average cost of enhancing environmental performance by one point increases to $8. The average cost under a practice-based program without stewardship provisions more than doubles to $17 per point, and increases to $73 per point when "good actors" are eligible for payments based on past implementation of conservation practices.

These results also show how improvements in environmental performance vary across program designs and across regions. For example, under the *Bid* program, the Northern Plains, Mountain, and Delta regions improve environmental performance the most, whereas under *Good-Act*, the Southeast, Delta, and Southern Plains improve environmental performance most.

[8]Two additional policies were considered, whereby the constraints on the regional distribution of practice-based payments were dropped. Under the altered *Good-Act* program, there is no improvement in environmental performance; i.e., eligible good actors soak up the entire $1-billion budget. Under the altered Practice program, cost-effectiveness is marginally higher.

Equity Concerns May Limit Cost-Effectiveness

Payments under the two practice-based programs are subject to regional budget constraints based on historic EQIP payments (see Web Appendix A *www.ers.usda.gov/publications/err5/* for additional details). This ensures that all regions will have participants, even at low national budget levels. However, it also lowers the cost-effectiveness of these programs. For example, under *Good-Act*, when producers are eligible for stewardship payments, not all eligible acres are able to participate in the program at lower budgets (fig. 3.4). The regions with the highest demand for participation, given fixed regional budgets, are the Corn Belt and Lake State regions because there are already many producers using payment-eligible practices. Even at $1 billion, acres that are eligible for stewardship payments are unable to participate, which indicates that in these regions no new practices are being adopted. It is only at $1.5 billion in funding that all eligible acres in these regions are able to receive stewardship payments. When all producers receive payments for practices they are doing already, the program can start to encourage the adoption of new practices.

Also, practice-based payments are differentiated by region, but the ability of funded practices to produce environmental benefits is not homogenous within a region or across regions. Performance-based programs have more potential to increase environmental performance on working lands. By basing payments on estimated environmental performance rather than on practices, they account for dissimilarity in practices and regions. Therefore, certain regions will have lower costs of generating benefits than others. For example, under the *Performance* scenario, producers in the Northern Plains are able to improve environmental performance at least cost, whereas the costs of improvement are highest in the Northeast (fig. 3.5).

Figure 3.4

Percentage of eligible acres in the Lake States and Corn Belt that can participate in *Good-Act*

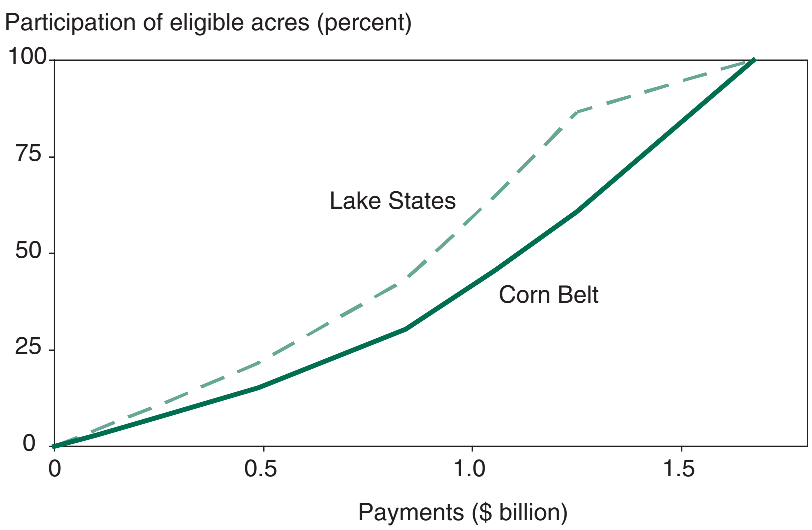
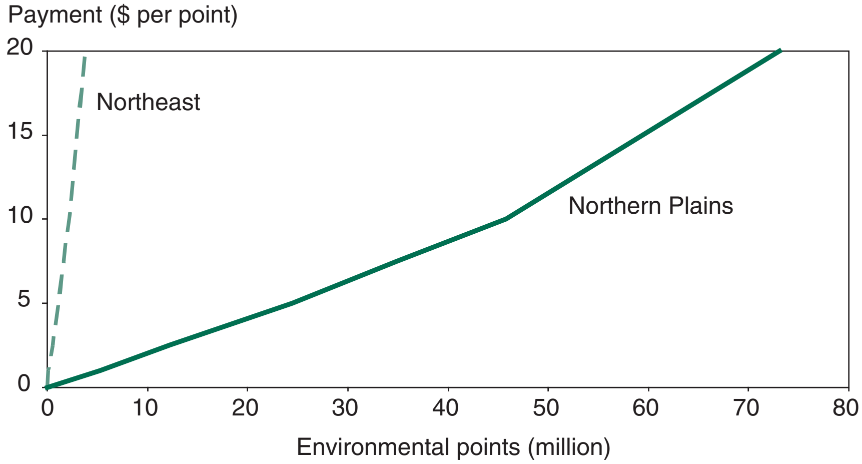


Figure 3.5
With regional EQIP weights, cost of improving environmental performance in the Northern Plains and Northeast under a performance-based program



Weights Matter to Outcomes

How the aggregate environmental index is created will also affect who participates in the performance-based programs. Until this point in our analysis, environmental performance has been measured using an AEI derived from regional EQIP weights. However, we devised five other weighting schemes for use in constructing the AEI to illustrate how environmental performance might be influenced by program decisionmakers' preferences across resource concerns (table 3.4). The first three schemes are derived from the CRP: national-level weights, regional weights incorporating environmental preferences, and regional weights without soil productivity. The fourth and fifth weighting schemes are derived from national and regional expenditures on EQIP contracts. The sixth scheme weights all environmental criteria equally across all regions.[9]

We compare these six weighting schemes under the *Performance* design holding the budget fixed at $1 billion (table 3.5). Under all weighting schemes, the improvements in environmental performance are quite similar when aggregated to the national level. However, the regional CRP weights (scheme 2) enhance environmental performance more than the national CRP weights (except for wind erosion). Thus, a national preference for reduced wind erosion may diminish the potential to address other resource concerns, at least in aggregate. However, with EQIP-derived weights (except for pesticide runoff), focusing on regional preferences may impair overall reductions at the national level.[10]

Some argue that soil productivity is not a resource concern because producers are self-motivated in that respect (Trimble and Crosson, 2000). What might result if soil productivity was not directly rewarded under such programs? One way to look at this is to give soil productivity loss a zero weight (scheme 3). Similarly, under a simple uniform weighting scheme (scheme 6), the weight on soil productivity is identical to those of the other indicators; i.e., it receives a lower weight than in four other weighting

[9]See box, "Weighting Multiple Environmental Criteria," p. 24, and Web Appendix B *www.ers.usda.gov/publications/err5/* for more details of these weights.

[10]These comparisons might not hold if the other practices that are eligible under EQIP, including those for livestock producers, were included in the analysis.

Table 3.4—Options for weighting multiple environmental criteria

Weighting schemes	Description
1	National-level weights taken from the Conservation Reserve Program's Environmental Benefits Index (EBI)
2	Regional-level weights generated by applying regional values for environmental benefits to the national-level EBI weights (above)
3	As above, with a zero weight on soil productivity
4	National-level weights derived from aggregate EQIP expenditures
5	Regional-level weights derived from regional EQIP expenditures
6	Uniform weights across regions and indicators

Table 3.5—Effect of weights on environmental indicators[1]

	Reductions under alternative weighting schemes[2]					
Environmental indicator	1	2	3	4	5	6
			Percent			
Sheet and rill erosion	15	17	11	17	17	16
Nitrogen to ground water	14	18	14	16	14	13
Nitrogen to surface waters	12	13	9	14	13	12
Phosphorus to surface waters	15	16	10	16	15	14
Loss in soil productivity	295	307	57	350	323	176
Wind erosion	21	19	16	21	21	17
Carbon emissions	8	8	6	8	7	7
Pesticides to surface waters	4	8	8	6	7	13
Pesticides to ground water	8	13	9	10	9	12

[1]Here, estimated levels of pollutants are compared to base levels. See appendix table B-1 for base levels of annual discharge, leaching, and emissions.

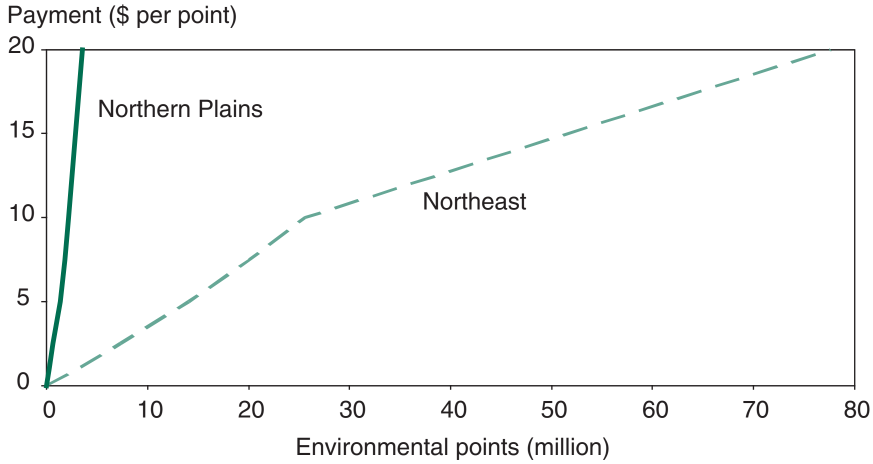
[2]No. 1 = national weights from the CRP; No. 2 = regional CRP weights; No. 3 = Regional CRP without soil productivity weight; No. 4 = national EQIP weights; No. 5 = regional EQIP weights; No. 6 = uniform weights.

schemes. As might be expected, reductions in soil productivity loss under these two weighting schemes are less than under the other weighting schemes, albeit still positive.[11]

Even though aggregate improvements in environmental performance are similar at the national level, regional results are more likely to depend upon the weights chosen. For example, if the weights chosen for environmental quality are developed using regional preferences for environmental quality, improvements in regions with higher population densities will be valued more than in regions with low population densities. This is evident in scheme 2, a performance-based program simulated using regional CRP weights (fig. 3.6). Under the assumption of population-based value, the Northeast is able to provide improvements in environmental performance at lowest cost; the highest cost regions are the Northern Plains and Southern Plains. The order of regional cost-effectiveness in achieving environmental improvements is essentially reversed, compared with regional EQIP weights

[11]When the percentage reduction in lost soil productivity exceeds 100, a soil productivity gain is indicated; i.e., when compared to baseline losses in long-term soil productivity, adjusted production patterns actually increased soil productivity.

Figure 3.6
With regional CRP weights, cost of improving environmental performance in the Northern Plains and Northeast under a performance-based program with regional CRP weights



(see fig. 3.5), which reflect regional **expenditures** on different resource concerns and not regional differences in the **value** of environmental quality improvement.

Different Programs Have Different Economic Impacts

Alternative program designs (including good-actor, hurdle rates, and bidding provisions) will affect returns to production, production levels, and prices differently. For example, programs that reward reduced soil erosion may also induce a change in residue management and the mix of crop rotations in a particular region, such as increased use of no-till cultivation. Such changes will affect crop yields and crop prices, and ultimately will result in a new equilibrium between crop and livestock supply and their demand across regions and sectors. We use our simulation model of regional agricultural production and consumption to examine the economic implications of new production and consumption patterns from different program designs.

Among the practice-based programs, *Good-Act* has smaller impacts on crop production than *Practice*, simply because most of the budget goes toward stewardship payments and no change in practices or production is required to receive program payments. On the other hand, bidding provisions should induce more crop adjustments than a fixed-rate performance-based program under equally funded programs. This is because the program payments are devoted entirely to paying producers' WTA for improvements in environmental performance. By contrast, under a fixed-rate, performance-based program such as *Performance*, producers can still receive payments that exceed their WTA (see fig. 3.3).

All WLPPs will influence returns to the livestock sector via their effects on feed crop supply and prices. Similarly, changes in commodity production will affect consumers' well-being; prices will change for commodities based on increasing or decreasing returns to agricultural production, and consumers will end up paying more or less for foodstuffs. Moreover, taxpayers fund these programs, which is also an important element in the final calculus.

Because performance-based programs result in more changes to management practices, the economic impacts on all sectors are much more pronounced under the performance-based than practice-based programs (table 3.6) for a given budget ($1 billion). Under practice-based programs, higher returns to agricultural production result mainly from program payments (i.e., returns to crop production increase just above $1 billion), not from increased commodity prices, and thus cost taxpayers roughly the price of the working-land payment programs. That said, returns to agriculture increase under all the programs by more than the $1 billion in program payments. Still, not all sectors benefit from these programs. While crop producers benefit in general from practice- or performance-based programs, livestock producers and consumers do not.[12]

[12]This conclusion does not hold for working-land payment programs such as EQIP with specific livestock components.

The returns to crop production under a $1-billion performance-based program would increase by nearly $2.6 billion. This includes the $1 billion in payments for conservation efforts, implying that an additional $1.6 billion accrues to crop producers based on changes in prices, production costs, and production levels. Livestock producers would face higher prices for their feed material, resulting in a decrease in overall returns by $400 million. This is partially due to a reduction in feed crop production[13] and higher feed prices for livestock and poultry producers. Returns to agricultural production increase by nearly $2.2 billion. Still, overall losses are $331 million, reflecting lost consumer surplus due to higher prices.

[13]Under performance-based programs, farmers have an incentive to adopt less intensive management systems with lower overall crop yield and less environmental impact.

To calculate the net effect on society, that loss of $331 million must be weighed against the value of a 12-percent improvement in environmental performance on working cropland (see table 3.3). Underlying this 12-percent improvement in environmental performance is an estimated 17-percent reduction in sheet and rill erosion—about 36 million tons (table 3.5, column 5). A conservative estimate of the benefit of reducing sheet and rill erosion at the edge of the field is about $2 per ton.[14] The estimated 36-million-ton reduction to instream sediment loads from sheet and rill erosion results from reducing edge-of-field losses by approximately 166 million tons. Therefore, the value of reducing sheet and rill erosion alone could be as high as $332 million, which would offset the $331-million loss in overall surplus. Moreover, this does not incorporate the values of other environmental improvements attained simultaneously. In addition to the reductions in sheet and rill erosion, nitrogen leaching falls by 14 percent, nitrogen runoff by 13 percent, phosphorus runoff by 15 percent, soil productivity losses by more than 300 percent, wind erosion by 21 percent, carbon emissions by 7 percent, pesticide leaching by 9 percent, and pesticide runoff by 7 percent (table 3.5, column 5).

[14]Ribaudo et al. (1990) estimate the value of reducing soil erosion for recreational fishing to be $2 per ton ($2004). Other estimates include additional values, such as reduced dredging costs, reduced water treatment costs, and increased water-based recreation (e.g., $4 per ton—Hansen and Claassen, 2001).

Table 3.6—Economic impacts of stylized WLPPs (budget = $1 billion)

		Change[1]					
		Practice		Performance			
Sector	Base	Good-Act	Practice	Hurdle-L	Hurdle-H	Performance	Bid
				$ million			
Crop returns	32,744	1,059	1,273	1,205	1,210	2,560	3,182
Livestock returns	44,665	0	-80	-47	-42	-398	-570
Returns to agriculture	77,410	1,058	1,193	1,158	1,168	2,162	2,612
Overall gain/loss[2]	508,018	-79	-318	-186	-178	-331	-629
Change in environmental performance (percent)		1.3	5.6	3.3	4.4	11.7	15.5

[1] These changes are relative to the USDA baseline projections for the year 2010 (USDA, WAOB, 2001).
[2] Overall gains or losses include changes in returns to agricultural producers and changes in consumer surplus in addition to any deadweight losses associated with movement from the initial steady-state equilibrium. The value of the environmental benefits obtained under these scenarios is not included in the calculations.

Conclusion

The modest size of EQIP prior to 2002 and the implementation of CSP in 2004 means there are little data to assess their outcomes directly. But through simulation models, as undertaken in this chapter, unanswered questions can be explored over a range of program designs—i.e., budget levels, enrollment options, eligibility criteria—and across the heterogeneous landscape of U.S. agriculture.

- *To what extent can programs improve producers' environmental performance?* At funding of $1 billion, a performance-based program with bidding provisions achieves improvements at an average cost of $6 per AEI point. Without the bidding provision, the average cost of enhancing environmental performance by one AEI point increases to $8. The average cost under a practice-based program without stewardship provisions more than doubles to $17 per point, and increases to $73 per AEI point when producers are eligible for stewardship payments based on past conservation efforts.
- *What are the tradeoffs between improving the environment and supporting farm incomes?* If the objective of the program is simply to increase incomes of crop producers, performance-based programs are the most cost-effective. They result in higher returns to production than under the two practice-based programs. Returns to crop production increase by approximately $9 per acre and $8 per acre under *Bid* and *Performance*, at the $1-billion budget level. Incomes increase by just $4 per acre and $3 per acre under the *Practice* and *Good-Act* programs.

In general, WLPPs, as modeled here, increase returns to the agricultural sector overall, but consumers (who fund these programs) may pay more for less food depending on the program specifics. Overall, economic losses outweigh the gains under all programs modeled here. However, we have not included the value of the environmental gains—the impetus of these programs. Putting a price tag on all the relative environmental improvements is beyond the scope of this report, but evidence suggests that the value of these benefits could far exceed the lost surplus at the aggregate market level.